

## SECTION 21 22 00

### CLEAN AGENT FIRE SUPPRESSION SYSTEM PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 21 01 00, "Mechanical General Provisions", govern this Section.

#### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide an engineered, fixed piped clean agent total flooding Clean Agent fire suppression system to protect [ ] as shown on the Drawings. The system is to be designed to conform to the National Fire Protection Association Standard 2001. This system shall be capable of discharging in a nominal 10 seconds or less.

#### 1.3 STANDARDS:

- A. Products, design and installation shall comply with the most stringent requirements of all applicable sections of the following:
  1. NFPA 2001 (most recent edition)- Clean Agent Fire Extinguishing Systems.
  2. NFPA 70-(most recent edition)- - National Electrical Code.
  3. NFPA 72 National Fire Alarm and Signaling Code.
  4. The Federal Occupational Safety and Health Act.
  5. Texas Insurance Code Chapter 6001
  6. Texas Administrative Code §§ 34.500 (fire extinguisher rules)
  7. Applicable local, state and federal laws and regulations.
  8. Underwriters' Laboratories, Inc. (UL) listing and standards.
  9. Factory Mutual (FM) approval and standards.

#### 1.4 QUALITY ASSURANCE:

- A. Manufacturers: All system components shall be the products of a single manufacturer and shall be manufactured by Fire Protection Systems Division of Fike Corporation, Inergen or an approved equal.
- B. Installing Contractor: The entire system shall be installed, tested and certified by an experienced contractor licensed by the State of Texas regularly engaged in the installation of automatic fire suppressions systems. The installing contractor shall have a minimum of 5 years of experience, design, installation and testing of fire suppression systems and shall be an authorized installer for the fire suppressions system manufacturer.

#### 1.5 SUBMITTALS:

- A. The University of Houston Project Manager shall review and distribute all submittals for approval by the University insurer, the U of H Fire Marshal, the Owner's representative, and others as appropriate.
- B. Refer to provisions established in the Project Specifications and in related section of Division 01 – General Requirements. All product data shall be submitted under provisions of Division 01.

- C. Shop drawing submittals shall include, but not be limited to, the following:
1. Material and equipment information including manufacturers catalog cuts and technical data for each component or device used in the system which shall include, but not be limited to, detectors, manual discharge switches, abort switches, control panel, graphic annunciator, alarm devices, extinguishing agent and extinguishing agent storage containers, mounting brackets, and nozzles.
  2. Sequences of operation, electrical schematics and connection diagrams shall be provided to completely describe the operation of the Clean Agent fire suppression system controls.
  3. The Contractor shall illustrate the Clean Agent distribution system and provide calculations to demonstrate the volumetric concentration. The following information is to be provided for each:
    - a. Room dimensions and volume.
    - b. Design temperature.
    - c. Specific volume and pressure at design.
    - d. Any air change rate not shutdown (cfm).
    - e. Clean Agent volume required.
    - f. Discharge time.
    - g. Number and size of nozzles.
    - h. Agent discharged per discharge nozzle.
    - i. Computerized hydraulic calculations of the agent distribution system taking into account each component of piping and the frictional losses associated with that component.
    - j. Concentration of agent at design.
  4. Shop drawings submittals shall indicate locations, installation details and operation details of all equipment associated with the Clean Agent fire suppression system. Floor plans showing equipment locations, piping and other details, as required, shall be provided. Floor plans shall be drawn to a scale of not less than 1/4" = 1'-0". Elevations, cross sections and other details shall be drawn to a larger scale, as required.
  5. No work shall be performed until the University has approved the shop drawings, calculations, and data sheets. The Contractor is solely liable for any work performed prior to this approval.
  6. Information outlining warranty of each component or device used in the system.
  7. Elevation of the graphic annunciator panel including all nameplates, text, and control devices.
  8. Complete and detailed point-to-point wiring diagrams for all system components and devices.
  9. A copy of the form to be used for final system testing and certification.
  10. Additional information as required in Section 23 01 00.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Deliver fire suppression system components in factory-fabricated water resistant packaging.
- B. Handle fire suppressions system components carefully to avoid damages to components, enclosures, and finish.
- C. Store fire suppression system components in a clean, dry space, and protect from weather.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS:

