

## **FIRE PROTECTION HISTORY: THE FIRST EDITION OF THE SPRINKLER STANDARD (1896)**

By Richard Schulte

The concept of the sprinkler system was developed in the latter half of the 19<sup>th</sup> century, however, the implementation of this concept was initially experimental. In the early days of sprinkler protection, what constituted adequate sprinkler protection was simply an unknown.

With multiple sprinkler system designs being developed and installed in manufacturing buildings in the New England states, there was a need for standardization. This need served as the impetus for the formation of the National Fire Protection Association (NFPA).

The following is the text of the first sprinkler installation standard developed by the NFPA published in the 1897-1900 Volume of the "*NFPA Proceedings*":

### ***"REGULATIONS GOVERNING INSTALLATION OF AUTOMATIC SPRINKLERS.***

*This is a reprint from pamphlet issued in Spring of 1896, containing report of Committee on Automatic Sprinkler Protection adopted at conference held in New York, March 18<sup>th</sup> and 19<sup>th</sup>, 1896.*

*It is put forward at this time that all members may possess a copy of the Sprinkler Rules which are to receive revision by the Automatic Sprinkler Committee during the coming year.*

### **LOCATION AND ARRANGEMENT OF SPRINKLERS.**

- 1. Sprinklers should be located preferably in an upright position on top of pipes.*
- 2. In all cases deflectors must be parallel to ceilings, roofs, or the incline of stairs. (The deflectors of sprinklers in the peak of a pitch roof to be horizontal.)*
- 3. Distance of deflectors from ceilings or bottom of joists to be not less than 3 inches or more than 10 inches.*

4. *Sprinklers to be placed throughout premises, including inside all closets, basements, lots and elevator wells, and under stairs. Special instruction must be obtained relative to placing sprinklers under large shelves, benches, tables, overhead storage racks and platforms, and inside small enclosures, such as drying and heating boxes, caul boxes, tenter and dry room enclosures, shutes [chutes] and cupboards. Also over all shafting and gears, even in wet basements and in boiler rooms, especially if steam for pump depends on said boilers for its steam supply. Sprinkler not to be omitted in any rooms merely because it is damp or wet, without special written consent. It is the province of automatic sprinklers to subdue a fire in its early stages. A fire originating in an unsprinklered section is liable to gain sufficient headway to prevent its being checked by the sprinklers in other portions. It is essential, therefore, that equipment be thorough.*
5. *Not more than 6 sprinklers to be placed on one branch line of pipe except under special regulations as to pipe sizes. (See Article 22.)*
6. *Each automatic sprinkler to have an unobstructed outlet of such size and form that with 5 pounds pressure maintained at the sprinkler it will discharge approximately 12 gallons per minute.*
7. *“Centre central” or “side central” feed to sprinklers is recommended. The former preferred, especially where there are over 6 sprinklers on a branch line. End feed is not approved.*
8. *There should be a separate riser in each building, and in each section of a building divided by fire walls. The size of each riser to be sufficient to supply all the sprinklers on any one floor, as determined by the standard schedule of pipe sizes. If the conditions warrant, special permission will be granted allowing the sprinklers in a fire section of small area to be fed from the riser in another section.*
9. *Where there are sprinkler enough in one room to require a 6-inch riser, according to schedule, it is preferable to have these sprinklers supplied through two or more smaller risers.*
10. *A belt, stair or elevator tower having floor openings without “shut-offs” is to be treated as one room and pipe sizes arranged accordingly. Sprinklers to be on a separate riser with independent shut-off and drip valves.*
11. *Circulation of water in sprinkler pipes is very objectionable, owing to greatly increased corrosion, deposit of sediment and condensation drip from pipes; for this reason pipes must not be used in any way for domestic service.*

12. *Hand hose, to be used for fire purpose only, may be attached to sprinkler pipes within a room under the following restrictions. Hose not to be larger than 3/4 inch. Nozzle not to be larger than 3/8 inch. Hose not to be connected to any sprinkler pipe smaller than 2[-]½ inch, never to be attached to a dry system.*

