



Delivering water and power™

Construction Specification Manual

Salt River Project

Technical Specification Index – September 2025

Division 21

Division	Title	Updated
DIVISION 21: FIRE SUPPRESSION		
211313	Wet-Pipe Sprinkler Systems	Revised 03/22
211316	Dry-Pipe Sprinkler Systems	Revised 03/22
212113	High Pressure Carbon Dioxide Fire Extinguishing Systems	Created 09/25
212120	Hybrid Fire Extinguishing System	Created 09/25
212203	Novec 1230 Fire Extinguishing Systems	Revised 03/22

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gauges.

B. Related requirements:

1. Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for fire water service backflow prevention devices.
2. Section 21 11 19 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.
3. Section 23 05 23 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.2 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.
- B. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated below. Provide annotated catalog data showing manufacturers name, model, and catalog number for all equipment and components, with data highlighted to indicate model, model numbers, size, and all selected options.
1. Pipes, fittings, and specialties.
 2. Cover system for sprinkler piping.
 3. Specialty valves.

4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gauges.
9. Fire hose valves
10. Pipe hangers and supports
11. Backflow prevention devices

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For wet-pipe sprinkler systems.

1. Submit six copies of the following, no later than 21 day prior to the start of the system installation in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise shall be no smaller than the Contract Drawings.
 - a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 - b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections and other details required to clearly describe the proposed arrangement.
 - c. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.
 - d. Details of each type of pipe hanger and related components.
 - e. Shop Drawings and calculations shall be prepared by a qualified NICET Level III (or IB) Technician.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Design Data:
1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

- C. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
- D. Qualification Data: For subcontractor, supervisor, installer, and test personnel.
- E. Welding certificates.
- F. Field Test Reports:
 - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - 2. Fire-hydrant flow test report.
- G. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.
- C. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.

- D. Qualifications - Subcontractor: An Arizona licensed contractor in possession of a valid fire sprinkler contractor's license. Design and installation must be performed by a sprinkler contractor whose business is located within a 75-mile radius of the project site. Subcontractor shall have a minimum of 5 years of experience in the installation of automatic sprinkler systems in similar facilities.
- E. Qualification - Design Services: Shop (working) drawings and calculations shall be prepared under the direction of and signed by a qualified registered Professional Engineer or a NICET Level III (minimum) in water-based systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 - 1. A registered professional engineer having passed the NCEES examination in fire protection engineering.
 - 2. Registered professional engineer with verification of experience and at least 5 years of current experience in the design of the fire protection and detection systems.
- F. Qualifications - Supervisor: A NICET Level III (minimum) in water-based systems shall supervise the installation of the fire sprinkler system.
- G. Qualifications - Installer: Fire sprinkler installers with a minimum of 2 years of experience or who possess a CSA certification shall be permitted to assist in the installation of the fire sprinkler system.
- H. Qualifications - Test Personnel: Fire sprinkler technicians with a minimum of 8 years of experience shall be utilized to test and certify the installation of the fire sprinkler system. The fire sprinkler technicians testing the equipment shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.8 REGULATORY REQUIREMENTS

- A. All system components shall be listed or approved for their intended use and shall be compatible with the system and its components. Where the terms "listed" or "approved" appear in this specification section, they shall mean UL-listed (UL Fire Prot Dir), FM-approved (FM App Guide), or listed by a nationally recognized testing laboratory (NRTL). Omission of these terms under the description of any item of equipment described shall not be construed as waiving the requirement for listing or approval. All listings or approvals shall be based on an existing ANSI or UL published standards.
- B. Compliance with NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this section and applicable standards, this specification section shall govern.

- C. Install work in full conformance with the requirements of all local and governmental authorities having jurisdiction over these matters, utility company requirements, and requirements of the latest issues of all applicable Codes, including the IBC and IFC.
- D. The fire protection installation and the installing subcontractor shall comply fully with all city, county and state laws, ordinances and regulations applicable to fire protection installations.
- E. Should any change in Drawings or Specifications be required to comply with governmental regulations, Contractor shall notify Engineer at the time of submission of Bid.
- F. Secure and pay for necessary approvals, permits, inspections, etc., and deliver the official records of the granting of permits to the Client Representative without additional cost to Client.
- G. A Work Authorization is required for all wet-pipe sprinkler work. The Client Project Manager (PM) shall apply for and receive the Work Authorization. The fire protection contractor will receive the Work Authorization from the Client PM. The Work Authorization must be prominently displayed at the jobsite before any work, to include demolition, can begin. Upon completion of the work, a final inspection by the Client Fire Marshal, and the satisfactory resolution of all issues identified by the Final Inspection, the Client Fire Marshal shall sign and close out the Work Authorization which indicates acceptance of the permitted work.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.
- B. Before commencing Work, examine all adjoining work on which sprinkler system work is in any way dependent for perfect workmanship according to the intent of this Section, and report to the Client Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.
- C. Contractor shall become familiar with all details of the Work, verify all dimensions in the field, and shall advise the Client Representative of any discrepancy before performing the Work.

1.10 SCHEDULING

- A. Provide a schedule to Client indicating the installation sequence and timeframe prior to beginning work. Provide weekly updates to Client. All equipment, valve, piping and device installation shall be completed in time to conduct all tests as outlined in this Section.
- B. Coordinate the Acceptance Test for each fire sprinkler system with Client and other necessary parties identified by Client.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.
- B. All pipes shall either be capped or plugged until installation.
- C. Coordinate the storage arrangement and location with Client.
- D. Deliver and store products in shipping containers/boxes, with labeling in place.
- E. Provide temporary protective coating on cast iron and steel valves.

1.12 SPARE PARTS

- A. Repair Service/Replacement Parts: During warranty period, the service technician shall be on-site within 24 hours after notification. All repairs shall be completed within 24 hours of arrival on-site.
- B. Provide spare sprinklers, sprinkler wrench and sprinkler cabinet in accordance with NFPA 13.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure. Where systems require higher pressures, provide components rated for the maximum expected pressure in the system.

- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design wet-pipe sprinkler systems.
1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: <Insert test date>.
 - b. Time: <Insert time> [a.m.] [p.m.]
 - c. Performed by: <Insert operator's name> of <Insert firm>.
 - d. Location of Residual Fire Hydrant R: <Insert location>.
 - e. Location of Flow Fire Hydrant F: <Insert location>.
 - f. Static Pressure at Residual Fire Hydrant R: <Insert psig >.
 - g. Measured Flow at Flow Fire Hydrant F: <Insert gpm >.
 - h. Residual Pressure at Residual Fire Hydrant R: <Insert psig >.
 2. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Automobile Parking Areas: Ordinary Hazard, Group 1.
 - 2) Building Service Areas: Ordinary Hazard, Group 1.
 - 3) Churches: Light Hazard.
 - 4) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 5) Dry Cleaners: Ordinary Hazard, Group 2.
 - 6) Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
 - 7) General Storage Areas: Ordinary Hazard, Group.
 - 8) Laundries: Ordinary Hazard, Group 1.
 - 9) Libraries except Stack Areas: Light Hazard
 - 10) Library Stack Areas: Ordinary Hazard, Group 2
 - 11) Machine Shops: Ordinary Hazard, Group 2.
 - 12) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 13) Office and Public Areas: Light Hazard.
 - 14) Plastics Processing Areas: Extra Hazard, Group 2.
 - 15) Printing Plants: Extra Hazard, Group 1.
 - 16) Repair Garages: Ordinary Hazard, Group.
 - 17) Residential Living Areas: Light Hazard.
 - 18) Restaurant Service Areas: Ordinary Hazard, Group 1.
 - 19) Solvent Cleaning Areas: Extra Hazard, Group 2.
 - 20) Upholstering Plants: Extra Hazard, Group 1.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
 - b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - e. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - f. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - g. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Minimum Density for Deluge-Sprinkler Piping Design:
 - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
 - b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.
 - c. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over entire area.
 - d. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over entire area.
 - e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 5. Maximum protection area per sprinkler according to UL listing.
 6. Maximum Protection Area per Sprinkler:
 - a. Residential Areas: 400 sq. ft.
 - b. Office Spaces: 120 sq. ft.
 - c. Storage Areas: 130 sq. ft.
 - d. Mechanical Equipment Rooms: 130 sq. ft..
 - e. Electrical Equipment Rooms: 130 sq. ft.
 - f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7. See Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

2.2 MATERIALS AND EQUIPMENT

- A. Standard Products: Material and equipment shall be the standard products of a manufacturer, where possible, and not a combination of manufacturers for any particular classification of materials. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. All materials and equipment supplied shall be new, first quality and the manufacturer's best type and latest model capable of complying with all requirements of this Section, and shall have been in continuous production and in continuous service in commercial applications for at least 1-year. Obsolete equipment shall not be used.
- B. Nameplates: Major components of equipment shall have the manufacturer's name, model or serial number, and date of installation provided on a new plate permanently affixed to the item or equipment. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.3 UNDERGROUND PIPING SYSTEMS

- A. Pipe: Pipe shall comply with NFPA 24. Minimum pipe size shall be minimum 6 inches. Piping more than 5 feet outside the building walls shall comply with Section 33 11 00 "Water Utility Distribution Piping. A continuous section of welded stainless steel fire water service piping from a point outside the building perimeter to a flanged fitting at least 1-foot above the finished floor within the building is acceptable.

- B. Fittings and Gaskets: Fittings shall be ductile-iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile-iron pipe joints shall conform to AWWA C111/A21.11.
- C. Gate Valve and Indicator Posts: Installation shall comply with NFPA 24. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.
- D. Valve Boxes: Except where indicator posts are provided, for each buried valve, provide a cast-iron, ductile-iron, or plastic valve box of a suitable size. Plastic boxes shall be constructed of acrylonitrilebutadiene-styrene (ABS) or inorganic fiber-reinforced black polyolefin. Provide cast-iron, ductile-iron, or plastic cover for valve box with the word "WATER" cast on the cover. The minimum box shaft diameter shall be 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint applied to a minimum dry-film thickness of 10 mils.
- E. Buried Utility Warning and Identification Tape: Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.4 ABOVEGROUND PIPING SYSTEMS

- A. Pipe: Pipe shall be standard weight conforming to ASTM A795, ASTM A53, or ASTM A135. Piping less than 3-inch in diameter shall be minimum schedule 40 and joined by threaded fittings. Piping 4 inches and greater shall be minimum schedule 10 and joined by threaded, grooved or flanged fittings.
 - 1. Pipe in which threads or grooves are cut shall have a corrosion resistance ratio (CRR) of 1.00 or greater after threads or grooves are cut.
 - 2. Pipe shall be marked as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the "Product Marking" provisions of the ASTM standard.
- B. Plastic Pipe: Plastic piping (PVC, CPVC, polybutylene) is not permitted.
- C. Grooved Fittings and Couplings: Grooved fittings, couplings and bolts shall be provided by the same manufacturer.
 - 1. Fittings and couplings shall be malleable iron complying with ASTM A47 or ductile-iron complying with ASTM A536.
 - 2. Couplings shall be of the rigid type except that flexible type will be provided where flexible joints are specifically required by NFPA 13.

3. Coupling gaskets shall be Grade E (EPDM) approved for fire protection service. Gasket shall be the flush type that fills the entire cavity between the coupling and the pipe.
 4. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.
 5. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe, shall not be used.
- D. Non-Grooved Fittings: Non-grooved fittings shall be threaded or flanged. Threaded fittings shall be cast-iron conforming to ASME B16.4, malleable iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536.
1. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type.
 2. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe, shall not be used.
- E. Flanges and Gaskets: Flanges shall conform to NFPA 13 and ASME B16.1. Flanges shall be the type that are welded or threaded to the pipe. Flanges which are bolted to grooved pipe shall not be permitted. Gaskets shall be full-face type EPDM or other approved material.
- F. Pipe Hangers: Hangers shall be listed or approved and be of the type suitable for the application, construction and size pipe involved. Earthquake bracing shall be listed.
- G. Control Valve: Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type or butterfly type and shall be listed or approved.
- H. Check Valve: Check valve 2 inches and larger shall be listed or approved. Check valves 4 inches and larger shall be of the swing type with flanged cast-iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.
- I. Hose Valve: Valve shall comply with UL 668 and shall have a minimum rating of 300 pounds per square inch. Valve shall be non-rising stem, all bronze, 90-degree angle type, with 2 1/2-inch American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be polished brass.

2.5 BACKFLOW PREVENTION ASSEMBLY

- A. Reduced-pressure principle valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation.

- B. Backflow Preventer Test Connection: Test connection shall consist of a series of listed hose valves with 2 1/2-inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand, and provide enough valves to flow the total system design demand, including interior hose steam allowances, during the test. Provide a permanent sign that reads "TEST VALVES" immediately adjacent to these valves on the wall.

2.6 FIRE DEPARTMENT CONNECTION

- A. Fire department connection shall be projecting type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with finish to be coordinated with Architect. The connection shall have individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2 1/2-inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963 and comply with UL 405.

2.7 ACCESSORIES

- A. Sprinkler Cabinet: Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.
- B. Pipe Escutcheon: Escutcheons 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.
- C. Sprinkler Guard: Guards shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers subject to damage.
- D. Identification Signs:
 - 1. Provide properly lettered and approved metal or plastic signs to each control valve, alarm device, inspector's test valve, drain valve, and alarm bypass valve. Each sign shall indicate the normal valve position as well as the portion of the system that the valve serves.
 - a. Valve identification signs shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background.
 - b. Wording of sign shall include, but not be limited to "main drain", auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components.
 - 2. Permanently affix metallic hydraulic design data nameplates complying with NFPA 13 to the riser of each system. Hydraulic information shall be permanently engraved on the nameplate. The use of permanent marker only is not acceptable.
 - 3. Provide a laminated 8.5-inch x 11-inch diagram, hung on each riser, showing the floor area protected by that riser.

2.8 SPECIALTY SPRINKLER FITTINGS

- A. Listed or approved, made of steel, ductile-iron, or other materials compatible with piping.
- B. Drop-Nipple Fittings: Adjustable drop nipples are not permitted.
- C. Mechanical-T Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.
- D. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlets.
- E. Sprinkler, Drain and Alarm/Inspector's Test Fittings: Cast-iron or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.
- F. Sprinkler, Branch Line Test Fittings: Brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.

2.9 PRESSURE GAUGES

- A. Pressure gauges shall be UL-listed (UL 393), 3 1/2-inch to 4 1/2-inch diameter dial with dial range of 0 to 250 pounds per square inch gage.

2.10 COVER SYSTEM FOR SPRINKLER PIPING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. DecoShield Systems, Inc.
- B. Description: System of support brackets and covers made to protect sprinkler piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Extruded-PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.11 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
 - 2. High-Pressure Piping Specialty Valves: 300-psig.
- C. Body Material: Cast or ductile iron.

- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco by Johnson Controls Company.
 - d. Venus Fire Protection Ltd.
 - e. Victaulic Company.
 - f. Viking Corporation.
 - 2. Standard: UL 193.
 - 3. Design: For horizontal or vertical installation.
 - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
 - 5. Drip cup assembly pipe drain without valves and separate from main drain piping.
 - 6. 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.
- G. Automatic (Ball Drip) Drain Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco by Johnson Controls Company.
 - 2. Standard: UL 1726.
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Type: Automatic draining, ball check.
 - 5. Size: NPS 3/4
 - 6. End Connections: Threaded.

2.12 AIR VENT

- A. Manual Air Vent/Valve:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. National Fittings, Inc.

- c. Shurjoint-Apollo Piping Products USA Inc.
 - d. Victaulic Company.
- 2. Description: Ball valve that requires human intervention to vent air.
- 3. Body: Forged brass.
- 4. Ends: Threaded.
- 5. Minimize Size: 1/2 inch (13 mm).
- 6. Minimum Water Working Pressure Rating: 300 psig.

B. Automatic Air Vent:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. CLA-VAL.
 - c. Metraflex Company (The).
 - d. Val-Matic Valve & Manufacturing Corp.
- 2. Description: Automatic air vent that automatically vents trapped air without human intervention.
- 3. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler systems.
- 4. Vents oxygen continuously from system.
- 5. Float valve to prevent water discharge.
- 6. Minimum Water Working Pressure Rating: 175 psig.

2.13 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Anvil International.
 - c. National Fittings, Inc.
 - d. Shurjoint-Apollo Piping Products USA Inc.
 - e. Tyco by Johnson Controls Company.
 - f. Victaulic Company.
- 2. Standard: UL 213.
- 3. Pressure Rating: 175-psig minimum.
- 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 5. Type: Mechanical-tee and -cross fittings.
- 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco by Johnson Controls Company.
 - d. Victaulic Company.
 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 3. Pressure Rating: 175-psig minimum.
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Elkhart Brass Mfg. Co., Inc.
 - c. Fire-End & Croker Corporation.
 - d. Potter Electric Signal Company, LLC.
 - e. Potter Roemer LLC; a Division of Morris Group International.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing, Inc.
 - b. Triple R Specialty.
 - c. Tyco by Johnson Controls Company.
 - d. Victaulic Company.
 - e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aegis Technologies, Inc.
 - b. CECA, LLC.
 - c. CPS Products, Inc.
 - d. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ALEUM USA.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping for sprinkler.

2.14 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc. (The).

3. Tyco by Johnson Controls Company.
 4. Venus Fire Protection Ltd.
 5. Victaulic Company.
 6. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 300-psig minimum.
- F. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199
 3. Residential Applications: UL 1626.
 4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- G. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
1. Nominal Orifice:
 - a. 1/2 inch, with discharge coefficient K between 5.3 and 5.8
 - b. 17/32 inch with discharge coefficient K between 7.4 and 8.2
- H. Sprinkler Finishes: Chrome plated
- I. Special Coatings: Where subject to corrosion, provide wax coated sprinkler heads, or provide with PTFE corrosion resistant paint.
- J. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel one piece, flat.
- K. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco by Johnson Controls Company.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.15 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco by Johnson Controls Company.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 753.
 3. Type: Mechanically operated, with Pelton wheel.
 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 5. Size: 8-1/2-inches diameter.
 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 7. Inlet: NPS 3/4.
 8. Outlet: NPS 1 drain connection.
- C. Electrically Operated Notification Appliances:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Notifier.
 - c. Potter Electric Signal Company, LLC.
 2. Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 6-inch minimum.
 - d. Voltage: 120 V ac, 60 Hz, 1 phase.
 - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
 3. Strobe/Horn:
 - a. Standard: UL 464.
 - b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
 - c. Voltage: 120 V ac, 60 Hz.
 - d. Effective Intensity: 110 cd.
 - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."

- f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing reader to call 911, police, or fire department.

D. Water Flow Indicators:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig.
- 7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Barksdale, Inc.
 - b. Detroit Switch, Inc.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 - e. Tyco by Johnson Controls Company.
 - f. United Electric Controls Co.
 - g. Viking Corporation.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised water-flow switch with retard feature.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
 6. 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.

2.16 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.17 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 3. 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. Manual Control Stations, Electric Operation: Metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations, Hydraulic Operation: With union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
 1. Power supply.
 2. Battery charger.
 3. Standby batteries.

4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.18 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AGF Manufacturing, Inc.
 2. AMETEK, Inc.
 3. Ashcroft Inc.
 4. Brecco Corporation.
 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.
- C. Upon completion of the Work, a final inspection by the Client Fire Marshal, and the satisfactory resolution of all issues identified by the Final Inspection, the Client Fire Marshal shall sign and close out the Work Authorization which indicates acceptance of the permitted Work.

3.2 SERVICE ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

- B. The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet from the top of the pipe.
- C. Joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe.
- D. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 33 11 00 "Water Utility Distribution Piping."
- E. Install shutoff valve, pressure gauge, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping."
- F. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor

3.3 WATER SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping."
- C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they are not subject to freezing.
- N. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.
- O. Fill sprinkler system piping with water.
- P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 21 05 33 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 21 07 00 "Fire-Suppression Systems Insulation."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.5 UNDERGROUND PIPING INSTALLATION

- A. The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet from the top of the pipe.
- B. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor.
- C. Joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe.
- D. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Section 33 11 00 "Water Utility Distribution Piping."

