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USACE / NAVFAC / AFCEC / NASA **UFGS-21 21 01.00 20 (November 2009)**

Preparing Activity: NAVFAC **Superseding**
UFGS-21 21 01.00 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 21 01.00 20

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11/09

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SECTION 21 21 01.00 20

CARBON DIOXIDE FIRE EXTINGUISHING (HIGH PRESSURE)
11/09

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NOTE: This guide specification covers the requirements for high-pressure carbon dioxide fire extinguishing systems for protection of data processing equipment and similar electronics occupancies.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: System requirements must conform to UFC 3-600-01, "Fire Protection Engineering for Facilities" and NFPA 12, "Carbon Dioxide Extinguishing Systems."

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NOTE: With minor changes, this guide specification can be adapted to other occupancies or needs, such as the protection of electric generators. Total flooding carbon dioxide systems shall not be installed in normally occupied spaces. In other spaces, consideration must be given to the possibility that personnel could be trapped in an atmosphere made by the discharge of carbon dioxide. Lockout keyed switches or audible pre-discharge

signals shall be provided. Provide a sufficient time delay to allow for evacuation under worst case conditions. Refer to safety cautions in NFPA 12. If there are questions concerning system design, the Engineering Field Division, Naval Facilities Engineering Command, Fire Protection Engineer, should be consulted.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 12	(2018) Standard on Carbon Dioxide Extinguishing Systems
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 72	(2019; TIA 19-1; ERTA 1 2019) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

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NOTE: Identify the rooms, spaces, or areas, as appropriate, which are to be protected by each type of system. If the volume of the space under raised floors does not exceed 56.60 cubic meters 2000 cubic feet, total flooding system is not required.

****

Design and provide [new and modify existing] high-pressure carbon dioxide [hose reel fire extinguishing systems for protection of [_____]] [and] [underfloor total flooding fire extinguishing systems for spaces under raised floors] for protection of [_____]. The system design and manufacturer's products including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 12, [NFPA 70,] [NFPA 72,] [NFPA 75,] [and] [NFPA 90A,] except as modified herein. Each system [shall be designed for earthquakes and] shall include all materials, accessories, and equipment inside and outside the building

to provide each system complete and ready for use. Design and provide piping layout of each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and other construction and equipment in accordance with detail working drawings to be submitted for approval. Devices and equipment for fire protection service shall be listed in UL Fire Prot Dir or approved by FM APP GUIDE for use in carbon dioxide fire extinguishing systems.

1.2.1 Detail Drawings

Prepare A1 841 by 594 mm 24 by 36 inch detail working drawings of carbon dioxide piping layout in accordance with NFPA 12 "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point-to-point electrical wiring diagrams.

1.2.2 System Calculations

Submit calculations showing that open-area smoke detectors calculations comply with specified power consumption limitation requirements.

1.2.3 As-Built Drawings of Each System

After completion, but before final acceptance of the work, submit a complete set of as-built working drawings of each system for record purposes. Submit A1 841 by 594 mm 24 by 36 inches reproducible mylar film with title block similar to full-size contract drawings. Furnish the as-built (record) working drawings in addition to the as-built contract drawings required by Division 1, "General Requirements."

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[The [_____] Division, Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve all submittals in this section requiring Government approval.]

****

NOTE: For projects administered by the Pacific Division, Naval Facilities Engineering Command, use the optional "SUBMITTALS" article immediately below and delete the general "SUBMITTALS" article above.

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[The [_____] Division, Naval Facilities Engineering Command, Fire Protection Engineer delegates the authority to the Quality Control (QC) Representative's U.S. Registered Fire Protection Engineer for review and approval of submittals required by this section. Submit to the [_____] Division, Naval Facilities Engineering Command, Fire Protection Engineer one set of all approved submittals and drawings immediately after approval but no more later than 15 working days prior to final inspection.]

