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FIRE PROTECTION HISTORY-PART 126: 1961 (SPRAY SPRINKLER SPACING/SPRINKLER SYSTEM HYDRAULICS/ WILBUR STUMP)

By Richard Schulte

The Sixty-fifth Annual Meeting of the National Fire Protection Association was held in Detroit, Michigan in May 1961. Among the various changes to the Sprinkler Installation Standard discussed at this meeting was a proposal by the Automatic Sprinkler Committee to increase the allowable spacing for spray sprinklers from 100 square feet per sprinkler to 130 square feet per sprinkler. This proposal generated a lengthy discussion on the merits of increasing the allowable sprinkler spacing and also on the merits of the pipe schedule.

The following is an excerpt of the transcript of the discussion on sprinkler spacing for spray sprinklers and the pipe schedule:

> *Chief J. E. Clougherty (Boston Fire Dept.): I think everybody in the room should give this careful consideration before they make up their minds as to how to vote on this Standard. The indirect application of water is necessary with the spacing of these so-called spray sprinklers. In other words, referring to joisted construction the extinguishment of fire in joist space is dependent on the water coming down and a certain amount of smothering and cooling effect on the fire. In other words, it is an indirect application approach and I personally believe, and have seen by actual fire experience, that the indirect application of water has been exaggerated to the utmost. In my opinion if a fire originated outside a building and went through, let us assume, a cellar space or window and into a joist space I question very much whether the sprinklers would handle this fire as the fire would be intense before the sprinklers start to operate.*
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> *We had four buildings involved in fires which extended to attic spaces. The attics involved in two buildings were so that you couldn't enter them. We went up through the ceiling of the second floor, pushed the floor boards up, and that attic area was a live inferno. If you had put your head up you would have lost your head. I say this is a good chance for this indirect application. We had a 250 gallon nozzle which sprayed. We put the nozzle up in the hole and it absolutely would not put out the fire and until such time as we could get our heads up in that area and wash the fire out we couldn't put it out. The point I want to make is that unless you can put it on the fire directly you can't put it out.*

Also on this factor I have a report here prepared by a group of insurance companies, put out by the Federation of Mutual Insurance Companies, and they are citing figures and from 1897 to 1924 automatic sprinklers extinguished 66 per cent of fires. From 1925 to 1959 they extinguished 57 per cent and held 39 in check. But in the ten-year span between '49 and '59–understand these spray sprinklers are only in existence since 1954, I believe --they extinguished 31 per cent and held in check 65 per cent. In other words, 65 per cent of the fires from 1959 according to the report were not extinguished by the sprinklers. We reversed the ratio. In other words, without fire department's assistance sprinklers are not putting out fires.

Now we are asking for additional spacing up to 130 square feet per sprinkler which means, in my opinion, we are going to have more fires to be controlled by the fire department. Not that I undersell the fire department. I realize they do a good job, but there are many factors that enter, like safety of life which I am sincerely interested in. I am of the opinion to put these sprinklers a great deal further apart the fire is going to burn longer, heavier smoke damage, and as a result we are going to endanger the health of the people in the building.

I don't believe we have enough fire research at this present time to warrant a change in this Code and also I would like any other Fire Marshals here if they have anything to say or any background relative to this indirect application if they would speak up for the good of the fire service.

Mr. D. K. Auck: The bulletin to which Chief Clougherty has referred I have to confess is my baby. The statistics are not mine. The percentages from 1897 to date are from the July 1960 issue of the Quarterly. The figures from the '53 period are obtained from the Handbook for Fire Protection. If we subtract the '53 figures from the 63-year figures we find that the position of fires extinguished as to fires held in check has completely reversed itself.

