NFSA
NATIONAL FIRE SPRINKLER ASSOCIATION
The Voice of the Fire Sprinkler Industry

THE WORLD OF PRESSURE-REGULATING DEVICES

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PRESENTER – TERIN HOPKINS

Terin is currently the Manager of Public Fire Protection in Codes, Standards, Public Fire Protection and Training Department, for the National Fire Sprinkler Association (NFSA), headquartered in Baltimore, Maryland." Terin has 34 years in public safety beginning his public safety career in 1981 as a Volunteer Firefighter/EMT and then serving 25 years with the Prince George's County Maryland Fire/EMS Department, retiring in 2009. He then went to work for the Howard County Maryland Department of Fire Rescue Service, Office of the Fire Marshal.

In 2018 he was hired as the Mid-Atlantic Field Service Coordinator with NFSA. Terin represents NFSA on several NFPA technical committees including, NFPA 1 *Fire Code*, NFPA 14 *Standard for the Installation of Standpipes and Hose Systems*, *UL 47 Standard for Standpipe Devices* and eight fire service training standards covered by NFPA 13E *Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems*.

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PROGRAM DESCRIPTION

This presentation will cover the history of pressure-restricting devices all the way though today's requirements for pressure-reducing valves (PRV's). It will cover the use of indirect and direct acting pressure-regulating valves and a discussion on how design effect the fire department's tactical considerations for operations. We will finish up with requirements for inspections, testing and maintenance.

EMPIRE STATE BUILDING - 1931

102-Stories 1,454 feet
Tallest building in the world for

41 years (1931-1972)

