SECTION 21 2200

CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

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LANL MASTER SPECIFICATION SECTION

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| Rev. 7 Summary of changes: Major revision adopting content aligned with commercial industry practice. |

Word file at <http://engstandards.lanl.gov>

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  The specification section must also be edited to delete requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from requirements in this section that are applicable, contact the Engineering Standards Manual Fire [POC](http://engstandards.lanl.gov/POCs.shtml#fire). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Note that DOE-STD-1066 Appendices A and B are not applicable to the Work specified herein. Consider the scope and purpose of DOE documents as pertains to commercial construction before editing such requirements into this specification.

This template is developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality sections.
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1. GENERAL
2. SECTION INCLUDES
3. Fire suppression system control panel.
4. Space or area signage.
5. System piping and specialties.
6. Clean-agent containers.
7. Agent discharge nozzles.
8. RELATED SECTIONS
9. Section 01 2500, *Substitution Procedures*
10. Section 01 3300, *Submittal Procedures*
11. Section 01 4000, *Quality Requirements – Non-Nuclear*
12. Section 01 4444, *Offsite Welding, Brazing and Joining Requirements*
13. Section 01 4525, *Nondestructive Examination (NDE) Requirements*
14. Section 01 7700, *Closeout Procedures*
15. Section 07 8400, *Firestopping*
16. Section 08 7100, *Door Hardware*: Release hardware for automatic closing doors
17. Section 09 9100, *Painting*
18. Section 23 3300, *Air Duct Accessories*: Control dampers
19. Section 25 5000, *Integrated Automated Facility Controls*
20. Section 26 0519, *Low Voltage Electrical Power Conductors and Cables*
21. Section 28 4600, *Fire Detection and Alarm*: Building fire alarm system and devices
22. REFERENCES
23. ASHRAE 135 - A Data Communication Protocol for Building Automation and Control Networks.
24. ASME A13.1 – Scheme for the Identification of Piping Systems
25. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
26. ASME B31.1 - Power Piping.
27. ASME B40.100 - Pressure Gauges and Gauge Attachments.
28. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.
29. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
30. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
31. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
32. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe.
33. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
34. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
35. NFPA 4 – Standard for Integrated Fire Protection and Life Safety System Testing.
36. NFPA 70 - National Electrical Code.
37. NFPA 72 - National Fire Alarm and Signaling Code.
38. NFPA 75 – Standard for the Fire Protection of Information Technology Equipment.
39. NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems.
40. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
41. UL 404 – Pressure-Indicating Gauges for Compressed Gas Service.
42. UL 1076 - Proprietary Burglar Alarm Units and Systems.
43. ACTION SUBMITTALS
44. Per the requirements of 01 4444, *Offsite Welding and Joining Requirements*, submit to this section:

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For high-risk applications such as ML‑1 or ML‑2, add submittals for "Weld Filler Material Control Procedures" and "Filler Material Certified Material Test Reports (CMTRs)" when required. Add "Post‑Weld Heat Treatment Procedures" when required.

