SECTION 212113.13 - HIGH-PRESSURE, CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEMS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
   * + 1. RELATED DOCUMENTS
          1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
       2. SUMMARY
          1. Section Includes:

Carbon dioxide.

Pipes and fittings.

High-pressure flexible-hose connectors.

Carbon-dioxide cylinders.

Cylinder valves.

Discharge nozzles.

Hangers and supports.

Fire-control panels.

Detection devices.

Manual stations.

Switches.

Alarm devices

* + - 1. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the

General Conditions.

* + - * 1. Manufacturer’s installation instructions shall be provided along with product data.
        2. Submittals shall be provided in the order in which they are specified and tabbed (for

combined submittals).

* + - * 1. Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control panels.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

USE PARAGRAPH BELOW WITH EPD REQUIREMENT WHEN PROJECT ESTIMATE IS $1M OR MORE.

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for steel pipe within this specification section, if available. A statement of the contractor’s good faith effort to obtain the EPD shall be provided if not available.

Manufacturer-provided EPDs must be Product Specific Type III (Third-Party Reviewed), in adherence with ISO 14025 *Environmental labels and declarations*, ISO 14044 *Environmental management – Life cycle assessment*, and ISO 21930 *Core rules for environmental product declarations of construction products and services*.

* + - * 1. Shop Drawings: For high-pressure, carbon-dioxide fire-extinguishing system, signed and sealed by a qualified professional engineer.

Include plans, elevations, sections, and [**mounting**] [**attachment**] details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring.

* + - * 1. Delegated-Design Submittal: For high-pressure, carbon-dioxide fire-extinguishing system, signed and sealed by a qualified professional engineer.

Indicate compliance with performance requirements and design criteria, including analysis data.

Design Calculations: For weight, volume, and concentration of extinguishing agent required for each hazard area.

Reflected Ceiling Plans:

Show ceiling penetrations.

Ceiling-mounted carbon-dioxide fire-extinguishing system items.

Extinguishing-agent containers if mounted above floor.

Piping, discharge nozzles, detectors, and accessories.

Hangers and supports, including hanger types and spacing and methods for attaching hangers to building structure.

Coordination with items mounted in and above ceiling other than carbon-dioxide fire-extinguishing systems, including ceiling construction components.

Occupied Work Area Plans:

Controls and alarms.

Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.

Coordination with equipment and furnishings protected by the system.

Access Floor Space Plans:

Extinguishing-agent containers, piping, discharge nozzles, detectors, and accessories.

Method of supporting piping.

* + - * 1. Design Data:

Permit-Approved Drawings: Working plans, including design calculations prepared according to NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”, that have been approved by authorities having jurisdiction.

Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates, for container foundations, cylinder racks, supports, hangers, braces, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Welding certificates" Paragraph below if retaining "Welding Qualifications" Paragraph in "Quality Assurance" Article.

* + - * 1. Welding certificates.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For carbon-dioxide fire-extinguishing system to include in emergency, operation, and maintenance manuals.
      2. MAINTENANCE MATERIAL SUBMITTALS
         1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Director’s Representative.

Detection Devices: Not less than [**20**] <**Insert number**> percent of amount of each type installed.

Container Valves: Not less than [**10**] <**Insert number**> percent of amount of each size and type installed.

Nozzles: Not less than [**20**] <**Insert number**> percent of amount of each type installed.

Extinguishing Agent: Not less than [**100**] <**Insert number**> percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

* + - 1. QUALITY ASSURANCE

Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Informational Submittals" Article.

* + - * 1. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 “Structural Welding Code – Steel”.
        2. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified professional engineer to design a high-pressure, carbon-dioxide fire-extinguishing system, and obtain approval from authorities having jurisdiction.

Retain "Total-Flooding System Design Criteria" Subparagraph below for total-flooding systems.

Total-Flooding System Design Criteria:

Hazard Type: [**Data-processing center**] [**Manufacturing process**] [**Power generation**] [**Telecommunications center**] [**Electrical equipment room**] <**Insert hazard type**>.

Discharge carbon dioxide for [**60 seconds**] <**Insert time**> and maintain [**34**] <**Insert number**> percent concentration by volume at 70 deg F for [**10-minute**] <**Insert time**> holding time in hazard areas.

Provide system with separate zones above and below the ceiling [**and beneath the raised floor**].

