MIT
Design Standards

DIVISION 21 —— Fire Protection

Issued 2022

Department of Facilities

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1. MIT FIRE PROTECTION SYSTEM GOALS

The first goal of MIT's fire protection system is to ensure the safety of students, faculty and staff. A secondary goal is to reduce the Institute's exposure to property loss or interruption in carrying out its mission of education and research. In order to meet these goals, fire sprinkler coverage is required in 100% of all spaces in all facilities. Projects in existing buildings will bring all renovated areas into conformance with the Institute standards and current code requirements.

Designers should understand that MIT requirements may differ from normal industry practice. This is most apparent in the level and quality of testing that MIT requires for all fire protection systems whether new or modified. Particular attention must be paid to such differences and the contract documents must clearly explain the contractor's responsibilities. This document will point out some of those differences but close cooperation with the MIT project manager and fire protection engineer will be necessary for a complete understanding of the Institute's requirements.

MIT's Underwriter is FM Global which has additional design and product requirements that must be adhered to. These requirements often exceed the requirements of the NFPA and Building Codes. FM Global now posts all of its data sheets with guidelines for the design of fire protection systems online at www.fmglobaldatasheets.com. The appropriate FM Global data sheets must be reviewed during the schematic and design development phases to ensure requirements for a particular project are incorporated into the design. The Engineering Design Professional must submit the basis of design, working drawings and hydraulic calculations for review and approval of the FM loss prevention consultant in addition to review by MIT. Further and of important note, all MIT facility designs are reviewed by FM Global for acceptance and/or comment.

Maintenance of the fire protection systems is a high priority of the Institute. MIT conducts regular maintenance on fire protection systems in accordance with NFPA 25 and FM Global requirements. The designer must consider the impacts of the system design and installation on maintenance, which may include requiring all control valves, flow switches, pressure switches etc., as being readily accessible. Identification of the fire protection systems is important to minimize the impacts of an impairment associated with modifications and to prevent damage in the event of an activation.

MIT maintains several active campus fire mains that serve portions of the campus. It is the designer's responsibility to coordinate with the MIT Fire Protection Engineer to determine if a particular project should utilize the campus fire main as well as any required hydraulic flow results. Projects may be required to extend the existing fire main to connect to the specific project.

2. DESIGN REVIEW CHECKLIST

The designer is required to submit documentation at the Tier One, Two and Three stages of the project in accordance with section 901.2.1 of 780 CMR. MIT requires documentation beyond that required in 780 CMR as specified below at the Schematic (SD), Design Development (DD), 90% Contract Documents (CD) and CD phases as well as during the Shop Drawing and Record Drawing phases of each project. A summary of those requirements follows and, in some cases, a more detailed description is contained in the relevant portion of the Guideline.

The Design Consultant is responsible for filling out, signing, and submitting this checklist at each phase of design as a guide for review by MIT Facilities.

2.1 Schematic Design (SD) Phase

1. Review of applicable codes, regulations, and standards.
2. One-line riser diagram.
3. Fire pump / service room layout (coordinate water service entrance location).
4. Space requirements for distributed wet / dry / pre-action risers.
5. Shaft requirements (concealed standpipes at egress stairs).
6. Preliminary fire pump sizing and basis for sizing (refer also the section on fire pump zone control assemblies below).

2.2 Design Development (DD) Phase

1. Legend, notes, and abbreviations.
2. Floor Plans: Main distribution to standpipes; standpipes and Zone Control Assemblies (ZCAs); sprinkler mains; areas or hazards requiring pre-action or fire extinguishing systems identified.
3. Part Plan: Fire pump and service room.
4. Sprinkler layout in representative areas.
5. Standard details.
6. Updated one-line riser diagram.
7. Preliminary sprinkler plans for submittal to Factory Mutual.

2.3 90% Construction Documents and Construction Documents (CD) Phase

1. Legend, notes, and abbreviations.
2. Floor Plans: Main distribution to standpipes; standpipes and Zone Control Assemblies (ZCAs); sprinkler mains; areas or hazards requiring pre-action or fire extinguishing systems identified; at minimum sprinklers shown in remote areas with reflected ceiling plan overlay.

3. Sprinkler Layout: Reflected ceiling plan sprinkler layouts in key architectural areas shown as part plans with remote calculations
4. Completed sprinkler plans with design densities, hydraulic calculations with nodes and pipe layout for resubmittal to Factory Mutual.
5. Written response to FM comments and suggestions.
8. Part Plans:

    a. Fire pump and service room.
    b. Pre-action, clean agent, and foam.

9. Standard details.
10. Project specific details.
11. One-line riser diagram.
12. Final product schedules.

2.4 Shop Drawing Phase

1. Ensure that shop drawing submittals comply with all aspects of the contract documents; note in writing any deviations for discussion with MIT or provide written certification that shop drawing submittals are compliant.
2. Shop drawings shall distinguish between settings the contractor must set in the field, and manufacturer specific settings established in the factory.
3. Review of, and written comment on, final hydraulic calculations.
4. Additional requirements as specified below.
5. Valve tags as specified in Division 22 - Plumbing, Par 4.2.

2.5 Record Drawing Phase

1. Review record drawings and final submittals for compliance. Provide a written report of compliance or deviations.
2. Insure that hydraulic design information signs are installed; see Acceptance Testing section of this document for further information.
3. Laminated as-built drawings are to be located as indicated below and as requested.
4. Valve tags as specified in Division 22 - Plumbing, Par 4.2.

