**SECTION 21 25 40 – Victaulic Vortex™ HYBRID FIRE EXTINGUISHING SYSTEM for DATA CENTERS**

**PART 1 – GENERAL**

* 1. RELATED DOCUMENTS
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
	1. SUMMARY
2. This Section includes hybrid fire extinguishing products and solutions:
	1. Hybrid fire extinguishing systems.
	2. Pipe and fittings.
	3. Fluid Panels/Combination Panels.
	4. Extinguishing-agent containers.
	5. Fire extinguishing agent.
	6. Discharge Emitters.
	7. High Pressure Manifold/ Piping
	8. Fire control panels.
	9. Detection devices.
	10. Manual stations.
	11. Transducers.
	12. Alarm devices.
3. Related Requirements:
	1. Refer to FP series Drawings for additional requirements and clarifications.
	2. DEFINITIONS
4. AHJ: Authority Having Jurisdiction
5. EPO: Emergency Power Off
6. FM: Factory Mutual Approved
7. NFPA: National Fire Protection Association
8. UL: Underwriters Laboratory
	1. SYSTEM DESCRIPTIONS
9. Hybrid Fire Extinguishing System: A fire extinguishing system capable of delivering hybrid media at the specified design rate and proportion.
10. Hybrid Media: An extinguishing media created by the simultaneous discharge of water mist and inert gas agent in a controlled proportion from a common discharge device that results in an oxygen concentration less than 16 percent.
11. Hybrid Nozzle/Emitter: A special purpose device containing one or more orifices specifically designed to deliver the hybrid media to the fire.
	1. SUBMITTALS
12. Product Data: Manufacturer’s product technical data shall be provided to verify compliance with this specification and corresponding Contract Documents.
	1. Active Release Manifold System – Featuring Series 950 3000 psi Nitrogen Supply Cylinders and Cylinder Storage for Use with Victaulic Vortex™ Hybrid Fire Extinguishing System for Wet Benches. (70.07)
	2. Victaulic Vortex™ Hybrid Fire Extinguishing System Series 951 Panels. (70.03)
	3. Victaulic Vortex™ Hybrid Fire Extinguishing System Data Centers with Series 954 Hybrid Emitters. (70.12)
	4. Victaulic Vortex™ Flow Cartridge and Strainer Kit (70.16)
13. Sustainable Design Submittals:
	1. No ozone depletion potential or Global Warming Characteristic shall be accepted.
14. Shop Drawings: Working plans prepare in accordance with requirements of the applicable FM Datasheets [FM Data Sheet 5-32] [FM Data Sheet 4-6], or NFPA 770, to include, but not be limited to, the following:
	1. Plans, elevations, sections, and attachment details.
	2. Design calculations.
	3. Details of equipment assemblies. Indicate dimensions, weights, loads, manufacturer-required clearances, method of field assembly, components, and location and size of each field connection.
	4. Diagrams for power, signal, and control wiring.
	5. Permit-Approved Documents: Working plans and hydraulic calculations approved by authorities having jurisdiction.
15. Delegated-Design Submittal: For Hybrid fire extinguishing systems indicated to comply with performance-based design criteria, including analysis data verified by a licensed and qualified person.
16. Informational Submittals:
	1. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades in accordance with FM Datasheet [FM Data Sheet 5-32] [FM Data Sheet 4-6] requirements or NFPA 770 requirements.
17. Closeout Submittals and Documentation:
	1. Operation and Maintenance Data: For Hybrid fire extinguishing system to include operation, and maintenance manuals.
18. Maintenance Material Submittals:
	1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
	2. Container Valves: Not less than [10] <Insert number> percent of amount of each size and type installed.
	3. Emitters: Not less than [20] <Insert number> percent of amount of each type installed.