SD-02 Shop Drawings

Piping layout; G[, [_____]]

Electrical wiring diagrams; G[, [_____]]

SD-03 Product Data

Storage cylinders; G[, [_____]]

Discharge head; G[, [_____]]

Manifolds; G[, [_____]]

Discharge alarm; G[, [_____]]

Pipe and fittings; G[, [_____]]

Pipe hangers and supports; G[, [_____]]

Actuating stations; G[, [_____]]

Pressure switch; G[, [_____]]

Control panel; G[, [_____]]

Smoke detectors; G[, [_____]]

Heat activated detectors; G[, [_____]]

Alarm horns; G[, [_____]]

Alarm bells; G[, [_____]]

[Audio] Visual alarms; G[, [_____]]

Dampers; G[, [_____]]

Main and reserve switch; G[, [_____]]

Warning signs; G[, [_____]]

Storage batteries; G[, [_____]]

Battery charger; G[, [_____]]

Annotate descriptive data to show the specific model, type, and size of each item.

SD-05 Design Data

System calculations; G[, [_____]]

Calculations substantiating battery capacity; G[, [_____]]

Open-area smoke detectors calculations; G[, [_____]]

SD-06 Test Reports

Preliminary tests on piping systems; G[, [_____]]

Submit certificates for preliminary test on piping systems.

SD-07 Certificates

Qualifications of installer; G[, [_____]]

SD-10 Operation and Maintenance Data

Discharge head, Data Package 3; G[, [_____]]

Control panel, Data Package 3; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

As-built drawings of each system; G[, [_____]]

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Installer

Prior to installation, submit data showing that the Contractor has successfully installed high-pressure carbon dioxide fire extinguishing systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily for not less than 18 months.

****

NOTE: For projects administered by the Pacific Division, Naval Facilities Engineering Command, include the following optional paragraph requiring the minimum qualification of a NICET Level-III technician for preparation of all fire protection system drawings.

****

[Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in Special Hazard System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.]

1.5 SPARE PARTS

Furnish the following spare parts:

a. Two of each type detector installed.

b. One of each type of audible and visual alarm device installed.

c. Two of each type of fuse required by the system.

d. Five complete sets of system keys.

1.6 ELECTRICAL WORK

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control [and fire alarm] wiring.[Provide fire alarm system under Section [28 31 60 INTERIOR FIRE ALARM SYSTEM, NON-ADDRESSABLE] [28 31 66 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, NON-ADDRESSABLE] [28 31 70 INTERIOR FIRE ALARM SYSTEM, ADDRESSABLE] [28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE].] Provide control [and fire alarm] wiring[, including connections to fire alarm systems,] under this section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

PART 2 PRODUCTS

2.1 DESIGN OF CARBON DIOXIDE FIRE EXTINGUISHING SYSTEMS

NFPA 12, except as modified herein.

2.1.1 Underfloor Total Flooding Systems

Provide uniform discharge to each raised floor space to achieve a factor of one pound of carbon dioxide for each [0.28 cubic meters 10 cubic feet of underfloor volume in one minute for underfloor volumes of 56.6 cubic meters 2000 cubic feet or less] [and] [0.34 cubic meter 12 cubic feet of underfloor volume in one minute for underfloor volumes greater than 56.6 cubic meters 2000 cubic feet, except that minimum supply of carbon dioxide shall be 91 kg 200 pounds].

2.1.2 Underfloor Total Flooding Systems Supply

****

NOTE: Designer must ensure that no suffocation hazard will exist in any rooms with underfloor total flooding systems or within any space to which the carbon dioxide might migrate after discharge. Check with Fire Protection Engineer if in doubt.

****

****

NOTE: When a single total flooding underfloor supply is to protect more than one underfloor zone, clearly indicate the requirements on the drawings.

****

Supply shall include high-pressure storage cylinders, racks, manifolds, beam scales, and associated equipment. Supply shall consist of carbon dioxide in [_____] [34 kg] [75 pound] cylinders. Arrange the first [_____] cylinders for discharge upon activation of the main control, and the remaining [_____] cylinders for discharge upon activation of the reserve control.

2.2 PIPE AND FITTINGS

2.2.1 Pipe

Threaded end connections, Schedule 80 or Weight Class XS (Extra Strong), except that sizes smaller than one inch may be Schedule 40 or Weight Class STD (Standard).

a. ASTM A53/A53M, Type E (electric-resistance welded, Grade A or Grade B) or Type S (seamless, Grade A or Grade B).

b. ASTM A106/A106M, Grade A or Grade B.

