

## FIRE SPRINKLER SYSTEMS

### DESIGN & INSTALLATION

#### 1. Design Documents

- a. Fire sprinkler drawings and specifications intended for bid shall include, at a minimum, the following:
  - Extent of the scope of work on plans
  - Design Criteria (sprinkler discharge density, hazard, spacing, hose allowance) for the area of work, including NFPA 13 and FM Global criteria
  - Location of floor control valve assembly or riser assembly serving the area of work, locations of drain terminations, and location of automatic air-release valve serving system
  - Indicate compliance with FM Global Guidelines
  - Smoke zone boundaries, underground connection, valves, and fire pump location (where included in scope of work)
- b. Shop/Installation drawings shall be provided in accordance with NFPA 13 Section 22.1.3 (2007/2010 Edition) / 23.1.3 (2013/2016 Editions), and FM Global Data Sheet 2-0 Section 2.7 for Working Drawings.
- c. Both bid documents and shop drawings shall be sent to FM Global for review:
  - FM Global, 540 Maryville Centre Drive, Suite 400, St. Louis, MO 63141.

#### 2. Building-Specific Deficiencies:

- a. Contact WUSM Design and Construction Department for renovation projects concerning ongoing building deficiencies which need to be incorporated as part of the scope of work.

#### 3. Backflow Preventers

- a. For new installations, provide redundant double-check backflow preventers with OS&Y valves. Horizontal orientation is preferred.

*Redundancy allows servicing, maintenance, and replacement of backflow preventers without loss of sprinkler protection to the facilities.*
- b. Do not locate any portion of the backflow preventer above 6 feet above finished floor.

#### 4. Clean Agent Systems

- a. Provide clean agent systems in computer/data centers, rare book rooms, or where deemed necessary by WUSM Design & Construction Department.
- b. Clean agent systems shall utilize NOVEC-1230 agent.
- c. Manual release and abort stations shall utilize a toggle-switch activator, not plunger-type.
- d. Clean agent systems protecting rooms over 500 sqft shall be provided with a telephone at any manual release and abort station.

5. Corrosion:

*Oxygen-based corrosion is the largest determinant in the life expectancy of a fire sprinkler system. Reduction of corrosion significantly extends the service life of a fire sprinkler system.*

- a. Every new or modified wet-pipe fire sprinkler system shall include or add an automatic air-release valve.

*The 2016 Edition of NFPA 13 now requires venting in order to reduce corrosion in fire sprinkler systems, which automatic air vents meet. FM Global Data Sheet 2-1 recommends inclusion of automatic air release valves at high points in wet systems to prevent corrosion.*

- b. Nitrogen inertion shall be provided for every new dry-pipe or pre-action system installation. Every modified dry-pipe or pre-action fire sprinkler system shall be evaluated with WUSM Design and Construction Department for inclusion of a nitrogen inertion system, based on the degree of modification.

*Dry and pre-action systems experience significantly greater corrosion potential than wet-pipe sprinkler systems, as moist air (containing oxygen and water vapor) is regularly injected into dry and pre-action systems to compensate for any leakage in the system. Life expectancy of dry and pre-action systems is therefore significantly shorter, which can be significantly extended with nitrogen inertion systems.*

*For projects with dry or pre-action sprinkler systems, the Fire Sprinkler Designer/Engineer shall evaluate with WUSM whether a nitrogen inertion system should be provided. FM Global Data Sheet 2-1 recommends nitrogen inertion for dry or pre-action sprinkler systems with use of black steel pipe.*

- c. Replace any schedule 10 or galvanized pipe within renovated areas. Coordinate replacement with WUSM project manager.

6. Drainage

- a. Drains from the fire sprinkler system shall terminate at interior drain pits or suitable interior locations, capable of handling the flow. Where approved to run to exterior, locate drainage to prevent flooding, damage to landscaping, or wetting of walkways.

*Testing and system drainage is used in the winter, and termination outside of the building has iced walking paths and pipe segments.*

- b. Where new standpipe systems are provided, provide an express drain with outlets for standpipe flow testing.
- c. Where any portion of the system contains trapped water, provide a 1-inch, plugged, globe or ball valve as an auxiliary drain. These valves do not require pipe to a drain.

