UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 21 - FIRE SUPPRESSION

SECTION 21 21 02.00 20

CARBON DIOXIDE FIRE EXTINGUISHING (LOW PRESSURE)

11/09

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USACE / NAVFAC / AFCEC / NASA	**UFGS-21 21 02.00 20 (November 2009)**

Preparing Activity: NAVFAC	**Superseding** **UFGS-21 21 02.00 20 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 21 21 02.00 20

CARBON DIOXIDE FIRE EXTINGUISHING (LOW PRESSURE)
11/09

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NOTE: This guide specification covers the requirements for low-pressure carbon dioxide fire extinguishing systems.

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: If the total carbon dioxide system requirement, including reserves, does not exceed 908 kg 2000 pounds, design a high pressure carbon dioxide system using Section 21 21 01.00 20 CARBON DIOXIDE FIRE EXTINGUISHING (HIGH PRESSURE). System requirements must conform to UFC 3-600-01, "Fire Protection Engineering for Facilities".

****

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NOTE: If there are questions concerning system design, consult with the Engineering Field Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer.

****

****

NOTE: Project drawings should indicate the following information:

1. Locations of refrigerated storage tank, hose reels, control stations, control panels, storage batteries, battery chargers, and associated connections.

2. The arrangement and location of additional zone selector valves for total flooding and local application systems.

****

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.

****

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	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) 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	(2022) Standard on Carbon Dioxide Extinguishing Systems
NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-2962	(Rev A; Notice 2) Enamel, Alkyd, Gloss, Low VOC Content
FS TT-P-645	(Rev C; Notice 1) Primer, Paint, Zinc-Molybdate, Alkyd Type

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 [RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

]1.3 DEFINITIONS

a. Installer: The installer of the low-pressure carbon dioxide fire extinguishing system; either the Contractor or the subcontractor proposed by the Contractor to perform the work and with whom the Contractor has a firm contractual agreement.

1.4 SYSTEM DESCRIPTION

****

NOTE: Identify the rooms, spaces, or areas, as appropriate, which are to be protected by each type of system. Refer to MIL-HDBK-1008A for guidance.

****

Design and [provide new] [and] [modify existing] low-pressure carbon dioxide [hose reel fire extinguishing systems for protection of [_____]] [and] [[underfloor] [and] [total flooding] [and] [local application] fire extinguishing systems for protection of [_____]]. Design, equipment, materials, installation, workmanship, examination, inspection, and testing shall be in accordance with 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 necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and other construction and equipment in accordance with the approved submitted drawings.

1.4.1 Piping Layout

Submit drawings on sheets not smaller than A0 1189 by 841 mm 30 by 42 inches, in accordance with the requirements for "Working Drawings (Plans)" as specified in NFPA 12, and include data essential for proper installation of each system. Submit drawings showing detail plan view including elevations and sections of the system supply and piping. Show piping schematic of system supply, devices, valves, pipe and fittings. [Show point-to-point electrical wiring diagrams.] Include general layout and arrangement of the system in plan and elevation view of tank and a typical hose reel.

1.4.2 Fire Extinguishing System Calculations

Submit fire extinguishing system calculations including substantiating battery capacity calculations. Show compliance of open-area (spot type) smoke detectors with specified power consumption limitation requirements.

1.4.3 As-Built Record Drawings

After completion, but before final acceptance of the work, submit a complete set of as-built (record) drawings of each system for record purposes. Drawings shall be not smaller than A0 1189 by 841 mm 30 by 42 inches reproducible drawings on mylar film with title block (200 by 100 mm 8 by 4 inches) similar to full-size contract drawings. Submit the as-built (record) working drawings in addition to the as-built contract drawings required by Division 1, "General Requirements."

1.5 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 fire protection engineer, [_____] Division, Naval Facilities Engineering Systems Command will review any approve all submittals in this section requiring Government approval.]

****

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

****

[The [_____] Division, Naval Facilities Engineering Systems 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 Systems 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

Refrigerated Storage Tank; G[, [_____]]

Valves; G[, [_____]]

Alarm Bells; G[, [_____]]

Pressure Relief Devices; G[, [_____]]

Hose Reels and Hose; G[, [_____]]

Discharge Nozzles; G[, [_____]]

Pipe and Fittings; G[, [_____]]

Pipe Hangers and Supports; G[, [_____]]

Actuating Station; G[, [_____]]

Pressure Switches; G[, [_____]]

Control Panel; G[, [_____]]

Storage Batteries; G[, [_____]]

Smoke Detectors; G[, [_____]]

Spot Heat Detectors; G[, [_____]]

Alarm Horns; G[, [_____]]

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

Dampers; G[, [_____]]

Warning Signs; G[, [_____]]

Battery Charger; G[, [_____]]

For valves, include data for tank shut-off valve, master valve, selector valves, and by-pass valves. Data shall clearly indicate compatibility of detectors with control panel provided and maximum number of detectors permitted per zone.