2.2.2 Threaded Fittings

ASME B16.11, except sizes 50 mm 2 inches and smaller may conform to ASME B16.3, Class 300.

2.2.3 Unions

ASME B16.39, Class 300.

2.3 PIPING ACCESSORIES

2.3.1 Escutcheon Plates

Provide split hinge 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.

2.3.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide 25 mm one inch minimum clearance between exterior of piping and interior of sleeve 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.

a. 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.

b. Sleeves in Other Than Masonry and Concrete: Provide 26 gage galvanized steel sheets.

2.3.3 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1, with adjustable type support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

2.4 PRESSURE RELIEF DEVICE

Provide each system with an approved device designed to operate between 16.50 and 20.70 MPa (gage) 2400 and 3000 psig. Locate the device between the storage cylinder manifolds and normally closed valves.

2.5 SYSTEM CONTROL

Provide apparatus, accessories, components, and associated materials specified or required. Provide [automatic] [and] [manual] [combination] [electric] [and] [pneumatic] [mechanical pull cable] type of actuating stations complete and ready for operation. For electrically actuated systems, provide main and reserve switch. Switch will select between main

and reserve carbon dioxide supplies, located adjacent to the cylinder bank or at the control panel. [Detection system shall be complete Class A electrically supervised, combination, automatic, and manual. Automatic automation shall be accomplished by [smoke] [and] [heat] detectors.]

2.5.1 Manual Control Station for Underfloor Total Flooding System

****
NOTE: Omit if total flooding system for underfloor areas is not to be provided.
****

[Provide stations [at the principal exits from each protected space] [_____].] For systems that are mechanically or pneumatically activated, provide a separate station for main supply and for reserve supply of carbon dioxide at each location. For electrically activated systems, provide one station at each location. Mark each station to indicate its function.

2.5.2 Sequence of Operation

Smoke detection system shall be [cross-zoned,] [priority matrix,] [or have common circuit individual detector verification capability]. [If a cross-zoned system is used, each protected area shall contain two smoke detection circuits (zones), with each circuit having an equal number of detectors connected thereto and no two adjacent detectors connected to the same zone.] Upon activation of any smoke detector, the system shall simultaneously activate pre-discharge alarms in the protected areas, signal the building fire alarm control panels to activate the building fire evacuation alarms, and send a signal to the base fire department via the base fire alarm system. Upon activation of a second detector (on the opposite zone of a cross-zoned system), the systems shall immediately shut down [computer] [_____] equipment and air conditioning power, close fire dampers [and fire doors], activate the discharge alarms, and initiate an adjustable zero to 60 second discharge time delay. At the end of the time delay, [computer power shall shut down,] [and] carbon dioxide shall discharge into the protected area [and post discharge visual alarms shall activate].

a. Upon activation by a manual station, the system shall immediately perform the above listed alarm functions and shutdown functions, and initiate the adjustable time delay. At the end of the delay, carbon dioxide shall discharge into the protected area.

[b. Upon manual activation of the inhibit switch, time delay countdown, equipment shutdown, and agent discharge shall be delayed. All other functions shall continue unimpeded. Upon release of inhibit switch, shutdown and discharge functions shall resume. Time delay shall not reset and shall resume countdown to discharge after release of switch.]

[c. Activation of the manual discharge lever on the cylinder master discharge head shall cause immediate agent discharge and immediate operation of all alarm and shutdown functions specified in paragraph entitled "Sequence of Operation."]

2.5.3 Pressure-Operated Fire Alarm Switch

Provide a pressure switch to actuate the building interior fire alarm system upon the discharge of carbon dioxide.

2.5.4 Pressure-Operated Equipment Switch

****
NOTE: Omit if there is no air handling system serving the underfloor areas.
****

For each protected space, provide a switch to automatically shut down the air handling equipment upon the discharge of carbon dioxide.