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* 1. Welding Procedure Specification (WPS) and supporting Procedure Qualification Record (PQR).
	2. Welder Performance Qualification Records (WPQR) including continuity
1. Per the requirements of 01 4525, *Nondestructive Examination (NDE) Requirements,* submit to this section:
	* + 1. Written Practice or Procedure for Qualification and Certification of NDE Personnel
			2. NDE Personnel Qualification Records
			3. NDE Procedures
			4. NDE Procedure Qualification Records (when required by code)
			5. NDE Report(s).
2. DELEGATED DESIGN SUBMITTALS
3. Submit shop drawings, corresponding calculations and product data to the LANL Fire Marshal’s office for approval in accordance with 01 3300, *Submittal Procedures*.
4. Product Data: Provide system and component data. Include detectors, release devices, discharge nozzles, manual controls, alarm devices, annunciators, extinguishing agent containers, manifolds, and control panel.
5. Shop Drawings:
6. Floor Plan(s): System layout with proposed raceway, piping, and component locations with a minimum drawing scale of 1/8 inch to 1 foot, use larger scale for details.
7. Schematics: System riser, control and wiring diagrams with written sequence of operation.
8. Pipe supports to include seismic bracing, as required.
9. Calculations: Submit design calculations. Include the following:
	1. Calculated system concentration, pressures, nozzle flow rate, orifice code numbers, piping pressure losses, component flow data, pipe sizes.
	2. Egress time study in accordance with NFPA 2001.
	3. Seismic design.
10. INFORMATIONAL SUBMITTALS
11. Certificates: Certify that products meet or exceed specified requirements.
12. Manufacturer: Certify that system meets or exceeds specified requirements.
13. Manufacturer's Installation Instructions: Include recommended equipment installation and system components.
14. Test Reports: Indicate successful completion of tests; include certification of extinguishing agent container pressure and extinguishing agent quantity.
15. As-Built Drawings: Record actual locations of components and equipment, equipment identification markings, conduit and piping routing details, and agent container positions.
16. Operation and Maintenance Data:
17. Prior to [training; Substantial Completion; Final Completion], provide electronic files of operation and maintenance data.
18. Include system schematic, written description of system design, drawings illustrating piping and equipment locations, and technical brochures describing equipment.
19. Include controls schematic, and all control sequences.
20. Include electrical schematic.
21. Include manufacturer recommended spare parts list.
22. Include checklists and procedures for routine maintenance, emergencies, troubleshooting techniques, abort functions, system control panel operation, trouble procedures, and safety requirements.
23. Manufacturer’s standard warranty.
24. Maintenance Materials: See Section 01 7700, *Closeout Procedures* for additional provisions. Furnish the following:
25. Equipment Maintenance Tools: One set, including special tools necessary for servicing and maintaining the equipment installed.
26. Extra Detectors: [One; Two; or \_\_\_\_] of each type.
27. QUALITY ASSURANCE
28. Perform Work in accordance with NFPA 2001.
29. Designer Qualifications: Design system under direct supervision of a [Professional Fire Protection Engineer experienced in fire protection design and licensed in NM state; NICET Level IV certified technician in “Special Hazards Systems”]. Drawings and calculations shall be sealed by NICET Level IV or Professional Engineer. Designer/installer shall be certified by the system manufacturer.
30. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than [three; or \_\_\_\_\_] years[ documented; \_\_\_\_\_; or None - N/A] experience.
31. Welding Materials and Procedures: Comply with [ASME BPVC-IX](http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASME%20BPVC-IX) and Sections 01 4444 for offsite welding and 01 4525 for NDE (nondestructive examination).
32. Installer Qualifications: Company specializing in performing the Work of this section and with at least [five; or \_\_\_\_\_] years of[ documented; \_\_\_\_\_; or None - N/A] experience[ and approved by manufacturer; or None - N/A].
33. DELIVERY, STORAGE, AND HANDLING
34. Deliver and store equipment in shipping containers with labeling in place. Deliver fire extinguishing agent in approved containers.
35. WARRANTY
36. See Section 01 7700, *Closeout Procedures* for additional warranty requirements.
37. Provide [one; or \_\_\_\_] year system warranty for materials and labor.
38. Provide manufacturer's standard [two; or \_\_\_\_] year warranty for complete replacement of fire extinguishing agent due to regulatory changes.
39. Provide manufacturer's standard [two; or \_\_\_\_] year warranty for complete replacement of fire extinguishing agent due to system discharge, regardless of cause.
40. PRODUCTS
41. SEISMIC PERFORMANCE REQUIREMENTS

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The following paragraph is based on NFPA 2001-2018, MSS SP-127-2014a, and LANL ESM Ch. 5 Sect. II, Rev. 12, para. 1.8, *Section 1613 Earthquake Loads*. If the code/standard edition is different from the above, designer must update this section accordingly.