SD-05 Design Data

Fire Extinguishing System Calculations; G[, [_____]]

Substantiating Battery Capacity Calculations; G[, [_____]]

Open-area (Spot Type) Smoke Detectors Calculations; G[, [_____]]

SD-06 Test Reports

[Open-area (Spot Type) Smoke Detectors; G[, [_____]]

Submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use.]

Fire Extinguishing System Preliminary Tests; G[, [_____]]

SD-07 Certificates

Parts Reliability; G[, [_____]]

Installer Qualifications; G[, [_____]]

Test Procedures; G[, [_____]]

Installation Personnel; G[, [_____]]

Current UL Listings or FM Approvals; G[, [_____]]

Contractor's Material and Test Certificate; G[, [_____]]

Pipe and Fittings; G[, [_____]]

SD-10 Operation and Maintenance Data

Refrigerated Storage Tank, Data Package 3; G[, [_____]]

Hose Reels, Data Package 3; G[, [_____]]

Discharge Nozzles, Data Package 2; G[, [_____]]

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

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit copies of the manual after approval of drawings, prior to training course, and [_____] calendar days prior to date of beneficial occupancy.

SD-11 Closeout Submittals

Actuating Station Operating Instructions Legend; G[, [_____]]

As-built Record Drawings; G[, [_____]]

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

1.6.1.1 Installer Qualifications

Prior to installation, submit evidence including system type and design showing that installer has successfully installed at least two low-pressure carbon dioxide fire extinguishing systems conforming to the requirements of NFPA and of the same type and design specified herein. Include names and locations of the installations and written certification from the users that the systems have performed satisfactorily for a period of not less than 18 months.

****

NOTE: For projects administered by the Pacific Division, Naval Facilities Engineering Systems 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.]

1.6.1.2 Carbon Dioxide System Technician or Engineer

Make installation, adjustments, and tests under the supervision of a technician or engineer retained by the Contractor who is qualified with at least 2 years experience in the installation and operation of low-pressure carbon dioxide fire extinguishing systems of the type specified.

1.6.2 Parts Reliability

Certify that materials and equipment furnished are identical to items that have been in satisfactory use for at least two years prior to bid opening.

1.6.3 Test Procedures

Submit detailed test procedures for the low-pressure carbon dioxide fire extinguishing system [60] [_____] calendar days prior to performing system tests.

1.6.4 Installation Personnel

Submit names of personnel who will supervise installation and testing of system, and who will instruct government personnel. Submit manufacturer's certification of named individuals' qualifications.

1.6.5 UL Listings or FM Approvals

Submit copies of current UL listings or FM approvals for the system in configurations offered.

1.6.6 Fire Extinguishing System Preliminary Tests

After successfully completing final acceptance tests and making corrections, submit test results in booklet form showing field tests performed were in compliance with specified performance criteria. Submit certificates for preliminary tests on piping system.

1.6.7 Contractor's Material and Test Certificate

Submit certificate.

1.6.8 Regulatory Requirements

Materials and equipment for carbon dioxide fire protection system shall be listed by UL Fire Prot Dir, or approved by FM APP GUIDE. Provide current materials and equipment manufacturer regularly engaged in production of such equipment [and essentially duplicate items that have been in satisfactory use for at least 2 years] prior to bid opening.

1.6.9 Modification of References

In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the [_____] Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

Store and protect equipment from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.8 [EXISTING CONDITIONS

Existing system was manufactured by [_____], and new equipment shall be compatible with and not reduce existing system operations and reliability.

]1.9 MAINTENANCE

1.9.1 Special Tools

Furnish to the Contracting Officer, suitable special tools required for maintenance of equipment, and a metal tool box for said special tools.

1.9.2 Spare Parts

****
NOTE: Delete equipment which is not applicable.
****

a. Two of each type detector installed;

b. One of each type of audible [and] [or] visual alarm device installed;

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

d. Five complete sets of system keys.

PART 2 PRODUCTS

2.1 CARBON DIOXIDE FIRE EXTINGUISHING SYSTEMS

NFPA 12, except as modified herein.