2.5.5 Control Panel

****
NOTE: Use only when electrical actuation is specified.
****

Provide modular type panel in a [flush] [surface] mounted steel cabinet with hinged door and cylinder lock. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact, factory-wired assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide separate alarm and trouble lamps located on the exterior of the cabinet door or visible through the cabinet door for each zone initiating circuit. Provide prominent rigid plastic or metal identification plates for all lamps and switches. [Provide a 100 mm 4 inch remote system trouble bell, installed [in a constantly attended area] [where shown], arranged to operate in conjunction with the internal trouble signals of the panel. Provide remote bell with a rigid plastic or metal identification sign which reads "Carbon Dioxide System Trouble." Lettering on identification sign shall be a minimum of one inch high.] System control panel shall be UL listed or FM approved for use in carbon dioxide fire extinguishing system control (releasing device service). [Provide supervised isolation switch to permit testing or servicing of electrical control system without tripping of carbon dioxide system.]

2.5.5.1 Trouble Signals

A single open or ground fault condition in detection (initiating) circuit shall not result in any loss of system function, but shall cause the actuation of system trouble signals. A ground fault condition or single break in any other circuit shall result in the activation of the system trouble signals. [Supervision of wiring external to the control panel for mechanical equipment shutdown is not required, provided a break in such wiring will cause the associated mechanical equipment to shut down.] Loss of AC power, a break in the standby battery power circuits, or abnormal AC power or low battery voltage shall also result in the operation of the system trouble signals. The abnormal position of any system switch in the control panel shall also result in the operation of the system trouble signals. Trouble signals shall operate continuously until the system has been restored to normal at the control panel.

2.5.5.2 Panel Switches

Panel shall be provided with the following switches:

a. Trouble silencing switch which transfers trouble signals to an

indicating lamp. Upon correction of the trouble condition, audible signals shall again sound until the switch is returned to its normal position, or the trouble circuit shall be automatically restored to normal upon correction of the trouble condition. The silencing switch shall be a momentary action, self-resetting type.

b. Evacuation alarm silence switch which when activated shall silence associated alarm devices and cause operation of system trouble signals.

c. Individual zone disconnect switches which when operated shall disable only their respective initiating circuit and cause operation of the system and zone trouble signals.

d. Reset switch which when activated shall restore the system to normal standby status after the cause of the alarm has been corrected.

e. Lamp test switch.

2.5.6 Secondary Power Supply

****
NOTE: Use only when electrical actuation is specified.
****

Provide nickel cadmium, lead calcium, or sealed lead acid batteries and charger. Dry cell batteries will not be permitted. Provide steel cabinet with cylinder lock for batteries or house within control panel.

2.5.6.1 Storage Batteries

****
NOTE: Use only when electrical actuation is specified.
****

Provide batteries of the proper ampere-hour rating to operate the system under standby conditions for [60] [24] hours and alarm conditions for an additional [30] [15] minutes. Supervise batteries for low voltage and circuit continuity. Provide calculations substantiating battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.5.6.2 Battery Charger

****
NOTE: Use only when electrical actuation is specified.
****

Provide automatic [high and low charging rate type] charger, capable of recovering batteries from full discharge to full charge in 48 hours or less. [Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge.] Provide a red pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if high-rate switch is provided.

2.6 DETECTOR

2.6.1 Open-Area (Spot-Type) Smoke Detectors

Design for detection of abnormal smoke densities by the [ionization] [photoelectric] principle. Provide control and power modules required for operation integral with the main control panel. Detectors and associated modules shall be compatible with the main control panel and shall be suitable for use in a supervised circuit. [Detector circuits shall be of the four-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit.] [As an alternate, detector circuits of the two-wire type whereby the detector operating power is transmitted over the initiating circuits are permitted if:]

a. Detectors used are approved by the control panel manufacturer for use with the control panel provided.

b. The detectors are UL listed or FM approved as being compatible with the control panel.

[When two-wire detectors are used, the total number of detectors on a detection circuit shall not exceed 50 percent of the maximum number of detectors allowed by the control panel manufacturer for that circuit and the standby current draw of the entire system shall not exceed 50 percent of the rated output of the system power supply modules. Additional zones above those specified in the paragraph entitled "Annunciation Zones" shall be provided if required to meet the above requirements. Calculations showing compliance with the specified power consumption limitation requirements shall be submitted.] The manufacturer's data submitted under the paragraph entitled "Manufacturer's Catalog Data" shall clearly indicate the compatibility of the detectors with the control panel provided and the maximum number of detectors permitted per zone. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Each detector shall contain a visible indicator lamp that flashes when the detector is in the normal standby mode and glows continuously when the detector is activated. [Remote indicator lamp shall be provided for each detector located above ceilings, beneath raised floors, or otherwise concealed from view.] Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making wiring connections. Detector head shall be removable from its base without disconnecting wires. Removal without disconnecting any wires. Removal of detector head from its base, shall cause activation of system trouble signals. Each detector shall be screened to prevent the entrance of insects into the detection chambers.