* 1. QUALITY ASSURANCE
1. Installer Qualifications: Installer’s responsibilities shall include but are not limited to design, fabrication, and installing of hybrid extinguishing systems and providing professional technical design services needed to assume engineering responsibility.
	1. Engineering Responsibility: Preparation of working plans, hydraulic calculations, and field test reports by a qualified fire protection engineer (FPE), professional engineer (PE), or where permitted by the AJH, a Certified Integrator, Level III or greater (NICET) National Institute of Certified Engineering Technician certified in Water-Based Systems Layout or Special Hazards Systems, shall be acceptable.
2. Hybrid extinguishing system design, equipment, specialties, accessories, installation, and testing shall comply with the following:
	1. Authority Having Jurisdiction
	2. FM Global Property Loss Prevention Data Sheets
	3. The most current edition of NFPA 770 – Standard on Hybrid (Water and Inert) Fire Extinguishing Systems
	4. Manufactures Installation and Technical Data sheet requirements.
	5. COORDINATION
3. Coordinate layout and installation of piping, valves, panel, nitrogen tanks, devices, and emitters with other trades prior to installation.

**PART 2 – PRODUCTS**

* 1. PERFORMANCE REQUIREMENTS
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Seismic Performance: Fire-suppression piping shall withstand the effects of earthquake motions determined in accordance with Applicable FM Datasheets.
	1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified [and the unit will be fully operational after the seismic event].
	2. HYBRID SYSTEMS
3. Victaulic Vortex™ Hybrid Fire Extinguishing System for Data Centers
4. Source Limitations: Obtain Hybrid systems from single source from single manufacturer.
5. Description: Unless otherwise specified, protection shall be by an engineered hybrid, Victaulic Vortex™ Hybrid Fire Extinguishing System for Data Centers hybrid media system. The system shall incorporate separate pressurized streams of nitrogen and water which are combined and discharged as a hybrid inert gas fog into the fire hazard.
6. Delegated-Design: For Hybrid fire extinguishing systems indicated to comply with performance and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
7. Performance Requirements: Discharge Hybrid Fire Fighting Media within the time as specified by the appropriate design standard.
8. System Capabilities
	1. Piping Requirements
		1. In accordance with Section 2.4 of this specification
		2. Piping size and fittings sized for required nitrogen/ water flows and delivery per appropriate I-Vortex manual.
		3. Pressure rating:
			1. Nitrogen piping:
				1. Minimum 3000 psig minimum working pressure upstream of fluid/ combination panel

Lower ratings permissible with lower pressure nitrogen supplies protected by an appropriately sized relief valve

* + - * 1. Minimum 175 psig from outlet of combination or zone panel to emitters
				2. Minimum 175 psig from fluid panel outlet to zone panel inlet

Protect fluid to zone panel piping with appropriately sized pressure relief valve