Operations and Controls: Discharge extinguishing agent in the underfloor zone only if smoke is detected below the raised floor. Discharge extinguishing agent in zones above and below the ceiling, and below the floor if smoke is detected below the ceiling. Discharge extinguishing agent only in the zone above the ceiling if smoke is detected above the ceiling.

Retain "Local-Application System Design Criteria" Subparagraph below for local-application systems.

Local-Application System Design Criteria:

Single zone with an individual nozzle protecting indicated hazard surface.

Determine discharge rate by the listing information on the nozzle and as recommended by the fire-extinguishing system manufacturer.

Retain "High-Pressure Piping Design Criteria" Subparagraph below if another type of high-pressure piping is used.

High-Pressure Piping Design Criteria:

Comply with ASME B31.1 “Power Piping”.

Internal Pressure: 2800 psig.

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Data" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Cylinder racks, supports, hangers, and braces shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[**, and the system will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor is [**1.5**] [**1.0**].

Delete "System Design" Paragraph below if system is already designed and approved.

* + - * 1. System Design: Design high-pressure, carbon-dioxide fire-extinguishing system, and obtain approval from authorities having jurisdiction. Design system for <**Insert hazard type**> as appropriate for areas being protected, and include safety factor.
      1. SYSTEM DESCRIPTION

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6210) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ansul; brand of Johnson Controls International plc, Building Solutions North America.

[Fike Corporation](http://www.specagent.com/Lookup?uid=123457152660).

Approved equivalent.

Describe basic system design in this article, which contains sample descriptions of basic systems. Revise descriptions to define the zoning of the system and coordinate with Drawings.

Retain one of or both "Total-Flooding System" and "Local Application" paragraphs below. Retain both paragraphs if both types of systems are required for Project. If retaining both, identify each system on Drawings.

* + - * 1. Total-Flooding System: Pre-engineered carbon-dioxide fire-extinguishing system designed for total flooding of the hazard area, including the room cavity above the ceiling, below the ceiling, and below the raised floor.
        2. Local Application: Pre-engineered carbon-dioxide fire-extinguishing system designed for local application directly on indicated hazards and adjacent areas.
        3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.
        4. NFPA Compliance: Fire-extinguishing system, equipment, and components shall comply with NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”.

Retain "FM Global Compliance" Paragraph below if FM-Approved components are required.

* + - * 1. FM Global Compliance: Provide components that are FM Approved and that are listed in FM's "Approval Guide."
        2. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."
      1. CARBON DIOXIDE
         1. Vapor Phase: Equal to or more than 99.5 percent carbon dioxide.
         2. Taste and Odor: None detectable.
         3. Water Content: Comply with CGA G-6.2 “Commodity Specification for Carbon Dioxide”.
         4. Oil Content: Equal to or less than 10 ppm by weight.
      2. PIPES AND FITTINGS
         1. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”, Section "Distribution," for charging pressure of system.

In "Steel Pipe" Paragraph below, Schedule 80 and Schedule 160 wall thicknesses are also available but are not normally required. If more than one pipe material, wall thickness, or joining method is required on Project, insert a piping schedule at the end of this Section or on Drawings to identify where each material is required.

* + - * 1. Steel Pipe: ASTM A53 “Standard Specification for Pipe, Steel, Black and Hot-Dipper, Zinc-Coated, Welded and Seamless”, Grade B, Schedule 40, [**Type E**] [**Type S**] or ASTM A106 “Standard Specification for Seamless Pressure Pipe”, [**Grade A**] [**Grade B**] [**Grade C**], [**black**] [**and**] [**galvanized**] finish, seamless-steel pipe.

Threaded Fittings:

Malleable-Iron Fittings: ASME B16.3 “Malleable Iron Threaded Fittings Classes 150 and 300”, Class 300.

Flanges and Flanged Fittings: ASME B16.5 “Pipe Flanges & Flanged Fittings”, Class 300 unless Class 600 is indicated.

Welding Fittings: ASME B16.9 “Factory-Made Wrought Buttwelding Fittings”.

Coordinate joining material selection with pipe, tube, and fitting selections.

Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

ASME B16.21 “Nonmetallic Flat Gaskets for Pipe Flanges”, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

Flange Bolts and Nuts: ASME B18.2.1 “Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws” carbon steel.

Welding Filler Metals: Comply with AWS D10.12 “Guide for Welding Mild Steel Pipe” for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

* + - * 1. Stainless Steel Pipe: ASTM A269 “Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service” or ASTM A312 “Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes”, [**Grade TP304**] [**Grade TP316**] [**Grade TP304L**] [**or**] [**Grade TP316L**].