3. FIRE PROTECTION SYSTEMS DESIGN CRITERIA

3.1 General Requirements

Fire protection systems must conform to the latest referenced editions of NFPA 13 and NFPA 14 as adopted by the Commonwealth of Massachusetts in addition to meeting the above referenced

FM requirements. The FM requirements are contained in a series of Approval Standards which are available on the FM website or through MIT's FM representative. While these requirements deal with the characteristics of specific products they also have a fundamental impact on system design in such areas as sprinkler flow rates and coverage areas. The designer is cautioned regarding the need to understand these requirements at the very beginning of the design process to avoid major changes later in the design. Particular attention should be paid to FM Data Sheet 3-26, Fire Protection Water Demand for Non Storage Sprinklered Properties which will determine sprinkler design demands and therefore impact pipe sizing.

Where small, light hazard areas with 6 or fewer sprinklers are to be renovated, hydraulic calculations may not be required and a pipe schedule approach may be substituted with prior approval. If this approval is given, the requirements of NFPA 13 chapter 22.5 must still be followed.

Automatic sprinklers shall be installed throughout all areas of each building, unless otherwise indicated. All sprinkler systems shall be designed to meet NFPA 13 and FM Global requirements. Designing to NFPA 13R or 13D is not permitted.

Small room exceptions as permitted in NFPA 13 shall not be utilized at MIT. Small rooms shall not be permitted to be omitted from hydraulic calculations, and spacing exceptions for small rooms per NFPA 13 shall not be permitted. Exceptions as permitted in NFPA 13 for omission of sprinklers in closets and bathrooms shall not be permitted.

All components of the fire protection system are required to be listed by UL and FM Global. UL and FM provide an online database of all listed products at the following locations:

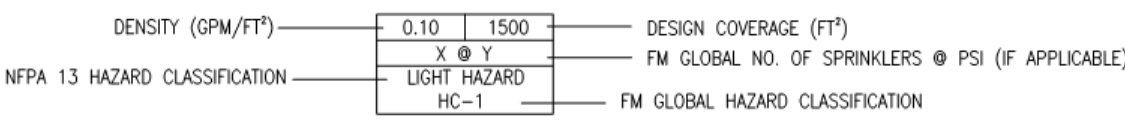
1. www.ul.com/database
2. www.ApprovalGuide.com

3.2 Sprinkler Systems Design Criteria

Supply for the sprinkler system will be provided from one of the two campus fire main loops (West and Main) or from city water if the campus fire mains are not readily accessible. Discuss the connection of the fire protection system to the water supply source with the MIT Fire Protection Engineer and project manager.

Preliminary and final hydraulic calculations are required to be completed by the designer, who must be a Massachusetts licensed Fire Protection Engineer or Mechanical Engineer with minimum twenty years of fire protection design experience. Sprinkler system layouts may be done by a NICET Level 4 certified designer but must be approved by the Engineer of Record. The hydraulic calculations based on the final sprinkler fabrication drawings must be completed by the contractor and reviewed by the engineer of record. The calculations shall include hose stream allowances in accordance with NFPA 13 and FM Global requirements, but in no case shall the hose stream be less than 250 gpm. The fire protection system shall be designed to achieve a minimum 10 percent or 10 psi safety factor, whichever is greater. MIT maintains data on hydrant flow tests and available water pressure at various campus locations which may be used for preliminary calculations. The project manager will supply this information on request. The final contractor calculations must be based on hydraulic flow data from an independent testing firm and that data must be less than one year old. The test data must be taken with properly calibrated FM Approved gauges and in accordance with the procedures outlined in FM Global Property Loss Prevention Data Sheet 3-0.

Sprinkler densities and minimum k-factors must be based on both NFPA 13 and FM Global requirements. Sprinkler densities for both NFPA 13 and FM Global must be shown on the plans. The contractor shall be required to submit hydraulic calculations based on the more demanding of the FM Global and NFPA 13 requirements. It should be noted that FM Global has many different requirements for densities depending upon the particular hazard including but not limited to: storage, non-storage, flammable liquids etc., that must be consulted. The designer shall pay particular attention and care to fully understand the FM Global and MIT requirements to avoid significant redesign late in the project. An example of such design requirements is illustrated below:



Sprinkler systems shall be designed in accordance with the density/area method in accordance with NFPA 13 and FM Global requirements. The sprinkler system shall be designed to produce the required pressures and flows over a minimum area of 1,500 square feet. Decreases are not permitted. The room design method may be considered in certain applications only when specifically reviewed with the MIT Fire Protection Engineer.

In addition to the NFPA 13 working plan requirements, the designer shall require that all shop drawings describe the necessary settings that the contractor must set in the field and settings that are manufacturer specific or preset in the factory. These settings may include air compressor cut in and cut out pressures, normal air pressure to set the air maintenance device, and activation of the supervisory air pressure switch.

Due to the varying quality of shop drawings and hydraulic calculation formats that are often received, the designer shall require the following in addition to the NFPA 13 hydraulic calculations:

1. Detailed riser diagram showing a schematic of system supply, supply connection, devices, valves, pipe and fittings. Hydraulic nodes shall also be indicated on the riser diagram.
2. Hydraulic calculations shall be computer generated by a listed program. The name of the

hydraulic calculation program shall be provided by MIT at the appropriate time. Methods using Microsoft excel or other spreadsheet program will not be accepted.

3. Shop drawings shall be required to include details specific to the installation including but not limited to:

   a. Hanger installation.
   b. Seismic bracing installation.
   c. Dry pipe and deluge valves.
   d. Compressor and air maintenance details.
   e. Floor control assembly details.
   f. Typical sprinkler installation details to convey the installation intent including sprinklers with respect to obstructions, sprinklers above open grid ceilings etc.
   g. Fire stopping.