Currently 57th in the world

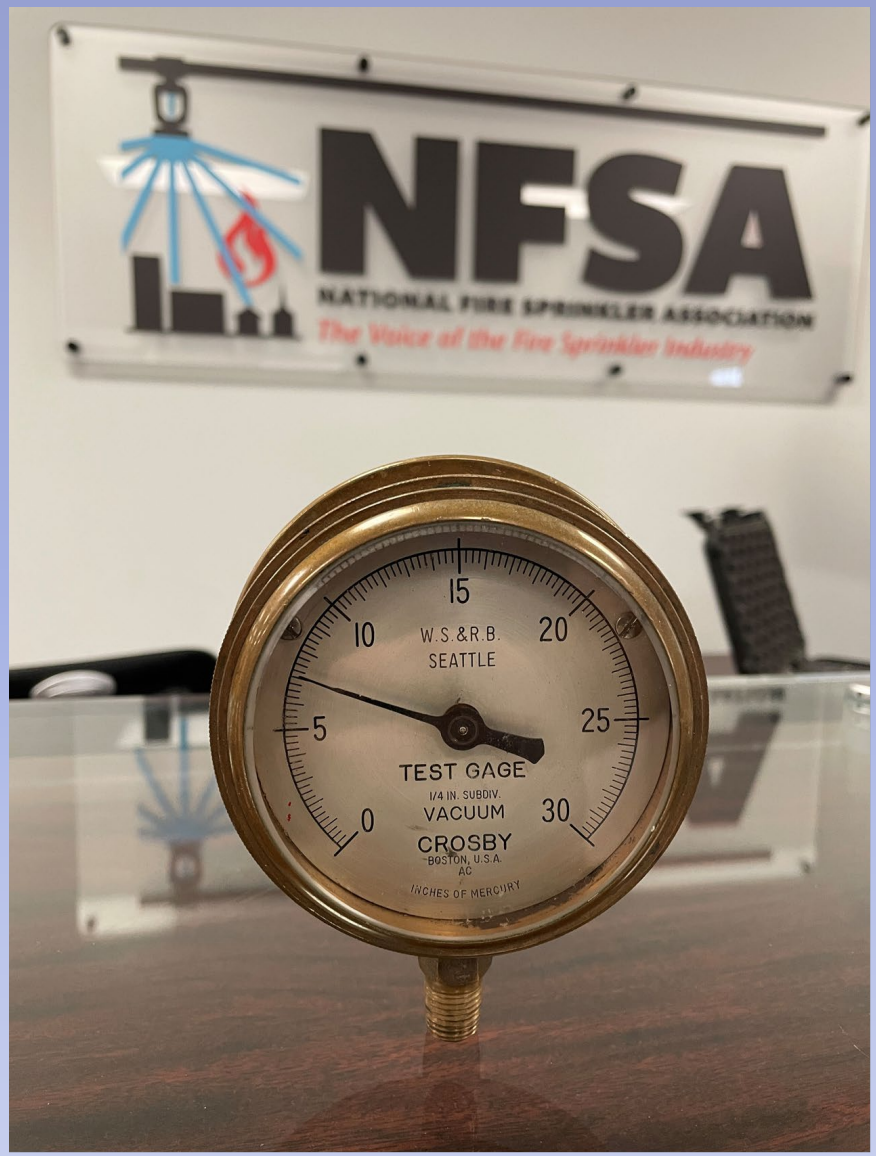
PRESSURE

A continuous physical force exerted on or against an object

A cubic foot of water weighs 28kg/62.4 lb. and exerts

.0299bar/.4333 psi

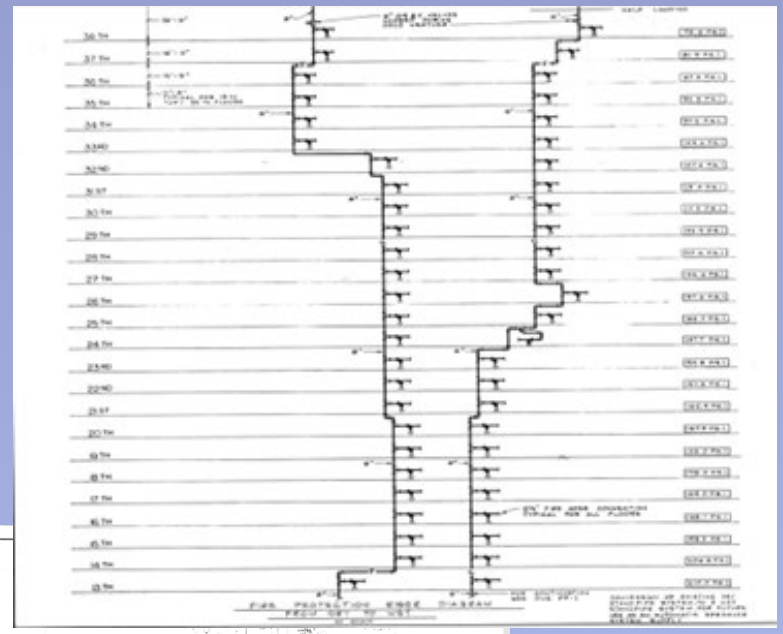
100 feet=43.33psi

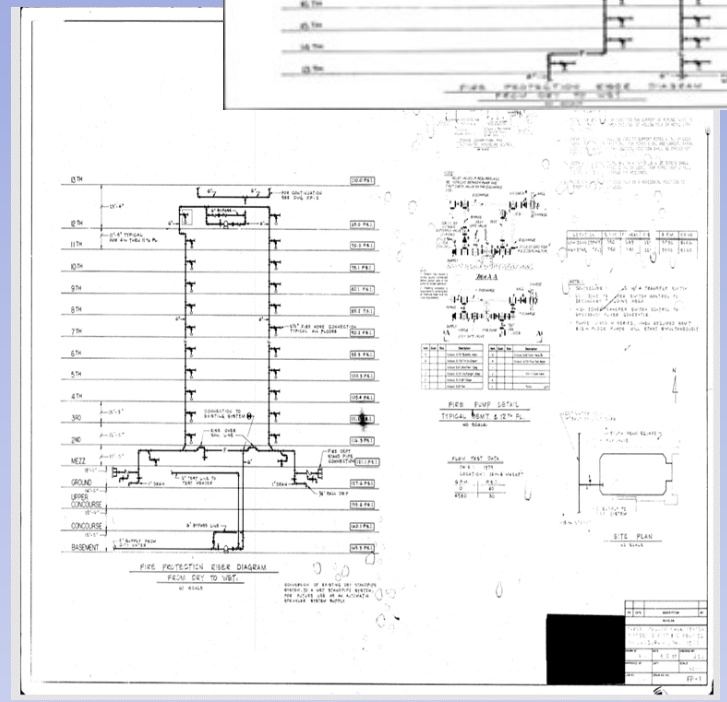


ONE MERIDIAN PLAZA FIRE FEB,23RD 1991

There is no fire department in the world that can control a major fire in a high-rise building on an upper floor, if the fire protection and redundancy that are built into those system all fail.