### **SPACING OF SPRINKLERS.**

13. *The distance from wall or partitions must never exceed one half the distance between sprinklers in the same direction.*
14. *A line of sprinkler should be run on each side of a partition. Cutting holes through a partition to permit sprinklers on one side thereof to distribute water to the other side is not effectual.*
15. *Under Mill Ceiling (smooth solid plank and timber construction, 6 to 12 feet bays) – One line of sprinkler should be placed in centre of each bay and distance between the sprinkler on each line should not exceed the following:*

*7 to 8 feet in 12 feet bays (measuring centre to centre of timbers).*

*8 to 9 feet in 11 feet bays (measuring centre to centre of timbers).*

*10 feet in 6 to 10 feet bays (measuring centre to centre of timbers).*

**Note:** The original text has been modified for clarity.

16. *Under Joist Ceilings, Open Finished – Distance between sprinklers not to exceed 7 to 8 feet at right angles with joists or 9 to 10 feet parallel with joists.*
17. *Bays formed by timbers which supported the joists, if from 10 to 11[-]½ feet wide from centre to centre of timbers, may, by special permission, have but one line of sprinklers, if the conditions warrant. In all cases where such bays are over 11[-]½ feet wide, two or more lines of sprinklers must be installed as required by the standard.*
18. *Under a Pitch Roof sloping more steeply than one in four – One line of sprinkler to be located in peak of roof, and sprinklers on either side to be spaced according to above requirements. Distance between sprinklers to be measured on a line parallel with roof.*

19. *Under open finish, joisted construction floors, decks and roofs, the sprinkler shall be "staggered" spaced, ensuring that heads on adjacent lines shall not spray into the same joists channel ways. The end and intermediate sprinklers not to violate the rules for joist work spacing.*
20. *Special instructions must be received relative to location of sprinkles under floors and roofs of unusual construction which would interfere with distribution of water.*
21. *In no case shall the number of sprinklers on a given size pipe exceed the following:*

<i>Size of Pipe.</i>	<i>Maximum No. of Sprinklers Allowed.</i>
<i>3/4 inch.</i>	<i>1 sprinkler.</i>
<i>1 inch.</i>	<i>2 sprinklers.</i>
<i>1-1/4 inch.</i>	<i>4 sprinklers.</i>
<i>1-1/2 inch.</i>	<i>8 sprinklers.</i>
<i>2 inch.</i>	<i>16 sprinklers.</i>
<i>2-1/2 inch.</i>	<i>28 sprinklers.</i>
<i>3 inch.</i>	<i>48 sprinklers.</i>
<i>3-1/2 inch.</i>	<i>78 sprinklers.</i>
<i>4 inch.</i>	<i>110 sprinklers.</i>
<i>5 inch.</i>	<i>150 sprinklers.</i>
<i>6 inch.</i>	<i>200 sprinklers.</i>

*The above schedule is considered ample for general practice.*

22. *Schedule for "branch lines," where more than six sprinklers are on one "branch line"; after passing the sixth sprinkler the pipe schedule shall apply to the next larger size of piping, viz.:*

<i>Size of Pipe.</i>	<i>Maximum No. of Sprinklers Allowed</i>
<i>3/4 inch.</i>	<i>1 sprinkler.</i>
<i>1 inch.</i>	<i>2 sprinklers.</i>
<i>1-1/4 inch.</i>	<i>4 sprinklers.</i>
<i>1-1/2 inch.</i>	<i>6 sprinklers.</i>
<i>2 inch.</i>	<i>8 sprinklers.</i>
<i>2-1/2 inch.</i>	<i>16 sprinklers.</i>
<i>3 inch.</i>	<i>28 sprinklers.</i>

*Furthermore, no feeder to any such "branch line" shall be smaller than said "branch line".*