3.3 Wet Pipe Systems Design Criteria

Where the sprinkler system is served by multiple risers, the system shall be hydraulically calculated to deliver the required demand through the hydraulically most remote riser. Splitting flows through multiple risers is not permitted.

Combined automatic sprinkler and standpipe risers should not be interconnected by sprinkler system piping. In sprinkler systems where the risers are interconnected on a floor, control valves shall be located on both sides of the check valve and a sign shall indicate that the systems are interconnected. No hydraulic credit may be taken for interconnected systems.

The NFPA 13 exception for the elimination of sprinklers in electric rooms is not acceptable to MIT and must not be used. All electrical rooms shall be protected with high temperature sprinklers equipped with listed guards. Upright sprinklers are preferred in rooms where a ceiling is not installed. A supervised control valve shall be provided outside of electrical rooms to isolate the electrical room sprinklers only for electric rooms protected with more than one sprinkler, and any room that contains equipment where the voltage is greater than 600 V. An auxiliary drain shall be provided outside of electrical rooms and all piping shall be sloped to facilitate drainage to the auxiliary drain.

1. High voltage rooms with power greater than 600 volts (transformer vaults, primary switchgear, etc.) are to be protected with a pre-action sprinkler system. The protection of these rooms shall be reviewed with the MIT Fire Protection Engineer. Most high voltage rooms on campus are owned by MIT In some instances the electrical Utility owns the vault. The protection of high voltage rooms shall be reviewed with the MIT Fire Protection Engineer and the utility company.

Automatic sprinklers should not be installed in elevator machine or control rooms or at the top or bottom of hoistways where the hoistway is of rated construction in accordance with the Massachusetts State Building Code.

Where dry sprinklers are attached to wet systems, the designer shall be responsible for providing the temperature criteria to avoid freezing due to conduction. The minimum permitted temperature on the heated side is 50 deg F. Designers should assume an exterior design temperature of at least -10 deg F. The designer is required to confirm design temperatures of the protected space.

Sprinkler Waterflow Alarm-Initiating Devices:

1. Waterflow detectors shall be vane type with retard.
2. A main waterflow switch shall be provided.
3. The main waterflow switch should be set to activate between 45 and 60 seconds, and the floor or zone waterflow switch should be set to activate between 30 and 40 seconds.

3.4 Dry Pipe Systems Design Criteria

All dry systems must be designed to meet a maximum water delivery time in accordance with NFPA 13 and FM Global requirements. Accelerators should be avoided wherever possible and their use should be reviewed with the MIT Fire Protection Engineer. In locations where an accelerator is required, an electric type should be specified. In no case shall a mechanical accelerator be utilized.

The dry pipe valve shall be located in a heated enclosure. Wherever practical the valve shall be located as close as possible to the area being protected to limit system volume size. The designer shall require the contractor to submit water delivery time calculations based on the fabrication drawings for all dry pipe systems larger than 500 gallons. For all water delivery calculations, the calculations shall indicate water will be delivered within 50 seconds (includes a 20 percent safety factor to account for changes in the field). The designer may specify a minimum size for the dry pipe valve, however the designer must make the contractor responsible for final sizing of the dry pipe valve and associated piping to comply with NFPA, FM Global and specific MIT requirements.

The MIT standard dry pipe valve is the Tyco DPV valve.

All dry systems must use seamless hot-dipped galvanized pipe and fittings. Weld-o-lets are not allowed.

In small areas such refrigerators, loading docks, etc. the design should consider dry pendent or sidewall sprinklers.

Riser mounted compressors should be provided with a listed reservoir and air pressure maintenance device to prevent short cycling of the compressor. A tank mounted compressor and air pressure maintenance device is to be specified. Pressure maintenance devices shall be installed in accordance with manufacturer's recommendations. Compressors with desiccant dryers shall be specified for dry systems serving freezers and other similar protected areas. The dryers shall be used to remove water vapor from the compressed air system. Compressors shall also be specified with a listed external motor starter compatible for the compressor to maintain equipment warranty and prevent damage to the motor. The motor starter must be specified with the necessary contacts to be monitored by the fire alarm system. The fire alarm system is required to monitor that power is present after the disconnect and that the starter has not been overloaded.

3.5 Pre-Action Systems Design Criteria

Pre-action systems may only be specified for special applications where there is irreplaceable equipment or where conventional systems pose a life safety hazard. The use of pre-action systems must be approved by the MIT Fire Protection Engineer. Where pre-action systems used, they must be single interlocked.

Double interlocked systems are not allowed. All pre-action systems are to be electric actuation. MIT's preferred valve is the Reliable DDX deluge valve with solenoid valve trim.

The releasing service control unit for the pre-action system is required to comply with the 'Fire Alarm Releasing Service Control Units' section in this document.

3.6 Antifreeze Systems Design Criteria

Antifreeze systems are not acceptable and are not to be designed. Existing antifreeze systems where discovered should be replaced with dry pipe systems or dry type sprinklers wherever practical. Where impractical to replace existing antifreeze systems, and systems served directly from the city water supply, such systems shall be equipped with reduced pressure backflow preventers in accordance with Massachusetts cross-connection regulations, and expansion chambers as required to comply with NFPA 13 and FM Global requirements. Such systems are to be reviewed with the MIT Fire Protection Engineer.