Roger Ulshafer Philadelphia Fire Commissioner 1988-1992



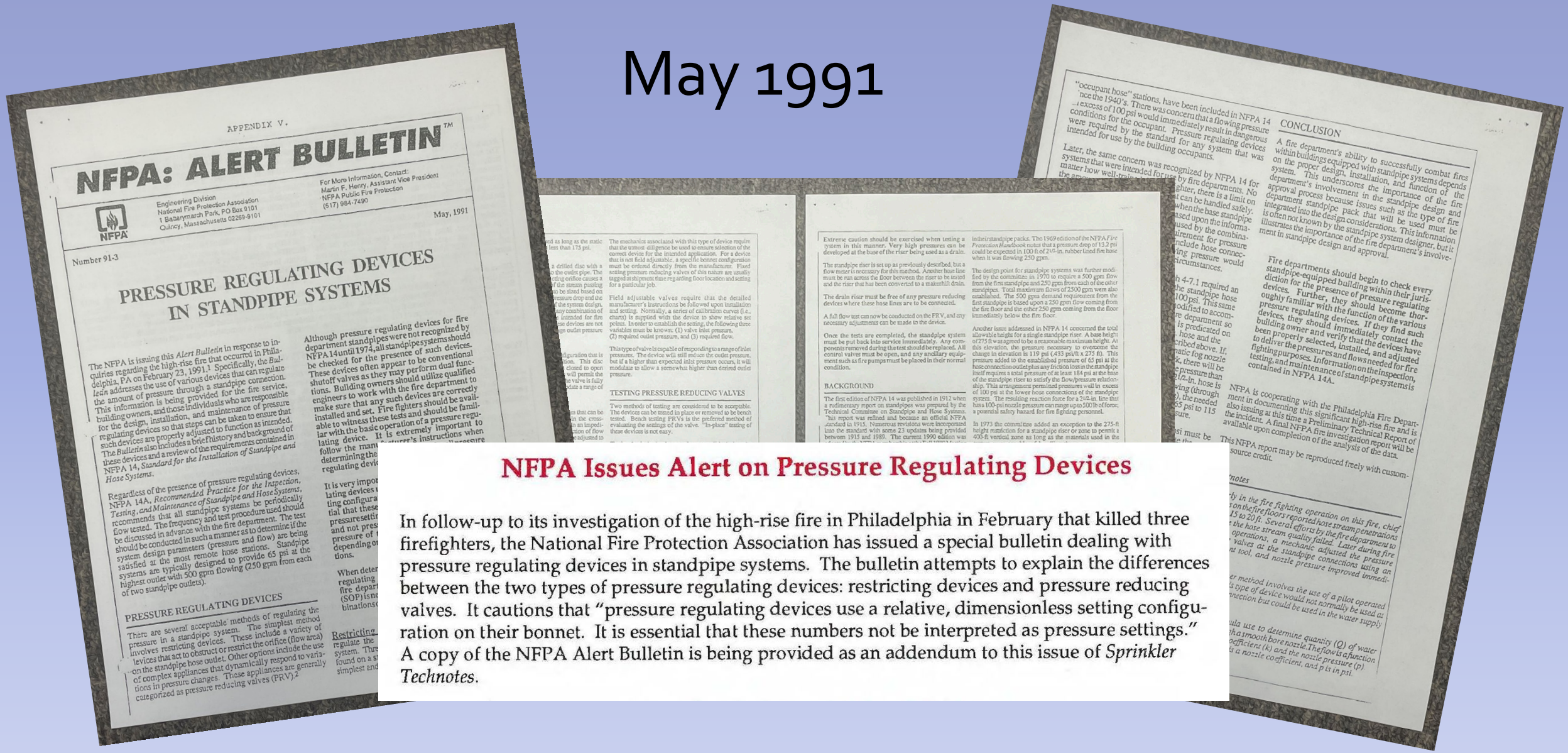


US Fire Administration TR047
PRD floors Mezz, 2nd, 26-30
PRV floors 13-25

Reports of pressure from **3-4bar/40-58psi** (Minimum standard required 4.5bar/65psi)
PFD - 150' 1 3/4 In. hose w/fog nozzle (Nozzle pressure??)

NFSA TECH NOTES: ALERT BULLETIN 91-3

May 1991



APPENDIX V.

NFPA: ALERT BULLETIN™

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May, 1991

Number 91-3

PRESSURE REGULATING DEVICES IN STANDPIPE SYSTEMS

The NFPA is issuing this *Alert Bulletin* in response to inquiries regarding the high-rise fire that occurred in Philadelphia, PA on February 23, 1991.[1] Specifically, the *Bulletin* addresses the use of various devices that can regulate the amount of pressure through a standpipe connection. This information is being provided for the fire service, building owners, and those individuals who are responsible for the design, installation, and maintenance of pressure regulating devices so that steps can be taken to ensure that such devices are properly adjusted to function as intended. The *Bulletin* also includes a brief history and background of these devices and a review of the requirements contained in NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

Regardless of the presence of pressure regulating devices, NFPA 14A, *Recommended Practice for the Inspection, Testing, and Maintenance of Standpipe and Hose Systems*, recommends that all standpipe systems be periodically flow tested. The frequency and test procedure used should be discussed in advance with the fire department. The test should be conducted in such a manner as to determine if the system design parameters (pressure and flow) are being satisfied at the most remote hose stations. Standpipe systems are typically designed to provide 65 psi at the highest outlet with 500 gpm flowing (250 gpm from each of two standpipe outlets).

PRESSURE REGULATING DEVICES

There are several acceptable methods of regulating the pressure in a standpipe system. The simplest method involves restricting devices. These include a variety of devices that act to obstruct or restrict the orifice (flow area) on the standpipe hose outlet. Other options include the use of complex appliances that dynamically respond to variations in pressure changes. These appliances are generally categorized as pressure reducing valves (PRV).[2]

Although pressure regulating devices for fire department standpipes were not recognized by NFPA 14 until 1974, all standpipe systems should be checked for the presence of such devices. These devices often appear to be conventional shutoff valves as they may perform dual functions. Building owners should utilize qualified engineers to work with the fire department to make sure that any such devices are correctly installed and set. Fire fighters should be available to witness these tests and should be familiar with the basic operation of a pressure regulating device. It is extremely important to follow the manufacturer's instructions when determining the [illegible] regulating devices.

It is very important [illegible] lating devices [illegible] ting configura[illegible] tial that these [illegible] pressure setti[illegible] and not pres[illegible] pressure of [illegible] depending o[illegible] tions.

When deter[illegible] regulating [illegible] fire depart[illegible] (SOP) is n[illegible] binations[illegible]

Restricting [illegible] system. Thes[illegible] regulate the [illegible] found on a s[illegible] simplest and[illegible]

The mechanics associated with this type of device require that the utmost diligence be used to ensure selection of the correct device for the intended application. For a device that is not field adjustable, a specific bonnet configuration must be ordered directly from the manufacturer. Fixed setting pressure reducing valves of this nature are usually tagged at shipment time regarding floor location and setting for a particular job.

Field adjustable valves require that the detailed manufacturer's instructions be followed upon installation and setting. Normally, a series of calibration curves (i.e., charts) is supplied with the device to show relative set points. In order to establish the setting, the following three variables must be known: (1) valve inlet pressure, (2) required outlet pressure, and (3) required flow.

This type of valve is capable of responding to a range of inlet pressures. The device will still reduce the outlet pressure, but if a higher than expected inlet pressure occurs, it will modulate to allow a somewhat higher than desired outlet pressure.

TESTING PRESSURE REDUCING VALVES

Two methods of testing are considered to be acceptable. The devices can be tested in place or removed to be bench tested. Bench testing FRVs is the preferred method of evaluating the settings of the valve. "In-place" testing of these devices is not easy.

Extreme caution should be exercised when testing a system in this manner. Very high pressures can be developed at the base of the riser being used as a drain.

The standpipe riser is set up as previously described, but a flow meter is necessary for this method. Another hose line must be run across the floor between the riser to be tested and the riser that has been converted to a makeshift drain.

The drain riser must be free of any pressure reducing devices where these hose lines are to be connected.

A full flow test can now be conducted on the FRV, and any necessary adjustments can be made to the device.