## **WATER SUPPLY FOR SPRINKLERS.**

23. *Double Supply – Two independent water supplies are absolutely essential for the best equipment. At least one of the supplies should be automatic and one should be capable of furnishing water under heavy pressure. The following are accepted supplies: Public water works system, duplex steam pump, private reservoir or standpipe, elevated gravity tank, air pressure tank, rotary pump. The choice of water supplies to be determined by the underwriters having jurisdiction.*
24. *In addition to the above required double supply, a hose inlet to sprinkler system, fitted with a straightway check valve, may be made for connection from steamer of public fire department.*
25. *Public Water Works System – Should give good pressure at all hours of day at highest line of sprinklers, preferably not less than 25 pounds static pressure.*
26. *Street main should be of ample size, in no case smaller than 6 inches.*
27. *If possible, avoid a dead end in street main by arranging main to be fed at both ends.*
28. *Connection from yard pipe to sprinkler riser should be equal to or larger in size than the riser, and should supply no hydrant or standpipes.*
29. *No meter to be placed in this connection except by special consent.*
30. *Steam Pump – An approved duplex steam pump (underwrites' pattern preferred), never less than 500 gallons rated capacity per minute, so located on the premises as to be free from damage by fire or other causes, and to take water from reservoir or some other source having a sufficient quantity of water to supply the rated capacity of the pump for at least 60 minutes. Suction pipe to have a strainer, and, if the lift be more than 5 feet, a foot valve may be recommended. The smallest size pump approved is referred to above. Risks of any magnitude require a larger size, particularly if pump is to be a supply for hydrant and hose service as well as sprinkler system.*
31. *Where a pump does not take water under head, it should be primed from water tank of not less than 200-gallons capacity or its equivalent. Priming pipe to connect into each of the four water chambers.*

32. *The efficiency of a steam pump is liable to be impaired where it has a lift of over 15 feet, consequently any greater lift is to be avoided, especially where the suction pipe has a length over 50 feet.*
33. *Discharge pipe to contain a spring relief valve and pressure gauge.*
34. *Two and one-half inch hose connections with gates valves to be placed in pump discharge, at pump (one connection for every 250 gallons rated capacity of pump). These are required for the purpose of properly testing pump.*
35. *If an automatic regulator is placed in steam connection to pump, it must be on a by-pass with a shut-off valve on either side of same.*
36. *Steam pressure of not less than 50 pounds must be maintained at all times. Care should be taken to provide sufficient power to run pump to full rated capacity.*
37. *Where a steam pump is the primary supply[,] an automatic gauge to record the steam pressure shall be applied.*
38. *Pump to be operated at least once a week.*
39. *Any boiler house on which pump depends for steam supply should be of brick or stone, detached or cut off from main building by standard fire doors.*
40. *A gate valve to be located in boiler house so that all steam supply to main buildings may be cut off from them in time of fire and reserved for pumps.*
41. *Private Reservoir or Standpipe – Observe same general regulations as for public water works.*
42. *Gravity Tank – Elevation of bottom of tank above highest line of sprinklers on system which it supplies to be specified by the underwriters having jurisdiction, but in no case shall it be less than 12 feet. In plants of moderate size[,] a tank of not less than 5,000 gallons capacity is required. In extensive plants, or where secondary supply is limited in its capacity, a larger tank, or two or more tanks should be used.*
43. *Tank should be filled through a pipe of not less than 1[-]1/4 inch diameter, and not from sprinkler system.*

44. *Tank to be used as a supply to automatic sprinkler system only, except that, at the discretion of the underwriters, tank may be made larger than called for and the excess supply used for domestic service.*
45. *All gravity tanks to be provided with a water level indicating device satisfactory to the underwriters having jurisdiction.*
46. *End of sprinkler riser should enter bottom of tank and project above bottom 4 inches, to avoid sediment entering pipe system.*
47. *Provisions must be made to prevent water in tank and pipes communicating with the same from freezing. A tank exposed to the weather must have a double cover provided with trap doors. When a steam pipe is used for heating tank[,] it should be run directly from boilers, with controlling valve located in boiler room.*
48. *A permanent ladder or stairway must be maintained to allow access to tank.*
49. *Air Pressure Tank – Total capacity should be 3,500, 4,000 or 4,500 gallons. The 4,500-gallon tanks are generally called for; the diameter and length vary. Some of the more common dimensions follow:*

