Backflow Preventers and Fire Protection Systems

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For the past several years, there has been quite a debate about the need for backflow preventers on fire protection systems. This has culminated in an American Water Works Association (AWWA) study which was published in 1998. The purpose of this article is not to expand on that study, but to pick up with design requirements of backflow preventers specifically those meeting ASSE 1013, 1015, 1047 and 1048 and discuss improvements for fire protection systems. ASSE is an ANSI accredited standards writing organization & with that accreditation, comes responsibility of a 5 year review of standards to see if they are current and need to be updated. As it happens with all the controversy that has happened in the past several years on backflow protection on fire sprinkler systems, a list of industry concerns from the fire industry has been developed in respect to the use of backflow preventers on these systems. The list of issues centers around the main question of whether or not our current standards were written with the application of fire sprinkler systems in mind. I think the answer to this question is current backflow preventers do indeed work on fire sprinkler systems; however, when the standards were developed, no special consideration was given to the operating modes of these fire protection systems. It is therefore important in ASSE's review of these backflow standards that they now take very seriously these concerns that have been voiced by the fire protection industry. The list of concerns can be summed up as follows:

1. Cost
2. Size
3. Ease of installation
4. Pressure drop
5. Reliability & full flow capacity after extended static periods
6. Effects of backflow preventers during alarm testing
7. Relief valve discharge; both during the static as well as the flowing condition

Over the past 1½-years, an ASSE working group has been reviewing these concerns, along with others in a review of the subject ASSE standards. Probably the most significant action that the working group took was to agree that there was a need to consider the special needs and use of backflow preventers in fire protection systems. And, in fact, agreed to create a new classification of devices for reduced pressure principal, double checks, detector check assemblies, double check detectors, and reduced pressure detector assemblies. These products would receive the suffix of **"F"** ie.: **RPF**, **DCF**, **DCDAF**, and **RPDAF**.

If we look back to the list of concerns, I would like to take them in order and how they have been specifically addressed by the proposals from the current backflow working group.

Items 1-3 can actually be lumped together. In general, these issues are adequately handled by the existing standards in that they are performance based standards with very little prescriptive language on the physical design of the backflow preventers. As the needs and concerns of the fire protection industry have been made known, several manufacturers have responded with new and improved models. Specifically we now see backflow preventers that are lightweight due to either fabricated bodies or ductile iron castings. We now see the use of major plastic components in the large flanged backflow preventers as well as backflow preventers that are capable of various types of installations, such as vertical up or vertical down or combinations of both. I think this innovation that manufacturers have shown speaks well for ASSE standards in terms of them being performance rather than prescriptive standards. One specific item that the working group did address that did allow for cost savings on the detector assemblies was to agree that the by-pass lines which now by-pass both the first and second checks can simply by-pass the second in both the RPDA as well as the DCDA. And the by-pass line needs to configured with a new testable single check. Currently, the standards require a complete backflow assembly in the by-pass line, which is obviously more costly than the newly proposed testable single check. Another advantage for this arrangement is that the by-pass assemblies for the RPDA and the DCDA

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actually will be identical assemblies, since they are by-passing the second check on both valves. Also since we are by-passing only one check, there is less variation in static head loss across the mainline assembly, which means greater precision can be used in using the proper spring load for the by-pass line. This can result in lower overall static head losses in the assemblies.

Item 4 was a concern of the pressure drop presented by backflow preventers. Single check valves which have commonly been used in fire protection systems have static head losses as low as 1 p.s.i. and head losses at full flow as low as 3 p.s.i. In order to address this issue, the backflow working group is proposing to reduce the spring load on double checks and the second check of reduced pressure devices from the current 1 p.s.i. to 1/2 p.s.i. and on the reduced pressure principal backflow preventers allow the relief valve opening point to approach 1 p.s.i. Individually looking at these, it doesn't seem as though it would amount to much, but let's specifically look at each type of valve and what this small change in the spring load can accomplish. For example on a double check valve, the current standard requires 1 p.s.i. in each check valve.