Once the tests are completed, the standpipe system must be put back into service immediately. Any components removed during the test should be replaced. All control valves must be open, and any ancillary equipment such as fire pumps must be placed in their normal condition.

BACKGROUND

The first edition of NFPA 14 was published in 1912 when a rudimentary report on standpipes was prepared by the Technical Committee on Standpipe and Hose Systems. This report was refined and became an official NFPA standard in 1915. Numerous revisions were incorporated into the standard with some 23 updates being provided between 1915 and 1989. The current 1990 edition was in their standpipe packs. The 1969 edition of the NFPA *Fire Protection Handbook* notes that a pressure drop of 13.2 psi could be expected in 100 ft of 2½-in. rubber lined fire hose when it was flowing 250 gpm.

The design point for standpipe systems was further modified by the committee in 1970 to require a 500 gpm flow from the first standpipe and 250 gpm from each of the other standpipes. Total maximum flows of 2500 gpm were also established. The 500 gpm demand requirement from the first standpipe is based upon a 250 gpm flow coming from the fire floor and the other 250 gpm coming from the floor immediately below the fire floor.

Another issue addressed in NFPA 14 concerned the total allowable height for a single standpipe riser. A base height of 275 ft was agreed to be a reasonable maximum height. At this elevation, the pressure necessary to overcome the change in elevation is 119 psi (.433 psi/ft x 275 ft). This pressure added to the established pressure of 65 psi at the hose connection outlet plus any friction loss in the standpipe itself requires a total pressure of at least 184 psi at the base of the standpipe riser to satisfy the flow/pressure relationship. This arrangement permitted pressures well in excess of 100 psi at the lower hose connections of the standpipe system. The resulting reaction force for a 2½-in. line that has a 100-psi nozzle pressure can range up to 500 lb of force; a potential safety hazard for fire fighting personnel.

In 1973 the committee added an exception to the 275-ft height restriction for a standpipe riser or zone to permit a 400-ft vertical zone as long as the materials used in the

"occupant hose" stations, have been included in NFPA 14 since the 1940's. There was concern that a flowing pressure in excess of 100 psi would immediately result in dangerous conditions for the occupant. Pressure regulating devices were required by the standard for any system that was intended for use by the building occupants.

Later, the same concern was recognized by NFPA 14 for systems that were intended for use by fire departments. No matter how well-trained [illegible] higher, there is a limit on [illegible] it can be handled safely. [illegible] when the base standpipe [illegible] based upon the informa[illegible] used by the combina[illegible] irement for pressure [illegible] include hose connec[illegible] ding pressure would [illegible] circumstances.

[illegible] h 4-7.1 required an [illegible] the standpipe hose [illegible] 100 psi. This same [illegible] odified to accom[illegible] re department so [illegible] is predicated on [illegible] hose and the [illegible] cribed above. If, [illegible] hatic fog nozzle [illegible] k, there will be [illegible] e pressure than [illegible] ½-in. hose is [illegible] ving (through [illegible]), the needed [illegible] 55 psi to 115 [illegible] sure.

[illegible] si must be [illegible]

CONCLUSION

A fire department's ability to successfully combat fires within buildings equipped with standpipe systems depends on the proper design, installation, and function of the fire system. This underscores the importance of the fire department's involvement in the standpipe design and approval process because issues such as the type of fire department standpipe pack that will be used must be integrated into the design considerations. This information is often not known by the standpipe system designer, but it illustrates the importance of the fire department's involvement in standpipe design and approval.

Fire departments should begin to check every standpipe-equipped building within their jurisdiction for the presence of pressure regulating devices. Further, they should become thoroughly familiar with the function of the various pressure regulating devices. If they find such devices, they should immediately contact the building owner and verify that the devices have been properly selected, installed, and adjusted to deliver the pressures and flows needed for fire fighting purposes. Information on the inspection, testing, and maintenance of standpipe systems is contained in NFPA 14A.

NFPA is cooperating with the Philadelphia Fire Department in documenting this significant high-rise fire and is also issuing at this time a Preliminary Technical Report of the incident. A final NFPA fire investigation report will be available upon completion of the analysis of the data.

This NFPA report may be reproduced freely with custom- source credit.

[illegible] notes

[illegible] ty in the fire fighting operation on this fire, chief [illegible] s on the fire floors reported hose stream penetrations [illegible] 15 to 20 ft. Several efforts by the fire department to [illegible] e the hose stream quality failed. Later during fire [illegible] operations, a mechanic adjusted the pressure [illegible] valves at the standpipe connections using an [illegible] nt tool, and nozzle pressure improved immedi-

[illegible] er method involves the use of a pilot operated [illegible] s type of device would not normally be used at [illegible] nection but could be used in the water supply

[illegible] ula use to determine quantity (Q) of water [illegible] h a smooth bore nozzle. The flow is a function [illegible] efficient (k) and the nozzle pressure (p) [illegible] s a nozzle coefficient, and p is in psi.

NFPA Issues Alert on Pressure Regulating Devices

In follow-up to its investigation of the high-rise fire in Philadelphia in February that killed three firefighters, the National Fire Protection Association has issued a special bulletin dealing with pressure regulating devices in standpipe systems. The bulletin attempts to explain the differences between the two types of pressure regulating devices: restricting devices and pressure reducing valves. It cautions that "pressure regulating devices use a relative, dimensionless setting configuration on their bonnet. It is essential that these numbers not be interpreted as pressure settings." A copy of the NFPA Alert Bulletin is being provided as an addendum to this issue of *Sprinkler Technotes*.

