Preparing Activity: NASA Superseding
UFGS-21 22 00.00 40 (May 2013)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 22 00.00 40

CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

05/16

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 QUALITY CONTROL
1.3.1 Special Hazards Suppression Systems
1.3.2 Previous Product Installation
1.3.3 Predictive Testing And Inspection Technology Requirements

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION
2.1.1 Installation Drawings
2.1.2 Design Requirements
2.1.3 Equipment Approval
2.1.4 Performance Requirements
2.2 EQUIPMENT
2.3 COMPONENTS
2.3.1 Piping
2.3.1.1 Pipe Hangers And Supports
2.3.1.2 Pipe Sleeves
2.3.2 Escutcheons
2.3.3 Supervisory Switch
2.3.3.1 Low Pressure Alarm Switch
2.3.4 Control Panel
2.3.4.1 Secondary Power Supply
2.3.4.1.1 Storage Batteries
2.3.4.1.2 Battery Charger
2.3.5 Manual Actuation Stations
2.3.6 Smoke Detectors
2.3.6.1 Ionization Detectors
2.3.6.2 Photoelectric Detectors
2.3.6.3 Detector Spacing and Location
2.3.7 Inhibit Switch

2.3.8 Alarm Signaling Devices
2.3.8.1 Audible Alarms
2.3.8.2 Visual Alarms
2.3.9 Main Annunciator
2.3.9.1 Annunciation Zones
2.3.9.2 Annunciator Panels
2.3.10 Automatic Fire Dampers
2.3.11 Electromagnetic Door Holder Release
2.4 ACCESSORIES
2.4.1 Electrical Work
2.4.1.1 Wiring
2.4.1.2 Operating Power
2.4.1.3 Conductor Identification

PART 3 EXECUTION

3.1 INSTALLATION
3.1.1 Warning Signs
3.1.1.1 Inside Control Room
3.1.1.2 Protected Space
3.1.1.3 Manual Activation or Release Station
3.1.2 System Control
3.1.2.1 Controls
3.1.2.2 Suppression System Safing/Disconnect Switch
3.1.3 Electrical Work
3.1.4 Operating Instructions
3.1.5 Field Painting
3.2 FIELD QUALITY CONTROL
3.2.1 Manufacturer's Field Service
3.2.2 Test Procedure
3.2.3 Preliminary Tests
3.2.4 Formal Tests
3.3 CLOSEOUT ACTIVITIES
3.3.1 Record Drawings

-- End of Section Table of Contents --

Preparing Activity: NASA

Superseding
UFGS-21 22 00.00 40 (May 2013)

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References are in agreement with UMRL dated July 2023

SECTION 21 22 00.00 40

CLEAN AGENT FIRE EXTINGUISHING SYSTEMS
05/16

NOTE: This guide specification covers the requirements for clean agent 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).

PART 1 GENERAL

NOTE: Edit this specification section as either a performance-designed system or a fully designed system as applicable.

Highlight all concealed spaces on the drawings that require protection, such as spaces above suspended ceilings.

A fully designed system includes all additional information that is required by NFPA 2001 for a fully operational system.

Select the appropriate Division 28 Fire Detection and Alarm section to address the project

requirements.
****

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 are automatically 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.

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD-5008	(2011b; R 2016; E 2016; Change 1) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment
RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 2001	(2022) Standard on Clean Agent Fire Extinguishing Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 536	(2021) UL Standard for Safety Flexible Metallic Hose
UL 2127	(2017, Reprint Nov 2021) UL Standard for Safety Inert Gas Clean Agent Extinguishing System Units
UL 2166	(2017; Reprint Dec 2021) UL Standard for Safety Halocarbon Clean Agent Extinguishing System Units

1.2 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:

SD-01 Preconstruction Submittals

Previous Product Installation; G[, [____]]

SD-02 Shop Drawings

High-Pressure Cylinders; G[, [____]]

Piping Materials; G[, [____]]