7. Dry or Pre-Action Systems

- a. Use of dry or pre-action system requires an evaluation for whether a nitrogen inertion system is necessary based upon the scope of work of the project. See Corrosion above.
- b. When installed, dry or pre-action system compressors shall not be located near regularly occupied working areas (such as offices, exam rooms, or noise-sensitive areas).
- c. Compressors serving nitrogen inertion or air maintenance of dry and pre-action systems shall be low-noise producing, tank-mounted air compressors. Tank shall be floor mounted with vibration isolation pads. Riser-mounted air compressors are not permitted.

*Noise from compressors is a common disturbance for areas near dry and pre-action sprinkler system risers. Care should be taken to reduce the noise burden due to the running of these compressors.*

- d. Where multiple dry or pre-action systems share the same air compressor, the compressor shall be sized for refilling *all* the connected systems in 30 minutes, or multiple air compressors shall be provided each sized for the largest system.

*NFPA 13 permits multiple systems to be served by an air compressor sized for the largest system, but refill of multiple systems at the same time then requires significant time to recharge. Providing multiple air compressors reduces the time to refill the systems and permits repair, maintenance, or replacement of a single compressor while keeping the systems in operation.*

#### 8. Flexible Drops

- a. Flexible drops are not permitted, unless specifically allowed by WUSM Design & Construction Department.

*Flexible drops require careful supervision and monitoring to ensure that they are installed in accordance with their listing. Specifically, hydraulic friction loss must be accounted for, minimum pipe bend radius must be upheld during original installation and without tampering over time, and the maximum number of bends must be satisfied over the life of the install.*

*Additionally, many installations for WUSM projects are near or above high-value equipment. Potential failure of o-rings or washers over time could present leakage.*

*FM Approval and code allowance permits use of flexible drops, which provide labor savings and better seismic performance than hard-pipe return bends. However, for most projects, the benefits to using flexible drops do not outweigh the risk for these facilities.*

- b. Where approved for use, flexible drops must comply with the following:

- Minimum of 1-inch internal diameter.
- Flexible drops shall be FM Approved.
- Flexible drops shall contain no rubber o-rings or washers.
- Where provided as retrofits in existing buildings, provide hydraulic calculations indicating minimum hydraulic safety factor of 5 PSI or 10%, whichever is greater, is met.

*Flexible drops can provide significant labor installation time savings and perform better than return bends in seismic areas.*

*Care must be taken that flexible drops are designed and installed in accordance with their listing. Proper consideration must be made to include hydraulic friction loss, abide by minimum pipe bend radius, and not exceed the maximum number of bends to satisfy the manufacturer's listing.*

#### 9. Fire Department Connection Check Valve Bypass

- a. Where fire department connections are new or modified as part of the scope of work, a supervised indicating normally-closed butterfly valve shall be provided as a bypass of the check valve serving the fire department connection. The bypass valve is provided to better allow for annual forward flow testing of the backflow preventer.

*Forward flow testing of backflow preventer is required annually by NFPA 13 Section 16.2.5.1 (2002 Edition) / 10.10.2.5 (2007-2016 Editions) and NFPA 25 Section 12.6.2.1 (2002 Edition) / 13.6.2.1 (2008-2014 Editions) / 13.7.2.1 (2017 Edition). Flow must be conducted at the system flow rate of the system demand, which is only often achievable through an open orifice as large as that serving the fire department connection.*

*Some contractors perform the forward flow test by reversing the check valve serving the fire department connection which requires system shutoff, modification of the system, and then re-arrangement for each test. Providing a bypass valve significantly reduces the testing burden upon the testing authority.*