2.1.1 Carbon Dioxide Discharge Rates

Calculate for each system as follows:

2.1.1.1 Hand Hose Reel Stations

****
NOTE: Omit if hose stations are not to be provided.
****

Discharge rate from each station nozzle shall be 0.76 kg 100 poundsof carbon dioxide per second minute. Supply stations through a single master control valve from the refrigerated storage tank, so that actuation of any station shall cause carbon dioxide to be available to all stations simultaneously.

2.1.1.2 Underfloor Flooding Systems

****
NOTE: If there is more than one underfloor area (separated from other underfloor spaces by essentially gas-tight partitions) which requires protection, they must be listed as separate areas and each such area delineated by reference to room numbers, space designations, or zones. Where practicable, such zones should also be delineated on the drawings. Omit if total flooding system for underfloor areas is not to be provided.
****

Provide uniform discharge to each raised floor space to achieve a concentration of 0.45 kg 1.0 pound of carbon dioxide for each [0.28 cubic meter10 cubic feet of underfloor volume in one minute for underfloor volumes of 56.60 cubic meter 2000 cubic feet or less] [and] [0.34 cubic meter 12 cubic feet of underfloor volume in one minute for underfloor volumes greater than 56.60 cubic meter 2000 cubic feet, except that minimum supply of carbon dioxide shall be 91 kg 200 pounds]. [Divide the systems into [_____] separate areas. Supply each area with carbon dioxide through a separate selector valve from the storage tank, so that activation of the system in one area shall not cause discharge of carbon dioxide into another area. Area No. 1 shall consist of [_____]. Area No. 2 shall consist of [_____].]

2.1.1.3 Room Total Flooding Systems

****
NOTE: For total flooding of rooms and spaces such as generator rooms, flammable liquid storage rooms, rare document vaults, etc., use this paragraph. Calculating flooding factor IAW NFPA 12. Whenever possible, provide for automatic closing of openings and shutting down ventilation systems prior to start of agent discharge. When this cannot be done, identify size of openings and capacity of ventilation systems accordingly.
****

Provide uniform discharge to each space to achieve a flooding factor of one pound of carbon dioxide for each [_____] cubic meter feet in one minute [except that minimum supply of carbon dioxide shall be 91 kg 200 pounds]. [Provide additional carbon dioxide discharge as required by NFPA 12 to compensate for [openings that cannot be closed] [and] [ventilating systems that cannot be shut down] [and high ambient

temperatures of [_____] degrees C F] [low ambient temperatures of [_____] degrees C F].]

2.1.1.4 Local Application Systems

****
NOTE: Use this paragraph for dip tanks, quench tanks, and similar hazards that cannot be total flooded because they are not enclosable. Follow NFPA 12 for design requirements.
****

Provide local application of carbon dioxide for the protection of [_____]. Calculate quantity of carbon dioxide required for local application in accordance with NFPA 12. Base calculations on the total rate of discharge needed to blanket the [area] [or] [volume] protected, and the time that discharge must be maintained to ensure complete extinguishment. Minimum discharge time shall be [30 seconds] [[_____] minute(s)]. Base calculations on the [rate by area method for flat surfaces] [and] [rate by volume method for three-dimensional hazards].

2.1.2 Systems Supply

****
NOTE: Supply shall include sufficient carbon dioxide to meet requirements for the largest hazard, calculated IAW NFPA 12, plus 91 kg 200 pounds for hose reels (if provided), plus 100 percent reserve. If the total requirement, including reserve, does not exceed 908 kg 2000 pounds, use a high pressure system. If the hose reels are located remote from the other hazards, it may be more economical to supply the hose reels from separate high pressure storage near the hose station. Calculate size of tank to determine the area required for its installation. Final sizing of tank shall be done by the Contractor's system calculations.
****

Provide an approved low-pressure (2068 kPa (gage) 300 psig) refrigerated carbon dioxide storage tank, complete with full charge of carbon dioxide, and necessary components and appurtenances. Calculate size of tank to include sufficient carbon dioxide for the hazard requiring the largest volume of carbon dioxide [plus 136 kg 300 pounds for hose reels], plus 100 percent reserve supply. In the event this calculated amount falls between available sizes of tanks, provide next largest tank. Supply [underfloor] [and] [room total] flooding systems [and] [local application systems] [and] [hand hose reel stations] from this tank.