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

Pressure Alarm Switch; G[, [____]]

Nozzle; G[, [____]]

Manual Actuation Station[s]; G[, [____]]

Installation Drawings; G[, [____]]

SD-03 Product Data

Escutcheons; G[, [____]]

Storage Batteries; G[, [____]]

Battery Charger; G[, [____]]

Smoke Detectors; G[, [____]]

Audible Alarms; G[, [____]]

Visual Alarms; G[, [____]]

Annunciator Panels; G[, [____]]

Electromagnetic Door Holder Release; G[, [____]]

Pressure-Relief Device; G[, [____]]

SD-05 Design Data

Design Analysis; G[, [____]]

Discharge Calculations; G[, [____]]

SD-06 Test Reports

Test Procedure; G[, [____]]

Preliminary Tests; G[, [____]]

Formal Tests; G[, [____]]

SD-07 Certificates

Certificates of Compliance

SD-10 Operation and Maintenance Data

Operating Instructions; G[, [____]]

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

Use State certified contractors to supervise installation and perform acceptance testing of the system in accordance with NFPA 2001.

****
NOTE: Subject to project type and scope, keep the section reference below, or delete, and insert the applicable section for the type of alarm and detection system desired.
****

Perform all work by, or under the direct supervision of the certified contractor[.][, the same certified contractor providing work under Section [28 31 60 INTERIOR FIRE ALARM SYSTEM, NON-ADDRESSABLE [_____]].]

1.3.1 Special Hazards Suppression Systems

Provide the services of a Certified Special Hazards Design Specialist (CSHDS) thoroughly experienced in Clean Agent Suppression System installations on site, to perform or directly supervise the installation, make all necessary adjustments, and perform all tests.

A CSHDS is considered certified when the specialist holds a valid System Layout Certification, Level IV Certification from the National Institute for Certification in Engineering Technologies (NICET)[or is licensed by the State of [_____] as a Contractor in accordance with [_____] State Statutes, and holds a current Certificate of Competency].

Certification of other recognized agencies with equivalent requirements may be considered. Provide evidence of the Contractor's State Certification and the basis of certification to the Contracting Officer for approval prior to any work being performed.

1.3.2 Previous Product Installation

Submit the names, locations, and client contact information of five successful previous projects of similar size and scope that the installer has constructed using the manufacturer's submitted products for this project.

1.3.3 Predictive Testing And Inspection Technology Requirements

****
NOTE: The Predictive Testing and Inspection (PT&I) tests prescribed in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS are MANDATORY for all NASA assets and systems identified as Critical, Configured, or Mission Essential. If the system is non-critical, non-configured, and not mission essential, use sound engineering discretion to assess the value of adding these additional test and acceptance requirements. See Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS for additional information regarding cost feasibility of PT&I.
****

This section contains systems and equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed have been installed properly and contain no identifiable defects that shorten the design life of a system and its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the work.

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Design clean agent extinguishing system as per NFPA 2001. Submit plans and calculations for approval before installation. Submit certificates of compliance for the following items showing conformance with the referenced standards contained in this section:

a. Piping Materials and Supports

b. High-Pressure Cylinders

c. Escutcheons

d. Pipe Hangers and Supports

e. Pressure Alarm Switch

f. Internal Cleaning and Swabbing of Pipe

2.1.1 Installation Drawings

Submit installation drawings for Clean Agent Fire Protection Systems. Annotate clean agent extinguishing system piping layout with reference points for design. In field wiring diagrams, show locations of devices and points of the system. Prepare working drawings in accordance with the requirements for "Specifications, Plans and Approvals" as specified in NFPA 2001. Include data essential to the proper installation of each system. Integrate with the alarm and detection system specified.

Include details of equipment layout and design. Indicate the general physical layout of all controls, manual actuation station[s], and internal tubing and wiring details.

Give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment for the layout of the system.

[Provide electronic drawings in Microstation.dgn format or AutoCAD.dwg format. If the electronic files are AutoCAD format, only use standard AutoCAD fonts and line styles and furnish the pcp file.