NFPA ALERT HIGHLIGHTS 1991

Understanding Pressure Regulating Devices

- **Restricting, Regulating and Reducing**
- Pressure Reducing Valves
  - Factory and Field adjustable
  - Direct Acting and Indirect Acting

Testing methods

Fire department hose package considerations

Zone height

84m/275 feet

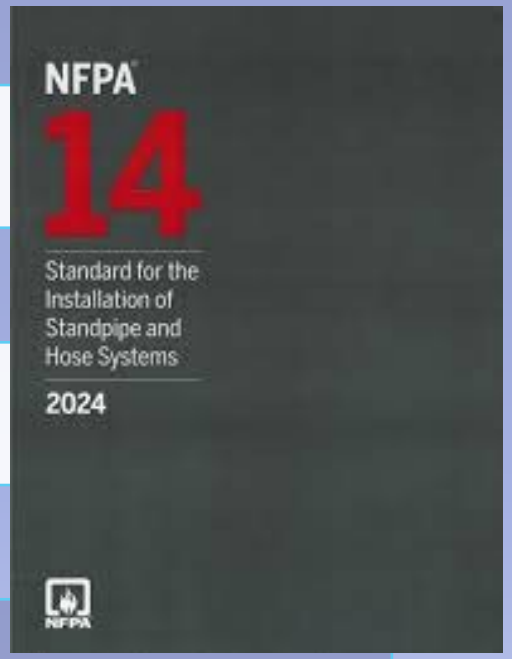
122m/400 feet

NFPA 14 MIN/MAX SYSTEM PRESSURES

NFPA 14 Standpipes

Minimum 100psi (7 bar)

Maximum 175 (12bar)



- Maximum 400psi (28bar) - Exception for express risers, no hose connections and in accordance with **listing**

NFPA 13 MAX

NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
The Voice of the Fire Sprinkler Industry

NFPA 13 Sprinklers

Maximum 175psi (12 bar)

TALL BUILDINGS <300M/984 FEET

CTBUH - Pressure in **Tall** buildings < 300m/984ft

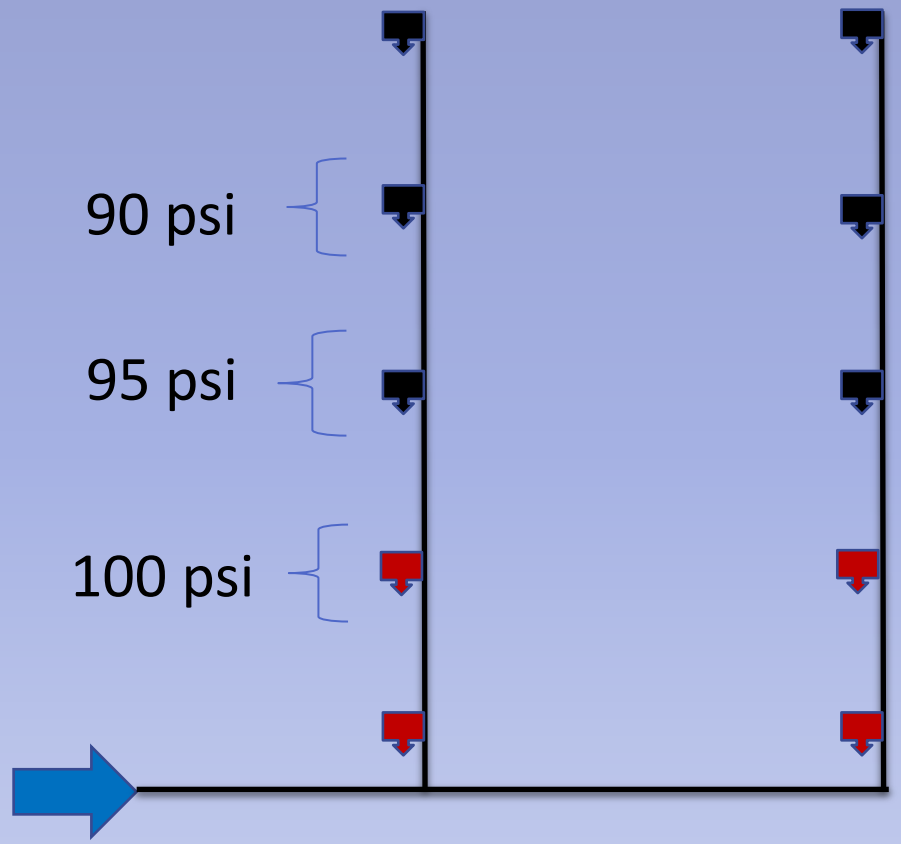
91m/300ft -182m/600ft

Capital One Tower
Virginia
143M/470 Feet 31 Stories
Three zones
Tallest occupied building in DMV