It is our opinion that if the sprinkler spacing is extended to the 130 feet limitation that we will further proliferate the number of fires held in check and we will have fewer fires in the extinguished category. There are a number of factors to be cited show why this change has occurred but the thing we are primarily interested in is that, from the insurance companies' standpoint, all the time fires are being held in check we are suffering losses and paying losses and we would much rather have a sprinkler system, especially in the life [light] *and ordinary hazard of occupancies, which would extinguish fires.*

Mr. W. Stump (U. S. Navy): This is a subject which I have discussed over a good many years. Nonetheless I feel it a duty to speak on the subject of a deterioration in the engineering considerations that are being given to automatic sprinkler protection, by and large, by the average fire protection engineer. All too often fire protection engineers, particularly a young engineer who has not had the benefit of getting his nose blistered in a fire and hasn't seen the results, reads the report of the automatic sprinklers in terms of totals rather than in terms of individuals.

This business of holding a fire in check until the fire department gets there to finish mopping up is fine and a noble thing provided you have a fire department. We have an awful lot of sprinklered property where we do not have the benefit of these dedicated people who appear on the scene at some point and do the final mopping up. As said by Mr. Auck and the Chief, we should look more closely at the fires extinguished by automatic sprinklers.

Now this continued progress towards wider and wider spacing approaches the point where it falls in the category of second sight. It is as though we know exactly where the fire is going to start and put one sprinkler head there and that is all we need for full protection.

The thing that disturbs me as much as anything is the fact that by increasing the spacing, as we are doing here, we haven't changed the sensitivity of the head, we haven't changed the opening of the head, so in the final analysis given the exact same fire location as we take the head farther and farther away from the center of that fire the head must be slower in opening. In other words, we are decreasing the sensitivity of the head which means when it does open there is a greater volume of heat present, a larger volume of fire, and we are discharging water in a condition which is more efficient than the old sprinkler except that we are not distributing it in such a way and in such proportions as the other.

Water has an absolute final amount of heat absorbent capacity and it merely takes a little arithmetic to determine how much heat it can absorb. We render lip service to the idea of adequate water supply. We call for 15 pounds on top sprinklers. Well, taking the table of average discharge of average spray sprinklers that is an awful lot of water but if it is delayed you have an area fire which is not being even touched by the spray.

Now after the first head opens, the second head doesn't have quite as much water because you are getting a loss of pressure. The pressure continues to drop and many of you would be not only amazed but very much flabbergasted to run hydraulic calculations on the average standard system where the pipes are according to the schedule in the book.

When we call for, shall we say, a minimum of water supply in the sprinkler system of 500 gallons a minute we are being dishonest when we imply that the system which we design according to this book will actually use 500 gallons a minute. It won't do it. I defy you to prove it unless you have a very high pressure.

It is my contention, and has been for many years–and I perhaps am the most vociferous exponent of the idea of hydraulic calculations–but it is my idea that we should investigate and improve the water distribution and characteristics of the pipes we connect to. In other words, I am not too concerned with the 130 square feet spacing as much as I am with the fact that on a fairly high ceiling fire if you open eight or ten or fifteen heads in accordance with the book and have average water to extinguish that fire and supply maximum efficiency, they fail to because the drop in pressure is such that the end head is starved. The head over near the door is delivering the water. It is stealing the water away from the farther head. I would say this, that we would be in no danger if instead of putting a table in the standard which gives the discharge of the sprinkler at various pressures, that particularly in poor buildings we require a greater attention to calculation of the pipe sizes that supply these heads which are spaced on 130 square feet. We are going to have more and more heads open to contain or control or extinguish the average fire. By doing these calculations we will be able to increase the number of fires which are actually extinguished with two or three heads or five heads without any help from anyone, and this would mean saving not to the insurance company but to the general economy of this country many hundreds of millions of dollars every year. It would reduce the number of unsatisfactory sprinkler performances that we have due to weak water supplies that perhaps can supply 500 gallons a minute, a thousand gallons a minute, but when the fire gets away from the sprinklers it gives you a total loss. Look not at the 96 per cent. Look at the fires extinguished and also at the fires that were sprinkler failures. (Applause)

Mr. P. R. Bechtolt (Western Actuarial Bureau): I have a feeling sitting here that perhaps some people might get the impression that insurance companies and the sprinkler industry are giving away something here. Now there were several statements made about this question of sprinkler performance and I would like to make certain observations on them.