]2.1.2 Design Requirements

Submit design analysis and calculations for Fire-Protection Systems including spray areas, hazard by class, and pressure calculations.

Submit clean agent discharge calculations verifying total storage requirements, flooding concentrations, discharge times, flow through the piping network, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 2001.

Design the total flooding system to a concentration of [_____] percent for [_____] minutes.

2.1.3 Equipment Approval

Provide devices and equipment of make and type listed by the Underwriters Laboratories, Inc. (UL),[UL 2127,][UL 2166,] or Factory Mutual (FM) approved. In the UL and FM publications, consider the advisory provisions as mandatory. Reference to the "authority having jurisdiction", AHJ is interpreted as the [_____].

Provide an approved high-pressure total flooding type Fire-Extinguishing system conforming to NFPA 2001. Acceptable product trade names are FM-200,Novec-1230 (Sapphire), Intergen, HCFC, [_____], or approved equal.

2.1.4 Performance Requirements

Provide construction type, test, and mark of high-pressure cylinders in accordance with U.S. Department of Transportation specifications for seamless steel cylinders.

Provide each cylinder with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices are to be Interstate Commerce Commission approved frangible safety disks.

Provide cylinder support racks that anchor to walls and floors.

Main System: Arrange system for fully automatic and manually operated electric control operation, with operating controls of the enclosed release type to prevent accidental operation. Also provide for [a] manual actuation station[s] and keyed override operations.

2.2 EQUIPMENT

Design and construct the system as a total-flood system to include a fixed supply of extinguishing agent connected to properly sized, fixed piping with fittings and nozzles to direct this agent into the protected area.

2.3 COMPONENTS

2.3.1 Piping

Provide only galvanized, ferrous piping, Schedule 40 manifolds and distribution piping materials conforming to ASTM A53/A53M, nonferrous drawn seamless copper tubing conforming to ASTM B88, and flexible metallic hose conforming to UL 536.

Provide fittings for changes in direction of piping and for all connections. Reduce pipe sizes in the fitting. Do not use flush bushings. Fuse brazed joints, when used, with an alloy with a melting point above 537 degrees C 1,000 degrees F.

Provide pipe and fittings having a minimum bursting pressure of 34.47 megaPascal 5,000 psi. For 12.7 mm 1/2 inch and 19.05 mm 3/4 inch iron pipe size (ips), provide Schedule 40. For 25.4 mm 1 inch or greater, use only Schedule 80 pipe. Standard malleable iron banded fittings or ductile iron fittings are to be used up through 19.05 mm 3/4 inch ips. Use extra heavy malleable iron or ductile iron fittings through 50.8 mm 2 inch ips. Use forged steel fittings in all sizes over 50.8 mm 2 inches.

Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Design discharge nozzles to uniformly distribute the clean agent throughout the hazard area.

2.3.1.1 Pipe Hangers And Supports

Provide pipe hangers and supports conforming to MSS SP-58, adjustable type, zinc-coated.

2.3.1.2 Pipe Sleeves

Provide sleeves where piping passes through masonry or concrete walls, floors, roofs and partitions. Use standard weight zinc coating for steel pipe sleeves in outside walls, below and above grade, in floor, and roof slabs. Zinc coat steel sleeves in partitions having a nominal weight of not less than 4.40 kg per sq meters 0.90 pounds per square foot. Ensure space between piping and the sleeve, is not less than 13 mm 0.5-inch. Use sleeves of sufficient length to pass through the entire thickness of walls, partitions and slabs. Extend sleeves in floor slabs 50 mm 2-inches above the finished floor. Pack space between the pipe and sleeve with asbestos free insulation and caulk at both ends of the sleeve with plastic waterproof cement.

2.3.2 Escutcheons

Provide approved-type escutcheons for piping passing through floors, walls, and ceilings, consisting of one-piece or split-type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast iron, with aluminum paint finish. Securely fasten escutcheons in place with setscrews or other positive means.

