	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

PART 1 - INTRODUCTION

1.1 PURPOSE

- A. This section is intended to define the general installation and minimum product requirements for fire protection systems.


PART 2 - GENERAL DESIGN REQUIREMENTS

2.1 SUMMARY

- A. This section describes procedures and provisions that are applicable to all fire protection designs.
- B. Arrange a pre-design meeting with Yale Office of Fire Marshal to review system design.
- C. Refer to other divisions of Yale Standards for related requirements.

2.2 REFERENCES

- A. Designs shall conform to the following National, State, and Local Codes and Standards, Underwriters Laboratory's listings (UL), and FM Global (FM) approval guides.
 1. Connecticut State Fire Safety Code (most current adopted version.)
 2. Connecticut State Fire Prevention (most current adopted version)
 3. NFPA 13 Standard for the Installation of Sprinkler Systems (most current adopted version.)
 4. NFPA 13 D Standard for the Installation of Sprinkler Systems in One and Two Family Dwellings and Manufactured Homes (most current adopted version)
 5. NFPA 13 R Standard for the Installation of Sprinkler Systems in low-rise Residential Occupancies Up To and Including Four Stories in Height (most current adopted version)
 6. NFPA 14 Standard for Installation of Standpipe and Hose Systems (most current adopted version)
 7. NFPA 15 Standard for Water Spray Fixed Systems for Fire Protection (most current adopted version)
 8. NFPA 20 Standard for the Installation of Stationary Fire Pumps for Fire Protection (most current adopted version)
 9. NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances (most current adopted version)
 10. NFPA 70 National Electrical Code (As amended by the State Building Code, or the most current adopted version)
 11. NFPA 101 Life Safety Code – See the Regulations of Connecticut State Agencies adopted under the authority of section 29-292 of the Connecticut General Statutes, known as the Connecticut State Fire Safety Code (the most current adopted version)
 12. Safety Code for Elevator and Escalators (ASME/ANSI A17.1. See the Regulations of

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

Connecticut State Agencies adopted under the authority of section 29-192 of the Connecticut General Statutes, known as the Connecticut Safety Code for elevators and Escalators or the most current adopted version)


13. Safety Code for Existing Elevators and Escalators (ASME/ANSI A17.3. See the Regulations of Connecticut State Agencies adopted under the authority of section 29-192 of the Connecticut General Statutes, known as the Connecticut Safety Code for Elevators and Escalators or the most current adopted version)
14. Connecticut State Building Code (most current adopted version)

2.3 SUBMITTALS

- A. Information to be submitted by suppliers to Owner is described in section 23000.
- B. Construction documents shall require submittal of product data and shop drawings for all equipment for which acceptable manufacturers are listed in this Design Criteria manual. The following information will be required to be submitted with product data and shop drawings:
 1. Cover sheet (in addition to letter of transmittal), 8-1/2 inches by 11 inches, attached to each copy of all submittals, indicating name of project, Yale project number, items included in submittal (with specification reference), names of contractor and fire protection subcontractor, and number and date of submission. Cover sheet shall include minimum 6 inch high by 8-1/2 inch wide space for review stamps and comments.
 2. Manufacturer's catalog cuts, specifications, and other data required to demonstrate compliance with specified requirements, with all options and accessories clearly indicated. Dimensional drawings, wiring diagrams, capacity calculations, etc., are to be included where applicable. All products should be made in the U.S.A. including pipes and fittings.
 3. Evidence of listing of equipment by a nationally recognized testing laboratory.
 4. Manufacturer's installation instructions and operation and maintenance instructions.
 5. Warranty information for all products for which warranties in excess of one year are required or offered without additional cost.

2.4 SYSTEM DESCRIPTION/PERFORMANCE


- A. A field survey of the area where the work is to be performed must be conducted by the engineer of record or his/her designee BEFORE the system is designed.
- B. Fire Protection designs shall take into account the needs of the end users and the actual conditions, which will be encountered in the field during construction. Coordinate locations of equipment with existing and new architectural, structural, and mechanical work. Fire pumps must have a clear work area excluding associated pipe and equipment for an area of three feet in all directions. Pre-Action fire alarm panels must have a minimum clear space of at least three feet in front of the panel, or the width of the cabinet access door, whichever is greater. All fire control valves must be easily accessible and no higher than 6'-6" above finished floor level.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

- C. Construction drawings shall reflect as closely as possible the actual locations of equipment and the actual routings of pipe.
- D. Where possible, equipment such as panel boards, starters, contactors, and control panels for systems such as fire alarm shall be surface mounted in dedicated electrical rooms so that exposed conduits may be run to such equipment, facilitating future changes to the systems. Where dedicated electrical rooms are not available, such equipment shall be located in mechanical rooms or electrical closets.
- E. Provide a fire alarm annunciator panel at the designed fire department access into the building.
- F. Earthquake Protection: Seismic Bracing. Requirements to follow NFPA 13, ASCE 17, IBC and IMC.
- G. All fire sprinkler piping must be concealed where possible or directed.