In the first place, in this fire record of NFPA listings I don't know if this group here could agree on what constitutes a sprinkler extinguishment and what constitutes a sprinkler control. This is a very subjective opinion of people. I think the overall record of sprinklers in combination of control and extinguishment is the important feature. We have to recognize that certain people would call a fire extinguished when there was only residual burning. Others might call it controlled under that circumstance.

The second factor, that the reference to the record of sprinklers in recent years is not separated, to the best of my knowledge, into records of the old type sprinklers and the new standard sprinklers. There seems to be some implication that the poor record of "extinguishment" in recent years is due to the standard sprinkler. I don't believe that the record will support this.

The third fact is that since World War II we are certainly aware of the tremendous increase in the complexity and nature of industrial fire hazards. Now certainly there have been sprinkler failures and there will continue to be sprinkler failures but I don't think that these failures to a large degree have been the result of so-called ordinary occupancy. We have had plastic materials. We have had extreme use of large quantities of flammable liquids which have overpowered sprinkler systems.

The principal challenge we are concerned with today does not affect these hazardous operations. It affects the so-called ordinary occupancy where the old style of sprinkler had a magnificent record for a period of some sixty-odd years. The tests that were run I think have indicated that the standard sprinkler at 130 square foot spacing gives protection which is at least as good if not better than the old style sprinkler at the spacing we are all accustomed to.

So I think we ought to consider these factors plus this one important additional factor. Mr. Stump spoke about water supply. Certainly water supply is of extreme importance and as we all know the spacing of the sprinkler has nothing to do with the quantity of the water supplied to a fire. It is a combination of complex factors. It requires additional water supplies because of additional hazards. This matter was considered very carefully by the NFPA Sprinkler Committee at a full two-day meeting in January and, as Mr. Price reported, all but two members of the Committee were present and it is the considered opinion of this Committee that this change in the Standard will not result in reduced sprinkler protection but will in fact encourage additional sprinkler protection because we will incur certain economies in sprinkler installation. (Applause)

Mr. Stump: I just want to say I had no intention when talking of water supplies to suggest that this is the only factor involved and that merely having additional water is the thing. I do however disagree violently with the previous speaker when he says the water supply available is not the index or is not affected by the spacing of these sprinklers.

When we call for 500 gallons a minute in the water mains as a standard supply to the sprinklers we are implying that we can use all of that 500 gallons. That is not so. What it does is open more heads which demand more water and you will have less of the 500 gallons available because you will have pressure drop.

President Bush: Any other comments? Hearing none, we are on the motion to adopt the report as amended.

(Motion adopted.)

An interesting discussion above and interesting comments on both sides. Does the sprinkler spacing affect the capability of sprinklers to control or extinguish a fire? Well, of course, the answer to that question is obvious. The greater the sprinkler spacing, the less water spray is applied by an operating sprinkler on a square foot basis, all other things being equal. Hence, the sprinkler spacing does indeed affect the water supply required to operate a sprinkler system so that adequate protection is achieved.

Once again, Wilbur Stump effectively makes the case against sprinkler systems designed utilizing the pipe schedule and for hydraulically designed sprinkler systems, but it will take another decade for the profession to begin the move to the use of hydraulic calculations for sprinkler system design.

In regards to the increase in the spacing of sprinklers, the fire record of sprinkler protection since this change was adopted has shown that the increase in the spacing of (standard) spray sprinklers from 100 square feet to 130 square feet has not had an adverse impact on the fire record of sprinkler protection. With more than 50 years experience with spray sprinklers spaced up to 130 square feet behind us, it seems safe to conclude that the concerns about the increase in sprinkler spacing from 100 square feet to 130 square feet were not valid.

Indeed, experience has shown that spray sprinkler spacing in excess of 130 square feet works (where sprinklers protect ordinary hazards). This is reflected in the listings for extended coverage spray sprinklers protecting ordinary hazard occupancies.

While all of the above is “ancient history” with regards to how sprinkler systems are designed today, the discussion above should still be of interest simply because history has a tendency to repeat itself.

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