* + - 1. Water piping:
				1. Minimum 175 psig
1. System Operating Sequence:
	1. Dry Contact - Upon activation of the detection system, a release signal from the agent-releasing FACP is routed to the Combination or Fluid Panel. The signal is then sent to the primary solenoid release assembly. The primary solenoid release assembly allows pressure from the primary cylinder into the connected pilot line, which provides a conduit for the pressure to enter the upper chambers of the remaining cylinder valves. When the upper chamber becomes pressurized, the cylinder valve opens, (indicated by the upward movement of the valve position indicator located on top of the cylinder valves). The open cylinder valves allow nitrogen gas to pressurize the manifold. The Victaulic Vortex system is designed to begin to discharge upon application of the second 24V release signal to the automatic water valve. When nitrogen flow starts, a downstream of the panel (combination or fluid) the pressure transducer senses pressure within the system piping. The pressure transducer provides a continuous signal to the ARV during actuation to maintain constant system pressure until the pressure in the cylinders is depleted.
	2. Active Release - Upon activation of the detection system, a release signal from the agent-releasing FACP is routed to the Combination or Fluid Panel. The signal is then sent to the primary solenoid release assembly. The primary solenoid release assembly allows pressure from the primary cylinder into the connected pilot line, which provides a conduit for the pressure to enter the upper chambers of the remaining cylinder valves. When the upper chamber becomes pressurized, the cylinder valve opens, (indicated by the upward movement of the valve position indicator located on top of the cylinder valves). The open cylinder valves allow nitrogen gas to pressurize the manifold. The Victaulic Vortex system may be designed to begin to discharge upon pressure detected at the inlet of the panel. When nitrogen flow starts, a downstream of the panel (combination or fluid) the pressure transducer senses pressure within the system piping. The pressure transducer provides a continuous signal to the ARV during actuation to maintain constant system pressure.
	3. Extinguishing - agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
	4. Manual stations shall immediately discharge extinguishing agent when activated.
	5. Operating abort switches (if applicable) will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release hand pressure on the switch to cause agent discharge after the time delay has expired.
	6. EPO: Will terminate power to protected equipment immediately on actuation.
	7. Low-Nitrogen Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
	8. VALVES AND DEVICES
2. Valves and Devices - The valves used shall be in accordance with the I-VORTEX manuals and use one of the following in conjunction with the pressure transducer:
	1. Single Zone Options (multiple single zone options can be used for multizone systems)
		1. Combination Panel Dry Contact Panel with Automatic Drain Valve
			1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
			2. Alarm current: 3 amps maximum.
			3. Standby current: 210 mA.
			4. Supervisory connections: 500 mA @ 30 VDC resistive load.
			5. XNEMA 12/ IP52.
		2. Combination Panel Active Release Panel with Automatic Drain Valve
			1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
			2. Alarm current: 3 amps maximum.
			3. Standby current: 210 mA.
			4. Supervisory connections: 500 mA @ 30 VDC resistive load.
			5. NEMA 12/ IP52.
	2. Multi-Zone Options (Fluid Panel is Nitrogen Only, Zone Panel is Water only)
		1. Fluid Panels and Zone Panels Dry Contact
			1. Fluid Panel Electrical Requirements:
				1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
				2. Alarm current: 3 amps maximum.
				3. Standby current: 210 mA.
				4. Supervisory connections: 500 mA @ 30 VDC resistive load.
			2. Zone Panel Electrical Requirements:
				1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
				2. Alarm current: 4 amps maximum.
				3. Standby current: 45 mA.
				4. Supervisory connections: 500 mA @ 30 VDC resistive load.
		2. Fluid Panels and Zone Panels Active Release
			1. Fluid Panel Electrical Requirements:
				1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
				2. Alarm current: 3 amps maximum.
				3. Standby current: 210 mA.
				4. Supervisory connections: 500 mA @ 30 VDC resistive load.
		3. Zone Panel Electrical Requirements:
			1. Operating voltage: 24VDC continuous power supply (20.4-27 VDC), polarity sensitive.
			2. Alarm current: 4 amps maximum.
			3. Standby current: 45 mA.
			4. Supervisory connections: 500 mA @ 30 VDC resistive load.
		4. Pressure Transducer- Used with Combination and Fluid Panels
			1. Operating voltage: 24VDC nominal, polarity sensitive.
			2. Output: 4-20 mA (0 - 100 psi/0 - 6.9 Bar).
			3. Connections: 18 AWG shielded, twisted pair.
			4. 3.8 - 4.2 mA at atmospheric pressure.
			5. Operating Pressure: 25 – 50 psi / 1.7 – 3.4 Bar.
3. Discharge Emitters | Flow Cartridge
	1. Water Pressure 30-psi/2.1-Bar minimum and 100-psi/6.9-Bar maximum.
		1. Total Flooding Protection of Data Center applications with Volumes Up to and Including 31,350 ft3/888 m3 Applications.
			1. 3/8”, 5/8” and 1” Series 954 Cavity Foil with 0.13 – 1.06 gpm Water Flow Cartridge at a nitrogen design pressure of 25 – 50 psi.
	2. SYSTEM PIPING