2.5 HYDRAULICALLY CALCULATED FIRE PROTECTION SYSTEMS

- A. Sprinkler systems shall be hydraulically designed for each hazard group density in a project based on NFPA and FM Global Data Sheet requirements, the corresponding campus high pressure fire main system, Yale Office of the Fire Marshal requirements and/or municipal requirements.
- B. Fire pump and hydrant flow test data must be obtained from the Yale Office of the Fire Marshal and/or the local Municipal Water Authority to determine the water supply available and its pressure at the project location.
- C. Campus high-pressure fire main data for all grids and fire pumps must be obtained from the Yale Office of the Fire Marshal.
- D. The fire main minimum piping size shall be 10" for underground pipe and 8" for aboveground pipe. Exception: If a building has a fire main loop and is connected at both ends, a 6" main may be used.
 - 1. 6" Loop within a building
 - 2. 8" Feeder for a building from express main.
 - 3. 10" Express main for more than one building
- E. Multiple Water Feeds/Supply to a Single Area.
 - 1. Multiple water feeds/supply to the same area and cross connection of mains and branch lines (Boston Grid) are not allowed. Fire mains on each floor must have one control valve per section. If a floor requires more than one feed/supply, the system shall be split with a separate feed/supply for each section of the building.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

F. Hydraulic Design vs. Pipe Schedule:

1. All fire protection sprinkler systems to be designed based on hydraulic design as stated above and per NFPA 13. The design must include inside and outside hose streams as listed in NFPA 13. Pipe Schedule to be used only when adding to an existing system that was installed based on a Pipe Schedule system and the number of sprinkler heads to be added are less than 10. If 10 or more sprinkler heads are to be added, then the entire system for the floor is to be based on hydraulic design. If additional sprinkler heads are to be installed on a hydraulically designed system, the addition must be hydraulically designed.

G. Hydraulic Design Plates:

1. Hydraulic Design Plates as per NFPA 13 are to be completed and mounted at the alarm check valve, dry pipe valve, pre-action valve for each area of the building. If different designs are used in the building, then only the design for the most remote area is to be completed on the plate. Sign to be attached to valve with jack chain. One sign for each hazard area.


H. Hydraulic Calculations:

1. Hydraulic Calculations to be provided by the fire protection engineer/contractor for review to: Project Engineer, Project Management, Plant Engineering and the Yale University Office of the Fire Marshal. These are to be submitted at the same time as the working drawings.
2. The engineer to do basic layout, scope of project, pipe mains and risers locations. The engineer shall also provide the contractor with Fire Protection hazard type and group, for each area and show water density per square foot for each Fire Protection hazard type and group.
3. The Fire Protection Contractor shall prepare hydraulic calculations and shop drawings. The Contractor shall provide sealed shop drawings and hydraulic calculations by a Professional Engineer to the Yale University Office of the Fire Marshal and the Yale Project Manager.

2.6 SPRINKLER REQUIREMENTS

A. Sprinkler Protection: Areas to be included.

1. Sprinkler protection to be provided throughout the building or construction area and include all computer rooms, electrical rooms, electrical vaults, elevator rooms, elevator shafts, elevator pits, telephone rooms and closets, storage closets and janitor's closets.
2. Stairwells to have a sprinkler head on each floor level and at the top and bottom of the stair landings.
3. Elevator shafts to have sprinkler protection at the top and bottom of the shaft (elevator pit). The installation shall be per NFPA 13; The National Electrical Code NFPA 70 and the Elevator code A17.1 Latest Edition. The branch sprinkler piping shall be provided with shut-off valve and tamper switch.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

B. Sprinkler Protection Exception:

1. Sprinkler Protection is not required in bathrooms that are located within DWELLING units, that do not exceed 55 Sq. Ft. in area, and that have walls and ceilings of noncombustible or limited combustible materials with a 15 minute thermal barrier rating including the walls and ceilings behind fixtures. Sprinklers are required in bathrooms opening directly onto public corridors or exit ways.
2. Sprinkler protection shall not be installed in Fire Service Elevator machine rooms, machine spaces and hoist ways. Occupant Evacuation Elevator machine rooms and machine spaces are also prohibited from having automatic sprinkler protection.

C. Combined Standpipe and Sprinkler System:

1. Design to follow NFPA 13 and NFPA 14 for a combined system. Riser Control Valves to be provided at each riser with a proper drain. Drains must be properly sized to handle the anticipated flow, and terminate at a location capable of handling the anticipated flow with causing building flooding or causing exterior erosion. System design requires that the sprinkler system on a floor can be shut down and drained without having to shut down the standpipe system or sprinkler on other floors. Valves: Milwaukee and Victaulic.