- A. The system shall be a total flooding Clean Agent fire suppression system designed to provide a uniform concentration of Clean Agent for the areas shown on the Drawings. The minimum agent concentration shall be 1% greater than the concentration required in NFPA for the agent being used.
- B. The amount of Clean Agent to be provided shall be the amount required to obtain a uniform concentration 1% greater than the concentration required in NFPA for the agent being used., for 10 minutes. The Contractor shall take into consideration such factors as non-closeable openings, "coast-down" time of fans, time required for dampers to close, requirements for any additional dampers, and any other feature of the facility that could affect concentration.
- C. The work to be performed by the Contractor under this Specification includes all labor, materials, equipment, tools, supervision, storage, and each and every item of expense necessary to design, supply and install complete Clean Agent fire detection and suppression systems.
- D. The Contractor shall comply with all local, state, and federal laws and regulations and UH Fire Marshal and with the Federal Occupational Safety and Health Act. The Contractor shall obtain any permits required at no additional cost.
- E. All work under this Contract shall be done in a neat and workmanlike manner whether finally concealed or exposed.
- F. All material and equipment furnished and installed shall be new and free of defects, of recent manufacture and standard manufacturer's equipment.

## 2.2 SYSTEM DESIGN:

- A. All system components shall be designed and selected by a State of Texas licensed fire protection contractor. All system components shall be listed and approved by UL and FM, both individually and as used on this project as a system designed in accordance with NFPA.

## 2.3 SYSTEM OPERATION:

- A. The system shall be actuated by an **[addressable device] [dual zone] [or] [verified detection]** system with **[analog]** photoelectric smoke detectors. Automatic operation in each protected area(s) shall be as follows:
  - 1. Actuation of an initial detector **[in either zone]** shall:
    - a. Audibly and visually indicate the respective device in alarm at the control unit.
    - b. [Illuminate the detector indicating LED on the graphic annunciator (Data Center only).]**
    - c. Activate the pre-alarm audible and visual signals associated with the area in which the detector is an alarm.
    - d. Close the air conditioning system dampers serving the area in alarm, as applicable.
    - e. Shut down dedicated air conditioning equipment serving the area in alarm.
    - f. [Activate the remote alarm/trouble chime in the adjacent office area (Data Center only).]**
    - g. Initiate an alarm condition to the building fire alarm system **[floor zone on the floor where the alarm occurred].**
  - 2. Action of a second detector in the same area **[, but on the second detection zone]** shall:
    - a. Audibly and visually indicate the respective device in alarm at the control unit.
    - b. [Illuminate the detector indicating LED on the graphic annunciator (Data Center only).]**
    - c. Activate the discharge alarm audible and visual signals associated with the area in which the detector is in alarm.

- d. Actuate a time delay mechanism which shall delay release of the Clean Agent for 30 seconds. The Clean Agent shall be released at the end of this time interval unless a " Clean Agent Hold" (Abort) button is pressed at any time during the interval which shall immediately restore the time delay mechanism. Upon release, the time delay cycle will restart unless the entire system has been restored to normal by pressing the reset button on the control unit. Time in seconds remaining to discharge shall be displayed at digital abort stations.
  3. Timing out of the time delay shall:
    - a. Shut down power to all equipment within the Clean Agent protected area in alarm via a dry relay contact.
    - b. Discharge Clean Agent in the zone in alarm in the total space.
    - c. Activate the Clean Agent discharge strobes associated with the zone in alarm.
  - B. The system shall be capable of being actuated by manual discharge switches in the projected area. Operation of a manual discharge switch shall cause immediate or optionally programmable delayed discharge of the Clean Agent and shall cause alarm and shutdown devices to operate the same as if the system had operated automatically. Operation of a manual discharge switch shall be provided in each projected area at the exits and as shown on the Drawings.
  - C. System design shall incorporate the capability of checking all detection, discharge, abort power and air conditioning shutoff, damper control functions without discharge of the Clean Agent. It shall also be possible to test without shutting off computer power and/or air conditioning equipment. The system shall include an emergency power backup. Upon loss of power supplying the control unit, the system shall automatically transfer to standby power supplied by the control unit, and stay on line for 24 hours of supervision with capacity for Clean Agent release and 5 minutes of system alarm.
  - D. System supervision shall be provided to detect trouble conditions in all connected devices and wiring. A system trouble condition shall initiate the following:
    1. Indicate the respective zone/device in trouble condition at the control unit.
    2. **[Activate the remote alarm/trouble chime in the adjacent office area (Data Center only).]**
    3. Initial a trouble condition on the building fire alarm system **[floor zone on the floor where the trouble condition].**
- 2.4 DEVICE LOCATIONS:
- A. System devices shall be located as follows:
    1. Control panel **[and graphic annunciator]** shall be located as shown on the Drawings. Panels shall be flush-mounted, unless noted otherwise on the Drawings.
    2. Smoke detectors shall be installed **[above the ceiling,]** on the ceiling **[and below the raised access floor]** of each protected area. Minimum number of detectors shall be as shown on the Drawings.
    3. Manual discharge stations shall be installed at each exit from protected areas and as shown on the Drawings.
    4. A digital abort station shall be installed next to the control panel and in the **[\_\_\_\_\_ \_].**
    5. Standard abort stations shall be provided at locations shown on the Drawings.
    6. Audible and visual alarm devices for pre-alarm and discharge alarm shall be located in the protected areas. A visual discharge signal shall be located outside each entrance to the protected area. **[A remote combination trouble/alarm chime shall be provided in the office area adjacent to the protected area.]**