#### 10. Insurance Provider

- a. Washington University School of Medicine is insured by Factory Mutual (FM) Global.
- b. Design and installation must conform to the following guidelines, at a minimum, where applicable to the scope of work:
  - FM Data Sheet 2-0, Guidelines for Automatic Sprinklers
  - FM Data Sheet 2-1, Internal Corrosion of Automatic Sprinklers
  - FM Data Sheet 2-8, Earthquake Protection
  - FM Data Sheet 2-10R Dry Pipe, Deluge, Pre-Action Valves & Accessories
  - FM Data Sheet 3-0, Hydraulics of Fire Protection Systems
  - FM Data Sheet 3-7, Fire Protection Pumps
  - FM Data Sheet 3-26, Fire Protection Demand for Non-Storage Occupancies
  - FM Data Sheet 8-1, Commodity Classification
  - FM Data Sheet 8-9, Storage of Commodities

#### 11. System Impairment & Fire Watch

- a. Disruptions to fire sprinkler service shall be minimized.
- b. Fire watch is to be provided by the contractor where a required fire protection system is out of service, in accordance with the International Fire Code Section 901.7 (2003-2015 Editions)

#### 12. Valves

- a. Supervised indicating valves shall be provided in stairwells.

*Note: Other locations only as approved by WUSM Capital Projects or Design & Construction Department.*
- b. Sprinkler systems for multi-level buildings shall be provided with valves for floor isolation. Each floor level control valve must also have a check valve on the downstream side of the floor control valve.

*Providing floor-level control valves permits isolation of each floor for testing, maintenance, modifications or repairs. Providing check valves on the downstream side of the floor control valve keeps systems charged in the event of a system-wide drain and can help reduce nuisance waterflow alarms.*
- c. Valves shall be readily accessible and shall not be located above ceilings.

- d. Building areas greater than 20,000 square feet shall be subdivided into separate systems, capable of being isolated and drained independently.

*Large sprinkler systems bring greater portions of building out of protection when a system is being modified. Large sprinkler systems also require longer drain and refill times. Subdividing sprinkler systems reduces the number of drain and refill instances, which helps reduce corrosion. This reduction is significantly less than the NFPA 13 limitation of 52,000 sqft for light and ordinary hazard systems of Section 5-2 (1999 Edition), or 8.2.1 (2002-2016 Editions).*

- e. Sprinkler systems which require floor-level pressure reducing valves (PRV) shall have the pressure reducing valve installed on the downstream side of the floor control valve. Combination floor control valve/pressure reducing valves are not permitted.

*Pressure reducing valves are not preferred due to their cost and high frequency of failure. Combination floor control valve/pressure reducing valves are more expensive to replace, and when replaced, would require the entire sprinkler riser to be drained. Replacement of a pressure reducing valve on the downstream side of a control valve only requires isolation and draining of a floor level system.*

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## EQUIPMENT

1. All Equipment
  - a. All equipment, pipe, pipe accessories, pipe fittings, switches, valves, and any other equipment serving fire sprinkler systems shall be manufactured in the United States of America.
  - b. All equipment shall be FM Approved.
2. Air Compressor & Tank
  - a. Acceptable Manufacturer: Floor-Mounted Tank with Tank-Mounted Air Compressor, Oil less, Quiet Series or Quiet Rating
  - b. Air Compressors shall have a noise rating of 65 dBA or less at 10 ft.
3. Automatic Air Release Valves (Wet Systems)
  - a. Acceptable Manufacturers:
    - Potter Signaling Systems, Model PAV (requires drain piping)
    - AGF Manufacturing, Model 7950ILV (requires drain piping)
    - Engineered Corrosion Solutions (ECS), Model PAV-W or PAV-WS
4. Backflow Preventer
  - a. Acceptable Manufacturers:
    - Ames
    - Watts
5. Clean Agent & Releasing Panel
  - a. Acceptable Clean Agent Equipment Manufacturer: ANSUL SAPPHIRE
  - b. Acceptable Releasing Panel Manufacturer: Notifier
6. Fire & Jockey Pumps
  - a. Acceptable Manufacturer: Aurora
  - b. Jockey Pump: Shall be in-line configured for 480-volt, 3 phase, 3 hp or greater
7. Fire Pump Controllers
  - a. Starting method: controller shall be of the combined manual and automatic type designated for full voltage
  - b. Pump Controller shall be capable of indicating alternate power use, fire pump run, power fail, and phase reversal.
  - c. Provide a non-fused and lockable disconnect rated for locked rotor current to be installed between the normal power substation tap and the fire pump controller.
  - d. Acceptable Manufacturers:
    - Metron, Cutler Hammer, Eaton or Tornatech