The modification to MSS SP-127 is because the concrete-anchor tables therein are not compliant with the anchorage-to-concrete provisions in ESM Ch. 5 Sect. II (i.e., Appendix A) or those in the IBC (i.e., Sect. 1901.3).

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* + 1. Pipe Hangers and Supports: Design hangers and supports for system piping in accordance with NFPA 2001 paragraph 4.2.3 and modified as follows:
			1. Modify subparagraph 4.2.3.5 as follows: Seismic bracing shall be in accordance with MSS SP-127 based on the following:
				1. Seismic Design Category (SDC) is D.
				2. Seismic design accelerations shall be based on ESM Ch 5, Section II.
				3. If anchorage to concrete is applicable, follow MSS SP-127 paragraph 4.24 as modified by LANL ESM Chapter 5 Section II Appendix A and ACI 318 (LANL adopted edition) as amended by IBC (LANL adopted edition) Section 1905.
1. MANUFACTURERS
2. ANSUL, a Tyco brand, Johnson Controls International, LLC
3. Fike Corporation
4. Kidde Fire Systems, a Carrier Company
5. Pyro-Chem, a Tyco brand, Johnson Controls International, LLC
6. Substitutions: [Alternate products may be accepted, follow Section 01 2500, *Substitution Procedures*; or Not permitted – No substitutions].
7. CLEAN-AGENT FIRE SUPPRESSION SYSTEM REQUIREMENTS
8. Engineered fire detection and suppression system that totally floods protected area with clean-agent fire extinguishing agent to extinguish fire.
9. Comply with [NFPA 2001](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=NFPA%202001) and [NFPA 72](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=NFPA%2072).
10. Fire Extinguishing Agent: [HFC-227ea, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_].
11. Locate extinguishing agent supply[ and backup supply] [in; near] each protected area.
12. Provide all manufactured system components from a single source and by a single manufacturer.
13. Provide components listed and labeled by [UL; and/or FM] for the type of system required and for use with the other components of the system.
14. System and Component Listings: [FM](http://www.fmglobal.com) and/or [UL](http://www.ul.com/) for intended purpose.
15. Products Requiring Electrical Connection: Listed and classified by [UL or \_\_\_\_\_] as suitable for the purpose specified and indicated.
16. Permanently mark valves with manufacturer's name and pressure rating.
17. Engineering System Design Criteria:
18. Provide total flooding of fire extinguishing agent at manufacturer's recommended concentration. Provide an egress time study.
19. Provide minimum of two zone circuits in each contiguous protected space.
20. Direct discharge parallel to ceiling; use 360 degree pattern nozzles except where obstructions would make 360 distribution inefficient.
21. Use UL-listed flow calculation software.
22. Provide sufficient amount of fire extinguishing agent. Consider the following when computing volume:
23. Volume of protected area.
24. Specific volume of fire extinguishing agent.
25. Additional quantities of fire extinguishing agent required to compensate for openings, pipe losses.
26. Forced ventilation, fan coast-down time, and damper actuation time.
27. Mechanical smoke control system.
28. Other special conditions affecting extinguishing agent concentration.
29. FIRE SUPPRESSION SYSTEM CONTROL PANEL
30. Provide system controller in the form of [fire alarm system connected programmable modules, or fire alarm system integrated control panel (see Section 28 4600, *Fire Detection and Alarm*); fire alarm system monitored, self-contained control panel or module; stand-alone, self-contained control panel].
31. Type: Combination type approved as both alarm and releasing device, with solid state internal circuitry enclosed in [NEMA ICS 6](https://global.ihs.com/doc_detail.cfm?document_name=NEMA%20ICS%206), Type 1 cabinet.
32. Provide [NFPA 72](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=NFPA%2072), Class [A; B; or \_] circuit supervision for wire break or ground faults of:
33. Zone detection loops.
34. Remote manual discharge stations.
35. Suppression system solenoid valves.
36. Power supply and circuit wiring and fuse.
37. Battery interconnecting wires and fuse.
38. Alarm in abort mode.
39. Conceal control switches and indicators, with exception of Power On, Master Trouble, Supervisory Trouble, Circuit 1 Alarm, Circuit 2 Alarm and Release Indicators.
40. Equip panel with following standard features:
41. Visual and audible annunciation of trouble or alarm signals.
42. Panel reset switch.
43. Trouble alarm silence switch with ring back feature.
44. Single Zone Detection: Cross zone.
45. Battery test meter and switch.
46. Manual discharge switch.
47. Deadman abort switch.
48. Programmable timers for pre-discharge and discharge, 0 to 60 second cycle.
49. Isolated relay contactors for external alarm or equipment and ventilation shutdown.
50. Relay contactors for general trouble signal.
51. Relay contactor activated by detector zone board in alarm or trouble mode.

