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FIRE PROTECTION HISTORY-PART 131: 1905 (THE SPRINKLER SYSTEM PIPE SCHEDULE AND WATER SUPPLIES)

By Richard Schulte

The ninth Annual Meeting of the National Fire Protection Association was held in New York City in May 1905. Among the technical committees reporting at this meeting was the Committee on Installation of Automatic Sprinkler Equipments. The discussion of proposed changes to the Sprinkler Standard addressing the pipe schedule and the minimum water supply requirements which took place over a century ago is quite interesting. The following is an excerpt from the transcript of this Committee Report addressing these provisions in the sprinkler installation standard:

"***INSTALLATION OF AUTOMATIC SPRINKLER EQUIPMENTS.***

[TEXT OMITTED]

SECTION D–PIPE SIZES.

1. General Schedule.–In no case shall the number of sprinklers on a given size pipe exceed the following:

Size of Pipe.	*Maximum No. of Sprinklers Allowed.*
3/4-inch	*1 sprinkler.*
1 "	*2 "*
1-1/4 "	*3 "*
1-1/2 "	*5 "*
2 "	*10 "*
2-1/2 "	*20 "*
3 "	*36 "*
3-1/2 "	*55 "*
4 "	*80 "*
5 "	*140 "*
6 "	*200 "*

Note: Where practicable it is desirable to arrange the piping so that the number of sprinklers on a branch line will not exceed eight . Care should be taken to ream out all burr at the ends of each length of pipe. This is of particular importance where the piping is cut by means of wheel cutters.

Mr. Boone. I should like to ask why there has been such a radical increase in our present pipe size schedule?

Mr. Robinson. The committee had a very long discussion on this subject, and it was felt that inasmuch as our original pipe scale was a compromise scale, and inasmuch as there had been some considerable criticism of the sizes of pipe, particularly the smaller sizes, this was a proper time to take up the question and harmonize all the points if possible. We had the results of some considerable number of tests before us, and the general feeling of the committee was that this scale as recommended would fill the bill from now on, as far as we could see, without the necessity of any further change. It already had been used by certain associations, and in certain localities, and it seemed to be the best scale which was available to-day.

Mr. Stone. I should like to know if there is no difference made with regard to pressure? It seems to me that pressure is entirely ignored here. Is there no provision anywhere for that?

Mr. Robinson. The pressure, of course, has a very vital influence on the pipe scale, but this scale is deemed to be best under all pressures.

Mr. Stone. Twenty pounds will be sufficient, and 70 pounds would not be any too much; is that it?

Mr. Robinson. It might be more than necessary, but still not too much.

Mr. Stone. You are not giving any advantage to those who have a [high] *pressure. For instance, take a high pressure service, with sprinklers on a high pressure service of 75 or 80 or 100 pounds,–I know of one with 100 pounds pressure–are you not going to give any advantage for that 100 pounds pressure, but require as big pipe as is necessary with 20 pounds pressure?*

Mr. Robinson. I think probably if we tried to adopt different scales according to the amount of pressure available we would have to have as many scales as there are cities.

Mr. Stone. That would not follow, because you could make the schedules within certain reasonable limits of pressure. I think it is a very unsatisfactory system which does not take any cognizance of pressure.

Mr. Sullivan. In reply to the gentleman who has just spoken, the old saying is that a chain is no stronger than its weakest link; and of course the greatest percentage of our sprinklered risks have one low pressure supply, that is from a gravity tank. I think the schedule of piping should be such as to meet that condition.

Mr. Crosby. I think Mr. Stone's inquiry might be answered in this way; that so far as engineering is concerned we wish 25 pounds at the highest line of pressure maintained with the amount of water flowing through pipes of this size. There are manifestly conditions which would be better than that, and it is the local underwriter who is coming in, in such a case as Mr. Stone suggests where they have 100 pounds pressure, and he can give recognition for it if it is better than the standard. In that way a man can obtain what he wishes.

Mr. Boone. My thought was that we were adding to the expense of installing the equipment, and that is something to be considered. We certainly want this automatic sprinkler protection, but I feel that if we adopt this schedule as laid down it will mean an unnecessary added expense.

Mr. Robinson. I have been informed that in a number of cases the use of our jump scale costs more than the scale now recommended.

The President. If there are no further remarks the recommendation as to pipe sizes will be considered as adopted.

[TEXT OMITTED]

SECTION I–WATER SUPPLIES.

1. Double Supply. Two independent supplies are absolutely essential to the best equipment. At least one of the supplies to be automatic and one to be capable of furnishing water under heavy pressure. The choice of water supplies for each equipment to be determined by the underwriters having jurisdiction.