3.7 Deluge Systems Design Criteria

Deluge systems are for special application only and must be approved by the MIT Fire Protection Engineer. If allowed, the design must provide testing capability.

3.8 Special Systems Design Criteria

The specification of FM-200, FE-13, Inergen, Mist and other similar systems require approval of the MIT Fire Protection Engineer. Clean agent extinguishing systems are considered supplemental fire extinguishing systems and are not to be installed in place of a sprinkler system. Carbon dioxide extinguishing systems are not permitted to be installed unless they protect spaces that are not normally occupied such as machinery spaces.

It is MIT's intent that kitchen fire suppression systems be specified in Division 11 and by the kitchen consultant but coordinated and reviewed by the fire protection engineer of record. These systems shall be wet chemical type designed in accordance with NFPA 17A. Foam and CO2 systems are not acceptable. When hoods are protected by separate extinguishing systems and are connected to a common exhaust duct, a dedicated extinguishing system is required to be provided to serve the common exhaust duct. Drawings are to be developed for each system that include an isometric drawing of the piping, nozzle sizes and locations with respect to the hazard protected, and agent and gas cartridge tank sizes. All wet chemical extinguishing systems are required to be designed by a NICET Level 4 certified fire protection specialist contractor. Laminated as-built drawings are to be located within the enclosure assembly.

3.9 Fire Alarm Releasing Service Control Units Design Criteria

UL listed and FM Approved Fire Alarm Releasing Service Control units shall be provided by the fire alarm contractor and installed by the fire protection contractor. Coordination between the designers of the two systems will be required. The following text, while providing information for the fire alarm system designer is inserted here as information for the fire protection system designer and to facilitate the necessary coordination. If releasing service control units and associated equipment are provided by the sprinkler system contractor, the design documents need to incorporate listed MIT fire alarm requirements.

The releasing service control unit is required to be an addressable control unit designed for releasing purposes. The system designer must specify that the battery capacity provides a minimum 90 hour standby duration followed by 10 minutes of releasing power per FM Global requirements. The designer must specify that the solenoid releasing valves are listed for use with the control unit. Interfacing outputs from the releasing panel to the fire alarm control unit need to be included in the design drawings. At a minimum the following points are required to be interfaced with the building fire alarm system:

1. Discharge (if applicable).
2. Waterflow (if applicable).
3. Automatic alarm.
4. Automatic pre-alarm.
5. Manual alarm.
6. Supervisory.
7. Trouble and new trouble.

When activation of a special suppression system is by smoke detectors, a minimum of two smoke detectors are to be installed in each protected space. At least two detectors must activate before the solenoid is released.

3.10 Fire Pumps Design Criteria

The preliminary system hydraulic calculations will assist in determining whether a fire pump is required. These calculations must be performed during the SD phase so that space and a location for the fire pump can be determined as early as possible in the project. High rise buildings on the campus may require an onsite secondary water supply based on site soil conditions. Please consult the Seismic section of these Guidelines for additional information. The need for the onsite secondary water supply must be determined in the SD phase. Discuss the preliminary hydraulic calculations and the need for a fire pump or a secondary water supply with the MIT Fire Protection Engineer and Project Manager. Fire pumps manufactured by Peerless, Aurora, and A-C | Xylem are acceptable. FM Data Sheet 3-7 gives detailed requirements for both electric and diesel fire pumps, these requirements must be followed.

Electric pumps are preferred; diesel pumps are allowed in existing buildings where there is insufficient electric capacity. Discuss this issue with the MIT Fire Protection Engineer and Project Manager.

Electric pump motors shall have a synchronous speed of no greater than 1800 rpm.

The use of pressure reducing valves at each floor is not permitted. Master PRV assemblies are permitted in certain applications and shall be reviewed with the MIT Fire Protection Engineer. All efforts to avoid the use of pressure reducing valves including, high and low pressure zones, and variable speed fire pump controllers shall be explored. A means shall be provided for testing all PRV valves.

Due to the varying city water pressures within the city of Cambridge and MIT campus loops, all electric fire pumps should be equipped with a variable speed fire pump controller whenever the churn pressure of the fire pump is greater than 165 psi. If a variable speed controller is used insure that the fire pump motor is rated for inverter duty. All diesel fire pumps shall be equipped with a pressure-limiting diesel driver listed for fire pump service whenever the churn pressure of the fire pump is greater than 165 psi.

Additional requirements pertinent to the fire pump installation shall be included in the specification as follows:

1. Pump is laser aligned.
2. Full coordination shop drawings of the pump room layout including all system piping, controllers, valves, other building systems etc., shall be provided. The contractor is required to provide 3D drawings of the fire pump room.

3.11 Fire Pumps Controllers Design Criteria

All fire pump controllers (electric or diesel) shall be manufactured by MasterControls.

1. Variable speed electric fire pump controllers shall be provided with a soft start and across the line bypass in the event the VFD fails.
2. The fire pump system shall be monitored by the fire alarm system in accordance with the requirements stated in the Fire Alarm section. The designer should note and coordinate with the fire alarm system the following outputs from the fire pump:

    a. Fire pump running.
    b. Loss of phase (electric only).
    c. Phase reversal (electric only).
    d. Controller connected to alternate source (electric only).
    e. Controller main switch is turned off or to manual position (diesel only).
    f. VFD failure.
    g. VFD bypass.
    h. VFD overpressure.
    i. Common pump trouble (electric) to indicate, high pump room temperature, under voltage, overvoltage, phase unbalance.
    j. Common pump trouble (diesel) loss of output of battery charger, battery failure or missing battery, battery charger failure, low air or hydraulic pressure, system overpressure, ECM selector switch in alternate ECM position, fuel injection malfunction, low fuel level, low engine temperature.
    k. Relief valve discharge, monitored through a pressure switch.
    l. High discharge water pressure, monitored through a pressure switch.