2.2 PIPE AND FITTINGS

2.2.1 Pipe

Hot-dipped galvanized, threaded end connections; Schedule 80 for continuous pressure piping between storage tank and selector valves, [and between selector valves and hand hose stations] and Schedule 40 for piping not under continuous pressure.

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

or Type S (seamless, Grades A or B).

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

2.2.2 Threaded Fittings

ASME B16.11, hot-dipped galvanized, for continuous pressure pipe fittings between storage tank and selector valves, [and between selector valves and hand hose stations] and ASME B16.3, Class 150, hot-dipped galvanized, for pipe fittings not under continuous pressure.

2.3 PIPING ACCESSORIES

2.3.1 Escutcheon Plates

Provide one piece or split hinge type metal plates for piping passing through 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.

2.3.2 Pipe Sleeves

Where piping passes entirely through walls, ceilings, roofs, floors, and partitions, provide sleeves of sufficient length to pass through the entire thickness. Secure sleeves in proper position and location. [Provide [not less than 6.50 mm 0.25 inch space between exterior of piping and interior of sleeve or drilled holes.] [25 mm one inch minimum clearance between exterior of piping and interior of sleeve or drilled holes and firmly pack space with mineral wool insulation.] Caulk both ends of sleeve or drilled holes with plastic waterproof cement which will dry to a firm but pliable mass; or provide a segmented elastomeric seal.] [Provide 25 mm one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole and caulk both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or use a segmented elastomeric seal.] In fire walls and fire floors, caulk both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.3.2.1 Sleeves Through Masonry and Concrete

Provide ASTM A53/A53M Schedule 40 or Standard Weight, hot-dipped zinc coated steel pipe sleeves. Extend sleeves in floor slabs 76 mm 3 inches above the finished floor. When cavities in core-drilled holes are completely grouted smooth, sleeves may be omitted.

2.3.2.2 Sleeves Through Other Than Masonry and Concrete

Provide hot-dipped galvanized steel sheet having a nominal weight of not less than 4.40 kg per sq meter 0.90 pounds per square foot.

2.3.3 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1, of the adjustable type, except as modified herein or indicated otherwise. Use Type 21, 28, 29, or 30 clamps for attachments to steel W or S beams. Use Type 20 clamp with a beam clamp channel adaptor for attachments to steel angles and channels (with web vertical). Use drilled holes on centerline and double nut and washer

for attachments to steel channel (with web horizontal). Use Type 18 insert or a drilled hole with expansion anchor for attachments to concrete. Attachments to wood shall be as indicated. Hanger rods and attachments shall be full size of the hanger threaded diameter. Provide steel support rods.

2.4 PRESSURE RELIEF DEVICES

Provide each section of closed piping with an approved pressure relief device designed to operate at 3102 kPa (gage) 450 psig.

2.5 HAND HOSE REEL STATIONS

****
NOTE: Omit if hose stations are not to be provided.
****

Provide each station complete including [15] [23] meters of 20 mm [50] [75] feet of 0.75 inch high-pressure hose, hose reels, squeeze-type quick-opening valve, discharge nozzle, and horn. Securely mount hose reels on walls. Provide each hose reels and hose station with a device to secure discharge nozzle to wall when not in use.

2.5.1 Stop Valves

Provide manually operated, quick-opening, lever-type stop valves. Locate valves approximately 1.50 meters 5 feet above floor.

2.5.2 Discharge Nozzles

****
NOTE: Omit if hose stations are not to be provided.
****

Provide each station discharge nozzle with a standard orifice of the size determined by the flow calculations for the individual hose station. Provide each discharge nozzle with the standard orifice code number, reflecting the orifice size in accordance with NFPA 12.

2.6 SYSTEM CONTROL

Provide apparatus, accessories, components, and associated materials specified or required. Provide [automatic] [and] [manual] electric type of actuating control system complete and ready for operation. Provide complete "Class A" electrically supervised, combination, automatic, and manual detection system. Achieve automatic actuation by [smoke] [and] [or] [heat] detectors. Do not use break-glass-front manual stations. Manual stations incorporating a hinged cover face with a glass view window, in which the cover must be pulled open prior to actuating the station, are acceptable. Provide guarded-front stations.

2.6.1 Control Station for Hose Reel

****
NOTE: Omit if hose stations are not to be provided.
****

Provide single push-button momentary contact station adjacent to each hose reel. Depressing the button shall cause carbon dioxide to flow from the

storage tank, through the hose reel station system selector valve, to all hose reel stations installed on the system for a period of one minute. At the completion of the one minute discharge, the system shall automatically recycle and again be ready for actuation.