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The following characteristics are not available from all manufacturers – verify.

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1. Drift compensation.
2. Sensitivity test complying with [NFPA 72](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=NFPA%2072), Chapter 5.
3. Maintenance alert feature.
4. System status report to display or printer.
5. Alarm verification with verification counter.
6. Presignal complying with [NFPA 72](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=NFPA%2072), paragraph 23.8.1.1.
7. Rapid (less than 2 seconds) manual station reporting.
8. Non-alarm points for general control.
9. Periodic, programmed detector self-test program software.
10. Pre-alarm advanced fire warning feature.
11. Detection: Capability of counting two detectors in alarm, two software zones in alarm or one smoke and one thermal detector in alarm.
12. March time and temporal coding.
13. Walk test with check for two detectors set to same address.
14. [UL 1076](http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=UL%201076) Security Monitor Points.
15. Control-by-time feature for non-fire operations with holiday schedule.
16. Automatic day or night adjustment of detector sensitivity.
17. Detector blink control for sleeping areas.
18. Annunciation: Provide the following annunciation:
19. Power On: Green.
20. System Trouble: Amber.
21. Battery Trouble: Amber.
22. Circuit 1 Trouble: Amber.
23. Circuit 2 Trouble: Amber.
24. Ground Fault: Amber.
25. Release trouble: Amber.
26. Alarm Circuit 1: Red.
27. Alarm Circuit 2: Red.
28. Agent Release: Red.
29. Alarm Silence: Amber.
30. Battery Polarity: Amber.
31. Abort Trouble: Amber.
32. Alarm Output Trouble: Amber.
33. Supervisory Trouble: Amber.

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Coordinate Standby Power source with Electrical Engineer. Delete following paragraph if standby power is provided by means other than battery.