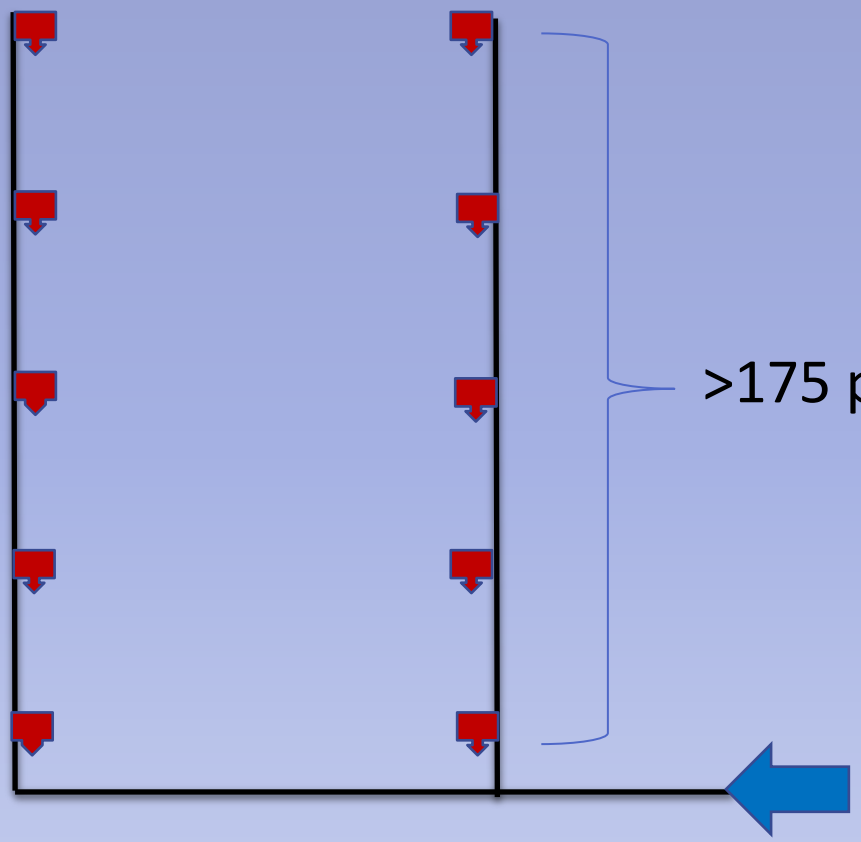
Managing Pressure:

- Multiple zones
- Pressure regulating valves (Direct and/or Indirect)
- Master (system) pressure regulating piloted valve
- Combination

CHANGES IN DESIGN



Pre 1993 PRD



Today's design PRV

REDUNDANCY

Above the level of fire department pump capabilities NFPA 14/20

Redundancy

- Vary Tall 128M/420 feet water supply feeds
- High water storage tanks
- Multiple pumps
- Variable speed pumps

PRESSURE REDUCING VALVE(S) PRV'S

Pressure regulating devices - used for reducing, regulating, controlling or restricting water pressure.

Pressure Restricting Devices (PRD)

Only control residual (flowing) water pressure.

Pressure Reducing Valves (PRV) - reduce residual (flowing) and static (non-flowing) water pressure.

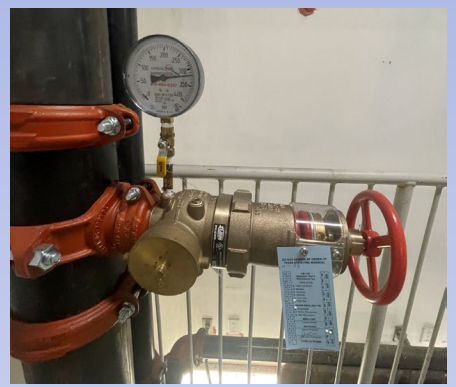
NFSA BLOG'S

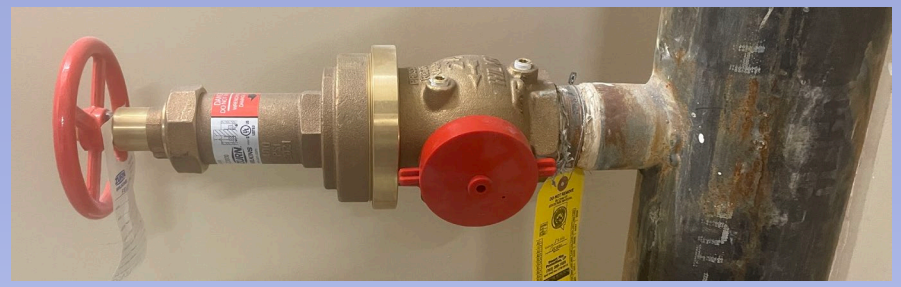
ROLLS RIGHT OFF THE TONGUE

REGULATING, RESTRICTING AND REDUCING

DIRECT ACTING PRESSURE REGULATING

Factory Set or Field Adjustable
Direct acting
Minimum Inlet pressure 7bar/100psi
Max outlet pressure 12bar/175psi