2.5 SYSTEM CONTROL PANEL:

- A. General: Provide an integrated system of automatic detection devices. The devices, along with manual stations shall be used to activate a control panel. This panel shall process all input signals, sequence the levels of alarm signals, and provide outputs to shutdown fans, activate dampers, contact other agencies, annunciate on remote devices as specified. The system shall have a standard standby battery supply to provide a minimum of 24 hours of emergency power. Detection wiring shall be of a Class "B" type and utilize devices connected in parallel.

**[SELECT ONE OF THE FOLLOWING]**

**[ADDRESSABLE DEVICE]**

- B. **[Control Panel]**: The control panel for the Automatic Fire Detection and Alarm System and Clean Agent Fire Suppression System shall be a Fike Cheetah or approved equal fire control system. The control panel shall be UL -listed for Clean Agent. The control panel shall include the following modules:
1. Ideally suited for Fire Alarm, Clean Agent Suppression, Carbon Dioxide Suppression, and Sprinkle/Pre-Action fore Detection and Control Systems
  2. Digital Communication Protocol with addressable devices and sensors to increase communications reliability and immunity to noise
  3. Response time of less than 3 seconds for fully loaded system
  4. Up to 240 zones to map initiation devices to control functions
  5. Two signaling Line Circuits (SLC) which support up to 254 addresssable points
  6. SLC distances of over 6000' possible
  7. SLC meets style 4, 6 or 7
  8. Input either 120Vac, 240Vac 50/60 Hz, or 24Vdc
  9. Power supply capable of supporting 508 points plus 5.0 A usable power plus 65 Ah of standby battery capacity
  10. Two notification Appliance Circuits (NAC), 2.0A each
  11. Dedicated Alarm , Trouble and Supervisory SPDT relays(30 Vdc/2A, 110Vac/0.5A)
  12. Two continuous and one resetable auxiliary power outputs, 2.0A each
  13. Releasing function provides three input types; cross zone, counting zone and single detector, and 6 abort types.
  14. Reliable software and firmware integration utilizing KeyWord code construction and Intelligent Output controls
  15. 80 Character LCD display with 8 status LEDS to provide instant visual information
  16. Completely field programmable, without requiring use of a personal computer
  17. Automatic Learn mode allows quicker, reliable system configuration
  18. Three levels of password protection with built in individual user profiles
  19. Full function 24 button keypad
  20. 1800 event history buffer with dedicated 600 event alarm buffer
  21. Two levels of adjustable pre-alarm thresholds for smoke sensor to provide early warning

**indication of potential emergency conditions**

22. **Automatic Day/Night smoke sensor sensitivity adjustments with Weekend and Holiday schedule adjustments**
23. **Automatic sensitivity testing in accordance w/NFPA 72**
24. **Sophisticated Drift Compensation routines used on addressable sensors to compensate for dust/dirt accumulation**
25. **Walktest capability with optional notification appliance verification**
- 26..

[OR]

[VERIFIED DETECTION]