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1. Standby Power: Provide [nickel cadmium; sealed lead acid] batteries and charger for continuous operation of detection, alarm, actuation and supervision functions for 24 hours, and alarm for 15 minutes. Provide automatic battery switch-over upon failure of primary power supply.
2. Building Automation interface: [ASHRAE 135, BACnet SC; ASHRAE 135, BACnet IP; ASHRAE 135, BACnet MS/TP].
3. Initiating Devices:
4. Refer to Section 28 4600, *Fire Detection and Alarm* for initiating devices.
5. Initiating devices shall be listed for use with the selected releasing panel.
6. Manual System Abort Switch:
7. Stainless steel plate with momentary contact push button, [countdown timer; or None - N/A][magnetic door holders manual release,; or None - N/A] for mounting on electrical outlet box; addressable using manufacturer's standard monitor module.
8. Engraved Sign or Label: Provide adjacent to each manual abort station, indicating area protected and that actuation will prevent discharge of fire extinguishing agent after automatic system is activated.
9. Notification and Control Devices:
10. Refer to Section 28 4600, *Fire Detection and Alarm* for notification appliances.
11. Refer to Section 23 3300, *Air Duct Accessories* for control dampers.
12. Fire-Suppression Operating Sequence:
13. Actuation of one detector in either zone circuit:
14. Illuminate zone indicator.
15. Energize alarm bell.
16. Shut down air-conditioning system and close dampers.
17. Close doors to area.
18. Signal building fire alarm system.
19. Actuation of second detector on second zone circuit:
20. Illuminate zone indicator.
21. Energize alarm horn.
22. Shut down power to protected equipment.
23. Actuate time delay for up to [30; 60; or \_\_\_\_] seconds.
24. Release extinguishing agent into protected area.
25. If abort switch is engaged, delay release.
26. Upon abort switch disengagement release extinguishing agent unless system cleared and reset.
27. Discharge of Extinguishing Agent:
28. Sounds alarm bells and horns.
29. Operates strobes.
30. Temperature Detection:
31. Lower Temperature: Illuminate indicator and energize [bell; horn; or \_\_\_\_].
32. Higher Temperature: Shut down power to protected equipment.
33. High Temperature Detection: Close circuit to sprinkler pre-action valve.
34. SPACE OR AREA SIGNAGE
35. Entrance Warning Sign: One warning sign at each entrance to protected area.
36. Exit Warning Signs: One lighted, flashing warning sign at each exit from protected area.
37. SYSTEM PIPING AND SPECIALTIES
38. Steel Pipe: [ASTM A53](http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM%20A53/A53M) or [ASTM A106](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM%20A106/A106M) Schedule 40, or [ASTM A135](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM%20A135/A135M) Schedule 10, [galvanized as specified in ASTM A53; black steel].
39. Fittings: [ASME B16.3](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASME%20B16.3) malleable iron class 300 for sizes 2 inch and smaller, or [ASTM A234](http://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASTM%20A234/A234M), wrought steel welding type fittings.
40. Joints: Threaded, welded, or grooved and shouldered pipe end couplings.
41. Pipe Hangers: [ASME B31.1](https://global.ihs.com/doc_detail.cfm?rid=BSD&document_name=ASME%20B31.1), [FM; UL] approved listing for sprinkler systems, split clamp up to [2-1/2 inch; \_\_\_\_ inch] size, riser clamps over [2-1/2 inch; \_\_\_\_ inch] size, adequate to offset discharge thrust.
42. Seismic Restraints: Provide seismic restraints per Article [2.1] Seismic Performance Requirements.
43. Escutcheons: Chrome plated pressed or stamped brass, one-piece or split pattern, minimum [2 inches; \_\_\_\_ inches] larger than opening.
44. Gauges: [ASME B40.100; UL 393; UL 404; or \_\_\_\_\_]; [3-1/2 inch; other] in diameter cast aluminum case, phosphor bronze bourdon tube, rotary brass movement, brass socket, front re-calibration adjustment, black figures on white background, 1 percent mid-scale accuracy, scale calibrated in [psi; kPa; both psi and kPa; or \_\_\_\_\_\_\_\_\_\_\_\_\_\_].
45. CLEAN-AGENT CONTAINERS
46. Containers: [None - N/A; or Comply with ASME BPVC-VIII-1.]
47. Steel, red enamel finish; standard model and size for ease of replacement and addition.
48. Where multiple, replaceable containers are used, provide only containers of the same size and holding the same amount of extinguishing agent.
49. Contents: Fill with required fire extinguishing agent.
50. Identification: Permanent plate or marking, specifying agent, tare and gross weight, pounds of fire extinguishing agent, and pressurization level; installed so plate or marking is visible and readable.
