

# Engineering Specifications



**SAPPHIRE® Clean Agent  
Fire Suppression System  
with AUTOPULSE Z-10  
Conventional  
Detection System**

**FIRE DETECTION/SAPPHIRE® FIRE SUPPRESSION SYSTEM  
ENGINEERING SPECIFICATIONS**

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**Tyco Fire Protection Products**

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**PART 1 – GENERAL**

**1.01 SCOPE**

- A. 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 service necessary and required, to complete and test the suppression system.

**1.02 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. National Fire Protection Association (NFPA) Standards:
    - NFPA 2001: Standard on Clean Agent Fire Extinguishing Systems
    - NFPA 70: National Electrical Code
    - NFPA 72: National Fire Alarm and Signaling Code
    - NFPA 75: Standard for the Fire Protection of Information Technology Equipment
    - NFPA 76: Standard for the Fire Protection of Telecommunications Facilities
  2. Factory Mutual Systems (FM) Publication
    - Factory Mutual Approval Guide
  3. Underwriters Laboratories, Inc. (UL) Publication
    - UL 217: Standard for Single and Multiple Station Smoke Alarms
    - UL 228: Standard for Door Closers-Holders, With or Without Integral Smoke Detectors
    - UL 268: Smoke Detectors for Fire Alarm Systems
    - UL 268A: Standard for Smoke Detectors for Duct Application
    - UL 521: Standard for Heat Detectors for Fire Protective Signaling Systems
    - UL 864: Standard for Control Units and Accessories for Fire Alarm Systems
    - UL 1638: Standard for Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
    - UL 1971: Standard for Signaling Devices for Hearing Impaired
  4. Department of Transportation (DOT)
    - Title 49 Code of Federal Regulations Parts 100 to 199
    - Transportation of Hazardous Materials, DOT3AAZ300 or 3AAZ15T
  5. National Electrical Manufacturers Association (NEMA) Publication
    - Enclosures for Industrial Controls and Systems
  6. U.S. Environmental Protection Agency, Protection of Stratospheric Ozone 59 FR 13044, March 18, 1994 (Final SNAP Ruling)
  7. Industrial Risk Insurers (IRI) Interpretive Guide (Detection and Controls)
  8. Requirements of the Authority Having Jurisdiction (AHJ)
  9. Manufacturer's Design, Installation, Operation, and Maintenance Manual
  10. The system complete shall have the following applicable listings and approvals
    - a) Underwriters Laboratories Inc.
    - b) Factory Mutual Global

- B. The standards listed, as well as all other applicable codes, standards, and good engineering practices, shall be used as "minimum" design standards.

### 1.03 REQUIREMENTS

- A. This installation shall be made in strict accordance with the drawings, specifications and applicable NFPA Standards. All equipment and devices used shall be listed by the standardizing agencies (UL and/or FM).
- B. Design and installation of the fire detection/SAPPHIRE fire suppression system will be in strict accordance with the following guidelines and regulatory agencies:
  1. NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems
  2. NFPA 72 National Fire Alarm and Signaling Code, Latest Edition
  3. NFPA 70 National Electrical Code, Latest Edition
  4. Americans with Disabilities Act, Title 24, Latest Edition

### 1.04 EXCLUSIONS

- A. The work listed below shall be provided by others, or under other sections of this specification:
  1. 120 VAC or 220 VAC power supply to the system control panel.
  2. Interlock wiring and conduit for shutdown of HVAC, dampers and/or electric power supplies, relays or shunt trip breakers.

### 1.05 QUALITY ASSURANCE

- A. MANUFACTURER:
  1. The manufacturer of the suppression system hardware and detection components shall be ISO 9001 registered.
  2. The manufacturer brand name shall appear on all major components.
  3. All devices, components, and equipment shall be the products of the same manufacturer, or supplied by 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 UL 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 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 the company carries a minimum \$2 million 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 24 hours a day, 7 days a week.