- C. **[Control Panel]:** The Control Panel for the Automatic Fire Detection and Clean Agent Suppression System shall be a Fike Fire Suppression System SHP or approved equal releasing control. The Control Panel shall be UL and ULC-listed and bear Factory Mutual approval.
1. The control panel shall include:
    - a. Verified detection (cross-zoning will [not] be considered equal).
    - b. Parallel wired agent release modules using electrical initiators.
    - c. Class "B" wiring of the detection and Clean Agent release circuits.
    - d. Minimum of 24 hours of battery standby power, housed in same cabinet.
    - e. Three supervised audible circuits, each individually silenceable.
    - f. Three sets of auxiliary contacts.
  2. The control panel shall operate on the "verified Detection concept". Cross-zoning will [not] be considered as equal. With the verified detection concept, any single activated detector will be processed by the control panel and be indicated as an "Alarm 1" condition. This shall cause the "Alarm 1" audible circuit and the red "Alarm 1" LED on the cover to activate. The activation of any second detector, regardless of its location, shall cause the system to enter the "Alarm 2" condition, activate the "Alarm 2" audible circuit, and start the programmed, solid state, time delay circuit. If no time delay is programmed, then the system shall immediately discharge upon activation of the second detector. Each audible circuit be capable of being individually silenced.
  3. The control panel shall utilize parallel wired initiators at the method of discharging the extinguishing agent. The electrical initiator at each container shall be connected to the Agent Release Module which shall be a solid state circuit which provides the firing voltage. When a discharge signal is generated at the control panel, all agent release modules shall operate instantly discharging the containers. All Agent Release Modules shall be wired in a Class "B" configuration. [Any system utilizing series initiators, series solenoids or mechanically operated valves shall not be acceptable.] All relays shall be rated 10 amps.
  4. The control panel shall house its own standby battery power. Batteries shall be sized to provide a minimum of 24 hours stand by power but in no case shall be less than 6-1/2 AH capacity. Batteries shall be supervised and provide a trouble signal upon low battery voltage or open cell.
  5. The control panel shall accommodate supervised abort switches.

6. **The control panel shall be furnished with a solid state, field-programmable time delay. The time delay shall be programmable with a maximum setting of 60 seconds.**
7. **The control panel shall be constructed of 18 gauge steel finished with [the manufacturers standard pain finish]. [a custom color or selected by the Architect.] Only the audio/visual signals activated shall be visible with the cabinet door closed. Cabinet shall be sized so that the batteries may be located in the same enclosure. All terminal strips which may have more than 24 volts dc, such as power input and auxiliary relays shall have protective covers to prevent anyone from coming into accidental contact with a live terminal. Cabinet shall be capable of being flush-mounted without the need of any accessories. the control panel shall operate off of 120 volt ac, 60 cycle power. Within the panel the ac inputs shall be protected by a circuit breaker in lieu of fuses.]**

2.6 **[GRAPHIC ANNUNCIATOR:**

- A. **Provide a flush-mounted LED type graphic annunciator. the annunciator shall be provided complete with all required circuit boards and LEDs for each device, lamp test button, and shall have a graphic representation of the protected area floor plan with appropriate descriptive legends silk screened on the annunciator face.]**

**[SELECT ONE OF THE FOLLOWING]**

**[ADDRESSABLE DEVICE]**

2.7 **[SMOKE SENSORS (DETECTORS):**

- A. **Smoke sensors shall be Fike No. 63-021 or an approved equal base-mounted analog photoelectric smoke sensors. All sensors shall be of the photoelectric type and each sensor shall be individually addressable. Each sensor shall measure the percentage of obscuration due to airborne particles and report an analog value based on the percentage of obscuration to the control panel. Alarm thresholds shall be established at the control panel. Smoke sensors which make the alarm/normal decision internally will not be acceptable.**
- B. **The Fike Analog Photoelectric Smoke Sensor shall been designed with a unique chamber, enabling the sensor to be sensitive to a wider range of hazards than traditional photoelectric sensors. In addition to the better response to different hazard types, the sensor shall provide a dual point calilbration. Important operating parameters are maintained within the sensor using non-volatile RAM, increasing reliability and reducing chances of false alarm. The interrupt driven digital protocol combines maximum communication reliability with fast response to emergency conditions.**
- C. **Sensors shall be EMI, RFI and ESD-protected].**

**[OR]**

**[VERIFIED DETECTION]**

2.8 **[SMOKE DETECTORS (PHOTOELECTRIC):**

- A. **Smoke detectors shall be Fike No. 63-024 or an approved equal base mounted photoelectric smoke detectors. Detectors shall utilize solid state circuitry, a pulsed infrared LED light source and a silicon photo diode receiving element. In normal conditions, the photo diode shall not sense any light from the LED source. When smoke particles enter the sensing chamber, the light source shall be reflected to the sensing element. Comparator circuitry shall be provided to discriminate between a valid "smoke" source and an intermittant "non-**



**smoke" source. The entrance to the sensing chamber shall be surrounded by a fine stainless**

**steel mesh to minimize entry of foreign material into the sensing chamber. Detectors shall be dewproof and uninfluenced by high air velocities.**

- B. **Each detector shall utilize a standard base interchangeable, without modifications with ionization or thermal detectors. The detector head shall be equipped with a LED which blinks while the detector is in normal standby and lights steadily upon the detector sensing an alarm condition. The detector shall have the ability to power a remote annunciator which shall duplicate the alarm LED during an alarm condition.**
- C. **The detector head shall be removable from its base from cleaning, service or replacement. The detector shall be capable of having its calibration checked or adjusted in the field via a standard detector sensitivity monitor. The detector may have its sensitivity tested either in place as it is exposed to the environment or in a calibrated smoke chamber to give a reading of sensitivity which can be referenced against other like detectors under know conditions. Detector shall be Factory Mutual approved and UL-listed to UL Standard 268.**