D. Separate Standpipe and Sprinkler System:

1. Design to follow NFPA 13 and NFPA 14 for separate systems. Riser Control Valves to be provided at each riser with a proper drain. Drains must be properly sized to handle the anticipated flow, and terminate at a location capable of handling the anticipated flow with causing building flooding or causing exterior erosion.

E. Inspector's Test and Drain Locations:


1. Each system to be provided with an inspector's test for testing each flow/pressure switch. The inspector's test location to be a max of 6'-6" above finished floor. The inspector's test can be a combined Drain/Inspector's Test Station. Drains must be properly sized to handle the anticipated flow, and terminate at a location capable of handling the anticipated flow without causing building flooding or causing exterior erosion.

F. Auxiliary Vent Valve:

1. Each system shall be provided with a 3/4" ball valve equipped with a hose bibb adapter and a solid brass cap, installed at an accessible location, as remote as possible from the system control valve. This valve will be used to allow air to enter the system to speed draining for maintenance intervals and to bleed air from the system when refilling

G. Drains:


1. All drain lines from Alarm Check Valves, Dry Pipe Valves, Pre-Action Valves, Deluge Valves, Riser Valves and Sectional Drain Connections including drain lines at floor control valves shall be piped to the outside the building or to a sump pit that can handle a flow of 250 GPM for at least 3 Minutes. The size of the main drain shall be as per NFPA 13.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

- H. Victaulic grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an alternate to welding, threading or flanged methods. All grooved components including grooving tools and lubricant shall be of one manufacturer (Victaulic Company of America), and conform to local code approval and/or as listed by ANSI-B31.1, B-31.9, ASME, UL/FM, IAPMO or IMC. Grooved product manufacturer to be ISO-9001 certified. No other grooving tools will be allowed on the job site. Victaulic representative will review the tool operation and groove standards.
- I. All grooved piping systems shall be made in the U.S.A.

2.7 IDENTIFICATION SYSTEMS

- A. Piping:
 1. To be painted red or as directed by architect.
 2. Label piping - SETON pipe marking system as per NFPA 13.
- B. Labels:
 1. All sprinkler devices tied to the building fire alarm must be clearly labeled with the device address number. End of line resistor locations must be clearly marked on the device (if applicable).
- C. Valve Tags and Charts:
 1. Valve Tags on fire protection valves and valve charts to be provided. Valve tags to be brass and list the building and valve number. The chart to be wall mounted and its location to be coordinated with the Yale University office of the Fire Marshal.
- D. Signs:
 1. Signs to be provided on all valves as per NFPA 13 including Control Valves, Aux. Drains, Inspector's Test, Test Valves, Air Line, Main Drains etc. If a valve is above a ceiling the sign shall be on the wall near the valve in the ceiling. If behind a ceiling hatch, the sign shall be on or near the hatch. If behind a wall hatch, the sign shall be mounted on or near the wall hatch. Control Valves and Inspector's Test in closets or rooms to have a sign on or near the door to indicate the device is in the closet or room.
 2. Signs mounted on walls/ceilings/hatches to be permanently attached to the surface with fasteners or adhesive (Liquid Nails). Signs hung from a pipe or valve to be attached with jack chain. Wire not allowed, Sign to list area of coverage/control. Size 2" X 6".

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering


2.8 OCCUPANCY CLASSIFICATIONS

- A. Dwelling Units
- B. Light Hazard
- C. Ordinary Hazard I
 - 1. Attics and basements used for storage to be classified as Ordinary Hazard I.
 - 2. Dining Hall kitchens to be Ordinary Hazard I.
- D. Ordinary Hazard II.
 - 1. All laboratory units and library stack areas to be classified as Ordinary Hazard II.
- E. Comply with FM Global data sheet with regard to occupancy classification, hazard category, and water demand.

PART 3 - MINIMUM PRODUCT REQUIREMENTS

3.1 DRY PIPE SYSTEM

- A. Dry Pipe Systems:
 - 1. Dry Pipe Systems shall be installed in all areas subject to temperatures below 40°F such as, Attics, Loading Docks, and Unheated areas.
- B. Dry Pipe Valves:
 - 1. Valves to be Viking or Reliable. Any reset tools needed to reset the valve to be provided at the valve. Viking requires additional tools that must be provided.
 - 2. Dry pipe sprinkler systems to include: Dry pipe valve, butterfly control valve with built in tamper switch, trim package with 0-300 PSI water gauge and 0-120 PSI air gauge, low air switch, pressure alarm switch. The dry valve shall include a 2" drain line piped to proper discharge location. The drip cup drain shall be run separately with an air gap at the termination with another drain line, floor drain, or other approved drain location. The air compressor shall be sized for the application and field verified by the Engineer of record. Compressor service disconnect switch shall be provided at the compressor with a guard over the switch.
- C. Dry Pipe Piping:
 - 1. Piping to follow NFPA 13. All grooved piping to be rolled grooved and not cut grooved. Schedule 40 to be used for sprinkler and standpipe systems. Fittings can be either cast iron or malleable iron. All equipment to be U.L. listed/FM approved.
 - 2. Victaulic Type saddle fittings over 2" in diameter are not allowed in any Fire Protection piping. Provide full size Tees for 2-1/2" branch outlets or larger. All piping for dry pipe and pre-action sprinkler systems to be galvanized piping and fittings.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering


3. All dry and deluge sprinkler systems should be installed in mechanical areas in the lowest level of the building served. A floor drain must be located within four feet of the valve. If this is not possible, the floor covering must be water tight, and the area under the valve must be bermed and have a floor drain installed to keep water from escaping. In addition, the wall behind the valve must be properly designed/protected to withstand water penetration.
4. The drain assembly serving the dry or deluge valve associated trim piping must be a dedicated non-corrosive drain line that does not connect to any other drain line and does not contain any check valve assembly. The drain must be piped to atmosphere, either the floor drain in the area, or another appropriate location capable of accepting the full flow of the ball drip assembly for an indefinite amount of time.

D. Dry Pendant Heads:

1. Dry pendant heads or sidewall sprinklers to be installed in Cold/Environmental Rooms on wet pipe systems and from unheated attics on dry pipe systems. Piping layouts are to prevent any trapped sections of piping that will not drain and will trap water at the sprinkler heads. Sprinkler heads to have "Corrosion-Resistant Coatings" when installed to protect outside exposures or in hostile environments.

3.2 WET PIPE SYSTEM

- A. All systems to be wet pipe except in areas subject to temperatures below 40°F, which will have a Dry Pipe System, installed (Attic and Unheated Areas).
 1. Pre-Action System will be used only in areas where the concern for water damage by accidental activation or damage to a sprinkler head is of utmost concern.
- B. Piping:
 1. Piping to follow NFPA 13. All grooved piping to be rolled grooved and not cut grooved. Schedule 40 to be used for sprinkler and standpipe systems. In culturally sensitive buildings such as Museums, Art Galleries, Collection Study centers and cultural artifact storage, all wet piping shall be schedule 40 or a pre-action fire sprinkler system shall be installed.
- C. Fittings can be either cast iron or malleable iron. All equipment to be U.L. listed/FM approved.
 1. Victaulic Type saddle fittings over 2" in diameter are not allowed in any Fire Protection piping. Provide full size Tees for 2-1/2" branch outlets or larger.
 2. All branch connections be taken from the side or top of the main to prevent settlement of sediment in the heads possibly preventing actuation.
 3. All concealed type sprinkler heads are to be hard piped in an "arm over" configuration off the top of the branch lines. "Flex Head" type sprinkler heads and associated flexible supply lines are not allowed.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

D. Hangers: Per NFPA-13, UL listed/FM approved.

E. Alarm Check Valves:

1. An alarm check valve or equivalent to be installed at the main feed riser for each system. The trim on the valve to include, supply and system gauges, 0-300 PSI with shut off valves, main drain, sized as per NFPA 13, main flow switch. Flow switch to have 0-90 Sec. retard on the switch, set for 30 sec. and two sets of contacts. Alarm check valve to include trim package with bypass check valve and alarm.
2. The installation of an outside Water Motor Gong will be decided on a project to project basis as required by local ordinance and the AHJ.
3. Retard chamber drain to be separate from 2" drain line.
4. Approved Manufactures:
 - a. Alarm Check Valve: Reliable or Viking.
 - b. Flow Switch: Potter or System Sensor.
 - c. Water Motor Gong: Reliable, Viking.

3.3 HIGH PRESSURE WET PIPE SYSTEMS. OVER 100 PSI SYSTEMS

A. All systems to be wet pipe except in areas subject to temperatures below 40°F, which will have a Dry System, installed (Attic and Unheated Areas).


1. A Pre-Action System will be used only in areas where the concern for water damage by accidental activation or damage to a sprinkler head is of utmost concern.

B. Piping:

1. Piping to follow NFPA 13. All grooved piping to be rolled grooved and not cut grooved. Only Schedule 40 can be used for sprinkler and standpipe high-pressure systems. Only class 250 psi fittings can be used. Fittings can be either cast iron or malleable iron. All equipment to be U.L./FM listed.
2. Victaulic Type saddle fittings are not allowed in any high-pressure Fire Protection piping. Provide full size Tees for all branch outlets.