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 in. = 1 ft.- 0 in. 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, sub floor, and above ceiling) and for mechanical and electrical work.
  - d) 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.
  - e) Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.
  - f) Separate drawing providing symbol legend and identifying all symbols used.
  - g) Annunciator wiring schematics and dimensioned display panel illustration shall be provided. (Optional device)
  - h) 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 manufacturer's 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.
  - i) 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.
  - j) 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 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.

## **PART 2 – SYSTEM REQUIREMENTS**

### **2.01 SYSTEM DESCRIPTION AND OPERATION**

- A. The system shall be a Total Flood SAPPHIRE Fire Suppression System supplied by Tyco Fire Protection Products (hereinafter referred to as "TFPP").
- B. The system shall provide a NOVEC 1230 agent minimum design concentration of 4.5% by volume for Class A hazards and a minimum of 5.85% 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% 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 a mechanical and electrical installation, all detection and control equipment, agent storage containers, NOVEC 1230 agent, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, advisory signs, functional checkout and testing, training, and any other operations necessary for a functional UL listed SAPPHIRE Clean Agent suppression system.
- D. Provide two 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 photoelectric detectors installed for maximum area coverage of 250 ft<sup>2</sup> (23.2 m<sup>2</sup>) per detector, in the room, under the floor, and above the ceiling protected spaces. If the airflow is one air change per minute, photoelectric detectors only shall be installed for maximum area coverage of 125 ft<sup>2</sup> (11.6 m<sup>2</sup>) per detector (Reference NFPA 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 detector, within the system, shall:
    - a) Illuminate the "ALARM" lamp on the control panel face.
    - b) Energize an alarm bell.
    - c) Transfer auxiliary contacts, which can perform auxiliary system functions such as: Operate door holder/closures on access doors; Transmit a signal to a fire alarm system; 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/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 SAPPHIRE 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.

## 2.02 MATERIAL AND EQUIPMENT

### A. GENERAL REQUIREMENTS:

1. The SAPPHIRE Clean Agent system materials and equipment shall be standard products of the supplier's latest design and suitable to perform all 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.
3. Each system shall have its own supply of clean agent.
4. The system design can be modular, central storage, or a combination of both design criteria.
5. Systems shall be designed in accordance with the manufacturer's guidelines.
6. 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.
7. The clean agent shall be stored in SAPPHIRE Clean Agent storage tanks. Tanks shall be super-pressurized with dry nitrogen to an operating pressure of 360 psi at 70 °F (24.8 bar at 21 °C). Tanks shall be of high-strength low alloy steel construction and conforming to NFPA 2001.
8. Tanks (master) shall be actuated by either a resettable electric actuator or by pneumatic means from a nitrogen cartridge located in the releasing device. Explosive devices shall not be permitted.
9. Each tank shall have a pressure gauge and low pressure switch (optional) to provide visual and electrical supervision of the container pressure. The low-pressure switch shall be wired to the control panel to provide audible and visual "Trouble" alarms in the event the container pressure drops below 290 psi (20 bar). The pressure gauge shall be color coded to provide an easy, visual indication of container pressure.
10. Tanks shall have a pressure relief provision that automatically operates before the internal nominal pressure exceeds 730 psi (50 bar).
11. Engineered discharge nozzles shall be provided within the manufacturer's guidelines to distribute the NOVEC 1230 agent throughout the protected spaces. The nozzles shall be designed to provide proper agent quantity and distribution. Nozzles shall be available in 1/2 in. through 2 in. pipe sizes. Each size shall be available in 180° and 360° distribution patterns.
12. 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.

### B. AGENT:

1. The fire suppression agent shall be 3M NOVEC 1230 Fire Protection Fluid manufactured by 3M Company, St. Paul, MN or their approved supplier.
2. Agent shall not contain any Hydrofluorocarbons (HFC).

