

ENGINEERING SPECIFICATIONS

FM-200® CLEAN-AGENT FIRE SUPPRESSION SYSTEM

with

PYRO-CHEM® DETECTION/RELEASE SYSTEM

March 2001

SECTION 1 - GENERAL

I. SCOPE

This specification outlines the requirements for a "Total Flood" Clean Agent Fire Suppression System with automatic detection and control. The work described in this specification includes all engineering, labor, materials, equipment and services necessary, and required, to complete and test the suppression system.

II. APPLICABLE STANDARDS AND PUBLICATIONS

- A. The design, equipment, installation, testing and maintenance of the Clean Agent Suppression System shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards
 - 1) NFPA No. 2001 - Clean Agent Fire Extinguishing Systems
 - 2) NFPA No. 70 - National Electrical Code
 - 3) NFPA No. 72 - Standard For Protective Signaling
 - 4) Factory Mutual Approval Guide
 - 5) UL Listings
 - 6) Requirements of the Authority Having Jurisdiction (AHJ).
- B. The standards listed, as well as all other applicable codes, standards, and good engineering practices shall be used as "minimum" design standards.

III. REQUIREMENTS

The Suppression System installation shall be made in accordance with the drawings, specifications and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail.

IV. EXCLUSIONS

The work listed below shall be provided by others, or under other sections of this specification:

- A. 120 VAC or 220 VAC power supply to the system control panel.

- B. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.
- C. Connection to local/remote fire alarm systems, listed central alarm station(s) or sprinkler preaction/deluge valve actuation.

V. QUALITY ASSURANCE

A. MANUFACTURER

- 1) The manufacturer of the suppression system hardware and detection components shall be ISO 9000 registered.
- 2) The name of the manufacturer shall appear on all major components.
- 3) All devices, components and equipment shall be the products of the same manufacturer.
- 4) All devices, components and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.
- 5) All devices and equipment shall be U.L listed and/or FM approved.
- 6) Locks for all cabinets shall be keyed alike.

B. INSTALLER

- 1) The installing contractor shall be trained by the supplier to design, install, test and maintain fire suppression systems.
- 2) When possible, the installing contractor shall employ a NICET certified special hazard designer, Level II or above, who will be responsible for this project.
- 3) The installing contractor shall be an experienced firm regularly engaged in the installation of automatic Clean Agent, or similar, fire suppression systems in strict accordance with all applicable codes and standards.
- 4) The installing contractor must have a minimum of five (5) years experience in the design, installation and testing of Clean Agent, or similar, fire suppression systems. A list of systems of a similar nature and scope shall be provided on request.
- 5) The installing contractor shall show evidence that his company carries a minimum \$2,000,000.00 liability and completed operations insurance policy. These limits shall supersede limits required in the general conditions of the specifications.
- 6) The installing contractor shall maintain, or have access to, a Clean Agent recharging station. The installing contractor shall provide proof of his ability to recharge the largest Clean Agent system within 24 hours after a discharge. Include the amount of bulk agent storage available.
- 7) The installing contractor shall be an authorized stocking distributor of the Clean Agent system equipment so that immediate replacement parts are available from inventory.

- 8) The installing contractor shall show proof of emergency service available on a twenty-four-hour-a-day, seven-day-a-week basis.

C. SUBMITTALS

- 1) The installing contractor shall submit the following design information and drawings for approval prior to starting work on this project:
- a) Field installation layout drawings having a scale of not less than $1/8" = 1'-0"$ or 1:100 detailing the location of all agent storage tanks, nozzles, pipe runs including pipe sizes and lengths, control panel(s), detectors, manual pull stations, abort stations, audible and visual alarms, etc.
 - b) Auxiliary details and information such as maintenance panels, door holders, special sealing requirements and equipment shutdown.
 - c) Separate layouts, or drawings, shall be provided for each level, (i.e.; room, underfloor, and above ceiling) and for mechanical and electrical work.
 - d) A separate layout or drawing shall show isometric details of agent storage containers, mounting details, proposed pipe runs and sizes, and symbol legend.
 - e) Electrical layout drawings shall show the location of all devices and include point-to-point conduit runs and a description of the method(s) used for detector mounting.
 - f) Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.
 - g) Separate drawing providing symbol legend to identify all symbols used.
 - h) Annunciator wiring schematics and dimensioned display panel illustration shall be provided. (Optional device.)
 - i) Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for all engineered Clean Agent systems. Calculation sheet(s) must include the manufacturers name and UL listing number for verification. The individual sections of pipe and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.
 - j) Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms, initiating devices and auxiliary components under full load conditions.
 - k) A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.
- 2) Submit drawings, calculations and system component data sheets for approval to the local fire prevention agency, owner's insurance underwriter, and all other authorities having jurisdiction before starting installation. Submit approved plans to the architect/engineer for record.