Jockey pumps shall be provided for all fire pumps. Jockey pump controllers shall be variable speed, and manufactured by MasterControls. The fire alarm system shall monitor the following jockey pump conditions:

1. Loss of power.
2. Phase failure.
3. Switch not in Auto.
4. Fail to start.
5. Overload.
6. VFD failure.
7. Jockey pump running – status only.

Circulation test loops with listed flow meters shall be provided on all fire pump installations.

Fire pump rooms that open directly to the exterior are to be provided with low temperature sensor that is monitored by the fire alarm system.

3.12 Transfer Switch Design Criteria

Automatic transfer switches are to be housed separately from the fire pump controller. MIT's standard automatic transfer switch is by Russ Electric. Refer to the Electrical section and Division 26 requirements for specific requirements on transfer switches. An additional contact is required to be provided to interface with the building fire alarm system.

3.13 Standpipes Design Criteria

The connected hose stations shall have a 2-1/2 inch valve with a 1-1/2 inch reducer and cap without hoses with NH threads to match the Cambridge Fire Department. Cambridge Fire Department requirements may be different from those in other jurisdictions. The following sentences summarize those requirements:

1. The hose stations must be located on main and not intermediate landings.
2. The distance from fire department hose valve to the seat of fire cannot exceed 150 feet.
3. When calculating the 150 feet, the engineer must take into account corridor turns and obstructions which may be present in a building including stairs, chairs, stationary equipment and travel distance to interior spaces such as offices or mechanical rooms.
4. The hose stream may not be calculated into the equation i.e. 150 feet of hose plus 50 feet of water stream does not meet CFD's requirement.
5. Supplemental fire department hose valves must be added on the floor, if the 150-foot distance to the seat of the fire cannot be obtained. The maximum distance between hose valves in a building must be no greater than 200 feet.

The designer should note that pressure gauges and air relief valves are to be installed at the top of all standpipe risers.

Roof manifold connections are to be provided in accordance with NFPA 14. Valves controlling roof manifolds need to be readily accessible from the roof through the use of post indicator valves or other approved means. Valves interior to the building are not acceptable.

3.14 Fire Department Connections Design Criteria

Fire department connections shall be UL listed and FM Approved. All fire department connections shall have 2-1/2" NH threaded fittings. MIT and Cambridge fire have agreed that Storz connections will not be used on campus. Each fire department connection shall have an inlet for every 250 gpm of flow required.

Fire department connection locations shall be reviewed and coordinated with the MIT Fire Protection Engineer.

The number of fire department connections for each building shall be reviewed with the MIT Fire Protection Engineer. Site conditions, accessibility to the building and the size of the building may warrant additional fire department connections.

Hydraulic calculations shall be provided for each fire department connection serving standpipes in accordance with NFPA 14. When multiple fire department connections are provided, flows shall not be permitted to be split between fire department connections.

3.15 Valve Tags

Comply with requirements in Division 22 - Plumbing, Par. 4.2.

4. UNDERGROUND & SERVICE PIPING REQUIREMENTS

4.1 General Requirements

Mechanical pipe fittings are required, push on connectors are not acceptable

Designing fire protection piping under building slabs should be avoided with all practicality. Fire protection piping shall run under slabs for no more than five feet.

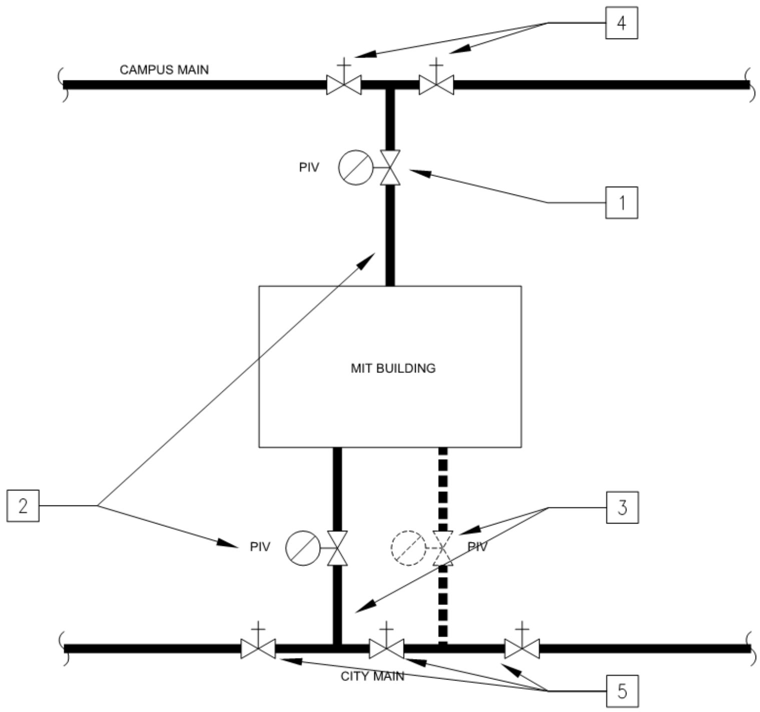
Piping penetration into building shall be by Link-Seal fittings.

Plastic piping is not to be used for underground pipe service.