2.6.2 Control Station for Flooding System(s)

****

NOTE: Omit if total flooding system, underfloor flooding or local application systems are not to be provided. Locate stations at or near exits from the protected areas. Provide separate stations for each hazard.

****

Provide single push-button momentary contact stations for [underfloor] [and] [total] flooding [and] [local application] system(s). Operation of any station shall cause carbon dioxide to flow from the storage tank, through the selector valve associated with the area which the station protects, and discharge into the protected area for a period of one minute. [For local application systems, discharge time shall be [30 seconds] [[_____] minute(s)].] At the completion of the timed discharge, the system shall automatically recycle and again be ready for actuation.

2.6.3 Sequence of Operation

Smoke detection system shall be [cross-zoned] [or priority matrix]. 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), systems shall immediately shut down [computer] [_____] equipment and air conditioning power, close fire dampers [and fire doors] [and windows], activate discharge alarms, and initiate an adjustable zero to 60 second discharge time delay. At end of time delay, [computer power shall shut down, and] carbon dioxide shall discharge into protected area [, and post discharge visual alarms shall activate].

2.6.4 Pressure-Operated Fire Alarm Switch

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

2.6.5 Pressure-Operated Equipment Switch

****

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

****

For each protected space, provide pressure switches to automatically shut down the air handling equipment [and close dampers] [and close room doors [and windows]] upon the discharge of carbon dioxide.

2.6.6 Control Panel

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

Provide complete electrical supervision of control circuitry. Provide modular type panel in a [flush] [surface] mounted steel cabinet with hinged door and cylinder lock. Ensure control panel is a neat, compact, factory-wired assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Loss of ac power or a ground fault condition which prevents the required operation of the system or a single break in a control circuit shall result in the activation of a system trouble bell. Trouble bell shall sound continuously until the system has been restored to normal at the control panel. Provide a silencing switch, which transfers trouble signals to an indicating lamp, in accordance with requirements of NFPA 72. In addition to the normal system trouble bell, provide a remote 100 mm 4 inch system trouble bell with a rigid plastic or metal identification sign with the words "CARBON DIOXIDE SYSTEM TROUBLE." Provide lettering on identification sign which is at least 25 mm one inch high. System control panel shall be UL listed or FM approved for use in fire protection extinguishing system control (releasing device service). Provide a supervised isolation switch to permit testing or servicing of electrical control system without discharging carbon dioxide system.

2.6.6.1 Trouble Signals

A single open or ground fault condition in detection (initiating) circuit shall not result in loss of system function, but shall cause actuation of system trouble signals. A ground fault condition or single break in an other circuit shall result in activation of 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 associated mechanical equipment to shut down.] Loss of ac power, a break in standby battery power circuits, or abnormal ac power or low battery voltage shall result in operation of system trouble signals. The abnormal position of a system switch in the control panel shall result in operation of system trouble signals. Trouble signals shall operate continuously until system has been restored to normal at the control panel.

2.6.6.2 Panel Switches

Provide panel with the following switches:

a. Trouble silencing switch which transfers trouble signals to an indicating lamp. Upon correction of trouble condition, audible signals shall again sound until switch is returned to normal position, or trouble circuit shall be automatically restored to normal upon correction of trouble condition. Silencing switch of a momentary action, self-resetting type is acceptable.

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 system to normal standby status after correcting cause of alarm.

e. Lamp test switch.

f. Isolation switch to permit testing or servicing of electrical control system without discharging carbon dioxide.

2.6.7 Secondary Power Supply

Provide nickel cadmium, lead calcium, or sealed lead acid batteries and charger. Do not use dry cell batteries. Provide steel cabinet with cylinder lock for batteries.

2.6.7.1 Storage Batteries

Provide batteries of proper ampere-hour rating to operate system under supervisory conditions for [60] [24] hours, discharging carbon dioxide at the end of that period, and then operating system under 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.

2.6.7.2 Battery Charger

Provide automatic high and low charging rate type charger, capable of recovering batteries from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge. Provide red pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly when high-rate switch is provided.

2.7 DETECTOR

2.7.1 Open-Area (Spot-Type) Smoke Detectors

Design for detection of abnormal smoke densities by the [ionization] [or] [photoelectric] principle. Provide control and power modules required for operation integral with main control panel. Ensure detectors and associated modules are compatible with main control panel and suitable for use in a supervised circuit. [Provide 4-wire detector circuits whereby detector operating power is transmitted over conductors separate from initiating circuit.] [As an alternate, provide 2-wire detector circuits whereby detector operating power is transmitted over initiating circuits when:

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

b. Detectors are UL listed or FM approved as being compatible with control panel.]