C. CONTROL PANEL:

1. The control panel shall be an AUTOPULSE Z-10 releasing panel supplied by TFPP.
2. The detection 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 in the system.
6. The control system shall be capable of supporting Cross Zoned Detection.
7. The control system shall supply integrated 2.0 amp (minimum) power supply circuitry.
8. Each control system shall contain four 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 30 approved 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 system shall contain release circuits for activation of a fire suppression system(s):
  - a) Each circuit shall be capable of Class B (Style Y) operation.
  - b) Each circuit shall be rated for a minimum of 1.5 amp @ 24 VDC.
10. Each control system shall contain two 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 a minimum of 1.5 amp @ 24 VDC.
11. Each control system shall provide an auxiliary power supply rated for 750 mA @ 24 VDC.
12. Each control system shall provide two (2) SPST relays: one for common alarm and one for common trouble. Four additional programmable relays can be added to each control system by adding a 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 photoelectric detector shall be an ANSUL® model.

E. MANUAL RELEASE (ELECTRIC):

1. The electric manual release shall be a dual action device which provides a means of manually discharging the suppression system when used in conjunction with the detection system.
2. The manual release shall be an ANSUL model.
3. The manual release 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 and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
5. Manual release shall be located at each exit from the protected hazard area.

- F. ABORT STATION (Optional):
1. The optional abort station shall be the "Dead Man" type and shall be located next to each manual release.
  2. The abort station shall be an ANSUL model.
  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 an ANSUL model.
  3. The visual alarm unit shall be an ANSUL strobe device.
  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:
1. Signs shall be provided to comply with NFPA 2001 and the recommendations of the SAPPHIRE equipment provider.
    - a) Entrance sign: one required at each entrance to a protected space.
    - b) Manual discharge sign: one required at each manual release station.
    - c) Flashing light sign: one 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 (NFPA 70), Article 725 and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 (National Fire Alarm and Signaling Code). 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.



## **PART 3 – TESTING AND DOCUMENTATION**

### **3.01 SYSTEM INSPECTION AND CHECKOUT**

- A. 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.
  - 1. All containers and distribution piping shall be checked for proper mounting and installation.
  - 2. All electrical wiring shall be tested for proper connection, continuity and resistance to earth.
  - 3. 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 days prior to the final acceptance tests.
  - 4. Each detector shall be tested in accordance with the manufacturer's recommended procedures and test values recorded.
  - 5. 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.
  - 6. Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.

### **3.02 TRAINING REQUIREMENTS**

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

### **3.03 OPERATION AND MAINTENANCE**

- A. Prior to final acceptance, the installing contractor shall provide four complete operation and maintenance instruction manuals 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.

### **3.04 AS-BUILT DRAWINGS**

- A. Upon completion of each system, the installing contractor shall provide four 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, manual pull station(s), and abort switch(s), etc.), as well as piping and conduit routing details. Show all room or facilities modifications, including door and/or damper installations completed. One copy of reproducible engineering drawings shall be provided reflecting all actual installation details.

### **3.05 ACCEPTANCE TEST**

- 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 or owner's representative 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 and manual actuation, HVAC and power shutdowns, audible and visual alarm devices, and manual override of abort functions. Supervision of all control 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 Retrotec Inc. Door Fan system, or equivalent, with integrated computer program. All testing shall be in accordance with NFPA 2001.
- D. If room pressurization testing indicates that openings exist which would result in leaks 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 his record. Upon acceptance by the owner, the completed system(s) shall be placed into service.

### **3.06 SYSTEM INSPECTIONS**

- A. During the one-year warranty period, the installing contractor shall provide two inspections of each system installed under this contract. The first inspection shall be at the 6-month interval, and the second inspection at the 12-month interval. Inspections shall be conducted in accordance with the manufacturer's guidelines and the recommendations of NFPA 2001.
- B. Documents certifying satisfactory system(s) inspection shall be submitted to the owner upon completion of each inspection.

### **3.07 WARRANTY**

- A. All ANSUL 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.

## **END OF SECTION**

**Note:** The converted metric values in this document are provided for dimensional reference only and do not reflect an actual measurement.

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