All new incoming fire mains into buildings shall be equipped with a Post Indicator valve. The valve shall be equipped with a tamper switch and port to be monitored by the fire alarm system. Provide Mueller post indicator valves or approved equal.

The MIT Fire Protection Engineer is to be present for all flushing tests.

Refer to the following sketch for the design intent of valve locations:



NOTES

1. IF AVAILABLE, UTILIZE CAMPUS FIRE MAIN.
2. IF A HIGHRISE BUILDING, ONE FEED TO BE PROVIDED FROM CAMPUS MAIN, AND AN ADDITIONAL FEED TO BE PROVIDED FROM THE CITY MAIN.
3. IF A HIGHRISE BUILDING (WITHOUT ACCESS TO CAMPUS MAIN), PROVIDE DUAL FEEDS WITH ABILITY TO ISOLATE EITHER FEED.
4. PROVIDE MIT APPROVED CURB BOXES ON CAMPUS MAIN TO ALLOW ISOLATION OF FEED MAIN TO THE BUILDING.
5. CAMBRIDGE WATER AUTHORITY APPROVED VALVES AND CURB BOXES.

4.2 MIT Campus Fire Mains

MIT has two (2) Campus Fire Main Loops (West Campus and Main Campus). Flow hydrants throughout the Campus and connected to the Campus Fire Main Loops are for used for the flow and flow measurement of water during a flow test. Backflow preventer devices are not required when connect to the Campus Fire Main Loop.

West Campus Fire Main Loop – fire main is controlled by three (3) fire pumps and they are located in Building W34, W51 and W79. W34 and W79 are electrical driven horizontal split case fire pump. W51 is diesel driven horizontal split case fire pump. West Campus Fire Main Loop is maintained at 175 PSI supply pressure. A pressure reducing valve station with strainer shall be provided for buildings connect to the West Campus Loop. Connected to the West Campus Fire Main Loop buildings are W1, W2, W4, W7, W15, W16, W33, W34, W35, W46, W51, W51C, W51D, W61, W70, W71, W84 and W85.

Main Campus Fire Main Loop – fire main is controlled by two (2) fire pumps and they are located in Building N16B. Both fire pumps are electric driven horizontal split case fire pump. Only one pump operates on a loss of campus fire main pressure, the other serves as a backup. Main Campus

Fire Main Loop is maintained at 145 PSI supply pressure. Connected to the Main Campus Fire Main Loop buildings are 1, 2, 3, 4, 5, 6, 6C, 7, 7A, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 24, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 42C, 43, 46, 48, 50, 54, 56, 57, 62, 64, 66, 68, N16, W20, W31 and W32.

All piping shall comply with NFPA 24 and American Water Works Association (AWWA) requirements.

Piping shall be minimum thickness class 52 ductile iron pipe, cement lined and tar coated per AWWA for fire main use.

MIT uses a special square curb box on all underground valves for the campus fire mains. These special curb boxes can be obtained from MIT

Backflow preventers are not required on incoming services connected to the campus fire main, however, an alarm check valve shall be provided within the building upstream of any further equipment or connections within the building.

4.3 Cambridge Public Water

All piping shall comply with Cambridge Water requirements.

A backflow preventer shall be installed on all incoming fire service mains in accordance with Cambridge Water and Massachusetts, 310 CMR requirements.

Double Check Valve Assemblies installed horizontally are required. MIT uses the Watts 709 backflow preventer with OS&Y valves.

5. ABOVE GROUND PIPING REQUIREMENTS

System Risers System risers, i.e., the aboveground horizontal or vertical pipe between the backflow preventer and the mains (cross or feed) that contains a control valve, pressure gauge, drain and water flow alarm device (floor control assembly) are required to be schedule 40 black steel piping with roll-grooved ends and couplings.

5.1 Wet Pipe Sprinkler System

All new piping 2 inch and smaller is to be schedule 40 with threaded fittings. Piping larger than 2 inch shall be schedule 10 or schedule 40 with roll-grooved ends and couplings. Schedule 40 pipe is required for all garages, mechanical room and generator rooms as well as in the Central Utility Plant. All gasket couplings shall be listed for the application. Rolled grooved fittings are to be American made, imported fittings are not acceptable. Cut grooved fittings may be permitted where reviewed and discussed with the MIT Fire Protection Engineer.

1. The designer shall include in the contract documents, requirements for the contractor to provide a quality assurance plan that all grooves in piping cut onsite and offsite comply with the applicable tolerance standards. The designer shall note in the contract documents that the contractor may be required to remove couplings in the field to demonstrate compliance.

5.2 Dry Pipe and Pre-Action Sprinkler System

All new piping 2 inch and smaller is to be seamless galvanized schedule 40 with galvanized threaded fittings. Piping larger than 2 inch shall be seamless galvanized schedule 40 with galvanized grooved ends and couplings. Grooved fittings are to be American made, imported fittings are not acceptable. Couplings shall use flush sealed gaskets or similar in accordance with manufacturer's recommendations. Schedule 10 piping is not permitted for dry-pipe or pre-action sprinkler systems. In accordance with FM Global data sheet 2-0 recommendations, galvanized pipe should not be used where the ambient temperature could exceed 130 deg F unless the pipe is specifically FM Approved for use in such conditions. If this situation arises, black steel pipe with an inert gas shall be utilized.

Provide nitrogen system if the sprinkler system has volume equal or more than 250 gallons. For system less than 250 gallons, provide desiccant dryers.

Provide supervisory control valves upstream and downstream of the dry/pre-action control valves.

Provide inspector test drain valve in between dry/ pre-action control valve and downstream supervisory control valve.