3.6 ABOVEGROUND PIPING INSTALLATION

- A. Piping: Group piping at common elevations where practical. Route piping in an orderly manner, plumb and parallel to the building structure where practical and as indicated on the approved drawings.
- B. Piping in Exposed Areas: Exposed piping shall be installed so as not to diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.
- C. Fittings: Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Install unions adjacent to each valve in pipes 2 inches and smaller. Unions are not required on flanged devices or in piping installations using grooved joints. Install flanges or flange adapters on non-grooved valves, apparatus, and equipment having 2 1/2-inch and larger connections.
- D. Pendent Sprinklers: Drop nipples to pendent sprinklers shall consist of minimum 1-inch pipe with a reducing coupling into which the sprinkler shall be threaded.
 - 1. 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 spaces.

- a. The outlet of the reducing coupling shall not extend more than 1-inch below the underside of the ceiling.
 2. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches.
 3. Recessed pendent 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.
 4. All sprinklers in suspended ceilings shall be center of tile (+/- 2 inches).
- E. 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.
- F. Install specialty sprinkler fittings according to manufacturer's written instructions.
- G. Pipe Joints: Pipe joints shall conform to NFPA 13, except as modified herein.
1. Not more than four threads shall show after joint is made up.
 2. Welded joints shall be permitted, only if welding operations are performed as required by NFPA 13 at the contractor's fabrication shop, not at project construction site.
 3. 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.
 4. Grooved couplings, fittings, and grooving tools shall be products of the same manufacturer.
 5. 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.
 6. 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.
 7. Grooved joints shall not be used to conceal locations, such as behind solid walls or ceilings, unless an access panel is shown on approved Shop Drawings for servicing or adjusting the joint.
- H. 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.

- I. Pipe Penetrations: Cutting structural members for passage of pipes for pipe-hanger fastenings will not be permitted.
 - 1. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves.
 - 2. 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.
 - 3. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13.
 - 4. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation.
 - 5. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be firestopped with a listed or approved through-penetration firestopping assembly.
 - 6. 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.
- J. 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.
- K. Inspector's Test Connection: Unless otherwise indicated, test connection shall consist of 1-inch pipe connected to the system riser; a test valve located approximately 7 feet above the floor; a sight glass assembly; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge. Concrete splash blocks shall be provided.
- L. Drains: Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13. Concrete splash blocks shall be provided.
- M. Hangers and Supports: Comply with NFPA 13 for hanger materials and installation.
- N. Sway Brace Protection: Install piping according to NFPA 13 to protect from building sway damage.
- O. 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 marked and permanently affixed to each sprinkler riser as specified in NFPA 13.

3.7 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

- N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- P. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

3.8 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.9 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.

E. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.11 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Coordinate with fire-alarm tests. Operate as required.
 6. Coordinate with fire-pump tests. Operate as required.
 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.13 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.15 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 3 and smaller shall be one of the following:
 - 1. Standard-weight, minimum Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 4 and larger shall be one of the following:
 - 1. Standard-weight, minimum Schedule 10, black-steel pipe with threaded, grooved, or flanged fittings.
 - 2. Standard-weight, minimum Schedule 10, galvanized-steel pipe with threaded, grooved, or flanged fittings.

3.16 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Flush, and concealed sprinklers as indicated on Drawings.

3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated
 5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
 6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Residential Sprinklers: Dull chrome.
 5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 21 13 16

DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe fittings.
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Requirements:

1. 21 12 00 "Fire-Suppression Standpipes" for standpipe piping.
2. 21 13 13 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
3. 21 13 39 "Foam-Water Systems" for AFFF piping.
4. 21 31 13 "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.
5. 28 31 11 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

1.2 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.
- B. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: <Insert test date>.
 - b. Time: <Insert time> [a.m.] [p.m.]
 - c. Performed by: <Insert operator's name> of <Insert firm>.
 - d. Location of Residual Fire Hydrant R: <Insert location>.
 - e. Location of Flow Fire Hydrant F: <Insert location>.
 - f. Static Pressure at Residual Fire Hydrant R: <Insert psig>.
 - g. Measured Flow at Flow Fire Hydrant F: <Insert gpm>.
 - h. Residual Pressure at Residual Fire Hydrant R: <Insert psig>.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: [10] [20] <Insert number> percent, including losses through water-service piping, valves, and backflow preventers.
 2. Sprinkler Occupancy Hazard Classifications:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1
 - b. Building Service Areas: Ordinary Hazard, Group 1
 - c. Churches: Light Hazard.
 - d. Electrical Equipment Rooms: Ordinary Hazard, Group 1
 - e. Dry Cleaners: Ordinary Hazard, Group 2
 - f. General Storage Areas: Ordinary Hazard, Group 1.
 - g. Laundries: Ordinary Hazard, Group 1.
 - h. Libraries Except Stack Areas: Light Hazard
 - i. Library Stack Areas: Ordinary Hazard, Group 2
 - j. Machine Shops: Ordinary Hazard, Group 2.
 - k. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
 - l. Office and Public Areas: Light Hazard.
 - m. Plastics Processing Areas: Extra Hazard, Group 2.
 - n. Printing Plants: Extra Hazard, Group 1.
 - o. Repair Garages: Ordinary Hazard, Group 2.
 - p. Restaurant Service Areas: Ordinary Hazard, Group 1.
 - q. Solvent Cleaning Areas: Extra Hazard, Group 2.
 - r. Upholstering Plants: Extra Hazard, Group 1
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft.area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft.area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft.area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft.area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft.area.

- f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 4. Maximum Protection Area per Sprinkler: Per UL listing.
- 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, provide annotated catalog data showing manufacturers name, model, and catalog number for all equipment and components, with data highlighted to indicate model, size, all selected options, model numbers, and quantity shall be provided. This shall include but not be limited to the following items:
 - 1. Pipes, fittings, and specialties.
 - 2. Cover system for sprinkler piping.
 - 3. Specialty valves.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gauges.
 - 9. Fire Hose Valves.
 - 10. Pipe Hangers and Supports.
 - 11. Backflow prevention Devices.
 - 12. Releasing control panel initiating and notification devices, manual release station, relays, monitor modules and wire.
 - 13. Sprinkler Signage.
 - 14. Spare Sprinkler Cabinets.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For wet-pipe sprinkler systems.
1. Submit six copies of the following, no later than 21 day prior to the start of the system installation in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise shall be no smaller than the Contract Drawings.
 - a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 - b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections and other details required to clearly describe the proposed arrangement.
 - c. Riser layout drawings drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.
 - d. Details of each type of pipe hanger and related components.
 - e. Shop drawings and calculations shall be prepared by a qualified NICET Level III (or IB) Technician.

1.5 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
- C. Qualification Data: For qualified Installer.
- D. Design Data:
1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- E. Welding certificates.
- F. Field Test Reports:
1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 2. Fire-hydrant flow test report.

- G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Qualifications - Fire Sprinkler Supervisor: A NICET Level III (minimum) in water-based systems shall supervise the installation of the fire sprinkler system.
- C. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.
- D. Qualifications - Contractor: The contractor shall be an Arizona licensed contractor in possession of a valid fire sprinkler contractor's license. Design and installation must be performed by a sprinkler contractor whose business is located within a 75-mile radius of the project site. The contractor shall have a minimum of 3 years of experience in the installation of automatic sprinkler systems in similar facilities.
- E. Qualification - Fire Sprinkler Design Services: Shop (working) drawings and calculations shall be prepared under the direction of and signed by a qualified registered Professional Engineer or a NICET
- F. Qualifications - Fire Sprinkler Installer: Fire sprinkler installers with a minimum of 2 years of experience or who possess a CSA certification shall be permitted to assist in the installation of the fire sprinkler system.

- G. Qualifications - Fire Sprinkler Test Personnel: Fire sprinkler technicians with a minimum of 8 years of experience shall be utilized to test and certify the installation of the fire sprinkler system. The fire sprinkler technicians testing the equipment shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.
- H. Qualifications - Releasing System Design Services: Shop (working) Drawings and calculations shall be prepared under the direction of and signed by a qualified registered Professional Engineer or a NICET Level III in fire alarm systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 - 1. A registered professional engineer having passed the NCEES examination in fire protection engineering.
 - 2. Registered professional engineer with verification of experience and at least 5 years of current experience in the design of the fire protection and detection systems.
- I. Qualifications - Releasing System Supervisor: A NICET Level III (minimum) fire alarm technician shall supervise the installation of the releasing system. The technician shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.
- J. Qualifications - Releasing System Technician: Technicians with a minimum of 4 years of experience shall be utilized to assist in the installation and termination of fire alarm devices, cabinets, and panels. The technicians installing the equipment shall be factory-trained in the installation and adjustment of the equipment specified herein and on the drawings.
- K. Qualifications - Releasing System Installer: Installer with a minimum of 2 years of experience shall be permitted to assist in the installation of fire alarm devices, cabinets and panels. An electrician shall be permitted to install wire, cable, conduit and backboxes for the fire alarm system.
- L. 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.
- M. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.9 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.
- B. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Client Representative any condition which prevents performance of first-class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.
- C. The contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Client Representative of any discrepancy before performing the work.

1.10 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinklers shall be installed over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.
- C. Wherever the contractor's work interconnects with work of other contractors, the contractor shall coordinate his work with other contractors to ensure that all contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers, etc.) concealed above hung ceilings by permanent colored pins/tabs in the ceiling directly below the item.
- D. Provide required supports and hangers for piping, conduit and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

- E. Field drilling and cutting of holes in structural decks, roofs, walls, etc., required for work under this section shall be coordinated through various trades in their respective materials and approved by the Client Representative. All such drilling, cutting, and reinforcing costs shall be borne by the contractor.
- F. Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It shall be the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.
- G. Cooperate with all other contractors and subcontractors to facilitate the completion of the work as a whole, subject to the direction of the Client Representative.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

- A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Galvanized-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME B16.1, Class 125.
- I. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Pressure-Seal Fittings:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Viega; Plumbing & Heating Systems.
 2. Standard: UL 213.
 3. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 4. NPS 2-1/2 to NPS 4 Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
- G. Grooved-Joint Copper Tube Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.
- H. Copper-Tube, Extruded-Tee Connections:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. T-DRILL Industries Inc.
 2. Description: Tee formed in copper tube according to ASTM F 2104.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 LISTED FIRE PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - 2. Standard: UL 1091 except with ball instead of disc.
 - 3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 5. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Bronze Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
 - 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig.
 - 4. Body Material: Bronze.
 - 5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.
 - p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.

- t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
- 2. Standard: UL 312
 - 3. Pressure Rating: 250 psig minimum
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.
- F. Bronze OS&Y Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 - 2. Standard: UL 262.
 - 3. Pressure Rating: 175 psig
 - 4. Body Material: Bronze.
 - 5. End Connections: Threaded.
- G. Iron OS&Y Gate Valves:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.

- I. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
 - 2. Standard: UL 262.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Body Material: Cast or ductile iron.
 - 5. End Connections: Flanged or grooved.
- H. Indicating-Type Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
 - 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 - 5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 - 6. Valve Operation: Integral [electrical, 115-V ac, prewired, single-circuit, supervisory switch] [electrical, 115-V ac, prewired, two-circuit, supervisory switch] [visual] indicating device.
- I. NRS Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.

- e. Kennedy Valve; a division of McWane, Inc.
- f. Mueller Co.; Water Products Division.
- g. NIBCO INC.
- h. Tyco Fire & Building Products LP.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast iron with indicator post flange.
- 5. Stem: Nonrising.
- 6. End Connections: Flanged or grooved.

J. Indicator Posts:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyco Fire & Building Products LP.
- 2. Standard: UL 789.
- 3. Type: Horizontal for wall mounting.
- 4. Body Material: Cast iron with extension rod and locking device.
- 5. Operation: Wrench.

2.7 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- 2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Southern Manufacturing Group.

2.8 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 - b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.

- d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
 - 6. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.
- C. Deluge Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. BERMAD Control Valves.
 - c. CLA-VAL Automatic Control Valves.
 - d. Globe Fire Sprinkler Corporation.
 - e. OCV Control Valves.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Venus Fire Protection Ltd.
 - i. Victaulic Company.
 - j. Viking Corporation.
 - 2. Standard: UL 260.
 - 3. Design: Hydraulically operated, differential-pressure type.
 - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
 - 5. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.

6. Air-Pressure Maintenance Device:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AFAC Inc.
 - 2) Globe Fire Sprinkler Corporation.
 - 3) Reliable Automatic Sprinkler Co., Inc.
 - 4) Tyco Fire & Building Products LP.
 - 5) Venus Fire Protection Ltd.
 - 6) Victaulic Company.
 - 7) Viking Corporation.
 - b. Standard: UL 260.
 - c. Type: Automatic device to maintain minimum air pressure in piping.
 - d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psigadjustable range, and 175-psigpsig outlet pressure.
7. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - c. Motor Horsepower: Fractional.
 - d. Power: 120-V ac, 60 Hz, single phase.
- D. Automatic (Ball Drip) Drain Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 2. Standard: UL 1726.
 3. Pressure Rating: 175 psig minimum.
 4. Type: Automatic draining, ball check.
 5. Size: NPS 3/4.
 6. End Connections: Threaded.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE"
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 4.

B. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. GMR International Equipment Corporation.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal Square Vertical.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Rough brass or bronze.
15. Outlet Size: NPS 4.

C. Yard-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Exposed, freestanding.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, floor type.
9. Outlet: Bottom, with pipe threads.
10. Number of Inlets: Two.
11. Sleeve: Brass.
12. Sleeve Height: 18 inches.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE"
14. Finish[, Including Sleeve]: Polished chrome plated.
15. Outlet Size: NPS 4.

2.10 SPRINKLER SPECIALTY PIPE FITTINGS

- A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
- B. Branch Outlet Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig minimum
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-T and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- C. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- D. Branch Line Testers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.

- c. Potter Roemer.
 - 2. Standard: UL 199.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Brass.
 - 5. Size: Same as connected piping.
 - 6. Inlet: Threaded.
 - 7. Drain Outlet: Threaded and capped.
 - 8. Branch Outlet: Threaded, for sprinkler.
- E. Sprinkler Inspector's Test Fittings:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with sight glass.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded.
- F. Adjustable Drop Nipples:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 - 2. Standard: UL 1474.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Body Material: Steel pipe with EPDM O-ring seals.
 - 5. Size: Same as connected piping.
 - 6. Length: Adjustable.
 - 7. Inlet and Outlet: Threaded.
- G. Flexible, Sprinkler Hose Fittings:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fivalco Inc.
- b. FlexHead Industries, Inc.
- c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.11 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AFAC Inc.
 2. Globe Fire Sprinkler Corporation.
 3. Reliable Automatic Sprinkler Co., Inc.
 4. Tyco Fire & Building Products LP.
 5. Venus Fire Protection Ltd.
 6. Victaulic Company.
 7. Viking Corporation.
- B. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
 4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig.
- C. Automatic Sprinklers with Heat-Responsive Element:
 1. Nonresidential Applications: UL 199.
 2. Residential Applications: UL 1626.
 3. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
 1. Chrome plated.
 2. Bronze.
 3. Painted.
- E. Special Coatings:
 1. Wax.

2. Lead.
 3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel] [Plastic, white finish, one piece, flat.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.12 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 753.
 3. Type: Mechanically operated, with Pelton wheel.
 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 5. Size: 10-inch diameter.
 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 7. Inlet: NPS 3/4.
 8. Outlet: NPS 1 drain connection.
- C. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Fire-Lite Alarms; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 2. Standard: UL 464.
 3. Type: Vibrating, metal alarm bell.
 4. Size: 6-inch diameter.
 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- D. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFAC Inc.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
 2. Standard: UL 346.
 3. Type: Electrically supervised water-flow switch with retard feature.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design Operation: Rising pressure signals water flow.
- E. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire-Lite Alarms; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
- F. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company.

- b. System Sensor; a Honeywell company.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.13 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.14 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.
 - 1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
 - 3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.15 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AMETEK, Inc.; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.

- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve,[backflow preventer,] pressure gage, drain, and other accessories indicated at connection to water-service piping.[Comply with requirements in Section 21 11 00 "Facility Fire-Suppression Water-Service Piping" for backflow preventers.]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for interior piping.
- B. Install shutoff valve,[backflow preventer,] pressure gage, drain, and other accessories indicated at connection to water-distribution piping.[Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for backflow preventers.]
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 1. Pressure gages and controls.
 2. Electrical power system.
 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
- O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- P. Drain dry-pipe sprinkler piping.

- Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

- J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Dry-Pipe and [Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air supply piping.
 - b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
 - c. Install compressed-air supply piping from building's compressed-air piping system.

3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.8 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
 - 1. Install three protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 05 50 00 "Metal Fabrications."
- C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.

8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller shall be one of the following:

1. Standard-weight, Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, Schedule 40 galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.

E. Standard-pressure, dry-pipe sprinkler system, [NPS 2-1/2 to NPS 4] shall be the following:

1. Standard-weight, Schedule 40], galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

F. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6 < shall be the following:

1. Standard-weight, Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

DRY-PIPE SPRINKLER SYSTEMS

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3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Dry recessed sprinklers.
 3. Wall Mounting: Dry sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright sprinklers.
 5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 21 2113 - HIGH-PRESSURE, CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this specification section to the extent referenced. The publications are referred to within the text by the basic designation only. Use the latest edition, unless noted otherwise.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B16.11, Forged Fittings, Socket-Welding and Threaded
 - 2. ASME B16.3, Malleable Iron Threaded Fittings, Classes 150 and 300
 - 3. ASME B16.39, Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
- C. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - 2. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
 - 1. IEEE C62.41.1, Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
 - 2. IEEE C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- E. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
 - 1. MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
 - 2. MSS SP-69, Pipe-Hangers and Supports-Selection and Application (ANSI Approved American National Standard)
- F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 1. NFPA 12, (2025) Standard on Carbon Dioxide Extinguishing Systems
 - 2. NFPA 170, (2024) Standard for Fire Safety and Emergency Symbols
 - 3. NFPA 70, (2023) National Electrical Code®
 - 4. NFPA 72, (2025) National Fire Alarm and Signaling Code®

G. UNDERWRITERS LABORATORIES (UL)

1. UL 1449, Surge Protective Devices
2. UL 1638, Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
3. UL 1971, Signaling Devices for the Hearing Impaired
4. UL 228, Standard for Door Closers-Holders, With or Without Integral Smoke Detectors
5. UL 268, Smoke Detectors for Fire Protective Signaling Systems
6. UL 464, Audible Signal Appliances
7. UL 497B, Protectors for Data Communications and Fire-Alarm Circuits
8. UL 521, Heat Detectors for Fire Protective Signaling Systems
9. UL 864, Control Units and Accessories for Fire Alarm Systems
10. UL Fire Prot Dir, <http://productspec.ul.com/index.php>

1.2 NOTICE TO BIDDERS

- A. Before submittal of bid, examine all drawings, specification, addenda, alternatives, special conditions, and all other bidding documents of all sections of this project, verifying all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the contract documents and no consideration will be granted for any claimed misunderstanding thereof.
- B. Submittal of a bid is deemed a representation by the bidder that he is qualified in all respects to properly perform the work for which he is bidding and has experience with similar work. Bidders are deemed to be aware, based on their background and experience, of materials which may be required in the discharge of their responsibilities, even though unspecified.

1.3 SYSTEM DESCRIPTION

- A. Design and provide new high-pressure carbon dioxide total flooding fire extinguishing system for protection of SRP assets. The system design and manufacturer's products including design, materials, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with NFPA 12, NFPA 70, and NFPA 72, except as modified herein. The system must include all mechanical and electrical installation, all detection and control equipment, storage containers, carbon dioxide, discharge nozzles, pipe and fittings, manual release, audible and visible alarm notification appliances, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional carbon dioxide extinguishing system. Arrange system for fully automatic and manually operated electronic control operation, with operating controls of the enclosed release type to prevent accidental operation. Each protected area must have audible and visible notification appliances with separate and distinct audible and visual pre-discharge

and discharge signals. The discharge signals must be distinct from those used by the building fire evacuation system.