8. Nitrogen Inertion for Dry Systems

a. Acceptable Manufacturers:

- Potter Signaling System Nitrogen Inertion, Quiet-Series Compressor
- Engineered Corrosion Solutions (ECS)

9. Gauges

- Gauges serving fire pump or jockey pump shall be liquid-filled type
- Gauges shall be minimum 3" in diameter

10. Pipe

- Schedule 40 Black Steel pipe is required.
- Schedule 7, Schedule 10, Schedule 10 Thinwall, CPVC, or Galvanized pipe are not acceptable.

*Dry and pre-action sprinkler systems using galvanized pipe have been found to fail earlier with pin-hole corrosion leakage as compared to black steel pipe systems. Atmosphere inside dry and pre-action systems is persistently moist and oxygen rich, leading to a higher rate of corrosion at localized points of failure. Black steel outperforms galvanized pipe because corrosion attack is not localized and does not include a cost premium.*

*Schedule 40 pipe has a thicker wall membrane, retaining strength over time and reducing susceptibility to leakage due to corrosion leakage.*

- Pipe serving MRI suites shall be non-ferrous pipe and approved by MRI manufacturer.

11. Pipe Fittings

- No roustabout or plain-end fittings are permitted.
- All threaded fittings shall be cast iron.
- All fittings shall be made in the United States.

12. Sprinkler Type

- Gypsum or acoustical tile ceilings: recessed type, white or chrome finish
- Clean rooms where airtight construction is critical: gasketed, concealed sprinklers
- MRI Suites: non-ferrous, concealed sprinkler, Viking VK462-MRI or Reliable F4FR-NF.
- Sidewall sprinklers (where necessary): horizontal recessed with white or chrome factory finish. Brass finish is permitted in non-public areas.
- Concealed sprinklers are not preferred. Where used, concealed sprinklers shall be white Viking VK462 or Reliable G4A or G5.

*Concealed sprinklers are permissible, but not preferred as the coverplate can loosen and disengage, are more expensive than recessed sprinklers, and are not FM Approved as Quick Response. The Viking VK462 helps maintain consistent products for replacement across WUSM facilities.*

- Vivarium Areas (enclosures for animals) require special attention. Consult WUSM for type of sprinkler used in vivarium areas.

*Recessed (non-concealed) sprinklers with fixed escutcheons may be acceptable, but the appropriate sprinkler type depends upon the enclosure application.*

13. Sprinkler Location

- a. Sprinklers shall be centered in tiles or located in quarter-points of 2'x4' ceiling tiles. Sprinkler shall be centered in 2'x2' tiles.
- b. Coordinate sprinkler locations with lab benches and upper cabinetry to avoid conflicts.

14. Sprinkler Temperature

- a. Provide high-temperature sprinklers within the room and in the adjacent corridor where autoclave, sterilizer, lab washer are present, or shall be 286 deg F in mechanical rooms with steam or heat producing equipment.

15. Supervisory Switch(es)

- a. Approved Manufacturers: Potter Electric or System Sensor

16. Valves

- a. OS&Y valves: provide where upstream of fire pump or when serving backflow preventer
- b. Control Valves: all other valves (other than OS&Y listed above) shall be supervised indicating butterfly valves with integral tamper switches. Victaulic or Anvil USA with large hand wheels only.
- c. Check valves: provide after each zone valve with a gauge and test & drain
- d. Dry Valves: Viking Models only
- e. Pre-Action Valves: Viking Model E-1 or F-1 only
- f. Pressure Reducing Valves: Combination control valve/pressure reducing valves are not permitted. Where required, provide pressure reducing valves on the downstream side of floor control valves.

17. Waterflow Switch(es)

- a. Approved Manufacturer: Potter Electric or System Sensor

END OF SECTION