Provide a low-pressure air switch and alarm.

Provide 'AC Power Lost' alarm for air maintenance devices.

5.3 Other General Piping Requirements

Other general piping requirements include:

1. Where mechanical T fittings are used, solid back strap only fittings shall be permitted. Snap-on and strapless fittings are not allowed.
2. Beam clamps or drop in anchors are permitted as a means of fastening to the structure. Powder actuated fasteners and concrete screws are not permitted.
3. Factory shop welded outlets are permitted.
4. Plastic piping shall not be permitted except for transitions to anechoic chambers or similar spaces where specifically reviewed with the MIT Fire Protection Engineer.
5. Copper piping is permitted for wet pipe sprinkler systems. Copper piping shall be Type K hard pipe (thickness L or M shall not be specified). Fittings shall be brazed, or FM listed pressure seal fittings. Hangers used on copper piping shall be felt lined or listed for

copper applications.

6. Flexible sprinkler fittings and drops are not permitted.
7. MIT's preferred coupling and fitting manufacturer is Victaulic.
8. All system drains are to be schedule 40 galvanized pipe.
9. Seismic bracing may be required, see the Guidelines section on Seismic for further information.

6. SYSTEM DRAINAGE AND TEST CONNECTIONS

Many of MITs buildings are directly accessible to public sidewalks. Wherever feasible fire protection system drains shall discharge to areas that will not disturb the public. System drains discharging to the interior shall indirectly discharge to an open hub drain/receiver or sump sized accordingly to handle the anticipated sprinkler flow. In no case, shall this open hub drain be smaller than 4-inches nominal diameter.

Special permission must be obtained for the sprinkler system to drain to the exterior. All exterior sprinkler drain locations shall be approved by the MIT Fire Protection Engineer. Sprinkler drains that must discharge to the exterior should be equipped with a minimum 2 inch downward turning elbow. The drains should discharge to MIT owned property wherever feasible and should limit disruption to the public.

A remote inspector's test connection is to be provided at the end of the most hydraulically remote area on every floor. The piping from the remote test connection should be piped back to the drain riser. In many instances electric solenoid valves that can be remotely operated by the fire alarm system will be required at the test connections. This should be reviewed with the MIT Fire Protection Engineer.

Exterior test connections or other approved means shall be provided for anything requiring flow greater than 500 gpm including backflow preventer tests, fire pump test headers etc. Test connections shall be listed, properly identified and equipped with 2-1/2 inch male NH threads to allow test valves and hose to be connected. All test connections shall be located on the building exterior. Normally closed and supervised valves shall be provided on test header piping. Test connections shall discharge to MIT owned property wherever feasible and shall be coordinated with exterior storm drains and hard surfaces. Test connections shall not discharge to surfaces such as grass, mulch, dirt, pedestrian walkways etc.

6.1 Sprinklers

All sprinklers must be UL listed and FM Approved. It is important for the designer to specify FM Approved sprinklers and to be aware that many variations of sprinklers depending upon the k-factor, finish, hazard protection etc., may affect listings.

UL listed and FM Approved residential sprinklers may be used inside dormitory rooms. Use of the "small room rule" is not permitted. Standard spray sprinklers are to be used elsewhere in residential occupancies. This approach is acceptable to FM Global.

Concealed sprinklers are not FM Approved as quick response sprinklers and are not to be used in light hazard occupancies.

Locations of high temperature and intermediate temperature sprinklers are often overlooked by contractors in the field. The designer needs to coordinate high temperature sprinklers with heat sources in accordance with NFPA 13. Identify locations on the contract documents where higher temperature sprinklers are required. Above and beyond NFPA 13 requirements, MIT requires the following minimum sprinkler temperature classifications:

1. Mechanical Rooms: Intermediate.
2. Electrical Rooms: High Temperature.
3. Generator Rooms: High Temperature.
4. AHU Filter Enclosures: High Temperature.

6.2 Miscellaneous Components and Requirements

Each sprinkler system by a city water source shall be equipped with a pressure switch located before the backflow preventer to indicate low city water pressure. This pressure switch shall be a Potter Signal switch equipped with a bleeding valve and pressure gauge assembly. The switch shall be accessible for maintenance and calibration. All pressure switches used in other parts of the building shall also meet these requirements.

1. The designer needs to specify the required supervisory pressure setting is to be determined by half the normal pressure plus 10 psi.

Normally closed butterfly valves where used shall be listed for such application. Normally open butterfly valves shall not be permitted to be used for normally closed applications such as test headers.

Water flow detectors shall be vane type with retard.

Each floor control assembly is to be labeled to identify the location served by each floor control assembly. The signage is required to be installed prior to fire alarm testing, the fire alarm contractor will use this information to program the fire alarm system. For systems connected to two risers, the sign is required to identify the location of the second riser. All signs are to be engraved or laser printed, white on red or red on white with a minimum character size of 1/2 inch.

A main waterflow switch shall be provided. Where the water velocity is expected to exceed the listing of a paddle type water flow switch (dry pipe system or pre-action systems for example) an alarm check valve is to be provided on the incoming water supply.

The designer needs to note that the sprinkler contractor will be required to coordinate sprinkler zones with the programming of the fire alarm system. Flow switches need to be programmed on the fire alarm system to indicate the area where water would be flowing and tamper switches to be programmed to indicate the location of the valve.

All control valves including remote inspector's test connections in the building need to be accessible. NFPA 13 defines accessible as not needing to be accessed by the use of equipment such as a portable ladder. Control valves should be located between 7 and 8 feet above the finished floor level where practical. Where this cannot be accomplished valves should be equipped with chain operated hand wheel, fixed ladder or other means reviewed with the MIT Fire Protection Engineer.