SECTION 2 – SYSTEM REQUIREMENTS

I. SYSTEM DESCRIPTION AND OPERATION

- A. The system shall be a Total Flood FM-200 Suppression System supplied by PYRO-CHEM.
- B. The system shall provide a FM-200 minimum design concentration of 7.2% by volume for Class A hazards and 9.0% by volume for Class B hazards, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected area. System design shall not exceed 10.5% for normally occupied spaces, adjusted for maximum space temperature anticipated, with provisions for room evacuation before agent release.
- C. The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, FM-200 agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/ advisory signs, functional checkout and testing, training and all other operations necessary for a functional, UL Listed and/or FM approved FM-200 Clean Agent Suppression System.
- D. Provide two (2) inspections during the first year of service. Inspections shall be made at 6-month intervals commencing when the system is first placed into normal service.
- E. The general contractor shall be responsible for sealing and securing the protected spaces against agent loss and/or leakage during the 10-minute "hold" period.
- F. The system(s) shall be actuated by a combination of ionization and/or photoelectric detectors installed for maximum area coverage of 250 sq. ft. (23.2 m²) per detector, in both the room, underfloor and above ceiling protected spaces. If the airflow is one air change per minute, photoelectric detectors only shall be installed for maximum area coverage of 125 sq. ft. (11.6 m²) per detector. (Ref. NFPA No. 72.)
- G. Detectors shall be Cross-Zoned detection requiring two detectors to be in alarm before release.
- H. Automatic operation of each protected area shall be as follows:
 - 1) Actuation of one (1) detector, within the system, shall:
 - a) Illuminate the "ALARM" lamp on the control panel face.
 - b) Energize an alarm bell and/or an optional visual indicator.
 - c) Transfer auxiliary contacts which can perform auxiliary system functions such as: i) Operate door holder/closures on access doors, ii) Transmit a signal to a fire alarm system, iii) Shutdown HVAC equipment.
 - d) Light an individual lamp on an optional annunciator.
 - 2) Actuation of a 2nd detector, within the system, shall:
 - a) Illuminate the "PRE-DISCHARGE" lamp on the control panel face.
 - b) Energize a pre-discharge horn or horn/strobe device.

- c) Shut down the HVAC system and/or close dampers.
 - d) Start time-delay sequence (not to exceed 60 seconds).
 - e) System abort sequence is enabled at this time.
 - f) Light an individual lamp on an optional annunciator.
- 3) After completion of the time-delay sequence, the FM-200 Clean Agent system shall discharge and the following shall occur:
- a) Illuminate a "SYSTEM FIRED" lamp on the control panel face.
 - b) Shutdown of all power to high-voltage equipment
 - c) Energize a visual indicator(s) outside the hazard in which the discharge occurred.
 - d) Energize a "System Fired" audible device. (Optional)
- 4) The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of a manual device shall duplicate the sequence description above except that the time delay and abort functions shall be bypassed. The manual discharge station shall be of the electrical actuation type and shall be supervised at the main control panel.

II. MATERIALS AND EQUIPMENT

A. GENERAL REQUIREMENTS

- 1) The FM-200 Clean Agent System materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.
- 2) All devices and equipment shall be UL Listed and/or FM approved.

B. FM-200 AGENT STORAGE AND DISTRIBUTION

- 1) Each system shall have its own supply of clean agent.
- 2) The system design can be modular, central storage, or a combination of both design criteria.
- 3) Systems shall be designed in accordance with the manufacturer's guidelines.
- 4) Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.
- 5) The clean agent shall be stored in PYRO-CHEM Agent Storage Containers. Containers shall be super-pressurized with dry nitrogen to an operating pressure of 360 psi @ 70 °F (24.8 bar at 20 °C). Containers shall be of high-strength low alloy steel construction and conform to NFPA 2001.