<i>Capacity</i>	<i>Diameter</i>	<i>Length</i>
<i>3,500 gallons</i>	<i>60 inches</i>	<i>24 feet</i>
	<i>66 inches</i>	<i>20 feet</i>
<i>4,000 gallons</i>	<i>72 inches</i>	<i>20 feet</i>
	<i>66 inches</i>	<i>22 feet</i>
<i>4,500 gallons</i>	<i>72 inches</i>	<i>22 feet</i>
	<i>66 inches</i>	<i>25 feet</i>

**Note:** The original text has been modified for clarity.

50. *To be located preferably in upper story of building. The two valves in water gauge are ordinarily to be kept closed and opened only to ascertain amount of water in tank; this that breaking of or leakage about glass may not cause the escape of pressure.*

51. *A 1[-]1/4 inch pipe is to be connected with water supply for filling tanks. An independent connection not smaller than 3/4 inch to be made from air pump to tank. Both water and air connection to be fitted with gate and check valves located at the tank.*
52. *Tanks are to be filled two-thirds full of water, and then an air pressure pumped up and maintained, such as will give not less than 75 pounds initial pressure on highest line of sprinklers.*
53. *Rotary Pump – An approved rotary pump, never less than 500 gallons per minute rated capacity, same to have outside gears at both ends. To be located where easy of access and free as possible from damage by fire. If inside main building, to be arranged together with water wheel to start from outside of building; to take water from a source having sufficient quantity of water to supply the rated capacity of the pump for sixty minutes.*
54. *The efficiency of a rotary pump is liable to be impaired where it has a lift of over 10 feet, consequently, any greater lift is to be avoided, especially when the suction pipe has a length of over 50 feet. To have hose connections, relief valve and pressure gauge same as steam pump. To be started by friction clutch or friction gearing. Care should be taken to provide sufficient power to run pump to full rated capacity.*
55. *Rust and usage will impair the efficiency of a rotary pump more quickly and to a much greater degree than an underwriter steam pump. In most cases, a rotary pump cannot be as advantageously located and is under less control. Consequently, it is not recommended when practicable to install a steam pump.*

#### **VALVES AND FITTINGS.**

56. *Pipes must be supported in a substantial manner by wrought or cast-iron hangers well secured.*
57. *Long bend fittings are recommended for all the larger pipe sizes.*
58. *On wet systems there shall be a test pipe one-half inch in diameter connected directly with riser in upper story and arranged to discharge outside building.*

59. *There shall be a straightway gate valve and a straightway check valve in the pipe connecting each water supply with sprinkler system. Straightway check valves to be placed in horizontal pipe, or in vertical pipe, "looking up", never "looking down."*
60. *All gate valves in supply pipes to sprinklers to be of indicator pattern, and to be strapped open with riveted leather straps passing around the riser and spoke of the wheel, or secured open with a seal. Draw-off valves to be secured closed. Cases about post gate valves to be arranged to drain.*
61. *Drip pipes to be arranged so as to drain all parts of system. Drip pipe at main riser to be not smaller than 2 inches.*
62. *It is recommended that main discharge pipes from gravity and pressure tanks, as well as from water works systems and pumps, connect with sprinkler system at foot of riser. Located in this lower level the check valve in each connecting pipe, also one gate valve controlling all water supply to sprinklers. Place the gate valve call for in each connecting pipe, close to the system as at the tank, pump, or in connecting pipe to riser from water works system.*
63. *Where sprinklers are supplied from yard-main, place an outside post indicator gate valve in connecting pipe a safe distance from building, if possible (say 40 feet).*
64. *When a pump, not located in a non-combustible pump house, discharges into a yard-main, fed by another supply, a check valve or post gate valve should be placed in this discharge pipe outside the building underground.*
65. *Underground check valves should be located in a pit accessible through manhole.*