2. Size of Connection.–Connection from water supply or main pipe system to sprinkler riser to be equal to or larger in size than the riser.

Mr. Mayes. What is the discriminating point between "heavy pressure?" It says, "capable of furnishing water under heavy pressure"; now, what pounds pressure do you determine as being "heavy"?

Mr. Robinson. That is left to the discretion of the underwriters having jurisdiction. No point has been determined.

Mr. Mayes. *It seems to me it should not be left to those having jurisdiction, because there are so many diverse opinions on it.*

Mr. Robinson. *That might hold true of any conclusion we arrived at here. I should say, in an off-hand way, anything over 25 lbs. at the highest head, flowing pressure, although I don't know as the rest of the Committee would agree with me on that.*

Mr. Lemmon. *That is covered under No. 1, J., where the pressure required is 25 lbs.*

Mr. Mayes. *Then why not incorporate it in this rule also under Section I, as you have stated it in J?*

Mr. Goddard. *Those two sections cannot he taken as explaining each other, because the public water works system will naturally be the automatic supply, and it says, "at least one of the supplies to be automatic." Now, if your standard for your automatic supply is 25 lbs. on the highest line, and you say here, "and one to be capable of furnishing water under heavy pressure," I think you would naturally infer that the 25 lbs. on the highest line was not considered "heavy pressure."*

Mr. Mayes. *All the more reason why you should state what is heavy pressure.*

Mr. Robinson. *It says "and one"; it may be the one which is the city supply.*

Mr. Goddard. *Supposing you had a city supply and a tank; they are both automatic; which is the heavy pressure?*

Mr. Robinson. *The city supply.*

Mr. Goddard. *At 25 lbs.?*

Mr. Robinson. *Yes. The tank is lower as a rule.*

Mr. Goddard. *I don't think you would consider that as being covered by the words "heavy pressure." That is the lowest pressure we ought to have on the automatic supply.*

Mr. Lemmon. *It says, "not less"; it is the minimum.*

Mr. Goddard: *It is the lowest, and it can't be considered that it is a heavy pressure.*

Mr. Fiske. It seems to me that No. 1 is an important rule, and at the time it came up in the Committee I didn't like it and I don't like it now. I think that second sentence is unfortunate. It tries to say a little something and it doesn't get anywhere: "At least one of the supplies to he automatic." That is a most indefinite thing; it may be an utterly unsatisfactory automatic supply. Now, if you are going to define what a standard equipment should be in the way of supplies, I should like to see it done,–that is, go a good deal further and say that a satisfactory primary supply must be of a certain pressure. This arrangement as it is here now in the rule seems to me so indefinite that it does not really help matters at all, and I had as soon have it left out as remain as it is.

The President. The Chair will entertain a motion, Mr. Fiske.

Mr. Fiske. The chief matter I have in mind is changing the word "automatic," to something like this: "At least one of the supplies to be automatic and of sufficient pressure to maintain 25 lbs. on the top line of sprinklers, and of satisfactory capacity." That is going a good deal further than this sentence goes.

Mr. Robinson. Satisfactory to whom?

Mr. Fiske. To the underwriters having jurisdiction.

Mr. Robinson. That is just about as indefinite as the other.

Mr. Kunhardt. I think the whole question is one that is necessarily indefinite. It must be indefinite. You cannot settle these questions of supplies. The meat of the whole matter is in the last sentence, that at the same time, while we didn't all of us agree and I think hardly any of us agreed that that sentence was absolutely right, it indicated what was right; that is, "at least one of the supplies to be automatic." That is, it was meant that it should be gravity, something which would be there all the time. And one of them "to be capable of furnishing water under heavy pressure." That means that one, which may be that same supply, which may be that gravity supply, must be capable of a good pressure. Now, under that condition you could put in a tank on the roof of the building connected with the public water supply with 50 to 75 or 100 lbs. pressure. If you didn't have 50 to 75 or 100 lbs. water pressure, you could put in a low pressure water supply and tie a pump onto it, and the pump would be the high pressure. But you have got one of those supplies automatic, it is there all the time, and one of them is a high pressure. Now, we lay out a system, and we decide whether we will put in a tank and public water supply, or if the water supply is low, we say it isn't very heavy, and we will put up a pump supply for the low pressure. It is a matter for determination in each individual case.