51. Safety Release: Equip with frangible disc safety device that operates when internal pressure exceeds [730 pounds per square inch; \_\_\_\_\_ pounds per square inch].
52. Safety Release: Equip with frangible disc safety device.
53. Valves: Heavy duty forged brass, with safety pressure relief device, manual control, discharge valve, and pressure gauge.
54. Pressure relief device activated at between 3000 to 3360 pounds per square inch.
55. Provide a solenoid pilot valve for each container or each bank of containers.
56. Actuator: Resettable electric or pneumatic with pressurized nitrogen cartridge. Explosive devices are NOT permitted.
57. Pressure Gauge: Visual indicator of internal pressure.
58. Low Pressure Switch: Electronic sensor; reports to control panel and provides audible and visual alarms when container pressure drops below [230 psi; \_\_\_\_\_ psi].
59. Manifold: Provide for systems with more than one container, with rack to secure each and check valves between each discharge and manifold.
60. Wall Bracket: [Manufacturer's standard; Manufacturer approved; or \_\_\_\_\_]; [UL; FM; or \_\_\_\_\_] listed, welded steel construction, modular design with saddle bottom and front bracket.
61. AGENT DISCHARGE NOZZLES
62. Nozzles: [UL](http://www.ul.com/) listed; orifice size providing required rates of discharge and coverage and to distribute extinguishing agent uniformly throughout protected area.
63. Construction: [Two-piece; One-piece; or \_\_\_\_\_][ chrome plated; \_\_\_\_\_\_\_\_\_\_; or None - N/A] brass or aluminum nozzle with textured finish with female pipe thread integral on body; one-piece deflector plate.
64. Orifice Union Nipple Assemblies:
65. Construction: Manufacturer's standard, [UL listed; FM approved; or \_\_\_\_\_\_\_].
66. Identification: Permanently marked with manufacturer's part number and [UL](http://www.ul.com/) listing or [FM](http://www.fmglobal.com) approval.
67. Rating: 2,000 lb.
68. Identification: Permanently mark nozzles with manufacturer's part number, UL listing and equivalent single orifice diameter.
69. EXECUTION
70. EXAMINATION
71. Verify that enclosing walls are continuous above ceilings and below raised floors to enable required concentration to be built up and maintained for required time to ensure fire is extinguished.
72. INSTALLATION
73. Ream pipe and tube ends. Remove burrs. Remove scale and dirt on inside and outside before assembly. Blow out pipe before nozzles or discharge devices are installed.
74. Route piping in orderly manner, concealed, plumb and parallel to building structure, and maintain gradient. Install piping to conserve building space, and not interfere with use of space and other work.
75. Securely support and brace piping in accordance with NFPA 2001, MSS SP-127 and ASME B31.1 with allowance for fire extinguishing agent thrust forces, and thermal expansion and contraction.
76. Use grooved mechanical couplings and fasteners only in accessible locations. Roll groove piping only.
77. Install unions downstream of valves and at equipment or apparatus connections.
78. Prepare pipe, fittings, supports, and accessories for finish painting, see Section 09 9100, *Painting*.
79. Identify in accordance with requirements of ASME A13.1.
80. Place directional arrows and system labels wherever piping changes direction and minimum [20 feet; \_\_\_\_ feet] on straight runs.
81. Containers: Mount and anchor as indicated on drawings.
82. In rooms with suspended ceiling tiles, clip or retain tiles within [4 foot; \_\_\_\_ foot] radius of the nozzles to prevent lifting during discharge.
83. Install wiring in compliance with [NFPA 70](https://downloads.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70) and Section 26 0519, *Low Voltage Electrical Power Conductors and Cables*.
84. Make final connections between equipment and system wiring under direct supervision of factory trained representative of manufacturer.
85. Install engraved plastic instruction plate, detailing emergency procedures, at control panel and at each manual discharge and abort switch location. At control panel identify control logic units, contacts, and major circuits with permanent nameplates.
86. Locate discharge nozzle approximately [6 inches; \_\_\_\_ inches] above or below ceiling and [6 inches; \_\_\_\_ inches] below raised floors. Avoid interference with other piping and equipment.
87. Locate remote manual releases at one or more doors to protect area where indicated. Locate deadman abort switch adjacent.
88. Mounting Height of Notification Appliances: Top-of-device between 72 and 80 inches above finished floor.
89. Locate extinguishing agent supply[ and backup supply] [in each protected area; near each protected area].
90. Locate manual release at each exit from protected area.
91. Locate strobe units at points of entrance to each protected area.
92. Locate abort station at points of exit from each protected area.