2.3.3 Supervisory Switch

2.3.3.1 Low Pressure Alarm Switch

Provide the clean agent tanks with a low pressure alarm switch to warn of clean agent tank depressurization.

2.3.4 Control Panel

[Provide a separate control panel for the clean agent system.][Route all supervision and control through the facility fire alarm panel.

][Provide the suppression system control panel with power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed. Ensure the following functions are accessible only by unlocking and opening the unit:

a. Alarm Silence

b. Trouble Silence

c. Supervisory Silence

d. Power On-Off (If standard by the manufacturer)

e. Alarm/Trouble Acknowledge

f. Auxiliary Devices (AHU shutdown relay) Maintenance By-pass Switches

g. System Reset

h. Manual Actuation Station

Provide the suppression system control panel with all components necessary to monitor and supervise all initiating device circuits. When any detector, connected to the control panel is activated, activate the control panels visual alarm indication and audible signal. (This causes all notification appliances to be activated, including all associated auxiliary control functions.) The control panel is to visually indicate the addressable device or zone in alarm and transmit an alarm condition to the remote Central Fire Monitoring System. Separate audible and visual notification appliance circuits. Provide audible and visual notification appliance circuits having sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity. Visual notification appliances are to remain operational until the panel has been reset.

Provide a control panel containing all components necessary to monitor and supervise all supervisory device circuits. When any valve tamper switch, pressure switch, or other supervisory device connected to the control panel is activated, they are to activate the control panel supervisory

visual indication and supervisory audible device. The control panel is to visually indicate the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Fire Monitoring System.

Provide a control panel containing all components necessary to operate and supervise the circuits for annunciator panels indicated and auxiliary devices controlling equipment. Provide circuits for auxiliary control relays which are supervised to within 914 millimeter 3-feet of the the device controlled in accordance with NFPA 101. Include a maintenance by-pass switch for all auxiliary control devices. Supervise the by-pass to report trouble when in the maintenance by-pass position.

Design the panel to monitor and report as trouble, open supervised circuits, ground faulted supervised circuits, removal of detector or device, removal or failure of control panel module, maintenance by-pass switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, and activation of the alarm silence switch. Identify all trouble signals by initiating notification appliance, auxiliary control, or signaling line device. Trouble signals are to activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Fire Monitoring System.

Provide alarm/trouble reset switches to reset a cleared device in alarm or trouble. Alarm or trouble signals are not to be self-restoring without activating the switch.

Alarm, supervisory, and trouble silence switches are to silence the alarm and trouble audible's. Either switch placed in other than the normal position is to provide the following:

a. Report as an alarm, supervisory, or a trouble to the Central Fire Monitoring System.

b. Transfer audible signal to a panel lamp visual indication.

c. Re-ring the trouble audible if the problem has been cleared, but the switch has been left in the silence position.

When the alarm silencing switches are in the silence position, subsequent alarms are to reactivate the notification appliances, with the strobes remaining operational until the reaction control panel is reset.

Ensure the control panel is suitable for use with the detectors and manual alarm stations, and other preaction devices specified in this section.

Provide a control panel having a normally closed set of dry contacts, single pole, double throw (SPDT), which opens for trouble conditions and a normally open set of dry contacts (SPDT), which closes under alarm conditions for connection to the Central Fire Monitoring System.

Provide continuous duty relays with self-cleaning contacts of silver or an alloy of equivalent performance. Suitably protect supervisory relays against dust by individual covers. For all relays that provide external functions, such as remote reporting, control device activation, and notification appliance activation, ensure at least one (1) set of space contacts are provided. Permanently mark relays with the coil resistance, operating-current range, and internal pin connections using standard pin

numbers.