C. Hangers:

1. Per NFPA-13, UL listed/FM approved. Note Exception No. 1 and Exception No. 2 in NFPA 4-14.2.3.3 copied below in *Italics*. Also, note Exception No. 1 in NFPA 4-14.2.3.4 copied below in *Italics*.
 - a. Exception No. 1*: When the maximum pressure at the sprinkler exceeds 100 psi (6.9 bars), and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the hanger assembly supporting the pipe supplying an end sprinkler in a pendent position shall be of a type that prevents upward movement of the pipe.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

- b. Exception No. 2*: When the maximum pressure at the sprinkler exceeds 100 psi (6.9 bars), the unsupported length between the end sprinkler in a pendent position or drop nipple and the last hanger on the branch line shall not be greater than 12 in. (305 mm) for steel pipe or 6 in. (152 mm) for copper pipe. When this limit is exceeded, the pipe shall be extended beyond the end sprinkler and supported by an additional hanger. The hanger closest to the sprinkler shall be of a type that prevents upward movement of the piping.
- 2. 4 14.2.3.4* The length of an unsupported arm over to a sprinkler shall not exceed 24 in. (610 mm) for steel pipe or 12 in. (305 mm) for copper tube.
 - a. Exception: Where the maximum pressure at the sprinkler exceeds 100 psi (6.9 bars) and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the length of an unsupported arm over to a sprinkler and drop nipple shall not exceed 12 in. (305 mm) for steel pipe and 6 in. (152 mm) for copper tube.
 - b. Where the limits of the unsupported arm over lengths of 4 14.2.3.4 or this Exception are exceeded, the hanger closest to the sprinkler shall be of a type that prevents upward movement of the piping.

D. Alarm Check Valves. Wet Pipe Systems:


- 1. An alarm check valve or equivalent to be installed at the main feed riser for each system. The trim on the valve to include, supply and system gauges, 0-300 PSI with shut off valves, main drain, sized as per NFPA 13, main pressure switch or main flow switch. Flow switch to have 0-90 Sec. retard on the switch, set for 30 sec. and two sets of contacts. Alarm check valve to include trim package with bypass check valve and alarm line.
- 2. The installation of an outside Water Motor Gong will be decided on a project to project basis.
- 3. Retard chamber drain to be separate from 2" drain line.
- 4. Approved Manufacturers:
 - a. Alarm Check Valve: Reliable or Viking.
 - b. Flow Switch: Potter or System Sensor.
 - c. Water Motor Gong: Reliable, Viking.

E. Pressure Restricting Valves:

- 1. Provide a pressure-restricting valve at each fire hose location over 100 psi as required by NFPA 14.
- 2. Pressure Restricting Valve: Croker fig-5066 or Potter-Roemer fig-4085, 2-1/2" with 2-1/2" x 1-1/2" reducer, cap and chain. Pin type is the only approved valve.

F. Pressure Reducing Valves:

- 1. Pressure reducing valves shall be installed on each zone of a High Pressure Wet Pipe System to maintain a maximum zone pressure of 175 psi as required by NFPA. The high-pressure valve shall be supervised, with a tamper switch. A butterfly/gate valve, supervised with a tamper switch, shall be installed before the pressure reducing valve for maintenance.
- 2. Approved Manufacturer: WATTS


	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

3.4 PRE-ACTION SYSTEMS

- A. Pre-Action System will be used only in areas where the concern for water damage by accidental activation or damage to a sprinkler head is of utmost concern.
- B. Pre-Action systems when used should be of the double interlock design with a check valve above the pre-action valve. If a single interlock is desired, then the fire alarm system must be programmed to activate by any two detectors on the floor in the area protected by the pre-action system. An air compressor, set to manufacturers recommended PSI is to be installed to keep the pre-action valve from opening until the sprinkler head is activated. If a single interlock is used, the compressor must be set at 25 PSI to provide trace air for the system and enough pressure to release the sprinkler head plug if the element is damaged. The fire alarm system smoke detection must be in alarm for that area before the pre-action valve can activate. The smoke detectors are to be connected to the building fire alarm system. A separate pre-action control panel is to be installed for each pre-action valve which will monitor the valve for Valve Tamper, Low Air, Pressure Alarm and will control the activation of the pre-action valve from the main fire alarm control panel. 90 Hours Battery Backup to be provided.
- C. Approved Manufacturer: VIKING
- D. Piping:
 1. Piping to follow NFPA 13. All grooved piping to be rolled grooved and not cut grooved. Schedule 40 to be used for sprinkler and standpipe systems. Fittings can be either cast iron or malleable iron. All equipment to be U.L. listed/FM approved.
 2. Victaulic Type saddle fittings over 2" in diameter are not allowed in any Fire Protection piping. Provide full size Tees for 2-1/2" branch outlets or larger.
 3. Piping - galvanized piping and fittings.