- 6) Containers shall be actuated by a resettable electric actuator with mechanical override located at each agent container or connected bank of cylinders. Non-resettable or explosive devices shall not be permitted.
- 7) Each container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure. The low-pressure switch shall be wired to the control panel to provide an audible and visual "Trouble" alarms in the event the container pressure drops below 247 psi (17 bar). The pressure gauge shall be color coded to provide an easy, visual indication of container pressure.
- 8) Each container shall have a pressure relief provision that automatically operates before the internal pressure exceeds 750 psi (51.7 bar).
- 9) Engineered discharge nozzles shall be provided within the manufacturer's guidelines to distribute the FM-200 agent throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution.
 - a) Nozzles shall be available in 3/8 in. through 2 in. (BPS 10 mm through 50 mm) pipe sizes. Each size shall be available in 180° and 360° distribution patterns.
 - b) Ceiling plates can be used with the nozzles to conceal pipe entry holes through ceiling tiles.
- 10) Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements, NFPA 2001 and approved piping standards and guidelines. All distribution piping shall be installed by qualified individuals using accepted practices and quality procedures. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.
 - a) All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.
 - b) All pipe threads shall be sealed with Teflon tape pipe sealant applied to the male thread only.

C. CONTROL PANEL

- 1) The control panel shall be a PCR releasing panel supplied by PYRO-CHEM.
- 2) The control system and its components shall be UL listed and FM approved for use as a local fire alarm system with releasing device service.
- 3) The control system shall perform all functions necessary to operate the system detection, actuation and auxiliary functions.
- 4) The control system shall include battery standby power to support 24 hours in standby and 5 minutes in alarm.
- 5) The control system shall be microprocessor based utilizing a distributed processing concept. A single microprocessor failure shall not impact operation of additional modules on the system.
- 6) The control system shall be capable of supporting Cross Zoned Detection.

- 7) The control system shall supply integrated 2.0 amp power supply circuitry.
- 8) Each control system shall four (4) initiating circuits.
 - a) Each circuit shall be capable of Class A (Style D) or Class B (Style A) operation.
 - b) Each circuit shall be capable of operating up to fifteen (15) approved detectors for thirty (30) detectors per system.
 - c) Each circuit shall be capable of monitoring contact devices configured for manual release, manual alarm, system abort, trouble input or auxiliary (non-fire) input.
- 9) Each control shall contain release circuits for activation of an extinguishing/suppression system(s).
 - a) Each circuit shall be capable of Class B (Style Y) operation.
 - b) Each circuit shall be rated for 1.5 amp @ 24 VDC.
- 10) Each control system shall contain two (2) indicating appliance circuits for annunciation.
 - a) Each circuit shall be capable of Class A (Style B) or Class B (Style Y) operation.
 - b) Each circuit shall be rated for 1.5 amp @ 24 VDC.
- 11) Each control system shall provide an auxiliary power supply rated for 2 amps @ 24 VDC.
- 12) Each control system shall provide two (2) SPST relays: one for common alarm and one for common trouble. Four (4) additional programmable relays can be added to each control system by adding an RX2M Relay Module.

D. DETECTORS

- 1) The detectors shall be spaced and installed in accordance with the manufacturer's specifications and the guidelines of NFPA 72.
- 2) The Ionization detector shall be a PYRO-CHEM model, or equal in quality, performance and features.
- 3) The Photoelectric detector shall be a PYRO-CHEM model, or equal in quality, performance and features.

E. MANUAL RELEASE (Electric)

- 1) The electric manual release switch shall be a dual action device which provides a means of manually discharging the Suppression System when used in conjunction with the control system.
- 2) The Manual Release switch shall be a PYRO-CHEM model, or equal in quality, performance and features.

- 3) The Manual Release switch or Manual Pull station shall be a dual action device requiring two distinct operations to initiate a system actuation.
- 4) Manual actuation shall bypass the time delay and abort functions shall cause the system to discharge and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
- 5) A Manual Release switch shall be located at each exit from the protected hazard.

F. ABORT STATION (Optional)

- 1) The optional Abort Station shall be the "Dead Man" type and shall be located next to each manual switch.
- 2) The Abort Station shall be a PYRO-CHEM model, or equal in quality, performance and features.
- 3) The Abort Station shall be supervised and shall indicate a trouble condition at the control panel, if depressed, and no alarm condition exists.
- 4) "Locking" or "Keyed" abort stations shall not be permitted.

G. AUDIBLE and VISUAL ALARMS

- 1) Alarm audible and visual signal devices shall operate from the control panel.
- 2) The Alarm Bell, Alarm Horn and Horn/Strobe devices shall be PYRO-CHEM model, or equal in quality, performance and features.
- 3) The visual alarm unit shall be a PYRO-CHEM Strobe device, or equal in quality, performance and features.
- 4) A Strobe device shall be placed outside, and above, each exit door from the protected space. Provide an advisory sign at each light location

H. CAUTION and ADVISORY SIGNS

Signs shall be provided to comply with NFPA 2001 and the recommendations of the FM-200 equipment supplier.