When 2-wire detectors are provided, total number of detectors on a detection circuit shall not exceed 80 percent of maximum number of detectors allowed by control panel manufacturer for that circuit and

standby current draw of entire system shall not exceed 80 percent of the rated output of the system power supply modules. [Provide additional zones above those specified in paragraph entitled "Annunciation Zones" when required to meet the above requirements.] Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Ensure each detector contains a visible indicator lamp that flashes when the detector is in the normal standby mode and glows continuously when the detector is activated. [Provide remote indicator lamp for each detector located above ceilings, beneath raised floors, or otherwise concealed from view.] Use plug-in detectors with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making wiring connections. Ensure detector head can be removed from its base without disconnecting wires. Removal of detector head from its base, shall cause activation of system trouble signals. Provide a factory installed screen for each detector to prevent the entrance of insects into the detection chambers.

2.7.1.1 Ionization Detectors

Use multiple chamber detectors responsive to both visible and invisible products of combustion. Ensure detectors are not susceptible to operation by changes in relative humidity.

2.7.1.2 Photoelectric Detectors

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

2.7.2 Spot Heat Detectors

Provide detectors for [surface] [flush] outlet box mounting. Support detectors independently of conduit, tubing, or wiring connections. Use completely metal-enclosed, [combination fixed temperature and rate-of-rise] [fixed temperature and rate compensated] [_____] type detectors. 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 shall 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 detectors.]

2.7.3 Detector Spacing and Location

NFPA 72, manufacturer's recommendations, and requirements stated herein. Spacing and location of detectors shall take into account airflow into room and supply diffusers. Do not place detectors within 1.50 meters 5 feet of discharge grilles. [Spacing of detectors under raised floors shall not exceed [23.25 square meter] [250 square feet] [_____] per detector.] Mount detectors installed beneath raised floors with detector base within 50 mm 2 inches of underside of raised floor framing, and with detector facing downward. Where space under raised floor is less than 305 mm 12 inches in height, mount detectors with their bases in upper half of underfloor space. Do not mount detectors facing upward under any circumstances.

2.8 INHIBIT SWITCH

****
NOTE: Do not use for Navy projects.
****

Provide one switch where indicated. Activation of switch shall delay only time delay countdown, equipment shutdown, and agent discharge. Switch shall be guarded, spring-loaded type which operates only when manually applying pressure to 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.

2.9 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 building is equipped with a separate fire evacuation alarm system, discharge signals shall 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. Pre-discharge alarm shall be labeled "FIRE" and discharge alarm shall be labeled "CARBON DIOXIDE DISCHARGE." [Locate post-discharge visual alarms outside entrances to protected areas, and provide with warning signs reading "CARBON DIOXIDE DISCHARGED WHEN FLASHING - DO NOT ENTER."]

2.9.1 Alarm Bells

[Surface mounted] [Recessed], [250 mm] [10 inch] [_____] diameter with matching mounting back box. Provide vibrating type bells suitable for use in an electrically supervised circuit. Provide underdome type bells which produce a sound output rating of at least 87 decibels at 3 meters 10 feet. Finish bells in red enamel.

2.9.2 Alarm Horns

[Surface Mounted] [Recessed], vibrating type suitable for use in an electrically supervised circuit and with a sound output rating of at least 87 decibels at 3 meters 10 feet. Finish horns in red enamel.

2.9.3 Visual Alarms

[Surface] [Flush] mounted lamp assembly suitable for use in an electrically supervised circuit. Provide flashing [stroboscopic] [incandescent] [rotary beacon] lamps, powered from the control panel alarm circuit. Use lamps with a minimum of 50 candle power. Ensure flash rate is between 60 and 120 flashes per minute. Protect lamps with a thermo-plastic 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.]

2.10 MAIN ANNUNCIATOR

Provide annunciator which is integral with main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit

located on exterior of cabinet door or visible through cabinet door. Supervision will not be required provided a fault in annunciator circuits results only in loss of annunciation and not affect normal functional operation of remainder of system. Identify the specific [zone] [area] [device] of each lamp by means of a permanent label. Do not use zone identification consisting of such words as "Zone 1," "Zone 2;" use a description of [zone] [area] [device].