3.5 UNDERGROUND FIRE MAINS

- A. All piping to be class 52, Ductile Iron, Cement Lined, and coated for direct burial. All underground fire mains to be at least 8". If the underground fire main is an express main for more than one building, then the size is to be 10". Installation of all piping shall to follow NFPA 24.
- B. All pipe connections to be by Mechanical Joint SSB-Ductile Iron Class 350 Fittings. Mechanical Joint Restraint shall be with retainer glands.
- C. All pipe to have full rodding for its entire length and not just at connections. Supports, Anchors, Tie Rods and Thrust Blocks to be installed as per NFPA 24 (most current adopted version).
- D. Piping Marking shall include buried warning tape.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

3.6 STANDPIPES


- A. All standpipes to be 6" ID except in the residential colleges where by hydraulic calculation they can be 4" in size. The standpipe system and the sprinkler risers can be combined when the system is hydraulically calculated. All fire hose valves shall be 2-1/2" pressure restricting angle valves with quick release pin and male hose threaded outlets and reducing to 1-1/2". Class I standpipe as per NFPA 14. No hose to be provided. Include 2-1/2" and 1-1/2" Caps and Chains. Finish of Fire Hose Valve (FHV) to be determined at the time of design with the architect. Install as per NFPA 14. All standpipe hose valves shall be installed to allow for a firefighter wearing gloves to easily operate the valve. Fire hose valve to be Crocker fig-5066 or Potter Roemer fig 4085. Spanner Wrench all caps. Pin type is the only approved valve. 0-300 PSI gauge plus valve to be installed at top of each stand pipe. Set pressure of fire hose valve based on location in building.

3.7 BACKFLOW PREVENTER

- A. A double check back-flow preventer shall be installed on all fire sprinkler/standpipe systems as required by the Regional Water Authority, but not on the Yale high pressure fire main since it already has a double check back-flow preventer. Any pressure reduction to be included in the Hydraulic Calculations for the system. The Back-Flow Preventer to be installed inside the building with control valves before and after the unit. Drain to be piped to a proper drain location such as outside, sump pit or floor drain that is in good condition. The condition of all drains to be verified before any piping is done. The back-flow preventer to be installed after the fire pump as per NFPA 20.
- B. Approved Manufacturers: FEBCO or WATTS.
- C. Where a chemical system (antifreeze, Foam, etc.) is installed as part of the fire sprinkler system a reduced pressure back-flow device, approved by the local water supplier, shall be installed at the point of use.

3.8 MAIN DRAINS

- A. All main drains from the sprinkler system and standpipe system are to be piped to a proper drain location that can handle both water supply testing and draining of the systems. These proper drains would be from Alarm Check Valves, Dry Pipe Valves, Pre-Action Valves, Deluge Valves, Riser Valves and Sectional Drain Connections including drain lines at floor control valves. These should be piped outside the building or to a sump pit that can handle a flow of 250 G.P.M. for at least 3 minutes. The size of the main drain to be as per NFPA 13. All Drains are to be galvanized pipe and fittings.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

3.9 AUXILLARY DRAINS

A. Including Low Point Drains


1. All low point drains to be provided as per NFPA 13 and to have a valve, hose Connection and solid brass cap provided with sign and chain. All plugs to be replaced with a hose connection and solid brass cap. All drains at floor control valves to be piped as per main drains.
2. Dry systems to be provided with drum drips at low points with valves, hose connection and cap. All drains are to be galvanized pipe and fittings.

B. Piping:

1. Piping to follow NFPA 13. All grooved piping to be rolled grooved and not cut grooved. Schedule 40 to be used for sprinkler and standpipe systems. Fittings can be either cast iron or malleable iron. All equipment to be U.L./FM listed.
2. Victaulic Type saddle fittings over 2" in diameter are not allowed in any Fire Protection piping. Provide full size Tees for 2-1/2" branch outlets or larger.

3.10 SPRINKLER HEADS

- A. All sprinkler heads to be UL listed Quick Response Commercial sprinkler heads designed for Ordinary Hazard Application. They must also be listed for installation in Light Hazard areas. All sprinkler heads to have a least a 1/2" orifice with a temperature rating to match location installed. High temperature heads to be installed in any location subject to high heat potential including mechanical areas, attic areas and unvented skylight areas where 200/212° F sprinkler heads are to be installed. Quick response and standard heads are not to be used in the same area.
- B. All concealed sprinkler heads to have white cover plates. Concealed sprinkler heads to be Reliable Model G5QR, 165F. Cover Plate White. K=5.62 or current model. Sprinkler heads with Corrosion-Resistant Coatings to be used in hostile environments.
- C. Spare sprinkler heads, storage box, wrench, cover plates and escutcheons to be provided as per NFPA 13 on each sprinkler project for each type of sprinkler head installed. At least six (6) sprinkler heads of each type shall be provided at each location as spare sprinkler heads. At least one sprinkler head wrench of each type shall be provided at each location as a spare sprinkler head wrench. If sprinkler caps are provided, then at least six (6) sprinkler caps are to be provided as spares. An example, if five different sprinkler heads are installed in a project with sprinkler caps, then the contractor must provide at least six (6) sprinkler heads of each type installed, total 30 sprinkler heads with five proper sprinkler wrenches and 6 sprinkler caps in a storage box.
- D. Sprinkler guards to be installed in any location where sprinkler heads are subject to mechanical damage or are located below 7' 6" above finished floor.
- E. Extended coverage sprinkler heads or light hazard or as listed.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