- B. Design any portions of the fire-extinguishing system that are not indicated on the Contract Drawings, including but not limited to locating and sizing nozzles, piping, tanks, pressure switches, valves, and equipment. Design any portions of the releasing system that are not indicated on the Contract Drawings, including but not limited to locating initiating devices, notification appliances, terminal cabinets, raceways, and pathways. Provide seismic bracing appropriate for the seismic design category and short-period spectral acceleration value applicable to the project. The design must include storage capacity to provide a single discharge to each protected area. Each protected area must have its own storage container or be manifolded together utilizing the same tanks and piping. One common control unit may control all systems individually. Each system must include all materials, accessories, and equipment inside and outside the building necessary to provide a complete system ready for use.
- C. Design and install each system to give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment and to be free from operating and maintenance difficulties.
- D. The contractor must be responsible for sealing and securing the protected space against agent loss and/or leakage during the "hold" period.
- E. Performance Requirements: Provide construction type, test, and marking of high-pressure cylinders in accordance with US Department of Transportation (USDOT) specifications for seamless steel cylinders. Each cylinder is to be provided with a safety device to relieve excessive pressure safely, in advance of the rated cylinder test pressure. Devices are to be Interstate Commerce Commission approved frangible safety disks. Provide cylinder support racks that anchor to walls and floors.
- F. Main System: Arrange system for fully automatic and manually operated electric control operation, with operating controls of the enclosed release type to prevent accidental operation. Also provide for manual release stations, and keyed override operations as indicated on the drawings.
- G. Circuit Requirements: All initiating device circuits (IDC), signal line circuits (SLC), and notification appliance circuits (NAC) must be Class A or B in accordance with NFPA 72. Provide a separate circuit for each zone. Fully supervise the solenoid circuits so that the occurrence of a single open or a single ground fault condition of the interconnecting conductors will be indicated at the control unit.
- H. Reserve Cylinders: Provide and install a connected reserve cylinder bank supply. As required by SRP.
- I. Work also includes, but is not limited to, the following:
 - 1. Installation of required signs to identify all valves, interconnections to the building fire alarm control unit, hangers, and audible and visible notification appliances. Any necessary core drilling through concrete or masonry floors or walls, with approval of the Owner's

Representative and/or a Structural Engineer. Firestopping of all extinguishing system piping and conduit penetrations through fire-rated walls, partitions, and floor-ceiling assemblies. Through-penetration firestop details, including Underwriter's Laboratories reference number, must be shown on the shop drawings.

- J. It is the contractor's responsibility to consult other specification sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete operational installation.

1.4 SYSTEM SEQUENCE

- A. Automatic operation of each protected area must be as follows:
 - 1. Actuation of one detector within the system must:
 - a. Activate the "ALARM" indicator lamp on the releasing control unit (RCU).
 - b. Energize the alarm audible and visible notification appliance located in the hazard area for evacuation of the protected area.
 - c. Operate door holder/closers on access doors.
 - d. Transmit an alarm signal to the main fire alarm control unit (FACU).
 - e. Activate the building fire alarm system.
 - f. Activate an individual visible indicator for that device on the graphic annunciator.
 - 2. Actuation of a second detector within the system must:
 - a. Activate the "PRE-DISCHARGE" indicator on the RCU.
 - b. Energize the pre-discharge audible and visible notification appliance located in the hazard area.
 - c. Shut down the HVAC system and close smoke dampers.
 - d. Start time delay sequence (not to exceed 60 seconds).
 - e. Light an individual lamp for that device on the graphic annunciator.
- B. After completion of the time delay sequence, the fire extinguishing system must activate, and the following must occur:
 - 1. Activate the "RELEASE" indicator on the RCU.
 - 2. Energize the visible notification appliance(s) outside the hazard area in which the discharge occurred.
 - 3. Energize the "System Release" audible device.
 - 4. Transmit a system release signal to the RCU.
- C. The system must be capable of being actuated by manual release stations located at each hazard exit. Operation of a manual release station must duplicate the sequence described above, except that the time delay MUST be bypassed. The manual release stations must be of the double-action, electrical actuation type and must be supervised at the RCU.

1.5 SUBMITTALS

- A. Submit an electronic copy in pdf format of the following, no later than 21 days prior to the start of system installation, in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise, must be no smaller than the Contract Drawings.
- B. Shop Drawings
 - 1. Detail drawings conforming to the requirements for "Plans" as prescribed in NFPA 12; drawings must be no smaller than the Contract Drawings, unless noted otherwise. Drawings must include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Annotate system piping layout with reference points for design. Provide field wiring diagrams showing locations of devices and points of the system. Each set of drawings must include the following:
 - a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 - b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections, and other details required to clearly describe the proposed arrangement.
 - c. Details of equipment layout and design, including wire counts and approximate location of conduit. Indicate the general physical layout of all controls, manual release stations, detectors, and wiring details. Show isometric details of agent storage containers, mounting details, and proposed pipe runs and sizes. Electrical layout drawings must show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting. Provide an internal control unit wiring diagram that includes power supply requirements and field wiring termination points.
 - d. Wiring Diagrams: Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the RCU and remote fire control units, initiating circuits, switches, relays, and terminals. Provide complete riser diagrams indicating the wiring sequence of devices and their connection to the control equipment.
 - e. Sequence of operation that describes how the system responds during an alarm, supervisory, and trouble condition. The description must include releasing control unit LEDs, audible and visible indications, initiating devices, notification appliances, auxiliary functions, shutdown functions, damper operation, time delay, and agent discharge for each zone or system. The description must provide sufficient information so that the exact function of each installed device and appliance is known.
 - f. Details of each type of pipe hanger and related components.
 - g. Shop drawings and calculations must be prepared by a qualified NICET Level III (or IV) technician.
 - h. Drawings must be produced in CAD. Use standard fonts and line styles and furnish the pcp file.

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- C. Calculations: Submit carbon dioxide discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 12. Calculations must include the total required venting area (both positive and negative), in square inches, for each protected enclosure.
- D. Product Data: Annotated catalog data showing manufacturer's name, model, and catalog number for all equipment and components to be considered for the project, as well as standby and alarm current for all initiation and notification appliances to verify calculations.
 - 1. High-pressure cylinders
 - 2. Piping materials
 - 3. Pipe hangers and supports
 - 4. Nozzles
 - 5. Pressure alarm switch
 - 6. Main and reserve switch
 - 7. Releasing control unit
 - 8. Manual release stations
 - 9. Terminal cabinets
 - 10. Batteries
 - 11. Battery charger
 - 12. Wiring and cable
 - 13. Notification appliances
 - 14. Addressable interface devices
 - 15. Electromagnetic door hold-open devices
 - 16. Line voltage surge protective devices
 - 17. Auxiliary power (booster) panels
 - 18. Firestopping
 - 19. Escutcheons
 - 20. Dampers
 - 21. Warning signs
 - 22. Paint
- E. Battery Calculations: Submit battery calculations as required in paragraph Battery Power Calculations. Submit a voltage drop calculation to indicate that sufficient voltage is available for proper operation of the system and all components, at a minimum rated voltage of the system operating on batteries.
- F. ASME Certification: Provide one electronic copy of ASME certification for all pressure vessels.
- G. Conduit Fill Calculations: Submit conduit fill calculations to ensure that the numbers of conductors located in the conduit is in accordance with NFPA 70.
- H. Test Procedures: 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 preliminary tests.

- I. Preliminary Test Report: Provide three copies of the completed preliminary test report, no later than 7 days after the completion of the preliminary tests. The preliminary test report must be as outlined in NFPA 12.
- J. Final Acceptance Test Report: Submit an electronic copy in pdf format of the completed final test reports, no later than 7 days after the completion of the final acceptance tests. Final acceptance test reports must be as outlined in NFPA 12.
- K. Installer's Qualifications: Qualifications must be approved prior to submittal of any other data or drawings, to substantiate that the proposed installer is regularly engaged in the installation of the type and complexity of fire protection system included in this project. Submit documentation to identify the location of three systems recently installed by the proposed installer which are comparable to the system specified. Contractor must certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months. Submit a copy of license to perform work in the local jurisdiction.
- L. As-Built Drawings: Furnish one flash drive containing software back-up and CAD based drawings, in the latest version of AutoCAD and DXF format, and pdf of as-built drawings and schematics. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, must be maintained on-site. These drawings must be maintained in a current condition at all times and be make available for review immediately upon request during normal working hours. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required for coordination between trades must be indicated in sufficient detail to accurately reflect the as-built conditions. Submit a complete set of as-built (record) working drawings including complete as-built circuit diagrams of each carbon dioxide system for record purposes within 14 calendar days after the final acceptance test of the system.
- M. Operation and Maintenance Data: Furnish one flash drive of manuals in loose-leaf binder format and grouped by technical sections consisting of manufacture's brochures, schematics, printed instructions, general operating procedures, and safety precautions. Manuals must be submitted and approved prior to final testing. In addition to the items specified in Division 01 Section 01723 "Operation and Maintenance Data", the manual must include a narrative description of the sequence or sequences of operation of the overall fire protection system and a separate description of each major subdivision. Information to be provided must include specific open/close settings for all adjustable valves. The manuals must list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manual must include system piping layout, conduit layout, equipment layout, simplified wiring and control diagrams for the system as installed. The manual must include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.
- N. Training Documentation: Provide in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize the Owner's designated personnel with the proper operation of the installed system. The maintenance training course must provide the Owner's designated personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

- O. Preliminary Equipment List: Provide a preliminary equipment list identifying the type, quantity, make and model number of each piece of equipment to be provided under this submittal. Types and quantities of equipment submitted must coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings. A final equipment list must be submitted with the Operating and Maintenance (O&M) manual.

1.6 QUALITY ASSURANCE

- A. Qualifications - Contractor: The contractor must be an approved distributor/installer for the carbon dioxide fire extinguishing systems and a licensed contractor in possession of a valid special hazard extinguishing systems contractor's license. The contractor must have a minimum of 5 years of experience in the installation of special hazard systems in similar facilities.
- B. Qualifications - Special Hazard Design Services: Shop (working) drawings and calculations must be prepared under the directions of and signed by a qualified registered Professional Engineer or a NICET Level III (or IV) in special hazard systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 - 1. A registered Professional Engineer having passed the NCEES examination in fire protection engineering.
 - 2. Registered Professional Engineer with verification of experience and at least 5 years of current experience in the design of fire protection and detection systems.
- C. Qualifications - Installation Supervisor: A NICET Level III (minimum) in special hazards systems must supervise the installation of the carbon dioxide fire extinguishing system.
- D. Qualifications - Releasing System Installer: Releasing system installer with a minimum of 2 years of experience is permitted to assist in the installation of releasing system devices, cabinets, and control units. An electrician is permitted to install wire, cable, conduit, and backboxes for the releasing system.
- E. Qualifications - Test Personnel: Special hazards system technicians, factory trained, with a minimum of 2 years of experience must be utilized to test and certify the installation of the fire extinguishment system. The special hazards system technicians testing the equipment must be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.7 REGULATORY REQUIREMENTS

- A. All system components must be listed or approved for their intended use and must be compatible with the system and its components. Where the terms "listed" or "approved" appear in this specification section, they mean UL-listed (UL Fire Prot Dir), FM-approved (FM App Guide), or listed by a nationally recognized testing laboratory (NRTL). The omission of these terms under the description of any item of equipment described must not be construed as waiving the requirement for listing or approval. All listings or approvals must be based on an existing ANSI or UL published standard.

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- B. Compliance with referenced standards is mandatory. In the event of a conflict between specific provisions of this specification section and applicable standards, this specification section must govern.
- C. Install all work in full conformance with the requirements of all local and governmental authorities having jurisdiction over these matters, utility company requirements, and requirements of the latest issues of all applicable Codes. The building permit will be secured by the Owner. Any additional permits, inspections, close-outs must be the responsibility of the contractor.
- D. Should any change in plans or specification be required to comply with governmental regulations, the contractor must notify the Engineer at the time of submitting his bid.
- E. Secure and pay for necessary approvals, permits, inspections, etc., and deliver the official records of granting the permits to the Owner's Representative without additional cost to the Owner.

1.8 VERIFYING ACTUAL FIELD CONDITIONS

- A. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Owner's Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate, or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.
- B. The contractor must become familiar with all details of the work, verify all dimensions in the field, and must advise the Owner's Representative of any discrepancy before performing the work.

1.9 COORDINATION OF TRADES

- A. The contract documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations required for a fully coordinated installation that respects the work of all trades.
- B. Pipe offsets, fittings, and any other accessories required must be furnished as required to provide a complete installation and to eliminate interference with other construction.
- C. Wherever the contractor's work interconnects with work of other contractors, the contractor must coordinate his work with other contractors to ensure that all contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers, etc.) concealed above hung ceilings by permanent-colored pins/tabs in the ceiling directly below the item.
- D. Provide required supports and hangers for piping, conduit, and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation

that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

- E. Field drilling and cutting of holes in structural decks, roofs, walls, etc., required for work under this specification section must be coordinated through various trades in their respective materials. All such drilling, cutting, and reinforcing costs must be borne by the contractor.
- F. Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It must be the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.
- G. Cooperate with all other contractors and subcontractors to facilitate the completion of the work as a whole, subject to the direction of the Owner's Representative.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment delivered and placed in storage from the weather, excessive humidity, temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.
- B. All pipes and fittings must either be capped or plugged until installation. Do not lay any metallic components in direct contact with ground or soil.
- C. Coordinate the storage arrangement and location with the Owner.
- D. Delivery and store products in shipping containers/boxes, with labeling in place.

1.11 WASTE REMOVAL

- A. At the conclusion of each day's work, clean up and stockpile on-site all waste, debris, and trash, which may have accumulated during the day as a result of work by the contractor and his presence on the job.
- B. Comply with all site-specific waste removal process. Coordinate with Owner or site contact for proper disposal.
- C. Provide SDS for all hazardous materials to be used.
- D. Sidewalks and street adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions of any kind caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

1.12 SPARE PARTS

- A. Repair Service/Replacement Parts: During warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site, unless a longer time is approved by the Owner.
- B. Interchangeable Parts: Spare parts furnished must be directly interchangeable with the corresponding components of the installed system. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Owner at the time of final acceptance testing.
- C. Spare Parts: Furnish the following spare parts and accessories:
 - 1. Fuses: Four of each for each type, rating, and size of fuse used in the system.
 - 2. Ten percent of each initiating device and notification appliance installed, but no less than two of each.
 - 3. Surge protective devices: Two low voltage and one 120 VAC surge protective devices.
 - 4. Addressable control and monitor modules: Ten percent of the installed quantity of each type, but no less than two devices of each type.
 - 5. Light bulbs: Four of each for each type of lamp used in the system.
 - 6. Keys: A minimum of three sets of keys must be provided and appropriately identified.
- D. Special Tools: Software, connecting cables, and proprietary equipment necessary for the maintenance, testing, and reprogramming of equipment must be furnished to the Owner.
- E. Spare Parts Cabinet: A wall-mounted, metal, locking cabinet, no less than 22 gage steel in black baked-on enamel must be provided and installed by the contractor, adjacent to the system control unit or another approved location as directed by the Owner's Representative. The cabinet must be sized to hold all spare parts and one copy of the O&M manual and training manual. An inventory list must be made of all items to be kept inside cabinet. Include on the list the number of all spare parts and keys to be provided. Give inventory list to the Owner's Representative during acceptance of the carbon dioxide fire extinguishing system for verification of items in the cabinet. The Owner's Representative will sign off on the list when all items on the list appear in the cabinet. The cabinet must be provided with a permanent label stating, "CARBON DIOXIDE SYSTEM SPARE PARTS".

1.13 WORK PERFORMED BY OTHERS

- A. The work listed below must be provided by others, unless otherwise discussed and approved by the Owner to perform work listed:
 - 1. 120 VAC or 240 VAC power supply to the RCU.
 - 2. Interlock wiring and conduit for shutdown of the HVAC, dampers, and/or electrical power supplies.
 - 3. Connection to local/remote fire alarm system(s) and listed central station(s).
 - 4. Structural review of floor assembly to verify adequate support for cylinders.
 - 5. Sealing of hazard area.
 - 6. Pressure venting of the hazard area.

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PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacture of such products and must essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials and equipment supplied must be new, first quality and the manufacturer's best type and latest model capable of complying with all requirements of this specification section and must have been in continuous production and in continuous service in commercial application for at least one year. Obsolete equipment must not be used. All equipment must be identical to the approved Bill of Materials.
- B. All equipment must have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Nameplates must be etched metal or plastic, permanently attached by screws to equipment or adjacent walls.

2.2 COMPONENTS

- A. Piping: Pipe must be steel conforming to NFPA 12. Provide pipe and fittings having a minimum bursting pressure of 5,000 pounds per square inch (psi). For 1/2-inch and 3/4-inch iron pipe size (ips) provide schedule 40. For 1-inch or greater, use only schedule 80 pipe. Provide fittings for changes in direction of piping and for all connections. Reduce pipe sizes in the fitting. Do not use flush bushings.
 - 1. ASTM A53, Type E (electric-resistance welded, Grade A or Grade B) or Type S (seamless, Grade A or Grade B).
 - 2. ASTM A106, Grade A or Grade B.
- B. Discharge Nozzle: Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Nozzles must be available in NPT sizes 1/4-inch to 2.0-inch and must be available in 180-degree and 360-degree patterns.
- C. Pipe Hangers and Supports: Provide pipe hangers and supports conforming to NFPA 12, MSS SP-58 or MSS SP-60, Type 1, with adjustable support rods and manufacturer's recommendations.
- D. Pipe Sleeves: Use standard weight zinc-coated steel pipe sleeves in outside walls below and above grade, in floor and in roof slabs. Zinc coat sheet steel sleeves in partitions having a nominal weight of not less than 0.90 pounds per square foot.
- E. Escutcheons: Escutcheons must be one-piece or split type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast-iron with aluminum paint finish.
- F. Storage cylinders must be constructed of high strength alloy steel, conforming to all applicable specifications of the Department of Transportation. Container design must permit on-site

reconditioning and refilling when required. Safety valves, manifolds, pressure gauges, and pressure switches must be furnished and installed. Each container must meet the following:

1. A pressure gauge to provide visual and electrical supervision of the container pressure. The pressure gauge must be color-coded to provide an easy, visual indication of container pressure.
2. A pressure relief provision that automatically operates when the internal temperature exceeds 130 degrees F. Each container must have a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure.
3. The requirements of the US Department of Transportation specifications, if used as shipping containers. If not used as a shipping container, each container must be designed, fabricated, inspected, certified, and stamped in accordance with section VIII of ASME BPVC.
4. Provide with support racks that anchor to walls and floors.
5. A permanent nameplate or other permanent marking that indicates the agent, tare and gross weights and super-pressurization level (where applicable) of the container.

2.3 RELEASING CONTROL UNIT (RCU)

- A. Provide an analog-addressable or conventional (zoned) releasing control unit that is compatible with the system, devices, and functions specified. The control system and its components must be listed for use as a local fire alarm system with releasing device service. The control system must perform all functions necessary to operate the system detection, actuation, and auxiliary functions. The control system must be microprocessor-based utilizing distributed processing concept. A single microprocessor failure must not impact operation of additional modules on the system. The control system must be capable of supporting an air-aspirating smoke detection system. The control system must have four initiating circuits that are capable of Class A or B operation. Each circuit must be capable of monitoring contact devices configured for manual release, manual alarm, , trouble input or auxiliary (non-fire) input. The control unit must release circuits for activation of an extinguishing/supervision system. The control unit must contain at least two indicating appliance circuits for annunciation.
- B. Wiring.
 1. Provide Class A or B initiating device circuits.
 2. Provide Class A or B signaling line circuits.
 3. Provide Class A or B notification appliance circuits.
- C. Graphic Annunciator: Annunciator must be interior and weatherproof type, flush or surface mounted unit. Annunciator must contain the building floor plan, drawn to scale, with remote alarm lamps mounted to represent the location of each alarm initiating device. Label principal rooms and areas shown with their room numbers or titles. Show the annunciator location on the floor plan. Ensure detectors mounted above ceilings, on ceilings, and beneath raised floors and different types of initiation devices have different symbols or lamps of different colors for identification. Ensure that lamps illuminate upon actuation of their corresponding device and remain illuminated until the system is reset. Provide a light test switch for the annunciator.