4. See I-Vortex Manuals for applications of pipe, tube, fitting, and joining materials.
5. Piping: Comply with types and standards listed in FM Datasheets and the I-Vortex Manuals.
6. Nitrogen Distribution Piping:
	1. High Pressure Nitrogen Piping- Fittings meeting or exceeding AFME B31.1 with a pressure rating of at least 3000 psi.
	2. Low Pressure Nitrogen Piping- Minimum Schedule 10 carbon steel pipe and/or galvanized pipe or Schedule 5 stainless steel pipe for 3-inch/88.9- mm and smaller diameter piping.
	3. Alternative Nitrogen piping materials may be used, provided that the pipe is rated for this service, is protected from external damage, and is allowed by the AHJ and all applicable codes and standards.
7. Water Distribution Piping
	1. Comply with types and standards listed in FM Datasheets or NFPA 770; which referenced NFPA 13.
	2. Water Piping from Flow Control Cartridge- copper tubing or stainless-steel tubing.
	3. Alternative water piping/tubing piping materials may be used, provided that the pipe is rated for this service, is protected from external damage, and is allowed by the AHJ and all applicable codes and standards.
8. Steel Pipe: ASTM A53/A53M, Type S, Grade B or ASTM A106/A106M, [Grade A] [and] [Grade B]; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.
	1. Standard-weight, Black-Steel Pipe: Schedule 10 for sizes 1” and larger meeting ASTM A135 and Schedule 40 for sizes 1” and larger meeting ASTM A53 and ASTM A795 standards, with pipe ends factory or field formed to match joining method shall be approved for use on water-based sprinkler systems.
	2. Grooved pipe ends for 1” Schedule 40 [Schedule 10] sprinkler pipe shall be Victaulic IGS™ roll grooved only.
	3. Schedule 40 ASTM A53 Type F pipe shall not be used for gasketed mechanical fittings for pipe sizes 2” and smaller. [Exceptions: Wheatland Tube Ultra Z Coat].
	4. Pipe ends shall be grooved in accordance with manufacturers current listed standards conforming to ANSI/AWWA C-606. Basis of Design: Victaulic
	5. Steel Pipe Nipples: ASTM A733, made of ASTM A 53/A or ASTM A 106, Schedule 40. Seamless steel pipe with threaded or grooved ends.
	6. SYSTEM FITTINGS
9. Cast-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
10. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
11. Cast-Iron Flanges: ASME B16.1, Class 125
12. Grooved fittings to be [UL, FM] and designed to accept grooved end couplings and shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12. Basis of design: Victaulic Firelock™ Short Radius or Victaulic Standard Radius.
	1. Installation-Ready**™** and small diameter IGS™ grooved fittings can be used on sizes 1” (DN25) thru 2-1/2” (DN65) providing direct “stab” installation onto grooved pipe end. Fittings shall have a ductile iron housing conforming to ASTM A-536, Grade 65-45-12; UL listed for working pressure to 300psi and FM approved to 365psi and designed for use on roll grooved schedule 10 and/or schedule 40 pipe. Basis of design: Victaulic IR - Installation-Ready™ Fittings and Firelock IGS™ - Innovative Grooved System**.**
	2. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage to prevent freezing. Basis of Design: Victaulic #10-DR.
13. Bolted Branch Outlet Fittings: [UL, FM] Bolted branch outlets shall have a locating collar and cast back housing manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic pressure-responsive rubber gasket.
	1. Branch Pipe Reductions - Basis of Design: Victaulic Style 920 and 920N.
	2. Sprinkler, Gauge, and Drain Reductions – Basis of Design Victaulic Style 922.
14. Grooved joint couplings to be [UL, FM] and shall consist of two ductile iron housing segments conforming to ASTM A536, Grade 65-45-12; pressure responsive center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth; ASTM A449 compliant bolts and nuts; Installation-Ready™ for direct stab installation without field disassembly or per manufacturers installation guidelines and utilize a “pad-to-pad” assembly with visual inspection for verification of proper assembly. Couplings which require exact gapping at specific torque ratings are not permitted. Basis of Design: Victaulic.
	1. Rigid Type: Shall providing system rigidity and hanging support in accordance with NFPA-13 with a maximum working pressure of 365psi (2517kPa). Basis of Design: Victaulic Style 108, 109, 009N, 005H, 107N and 107V.
	2. Flexible Type: For use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Style 75, 004N and 177N.
	3. Flexible Type: For use in locations where the installation for seismic protection is required. Basis of Design: Victaulic Style 75 and 177N.
	4. High Pressure: Rigid and Flexible Type for use on systems exceeding standard system pressures of 365psi. Used for systems up to 750psi. Basis of Design: Victaulic Style 07, 107N, 107V, HP70, 75, 77 and 177N
15. Grooved Reducing Couplings used to permit direct reduction of size on piping run to be [UL, FM] and shall consist of two ductile iron housing segments conforming to ASTM A536, Grade 65-45-12 and be rated to 500 psi. Basis of Design: Victaulic Style 750
16. Grooved Outlet Couplings used to provide reducing outlet on piping runs to be [UL, FM] and shall consist of two ductile iron housing segments conforming to ASTM A536, Grade 65-45-12 and be rated to 500 psi. Basis of Design: Victaulic Style 72
17. Threaded Fittings to be malleable-iron fittings: ASME B16.3, Class 300, with a working pressure: 620 psig (4278 kPa) minimum.
18. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
19. Steel, Grooved-End Fittings: FM Approved, UL Listed and NRTL listed, ASTM A47/A47M malleable iron or ASTM A536 ductile iron, with dimensions matching steel pipe and ends factory grooved in accordance with AWWA C606.
	1. VALVES
20. General Fluid Panel Requirements:
	1. Approved by the Authority Having Jurisdiction.
	2. Container Valves: Solenoid and manual release handwheel, capable of immediate and total agent discharge and suitable for intended flow capacity.
	3. Valves in Sections of Closed Piping and Manifolds: Fabricated to prevent entrapment of liquid or install valve and separate pressure relief device.
21. Valves in Manifolds:
	1. Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.
	2. EXTINGUISHING-AGENT CONTAINERS
22. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
	1. Finish: GLOSS BLACK, Gillespie P2100 or equivalent.
	2. Manifold:
		1. Single Piece Carbon Steel High Pressure Nitrogen manifold, painted for corrosion resistance.
		2. Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
	3. Storage-Tank Brackets:
		1. Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.
23. Bulk Tubes
	1. The Victaulic Vortex™ Hybrid Fire Extinguishing System for Data Center System may also use a bulk nitrogen supply, consisting of either high-pressure nitrogen tubes or a low-pressure nitrogen lank.
	2. Bulk tubes can provide custom-sized ASME rated high-pressure manifolded tubes for the nitrogen supply. DOT tube packs may be used if approved by the AHJ, in accordance with applicable local codes and standards. Contact Victaulic for sizing and site-specific solution.
	3. FIRE EXTINGUISHING CLEAN AGENT
24. Clean Agent
	1. Nitrogen: 99.9% quality of nitrogen.
25. Water
	1. Potable water. Do not use water supplied by sprinkler system, brackish or salt water, or still water.
	2. FIRE CONTROL PANELS
26. Description: FM Approved, including equipment and features required for testing, supervising, and operating fire extinguishing system in accordance with the local AHJ.
27. Power Requirements: 120/240 V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
28. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
29. Mounting: [Recessed flush with surface] [Surface].
30. Supervised Circuits: Separate circuits for each independent hazard area.
	1. Detection circuits equal to required number of zones, or addressable devices assigned to required number of zones.
	2. Manual pull-station circuit.
	3. Alarm circuit.
	4. Release circuit.
	5. Abort circuit.
	6. EPO circuit.
31. Control-Panel Features:
	1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
	2. Automatic switchover to standby power at loss of primary power.
	3. Storage container, low-pressure indicator.
	4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
32. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless steel or aluminum enclosure.
33. Standby Power: [Sealed lead calcium] [Sealed, valve-regulated, recombinant lead acid] [Vented, wet-cell pocket, plate nickel cadmium] batteries with capacity to operate system for 72 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.
	1. DETECTION DEVICES
34. Description: Comply with FM Datasheets; 24 V dc, nominal.
	1. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.
	2. Photoelectric Detectors: LED light source and silicon photodiode receiving element.
	3. Remote Air-Sampling Detector System: Includes air-sampling pipe network, laser-based photoelectric detector, sample transport fan, and control unit.
		1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.
		2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.
		3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05 inch wg (12.5 Pa) at all sampling ports.
	4. Other detection devices installed in accordance with their Listing with approval from the AHJ.
35. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.
36. Signals to the Central Fire-Alarm Control Panel: Any type of local system trouble is reported to central fire-alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to central fire-alarm control panel as separately identified zones.
	1. MANUAL STATIONS
37. Description: [Surface] [Semi-recessed] FM Approved, with clear plastic hinged cover, 120-V ac or low-voltage compatible with controls. Include contacts for connection to control panel.
38. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.
39. Abort Switch: "ABORT" caption, momentary contact, with green finish.
40. EPO Switch: "EPO" caption, with yellow finish.
	1. SWITCHES
41. Description: FM Approved, where available, [120-V] <Insert value> ac or low- voltage compatible with controls. Include contacts for connection to control panel.
	1. Low-Agent Pressure Switches: Pneumatic operation.
	2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
	3. Disconnect Switch installed in accordance with FM Datasheets, or NFPA 770, and NFPA 72.
	4. ALARM DEVICES
42. Description: FM Approved, low voltage, and surface mounting. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems" for alarm and monitoring devices.
	1. Bells: Minimum 6-inch (150-mm) diameter.
	2. Horns: With the applicable dBA ratings for the application.
	3. Strobe Lights: Translucent lens, with "FIRE" or similar caption.
	4. Oxygen Deficiency Monitor.
	5. Sampling Method and Range: Diffusion, zero to 25 percent O2.
		1. 24 V dc.
		2. Wall mounted with bracket.
		3. Built-in audible alarm 90 dBA.
		4. Backlit LCD.