**[SELECT FOR ADDRESSABLE SYSTEM ONLY]**

**2.9 [ADDRESSABLE CONTACT MONITORING MODULES:**

- A. **Modules shall be Fike No. 55-019 or approved equal addressable contact modules. Modules shall supervise any normally open contact configuration. This module shall provide an output signal (with one poll of the device) to the Control Unit which contains all the present status of the addressable device. The output signals shall distinguish between three circuit conditions; normal (open contact), short circuit (closed contact), and open circuit (field wire break). The device shall incorporate a monitoring LED which blinks with each activation of the address location. A seven bit dip switch shall be provided for individually assigning address locations to each device.]**

**2.10 HORN/STROBE UNITS:**

- A. **Horn/Strobe assemblies shall be Fike No. PYU-MMT-S17 or an approved equal low power dc horn and high-intensity Xenon strobe visual signal. The strobe lens shall be white with "CLEAN AGENT" printed in red. Printing shall be oriented to suit the direction of installation. The horn shall be capable of dual-tone operation to indicate both pre-alarm and discharge alarm conditions.**

**2.11 ALARM/TROUBLE CHIME:**

- A. **Alarm chimes shall be Fike or an approved equal low power, 24 volts dc alarm chime.**

**2.12 DISCHARGE STROBES:**

- A. **Discharge strobes shall be Fike No. PYU-S17 or an approved equal high-intensity Xenon strobe visual signal. The strobe lens shall be white with " CLEAN AGENT " printed in red. Printing shall e oriented to suit the direction installation.**

**2.13 MANUAL DISCHARGE STATIONS:**

- A. **Manual DISCHARGE stations shall be Fike No. MS.2H or equal red aluminum stations permanently labeled "FIRE" and " CLEAN AGENT DISCHARGE ".**

**2.14 ABORT STATIONS:**

- A. **Exit abort stations shall be Fike No. 10-1639 or approved equal momentary contact yellow pushbutton. Abort stations shall be permanently labeled " CLEAN AGENT DISCHARGE ABORT ".**

**2.15 DIGITAL ABORT STATIONS:**

- A. Digital abort stations shall be Fike No. 20-040 or an approved equal combination momentary contact yellow pushbutton and digital readout indicating the number of seconds remaining until Clean Agent discharge. Abort stations shall be permanently labeled " CLEAN AGENT DISCHARGE ABORT".

## 2.16 CLEAN AGENT

- A. General: The fire suppression agent shall be a clean, dry, non-corrosive, non-damaging, non-deteriorating gas meeting the requirements of NFPA. The agent shall be suitable for use in normally occupied spaces.
- B. Storage: The agent shall be stored in a container super pressurized with nitrogen to a maximum working pressure of 360 psia. Higher pressure agents are not acceptable.
- C. Characteristics: The agent shall be listed as acceptable on the EPA's SNAP List. The agent shall also have the following characteristics:
  - 1. Ozone Depletion Potential of Zero (0).
  - 2. Atmospheric Lifetime of less than 50 years.
  - 3. LC<sub>50</sub> > 800,000 ppm

## 2.17 CLEAN AGENT STORAGE CONTAINERS:

- A. General: A common bank of properly sized Fike or an approved equal modular design Clean Agent containers sized to the largest single hazard containing sufficient agent to produce the required concentration of Clean Agent shall be supplied. The containers shall have the capability of being charged to various weights, in one pound increments, so that excessive agent supply is avoided.
- B. Nameplate: Each container shall have a permanent nameplate indicating the manufacturer's name and part number, agent fill weight and total charged weight.
- C. Charging Pressure: Container charging pressure shall be a maximum of 360 psig.
- D. Pressure Gauges: Each container shall be equipped with a pressure gauge to visually display internal pressure. Each gauge shall be color coded for fast reference of pressure readings. Pressure gauges shall be supplied as an integral part of each container.
- E. Discharge Releasing Valve: The discharge valves shall be a straight through, vertical discharge type with no direction changes to provide maximum discharge efficiency and safety. The discharge releasing valve shall consist of a fast acting, scored, non-fragmenting rupture membrane which will burst when the pyrotechnic initiator is activated via an electric signal from the fire suppression panel. Solenoid actuated releasing mechanisms are not acceptable.
- F. Actuator: Release of the agent shall be accomplished via Fike Model 10-1832 or an approved equal electrically activated pyrotechnic release initiators. Systems using multiple storage containers shall have all initiators wired in parallel.
- G. Discharge Time: The containers and discharge valve shall be capable of releasing the agent as quickly as possible and full discharge time shall not exceed ten (10) seconds.
- H. Low Pressure Switch: Each agent storage container shall be equipped with a low pressure switch to indicate a loss of container pressure. A decrease in pressure from 360 psig to 275 psig shall cause a normally closed contact in the pressure switch to open, indicating a trouble condition at the fire suppression panel.
- I. Liquid Level Indicators: Each agent storage container with 100 pounds or more of agent shall be equipped with a Fike Model 10-xxx or an approved equal liquid level indicator to accurately indicate the amount of agent in the container.
- J. **Check Valves: All systems connected with a reserve supply shall be piped with check valves. Check valves shall be constructed of steel and shall be designed for a 750 psig**