But in reality, since field testing procedures are calling for 1 p.s.i. in the direction of flow and purchases expect this to be true, several years after installation manufacturers producing valves with spring loads on each check in the range of 1-1/2 to 2 p.s.i. This means that we are looking at a static head loss of 3 - 4 p.s.i. before water even flows through the device. If the 1/2 p.s.i. is adopted along with recommendations for field testing with backpressure as opposed to direction of flow, this could allow manufacturers to design their checks as low as 3/4 p.s.i., which would result in an overall static head loss across the complete assembly of only 1-1/2 p.s.i. This is at least a 50% reduction from where we are today. In the case of a reduced pressure principle device, again we can save in reality as much as 1 p.s.i. on the second check. But by lowering the relief valve opening point to 1 and replacing the prescriptive 3 p.s.i. buffer zone with a performance test, we can accomplish a great deal more. For example, with the relief valve opening point at 1 - 2 p.s.i., the first check valve differential could be as low as 4 p.s.i., and again the second check valve at 1/2 p.s.i. or 3/4 p.s.i. at the most, the total head loss across the device now is less than 5 p.s.i. Currently products that are produced, it is not unusual to see head losses at static from 8 to 10 p.s.i. Again, we have achieved a 50% reduction in static head loss.

To address item 5, the working group is recommending to require a seat adhesion test from UL #312, the standard for check valves for fire protection systems. This test insures that during long term static installations, there will be no bonding between the check valve disc and seat, which could result in a delayed or partial opening of the check valve under a fire demand.

To address the further concerns about the checks being affected long term by corrosion or mineral deposits, the working group is recommending two additional tests. The first is a hot water test that also incorporates a special test water which would rapidly indicate if a product was sensitive to build-up from minerals or calcium deposits. The second test is a life cycle test or as an alternative, a one year field test. The life cycle test consists of 5,000 cycles during which time it simulates the actual use in a fire protection system, which is basically static with only small flows that would occur during an alarm test cycle, about 50 gallons per minute.

Item 6 was a concern that the pressure drop on backflow preventers was giving false readings during a typical alarm test in which a test and drain valve is used which allows approximately 50 gallons a minute to flow through the system. The idea of this test is to simulate 1 sprinkler head going off and to verify that the alarm will actuate and ring during this test period.

Problems with backflow preventers have been traced to specific styles of backflow preventers that have a sharp decrease in pressure drop once the check valves open. This can be seen quite often in a toggle style swing check. To test for this condition and verify that will not occur, we have added a requirement in the flow testing that during the first 50 gallons per minute of flow through either a double check or an RP, or a detector assembly, that the head loss across the assembly cannot decrease until you are passed the 50 gallons per minute. Those who are intimately familiar with this type of problem in the field have agreed that this 50 gallon per minute test will indeed prevent field problems during the alarm testing.

Item 7 has been expressed as a concern of nuisance relief valve discharge which results in puddles of water on the flow. This of course can happen during static conditions with pressure fluctuation. Under the current standard, only 3 p.s.i. pressure fluctuation is anticipated and we all know that fluctuations greater than this occur in the field. Also, in current field testing procedures, several reference a 3 p.s.i. buffer between the relief valve opening point and the first check. Again, this would only protect from relief valve discharge under a 3 p.s.i. fluctuation. To be more realistic with the real world, the working group is recommending that the test for relief valve discharge be with a 15 p.s.i. pressure fluctuation. But in return as we mentioned under one of the other items, would be the elimination of the prescriptive 3 p.s.i. buffer between the relief valve opening point and the first check. If indeed fire protection backflow preventers do not have relief valve discharge regardless of the pressure difference between the relief valve opening point and the first check of up to 15 p.s.i., there is no point in demanding the 3 p.s.i. buffer which simply results in a higher static head loss. Also, it is recommended that during the flow test for all fire protection backflow preventers that the flow be increased up to 150% of the normal rated flow and during this period from 0 to 150% of the flow, there shall be no discharge of water from the relief valve.

It is obvious that the backflow working group has indeed been very hard at work with the special considerations for fire protection. They are to be commended for their work and for their willingness to step out with some rather innovative and creative resolutions to real world problems. These four standards have been approved by a consensus of the Product Standards Committee, and are being submitted to the ASSE Board of Directors for their review and approval. In addition, all four of these standards have been submitted to the American National Standards Institute to begin the open review process to become American National Standards. I look forward to the year 2000 when manufacturers are actually producing and selling this new classification of fire protection backflow preventers.