2.4 MANUAL RELEASE STATIONS

- A. Stations must be of the type not subject to operation by jarring or vibration. Stations must have a dual-action release configuration. Break-glass front stations are not permitted; however, a pull lever break-glass rod type is acceptable. Manual release stations must be a different color (such as yellow or orange) from building fire alarm pull stations.

2.5 COMBINATION FIXED TEMPERATURE AND RATE-OF-RISE HEAT DETECTORS

- A. Provide heat detectors for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing must be rated in accordance with UL 521. Detectors must be supported independently of wiring connections. Contacts must be self-restoring after response to rate-of-rise principle. Under fixed temperature actuation, the detector must have a permanent external indication which is readily visible. The UL 521 test rating of the rate-of-rise detectors must be rated for 50 by 50 feet.

2.6 SMOKE DETECTORS

- A. Photoelectric Smoke Detectors: Provide photoelectric smoke detectors as follows:
 - 1. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors must be listed for use with the releasing control unit.
 - 2. Provide self-restoring type detectors that do not require any re-adjustment after actuation at the RCU to restore them to normal operations.
 - 3. Components must be rust and corrosion resistant. Vibration must have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen must not inhibit the movement of smoke particles into the chamber.
 - 4. Provide twist lock bases constructed of white, high impact polycarbonate designed for mounting on a standard 1 1/2-inch or 4-inch octagonal or 4-inch square outlet box for detectors. The detectors must maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on screw terminals. The detector must have a visual indicator to show actuation. Insertion of an incorrect detector type into the base must cause a "Wrong Device" trouble condition at the RCU until the proper type of detector is installed, or the system is reprogrammed. The system program must recognize the insertion of a wrong device and must automatically default to the set point values corresponding to the inserted device and must monitor alarm and trouble conditions according to the default parameters.
 - 5. The detector address must identify the particular unit, its location within the system, and its sensitivity setting. Detectors must be of the low voltage type rated for use on a 24 VDC system.
 - 6. An operator at the control unit, having the proper access level, must have the capability to manually access the following information for each initiating device.

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Detector range (normal, dirty, etc.)

2.7 ADDRESSABLE INTERFACE DEVICES

- A. The system must 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 such as waterflow switches, valve supervisory switches, relays for output function actuation, etc. The monitor module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. Monitor modules must contain an integral LED that flashes each time the monitor module is polled and is visible through the device cover plate. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.8 ADDRESSABLE CONTROL MODULE

- A. The control module must be capable of operating as a relay (dry contact form C) for interfacing the control with other systems, and to control door holders, or initiate elevator fire service. The indicating device or the external load being controlled must be configured as a Class B notification appliance circuit. The system must be capable of supervising audible, visual, and dry contact circuits. The supervision must detect a short on the supervised circuit and must prevent power from being applied to the circuit. The control module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. The control module must contain an integral LED that flashes each time the control module is polled and is visible through the device cover plate. Control modules must be located in environmental areas that reflect the conditions to which they were listed and must include a mounting plate for installation in a junction box.

2.9 NOTIFICATION APPLIANCES

- A. Fire Alarm Horns: Horns must conform to the applicable requirements of UL 464. Horns must be semi-flush-mounted or surface-mounted with matching mounting backbox. Horns must produce a sound rating of at least 85 dBA at 10 feet. Device must be distinct in sound from the building fire alarm devices and through color or labeling (i.e., "Agent Discharge").
- B. Visible Notification Appliances: Visual notification appliances must conform to the applicable requirements of UL 1971 and conform to ADAAG. Fire alarm notification appliances must have clear high intensity optic lens, and output white light and be marked "Agent" in red letters. The light pattern must be disbursed so that it is visible above and below the strobe and from a 90-degree angle on both sides of the strobe. Strobe flash rate must be one flash per second and a minimum of 15 candela based on the UL 1971 test. Strobes must be semi-flush-mounted. Where more than two appliances are located in the same room, or corridor, or field of view, provide synchronized operation. Devices must use screw terminals for all field wiring.

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2.10 PRIMARY ELECTRIC POWER

- A. Power must be 120 VAC service for the RCU from the normal AC service to the building in accordance with NFPA 72.

2.11 SECONDARY POWER SUPPLY

- A. Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power must be automatic and must not cause transmission of a false alarm.
- B. Batteries: Provide sealed, maintenance-free, lead-acid batteries as the source for emergency power to the RCU. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid-state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.
 - 1. Capacity, Fire Alarm System: Battery size must have sufficient capacity to operate the fire alarm system under supervisory and trouble conditions, including audible trouble signal devices for 24 hours and audible and visual signal devices under alarm conditions for an additional 5 minutes.
 - 2. Battery Power Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements. Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Include ampere-hour requirements for each system component and each control unit component, and compliance with UL 864. Provide complete battery calculations for the alarm, alert, and supervisory power requirements. Include a 1.2 derating factor in all calculations.
 - 3. For battery calculations use the following assumptions: Assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required amp-hours for the specified standby time, and then calculate the required amp-hours for the specified alarm time. Calculate the nominal battery voltage after operation on batteries for the specified time period.
- C. Battery Chargers: Provide a solid-state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 VDC), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph Capacity above. Provide a pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided.

2.12 WIRING

- A. Alarm Wiring: SLC and IDC wiring must be copper cable in accordance with the manufacturer's requirements. Copper signaling line circuits and initiating device circuit field wiring must be No. 18 AWG size at a minimum. Visual notification appliance circuit conductors and notification appliances must be copper No. 14 AWG size conductors at a minimum. Wire size must be

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sufficient to prevent voltage drop below manufacture's recommendations. Power wiring, operating at 120 VAC minimum, must be a minimum of No. 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR, or FPLP as appropriate with red colored covering. Non-power-limited cables must comply with NFPA 70.

2.13 ENVIRONMENTAL ENCLOSURES OR GUARDS

- A. Environmental enclosures must be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the UL category that the component is currently listed. Guards required to deter mechanical damage must be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

2.14 ELECTROMAGNETIC DOOR HOLD-OPEN DEVICES

- A. Devices must be designed to operate on 24 VDC and require not more than 3 watts of power to develop 25 psi of holding force. Under normal conditions, the magnets must attract and hold the doors open. Operation must be fail safe with no moving parts. Electromagnetic door hold-open devices must not be required to be held open during building power failure. The device must be listed based upon UL 228.

2.15 LINE VOLTAGE SURGE PROTECTIVE DEVICES

- A. Line voltage surge protective devices must be provided to suppress all voltage transients which might damage releasing system control unit components. The surge protective device must wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrester must be installed directly adjacent to the power panel where the RCU breaker is located.
- B. Line voltage surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500-volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.
- C. Line voltage surge protective device for nominal 24 VAC, for alarm telephone dialer or ethernet connection, must be UL 497B listed and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge protective device must be base and plug style. The base assembly must have screw terminals for fire alarm wiring. The base assembly must accept a "plug-in" surge protective module.
- D. All surge protective devices (SPD) must be the standard product of a single manufacturer and be equal or better than the following:
 - 1. For 120 VAC nominal line voltage: DITEK DTK-120S20A series connected, 20 A AC power SPD.

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2. For 24-volt nominal line voltage: DITEK DTK-24MHLP24BWB series connected, modular, 5A maximum current SPD.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Install materials and equipment in accordance with NFPA 12. Provide each system complete and ready for operation. Provide each system with an approved pressure relief device designed to operate between 2,000 and 3,300 psi and located between the storage cylinder manifolds and any normally closed valve.
 - B. Distribution Piping and Fittings: Distribution piping and fittings must be installed in accordance with the manufacturer's requirements, NFPA 12, and approved piping standards and guidelines. All distribution piping must be installed by qualified individuals using good, accepted practices and quality procedures. All piping must be adequately supported and anchored at all directional changes and nozzle locations. All piping must be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish, and cutting oils before assembly. All pipe threads must be sealed with Teflon tape pipe sealant applied to the male threads ONLY.
 - C. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe hanger fastenings must not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must extend through its respective wall or floor and be cut flush with each surface. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes must be firestopped in accordance with Section 07 8400 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with a plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.
 - D. Escutcheon Plates: Provide one-piece or split hinge type metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide polished stainless-steel plates or chromium plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces. Securely anchor plates in place with setscrews or other approved positive means.
 - E. Pipe Sleeves: Provide where piping passes entirely through walls, ceilings, roofs, and floors. Provide sleeves of sufficient length to pass through the entire thickness. Provide 1-inch minimum clearance between exterior of piping and interior of sleeves or core-drilled hole. Firmly pack space with mineral wool insulation and seal both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL-listed fill, void or cavity material.
1. Sleeves in Masonry and Concrete: Provide hot-dipped galvanized steel, ductile-iron, or cast-iron sleeves at walls, ceilings, roofs, and floors. Core-drilling of masonry and concrete

- may be provided in lieu of sleeves provided that cavities in the core-drilled holes are completely grouted smooth.
2. Sleeves in Other Than Masonry and Concrete: Provide 26 gage galvanized steels.
- F. Escutcheons: Install escutcheons when piping is passing through floors, walls, or ceilings. Securely fasten escutcheons in place with setscrews or other positive means.
- G. Discharge Nozzle: Where clogging by external foreign materials is likely, discharge nozzles must be provided with frangible discs, blow-off caps, or other suitable devices.
- H. Pressure Relief Device: Provide each system with an approved device designed to operate between 2,400 and 3,000 psig. Locate the device between the storage cylinder manifolds and normally closed valves.
- I. Releasing Control Unit (RCU): The RCU must be located in a year-round environmentally conditioned space and not in the hazard area served, but adjacent to it. Locate RCU where indicated on the drawings. Recess, semi-recess or surface-mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnections must be permanently mounted in the RCU.
- J. Manual Release Stations: Provide manual release stations as indicated on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exterior door they serve, measured horizontally and at least 3 feet from the fire alarm manual pull stations.
- K. Heat Detectors: Locate detectors as required by NFPA 72 and their listing on a 4-inch backbox. Install heat detectors not less than 4 inches from a side wall to the near edge. Heat detectors located on the wall must have the top of the detector at least 4 inches below the ceiling, but no more than 12 inches below the ceiling.
- L. Smoke Detectors: Terminate field wiring on the screw terminals for all smoke detectors. Locate detectors as required by NFPA 70 and their listings on a 4-inch mounting box. Locate smoke detectors on the ceiling. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. Install smoke detectors no closer than 5 feet from air-handling supply outlets.
- M. Addressable Interface Devices: Must include a mounting plate for installation in a junction box or must be mounted in a locked cabinet or approved box.
- N. Electromagnetic Door Holder Release: Doors must be held open at a minimum 90 degrees so as not to impede egress from the space. Mount the armature portion on the door and have an adjusting screw for seating the angle of the contact plate. Wall-mount the electromagnetic release, with a total horizontal projection not exceeding 4 inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control unit for magnetic door holding circuits is not required.
- O. Extinguishing System Saving/Disconnect Switch: Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide
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and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE EXTINGUISHING SYSTEM SAFING SWITCH".

- P. Lockout valve: Provide for any system except where dimensional constraints prevent personnel from entering the protected space. This valve must be supervised. A discharge pressure switch shall be installed between the carbon dioxide supply and the lockout valve.
- Q. Operating Instructions: Provide at each remote control station. Instructions must clearly indicate steps for system operation. The proposed legend for operating instructions must be approved before installation. Instructions must be embossed white letters on red rigid plastic backgrounds. Lettering must be a minimum of 0.25-inch high for operating instructions and 1-inch high for identification of system operating devices and control valves.

3.2 SYSTEM FIELD WIRING

- A. Wiring within Cabinets, Enclosures, and Boxes: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box must be connected to screw-type terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. The use of wire nuts or similar devices is prohibited. Wiring must conform to NFPA 70.
- B. Terminal Cabinets: Terminal size must be appropriate for the size of the wiring to be connected. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted.
- C. Alarm Wiring: Voltages must not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Provide all wiring in electrical metallic conduit. The use of flexible conduit not exceeding a 6-foot length must be permitted to a single device or appliance. Run conduit or tubing (rigid, IMC, EMT, FMC, etc., as permitted by NFPA 72 and NFPA 70) concealed unless specifically indicated otherwise on the drawings. For shielded wiring, ground the shield at only one point that is in or adjacent to the RCU. Pigtail or T-tap connections to signal line circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. Color coding is required for circuits and must be maintained throughout the circuit. Conductors used for the same function must be similarly color coded.
- D. Conductor Terminations: Labeling of conductors at terminal blocks in terminal cabinets and at the RCU must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, RCU, NAC panel and remote RCU must contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing must be neat, using 12-point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals. Labeling nomenclature to match drawings.
- E. All existing wiring must be tested for abnormal conditions (grounds, shorts, opens, etc.) prior to re-use. In general, existing initiating device circuits can be re-used as signaling line circuits if the circuit is not loaded to more than 75 percent of the available circuit loading and the distance

limitations as set forth by the manufacturer's recommended specifications are not exceeded. Existing notification appliance circuits can be re-used, only if the existing circuit is not loaded to more than 75 percent of the available power for the circuit from the RCU. In the event that a signaling line circuit or a notification appliance circuit load exceeds 75 percent of the available circuit loading, new circuits must be installed.

- F. Exposed raceways must be run parallel and perpendicular to the walls and ceilings. Wherever practical, exposed raceways must be run on the ceiling as close as possible to a wall or as high as possible on a wall. Where exposed raceways must cross under a structural beam or rib, they must be run down on one side of the beam or rib, across its bottom, and up to the ceiling on the other side of the beam or rib. No spanning from beam to beam or rib to rib must be permitted. The use of a raceway body on one side of a beam or rib is permitted provided it must be readily accessible. Where metal raceway is installed exposed, it must be painted to match the walls and/or ceilings on which it is installed, as instructed by the Owner. The method and location of all exposed raceways must be approved by the Owner prior to start of any installation work.
- G. Circuit disconnecting means must have a red marking, must be accessible to authorized personnel, and must be identified as "FIRE ALARM CIRCUIT CONTROL". The location of the circuit disconnecting means must be permanently identified on a nameplate installed on the inside of the RCU.

3.3 FIRESTOPPING

- A. Provide firestopping for holes at conduit penetrations through floor slabs, fire-rated walls, partitions with fire-rated doors, corridor walls, and vertical service shafts.

3.4 PAINTING

- A. Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes red and conduits and surface metal raceways with a 1-inch-wide red band every 10 feet in unfinished areas.

3.5 WARNING SIGNS

- A. Provide three-layer red-white-red engraved to show white letters on a red background, warning signs. Letters are to be uppercase. Warning signs are to be 1/8-inch thick with beveled edges.
- B. Protected Space: Permanently affix a sign adjacent to every audible/visible alarm activated due to agent discharge reading:

WARNING

THIS SPACE IS PROTECTED BY A CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM. DO NOT ENTER WITHOUT AUTHORIZATION DURING OR AFTER DISCHARGE. THIS STROBE INDICATES DISCHARGE.

- C. Manual Activation of Releasing Station: Place a sign at every location where manual operation of the system may occur reading:

WARNING

ACTUATION OF THIS DEVICE WILL CAUSE FIRE EXTINGUISHING GAS TO DISCHARGE. BEFORE ACTUATING, ENSURE THAT PERSONNEL ARE CLEAR OF THE AREA.

3.6 FIELD QUALITY CONTROL

- A. After the system installation has been completed, the entire system must be checked out, inspected, and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards, in the presence of the Owner.
- B. Test Plan: The test plan must include a step-by-step description of all tests to be performed and must indicate the type and location of test apparatus to be employed. The tests must demonstrate that the operational and installation requirements of this specification section have been met. All tests must be conducted in the presence of the Owner's Representative and must not be conducted until the test plan has been approved by the Owner.
- C. Experienced technicians regularly employed by the contractor in the installation of the system and manufacturer's representative referred to elsewhere in this section must conduct the testing.

3.7 PRELIMINARY TESTS

- A. Visual Inspection: Inspection must be based on completed Record Drawings and system documentation that is required by NFPA 12 and NFPA 72 "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals of Fire Alarm Systems" chapter.
- B. Pressure Test: Pneumatically test each piping system with carbon dioxide, nitrogen, or dry air at 150 psig for 2 hours, with no leakage or reduction in gauge pressure. Gauges used must be calibrated.
- C. Room Pressurization Test: After construction is complete, conduct a room pressurization test in accordance with NFPA 12 in each carbon dioxide extinguishing system hazard area. Test must confirm enclosure's ability to retain the agent concentration level for the required hold time. If the test fails, the extinguishing system contractor must coordinate room sealing with the general contractor. Additional tests must be conducted until successful results are achieved. Include final test results with the final record drawings.
 - 1. A room pressurization test must be conducted in each protected space, to determine the presence of openings, which would affect the agent system concentration levels. The test(s) must be conducted using the RetroOTec Corp. Door Fan System, or equivalent, with integrated computer program.
 - 2. If room pressurization testing indicates openings exist that would result in leakage and/or loss of carbon dioxide fire extinguishing agent, the installing contractor must be

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responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his subcontractor or agent. The general contractor must be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor must inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. THE CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM INSTALLING CONTRACTOR MUST BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS. If the first room pressurization test is not successful, in accordance with this specification section, the installing contractor must inform the general contractor to determine and correct the cause of the test failure. If, after inspection of the additional sealing performed, the installing contractor is satisfied that the protected space is ready for retesting, the installing contractor must conduct additional room pressurization tests, at no additional cost, until a successful test is obtained. Copies of successful test results must be submitted to the Owner's Representative.

- D. Operational Test: After electrical circuitry has been energized, apply power to control unit and confirm proper unit operation. Comply with "Test Methods" table in "Testing" section of the "Inspection, Testing, and Maintenance" chapter of NFPA 72. Test and adjust controls and safeties.
- E. Pressure/Leak Test: Pneumatically test the piping in a closed circuit for a period of 10 minutes at 40 psi. At the end of 10 minutes, the pressure drop must not exceed 20 percent (8 psi) of the test pressure. Repair leaks and retest until no leaks exist.
- F. Carbon Dioxide System Test: A full initial discharge test must be performed in accordance with NFPA 12 with all equipment under normal operating conditions.
- G. Test and Inspection Reports: Factory authorized service representative must prepare the "Fire Alarm System Record of Completion" and the "Inspection and Testing" documents from NFPA 72 and all inspection and testing reports required by NFPA 12.

3.8 FINAL TESTS

- A. The system will be considered ready for acceptance testing only after the following have been accomplished:
 - 1. Preliminary tests have been made and deficiencies corrected.
 - 2. Testing reports have been submitted and approved.
- B. Final acceptance testing must be coordinated and performed by the contractor, in the presence of the Owner's Representative. In order to ensure attendance of the necessary representatives, each representative scheduled to witness the test must be provided with a minimum of 5 working days' notification of the proposed test date by the contractor. The test must not be conducted until all parties agree on the scheduled test date. The contractor must provide all necessary personnel and equipment to conduct the tests.
- C. The final acceptance test must repeat 100 percent of preliminary tests.

- D. If the final acceptance test fails, the contractor must pay all costs incurred to the Owner for any and all retesting.
- E. Include final test results with the final record drawings.
- F. Upon satisfactory completion of the tests, the contractor must leave the system in proper working order.
- G. Warranty: Except as otherwise expressly provided in the contract documents, the contractor guarantees all work to be free of all defects of workmanship and materials for a period of 1-year after final acceptance of the work by the Owner. Include service directory with telephone numbers for 24-hour emergency service.