Stainless Steel Fittings: ASTM A182 “Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service”, Class 3000.

* + - 1. HIGH-PRESSURE FLEXIBLE-HOSE CONNECTORS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6211) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Ansul; brand of Johnson Controls International plc, Building Solutions North America](http://www.specagent.com/Lookup?uid=123457152664).

Fike Corporation

Kidde; Carrier Global Corporation.

Approved equivalent.

* + - * 1. Description: Teflon-lined, braided hose with stainless steel wire-braid covering.

Design Standard: ASME B31.1 “Power Piping”.

Burst Pressure: 5000 psi minimum.

End Connections: Threaded male couplings.

* + - 1. CARBON-DIOXIDE CYLINDERS
         1. Operating Pressure: Between 2400 psi and 3000 psi.

Pressure Relief Device: Rupture-disk type.

Sized and fitted according to 49 CFR 178 “Specifications for Packagings”.

* + - * 1. Ambient Storage Conditions: Less than 120 deg F and more than 32 deg F.

Retain "Wall Storage Racks" and "Freestanding Storage Racks" paragraphs below if storage racks are required, and detail storage racks on Drawings.

* + - * 1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders, as indicated, or provide equivalent manufactured wall racks.
        2. Freestanding Storage Racks: Fabricate racks, as indicated, or provide equivalent manufactured storage racks.

If Project has more than one type or configuration of cylinder, delete "Storage Cylinder Nominal Size" Paragraph below, and schedule cylinders on Drawings.

* + - * 1. Storage Cylinder Nominal Size: [**50 lb**] [**75 lb**] [**100 lb**] <**Insert weight**>.
        2. Containers:

Minimum Manufacturing Standard: ASME Boiler & Pressure Vessel Code, Section VIII, Division 1.

Housing: [**Steel**] [**or**] [**fiberglass**].

Working Pressure: 363 psi.

Maintenance Pressure Requirements: 300 psi and 0 deg F with a design pressure of 325 psi

If Project has more than one type or configuration of storage container, delete "Bulk System Storage Container Nominal Size" and "Mini-Bulk System Storage Container Nominal Size" subparagraphs below, and schedule storage containers on Drawings.

Retain one of two subparagraphs below.

Bulk System Storage Container Nominal Size: [**3/4 ton**] [**2 tons**] [**10 tons**] <**Insert weight**>.

Mini-Bulk System Storage Container Nominal Size: [**800 lb**] [**1000 lb**] [**1500 lb**] <**Insert weight**>.

* + - 1. CYLINDER VALVES
         1. Bursting Pressure Rating:

Valves under Constant Pressure: 6000 psi.

Valves Not under Constant Pressure: 5000 psi.

* + - * 1. Discharge Valves:

Actuation: [**Pneumatic**] [**Electric**] [**Manual**].

Solenoid Actuator: [**12-V dc**] [**24-V dc**].

Pilot Hose: [**Rigid**] [**Flexible**].

Valve Material: Brass or stainless steel.

Slave Valve Material: Brass.

Lock-Out: Key-operation selector, for prevention of discharge during maintenance.

* + - 1. DISTRIBUTION VALVES
         1. Selector Valve:

Actuation: Pneumatic, electro pneumatic, or manual.

Design: [**Ball**] [**Butterfly**], with spring-return actuator.

Minimum Burst Pressure: 5000 psi.

Minimum Pressure without Permanent Distortion: 1800 psi.

Retain "Master Valve" Paragraph below when multiple, distant hazards exist and a single outlet from storage container is required. The master valve is positioned upstream from selector valves.

* + - * 1. Master Valve:

Actuation: Pneumatic, electro pneumatic, or manual.

Design: [**Ball**] [**butterfly**], with spring-return actuator.

Minimum burst pressure: 5000 psi.

Minimum pressure without permanent distortion: 1800 psi.

* + - 1. DISCHARGE NOZZLES

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6216) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Ansul; brand of Johnson Controls International plc, Building Solutions North America](http://www.specagent.com/Lookup?uid=123457152672).

Kidde; Carrier Global Corporation.

Danfoss Fire Safety A/S

Approved equivalent.

* + - * 1. Equipment manufacturer's standard material of working pressure, size, discharge pattern, and capacity required for application.
        2. Corrosion-resistant metal.
        3. Stamped with orifice size and type.
      1. HANGERS AND SUPPORTS
         1. Carbon-Steel Pipe Hangers and Supports:

Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.