2.10.1 Annunciation Zones

Arranged as follows:

Zone 1: [_____]

Zone 2: [_____]

Zone 3: [_____]

Zone X: [_____]

2.10.1.1 Remote Annunciator Panel

Locate as shown. Provide panel which duplicates requirements specified for main control panel annunciator, except that in lieu of individual zone trouble lamps a single trouble lamp may be provided. Provide panel with a lamp test switch. Identify zones by means of [permanently attached rigid plastic or metal plates] [silk-screened labels attached to reverse face of backlighted viewing windows]. Provide [interior] [waterproof] panel, [flush] [surface] [pedestal-mounted].

2.10.1.2 Graphic Annunciator Panel

****

NOTE: Use graphic panels only for complex building layouts and where building floor plan is not expected to change often.

****

Locate as shown. Provide [interior] [weatherproof] panel, [flush] [surface] [pedestal-mounted]. Provide panel with a panel graphic, showing floor plan of protected areas, drawn to scale, with remote alarm lamps mounted to represent location of each alarm initiating device. On panel graphic, show location of annunciator panel and control panel, and include a "you are here" arrow showing location of panel. Orient floor plan on graphic to location of person viewing the graphic, that is, the direction the viewer is facing shall be towards the top of the graphic display. Provide a North arrow. [Label principal rooms and areas shown with room numbers or titles.] Show panel location on floor plan. Use different symbols or lamps of different colors for identification of detectors mounted on ceilings, [above ceilings,] and beneath raised floors [and for identification of different types of initiating devices]. Lamps shall illuminate upon actuation of their corresponding device and remain illuminated until system is reset. Provide panel with a lamp test switch.

2.11 AUTOMATIC SMOKE-FIRE DAMPERS

Provide automatic control of smoke-fire dampers in openings and ductwork penetrating the envelope of the protected area. Smoke-fire dampers are specified in Section 23 30 00 HVAC AIR DISTRIBUTION. Dampers shall close

in sequence specified in paragraph entitled "Sequence of Operation."

2.12 SMOKE AND CARBON DIOXIDE EXHAUST SYSTEM

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][20] minutes after carbon dioxide discharge. [Ten][Twenty] minutes after carbon dioxide discharge, exhaust system shall be operable by the key switch even when smoke detectors are still in alarm mode. Locate switches outside protected spaces.

2.13 OPERATING POWER

[Obtain ac operating power to control panel and battery charger from line side of incoming building power source ahead of all building services [at location indicated]. Provide independent, properly fused safety switches, 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. Finish switch boxes 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.

2.14 CONDUCTOR IDENTIFICATION

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

2.15 OPERATING INSTRUCTIONS

Provide operating instructions at each remote actuating station. Clearly indicate steps for system operation in instructions. Use raised or embossed white letters on red rigid plastic or enameled steel backgrounds. Use lettering at least 6 mm 1/4 inch high.

2.15.1 Identification Signs

Provide identification signs for system operating devices and control valves. Provide signs of three-layer composition having a red face and engraved 25 mm one inch minimum white letters.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of discrepancies before performing the work.

3.2 INSTALLATION

Install piping straight and true to bear evenly on hangers and supports. Keep 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.

3.2.1 Electrical

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control [and fire alarm] wiring.[Fire alarm system is specified in 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.

3.2.2 Pipe and Fittings

Inspect, test, and approve piping before concealing. Provide fittings for direction changes in piping and for connections. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only to male threads. Provide exposed ferrous pipe threads with one coat of FS TT-P-645primer applied to a minimum dry film thickness of 0.025 mm 1.0 mil. Use Schedule 80 steel pipe, hot-dipped galvanized for pipe nipples 150 mm 6 inches long and shorter. Provide tapered-reducing pipe fittings for changes in piping size; bushings will not be permitted. Minimum nominal pipe size for hose and systems shall be 20 mm 0.75 inch.

3.2.3 Pipe Hangers and Supports

Provide additional supports for the concentrated loads in piping between pipe 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
Steel Piping	2.13	2.44	2.75	3.05	3.35	3.66	4.27	4.57	5.18

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	16	17

3.3 FIELD PAINTING

****
NOTE: Coordinate Section 09 90 00, PAINTS AND COATINGS with this paragraph.
****

Clean, pretreat, prime, and paint new carbon dioxide fire extinguishing systems including valves, piping, conduit, hangers, 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 metal surfaces with one coat of FS TT-P-645 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:

3.3.1 Systems in Unfinished Areas

Unfinished areas are defined as attic spaces, mechanical rooms, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. Provide primed surfaces with one coat of CID A-A-2962 red enamel applied to a minimum dry film thickness of 0.025 mm 1.0 mil.