93. SIGNS
	* 1. Caution/Advisory Signs: Provide labeling on entrances, piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001, including:
94. Entrance sign at each entrance to a protected space.
95. Manual Discharge sign at each manual discharge station.
96. Flashing Light sign required at each flashing light over each exit from a protected space.
97. INTERFACE WITH OTHER SYSTEMS
98. Provide interlock with automatic closing door releases.
99. Provide interlock with fire-smoke or smoke control damper(s).
100. Provide connection to fire alarm system. See Section 28 4600, *Fire Detection and Alarm*.
101. Remote Monitoring: Link auxiliary alarm and trouble/fault contacts to Building Automation System. Refer to Section 25 5000, *Integrated Automated Facility Controls*.
102. FIELD QUALITY CONTROL
103. Manufacturer Services: Provide experienced manufacturer's field engineer to supervise installation and performance testing of the system.
104. Perform field inspection and testing in accordance with Section 01 4000, *Quality Requirements – Non-Nuclear*.
105. Test distribution piping and valving, prior to nozzle installation, to [50 psi; \_\_\_\_ psi] air pressure test. Inspect joints using soap water solution or halide torch or lamp. Repair leaks and retest. Maintain test pressure for [four; or \_\_\_\_\_\_] hours.
106. Upon completion of installation provide final checkout inspection by factory trained representative of manufacturer to ascertain proper system operation. Leave system in a fully commissioned and automatic readiness state with circuitry energized and supervised.
107. Test circuits including automatic discharge, manual discharge, equipment shut-down, alarm devices, and storage container pressure. Test supervision of each circuit.
108. Check each ionization detector with a sensitivity meter, adjust. Record sensitivity, and include record in test report.
109. Submit original copies of tests, indicating that factory trained technical representatives of the manufacturer have inspected and tested systems and are satisfied with methods of installation, connections and operation.
110. Pressure test entire enclosure with test fan, pressurizing protected area both under positive and negative conditions. Confirm that leakage is within system design allowance.
111. ACCEPTANCE TESTING
112. Conduct acceptance tests in the presence of the LANL Fire Marshal’s office and LANL STR. Notify LANL STR at least 5 working days in advance to witness tests.
	* 1. The acceptance test shall be in accordance with the manufacturer’s recommended procedures and NFPA 2001, Section “Approval of Installations”, and include the following:
			1. The entire control system to determine it functions as designed and intended. All circuits shall be tested, including:
				1. automatic actuation,
				2. manual actuation,
				3. HVAC and power shutdowns,
				4. audible and visual alarm devices,
				5. manual override of abort functions,
				6. smoke/fire damper operation, and
				7. agent container pressure supervision.
113. Supervision of all panel circuits, including AC power and battery power supplies, shall be tested and qualified.
114. Conduct a room pressurization test for each protected space to determine the presence of openings that would impact concentration levels during an activation. Conduct in accordance with NFPA 2001 requirements.
115. If openings are discovered, coordinate the proper sealing of the protected space(s).
116. Upon completion of repairs, conduct additional room pressurization tests, at no additional cost, until a successful test is obtained.
117. Submit electronic copy of successful test results to the LANL STR.
118. TRAINING
119. Demonstrate that components, except discharge assemblies, are functioning properly and in conjunction with the controls system. Training session shall include system control panel operation, manual and abort functions, trouble procedures, auxiliary functions, and emergency procedures
120. Submit integrated step-by-step test procedure for approval [30; or \_\_\_\_] days prior to training.
121. Provide a total of [\_\_\_\_] hours of training in [ ] sessions for the LANL Personnel, Los Alamos Fire Department[, and \_\_\_\_\_\_\_].
122. Perform visual inspection and overall review of system installed.
123. Place minimum of three UL-listed recording analyzers in space. Provide certification that testing devices have been checked by recognized testing authority within two weeks of date of demonstration.
124. Discharge system using manual-release switch mounted on control panel. Run discharge test with [compressed nitrogen at 360 psi; compressed nitrogen at 600 psi; compressed nitrogen at \_\_\_\_ psi]. After discharge, check for complete pressure release.

 END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 21 2200 Rev. 7, dated December 5, 2024.