All sprinkler control valves are required to be installed with locks and chains in addition to electrical supervision. The contractor will be required to provide the chains and install the locks provided by MIT

The designer needs to note that all signage as stipulated in NFPA 13 is required to be provided. Specifically hydraulic design signs, general information signs, sprinkler identification signs and signs for every control valve and auxiliary drain valve need to be provided. Where multiple risers serve the same floor signage needs to indicate that all valves on the floor must be shut off.

Supervised control valves are to be located at the base of each sprinkler riser.

7. EXISTING BUILDING CONDITIONS

Renovations may identify or change the hazard classification of the area protected by the sprinkler system. Deficiencies are to be corrected as part of the renovation project. If sprinklers within the work area are more than 40 years old, the sprinklers are to be replaced to minimize disruption to occupants in the future. The contractor should be directed to notify the MIT Fire Protection Engineer if any other deficiencies are identified during construction such as obstructed piping.

8. ACCEPTANCE TESTING

Sprinkler system acceptance tests are required to be conducted in accordance with NFPA 13, 14, 20, 24, 25 and section 2.8 of FM Data Sheet 2-0. The system designer has the following responsibilities with regard to the tests:

1. Verify that FM plan review recommendations have been satisfactorily addressed.
2. Ensure that the system has been installed according to the approved plans.

3. Witness a hydrostatic test. Require that adequate notice be given for such tests. MIT may choose to witness the tests and will coordinate with the engineer.
4. Witness an incoming fire service main flushing test.
5. Witness a trip test of all pre-action and dry pipe systems to verify that the required water delivery times are met.
6. Verify that all required equipment identification tags are present. Hydraulic design data information signs are required by section 24.5 of NFPA 13 but are frequently not installed. This data is valuable for future renovation work and the designer is requested to call out this requirement in the documents and to ensure that the signs are installed.

In addition to the required contractor's material and test certificates per NFPA 13, 14, 20 and 24, the specifications must require that the contractor complete and provide MIT a copy of FM85A, Contractors Material and Test Certificate for Automatic Sprinkler Systems.

The specification must require that the contractor complete and provide MIT a copy of FM999C, Contractor's Hydraulic Analysis Certificate for Automatic Sprinkler Systems.

The specifications must require that the contractor to test all valve tamper alarms and verify that all valves, whether monitored or not, are open.

Design documents shall require the contractor to support the testing of the fire alarm system for the contractor and third party acceptance testing. All sprinkler components will be operated during this testing. Sprinkler contractor will be required to adjust flow switch retard times, tamper switches and pressure switches as necessary.

9. PRACTICES AND PROCEDURES

Require that the contractor follow NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations during construction. As mentioned above, this will require an impairment plan for renovations or additions and the MIT shutdown notification procedure shall be followed whenever any fire protection system is to be impaired. The contract documents must clearly spell out these requirements.

The sprinkler system designer must prepare a design narrative as required by the Massachusetts State Building Code, Section 903 for all fire protection systems.

9.1 Additional Fire Protection Guidelines

Cooling towers shall be protected with an automatic sprinkler system where required per FM Global data sheet 1-6 and NFPA 214. Non FM Approved cooling towers shall be equipped with automatic sprinkler protection.

FM Global data sheet 1-45 shall be consulted during the design of protection for air conditioning and ventilation systems. Sprinklers maybe required in air handling units. This shall be reviewed on a case by case basis with the MIT Fire Protection Engineer.

Generator enclosures shall be protected by a pre-action system activated by infrared and heat detectors.

There are no special MIT requirements for fire protection in lab hoods.

9.2 Areas Where MIT Requirements May Differ from Common Practice

These differences must be understood by the designer and must be clearly spelled out in the contract documents. Failure of the contractor to understand these differences and a consequent bid and schedule based on common practice will result in delays, RFI's and potential change orders.

1. The contractor must provide adequate allowance of time and cost for testing of fire protection systems as described above. Each project will have different requirements and MIT should be consulted to estimate the testing duration based on previous experience.
2. Due to the increased maintenance and additional likelihood of failure, the use of clean agent, antifreeze and pre-action systems need to be specifically reviewed with the MIT Fire Protection Engineer before being utilized. These systems may only be used in special applications where reviewed with the MIT Fire Protection Engineer.
3. The contractor must maintain fire protection equivalency during renovations and demolition. This will generally require submission of an impairment plan for MIT's approval. The designer must discuss this need with MIT prior to completion of the contract documents. This is strictly enforced by MIT but many owners do not require such a plan.
4. The designer must state design densities for each area of the project at the SD phase. These may differ from those used in past projects and for other owners. The FM Global sprinkler coverage chart contains this information and is referenced in the above sections.
5. The design must provide an inspectors test station, piped directly to the drain, at the hydraulically most remote point of every sprinkler system including wet sprinkler systems. Determination of that point must be confirmed with MIT System designers frequently leave this to later in the design and finding a suitable drain can be problematic.
6. The designer must provide fire protection in all concealed spaces that contain combustible material or the potential for combustible materials, such as wiring closets. Any areas proposed to be left non-sprinkler protected must be confirmed with MIT and should be pointed out in the narrative.
7. The designer should not meet with the Cambridge Fire Department without MIT approval. Generally a representative of MIT's Systems Engineering Group will arrange for and be present at such meetings. This will be coordinated through the project manager.

END OF DOCUMENT