#### **DRY PIPE SYSTEM.**

66. *A dry pipe system is not recommended when a wet system can be used.*
67. *The use of an approved dry valve, is, however, far preferable to entirely shutting off water supply during cold weather; the latter practice is not sanctioned.*
68. *Dry system to be maintained throughout the year unless changed by underwriters having jurisdiction.*

69. *Especial care must be taken to arrange all sprinkler pipes and fitting that they may be thoroughly drained. Sprinklers must be located in an upright position.*
70. *All water supplies to sprinklers must enter system below dry valve.*
71. *A large number of sprinklers (500 or more) on a dry system should be supplied through two or more dry valves. System to be divided horizontally.*

### **OPEN SPRINKLERS.**

72. *In order to obtain satisfactory protection where many open sprinkles are on one system, it is best to have the outlet at each sprinkler 3/8 of an inch in diameter; such sprinklers are to be arranged on piping not smaller than that used for automatic sprinklers.*
73. *Adequate service is provided in many cases if one line of open sprinklers is run directly under cornice.*
74. *Where a small surface is to be protected by open sprinklers, a good arrangement is to place one head outside of and opposite every window on each floor.*
75. *Risers for open sprinklers should feed into the line at centre and not to be supplied from automatic sprinkler system.*
76. *Supply to open sprinklers to be town water works, standpipe or pump, but never pressure or gravity tank used to supply automatic sprinklers.*
77. *Valve controlling the supply to be located at a safe distance from the exposure.*
78. *All pipes and fittings in such a system to be carefully arranged so that water can be entirely drawn from same.*
79. *Open sprinklers on the peak of roofs requires a different shape deflector from those used at cornices or sides of buildings, so that all water will be at once deflected upon the roof equally distributed on either side of peak.*
80. *Not over 10 open sprinklers to be on one line of pipe and they should not be located over 8 feet apart "on the line".*

## ALARM VALVES.

81. *Every automatic sprinkler system should contain an alarm valve so constructed that a flow of water through same would operate an electric gong, a mechanical gong, or both, as the character of the property and circumstances may require. In cities where there is a thermostat alarm company with a central station, the alarm valve may be connected with such central station. In other places, especially in small towns, the valve may be directly connected with public fire department house or some other suitable place.*

*The use of both electric and mechanical alarms is strongly recommended. The gong of the latter can be located on the outside of the building or any other desirable place on the premises.*

*Valve should be so constructed that the flow of water through but one sprinkler would cause it to operate. It must not be affected by the varying water pressure received from street mains or automatic pumps. It must have a water way equal to or greater than the pipe in which it is installed and must be so designed as to but little diminish the flow of water.*

*Valve to be so located that the passing of water from any of the sources of supply to any of the sprinklers will cause its action. To accomplish this is some equipments it would be necessary to use two or more alarm valves. Construction of valve to be such that it cannot be prevented from opening in full by water column, corrosion, sticking of parts, or sediment. No valve to be installed unless it has the approval of underwriters having jurisdiction.”*

The first NFPA sprinkler standard included the concept of the “pipe schedule”. This standard limited the maximum number of sprinklers on a branch line to six, but contained provisions which permitted more than six sprinklers on a branch line.

The first NFPA sprinkler standard permitted the use of 3/4 inch pipe and the pipe schedule in this first edition is much different than the pipe schedule included in later editions of NFPA 13.

It is also interesting to note that the first edition of the NFPA sprinkler standard contained a requirement that sprinkler systems be supplied by two water supply sources. Hence, the reason why you still see wood elevated tanks on the roof tops of many buildings in old cities, like Chicago.

Also of note are the references to steam-powered (positive-displacement) pumps and rotary pumps. The provisions for pressure tanks used as a water supply source for sprinkler systems are also of interest.

As one reviews the provisions of the first edition of the NFPA sprinkler standard, you can't help but think that we've come a very long way from this first effort at standardizing sprinkler installations.

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