3.3.2 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 CID A-A-2962 red 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, red bands may be deleted].

3.4 CORROSION AND FUNGUS PREVENTION

Protect metallic materials against corrosion. Coat outdoor equipment with a rust inhibiting treatment and standard finish by the manufacturer. Do not use aluminum in contact with the earth. Protect dissimilar metals with approved fittings and treatment. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a single layer of a pressure sensitive plastic tape, half-lapped. Protect components against corrosion and fungus.

3.5 FIELD QUALITY CONTROL

Perform tests to determine conformance with specified requirements in the

presence of the Contracting Officer.

3.5.1 Tests During Installation

Pneumatically test each piping system at 1034 kPa (gage) 150 psigfor a 2-hour period with no leakage or reduction in gage pressure. Gages shall be calibrated. Upon completion and before final acceptance of the work, test each piping system by discharging a minimum of 45.40 kg 100 pounds of carbon dioxide to demonstrate reliability and proper functioning of pressure-operated switches and discharge of carbon dioxide gas from each system discharge nozzle. After discharge, clean wire screens at nozzles, when provided. When screens or nozzles show evidence of plugging, discharge and additional 45.40 kg 100 pounds with the nozzles removed. Individually test remote control stations and other components and accessories to demonstrate proper functioning. Correct deficiencies prior to formal functional and operating tests of the system. Furnish carbon dioxide required for tests.

3.5.2 Final Performance and Acceptance Tests

After the system has been in service for at least 30 calendar days, notify the [_____] Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer, in writing that the system is ready for final acceptance tests. Furnish notification at least 15 calendar days prior to the date of the final acceptance test. Consider the system ready for testing after necessary preliminary tests have been made and deficiencies have been corrected to the satisfaction of the equipment manufacturer's technical representative and the [_____] Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer. An experienced technician regularly employed by the system installer shall be present during the inspection.

3.5.2.1 Acceptance Testing

Furnish proposed test procedures for approval at least 60 calendar days prior to commencement of acceptance testing. Perform the tests in the presence of the [Corps of Engineers, Contracting Officer] [[_____] Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer], or authorized representative under the supervision of the carbon dioxide system manufacturer's qualified representative. Furnish instruments, labor, and materials required for the tests. Arrange for the technician who supervised the installation to conduct the tests. Correct deficiencies found and retest the system. Repeat tests specified in paragraph entitled "Tests During Installation" as directed by the [Corps of Engineers, Contracting Officer] [[_____] Division, Naval Facilities Engineering Systems Command, Fire Protection Engineer], during final acceptance tests. Submit copies of performance test reports in accordance with paragraph entitled "Field Test Reports." [After successful completion of tests, refill storage tank with carbon dioxide.]

3.5.3 Additional Tests

When deficiencies, defects, or malfunctions develop during required tests, suspend further testing of system until proper adjustments, corrections, or revisions have been made to ensure proper performance of system. When these revisions require more than a nominal delay, notify the Contracting Officer when the additional work has been completed to arrange a new inspection and test of the low-pressure carbon dioxide fire extinguishing system. Repeat tests required prior to final acceptance, unless directed

otherwise.

3.5.4 Manufacturer's Field Services

3.5.4.1 Manufacturer's Representative

Furnish services of a qualified manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided to supervise testing, including final testing, and system adjustment.

3.5.4.2 Instructions of Government Personnel

Conduct a training course for operating staff as designated by the Contracting Officer. Training period shall consist of no less than one 8-hour working day, and shall start after system is functionally completed but prior to final acceptance tests. Field instructions shall cover items contained in the operating and maintenance instructions.

3.6 [CONTINUITY OF PROTECTION

During installation of system, there shall be no loss of function of the existing building carbon dioxide system. Temporary interruption in operability of the existing system, not to exceed 8 hours duration, may be permitted at the discretion of the Contracting Officer.]

3.7 SCHEDULE

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

Products	Inch-Pound	Metric
a. Hand Hose Reel Stations Nozzle Discharge Rate	100 #/min	0.76 kg/sec
b. Carbon Dioxide Storage Tank Working Pressure	300 psig	2068 kPa (gage)
c. Alarm Bells Diameter	10 inches	250 mm
d. Pressure Relief Devices Rated Pressure	450 psig	3102 kPa (gage)

-- End of Section --