Provide steel construction control panel, terminal cabinets and battery cabinets (when used). Provide panel and cabinets with a hinged cover and an integral pin-tumbler cylinder lock with removable core that accepts the key presently in use with other control units existing in the area; lock core is provided by the government. Paint cabinets with a prime coat and one or more finish coats of scratch-resistant baked enamel. Provide a red finish coat unless otherwise indicated. Permanently affix an etched metal or engraved laminated plastic identification plate labeled, "Suppression Control Cabinet", to the cabinet door of the preaction control unit to identity the cabinet as a preaction control system cabinet. For cabinets painted red, provide an identification plate with white letters on a black background. For cabinets not painted red, the identification plate is to have white letters on a red background.

Provide a system which operates from a power supply with 120 grounded Vac int and 24 Vdc output, satisfactorily with power input voltage varying from 85 to 110 percent of nominal value. Ensure that the power supply output is capable of powering all initiation, signaling, annunciation, and control devices during alarm condition with 25 percent minimum spare capacity.[If supplied within the cabinet, ensure the power on-off switch will disconnect all power sources to the control panel, and that the on-off switch has DC rated contacts.]

]2.3.4.1 Secondary Power Supply

Provide batteries, charger, and power transfer equipment which supplies the means of automatically supplying the entire preaction system with battery backup power in event of a primary power system failure, and switches to battery power in the event of AC power failure, and switches back to AC power upon return of primary power. Provide a control panel which operates when the backup batteries are disconnected for any reason, and controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure is to activate a preaction control panel trouble signal and visual indication.

2.3.4.1.1 Storage Batteries

Provide sealed and spill-proof battery modules (no corrosive fumes). Utilize only batteries which are listed for preaction service and suitable for high discharge currents required under alarm conditions, sized to operate the suppression and detection system (including voice evacuation systems and UV/IR flame detectors) in normal supervisory condition for [24][48][72] hours minimum, then operate the system in the alarm mode for [15] [_____] minutes, minimum.

Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.3.4.1.2 Battery Charger

Provide completely automatic high/low charging rate type charger capable of battery recovery 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 a red pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided.

2.3.5 Manual Actuation Stations

****

NOTE: Where there is no room flooding or no raised floor space, omit requirement for separate actuation stations.

****

Provide actuation stations for systems at the exits from the protected areas. Ensure manual station operation causes the control panel to go into full alarm condition and discharge Clean Agent into the protected area following the adjustable time delay. [Provide separate, clearly labeled, manual stations for control of underfloor discharge and room flooding.] Install stations of a type not subject to operation by jarring or vibration. Ensure stations have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted; however a pull lever break-glass-rod type is acceptable. Station color is yellow or orange. Place warning signs, ["Agent Trade Name"] manual release, at each station indicating that operation of the station initiates immediate Fire Suppression Agent discharge. Where building fire alarm pull stations are also mounted at the exits from the protected areas, separate them from Fire Suppression Agent actuation stations by at least one meter 3-feet horizontally. Provide labels to clearly distinguish building fire alarm stations from Fire Suppression Agent stations. Ensure Fire Suppression Agent stations are a different color from building fire alarm pull stations.

2.3.6 Smoke Detectors

Design for detection of abnormal smoke densities by the [ionization] [photoelectric] principle. Necessary control and power modules required for operation of the device is integral with the main control panel. Ensure detectors are compatible with the main control panel provided and are suitable for use in a supervised circuit. Ensure detectors do not draw power from the initiating circuit. Take operating power from a separate supervised power supply circuit. Ensure that malfunction of the electrical circuitry to the detector or its control or power units results in the operation of the system trouble devices. Ensure detectors are not susceptible to operation by changes in relative humidity. Each detector contains a visible indicator lamp to show when the unit is activated. Use plug-in type detectors in which the detector base contains screw terminals for making all wiring connections. Provide remote indicator lamps for each detector that is located above suspended ceilings, beneath raised floors or otherwise concealed from view.

[2.3.6.1 Ionization Detectors

Provide multiple chamber type detectors responsive to both visible and invisible products of combustion. Ensure the sensitivity of each detector is field adjustable to compensate for the specific operating conditions.