- 1) Entrance sign: (1) required at each entrance to a protected space.
- 2) Manual discharge sign: (1) required at each manual discharge station.
- 3) Flashing light sign: (1) required at each flashing light over each exit from a protected space.

I. SYSTEM and CONTROL WIRING

- 1) All system wiring shall be furnished and installed by the contractor.
- 2) All wiring shall be installed in electrical metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.

- 3) All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, and installed parallel and perpendicular to walls and partitions.
- 4) The sizes of the conductors shall be those specified by the manufacturer. Color-coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors. Final terminations between the control panel and the system field wiring shall be made under the direct supervision of a factory-trained representative.
- 5) All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electrical Code, Article 725 and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 -1993 edition. Wiring installation shall meet all local, state, province and/or country codes.
- 6) The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

SECTION 3 – TESTING AND DOCUMENTATION

I. SYSTEM INSPECTION and CHECKOUT

After the system installation has been completed, the entire system shall be checked out, inspected and functionally tested by qualified, trained personnel, in accordance with the manufacturer's recommended procedures and NFPA standards.

- A. All containers and distribution piping shall be checked for proper mounting and installation.
- B. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
- C. The complete system shall be functionally tested, in the presence of the owner or his representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.
 - 1) Each detector shall be tested in accordance with the manufacturer's recommended procedures, and test values recorded.
 - 2) All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.
 - 3) Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

II. TRAINING REQUIREMENTS

Prior to final acceptance, the installing contractor shall provide operational training to each shift of the owners personnel. Each training session shall include control panel operation, manual and (optional) abort functions, trouble procedures, supervisory procedures, auxiliary functions and emergency procedures.

III. OPERATION and MAINTENANCE

Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, four (4) copies for each system, to the owner. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

IV. AS-BUILT DRAWINGS

Upon completion of each system, the installing contractor shall provide four (4) copies of system "As-Built" drawings to the owner. The drawings shall show actual installation details including all equipment locations (i.e.: control panel(s), agent container(s), detectors, alarms, manuals and aborts, etc.) as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One (1) copy of reproducible engineering drawings shall be provided reflecting all actual installation details.

V. ACCEPTANCE TESTS

- A. At the time "As-Built" drawings and maintenance/operations manuals are submitted, the installing contractor shall submit a "Test Plan" describing procedures to be used to test the control system(s). The Test Plan shall include a step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met. All tests shall be conducted in the presence of the owner and shall not be conducted until the Test Plan has been approved.
- B. The tests shall demonstrate that the entire control system functions as designed and intended. All circuits shall be tested: automatic actuation, solenoid and manual actuation, HVAC and power shutdowns, audible and visual alarm devices and manual override of abort functions. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.
- C. A room pressurization test shall be conducted, in each protected space, to determine the presence of openings which would affect the agent concentration levels. The test(s) shall be conducted using the Retro-Tec Corp. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001, Appendix B.
- D. If room pressurization testing indicates that openings exist which would result in leakage and/or loss of the extinguishing agent, the installing contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent. The general contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The installing contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed. THE SUPPRESSION SYSTEM INSTALLING CONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESS OF THE ROOM PRESSURIZATION TESTS. If the first room pressurization test is not successful, in accordance with these specifications, the installing contractor shall direct the general contractor to determine, and correct, the cause of the test failure. The installing contractor shall conduct additional room pressurization tests, at no additional cost to the owner, until a successful test is obtained. Copies of successful test results shall be submitted to the owner for record. 5) Upon acceptance by the owner, the completed system(s) shall be placed into service.

VI. SYSTEM INSPECTIONS

- A. The installing contractor shall provide two (2) inspections of each system, installed under this contract, during the one-year warranty period. The first inspection shall be at the six-month interval, and the second inspection at the 12-month interval, after system acceptance. Inspections shall be conducted in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.
- B. Documents certifying satisfactory system(s) operation shall be submitted to the owner upon completion of each inspection.

VII. WARRANTY

All PYRO-CHEM system components furnished and installed under this contract shall be warranted against defects in design, materials and workmanship for the full warranty period which is standard with the manufacturer, but in no case less than one (1) year from the date of system acceptance.