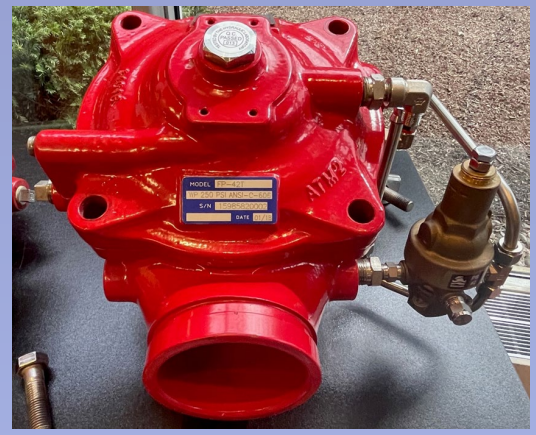
INDIRECT ACTING PRESSURE REGULATING

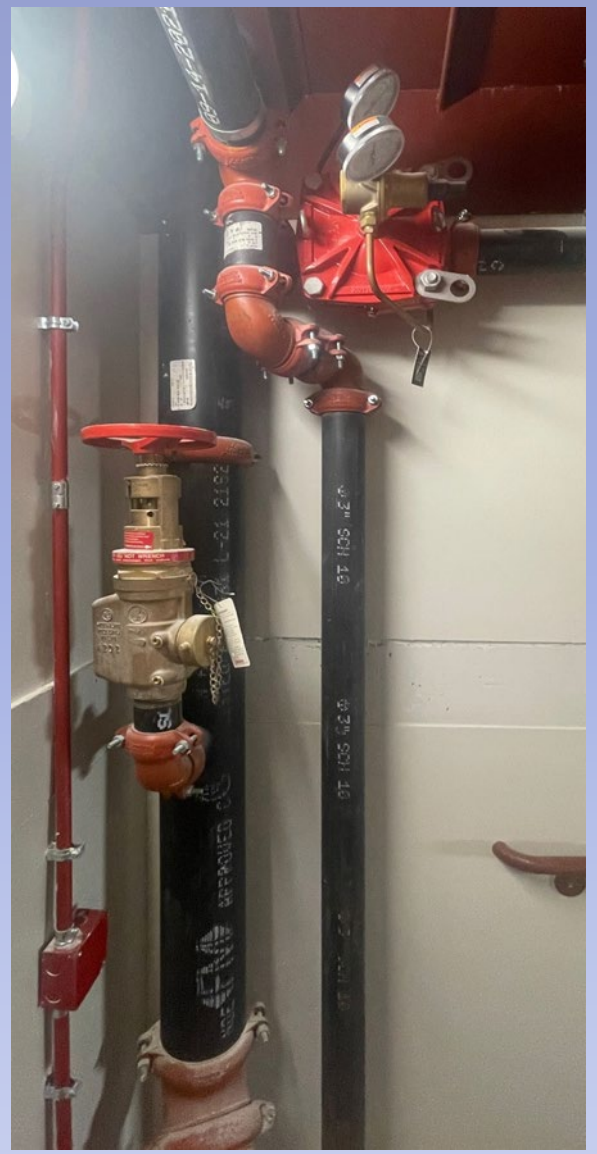
Factory Set or Field Adjustable

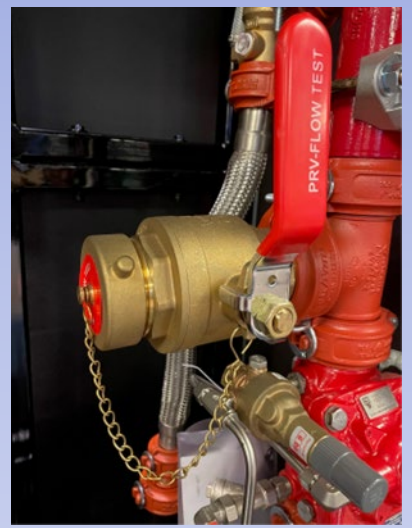
More than two downstream valves

Minimum Inlet pressure 7bar/100psi

Max outlet pressure 12bar/175psi





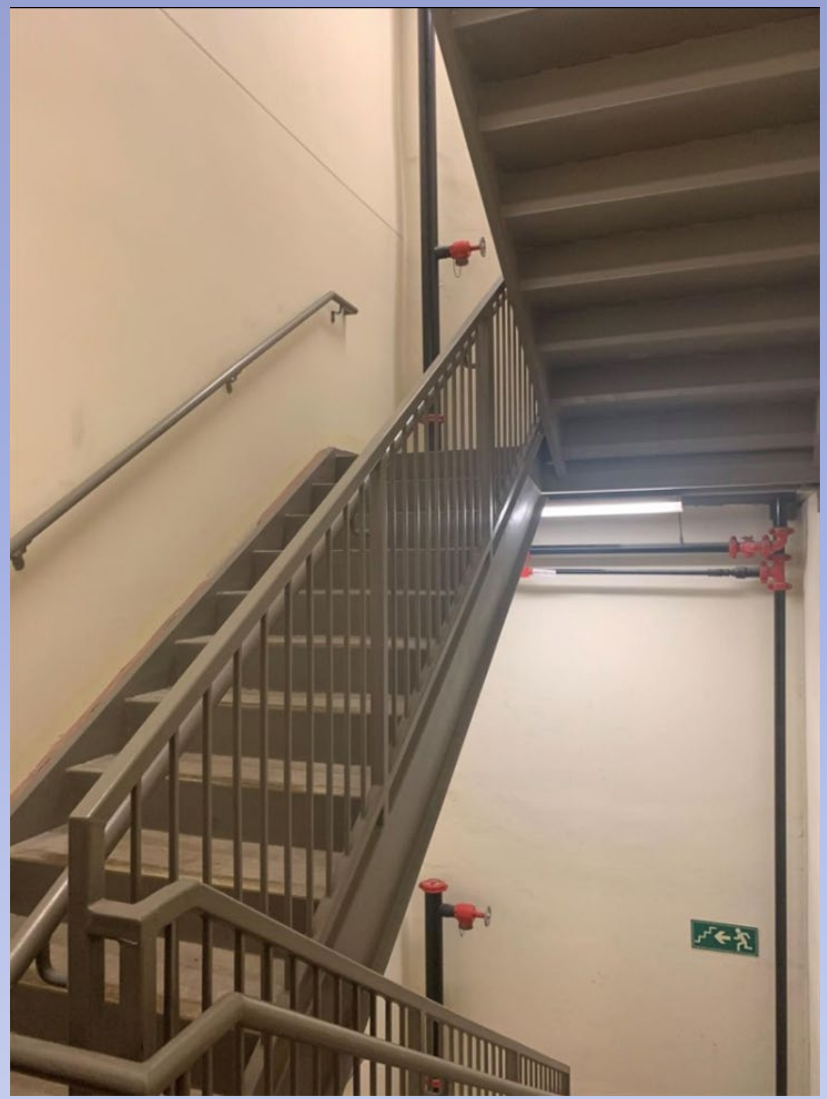


ZONES

Zone(s)