3.9 TRAINING

- A. Instructor: Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor must train the employees designated by the Owner, in the care, adjustment, maintenance, and operation of the fire extinguishing system. Each instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including training history to the Owner's Representative prior to training.
- B. Required Instruction Time: Provide 4 hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times as selected by the Owner's Representative. The instruction may be divided into two or more periods at the discretion of the Owner's Representative. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

END OF SECTION 21 2113

SECTION 21 22120 – HYBRID FIRE-EXTINGUISHING SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this specification section to the extent referenced. The publications are referred to within the text by the basic designation only. Use the latest edition, unless noted otherwise.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B16.11, Forged Fittings, Socket-Welding and Threaded
 - 2. ASME B16.3, Malleable Iron Threaded Fittings, Classes 150 and 300
 - 3. ASME B16.39, Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
- C. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - 2. ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
 - 1. IEEE C62.41.1, Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
 - 2. IEEE C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- E. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
 - 1. MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
 - 2. MSS SP-69, Pipe-Hangers and Supports-Selection and Application (ANSI Approved American National Standard)
- F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - 1. NFPA 170, (2024) Standard for Fire Safety and Emergency Symbols
 - 2. NFPA 70, (2023) National Electrical Code®
 - 3. NFPA 72, (2025) National Fire Alarm and Signaling Code®
 - 4. NFPA 770, (2026) Standard on Hybrid (Water and Inert Gas) Fire-Extinguishing Systems

G. UNDERWRITERS LABORATORIES (UL)

1. UL 1449, Surge Protective Devices
2. UL 1638, Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
3. UL 1971, Signaling Devices for the Hearing Impaired
4. UL 228, Standard for Door Closers-Holders, With or Without Integral Smoke Detectors
5. UL 268, Smoke Detectors for Fire Protective Signaling Systems
6. UL 464, Audible Signal Appliances
7. UL 497B, Protectors for Data Communications and Fire-Alarm Circuits
8. UL 521, Heat Detectors for Fire Protective Signaling Systems
9. UL 864, Control Units and Accessories for Fire Alarm Systems
10. UL Fire Prot Dir, <http://productspec.ul.com/index.php>

1.2 NOTICE TO BIDDERS

- A. Before submittal of bid, examine all drawings, specification, addenda, alternatives, special conditions, and all other bidding documents of all sections of this project, verifying all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the contract documents and no consideration will be granted for any claimed misunderstanding thereof.
- B. Submittal of a bid is deemed a representation by the bidder that he is qualified in all respects to properly perform the work for which he is bidding and has experience with similar work. Bidders are deemed to be aware, based on their background and experience, of materials which may be required in the discharge of their responsibilities, even though unspecified.

1.3 SYSTEM DESCRIPTION

- A. Provide a new, engineered hybrid, Victaulic Vortex™ Hybrid Fire Extinguishing System for Turbines and Machine Spaces hybrid media system in accordance with NFPA 770, NFPA 70 and NFPA 72. The system shall incorporate separate pressurized streams of nitrogen and water which are combined to form a hybrid media which is discharged into the fire hazard. The system must include all mechanical and electrical installation, all detection and control equipment, storage containers, agent, emitters/nozzles, pipe and fittings, manual release stations, audible and visible alarm notification appliances, auxiliary devices and controls, shutdowns, alarm interface, functional checkout and testing, training and all other operations necessary for a functional system.
- B. Performance Requirements: Discharge Hybrid Media within the time required by NFPA 770.
- C. Design any portions of the fire-extinguishing system that are not indicated on the Contract Drawings, including but not limited to locating and sizing emitters/nozzles, piping, tanks, pressure transducers, valves, and equipment. Design any portions of the releasing system that are not indicated on the Contract Drawings, including but not limited to locating initiating devices, notification appliances, terminal cabinets, raceways, and pathways. Provide seismic

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bracing appropriate for the seismic design category and short-period spectral acceleration value applicable to the project. The design must include storage capacity to provide a single discharge to each protected area. Each protected area must have its own storage container or be manifolded together utilizing the same tanks and piping.

- D. One common control unit may control all systems individually. Each system must include all materials, accessories, and equipment inside and outside the building necessary to provide a complete system ready for use.
- E. Design and install each system to give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment and to be free from operating and maintenance difficulties.
- F. Circuit Requirements: All initiating device circuits (IDC), signal line circuits (SLC), and notification appliance circuits (NAC) must be Class A or B in accordance with NFPA 72. Provide a separate circuit for each hazard area. Fully supervise the solenoid circuits so that the occurrence of a single open or a single ground fault condition of the interconnecting conductors will be indicated at the control unit.
- G. Work also includes, but is not limited to, the following:
 - 1. Installation of required pressure gauges, signs to identify all valves, interconnections to the building fire alarm control unit, hangers, and audible and visible notification appliances. Any necessary core drilling through concrete or masonry floors or walls, with approval of the Owner's Representative and/or a structural engineer. Firestopping of all extinguishing system piping and conduit penetrations through fire-rated walls, partitions, and floor-ceiling assemblies. Through-penetration firestop details, including Underwriter's Laboratories reference number, must be shown on the shop drawings.
- H. It is the contractor's responsibility to consult other specification sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete operational installation.

1.4 SYSTEM SEQUENCE

- A. Automatic operation of each protected area must be as follows:
 - 1. Actuation of one detector within the system must:
 - a. Activate the "ALARM" indicator lamp on the releasing control unit (RCU).
 - b. Transmit a signal to the Vortex Combination or Fluid Panel.
 - c. Operate door holder/closers on access doors.
 - d. Transmit an alarm signal to the main fire alarm control unit (FACU).
 - e. Activate the building fire alarm system.
 - f. Activate an individual visible indicator for that device on the graphic annunciator.

2. Actuation of a second detector within the system must:
 - a. Activate the "PRE-DISCHARGE" indicator on the RCU.
 - b. Transmit a signal to the Vortex Combination or Fluid Panel.
 - c. Shut down the HVAC system and close smoke dampers.
 - d. Start time delay sequence (not to exceed 60 seconds).
 - e. Discharge hybrid extinguishing system.
 - f. Light an individual lamp for that device on the graphic annunciator.
- B. After completion of the time delay sequence, the fire extinguishing system must activate, and the following must occur:
 1. Activate the "RELEASE" indicator on the RCU.
 2. Transmit a system release signal to the RCU.
- C. The system must be capable of being actuated by manual release stations located at each hazard exit. Operation of a manual release station must duplicate the sequence described above, except that the time delay **MUST** be bypassed. The manual release stations must be of the double-action, electrical actuation type and must be supervised at the RCU.

1.5 SUBMITTALS

- A. Submit an electronic copy in pdf format of the following, no later than 21 days prior to the start of system installation, in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise, must be no smaller than the Contract Drawings.
- B. Shop Drawings
 1. Detail drawings conforming to the requirements for "Plans" as prescribed in NFPA 770; drawings must be no smaller than the Contract Drawings, unless noted otherwise. Drawings must include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Annotate system piping layout with reference points for design. Provide field wiring diagrams showing locations of devices and points of the system. Each set of drawings must include the following:
 - a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 - b. Floor plans drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections, and other details required to clearly describe the proposed arrangement.
 - c. Details of equipment layout and design, including wire counts and approximate location of conduit. Indicate the general physical layout of all controls, manual release stations, detectors, and wiring details. Show isometric details of agent storage containers, mounting details, and proposed pipe runs and sizes. Electrical layout drawings must show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.

- Provide an internal control unit wiring diagram that includes power supply requirements and field wiring termination points.
- d. Wiring Diagrams: Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between equipment or systems that are supervised or controlled by the system. Diagrams must show connections from field devices to the RCU and remote fire control units, initiating circuits, switches, relays, and terminals. Provide complete riser diagrams indicating the wiring sequence of devices and their connection to the control equipment.
 - e. Sequence of operation that describes how the system responds during an alarm, supervisory, and trouble condition. The description must include releasing control unit LEDs, audible and visible indications, initiating devices, notification appliances, auxiliary functions, shutdown functions, damper operation, time delay, and agent discharge for each zone or system. The description must provide sufficient information so that the exact function of each installed device and appliance is known.
 - f. Details of each type of pipe hanger and related components.
 - g. Calculations showing method of support/attachment (hangers, straps, etc.) has sufficient strength to support system components.
 - h. Shop drawings and calculations must be prepared by a qualified NICET Level III (or IV) technician.
 - i. Drawings must be produced in CAD. Use standard fonts and line styles and furnish the pcp file.
- C. Product Data: Annotated catalog data showing manufacturer's name, model, and catalog number for all equipment and components to be considered for the project, as well as standby and alarm current for all initiation and notification appliances to verify calculations.
- 1. Hybrid fire extinguishing system
 - 2. Piping and fittings
 - 3. Pipe hangers and supports
 - 4. Tanks
 - 5. Pressure relief valves
 - 6. Fluid panels
 - 7. Fire extinguishing agent
 - 8. Hybrid emitters/nozzles
 - 9. Pressure alarm switch
 - 10. Main and reserve switch
 - 11. Releasing control unit
 - 12. Manual release stations
 - 13. Terminal cabinets
 - 14. Batteries
 - 15. Battery charger
 - 16. Wiring and cable
 - 17. Notification appliances
 - 18. Addressable interface devices
 - 19. Electromagnetic door hold-open devices
 - 20. Line voltage surge protective devices

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21. Auxiliary power (booster) panels
 22. Firestopping
 23. Escutcheons
 24. Paint
- D. Battery Calculations: Submit battery calculations as required in paragraph Battery Power Calculations. Submit a voltage drop calculation to indicate that sufficient voltage is available for proper operation of the system and all components, at a minimum rated voltage of the system operating on batteries.
- E. ASME Certification: Provide one electronic copy of ASME certification for all pressure vessels.
- F. Conduit Fill Calculations: Submit conduit fill calculations to ensure that the numbers of conductors located in the conduit is in accordance with NFPA 70.
- G. Test Procedures: 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 preliminary tests.
- H. Preliminary Test Report: Provide three copies of the completed preliminary test report, no later than 7 days after the completion of the preliminary tests. The preliminary test report must be as outlined in NFPA 770.
- I. Final Acceptance Test Report: Submit an electronic copy in pdf format of the completed final test reports, no later than 7 days after the completion of the final acceptance tests. Final acceptance test reports must be as outlined in NFPA 770.
- J. Installer's Qualifications: Qualifications must be approved prior to submittal of any other data or drawings, to substantiate that the proposed installer is regularly engaged in the installation of the type and complexity of fire protection system included in this project. Submit documentation to identify the location of three systems recently installed by the proposed installer which are comparable to the system specified. Contractor must certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months. Submit a copy of license to perform work in the local jurisdiction.
- K. As-Built Drawings: Furnish one flash drive containing software back-up and CAD based drawings, in the latest version of AutoCAD and DXF format, and pdf of as-built drawings and schematics. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, must be maintained on-site. These drawings must be maintained in a current condition at all times and be make available for review immediately upon request during normal working hours. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required for coordination between trades must be indicated in sufficient detail to accurately reflect the as-built conditions. Submit a complete set of as-built (record) working drawings including complete as-built circuit diagrams of each system for record purposes within 14 calendar days after the final acceptance test of the system.
- L. Operation and Maintenance Data: Furnish one flash drive of manuals in loose-leaf binder format and grouped by technical sections consisting of manufacture's brochures, schematics, printed

instructions, general operating procedures, and safety precautions. Manuals must be submitted and approved prior to final testing. In addition to the items specified in Division 01 Section 01723 "Operation and Maintenance Data", the manual must include a narrative description of the sequence or sequences of operation of the overall fire protection system and a separate description of each major subdivision. Information to be provided must include specific open/close settings for all adjustable valves. The manuals must list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manual must include system piping layout, conduit layout, equipment layout, simplified wiring and control diagrams for the system as installed. The manual must include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

- M. Training Documentation: Provide in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize the Owner's designated personnel with the proper operation of the installed system. The maintenance training course must provide the Owner's designated personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.
- N. Preliminary Equipment List: Provide a preliminary equipment list identifying the type, quantity, make and model number of each piece of equipment to be provided under this submittal. The equipment list must include the type, quantity, make, and model of spare equipment. Types and quantities of equipment submitted must coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings. A final equipment list must be submitted with the Operating and Maintenance (O&M) manual.

1.6 QUALITY ASSURANCE

- A. Qualifications - Contractor: The contractor must be an approved distributor/installer for the hybrid fire extinguishing systems and a licensed contractor in possession of a valid special hazard extinguishing systems contractor's license. The contractor must have a minimum of 5 years of experience in the installation of special hazard systems in similar facilities.
- B. Qualifications - Special Hazard Design Services: Shop (working) drawings and calculations must be prepared under the directions of and signed by a qualified registered Professional Engineer or a NICET Level III (or IV) in special hazard systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 - 1. A registered Professional Engineer having passed the NCEES examination in fire protection engineering.
 - 2. Registered Professional Engineer with verification of experience and at least 5 years of current experience in the design of fire protection and detection systems.
- C. Qualifications - Installation Supervisor: An individual that has been certified in Vortex installation, testing, and maintenance by Victaulic that is employed by a company under written agreement to be authorized as a Distributor of Vortex Components.

- D. Qualifications - Releasing System Installer: Releasing system installer with a minimum of 2 years of experience is permitted to assist in the installation of releasing system devices, cabinets, and control units. An electrician is permitted to install wire, cable, conduit, and backboxes for the releasing system.
- E. Qualifications - Test Personnel: Special hazards system technicians with a minimum of 8 years of experience must be utilized to test and certify the installation of the fire extinguishment system. The special hazards system technicians testing the equipment must be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.7 REGULATORY REQUIREMENTS

- A. All system components must be listed or approved for their intended use and must be compatible with the system and its components. Where the terms "listed" or "approved" appear in this specification section, they mean UL-listed (UL Fire Prot Dir), FM-approved (FM App Guide), or listed by a nationally recognized testing laboratory (NRTL). The omission of these terms under the description of any item of equipment described must not be construed as waiving the requirement for listing or approval. All listings or approvals must be based on an existing ANSI or UL published standard.
- B. Compliance with referenced standards is mandatory. In the event of a conflict between specific provisions of this specification section and applicable standards, this specification section must govern.
- C. Install all work in full conformance with the requirements of all local and governmental authorities having jurisdiction over these matters, utility company requirements, and requirements of the latest issues of all applicable Codes. Any additional permits, inspections, close-outs must be the responsibility of the contractor.
- D. Should any change in plans or specification be required to comply with governmental regulations, the contractor must notify the Owner's Representative at the time of submitting his bid.
- E. Secure and pay for necessary approvals, permits, inspections, etc., and deliver the official records of granting the permits to the Owner's Representative without additional cost to the Owner.

1.8 VERIFYING ACTUAL FIELD CONDITIONS

- A. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this specification section, and report to the Owner's Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate, or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

- B. The contractor must become familiar with all details of the work, verify all dimensions in the field, and must advise the Owner's Representative of any discrepancy before performing the work.

1.9 COORDINATION OF TRADES

- A. The contract documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations required for a fully coordinated installation that respects the work of all trades.
- B. Pipe offsets, fittings, and any other accessories required must be furnished as required to provide a complete installation and to eliminate interference with other construction.
- C. Wherever the contractor's work interconnects with work of other contractors, the contractor must coordinate his work with other contractors to ensure that all contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers, etc.) concealed above hung ceilings by permanent-colored pins/tabs in the ceiling directly below the item.
- D. Provide required supports and hangers for piping, conduit, and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.
- E. Field drilling and cutting of holes in structural decks, roofs, walls, etc., required for work under this specification section must be coordinated through various trades in their respective materials. All such drilling, cutting, and reinforcing costs must be borne by the contractor.
- F. Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It must be the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.
- G. Cooperate with all other contractors and subcontractors to facilitate the completion of the work as a whole, subject to the direction of the Owner's Representative.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment delivered and placed in storage from the weather, excessive humidity, temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.
- B. All pipes and fittings must either be capped or plugged until installation. Do not lay any metallic components in direct contact with ground or soil.
- C. Coordinate the storage arrangement and location with the Owner.
- D. Delivery and store products in shipping containers/boxes, with labeling in place.

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1.11 WASTE REMOVAL

- A. At the conclusion of each day's work, clean up and stockpile on-site all waste, debris, and trash, which may have accumulated during the day as a result of work by the contractor and his presence on the job.
- B. Comply with all site-specific waste removal process. Coordinate with Owner or site contact for proper disposal.
- C. Provide SDS for all hazardous materials to be used.
- D. Sidewalks and street adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions of any kind caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

1.12 SPARE PARTS

- A. Repair Service/Replacement Parts: During warranty period, the service technician must be on-site within 24 hours after notification. All repairs must be completed within 24 hours of arrival on-site.
- B. Interchangeable Parts: Spare parts furnished must be directly interchangeable with the corresponding components of the installed system. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Owner's Representative at the time of final acceptance testing.
- C. Spare Parts: Furnish the following spare parts and accessories:
 - 1. Emitters/Nozzles: Twenty percent of each type, but no less than two of each.
 - 2. Protective Caps: Equal to the number of cylinders installed.
 - 3. Container Valves: Ten percent of each size and type installed, but no less than one of each.
 - 4. Fuses: Four of each for each type, rating, and size of fuse used in the system.
 - 5. Ten percent of each initiating device and notification appliance installed, but no less than two of each.
 - 6. Surge protective devices: Two low voltage and one 120 VAC surge protective devices.
 - 7. Addressable control and monitor modules: Ten percent of the installed quantity of each type, but no less than two devices of each type.
 - 8. Light bulbs: Four of each for each type of lamp used in the system.
 - 9. Keys: A minimum of three sets of keys must be provided and appropriately identified.
- D. Special Tools: Software, connecting cables, and proprietary equipment necessary for the maintenance, testing, and reprogramming of equipment must be furnished to the Owner.
- E. Spare Parts Cabinet: A wall-mounted, metal, locking cabinet, no less than 22 gage steel in black baked-on enamel must be provided and installed by the contractor, adjacent to the system control unit or another approved location as directed by the Owner's Representative. The cabinet must be sized to hold all spare parts and one copy of the O&M manual and training

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manual. An inventory list must be made of all items to be kept inside cabinet. Include on the list the number of all spare parts and keys to be provided. Give inventory list to the Owner's Representative during acceptance of the hybrid fire extinguishing system for verification of items in the cabinet. The Owner's Representative will sign off on the list when all items on the list appear in the cabinet. The cabinet must be provided with a permanent label stating, "VORTEX FIRE EXTINGUISHING SYSTEM SPARE PARTS".

1.13 WORK PERFORMED BY OTHERS

- A. The work listed below must be provided by others, unless otherwise discussed and approved by the Owner to perform work listed:
 - 1. 120 VAC or 240 VAC power supply to the RCU.
 - 2. Interlock wiring and conduit for shutdown of the HVAC, dampers, and/or electrical power supplies.
 - 3. Connection to local/remote fire alarm system(s) and listed central station(s).
 - 4. Structural review of floor assembly to verify adequate support for cylinders.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacture of such products and must essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials and equipment supplied must be new, first quality and the manufacturer's best type and latest model capable of complying with all requirements of this specification section and must have been in continuous production and in continuous service in commercial application for at least one year. Obsolete equipment must not be used. All equipment must be identical to the approved Bill of Materials.
- B. All equipment must have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Nameplates must be etched metal or plastic, permanently attached by screws to equipment or adjacent walls.

2.2 COMPONENTS

- A. Steel Pipe: Pipe must be standard weight conforming to ASTM A795, ASTM A53, or ASTM A135. Piping less than 2-inch in diameter must be minimum schedule 40 and joined by threaded fittings. Piping 2 inches and greater must be minimum schedule 10 and joined by threaded, grooved, or flanged fittings. Piping in which threads or grooves are cut must have a corrosion resistance ratio (CRR) of 1.00 or greater after threads or grooves are cut. Pipe must be marked as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the "Product Marking" provisions of the ASTM standard.