2.6.1.1 Ionization Detectors

Multiple chamber type which is responsive to both visible and invisible products of combustion. Detectors shall not be susceptible to operation by changes in relative humidity.

2.6.1.2 Photoelectric Detectors

Operate on a multiple cell concept using a light-emitting diode (LED) light source.

2.6.2 Spot Heat Activated Detectors

Provide detectors for [surface] [flush] outlet box mounting. Support detectors independently of conduit, tubing, or wiring connections. Detectors shall be completely metal enclosed and shall be [combination fixed temperature and rate-of-rise] [fixed temperature and rate compensated] [_____] type. Contacts shall be self-resetting after [response to rate-of-rise] actuation. [Operation under fixed temperature actuation shall result in an indication which may be noted by external visual inspection of the detector, or the detector may be the self-resetting type.] Provide fixed temperature type detectors in areas subject to abnormal temperature changes. [Furnish a portable electric device suitable for testing the detectors.]

2.6.3 Detector Spacing and Location

NFPA 72, the manufacturer's recommendations, and the requirements stated herein. Spacing and location of detectors shall take into account the airflow into the room and supply diffusers. Detectors shall not be placed closer than 1.50 meters 5 feet from a discharge grill. [Spacing of detectors under raised floors shall not exceed [23.20 square meter] [250 square feet] [_____] per detector.] Detectors installed beneath raised floors shall be mounted with the detector base within 50 mm 2 inches of the underside of the raised floor framing, with the detector facing downward. Where the space under the raised floor is less than 305 mm 12 inches in height, detectors shall be mounted with their bases in the upper half of the underfloor space. Under no circumstances shall detectors be mounted facing upward.

2.7 INHIBIT SWITCH

Provide one switch where indicated. Activation of switch shall delay only time delay countdown, equipment shutdown, and agent discharge. Switch shall be guarder, spring-loaded type which operates only when pressure is manually applied to the switch. Upon release of manual pressure, switch shall deactivate allowing delayed functions to resume. After start of agent discharge, switch shall have no effect. Activation of switch during normal (non-alarm) conditions shall cause activation of system trouble signals.

2.8 ALARM SIGNALING DEVICES

Provide each protected area with audible and visual alarms located as shown. Alarm circuits shall be electrically supervised. Provide separate and distinct audible and visual pre-discharge and discharge signals. Where the building is equipped with a separate fire evacuation alarm system, the discharge signals shall also be distinct from those used by the building fire evacuation system. Each signal device shall be provided with a rigid plastic or metal identification sign with lettering a minimum of 40 mm 1.5 inches high. The pre-discharge alarm shall be labeled "FIRE" and the discharge alarm shall be labeled "CARBON DIOXIDE DISCHARGE." [Post-discharge visual alarms shall be located outside entrances to protected areas, and provided with warning signs reading "CARBON DIOXIDE DISCHARGED WHEN FLASHING - DO NOT ENTER."]

2.8.1 Alarm Bells

[Surface mounted] [Recessed], [_____] [250 mm] [10 inch] diameter with matching mounting back box. Bells shall be of the vibrating type suitable

for use in an electrically supervised circuit. Bells shall be of the underdome type and produce a sound output rating of at least 90 decibels at 3 meters 10 feet. Bells shall be finished in red enamel.

2.8.2 Alarm Horns

[Surface mounted] [Recessed], vibrating type suitable for use in an electrically supervised circuit and with a sound output rating of at least 90 decibels at 3 meters 10 feet. Horns shall be finished in red enamel.