][2.3.6.2 Photoelectric Detectors

Operate on a multiple cell concept using a light-emitting diode (LED) light source. Failure of the LED does not cause an alarm condition but

operates the detector trouble indicating lamp.

]2.3.6.3 Detector Spacing and Location

****

NOTE: Do not show detector locations on plans, however a detail for mounting smoke detectors to the raised flooring system or room ceiling in compliance with this paragraph, should be shown.

The use of air sampling detection is acceptable in lieu of spot type detectors. Design per NFPA 72.

****

Ensure detector spacing and location is in accordance with the requirements of NFPA 72, the manufacturer's recommendations and the requirements stated herein. Spacing and location of detectors takes into account the airflow into the room and supply diffusers. Do not place detectors closer than 1 1/2 meters 5 feet from any discharge grille. Spacing of detectors on room ceilings is not to exceed 41.80 square meter 450 square feet per detector. Spacing of detectors under raised floors is not to exceed 23.25 square meter 250 square feet per detector. Mount detectors installed beneath raised floors 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, mount detectors with their bases either horizontal or vertical, with the detection chambers mounted in the upper half of the underfloor space. Under no circumstances, mount detectors facing upward.

[2.3.7 Inhibit Switch

****

NOTE: Inhibit switches are optional devices which decrease system reliability and are not used without approval of the Division Fire Protection Engineer.

****

Provide one switch where activation of switch is to delay only equipment shutdown and agent discharge. Switch is guarded, spring-loaded type which operates only when pressure is manually applied to the switch. Upon release of manual pressure, switch de-activates allowing delayed functions to resume. After start of agent discharge, switch has no effect. Activation of switch during normal (non-alarm) conditions causes activation of system trouble signals.

]2.3.8 Alarm Signaling Devices

Provide each protected area with audible and visual alarms located where shown. Electrically supervise all alarm circuits. Provide separate and distinct audible and visual pre-discharge and discharge signals. Where the building is equipped with a separate fire evacuation alarm system, ensure the discharge signals is distinct from those used by the building fire evacuation system. Provide each signal device with a rigid plastic or metal identification sign with lettering a minimum of 40 mm 1.5-inches high. Label the pre-discharge alarm "FIRE" and the discharge alarm "Fire Suppression Agent DISCHARGE." [Locate post-discharge visual alarms outside all entrances to the protected areas, and provided with signs reading "Fire Suppression Agent DISCHARGED WHEN FLASHING - DO NOT ENTER].

2.3.8.1 Audible Alarms

a. Alarm bells

250 mmProvide 10 inch [surface mounted] [recessed] alarm bells with matching mounting back box. Install bells of the vibrating type suitable for use in an electrically supervised circuit. Install bells of the underdome type that have a sound output rating of at least 90 decibels at 3 meters 10 feet.

b. Alarm horns

Provide [recessed,] [surface mounted,] vibrating type alarm horns suitable for use in an electrically supervised circuit that have a sound output rating of at least 90 decibels at 3 meters 10 feet.

2.3.8.2 Visual Alarms

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

2.3.9 Main Annunciator

Annunciator is 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 is not required provided that a fault in the annunciator circuits results only in loss of annunciation and does not affect the normal functional operation of the remainder of the system. Ensure each lamp provides specific identification of the [zone] [area] [device] by means of a permanent label. Do not use generic nondescript wording such as "Zone 1," or "Zone 2," for the label identifications.