**PART 3 – EXECUTION**

* 1. EXAMINATION
1. Examine areas and conditions, with Installer present, for compliance with enclosure integrity requirements, installation tolerances, and other conditions affecting performance of the Work in accordance with FM Datasheets or NFPA 770.
2. Proceed with installation only after unsatisfactory conditions have been corrected.
	1. INSTALLATION
3. Install Hybrid containers, piping, and other components level and plumb, in accordance with manufacturers' written instructions.
4. Hybrid Container Mounting:
	1. Install Hybrid containers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in- Place Concrete."
	2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
	3. Comply with requirements for vibration isolation devices specified in Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."
5. Grooved Piping Joints: Groove pipe ends in accordance with AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant in accordance with manufacturer's written instructions.
6. Install pipe and fittings, valves, and discharge Emitters in accordance with requirements listed in FM Datasheets, Section "Distribution."
7. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valve sections of piping systems.
8. Support piping using supports and methods in accordance with FM Datasheets or NFPA 13.
9. Install seismic restraints for extinguishing-agent piping systems.
10. Install control panels, detection system components, alarms, and accessories, in accordance with requirements listed in FM Datasheets, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
	1. SYSTEM CONNECTIONS
11. Piping
	1. Drawings indicate general arrangement of piping, fittings, and specialties.
	2. Where installing piping adjacent to equipment, allow space for service and maintenance.
12. Electrical
	1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
	2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
	3. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
	4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
	5. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" or Section 284621.13 "Conventional Fire-Alarm Systems."
13. Controls
	1. Install control and electrical power wiring to field-mounted control devices.
	2. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
	3. IDENTIFICATION
14. Identify system components and equipment. Comply with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
15. Identify piping, extinguishing-agent containers, other equipment, and panels in accordance with FM Datasheets.
16. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a Hybrid fire extinguishing system.
17. Install signs at entry doors to advise persons outside the room the meaning of horn(s), bell(s), and strobe light(s) outside the protected space.
	1. FIELD QUALITY CONTROL
18. Testing Agency: [Owner will engage] [Engage] a Certified Installer testing agency to perform tests and inspections.
19. Manufacturer's Field Service: Engage a Certified Installer to test and inspect components, assemblies, and equipment installations, including connections.
20. Tests and Inspections:
	1. Perform tests and inspections [with the assistance of a Certified service representative].
	2. After installing Hybrid fire extinguishing system and after electrical circuitry has been energized, test for compliance in accordance with requirements listed in FM Datasheets, Section "Approval of Installation."
	3. Hybrid fire extinguishing system and associated protected enclosure will be considered defective if either does not pass required tests and inspections.
	4. Prepare test and inspection reports in accordance with requirements listed in FM Datasheets, Section "Installation Acceptance."
	5. CLEANING
21. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing Emitters or discharge devices.
	1. OPERATIONAL CONDITION SYSTEM FILLING
22. Verifications and Preparations:
	1. Verify that Hybrid fire extinguishing system and protected enclosure have passed all required tests and inspections in accordance with FM Datasheets.
	2. Verify that Hybrid fire extinguishing piping system installation is completed and cleaned.
	3. Verify complete enclosure integrity.
	4. Verify operation of ventilation and exhaust systems.
23. Filling Procedures:
	1. Fill Hybrid fire extinguishing containers with extinguishing agent and pressurize to indicated charging pressure.
	2. Install filled containers.
	3. Energize circuits.
	4. Adjust operating controls.
	5. DEMONSTRATION
24. [Engage a Certified representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain Hybrid fire extinguishing systems.

END OF SECTION