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**working pressure.]**

- K. Accessories: The containers are to stand in a normal upright position with suitable racking equipment, including an integral weigh-bar, low pressure switch, and liquid level indicator. All containers are to be of the same size and connected together by means of a common manifold sized to ensure the design discharge rate.

## 2.18 CLEAN AGENT NOZZLES

- A. Nozzles: Provide Clean Agent nozzles in proper sizes and quantities to distribute evenly the Clean Agent discharge. Each nozzle shall be capable of either 180 or 360 degree direction of coverage parallel to the floor and ceiling.. Nozzles shall be Fike 80 Series or an approved equal and shall be available in 1", 1-1/2", and 2" NPT sizes. Nozzles shall include provisions for mounting deflector plates. All nozzles shall be made of aluminum.
- B. Deflector Plates: Ceiling deflector plates shall be provided at all ceiling nozzles to allow discharge without damage to ceiling tiles and to eliminate the need to clip lay-in ceiling tiles to the grid. Deflector plates shall be constructed of corrosion resistant stainless steel and shall be Fike Model 80-xxx or an approved equal. Deflector Plates shall be compatible with the nozzle which they are installed with.

## 2.19 PIPE AND FITTINGS:

- A. General: Provide a suitable piping system to convey the Clean Agent from the cylinder battery to nozzles in the protected area.
- B. Materials: All pipe and fittings are to be hot-dipped galvanized and scale-free steel. The following specifications shall apply for a 360 psi system:
1. Pipe: Galvanized, Schedule 40 screwed steel pipe, ASTM 53.
  2. Fittings: Galvanized, screwed malleable iron, 620 psi minimum working pressure, ASTM 197.

## 2.20 SYSTEM WIRING:

- A. The equipment supplier shall furnish to the installing contractor a complete detailed point-to-point wiring diagram showing the system equipment and required number, type and sizes of conductors and conduit sizes. Where common devices which break the alarm circuit are installed on a common zone with shorting type device, the circuit breaking devices shall be wired electrically downstream of the shorting type devices.
- B. All alarm system wiring shall be installed in an approved raceway.
- C. All alarm wiring shall be multiconductor, UL-listed FLP for limited energy (300 volt) and fire alarm applications, and NEC approved fire alarm cable. Wiring shall be installed in accordance with NEC, local codes, Article 210 of NFPA Standard 72, and manufacturer's recommendations. All wiring shall be copper and installed in conduit sized in accordance with the National Electrical Codes.
- D. Alarm system wiring shall be color coded.
- E. All alarm system junction boxes including covers, shall be secured, painted red and marked in black lettering. The black lettering shall indicate the circuit number and function of each circuit contained within the box.
- F. Wire size shall be determined by calculated voltage drop and circuit loading. Minimum wire size shall be as follows:
1. #18 AWG twisted and shielded for data and communications circuits.
  2. #18 AWG for non-data and communications initiating and low voltage auxiliary control circuits.
  3. #16 AWG twisted for alarm circuits.
  4. #12 AWG for all EPO and air conditioning interface control circuits.

- G. All wiring for intelligent/addressable circuits shall be of the twisted/shielded type to guard against outside RF interference and induced noise.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION:**

- A. Installer shall examine the areas and conditions under which the fire suppression system is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Where the project requires releasing of a clean agent system, the room or area in which the suppression system is located shall utilize two separate smoke detectors or activation of a manual release station to activate the suppression system.