2.3.9.1 Annunciation Zones

Arrange annunciation zones as follows: [_____]

2.3.9.2 Annunciator Panels

a. Remote Annunciator Panels

Locate as shown. Ensure panel duplicates all requirements specified for the main control panel annunciator, except that in lieu of individual zone trouble lamps a single common system trouble lamp may be provided. Provide a panel lamp test switch. Provide zone identification by means of [permanently attached rigid plastic or metal plate(s).] [Silk-screened labels attached to the reverse face of backlighted viewing windows(s).] Provide [interior] [weatherproof] type, [flush] [surface] [pedestal-mounted] panel.

b. Graphic Annunciator Panel

Locate as shown. Provide [interior] [weatherproof] type, [flush] [surface] [pedestal]-mounted panel. Provide panel with the [building] [room] floor plan, drawn to scale, with remote alarm lamps mounted to represent the location of [each concealed detector] [each alarm in initiating device]. [Label principal rooms and areas shown with their room numbers or titles.] Show the panel location on the floor plan. Ensure detectors mounted above ceilings, [on ceilings,] and beneath raised floors [and different types of initiating devices] have different symbols or lamps of different colors for identification. Ensure that lamps illuminate upon actuation of their corresponding device and remain illuminated until the system is reset. Provide a lamp test switch for the panel.

[2.3.10 Automatic Fire Dampers

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NOTE: Automatic dampers are required in all ducts passing through walls, floors, and ceilings, to prevent the leakage of Clean Agent from the protected space, and to prevent the communication of fire and smoke. Locations of dampers should be shown on HVAC plans. Additional smoke dampers may be required in systems over 424,740 L/m 15,000 cfm by NFPA 90A, Air Conditioning and Ventilating Systems. Coordinate with Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. Provide access door in duct at each damper location. Connect duct detectors to Clean Agent system control panel only if no building fire alarm system is provided.

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Provide automatic control of fire dampers in air conditioning supply duct work as specified in Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. Ensure activation of fire dampers occurs upon second zone detection, or upon activation of Clean Agent discharge by manual pull station. Fire dampers are specified in Section 23 30 00 HVAC AIR DISTRIBUTION. Provide heaters for fusible links.

][2.3.11 Electromagnetic Door Holder Release

Provide where shown. Mount the armature portion on the door and have an adjusting screw for setting the angle of the contact plate. Wall mount the electro-magnetic release, with a total horizontal projection not exceeding 100 mm 4-inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control panel for magnetic door holding circuits is not required.

]2.4 ACCESSORIES

2.4.1 Electrical Work

[Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring.

]2.4.1.1 Wiring

Provide control and fire alarm wiring, including connections to fire alarm systems, under this section and conform to NFPA 70. Use No. 12 AWG minimum wiring for 120 volt circuits. Use No. [14] [16] AWG minimum

wiring for low voltage DC circuits. Color code all wiring. Use rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete and where not subject to mechanical damage.

2.4.1.2 Operating Power

Use 120 Vac power, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal and [master box] [transmitter] tripping circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Ensure transfer from normal to emergency power or restoration from emergency to normal power is fully automatic and does not cause transmission of a false alarm. 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. 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 red and suitably identify by a lettered designation.

2.4.1.3 Conductor Identification

Identify all 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 the markers in a manner that does not permit accidental detachment. Properly identify control circuit terminations.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment in accordance with NFPA 2001. Ensure each system is complete and ready for operation.

Conceal piping to the maximum extent possible. Inspect and test pipe; receive Contracting Officer approval before pipe is concealed.

Provide each system with an approved pressure-relief device designed to operate between 13.79 and 22.75 megapascal 2,000 and 3,300 psi and located between the storage cylinder manifolds and any normally closed valve.

3.1.1 Warning Signs

Provide signs manufactured of 3-layer red-white-red micarta, engraved to show white uppercase letters on a red background, warning signs. Warning sign thickness is 0.3175 cm 1/8-inch thick with beveled edges.

3.1.1.1 Inside Control Room

Permanently affix a sign adjacent to every audible/visual system alarm reading:

WARNING

WHEN THIS STROBE IS LIT,
RELEASE OF FIRE SUPPRESSION AGENT WILL OCCUR WITHIN 60 SECONDS

Make letters for "WARNING" 3.81 cm 1-1/2-inch tall, and all other lettering 1-inch tall.