Mr. Crosby. I think the whole sentence could be re-drafted to some advantage. We start off by saying what is necessary or essential for the best equipment, that is, two independent supplies. That is the full standard service. If that is worth saying at this point we might quite as well say that both of those supplies for best service should be automatic, and both of them should be under heavy pressure. It seems to me that a reasonable re-drafting of that paragraph would make it read, perhaps, something as follows: For full standard service two independent water supplies are required, both of those supplies to be capable of furnishing water under pressure of not less than 25 lbs. at all hours of the day at the highest line of sprinklers, and one of those supplies to be automatic. That is what is required for full standard service–two independent supplies, both of them up to the minimum requirement for pressure, one of them may be a pump and frequently not automatic, and then one of those supplies shall be automatic at all times. That is for full standard service, and that is all that we should try to define in this one sentence.

Mr. Robinson. How would that affect a gravity tank supply?

Mr. Crosby. That would mean that a gravity tank which did not give that service would fall short of what we regard to be desirable for full standard service. It might fall short to a very slight extent.

Mr. Goddard. Wouldn't that mean that one pressure tank which gave 25 lbs. on the top line would be better than a gravity tank which gave 20 with three times the water in it?

Mr. Crosby. You are all right until you get up to "three times the water in it." Say half the water, and it would be. That is a flexible unit.

Mr. Goddard. Then I will say it would mean that a pressure tank which gave 25 lbs. on the top floor would be better than any gravity tank of whatever size you might install that gave 20 lbs. on the top floor, and I don't believe it.

Mr. Phillips. It seems to me here is a case where we can leave well enough alone. I think the Committee have done first rate in wording this the way they have. The question of water supplies is one which is entitled to be given considerable leeway. Each case has to be treated upon its merits, and I would dislike to see any more definite statement made in regard to water supplies than is made in this rule.

The President. There is no motion which has been seconded.

Mr. Steeb. Referring to the first sentence of this same paragraph: "Two independent supplies are absolutely essential to the best equipment–isn't that intended to convey the idea that they are absolutely " necessary to a standard equipment? This is a standard, not the best equipment, but a standard equipment, isn't it, and they are absolutely necessary, not merely essential.

The President. The Committee will make a note of that suggestion.

Mr. Robinson. You mean to substitute for "best" the word "standard"?

Mr. Steeb. Yes, and "necessary" instead of "essential."

The President. The Committee will make a note of that. There is no motion, Mr. Robinson; continue.

SECTION J–PUBLIC WATER WORKS SYSTEM.

(Rules also applicable to private reservoir and stand pipe systems.)

1. Pressure Required.–Should give not less than 25 pounds static pressure at all hours of the day at highest line of sprinklers.

Note: Where the normal static pressure complies with the above, the supply to be also satisfactory to the underwriters having jurisdiction, in its ability to maintain 10 pounds pressure at highest sprinklers, with the water flowing through the number of sprinklers judged liable to be opened by fire at any one time."

Quite an interesting discussion regarding water supplies for sprinkler systems from over a century ago.

It becomes apparent that some in the discussion do not realize that flow and pressure are intricately linked and that an excess in the volume of flow is not a substitute for low pressure. On the other hand, some in the discussion realize that utilizing the same pipe schedule, regardless of the residual pressure available, is not an engineering approach to the design of sprinkler protection. Even though this discussion on the hydraulics of sprinkler system piping took place in 1905, it would be close to another 50 years before the a method of doing calculations to determine the size of the piping supply would be introduced.

Clearly, the discussion reflects some confusion regarding the water supplies necessary for the operation of a sprinkler system, however, since water supply provided for many sprinkler installations exceeded the minimum supplies required, the record of successful control of fires by sprinkler protection was still quite remarkable.

One other point of interest which deserves to be noted. The sprinkler installation standard recommended that all sprinkler system be provided with two water supplies. Typically, one of the water supplies provided was the municipal distribution system, while other supply was either an elevated tank or a pressure tank.

While it appears that the reason why two water supplies were required for sprinkler system installations was concern about the general reliability of municipal distribution systems, the primary reason why two water supplies were required appears to actually have to do with the prevention and control of conflagrations. Even in 1905, it was understood that a sprinkler system was capable of preventing the spread of fire between an unsprinklered building and a sprinklered building provided that the water supply for the sprinklered building was not depleted by use of hose streams to control the fire in the unsprinklered building.

In the event of a conflagration, it would be expected that the use of the municipal water supply by fire fighters would deplete the water supply throughout parts of the water distribution system and sprinkler protection would not provide any protection for the building if the only water supply for the sprinkler system was the municipal distribution system. Hence, the requirement for two water supply sources for a sprinkler system.

While the basis for this conclusion is not evident in the discussion on the sprinkler installation standard excerpted above, discussions of the importance of sprinkler protection in the event of conflagration at later meetings supports this conclusion. Without an adequate water supply independent of the municipal distribution system, sprinkler protection would be useless in a conflagration.

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Source: "*Proceedings of the Ninth Annual* [NFPA] *Meeting*", New York, New York, 1905.