#### **3.2 ALARM SYSTEM INSTALLATION:**

- A. General: Install system components and materials in accordance with manufacturer's instructions, roughing-in drawings and details. Install electrical work and use electrical products complying with the requirements of the applicable Division 26 sections of these Specifications. Mount manual stations and alarm devices at heights specified in Section 23 03 00 and Section 26 05 01. Heights in raised floor areas shall be from the finished raised floor. Install alarm output devices on walls or as shown on the Drawings.
- B. Wiring: All wiring shall be in accordance with NFPA 70, the National Electrical Code, and local codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
  1. Install alarm system line voltage and low-voltage wiring in a suitable raceway. Conceal alarm system conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.
  2. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and UL requirements. Intelligent loops may be T-tapped/branch wired due to inherent dynamic supervision.
  3. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.
  4. No ac wiring or any other wiring shall be run in the same conduit as alarm wiring.
  5. Number code and color code conductors appropriately and permanently for future identification and servicing of the system.
- C. Conduit/Raceway: All wire shall be installed in an approved conduit/raceway system. Maximum conduit "fill" shall not exceed 40% per NEC.
  1. Conduit and raceway system shall be 1/2 installed as specified other Sections of the Specifications.
  2. Minimum conduit size shall be 1/2"- 3/4" EMT. Install conduit per engineered shop drawings.
- D. Labeling: All system controls, indicators and other devices shall be labeled with names, designations and operating instructions as applicable. Labels shall be either engraved nameplates or covered printed labels and shall be approved by the Architect/Engineer.

- E. Checkout: Check wiring to ensure that wiring is in accordance with the system manufacturer's wiring diagrams and that the system is free of open circuits, short circuits, and grounds.

3.3 PIPING INSTALLATION:

- A. General: Install all Clean Agent piping in accordance with NFPA 2001 and other applicable Division 15 sections. All Clean Agent discharge piping shall be concealed to the maximum extent possible.
- B. Testing: All Clean Agent piping in accordance with NFPA 1002.

3.4 COORDINATION:

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire suppression system with all trades. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm to provide a complete and functional system.
- B. The installing contractor shall be fully responsible for coordinating all system and device messages and system operation with the **[Owner's] [Tenant's]** Representatives and Operating Personnel.

3.5 SYSTEM CHECKOUT AND TEST:

- A. A System checkout and test shall be performed to demonstrate and confirm to the Engineer, **[Owner's] [Tenant's]** representative and the UH Fire Marshal's Office, that the fire suppression system is 100% operational upon completion of the installation, and that it complies with all local code requirements and these specifications. It is intended that the System Checkout and Test be followed by a continuing program of inspection testing and maintenance. The Contractor shall provide to the **[Owner] [Tenant]** a Maintenance, Inspection and Quarterly testing Contract upon completion and system checkout.
- B. The system checkout and test shall be performed after the fire suppression system installation is completed and before project acceptance. The System Checkout and Test shall be performed by a minimum of two licensed fire suppression system technicians, one of which is licensed by the State of Texas, and acceptable to the Engineer and the UH Fire Marshal's Office. Testing shall verify that the entire fire suppression system functions as intended. All circuits and devices shall be tested and the entire fire suppression system functions as intended. All circuits and devices shall be tested and the testing shall include all functions and features except that a Clean Agent discharge test shall not be performed.
- C. This Contractor shall coordinate the test schedule with all necessary parties and subcontractors required to be present for a complete and functional test.
- D. The System Checkout and Test which is a comprehensive 100% inspection and test of all new fire alarm system equipment and shall include, but not be limited to the following:

1. Fire Alarm Control Equipment:

- a. A visual and functional test of all fire alarm control and auxiliary control equipment.
- b. A visual inspection shall be conducted to establish that all electrical connections and equipment as required are properly installed and operating.
- c. A remote functional simulation test shall be conducted on all relevant field wiring terminations to ensure that all wiring is properly supervised as required.
- d. All indicators shall be tested to ensure proper function and operation.
- e. All system auxiliary functions including, but not limited to, power shutdown, HVAC system shutdown, damper control and similar functions and shall be functionally tested to verify proper operation.
- f. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as

required. A 3 minute general alarm stress test both under ac power and standby power shall be conducted to further ensure complete operation of the system.