3.1.1.2 Protected Space

Permanently affix a sign adjacent to every audible/visual system alarm reading:

WARNING

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

Make letters for "WARNING" 3.81 cm 1-1/2-inch tall, and all other lettering 1-inch tall.

3.1.1.3 Manual Activation or Release Station

Place a sign at every location where manual operation of the system may occur, reading:

WARNING

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

Make letters for "WARNING" 1.905 cm 3/4-inch tall, and all other lettering 0.9525 cm 3/8-inch tall.

3.1.2 System Control

3.1.2.1 Controls

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NOTE: Select the appropriate Division 28 Fire Protection and Alarm section to address the project requirements.
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Provide an electrical and mechanical actuating control system contained in a fire alarm panel specified in Section 28 31 60 INTERIOR FIRE ALARM SYSTEM, NON-ADDRESSABLE as modified below.

3.1.2.2 Suppression System Safing/Disconnect Switch

Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE SUPPRESSION SYSTEM SAFING SWITCH".

3.1.3 Electrical Work

****
NOTE: Select the appropriate Division 28 Fire Protection and Alarm section to address the project requirements
****

Electrical work is specified in Section 28 31 60 INTERIOR FIRE ALARM SYSTEM, NON-ADDRESSABLE.

3.1.4 Operating Instructions

Submit operating instructions for Clean Agent Fire Protection Systems consisting of raised or embossed white letter on red rigid plastic or enameled steel background and of a size to permit them to be easily read.

Provide operating instructions at each remote control station. Instructions are to clearly indicate necessary steps for the operation of the system.

Submit [six][_____] copies of the operation and maintenance manuals 30 days prior to testing the Clean Agent Fire Protection Systems. Update and resubmit data for final approval no later than 30 days prior to contract completion.

3.1.5 Field Painting

Touch-up painting is to match equipment manufacturer's original paint.

Paint all equipment, piping, and other components of the system red per NASA-STD-5008, Zone 5, conforming to SAE AMS-STD-595A, Color 11105.

3.2 FIELD QUALITY CONTROL

Conduct testing to determine conformance with the requirements in the presence of the Contracting Officer.

3.2.1 Manufacturer's Field Service

Provide an experienced manufacturer's field engineer to supervise installation and testing of the system.

3.2.2 Test Procedure

Prepare and submit the clean agent system test procedure to the Contracting Officer for approval 30 days prior to the planned preliminary tests.

3.2.3 Preliminary Tests

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NOTE: If the specified system is identified as critical, configured, or mission essential, use Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS to establish predictive and acceptance testing criteria, and delete the second paragraph and add the following paragraph.

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Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Pneumatically test each piping system at 1.034 megapascal 150 psi gage to ensure no leakage or reduction in gage pressure after 2 hours. Use the discharge of breathing air from each system discharge nozzle to test discharge nozzles. Test remote control stations, and all other components and accessories individually to demonstrate proper functioning. At the completion of tests and corrections, submit a signed and dated certificate to the Contracting Officer attesting to the satisfactory completion of all testing and that the system is in operating condition.

3.2.4 Formal Tests

Provide the suppression agent, instruments, personnel, appliances, and equipment necessary for testing are furnished by the Contractor at his expense.

At a time agreed upon by the Government, the Designated Fire Protection Engineer (DFPE) will witness formal tests and approve systems before they are accepted. Ensure the presence of an experienced technician regularly employed by the system installer during the testing. During the testing, repeat any of the required tests, as directed by the Contracting Officer. Perform a fan test witnessed by the Government wherein the enclosure integrity is required to perform in accordance with NFPA 2001, Annex C.

Provide the formal test results to the Contracting Officer.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Record Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built (record) working drawings, including complete as-built circuit diagrams, of each clean agent system for record purposes. Provide record working drawings [no smaller than A0 1189 by 841 mm 30 by 42 inches, reproducible with title block 200 by 100 mm 8 by 4 inches similar to full size contract drawings][in [dgn.][dwg.]electronic format].

-- End of Section --