2.8.3 Visual Alarms

[Surface] [Flush] mounted lamp assembly suitable for use in an electrically supervised circuit. Lamp shall be the flashing [stroboscopic] [incandescent] [rotary beacon] type and powered from the control panel alarm circuit. Lamps shall provide a minimum of 50 candle power. Flash rate shall be between 60 and 120 flashes per minute. Lamps shall be protected by a thermoplastic lens, red for pre-discharge alarms and blue for discharge [and post-discharge] alarms. [Visual alarms may be part of an audio-visual alarm assembly.]

2.9 MAIN ANNUNCIATOR

Annunciator shall be integral with the main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit located on the exterior of the cabinet door or visible through the cabinet door. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the [zone] [area] [device] by means of a permanent label. In no case shall zone identification consist of such words as "Zone 1," "Zone 2," but shall consist of the description of the [zone] [area] [device].

2.9.1 Annunciation Zones

Arranged as follows:

2.9.1.1 Remote Annunciator Panel

Locate as shown. Panel shall duplicate all requirements specified for the main control panel annunciator, except that in lieu of individual zone trouble lamps a single trouble lamp may be provided. Panel shall have a lamp test switch. Zone identification shall be by means of [permanently attached rigid plastic or metal plate(s)] [silk-screened labels attached to the reverse face of backlighted viewing window(s)]. Panel shall be of the [interior] [waterproof] type, [flush] [surface] [pedestal]-mounted.

2.9.1.2 Graphic Annunciator Panel

Locate as shown. Panel shall be of the [interior] [weatherproof] type, [flush] [surface] [pedestal]-mounted. Panel shall be provided with the floor plan of the protected area(s), drawn to scale, with remote alarm lamps mounted to represent the location of each alarm initiating device. Panel graphic shall also show the location of the annunciator panel and control panel, and shall have a "you are here" arrow showing its location. Orient floor plan on graphic to location of person viewing the graphic; i.e., the direction the viewer is facing shall be towards the top of the graphic display. Provide a North arrow. [Principal rooms and areas shown

shall be labeled with their room numbers or titles.] The panel location shall be shown on the floor plan. Detectors mounted on ceilings, [above ceilings,] and beneath raised floors [and different types of initiating devices] shall have different symbols or lamps of different colors for identification. Lamps shall illuminate upon actuation of their corresponding device and remain illuminated until the system is reset. Panel shall have a lamp test switch.

2.10 AUTOMATIC SMOKE-FIRE DAMPERS

****
NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02.
****

Provide automatic control of smoke-fire dampers in openings and ductwork penetrating the envelop of the protected area. Smoke-fire dampers are specified in Section [23 30 00 HVAC AIR DISTRIBUTION][_____]. Dampers shall close upon activation of second detector or upon activation of carbon dioxide manual discharge station.

2.11 SMOKE AND CARBON DIOXIDE EXHAUST SYSTEM

****
NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02.
****

Provide under Section [23 30 00 HVAC AIR DISTRIBUTION][_____] and as specified herein. Provide a key-operated ON/OFF switch with red and green indicator lights for control of exhaust fans from each protected space. Green light shall remain illuminated when exhaust system is in standby status. Green light shall extinguish and red light shall illuminate when system is operating. Provide an interlock from the carbon dioxide system to prevent operation of exhaust system during carbon dioxide system discharge and for a minimum of 10 minutes after carbon dioxide discharge. Ten minutes after carbon dioxide discharge, exhaust system shall be operable by the key switch even if smoke detectors are still in alarm mode. Locate switches outside the protected spaces.

2.12 OPERATING POWER

****
NOTE: Delete the first three sentences (in brackets) if electrical actuation systems are not specified.
****

[Obtain AC operating power to control panel and battery charger from the line side of the incoming building power source ahead of all building services] [at the location indicated]. Provide independent, properly fused safety switch, with provisions for locking the cover and operating handle in the POWER ON position for these connections, and locate adjacent to the main distribution panel. Paint switch box with red enamel and identify by a lettered designation. Provide wiring in accordance with NFPA 70. Wiring for 120-volt circuits shall be No. 12 AWG minimum. Wiring for low-voltage DC circuits shall be No. 14 AWG minimum. Wiring shall be color coded. Provide wiring in metal conduit or electrical metallic tubing.

2.13 CONDUCTOR IDENTIFICATION

Identify circuit conductors within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by plastic-coated, self-sticking printed markers or by heat-shrink type sleeves. Attach the markers to prevent accidental detachment. Identify control circuit terminations.