F. Approved Manufacturers: RELIABLE or VIKING.

3.11 FLOOR CONTROL EQUIPMENT

- A. Floor control valves shall be butterfly valves (Milwaukee, Victaulic), with a built-in tamper switch and two sets of contacts (part of Tamper Switch). Each floor to have a Flow Switch with two sets of contacts and a retard switch (part of Flow Switch) from 0-90 Seconds. Set at 30 Seconds. In the residential colleges, the flow switch would be on the riser only for each entry way and not on every floor. A pressure gauge (Ashcroft) 0-300 PSI with shut off valve at each floor except in the residential colleges where the gauge would be at the riser control valve. The drain valve /inspector's test to be piped outside or to a drain that can handle a flow of 50 G.P.M. for 3 minutes such as a janitor's sink. They are not to be piped to a floor drain. In the residential colleges, the drain valve after the floor control valve can be a hose connection and cap. The drain/inspector's test after the riser control valve in the residential colleges to be piped as per the main drains. A sprinkler zone check valve shall be installed with each floor control assembly.
- B. All floor control vales shall be accessible without need for special tools and equipment and installed no more than 6'-6" above finished floor.

3.12 VALVES: ABOVEGROUND AND WITHIN BUILDINGS

- A. All control valves to be butterfly valves with a built-in tamper switch and two sets of contacts. Tamper switch shall be connected to the building fire alarm system as a separate point or zone as a supervisory alarm and not on the same point or zone of any alarm causing device. All valves to be Left Hand to Open (counter-clockwise).
- B. Approved Manufacturers: MILWAUKEE, VICTAULIC.

3.13 VALVES: UNDERGROUND AND POST INDICATOR


- A. All curb boxes, PIV's and other control valves to be Left Hand to Open (counter-clockwise). All PIV's to have a tamper switch with two sets of contacts included. All flexible and rigid conduit servicing the PIV tamper switch shall be water tight and non-corrosive.

3.14 CHECK VALVES

- A. Approved Manufacturers: VIKING, VICTAULIC, RELIABLE

3.15 FIRE PUMP

- A. Fire pumps to be installed as needed to increase the flow and pressure needed to meet the requirements of NFPA 13 and NFPA 14 in each building. The design to follow NFPA 20 and to include the following:

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

1. The fire pump shall be located in a separate secured space. The space shall be key locked using the Yale Fire Marshal master key.

- B. Flushing of piping: All piping to be flushed through the fire pump by-pass with the valves to the fire pump closed. The flushing rate as per NFPA 20. This is to be done before the fire pump test is started.

- C. Testing Requirements:
 1. The fire pump is to be tested following the guide lines of NFPA 20 and NFPA 25 with a complete report from the contractor with Mfg. test curves and actual test curves from on site testing. The test is to include RPM reading of the pump and ampere/voltage readings on all electric leads from the controller for each flow rate.

- D. The test is to be witnessed by the local AHJ or his/her designee and the Yale University Office of the Fire Marshal and to include, churn, rated, 150% flow rates and emergency power tests.

- E. A fire pump test header is to be provided on the outside of each building where a fire pump has been installed and its location to be coordinated with the University Fire Marshal's Office. Size of piping and number of outlets as per NFPA 20 including control valves and drain. All fire pumps to be provided with a bypass around the pump as outlined in NFPA 20. Controller is to be connected to fire alarm control panel for supervision of power supplies and fire pump status, such as pump running, no power, phase reversal, transfer of power etc.

- F. Control Valves (STOCKHAM) before and after the fire pump to be full flow type so as to not restrict the flow of the pump. OS&Y type, with tamper switches.

- G. All control valves to have a tamper switch installed with two sets of contacts and set for proper operation and connected to the fire alarm control panel. Potter or System Sensor


- H. All fire pump controllers to be combined Normal and Emergency Power type with automatic transfer between power supplies.

- I. Jockey Pump to be installed to maintain pressure on the system and to be set to start at 10 PSI below churn pressure of the fire pump and stop at 10 PSI above churn pressure of fire pump.

- J. Fire Pump to be set to start at 25 PSI below churn pressure and stop at churn pressure.

- K. Casing relief drain to be a separate drain line from drip cup drains.