- B. Nitrogen Distribution Piping: High Pressure Nitrogen Piping minimum wall thickness meeting or exceeding ASME B31.1. Low Pressure Nitrogen Piping- Minimum Schedule 10 carbon steel pipe and/or galvanized pipe or Schedule 5 stainless steel pipe for 3-inch/88.9- mm and smaller diameter piping.
- C. Grooved Fittings and Couplings: Grooved fittings, couplings and bolts must be provided by the same manufacturer. Fittings and couplings must be malleable iron complying with ASTM A47 or ductile-iron complying with ASTM A536. Couplings must be of the rigid type except that flexible type will be provided where flexible joints are specifically required. Couplings and gaskets for fittings must be by the fitting manufacturer. Coupling gaskets must be Grade E (EPDM) approved for fire protection service. Gaskets must be the flush type that fills the entire cavity between the coupling and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium plated or zinc electroplated. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe, must not be used. Comply with UL 213.
- D. Non-Grooved Fittings: Non-grooved fittings must be threaded or flanged. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable iron conforming to ASME B16.3, or ductile-iron conforming to ASTM A536. Fittings into which emitters are screwed must be threaded type. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe, must not be used.
- E. Flanges and Gaskets: Flanges must conform to NFPA 770 and ASME B16.1. Flanges must be the type that are welded or threaded to the pipe. Flanges which are bolted to grooved pipe must not be permitted. Gaskets must be full face type EPDM or other approved material that meet or exceed anticipated temperature and pressure.
- F. Pipe Hangers: Hangers must be listed or approved and be of the type suitable for the application, construction and size pipe involved. Comply with UL 203. Earthquake bracing must be listed.
- G. Check Valve: Check valve 2 inches and larger must be listed or approved. Check valves 4 inches and larger must be of the swing type with flanged cast-iron body and flanged inspection plate, must have a clear waterway, and must meet the requirements of MSS SP-71, for Type 3 or 4.
- H. Discharge Nozzle: Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Nozzles must be available in NPT sizes 1/4-inch to 2.0-inch and must be available in 180-degree and 360-degree patterns.
- I. Pipe Sleeves: Use standard weight zinc-coated steel pipe sleeves in outside walls below and above grade, in floor and in roof slabs. Zinc coat sheet steel sleeves in partitions having a nominal weight of not less than 0.90 pounds per square foot.
- J. Escutcheons: Escutcheons must be one-piece or split type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast-iron with aluminum paint finish.

- K. Agent cylinders: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gauge.
- L. Manifold: Single Piece Carbon Steel High Pressure Nitrogen manifold, coated for corrosion resistance. Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
- M. Cylinder Storage Racks: Factory, or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
- N. Hybrid Emitters/Nozzles: Per manufacturer's engineered design.

2.3 LOW-PRESSURE ALARM SWITCH

- A. The tanks must have a low-pressure switch to warn of nitrogen tank depressurization. The low-pressure switch must be wired to the RCU to provide an audible and visible "supervisory" signal in the event the container pressure drops 5 percent below normal operating pressure.

2.4 RELEASING CONTROL UNIT (RCU)

- A. Provide an analog-addressable or conventional (zoned) releasing control unit that is compatible with the system, devices, and functions specified. The control system and its components must be listed for use as a local fire alarm system with releasing device service. The control system must perform all functions necessary to operate the system detection, actuation, and auxiliary functions. The control system must be microprocessor-based utilizing distributed processing concept. A single microprocessor failure must not impact operation of additional modules on the system. The control system must be capable of supporting an air-aspirating smoke detection system. The control system must have four initiating circuits that are capable of Class A, B, or X operation. Each circuit must be capable of monitoring contact devices configured for manual release, manual alarm, trouble input or auxiliary (non-fire) input. The control unit must release circuits for activation of an extinguishing/supervision system. The control unit must contain at least two indicating appliance circuits for annunciation.
- B. Wiring.
 - 1. Provide Class A or B initiating device circuits.
 - 2. Provide Class A or B signaling line circuits.
 - 3. Provide Class A or B notification appliance circuits.
- C. Graphic Annunciator: Annunciator must be interior or weatherproof type, flush or surface mounted unit. Annunciator must contain the building floor plan, drawn to scale, with remote alarm lamps mounted to represent the location of each alarm initiating device. Label principal rooms and areas shown with their room numbers or titles. Show the annunciator location on the floor plan. Ensure detectors mounted above ceilings, on ceilings, and beneath raised floors and different types of initiation devices have different symbols or lamps of different colors for

identification. Ensure that lamps illuminate upon actuation of their corresponding device and remain illuminated until the system is reset. Provide a lamp test switch for the annunciator.

2.5 MANUAL RELEASE STATIONS

- A. Stations must be of the type not subject to operation by jarring or vibration. Stations must have a dual-action release configuration. Break-glass front stations are not permitted; however, a pull lever break-glass rod type is acceptable. Manual release stations must be a different color (such as yellow or orange) from building fire alarm pull stations.

2.6 COMBINATION FIXED TEMPERATURE AND RATE-OF-RISE HEAT DETECTORS

- A. Provide heat detectors for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing must be rated in accordance with UL 521. Detectors must be supported independently of wiring connections. Contacts must be self-restoring after response to rate-of-rise principle. Under fixed temperature actuation, the detector must have a permanent external indication which is readily visible. The UL 521 test rating of the rate-of-rise detectors must be rated for 50 by 50 feet.

2.7 SMOKE DETECTORS

- A. Photoelectric Smoke Detectors: Provide photoelectric smoke detectors as follows:
 - 1. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors must be listed for use with the releasing control unit.
 - 2. Provide self-restoring type detectors that do not require any re-adjustment after actuation at the RCU to restore them to normal operations.
 - 3. Components must be rust and corrosion resistant. Vibration must have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen must not inhibit the movement of smoke particles into the chamber.
 - 4. Provide twist lock bases constructed of white, high impact polycarbonate designed for mounting on a standard 1 1/2-inch or 4-inch octagonal or 4-inch square outlet box for detectors. The detectors must maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on screw terminals. The detector must have a visual indicator to show actuation. Insertion of an incorrect detector type into the base must cause a "Wrong Device" trouble condition at the RCU until the proper type of detector is installed, or the system is reprogrammed. The system program must recognize the insertion of a wrong device and must automatically default to the set point values corresponding to the inserted device and must monitor alarm and trouble conditions according to the default parameters.
 - 5. The detector address must identify the particular unit, its location within the system, and its sensitivity setting. Detectors must be of the low voltage type rated for use on a 24 VDC system.

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6. An operator at the control unit, having the proper access level, must have the capability to manually access the following information for each initiating device.
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Detector range (normal, dirty, etc.)

2.8 ADDRESSABLE INTERFACE DEVICES

- A. The system must 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 such as waterflow switches, valve supervisory switches, relays for output function actuation, etc. The monitor module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. Monitor modules must contain an integral LED that flashes each time the monitor module is polled and is visible through the device cover plate. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.9 ADDRESSABLE CONTROL MODULE

- A. The control module must be capable of operating as a relay (dry contact form C) for interfacing the control with other systems, and to control door holders, or initiate elevator fire service. The indicating device or the external load being controlled must be configured as a Class B notification appliance circuit. The system must be capable of supervising audible, visual, and dry contact circuits. The supervision must detect a short on the supervised circuit and must prevent power from being applied to the circuit. The control module must provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. The control module must contain an integral LED that flashes each time the control module is polled and is visible through the device cover plate. Control modules must be located in environmental areas that reflect the conditions to which they were listed and must include a mounting plate for installation in a junction box.

2.10 NOTIFICATION APPLIANCES

- A. Fire Alarm Horns: Horns must conform to the applicable requirements of UL 464. Horns must be semi-flush-mounted or surface-mounted with matching mounting backbox. Horns must produce a sound rating of at least 85 dBA at 10 feet. Device must be distinct in sound from the building fire alarm devices and through color or labeling (i.e., "Agent Discharge").
- B. Visible Notification Appliances: Visual notification appliances must conform to the applicable requirements of UL 1971 and conform to ADAAG. Fire alarm notification appliances must have clear high intensity optic lens and output white light and be marked "Agent" in red letters. The light pattern must be disbursed so that it is visible above and below the strobe and from a 90-degree angle on both sides of the strobe. Strobe flash rate must be one flash per second and a

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minimum of 15 candela based on the UL 1971 test. Strobes must be semi-flush-mounted. Where more than two appliances are located in the same room, or corridor, or field of view, provide synchronized operation. Devices must use screw terminals for all field wiring.

2.11 PRIMARY ELECTRIC POWER

- A. Power must be 120 VAC service for the RCU from the normal AC service to the building in accordance with NFPA 72.

2.12 SECONDARY POWER SUPPLY

- A. Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power must be automatic and must not cause transmission of a false alarm.
- B. Batteries: Provide sealed, maintenance-free, lead-acid batteries as the source for emergency power to the RCU. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid-state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.
 - 1. Capacity, Fire Alarm System: Battery size must have sufficient capacity to operate the fire alarm system under supervisory and trouble conditions, including audible trouble signal devices for 24 hours and audible and visual signal devices under alarm conditions for an additional 5 minutes.
 - 2. Battery Power Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements. Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Include ampere-hour requirements for each system component and each control unit component, and compliance with UL 864. Provide complete battery calculations for the alarm, alert, and supervisory power requirements. Include a 1.2 derating factor in all calculations.
 - 3. For battery calculations use the following assumptions: Assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required amp-hours for the specified standby time, and then calculate the required amp-hours for the specified alarm time. Calculate the nominal battery voltage after operation on batteries for the specified time period.
- C. Battery Chargers: Provide a solid-state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 VDC), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph Capacity above. Provide a pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided.

2.13 WIRING

- A. Alarm Wiring: SLC and IDC wiring must be copper cable in accordance with the manufacturer's requirements. Copper signaling line circuits and initiating device circuit field wiring must be No. 18 AWG size at a minimum. Visual notification appliance circuit conductors and notification appliances must be copper No. 14 AWG size conductors at a minimum. Wire size must be sufficient to prevent voltage drop below manufacture's recommendations. Power wiring, operating at 120 VAC minimum, must be a minimum of No. 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR, or FPLP as appropriate with red colored covering. Non-power-limited cables must comply with NFPA 70.

2.14 ENVIRONMENTAL ENCLOSURES OR GUARDS

- A. Environmental enclosures must be provided to permit fire alarm components to be used in areas that exceed the environmental limits of the listing. The enclosure must be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the UL category that the component is currently listed. Guards required to deter mechanical damage must be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

2.15 ELECTROMAGNETIC DOOR HOLD-OPEN DEVICES

- A. Devices must be designed to operate on 24 VDC and require not more than 3 watts of power to develop 25 psi of holding force. Under normal conditions, the magnets must attract and hold the doors open. Operation must be fail safe with no moving parts. Electromagnetic door hold-open devices must not be required to be held open during building power failure. The device must be listed based upon UL 228.

2.16 LINE VOLTAGE SURGE PROTECTIVE DEVICES

- A. Line voltage surge protective devices must be provided to suppress all voltage transients which might damage releasing system control unit components. The surge protective device must wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrester must be installed directly adjacent to the power panel where the RCU breaker is located.
- B. Line voltage surge protective devices for nominal 120 VAC must be UL 1449 listed with a maximum 500-volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device must feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing must be externally accessible.
- C. Line voltage surge protective device for nominal 24 VAC, for alarm telephone dialer or ethernet connection, must be UL 497B listed and have a maximum response time of 1-nanosecond. The surge protective device must feature multi-stage construction and be self-resetting. The surge

protective device must be base and plug style. The base assembly must have screw terminals for fire alarm wiring. The base assembly must accept a "plug-in" surge protective module.

- D. All surge protective devices (SPD) must be the standard product of a single manufacturer and be equal or better than the following:
1. For 120 VAC nominal line voltage: DITEK DTK-120S20A series connected, 20 A AC power SPD.
 2. For 24-volt nominal line voltage: DITEK DTK-24MHLP24BWB series connected, modular, 5A maximum current SPD.
 3. For alarm telephone dialers: DITEK DTK-MRJ31XSCPWP or approved equal.
 4. For IP-DACTs: DITEK DTK-MRJETHS or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Install materials and equipment in accordance with NFPA 770. Provide each system complete and ready for operation.
- B. Distribution Piping and Fittings: Distribution piping and fittings must be installed in accordance with the manufacturer's requirements, NFPA 770, and approved piping standards and guidelines. All distribution piping must be installed by qualified individuals using good, accepted practices and quality procedures. All piping must be adequately supported and anchored at all directional changes and nozzle locations. All piping must be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish, and cutting oils before assembly. All pipe threads must be sealed with Teflon tape pipe sealant applied to the male threads ONLY.
- C. Hybrid Container Mounting: Install Hybrid containers on cast-in-place concrete equipment bases.
- D. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe hanger fastenings must not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors must be core-drilled and provided with pipe sleeves. Each sleeve must extend through its respective wall or floor and be cut flush with each surface. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes must be firestopped in accordance with Section 07 8400 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe must be sealed at both ends with a plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.
- E. Escutcheon Plates: Provide one-piece or split hinge type metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide polished stainless-steel plates or chromium plated

finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces. Securely anchor plates in place with setscrews or other approved positive means.

- F. Pipe Sleeves: Provide where piping passes entirely through walls, ceilings, roofs, and floors. Provide sleeves of sufficient length to pass through the entire thickness. Provide 1-inch minimum clearance between exterior of piping and interior of sleeves or core-drilled hole. Firmly pack space with mineral wool insulation and seal both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL-listed fill, void or cavity material.
 - 1. Sleeves in Masonry and Concrete: Provide hot-dipped galvanized steel, ductile-iron, or cast-iron sleeves at walls, ceilings, roofs, and floors. Core-drilling of masonry and concrete may be provided in lieu of sleeves provided that cavities in the core-drilled holes are completely grouted smooth.
 - 2. Sleeves in Other Than Masonry and Concrete: Provide 26 gage galvanized steels.
- G. Escutcheons: Install escutcheons when piping is passing through floors, walls, or ceilings. Securely fasten escutcheons in place with setscrews or other positive means.
- H. Releasing Control Unit (RCU): The RCU must be located in a year-round environmentally conditioned space and not in the hazard area served, but adjacent to it. Locate RCU where indicated on the drawings. Recess, semi-recess or surface-mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnections must be permanently mounted in the RCU.
- I. Manual Release Stations: Provide manual release stations as indicated on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exterior door they serve, measured horizontally and at least 3 feet from the fire alarm manual pull stations.
- J. Heat Detectors: Locate detectors as required by NFPA 72 and their listing on a 4-inch backbox. Install heat detectors not less than 4 inches from a side wall to the near edge. Heat detectors located on the wall must have the top of the detector at least 4 inches below the ceiling, but no more than 12 inches below the ceiling.
- K. Smoke Detectors: Terminate field wiring on the screw terminals for all smoke detectors. Locate detectors as required by NFPA 70 and their listings on a 4-inch mounting box. Locate smoke detectors on the ceiling. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. Install smoke detectors no closer than 5 feet from air-handling supply outlets.
- L. Addressable Interface Devices: Must include a mounting plate for installation in a junction box or must be mounted in a locked cabinet or approved box.
- M. Electromagnetic Door Holder Release: Doors must be held open at a minimum 90 degrees so as not to impede egress from the space. Mount the armature portion on the door and have an

adjusting screw for seating the angle of the contact plate. Wall-mount the electromagnetic release, with a total horizontal projection not exceeding 4 inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control unit for magnetic door holding circuits is not required.

- N. Extinguishing System Saving/Disconnect Switch: Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE EXTINGUISHING SYSTEM SAFING SWITCH".
- O. Operating Instructions: Provide at each remote control station. Instructions must clearly indicate steps for system operation. The proposed legend for operating instructions must be approved before installation. Instructions must be embossed white letters on red rigid plastic backgrounds. Lettering must be a minimum of 0.25-inch high for operating instructions and 1-inch high for identification of system operating devices and control valves.

3.2 SYSTEM FIELD WIRING

- A. Wiring within Cabinets, Enclosures, and Boxes: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box must be connected to screw-type terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. The use of wire nuts or similar devices is prohibited. Wiring must conform to NFPA 70.
- B. Terminal Cabinets: Terminal size must be appropriate for the size of the wiring to be connected. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted.
- C. Alarm Wiring: Voltages must not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Provide all wiring in electrical metallic conduit. The use of flexible conduit not exceeding a 6-foot length must be permitted to a single device or appliance. Run conduit or tubing (rigid, IMC, EMT, FMC, etc., as permitted by NFPA 72 and NFPA 70) concealed unless specifically indicated otherwise on the drawings. For shielded wiring, ground the shield at only one point that is in or adjacent to the RCU. Pigtail or T-tap connections to signal line circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. Color coding is required for circuits and must be maintained throughout the circuit. Conductors used for the same function must be similarly color coded.
- D. Conductor Terminations: Labeling of conductors at terminal blocks in terminal cabinets and at the RCU must be provided at each conductor connection. Each conductor or cable must have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, RCU, NAC panel and remote RCU must contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing must be neat, using 12-point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

- E. The conductors for the notification appliance circuits must not be installed in the same raceway as the conductors for the signaling line circuits unless written certification from the manufacturer is supplied indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.
- F. All existing wiring must be tested for abnormal conditions (grounds, shorts, opens, etc.) prior to re-use. In general, existing initiating device circuits can be re-used as signaling line circuits if the circuit is not loaded to more than 75 percent of the available circuit loading and the distance limitations as set forth by the manufacturer's recommended specifications are not exceeded. Existing notification appliance circuits can be re-used, only if the existing circuit is not loaded to more than 75 percent of the available power for the circuit from the RCU. In the event that a signaling line circuit or a notification appliance circuit load exceeds 75 percent of the available circuit loading, new circuits must be installed.
- G. Exposed raceways must be run parallel and perpendicular to the walls and ceilings. Wherever practical, exposed raceways must be run on the ceiling as close as possible to a wall or as high as possible on a wall. Where exposed raceways must cross under a structural beam or rib, they must be run down on one side of the beam or rib, across its bottom, and up to the ceiling on the other side of the beam or rib. No spanning from beam to beam or rib to rib must be permitted. The use of a raceway body on one side of a beam or rib is permitted provided it must be readily accessible. Where metal raceway is installed exposed, it must be painted to match the walls and/or ceilings on which it is installed, as instructed by the Owner. The method and location of all exposed raceways must be approved by the Owner's Representative prior to start of any installation work.
- H. Circuit disconnecting means must have a red marking, must be accessible to authorized personnel, and must be identified as "FIRE ALARM CIRCUIT CONTROL". The location of the circuit disconnecting means must be permanently identified on a nameplate installed on the inside of the RCU.

3.3 FIRESTOPPING

- A. Provide firestopping for holes at conduit penetrations through floor slabs, fire-rated walls, partitions with fire-rated doors, corridor walls, and vertical service shafts.

3.4 PAINTING

- A. Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes red and conduits and surface metal raceways with a 1-inch-wide red band every 10 feet in unfinished areas.

3.5 FIELD QUALITY CONTROL

- A. After the system installation has been completed, the entire system must be checked out, inspected, and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards, in the presence of the Owner.

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- B. Test Plan: The test plan must include a step-by-step description of all tests to be performed and must indicate the type and location of test apparatus to be employed. The tests must demonstrate that the operational and installation requirements of this specification section have been met. All tests must be conducted in the presence of the Owner's Representative and must not be conducted until the test plan has been approved by the Owner.
- C. Testing Agency: Engage a Certified Installer testing agency to perform tests and inspections.
- D. Manufacturer's Field Service: Engage a Certified Installer to test and inspect components, assemblies, and equipment installations, including connections.

3.6 PRELIMINARY TESTS

- A. Visual Inspection: Inspection must be based on completed Record Drawings and system documentation that is required by NFPA 770 and NFPA 72 "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals of Fire Alarm Systems" chapter.
- B. Hybrid System Tests and Inspections:
 - 1. Perform tests and inspections with the assistance of a Certified service representative.
 - 2. After installing Hybrid fire extinguishing system and after electrical circuitry has been energized, test for compliance in accordance with requirements listed in NFPA 770.
 - 3. Prepare test and inspection reports in accordance with requirements listed in FM Datasheets, Section "Installation Acceptance."
- C. Operational Test: After electrical circuitry has been energized, apply power to control unit and confirm proper unit operation. Comply with "Test Methods" table in "Testing" section of the "Inspection, Testing, and Maintenance" chapter of NFPA 72. Test and adjust controls and safeties.
- D. Test and Inspection Reports: Factory authorized service representative must prepare the "Fire Alarm System Record of Completion" and the "Inspection and Testing" documents from NFPA 72 and all inspection and testing reports required by NFPA 770.

3.7 FINAL TESTS

- A. The system will be considered ready for acceptance testing only after the following have been accomplished:
 - 1. Preliminary tests have been made and deficiencies corrected.
 - 2. Testing reports have been submitted and approved.
- B. Final acceptance testing must be coordinated and performed by the contractor, in the presence of the Owner's Representative. In order to ensure attendance of the necessary representatives, each representative scheduled to witness the test must be provided with a minimum of 5 working days' notification of the proposed test date by the contractor. The test must not be

conducted until all parties agree on the scheduled test date. The contractor must provide all necessary personnel and equipment to conduct the tests.