2. Annunciators: All annunciators shall be tested to ensure that each point activates properly and labeling correctly defines the device in alarm.
3. Fire Alarm Peripheral Devices: All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
4. Initiating Devices (Manual and Automatic):
  - a. All manual and automatic initiating devices shall be inspected to ensure proper placement and mounting as recommended by the manufacturer and as indicated in these specifications.
  - b. All manual fire alarm stations and all automatic initiating devices (smoke detectors) shall be functionally tested for alarm operation.
  - c. All initiating devices shall be functionally tested for proper wiring supervision. Failure of any tested device on any zone shall require that all devices in that zone shall be tested for supervision.
5. Alarm Signaling Devices:
  - a. All visual alarm and discharge indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
  - b. Alarm signaling devices shall be field-checked and tested for proper operation and output.
  - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility, if required by the authority having jurisdiction. Additional devices may be required to provide adequate sound penetration (or as required by the local authority having jurisdiction). Contractor shall provide a unit price for such devices should they be required.
  - d. All alarm signaling devices shall be functionally tested for proper wiring supervision.
6. Clean Agent Control:
  - a. All Clean Agent discharge and monitoring functions shall be 100% tested, without Clean Agent discharge.
  - b. Functions tested shall include, but not be limited to, automatic discharge, manual discharge, abort, power and equipment shutdown, and storage container pressure.
7. Enclosure Integrity Testing:
  - a. Integrity of the room enclosure shall be verified using door-mounted pressurization fans and a smoke pencil in accordance with NFPA 2001.
  - b. All leaks in the enclosure shall be sealed to the maximum extent possible by the General Contractor. Leaks which cannot be sealed shall be compensated for in the Clean Agent quantity.
8. Pipe Testing: A "puff" test using compressed air or carbon dioxide shall be performed in accordance with NFPA 2001 to check for continuous and obstruction free piping.
9. Reporting:
  - a. Upon completion of the 100% System Checkout and Test, four copies of the final report shall be documented, certified, and sent to the Engineer for distribution to the Owner or authorized Owner's representative indicating that all fire suppression equipment has been tested and is 100% operational.
  - b. The final report shall be generated by the equipment manufacturers headquarters or authorized representative to ensure integrity and uniformity of all testing procedures and



reporting. The report shall contain the testing information, stating the precise location and operational status of each and every peripheral device.

- c. The 100% System Checkout and Test shall be performed by factory-trained representatives, and one of the individuals shall possess a state license for fire suppression system installation supervision.

### 3.6 TRAINING:

- A. Prior to final acceptance, the Contractor shall provide operation training to **[Owner's] [Tenant's]** personnel. Each training session shall include emergency procedures, abort functions, system control panel operation, trouble procedures, and safety requirements. Each session shall include a complete demonstration of the system with the exception of an actual Clean Agent discharge and shall demonstrate all control functions. Dates and times of the training period shall be coordinated through the **[Owner] [Tenant]**.
- B. The installing Contractor shall provide training on system operation, alarms, and functions for all personnel who work within the projected area.

### 3.7 AS-BUILT/RECORD DRAWINGS

- A. Two sets of operating manuals and as-built drawings shall be provided by the Contractor. The as-built drawings shall include a reproducible drawing and two copies of each as-built drawing. The drawings and manuals shall be used in the training sessions. At this time, manuals describing the system equipment, as-built wiring diagrams, system keys, and certification of a 100% system audit will be delivered to the **[Owner] [Tenant]**.
- B. Refer to Section 23 01 00 for additional As-Built/Record Drawings requirements.

### 3.8 WARRANTY:

- A. The fire suppression system shall be warranted against defects in workmanship and materials, under normal use and service, for a period of 5 years from the date of acceptance by the **[Owner] [Tenant]**. Any equipment shown to be defective shall be repaired, replaced, or adjusted free of charge.

### 3.9 CLEAN AGENT FIRE SUPPRESSION SYSTEM INSPECTIONS:

- A. The Contractor shall provide two inspections of each system installed under his contract during the first year of the warranty period. The inspections shall be at 6 month intervals after system acceptance. Inspections shall include determination of agent container weight and pressure, and that the system is in proper working order. Inspection shall also include a complete checkout of the control, detection, and alarm system. Documents certifying satisfactory system conditions shall be submitted to the **[Owner's] [Tenant's]** technical representative upon completion of each inspection.

### 3.10 SPARE PARTS:

- A. Upon completion of the project, the fire suppression system manufacturer shall provide a letter to the Owner stating that spare parts for this system will be made available for a period of 10 years from date of acceptance.

### 3.11 WARNING AND EQUIPMENT INSTRUCTION PLATES:

- A. Contractor shall provide engraved instruction plates detailing emergency procedures at each manual discharge station, abort switch, and control panel/annunciator location. Permanent nameplates shall be used in the control panel to identify control logic units, contacts and major circuits. Permanent nameplates shall be provided on the control panel and graphic annunciator to identify all indicators and control switches.
- B. Contractor shall provide warning signs, matching the lease space graphic standards, outside each entrance to the Clean Agent protected area.

## END OF SECTION 21 22 00