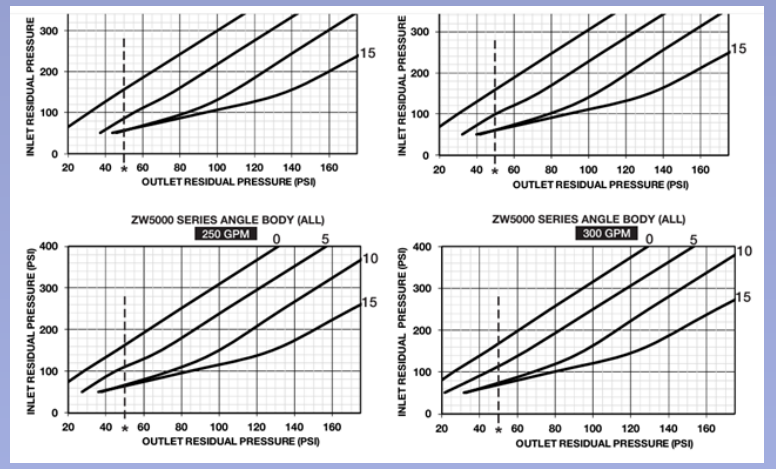
Up to the Level of Fire Department Pumping Capability

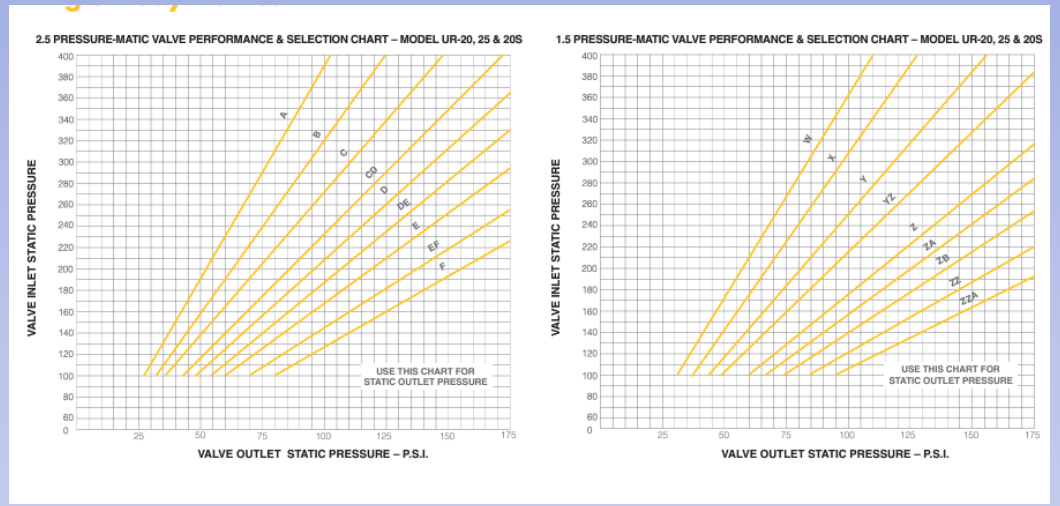
Above the Level of Fire Department Pumping Capacity

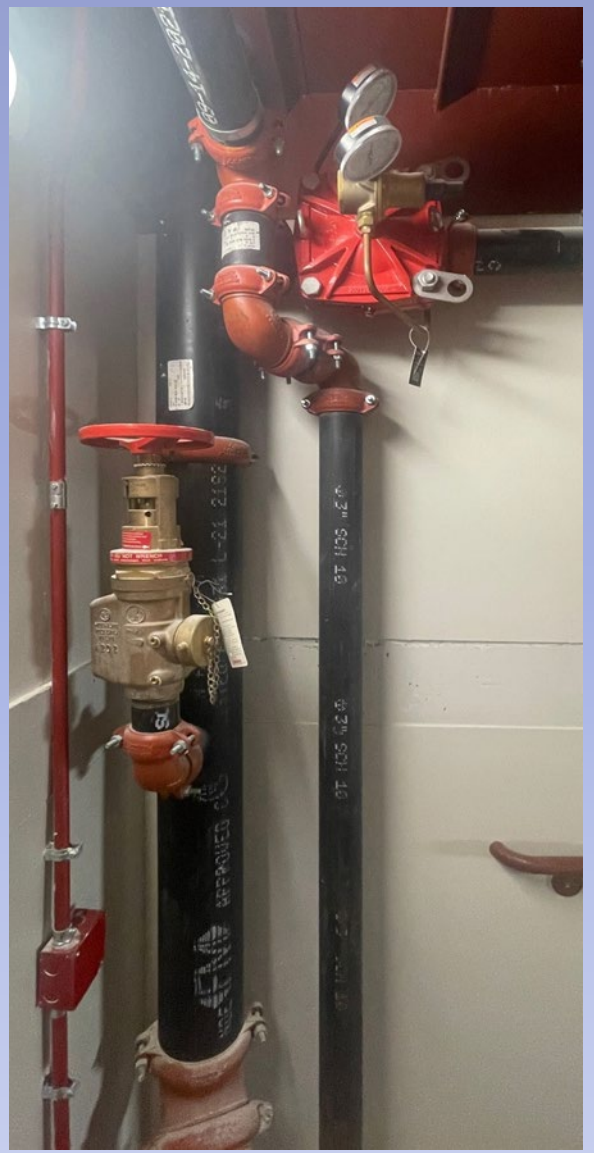


COMBINATION

- Variable speed pumps
- Multiple Pump(s)
- Master pressure regulating
- Zones
- Limitations of material







NFPA 4 & 25 TESTING (INTERGRADED TESTING)

System	**Five-year** full system flow testing – **automatic** systems
Direct acting valves	**Five- year** flow testing pressure-regulating valves
Indirect acting valves Master PRV-**Annually**	**Five-year** flow testing pressure-regulating valves

CENTRAL PARK TOWER 2019

Supertall

472m/1,550 feet (x.4333=46bar/672psi)

98 Stories

15th Tallest in the world

Tallest Residential in the World

QUESTIONS/ANSWERS?

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