- C. The final acceptance test must repeat 100 percent of preliminary tests.
- D. If the final acceptance test fails, the contractor must pay all costs incurred to the Owner for any and all retesting.
- E. Include final test results with the final record drawings.
- F. Upon satisfactory completion of the tests, the contractor must leave the system in proper working order.
- G. Warranty: Except as otherwise expressly provided in the contract documents, the contractor guarantees all work to be free of all defects of workmanship and materials for a period of 1-year after final acceptance of the work by the Owner. Include service directory with telephone numbers for 24-hour emergency service.

3.8 TRAINING

- A. Instructor: Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor must train the employees designated by the Owner, in the care, adjustment, maintenance, and operation of the fire extinguishing system. Each instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including training history to the Owner's Representative prior to training.
- B. Required Instruction Time: Provide 4 hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times as selected by the Owner's Representative. The instruction may be divided into two or more periods at the discretion of the Owner's Representative. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

END OF SECTION 21 2120

SECTION 21 22 03

NOVEC 1230 FIRE EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: High-pressure total flooding Novec 1230 fire extinguishing system conforming to NFPA 2001.
- B. System shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional clean agent extinguishing system. Design discharge nozzles to uniformly distribute the clean agent throughout the hazard area. Arrange system for fully automatic and manually operated electronic control operation, with operating controls of the enclosed release type to prevent accidental operation. Discharge nozzles shall be provided, within the manufacturer's guidelines, to distribute the clean agent unobstructed throughout the protected space. The installed nozzles shall be designed to provide the proper clean agent quantity and distribution. Provide manual release stations, dead-man style abort stations and keyed override. Provide material and equipment that are listed. Each protected area shall have audible and visible notification appliances with separate and distinct audible and visual pre-discharge and discharge signals. The discharge signals shall be distinct from those used by the building fire evacuation system.
- C. System design shall include fluid storage capacity to provide a single discharge to each zone. Each protected area shall have its own agent storage container and piping. One common control panel may control all systems individually. Each system shall include all materials, accessories and equipment inside and outside the building necessary to provide each system complete and ready for use.
- D. Design and install each system to give full consideration to built-in spaces, piping, electrical equipment, ductwork and all other construction and equipment and to be free from operating and maintenance difficulties.
- E. Design the total flooding system to a minimum concentration (by volume) of 4.5 percent for Class A fires, 5.9 percent for Class B fires, and 4.7 percent for Class C fires for 10 minutes. System design shall not exceed 10.0 percent for normally occupied spaces, adjusted for maximum space temperature anticipated, with provisions for room evacuation before agent release. Concentration shall be based upon shutting down the heating, ventilation and air conditioning (HVAC) systems at the time of agent discharge. The maximum liquid discharge time shall be 10 seconds.

- F. The contractor shall be responsible for sealing and securing the protected space against agent loss and/or leakage during the 10-minute "hold" period.
- G. Performance Requirements: Provide construction type, test, and mark of high-pressure cylinders in accordance with US Department of Transportation (USDOT) specifications for seamless steel cylinders. Each cylinder is to be provided with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices are to be Interstate Commerce Commission approved frangible safety disks. Provide cylinder support racks that anchor to walls and floors.
- H. Main System: Arrange system for fully automatic and manually operated electric control operation, with operating controls of the enclosed release type to prevent accidental operation. Also provide for manual release stations, dead-man style abort stations and keyed override operations as indicated on the Drawings.
- I. Clean Agent Recharging Station: The installing contractor shall maintain, or have access to, a clean agent recharging station. The installing contractor shall provide proof of his ability to recharge the system with clean agent within 24 hours of notification.
- J. Reserve Cylinders: If requested by the Client Fire Marshal, provide a connected reserve cylinder bank supply.
- K. Work also included, but is not limited to the following:
 - 1. Installation of required pressure gauges, signs to identify all valves, interconnection to the fire alarm control unit (releasing panel), hangers, and audible and visible notification appliances. Any necessary core drilling through concrete or masonry floors or walls, with approval of Client and or a structural engineer. Firestopping of all extinguishing system piping and conduit penetrations through fire-rated walls, partitions, and floor-ceiling assemblies. Through-penetration firestop details, including Underwriter's Laboratories reference number, shall be shown on the Shop Drawings.
 - 2. The contractor shall verify Novec 1230 supply information for those systems that are reconnected, refurbished, or expanded to comply with the applicable Codes and Standards.
- L. The work shall meet IBC and IFC requirements, Client requirements and includes all labor, materials, tools, equipment, transportation, and temporary construction necessary to design, fabricate, install and test complete Novec 1230 fire extinguishing systems specified hereinafter.

1.2 SYSTEM SEQUENCE

- A. Automatic operation of each protected area with spot-type detection shall be as follows:
 - 1. Actuation of one detector, within the system, shall:
 - a. Activate the "ALARM" indicator lamp on the releasing control panel (RCP).

- b. Energize the alarm audible and visible notification device located in the hazard area for evacuation of the protected area.
 - c. Operate door holder/closures on access doors.
 - d. Transmit an alarm signal to the main fire alarm control unit (FACU).
 - e. Activate the building fire alarm system.
 - 2. Actuation of a second detector, within the system, shall:
 - a. Activate the "PRE-DISCHARGE" indicator on the RCP.
 - b. Energize the pre-discharge audible and visible notification device located in the hazard area.
 - c. Shut down the HVAC system and close smoke dampers.
 - d. Start time delay sequence (not to exceed 60 seconds).
 - e. System abort sequence is enabled at this time.
 - f. [Shunt power to protected equipment.]
 - g. [Light an individual lamp for that device on the graphic annunciator.]]
- B. Automatic operation of each protected area with air-aspirating smoke detection shall be as follows:
 - 1. Actuation of Alarm Level 1 (Alert) within the system shall:
 - a. Activate the "ALERT" indicator lamp on the air-aspirating smoke detection control panel.
 - b. Transmit a supervisory signal to the [main fire alarm control unit (FACU)][releasing control panel (RCP)].
 - 2. Actuation of Alarm Level 2 (Action) within the system shall:
 - a. Activate the "Alarm" indicator lamp on the releasing control panel (RCP).
 - b. Energize the alarm audible and visible notification device located in the hazard area for evacuation of the protected area.
 - c. Operate door holder/closures on access doors.
 - d. Transmit an alarm signal to the main fire alarm control unit (FACU).
 - e. Activate the building fire alarm system.
 - f. [Activate an individual visible indicator for that device on the graphic annunciator.]
 - 3. Actuation of Alarm Level 3 (Fire 1) within the system shall:
 - a. Activate the "PRE-DISCHARGE" indicator on the RCP.
 - b. Energize the pre-discharge audible and visible notification device located in the hazard area.
 - c. Shut down the HVAC system and/or close dampers.
 - d. Start time-delay sequence (not to exceed 60 seconds).
 - e. System abort sequence is enabled at this time.
 - f. Shunt power to protected equipment.
 - g. Light an individual lamp for that device on the graphic annunciator.
- C. After completion of the time-delay sequence, the clean agent fire extinguishing system shall activate and the following shall occur:
 - 1. Activate the "RELEASE" indicator on the RCP.

2. Energize the visible notification device(s) outside the hazard area in which the discharge occurred.
 3. [Energize the "System Release" audible device.]
 4. Transmit a system release signal to the FACP.
- D. System shall be capable of being actuated by manual release stations located at each hazard exit. Operation of a manual release station shall duplicate the sequence description above except that the time delay and abort functions shall be bypassed. The manual release station shall be of the double-action, electrical actuation type and shall be supervised at the RCP.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for all equipment to be used, including but not limited to the following:
1. High-pressure cylinders.
 2. Piping materials.
 3. Pipe hangers and supports.
 4. Pressure alarm switches.
 5. Nozzles.
 6. Manual release stations.
 7. Abort stations.
 8. Escutcheons.
 9. Storage batteries, including battery charger.
 10. Smoke detectors.
 11. Audible alarms.
 12. Visual alarms.
 13. Releasing control panel.
- B. Shop Drawings: Detailed drawings conforming to the requirements for "Plans" as prescribed in NFPA 2001, and prepared as follows:
1. Shop Drawings and calculations shall be prepared by a qualified NICET Level III (or IV) Technician.
 2. Drawing Size: 34 x 22 inches in AutoCAD dwg format. Use standard AutoCAD fonts and line styles and furnish the pcg file.
 3. Include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance.
 - a. Give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment for the layout of the system.
 4. Annotate system piping layout with reference points for design.

5. Field Wiring Diagrams: Show locations of devices and points of the system. Include data essential to the proper installation of each system.
 - a. Integrate with alarm and detection system specified.
- C. Shop Drawings shall include the following:
 1. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
 2. Floor Plans: Drawn to a scale not less than 1/8-inch equals 1-foot clearly showing locations of devices, equipment, risers, electrical power connections and other details required to clearly describe the proposed arrangement.
 3. Riser Layout Drawings: Drawn to a scale of not less than 1/2-inch equals 1-foot to show details of each system component, clearances between each other and from other equipment and construction in the room.
 4. Include details of equipment layout and design, including wire counts and approximate location of conduit. Indicate the general physical layout of all controls, manual release station[s], detectors, abort stations, and wiring details. Show isometric details of agent storage containers, mounting details and proposed pipe runs and sizes.
 5. Electrical Layout Drawings: Show location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.
 - a. Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.
 6. Details of each type of pipe hanger and related components.

1.4 INFORMATIONAL SUBMITTALS

- A. Sequence of Operation, detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay, and agent discharge for each zone or system.
- B. Calculations: Novec 1230 discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 2001.
- C. Battery Calculations: For battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.
- D. Test 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.
- E. Preliminary Test Report: Provide three copies of the completed preliminary test report, no later than 7 days after the completion of the preliminary tests. The preliminary test report shall be as outlined in NFPA 2001.

- F. Final Acceptance Test report: Provide three copies of the completed final acceptance test reports, no later than 7 days after the completion of the final acceptance tests. Final acceptance test reports shall be as outlined in NFPA 2001.
- G. Installer's Qualifications: Data approved prior to submittal of any other data or drawings, to substantiate that the proposed installer is regularly engaged in the installation of the type and complexity of fire protection system included in this Project. Data shall identify the location of three systems recently installed by the proposed installer which are comparable to the system specified. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months. Submit copy of license to perform work in the local jurisdiction.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: In addition to six hard copies, furnish one set of CD or DVD discs containing software back-up and CAD-based drawings in the latest version of AutoCAD and DXF format and pdf copy of as-built drawings and schematics.
 - 1. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, shall be maintained on-site.
 - a. Maintain drawings in a current condition at all times and make available for review immediately upon request during normal working hours.
 - b. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required coordination between trades shall be indicated in sufficient detail to accurately reflect the as-built conditions.
 - 2. Submit a complete set of as-built (record) working drawings including complete as-built circuit diagrams of each clean agent system for record purposes within 14 calendar days after the final acceptance test of the system.
 - a. At least two sets of as-built (marked-up) drawings shall be provided to Client at the time of, or prior to the final acceptance test.
- B. Operation and Maintenance Data: Six manuals in loose-leaf binder format and grouped by technical sections consisting of manufacturer's brochures, schematics, printed instructions, general operating procedures, and safety precautions.
 - 1. Manuals shall be submitted and approved prior to on-site training.
 - 2. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," Manual shall include a narrative description of the sequence or sequences of operation of the overall fire protection system and a separate description of each major subsystem.
 - 3. Information shall include specific open/close settings for all adjustable valves.
 - 4. List routine maintenance procedures, possible breakdowns, and repairs, and troubleshooting guide.
 - 5. Include system piping layout, conduit layout, equipment layout, and simplified wiring and control diagrams for the system as installed.

6. Include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.
- C. Training Documentation: Provide in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training shall familiarize Client's designated personnel with proper operation of the installed system. The maintenance training course shall provide Client's designated personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.
- D. Schedule: Provide a schedule indicating the delivery dates of the equipment to be supplied; installation sequence; time frame, and the total amount of on-site technical assistance (in man-hours per phase) that the supplier of the equipment has included in their bid to comply with the requirements of this Specification section and Client's requirements; and final acceptance test dates to meet Client's scheduled project completion dates.
- E. Preliminary Equipment List: Provide a preliminary Equipment List identifying the type, quantity, make, and model number of each piece of equipment to be provided under this submittal. The Equipment List shall include the type, quantity, make and model of spare equipment. Types and quantities of equipment submitted shall coincide with the types and quantities of equipment used in the battery calculations and those shown on the Shop Drawings. A final Equipment List shall be submitted with the Operating and Maintenance (O&M) Manual.
- F. In the event that the contractor's submittal package is required to be revised and resubmitted due to nonconformance with this Specification section, illegibility of the submittal, incomplete submittals, noncompliance with the referenced local, state and national Codes, Standards and Regulations or nonconformance with pertinent documentation relative to the Project, the Contractor shall pay all fees associated with the additional submittal review. Payment of the fee shall be solely the contractor's responsibility.

1.6 QUALITY ASSURANCE

- A. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.
- B. Qualifications - Contractor: The contractor shall be an approved distributor/installer for Novec 1230 fire extinguishing systems and be an Arizona licensed contractor in possession of a valid special hazard extinguishing systems contractor's license. The design and installation must be performed by a qualified contractor whose business is located within a 75-mile radius of the Project site. The contractor shall have a minimum of 5 years of experience in the installation of special hazards systems in similar facilities.

- C. Qualifications – Special Hazard System Design Services: Shop (working) Drawings and calculations shall be prepared under the direction of and signed by a qualified registered Professional Engineer or a NICET Level III in special hazard systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 - 1. A registered professional engineer having passed the NCEES examination in fire protection engineering.
 - 2. Registered professional engineer with verification of experience and at least 5 years of current experience in the design of the fire protection and detection systems.
- D. Qualifications - Installer: A NICET Level III (minimum) in special hazards systems shall supervise the installation of the fire extinguishing system.
- E. Qualifications – Releasing System Installer: Releasing system installer with a minimum of 2 years of experience shall be permitted to assist in the installation of releasing system devices, cabinets and panels. An electrician shall be permitted to install wire, cable, conduit and backboxes for the releasing system.
- F. Qualifications - Test Personnel: Special hazards system technicians with a minimum of 8 years of experience shall be utilized to test and certify the installation of the fire extinguishing system. The special hazards system technicians testing the equipment shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified.

1.7 REGULATORY REQUIREMENTS

- A. All system components shall be listed or approved for their intended use and shall be compatible with the system and its components. Where the terms "listed" or "approved" appear in this Specification section, they shall mean UL-listed (UL Fire Prot Dir), FM-approved (FM App Guide), or listed by a nationally recognized testing laboratory (NRTL). The omission of these terms under the description of any item of equipment described shall not be construed as waiving the requirement for listing or approval. All listings or approvals shall be based on an existing ANSI or UL published standard.
- B. Compliance with NFPA standards is mandatory. In the event of a conflict between specific provisions of this Specification section and applicable standards, this Specification section shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean Client or Client's Representative.
- C. The fire protection installer and the contractor shall comply fully with all city, county and state laws, ordinances and regulations applicable to fire protection installations.
- D. Should any change in Drawings or Specification be required to comply with governmental regulations, Contractor shall notify the Engineer at the time of submitting his bid.

- E. A Work Authorization is required for all Novec 1230 work. The Client Project Manager (PM) shall apply for and receive the Work Authorization. The fire protection contractor will receive the Work Authorization from the Client PM. The Work Authorization must be prominently displayed at the jobsite before any work, to include demolition, can begin. Upon completion of the work, a final inspection by the Client Fire Marshal, and the satisfactory resolution of all issues identified by the Final Inspection, the Client Fire Marshal shall sign and close out the Work Authorization which indicates acceptance of the permitted work.

1.8 FIELD CONDITIONS

- A. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this Specification section, and report to the Client Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.
- B. Become familiar with all details of the Work, verify all dimensions in the field, and advise the Client Representative of any discrepancy before performing the Work.

1.9 COORDINATION OF TRADES

- A. The Contract Documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations required for a fully coordinated installation that respects the work of all trades.
- B. Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction.
- C. Wherever the contractor's work interconnects with work of other contractors, the contractor shall coordinate his work with other contractors to ensure that all contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers, etc.) concealed above hung ceilings by permanent colored pins/tabs in the ceiling directly below the item.
- D. Provide required supports and hangers for piping, conduit and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.
- E. Field drilling and cutting of holes in structural decks, roofs, walls, etc., required for work under this section shall be coordinated through various trades in their respective materials and approved by the Client Representative. All such drilling, cutting, and reinforcing costs shall be borne by the contractor.

- F. Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It shall be the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.
- G. Cooperate with all other contractors and subcontractors to facilitate the completion of the work as a whole, subject to the direction of the Client Representative.

1.10 SCHEDULING

- A. Provide a schedule to Client indicating the installation sequence and timeframe prior to beginning work. Provide weekly updates to Client. All wiring, circuit testing and device installation shall be completed in time for the equipment supplier to make all final connections and to conduct all tests as outlined in this Specification section.
- B. Coordinate the Acceptance Test for each fire alarm system with the Client Fire Marshal and other necessary parties identified by Client.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.
- B. All pipes and fittings shall either be capped or plugged until installation.
- C. Coordinate the storage arrangement and location with Client.
- D. Deliver and store products in shipping containers/boxes, with labeling in place.

1.12 SPARE PARTS

- A. Repair Service/Replacement Parts: During warranty period, manufacturer's service technician shall be on-site within 24 hours after notification. All repairs shall be completed within 24 hours of arrival on-site.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Standard Products: Material and equipment shall be the standard products of a manufacturer, where possible, and not a combination of manufacturers for any particular classification of materials.
 - 1. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years.

2. All materials and equipment supplied shall be new, first quality and the manufacturer's best type and latest model capable of complying with requirements, and shall have been in continuous production and in continuous service in commercial applications for at least 1-year.
 3. Obsolete equipment shall not be used. All equipment furnished shall be new and listed for its intended application.
- B. Nameplates: Major components of equipment shall have the manufacturer's name, model or serial number, and date of installation provided on a new plate permanently affixed to the item or equipment. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.2 COMPONENTS

- A. Piping: Pipe shall be steel conforming to ASTM 53, nonferrous drawn seamless copper tubing conforming to ASTM B88, and flexible metallic hose conforming to UL 536. Provide fittings for changes in direction of piping and for all connections. Reduce pipe sizes in the fitting. Do not use flush bushings. Fuse brazed joints, when used, with an alloy with a melting point above 1,000 degrees F. Provide pipe and fittings having a minimum bursting pressure of 5,000 per square inch (psi). For 1/2-inch and 3/4-inch iron pipe size (ips) provide schedule 40. For 1-inch or greater, use only schedule 80 pipe. Standard malleable iron banded fittings or ductile iron fittings through 2-inch ips. Use forged steel fittings in all sizes over 2 inches.
- B. Discharge Nozzle: Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Nozzles shall be available in NPT sizes 1/4-inch to 2.0-inch and shall be available in 180-degree and 360-degree distribution patterns.
- C. Pipe Hangers and Supports: Provide pipe hangers and supports conforming to NFPA 2001 and manufacturer's recommendations.
- D. Pipe Sleeves: Provide where piping passes through masonry or concrete walls, floors, roofs, and partitions. Use standard weight zinc-coated steel pipe sleeves in outside walls below and above grade, in floor and in roof slabs. Zinc coat sheet steel sleeves in partitions having a nominal weight of not less than 0.90 pounds per square foot. Ensure space between piping and the sleeve is not less than 1/2-inch. Use sleeves of sufficient length to pass through the entire thickness of walls, partitions and slabs. Pack space between the pipe and sleeve with asbestos-free insulation and approved sealant based on the material and the fire rating of the wall.
- E. Escutcheons: Provide approved type escutcheons for piping passing through floors, walls and ceilings, consisting of one-piece or split-type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast-iron with aluminum paint finish. Securely fasten escutcheons in place with setscrews or other positive means.