2.14 OPERATING INSTRUCTIONS

Provide at each remote control station. Instructions shall clearly indicate steps for system operation. The proposed legend for operating instructions shall be approved before installation. Instructions shall be embossed white letters on red rigid plastic backgrounds. Lettering shall be a minimum of 6.50 mm 0.25 inch high for operating instructions and 25 mm 1 inch high for identification of system operating devices and control valves.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 12, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.2 PIPE AND FITTINGS

Test, inspect, and approve piping before concealing. Provide fittings for direction changes in piping and for connections. Jointing compound for pipe threads shall be Teflon pipe thread paste; apply only to male threads. Provide exposed ferrous pipe threads with one coat of zinc molybdate primer applied to minimum dry film thickness of 0.025 mm 1.0 mil. Pipe nipples 150 mm 6 inches long and shorter shall be Schedule 80 steel pipe. Provide tapered-reducing pipe fittings for changes in piping size; bushings will not be permitted. Minimum pipe sizes for hose reel systems shall be 20 mm 0.75 inch.

3.3 PIPE HANGERS AND SUPPORTS

Provide additional supports for the concentrated loads in piping between hangers and supports, such as for valves. Support steel piping as follows:

MAXIMUM SPACING (METERS)									
Nominal Pipe Size (mm)	25.0 and Under	32	40	50	65	80	100	125	150

MAXIMUM SPACING (METERS)									
Steel Piping	2.10	2.40	2.75	3.00	3.40	3.70	4.30	4.60	5.20

MAXIMUM SPACING (FEET)									
Nominal Pipe Size (Inches)	1.0 and Under	1.25	1.5	2	2.5	3	4	5	6
Steel Piping	7	8	9	10	11	12	14	15	17

3.4 FIELD PAINTING

Clean, pretreat, prime, and paint new carbon dioxide fire extinguishing systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of pretreatment primer applied to a minimum dry film thickness of 0.076 mm 0.3 mil, and one coat of zinc molybdate primer applied to a minimum dry film thickness of 0.025 mm 1.0 mil. Shield operating devices with protective covering while painting is in process. Upon completion of painting, remove protective covering from operating devices. Remove devices which are painted and replace with new devices. Provide primed surfaces with the following:

3.4.1 Systems in Unfinished Areas

Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceilings are not painted or not constructed of a prefinished material. Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm 1.0 mil.

3.4.2 Systems in Other Areas

Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm 1.0 mil. Provide piping with 50 mm 2 inch wide red enamel bands or self-adhering red plastic tape bands spaced at maximum of 6 meters 20 foot intervals throughout the piping systems, except in finished areas, such as offices, the red bands may be deleted.

3.5 FIELD QUALITY CONTROL

Perform tests to determine compliance with the specified requirements in the presence of the Contracting Officer. Test, inspect, and approve piping before covering or concealing.

3.5.1 Preliminary Tests

Pneumatically test each piping system with carbon dioxide, nitrogen, or

dry air at 1034 kPa (gage) 150 psig for 2 hours with no leakage or reduction in gage pressure. Gages used shall be calibrated. Upon completion and before final acceptance of the work, test each piping system by discharging a minimum of one 34 kg 75 pound cylinder of carbon dioxide to demonstrate the reliability and proper functioning of each pressure-operated switch and the discharge of carbon dioxide gas from each system discharge nozzle. After discharge, clean wire screens at nozzles if provided. If screens or nozzles show evidence of plugging, discharge an additional cylinder with the nozzles removed. Individually test remote control stations and other components and accessories to demonstrate proper functioning. When tests have been completed and corrections made, submit a signed and dated certificate.

3.5.2 Formal Inspection and Tests

Do not submit request for formal tests and inspection until preliminary tests and corrections are complete and approved. The [_____] Division, Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve all systems before they are accepted. Submit written request for formal inspection at least [_____] [15] working days prior to the inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat the required tests as directed. Furnish carbon dioxide, instruments, appliances, equipment, and personnel for the tests.

3.6 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurement, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:

Products	Inch-Pound	Metric
Alarm Bells Diameter	10 inches	250 mm

-- End of Section --