- L. Approved Manufacturers:
 1. Fire Pump: ITT-AC, PEERLESS
 2. Fire Pump Controller: FIRETROL
 3. Jockey Pump: GRUNDFOS
 4. Jockey Pump Controller: FIRETROL

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

3.16 FIRE DEPARTMENT CONNECTIONS

- A. Provide a sign at connection. “Stand Pipe” or “Combined Standpipe and Sprinklers”
- B. Fire department connection (FDC) to be provided to each sprinkler/standpipe system with (2) 2-1/2" connections by a 6" feed to the system. Check valve and auto ball drip to be provided on each connection. Connection to be a brass flush unit whenever possible. Location to be coordinated with the City and Yale University Office of the Fire Marshal on the exterior of the building. Spanner wrench provided with all caps.
- C. Signage shall be installed instructing the Fire Department what pump pressure to supply to the FDC to meet the design intent.
- D. The installation of an outside Water Motor Gong will be decided on a project to project basis, in accordance with the direction of the AHJ.
- E. Approved Manufacturers: RELIABLE, VIKING

3.17 YARD HYDRANTS


- A. Fire hydrants installed on any Yale high pressure grid shall be Kennedy Guardian K81D. A Kennedy 7571 curb box valve, Left Hand to Open (counter-clockwise), shall be installed in the hydrant supply line within 6’ of the hydrant. All hydrant installations MUST be approved by the local Authority Having Jurisdiction (AHJ). Thread pitch and diameter to be approved by the AHJ and the local water company. All new hydrants must have the barrel painted to match the local jurisdiction (approved by AHJ) Hydrant caps to be color coded to match NFPA requirements.

3.18 ROOF MANIFOLDS

- A. Are to be provided as required to test the standpipe system for proper flow and pressure at the top of the most remote riser. All manifolds subject to freezing to be provided with a butterfly valve with a tamper switch and an Aux. Drain with valve, hose connection and cap above the control valve.
- B. Approved Manufacturers: Crocker, Potter Roemer

3.19 CORRIDOR FIRE MAINS

- A. Mains to be sized with a uniform size for the entire length of the corridor as per the hydraulic calculations so that the system can be expanded as needed. Such as Medical Laboratory Areas, 3" or 4" for the entire length of the corridor. Corridor fire mains that are installed before the rooms/labs have sprinkler protection to be provided with 2" taps on the main every 15 ft. for future connections.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

- B. Auxiliary Drains with valve, hose connection and cap to be provided on the main as per NFPA 13 to drain any trapped sections of piping. Signs to be provided as per NFPA 13 for these aux. drains. Provide signs above and below ceiling.

3.20 EXTINGUISHERS

- A. Type ABC: UL rated 4A-60B:C, 10 lb. capacity, stored-pressure multi-purpose dry chemical. Amerex 441
- B. Type BC UL rated 10 B:C 10 lb capacity, etc. Amerex 330
- C. Type BC UL rated 5 B:C SLB capacity Amerex 322
- D. Installation: provide wall brackets for surface-mounted extinguishers. Secure mounting to surface.
- E. Mounting heights: top maximum 60 inch above floor.


3.21 FIRE EXTINGUISHER CABINET

- A. Potter-Roemer 1700 Series; recessed; Cabinet to be constructed of #22 gage steel box; one piece #20 gage steel frame with a continuous steel hinge (brass pin); pull handle with friction catch; painted inside with baked-on enamel, outside with prime coat or as directed by Architect.
- B. Install cabinets in coordination with masonry coursing, and so that top of extinguisher is not more than five feet above floor. Set cabinets plumb, square, and level, with frame tight to wall surface securely anchored.

PART 4 - EXECUTION

4.1 LICENSE

- A. All piping shall be installed by licensed F-2 or F-1 pipefitters. Contractor shall provide names and license numbers of all persons working on fire protection systems. The contractor shall provide this information to the Yale Project Manager in charge of the project or work.

	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: 21 Fire Protection	Section: 21 00 00 Fire Protection
		Date: 01/25/19
		Author: Office of Utilities and Engineering

4.2 CLOSE OUT REQUIREMENTS

A. As Built Drawings:

1. As Built Drawings from the fire protection contractor are to be provided for review and final printing to both the Project Engineer for the Project and the Yale University of the Fire Marshal. When approved and sealed, the final sets are to be printed and provided to the plan room, engineer and to the Yale University Office of the Fire Marshal. Reproducible drawings are also to be provided to the plan room. A set of as built drawings shall to be located at the alarm check valve in a protective tube.

B. Flushing of Systems:

1. All sprinkler systems, standpipe systems, fire pumps, jockey pumps, and fire mains are to be flushed clean as outlined in NFPA 13, 14, 20 and NFPA 24. These standards outline the flow rates required to have the systems cleaned of any debris. This is to be included in the test reports and is to be signed and witnessed.

C. System Testing:

1. All piping, fittings and system components are to be tested as per NFPA 13, 14 and 24 with water which is 50 PSI above the highest static pressure for the system or 200 PSI for 2 Hours, whichever is greater. Both above ground and underground piping to be included. High pressure fire mains and systems shall be tested to 225 PSI. All hydrostatic testing MUST be witnessed by a Yale University Fire Inspector. Certificates to be completed and signed for each part of the system with copies provided to the Yale University Office of the Fire Marshal, Project Engineer, and Project Manager.

Date	Description of Change	Pages / Sections Modified	ID
1/25/19	Entire document	-	mg144