Galvanized Metallic Coatings: Pre-galvanized or hot-dip galvanized.

Nonmetallic Coatings: Plastic coating, jacket, or liner.

Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

Hanger Rods: Continuous-thread rod with compatible nuts and washers made of [**carbon steel**] [**stainless steel**] <**Insert material**>.

* + - * 1. Stainless Steel Pipe Hangers and Supports:

Description: MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”, Types 1 through 58, factory-fabricated components.

Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

Hanger Rods: Continuous-thread rod with compatible nuts and washers made of stainless steel.

* + - 1. FIRE-CONTROL PANELS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6212) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Ansul; brand of Johnson Controls International plc, Building Solutions North America](http://www.specagent.com/Lookup?uid=123457152668).

Kidde; Carrier Global Corporation

Fike Corporation

Approved equivalent.

* + - * 1. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
        2. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
        3. Enclosure: NEMA ICS 6 “Industrial Control and Systems: Enclosures”, Type 1, enameled-steel cabinet.

Mounting: [**Recessed flush with surface**] [**Surface**].

* + - * 1. Supervised Circuits: Separate circuits for each independent hazard area.

Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.

Manual pull-station circuit.

Alarm circuit.

Release circuit.

Abort circuit.

Emergency power-off circuit.

* + - * 1. Control-Panel Features:

Verify availability and applicability of control-panel features.

Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.

Automatic switchover to standby power at loss of primary power.

Storage container, low-pressure indicator.

Service disconnect to interrupt system operation for maintenance, with visual status indication on the annunciator panel.

* + - * 1. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless steel or aluminum enclosure.
        2. Standby Power: [**Sealed lead calcium**] [**Sealed, valve-regulated, recombinant lead acid**] [**Vented, wet-cell pocket, plate nickel cadmium**] batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high, depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.
      1. DETECTION DEVICES
         1. General Requirements for Detection Devices:

Comply with NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”, NFPA 72 “National Fire Alarm and Signaling Code”, and UL 268 “Smoke Detectors for Fire Alarm Systems”.

24-V dc, nominal.

* + - * 1. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
        2. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

Coordinate "Remote Air-Sampling Detector System" Paragraph below with Drawings.

* + - * 1. Remote Air-Sampling Detector System: Include air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.

Other pipe materials may be specified in "Pipe Network" Subparagraph below, depending on codes and authorities having jurisdiction.

Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.

Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.

Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05 inch wg at all sampling ports.

Control Unit: Multizone unit as indicated on Drawings. Include same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.

Signals to the Central Fire-Alarm Control Panel: Report local system trouble to the central fire-alarm control panel as a composite "trouble" signal. Individually report alarms on each system zone to the central fire-alarm control panel as separately identified zones.

* + - 1. MANUAL STATIONS
         1. Description: [**Surface**] [**Semirecessed**], FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.
         2. Manual Release: "MANUAL RELEASE" caption, with red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

Switches in "Emergency Power-Off Switch" Paragraph below are normally used for computer facilities. Retain if required.

* + - * 1. Emergency Power-Off Switch: "EPO" caption, with yellow finish.
      1. SWITCHES
         1. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction.

Control Voltage: [**120-V ac**] <**Insert electrical rating**> compatible with controls.

Include contacts for connection to control panel.

Discharge Pressure Switches: Pneumatic operation for shutdown of equipment.

Power-Transfer Switches: Key-operation selector for transfer of release circuit signal from main supply to reserve supply.

Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

* + - 1. ALARM DEVICES
         1. Description: FM Approved or listed and labeled by a nationally recognized testing agency acceptable to authorities having jurisdiction; low voltage and surface mounting.
         2. Bells: Minimum 6-inch diameter.
         3. Horns: 90 to 94 dBA.
         4. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting performance of the Work.
          2. Proceed with installation only after unsatisfactory conditions have been corrected.
       2. INSTALLATION, GENERAL
          1. Comply with requirements in NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”.

Coordinate piping installations and specialty arrangements with schematics on Drawings. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
        2. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
        3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
        4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
        5. Install piping adjacent to equipment and specialties to allow service and maintenance.
        6. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating.
        7. Install piping to permit valve servicing.
        8. Install piping free of sags and bends.
        9. Install fittings for changes in direction and for branch connections.
        10. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”, Section "Distribution Systems."

Install pressure-relief devices in piping systems.

Retain first subparagraph below if piping is required to withstand seismic design loads.

Install seismic restraints for carbon-dioxide cylinders and piping systems.

Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”, Section "Detection, Actuation, and Control," as required for supervised system application.

* + - * 1. Install carbon-dioxide cylinders in racks anchored to substrate.
      1. INSTALLATION OF HANGERS AND SUPPORTS
         1. Comply with Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices [**and seismic restraints**].
         2. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

Equipment support in "Equipment Support Installation" Paragraph below requires calculating and detailing for each use.

* + - * 1. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
        2. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
        3. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [**NPS 2-1/2**] <**Insert size**> and larger, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
        4. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
        5. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes to facilitate draining moisture and to not exceed maximum pipe deflections allowed by ASME B31.9 “Building Services Piping” for building-services piping.
        6. Install carbon-steel hangers and supports for steel piping and stainless steel hangers and supports for stainless steel piping.
        7. Vertical Piping: MSS Type 8 or 42 clamps.
        8. Individual, Straight, Horizontal Piping Runs:

100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.

Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

* + - * 1. Base of Vertical Piping: MSS Type 52 spring hangers.
        2. Support horizontal piping within 12 inches of each fitting and coupling.
        3. Support vertical runs of piping to comply with MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
        4. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

Retain paragraph below if piping is required to withstand specific design loads.

* + - * 1. Install seismic restraints on piping. Comply with requirements in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
      1. PIPING CONNECTIONS

Coordinate piping system installations and specialty arrangements with Drawings.

* + - * 1. Drawings indicate general arrangement of piping, fittings, and specialties.
        2. Where installing piping adjacent to equipment, allow space for service and maintenance.

Retain "Piping Connections for NPS 1/4 to 1/2" Paragraph below for flexible piping between actuators and manifold piping.

* + - * 1. Piping Connections for NPS 1/4 to 1/2: Braided stainless steel hose with threaded male couplings.
      1. ELECTRICAL CONNECTIONS
         1. Connect electrical devices to control panel. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
         2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
         3. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 “Standard for Electrical Safety in the Workplace” and NECA 1 “Standard for Good Workmanship”.
         4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of two subparagraphs below. First subparagraph cross-references Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of the product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

* + - 1. CONTROL CONNECTIONS
         1. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
      2. IDENTIFICATION
         1. Identify system components and equipment. Comply with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
         2. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
         3. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems”.
         4. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected by a carbon-dioxide fire-extinguishing system.

Revise paragraph below to require warning devices.

* + - * 1. Install signs at entry doors to advise persons outside the room of the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.
      1. FIELD QUALITY CONTROL

Retain first paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections according to NFPA 12 “Standard on Carbon Dioxide Extinguishing Systems “[**with the assistance of a Company Field Advisor per OGS Spec Section 014216**]:

Visual Inspections:

Inspect piping, equipment, and nozzles for proper size and location.

Verify that locations of alarms and manual emergency releases comply with approved Drawings.

Compare actual hazard configuration to original specification.

Inspect system for openings or other possible leakage paths.

Inspect labeling of devices and equipment for proper identification and nameplate data.

Testing: After installing carbon-dioxide fire-extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.

Perform nondestructive operational tests on all equipment.

Perform full-discharge test on all hazards.

Perform each electrical test and visual and mechanical inspection stated in NETA's "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems," Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.

Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Carbon-dioxide fire-extinguishing system will be considered defective if it does not pass tests and inspections.
        2. Prepare test and inspection reports.
      1. SYSTEM FILLING
         1. Preparation:

Verify that piping system installation is complete and clean.

Check system for complete enclosure integrity.

Check operation of ventilation and exhaust systems.

* + - * 1. Filling Procedures:

Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.

Install filled extinguishing-agent containers.

Energize circuits.

* + - * 1. Adjust operating controls.
      1. MAINTENANCE SERVICE

Verify with Owner that maintenance service is required for Project.

* + - * 1. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include [**three**] [**six**] [**nine**] [**12**] months' full maintenance by [**skilled employees of carbon-dioxide system Installer**] [**Company Field Advisor per OGS Spec Section 014216**]. Include [**monthly**] [**quarterly**] [**semiannual**] [**annual**] preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper carbon-dioxide fire-extinguishing system operation. Service to include manufacturer's authorized replacement parts and supplies.
      1. DEMONSTRATION
         1. [**Engage a Company Field Advisor per OGS Spec Section 014216 to train**] [**Train**] Facility’s maintenance personnel to adjust, operate, and maintain carbon-dioxide fire-extinguishing system.

END OF SECTION 212113.13