- F. Storage cylinders shall be constructed of high strength alloy steel, conforming to all applicable specifications of the Department of Transportation. Container design shall permit on-site reconditioning and refilling when required. Safety valves, manifolds, pressure gauges, and pressure switches shall be furnished and installed. Each container shall meet the following:
1. A pressure gauge to provide visual and electrical supervision of the container pressure. The pressure gauge shall be color-coded to provide an easy, visual indication of container pressure.
 2. A pressure relief provision that automatically operates when the internal temperature exceeds 130 degrees F. Each container shall have a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure.
 3. The requirements of the US Department of Transportation specifications if used as shipping containers. If not used as a shipping container, each container shall be designed, fabricated, inspected, certified, and stamped in accordance with Section VIII of ASME BPVC.
 4. Provided with support racks that anchor to walls[and floors].
 5. A permanent nameplate or other permanent marking that indicates the agent, tare and gross weights and super-pressurization level (where applicable) of the container.

2.3 LOW PRESSURE ALARM SWITCH

- A. The tanks shall have a low-pressure switch to warn of clean agent tank depressurization. The low-pressure switch shall be wired to the RCP to provide an audible and visual "Supervisory" signal in the event the container pressure drops 5 percent below normal operating pressure.

2.4 RELEASING CONTROL PANEL (RCP)

- A. Provide an approved releasing control panel that is compatible with the system, devices, and functions specified. The control system and its components shall be UL-listed or FM-approved for use as a local fire alarm system with releasing device service. The control system shall perform all functions necessary to operate the system detection, actuation, and auxiliary functions. The control system shall be microprocessor-based utilizing distributed processing concept. A single microprocessor failure shall not impact operation of additional modules on the system. The control system shall be capable of supporting an air-aspirating smoke detection system. The control system shall have four initiating circuits that are capable of Class A or Class B operation. Each circuit shall be capable of monitoring contact devices configured for manual release, manual alarm, system abort, trouble input or auxiliary (non-fire) input. The control panel shall release circuits for activation of an extinguishing/supervision system(s). Each circuit shall be rated for 1.5 amp @ 24 VDC. The control panel shall contain at least two indicating appliance circuits for annunciation. Each circuit shall be capable of Class A or Class B operation. Each circuit shall be rated for 1.5 amp @ 24 VDC.

- B. Primary Power Supply: Provide a system which operates from a power supply with 120 grounded VAC and 24 VDC output satisfactorily with power input voltage varying from 85 to 110 percent of nominal value. Ensure that the power supply output is capable of powering all initiation signaling, annunciation, and control devices during alarm condition with 25 percent minimum space capacity.
- C. Secondary Power Supply: Provide batteries, charger, and power transfer equipment which supplies the means of automatically supplying the entire system with battery backup power in the event of a primary power system failure, and switches to battery power in the event of AC power failure, and switches back to AC power upon return of primary power. Provide a control panel which operates when the backup batteries are disconnected for any reason, and controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. The battery charger and battery shall comply with the relevant codes, standards or regulations. Typically, 24 hours standby battery backup is required followed by 5 minutes in an alarm condition, unless site specific standby battery criteria is required. Follow local power supply standards that may apply. UL 1481 listed (provided the power supply and standby batteries have been appropriately sized/rated to accommodate the system's power requirements).
- D. Storage Batteries: Provide sealed and spill-proof battery modules (no corrosive fumes). Utilize only batteries which are listed

2.5 MANUAL RELEASE STATIONS

- A. Stations shall be of the type not subject to operation by jarring or vibration. Stations shall have a dual-action release configuration. Break-glass front stations are not permitted; however, a pull lever break-glass rod type is acceptable. Manual release stations shall be a different color (such as yellow or orange) from building fire alarm pull stations.

2.6 AIR SAMPLING SMOKE DETECTORS

- A. Detector Assembly: The detector, filter, aspirator and relay outputs shall be housed in a mounting box and shall be arranged in such a way that air is drawn from the fire risk and a sample passed through the dual stage filter and detector by the aspirator. Detection units shall be compact type and provided with scanning to identify which sampling pipe is carrying smoke. The scanning mechanism shall:
 - 1. Be integrated into the detector.
 - 2. Begin to sample each pipe individually upon detection of smoke.
 - 3. Be used to identify the level of smoke in each pipe.
 - 4. Be used to indicate in which pipe an alarm was first detected.
 - 5. Operate upon manual activation of the scan button on the display.
 - 6. Be automatically tested daily to ensure uninterrupted protection.

- B. The detector shall be laser-based type and shall have an obscuration sensitivity range of 0.0015 percent/obsc/ft to 6 percent obsc/ft. The detector shall have four independent field programmable smoke alarm thresholds per pipe (sector) and a programmable scan time delay.
- C. The aspirator shall be a purpose-designed rotary vane air pump capable of allowing for multiple sampling pipe runs up to 600 feet in total (four pipe runs per detector).
- D. The assembly must contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions. The assembly shall be able to be surface-mounted to a wall or recessed in the wall cavity (the unit may be inverted in either option). The assembly shall have built-in events and smoke logging. It shall store smoke levels, alarm condition, operator actions and faults. The date and time of each event shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events and does not require the presence of a display in order to do so.
- E. Display: The display shall provide the following features at a minimum:
 - 1. A 20 segment bar graph display.
 - 2. Four independent high intensity alarm indicators; Alert, Action, Fire 1 and Fire 2, corresponding to the four alarm thresholds of the indicated sector.
 - 3. Alarm threshold indicators for Alert, Action and Fire 1.
 - 4. LED indication that the first alarm sector is established.
- F. Detector Alarm Levels: The laser-based air sampling detection system shall have four alarm thresholds per pipe (sector). The four alarm levels may be used as follows:
 - 1. Alarm Level 1 (Alert): 0.025% obsc/ft.
 - 2. Alarm Level 2 (Action): 0.044% obsc/ft.
 - 3. Alarm Level 3 (Fire 1): 0.062% obsc/ft.
 - 4. Alarm Level 4 (Fire 2): 0.61% obsc/ft.
- G. Fault Alarms: The detector fault relay shall be connected to the appropriate alarm zone on the RCP in such a way that a detector fault would register a fault condition on the FACU.

2.7 SMOKE DETECTORS

- A. Photoelectric Smoke Detectors: Provide addressable photoelectric smoke detectors as follows:
 - 1. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors shall be listed for use with the fire alarm control unit.
 - 2. Provide self-restoring type detectors that do not require any re-adjustment after actuation at the RCP to restore them to normal operation.

3. Components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 4. Provide twist lock bases constructed of white, high impact polycarbonate designed for mounting on a standard 3 1/2-inch or 4-inch octagonal or 4-inch square outlet box for detectors. The detectors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on screw terminals. The detector shall have a visual indicator to show actuation. Insertion of an incorrect detector type into the base shall cause a "Wrong Device" trouble condition at the RCP until the proper type of detector is installed, or the system is reprogrammed. The system program shall recognize the insertion of a wrong device and shall automatically default to the set point values corresponding to the inserted device and shall monitor alarm and trouble conditions according to the default parameters.
 5. The detector address shall identify the particular unit, its location within the system, and its sensitivity setting. Detectors shall be of the low voltage type rated for use on a 24 VCD system.
 6. An operator at the control unit, having the proper access level, shall have the capability to manually access the following information for each initiating device:
 - a. Primary status.
 - b. Device type
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Detector range (normal, dirty, etc.)
- B. Laser Smoke Detectors: Provide addressable laser smoke detectors as follows:
1. Provide analog/addressable laser smoke detectors utilizing laser diode and patented smoke sensing chamber, designed to amplify signals from smoke but diminish stray internal reflections and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Smoke detectors shall be listed for use with the releasing control panel.
 2. Detector shall be able to achieve sensitivities from 0.02 percent per foot to 2 percent per foot obscuration. Laser smoke detector shall provide point identification of the fire location through addressability, shall experience no delay in response time due to smoke dilution or smoke transportation time, and shall offer complete supervision of wiring and detector.
 3. Provide self-restoring type detectors that do not require any re-adjustment after actuation at the releasing control panel to restore them to normal operation. Detectors shall be UL-listed as smoke-automatic fire detectors.
 4. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.

5. Provide twist lock bases for detectors. The detectors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.
 6. The sensor address shall identify the particular unit, its location within the system, and its sensitivity type. Detectors shall be of the low voltage type rated for use on a 24 VDC system.
 7. An operator at the control panel, having the proper access level, shall have the capability to manually access the following information for each initiating device:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).]
- C. Duct Smoke 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 Smoke 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 RCP.
1. Sampling tubes shall run the full width of the duct. The control functions, operation, reset, and bypass shall be controlled from the RCP.
 2. 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. Remote indicators shall be provided where required by NFPA 72 and these shall be provided with key-operated test and reset switches.
 3. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall provide for control of auxiliary contacts for shutdown. Auxiliary contacts provided for this function shall be located within 3 feet of the controlled circuit or appliance.
 4. The detectors shall be compatible with the RCP to ensure complete system compatibility.

2.8 ABORT STATIONS

- A. Abort station shall be guarded, spring-loaded type which operates only when pressure is manually applied to the switch. Upon release of manual pressure, switch deactivates allowing delayed functions to resume. After start of agent discharge switch has no effect. Activation of the abort switch during normal (non-alarm) conditions causes activation of system trouble signal.

2.9 ALARM SIGNALING DEVICES

- A. Audible Alarms: Audible notification appliance shall be [surface][flush]-mounted, vibrating type alarm horns suitable for use in an electrically supervised circuit and having a sound output rating of at least 90 decibels at 10 feet.
- B. Visual Alarms: [Surface][Flush]-mounted lamp assembly suitable for use in a electrically supervised circuit. Provide flashing strobe type lamps, powered from the releasing control panel alarm circuit. Provide lamps with a minimum 15 candela. Flash rate is between 60 and 120 flashes per minute. Protect lamps by a thermos-plastic lens, red for pre-discharge alarms and blue for discharge alarms. Visual alarms may be part of an audio-visual alarm assembly.

2.10 ELECTROMAGNETIC DOOR HOLDER RELEASE

- A. Devices shall be designed to operate on 24 VDC and require not more than 3 watts of power to develop 25 psi of holding force. Under normal conditions, the magnets shall attract and hold the doors open. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure. The device shall be listed based upon UL 228.

2.11 ELECTRICAL WORK

- A. Wiring: Provide power, control, and fire alarm wiring, including connections to the fire alarm systems under this section and conform to NFPA 70. Wiring for 120 volt circuits is No. 12 AWG minimum. Wiring for low voltage DC circuits is No. 16 AWG minimum. Color code all wiring. Use rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.
- B. Conductor Identification: Identify all circuit conductors within each enclosure where a tap, splice, or termination is made. Conductor identification is by plastic coated self-sticking printed markers or by heat-shrink type sleeves. Attach the markers in a manner that does not permit accidental detachment. Properly identify control circuit terminations.
- C. Alarm Wiring: The SLC wiring shall be [fiber optic][or][solid copper] cable in accordance with the manufacturer's requirements. Copper signaling line circuits and initiating device circuit field wiring shall be No. [14][16][18][] AWG size twisted and shielded solid conductors at a minimum. Visual notification appliance circuit conductors, that contain audible alarm appliances, shall be solid copper No. 14 AWG size twisted and shielded conductors at a minimum.[Speaker circuits shall be copper No. [16][] AWG size twisted and shielded conductors at a minimum.] Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than the UL-listed voltages for the sensors and/or appliances. Power wiring, operating at 120 VAC minimum, shall be a minimum No 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR or FPLP as appropriate with red colored covering. Non-power-limited cables shall comply with NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials and equipment in accordance with NFPA 2001. Provide each system complete and ready for operation. Provide each system with an approved pressure relief device designed to operate between 2,000 and 3,300 psi and located between the storage cylinder manifolds and any normally closed valve.
- B. The Work Authorization must be prominently displayed at the job site before any work, to include demolition, can begin.
- C. Upon completion of the Work, a final inspection by the Client Fire Marshal, and the satisfactory resolution of all issues identified by the Final Inspection, the Client Fire Marshal shall sign and close out the Work Authorization which indicates acceptance of the permitted work.
- D. Distribution Piping and Fittings: Distribution piping and fittings shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using good, accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly. All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male threads only.
- E. Pipe Penetrations: Cutting structural members for passage of pipes or for pipe-hanger fastenings shall 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 shall extend through its respective wall or floor and be cut flush with each wall surface. 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 firestopped in accordance with Section 07 84 13 "Penetration 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.
- F. Escutcheons: Escutcheons shall be listed for piping passing through floors, walls, and ceilings, consisting of one-piece or split-type. Provide chrome plated escutcheons where pipe passes through walls and ceilings in finished areas. Other escutcheons may be steel or cast-iron, with aluminum paint finish. Securely fasten escutcheons in place with setscrews or other positive means.
- G. Discharge Nozzle: Where clogging by external foreign material is likely, discharge nozzles shall be provided with frangible discs, blow-off caps, or other suitable devices.

- H. Manual Release Stations: Provide manual release stations as indicated on the Drawings. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than [5][] feet from the exit door they serve, measured horizontally.
- I. Smoke Detectors: Terminate field wiring on the screw terminals for all photoelectric and laser smoke detectors. Locate detectors [as required by NFPA 72 and their listings][as indicated] on a 4-inch mounting box. Locate smoke detectors on the ceiling. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. In raised floor spaces, install the smoke detectors to protect 225 square feet per detector. Install smoke detectors no close than 5 feet from air handing supply ducts.
- J. Duct Smoke Detectors: 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. Auxiliary contacts provided for this function shall be located within 3 feet of a controlled circuit or appliance.
- K. Electromagnetic Door Holder Release: Doors shall be help open at a minimum of 90 degrees so as not to impede egress from the space. Mount the armature portion on the door and have an adjusting screw for seating the angle of the contact plate. Wall-mount the electromagnetic release, with a total horizontal projection not exceeding 4 inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control panel for magnetic door holding circuits is not required.
- L. Releasing Control Panel (RCP): The RCP shall be located in a year round environmentally conditioned space and not in the hazard area served but adjacent to it. Locate the RCP [where indicated on the Drawings][]. [Recess][Semi-recess][Surface-mount] the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at [5][] feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the RCP.
- M. Extinguishing System Saving/Disconnect Switch: Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE EXTINGUISHING SYSTEM SAFING SWITCH".
- N. Operating Instructions: Submit operating instructions for clean agent fire extinguishing systems consisting of raised or embossed white letter on red rigid plastic or enameled steel background and of adequate size to permit them to be easily read. Provide operating instructions at each remote control station. Instructions are to clearly indicate necessary steps for the operating of the system. Submit three copies of the Operation and Maintenance manuals 30 days prior to testing the clean agent fire extinguishing systems. Update and resubmit data for final approval no later than 30 days prior to contract completion.

- O. Field Painting: Touch-up paint is to match equipment manufacturer's original paint.

3.2 WARNING SIGNS

- A. Provide three-layer red-white-red micarta engraved to show white letters on a red background, warning signs. Letters are to be uppercase. Warning signs are to be 1/8-inch thick with beveled edges.

- B. Inside Control Room: Permanently affix a sign adjacent to every audible/visual alarm activated due to agent discharge reading:

1. WARNING:

THIS SPACE IS PROTECTED BY A NOVEC 1230 CLEAN AGENT EXTINGUISHING SYSTEM. DO NOT ENTER WITHOUT AUTHORIZATION DURING OR AFTER DISCHARGE. THIS STROBE INDICATES DISCHARGE.

- C. Manual Activation of Release Station: Place a sign at every locations where manual operation of the system may occur reading:

1. WARNING:

ACTUATION OF THIS DEVICE WILL CAUSE FIRE EXTINGUISHING GAS TO DISCHARGE. BEFORE ACTUATING, ENSURE THAT PERSONNEL ARE CLEAR OF THE AREA.

3.3 FIELD QUALITY CONTROL

- A. After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards in the presence of Client.

- B. Test Procedure: At least 14 days [] prior to functional testing, the installing contractor shall submit a Test Plan describing the procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this Specification section have been met. All tests shall be conducted in the presence of the Client Representative and shall not be conducted until the Test Plan has been approved by Client.

- C. Experienced technicians regularly employed by the contractor in the installation of the system and manufacturer's representative referred to elsewhere in this section shall conduct the testing.

3.4 PRELIMINARY TESTS

- A. Visual Inspection: Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals of Fire Alarm Systems" chapter.
- B. Room Pressurization Test: After all construction is complete, conduct a room pressurization test in accordance with NFPA 2001 in each clean agent extinguishing system hazard area. Test shall conform enclosure's ability to retain the agent concentration level for the required hold time. If the test fails, the extinguishing system contractor shall coordinate room sealing with the general contractor. Additional tests shall be conducted until successful test results are achieved. Include final test results with the final record drawings.
 - 1. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings, which would affect the agent system concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001.
 - 2. If room pressurization testing indicates openings exist that would result in leakage and/or loss of clean agent fire extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his subcontractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. THE CLEAN AGENT FIRE EXTINGUISHING SYSTEM INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS. If the first room pressurization test is not successful, in accordance with this Specification section, the installing contractor shall inform the general contractor to determine and correct the cause of the test failure. If, after inspection of the additional sealing performed, the installing contractor is satisfied that the protected space is ready for retesting, the installing contractor shall conduct additional room pressurization tests, at no additional cost, until a successful test is obtained. Copies of successful test results shall be submitted to the Client Representative.
- C. Operational Test: After electrical circuitry has been energized, apply power to control panel and confirm proper unit operation. Comply with "Test Methods" table in "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72. Test and adjust controls and safeties.
- D. Clean Agent Fire Extinguishing Systems Test: Using nitrogen or other inert gas, perform a flow test on the piping network to verify that flow is continuous and unobstructed through piping and nozzles.
- E. Pressure/Leak Test: Pneumatically test the piping in a closed circuit for a period of 10 minutes at 40 psi. At the end of 10 minutes, the pressure drop shall not exceed 20 percent of the test pressure. Repair leaks and retest until no leaks exist.

- F. Test and Inspection Reports: Factory authorized service representative shall prepare the "Fire Alarm System Record of Completion" and the "Inspection and Testing" documents from NFPA 72.

3.5 FINAL TESTS

- A. The system will be considered ready for acceptance testing only after the following have been accomplished:
 - 1. Preliminary tests have been made and deficiencies corrected.
 - 2. Testing reports have been submitted and approved.
- B. Final acceptance testing shall be coordinated and performed by the contractor, in the presence of Client. In order to assure attendance of the necessary representatives, each representative scheduled to witness the test shall be provided a minimum of 5 working days' notification of the proposed test date by the contractor. The test shall not be conducted until all parties agree on the scheduled test date. The contractor shall provide all the necessary personnel and equipment to conduct the tests.
- C. The final acceptance test shall repeat 100 percent of preliminary tests.
- D. If the Final Acceptance Test fails, the contractor shall pay all costs incurred to Client for any and all retesting.
- E. Upon satisfactory completion of the tests, the contractor shall leave the system in proper working order.
- F. Warranty: Except as otherwise expressly provided in the contract documents, and excepting only items of routine maintenance, ordinary wear and tear or unusual abuse or neglect, contractor guarantees all work executed by the contractor and all supplies, materials, and devices of whatsoever nature incorporated in, or attached with the work, or otherwise delivered to Client as part of the work pursuant to the contract to be absolutely free of all defects of workmanship and materials for a period of 2 years after final acceptance of the work by Client. Include service directory with telephone numbers for 24-hour emergency service.

3.6 TRAINING

- A. Instructor: Include in the Project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.
 - 1. Instructor shall train the employees designated by Client, in the care, adjustment, maintenance, and operation of the fire extinguishing system.
 - 2. Each instructor shall be thoroughly familiar with all parts of this installation.
 - 3. The instructor shall be trained in operating theory as well as in practical O&M work.
 - 4. Submit the instructor's information and qualifications including training history to Client prior to training.

- B. Required Instruction Time: Provide [4][8] hours of instruction after final acceptance of the system.
1. The instruction shall be given during regular working hours on such dates and times as selected by Client.
 2. The instruction may be divided into two or more periods at the discretion of Client.
 3. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

END OF SECTION