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TechNotes

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Hydrostatic Testing of Modifications to Systems

This issue of TechNotes has been written by Robert Upson, NFSA's Manager of Installation Standards.

The question of what pressure is required for acceptance hydrostatic testing after sprinkler alterations is a recurring and misunderstood theme. When should systems be tested to 200 psi and when should testing be limited to the system's normal working pressure?

Under NFPA 13, 2013 edition, hydrostatic tests during system acceptance are conducted at 200 psi (25.2.1.1) or at the system's normal working pressure plus 50 psi (25.2.1.2) but there are exceptions and special provisions that bear note when existing systems are modified. In these cases, lower testing pressures are permitted depending on the extent of the modifications.

When modifications affect 20 or fewer sprinklers, hydrostatic testing need not exceed system working pressure (25.2.1.4). When additions are made to existing systems, or modifications that affect more than 20 sprinklers, the added/ modified portion of the system must be isolated from the rest of the system, if possible, and tested to 200 psi (25.2.1.5). Exceptions are provided for "modifications that cannot be isolated" which need only be tested to system working pressure (25.2.1.6). The rules appear deceptively simple at first but the frequency with which questions arise about this issue suggests otherwise.

A good place to start would be an understanding of the purpose served by hydrostatic testing. Back in 2006, this topic was discussed in an e-Tech Alert:

> "The hydrostatic test has multiple purposes. It is intended to make sure that the joints in the sprinkler system are put together correctly and that the pieces and parts, as they have been assembled, can handle the maximum system pressure, plus a safety margin. The maximum pressure that most systems are going to see is the 150 psi that is typically applied by a fire department to pump into a fire department connection. The 200 psi value for the test adds a safety margin of 50 psi. If system pressures are expected to exceed 150 psi, then the same 50 psi safety margin is used and the test is performed at the expected pressure plus 50 psi. Once an entire system has been tested, the whole system does not need to be tested again if small changes are made." (Tuesday e-Tech Alert, August 8, 2006, Number 62)

The specific language of this section of the sprinkler standard has been refined since then but the purpose of the test remains the same. The limiting side of hydrostatic testing is an abundance of caution. A more recent

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"Best of EOD" issue of e-TechNotes included this cautionary advice about testing modifications or additions:

> "The intent of NFPA 13 is to be very careful and only expose new piping and components to the 200 psi test. Remember that most piping and components are only rated for 175 psi maximum pressure. We should not be exposing existing components to any pressure more than 175 psi. Any AHJ that forces a test to be conducted on existing system piping at 200 psi is exposing the system to unnecessary excess pressure and is risking severe damage to the system." (e-TechNotes, Issue# 259, February 12, 2013)

In short, the ultimate goal of hydrostatic testing lies balanced somewhere between testing the integrity of the piping system and not damaging it. The rules for hydrostatic testing provide benchmarks for testing but there are still areas where good judgment comes into play.

The benchmarks provided can be summarized in four general categories with descending test pressure requirements.

1. Test to the greater of 200 psi or system pressure plus 50 psi – All New Systems

   The first category is the most clearly defined as it applies to all new systems. There are generally few misunderstandings in this category but it should be noted here that the pressure requirement is applied at some convenient point near the lowest point in the system (25.2.1.8). If the system is pressurized to 200 psi at the ground floor level, for instance, parts of the system near the ceiling of a hypothetical sixth floor will only be pressurized to about 175 psi due to the change of elevation. It is not necessary to pressurize the entire system to 200 psi – just the lowest point.

2. Test to 200 psi – Additions to Existing Systems or Modifications Affecting More Than 20 Sprinklers that Can Be Isolated

   The second category affects changes to existing systems both in terms of additions of all new sprinklers and/or piping and large modification in terms of relocating existing sprinklers and/or piping. The key to this category is recognizing that it applies to all additions to the existing system and determining how many sprinklers have been affected by modifications. This includes all sprinklers added, relocated, or otherwise located "downstream" of any change in system piping unless they cannot be isolated (i.e. exempt under the fourth category below). System additions or modifications of this extent require a hydrostatic test of 200 psi maximum measured at the lowest point in the piping being tested. (There is no provision in this category that would require system working pressure plus 50 psi if it is higher as included for new systems.)

3. Test to System Working Pressure – Modifications to Existing Systems Affecting 20 Sprinklers or Less

   The third category affects small modifications to existing systems. This could typically occur with common changes such as

changing drop lengths or moving a branch line to adjust to changes in building layout. As long as the modifications affect 20 sprinklers or fewer, hydrostatic testing requires only system working pressure.

4. Test to System Working Pressure – Modifications That Cannot Be Isolated

   Note that this category does not have a limit in terms of the number of sprinklers that are affected by the change. Regardless of whether the modification affects more than 20 sprinklers or less than 20 sprinklers, if it cannot be isolated, it is only required to be tested at the system working pressure. This category requires the most judgment of the four with respect to determining what can or cannot be reasonably isolated. The standard specifically places simple relocated drops into this category but other cases including additions of new branches, etc. are conceivable. This is also the category that is probably the most likely to generate differences of opinion with AHJs.

Section 25.2.1.6 of the standard says, "Modifications that cannot be isolated, such as relocated drops, shall not require testing in excess of system working pressure." The usual point of contention is what else, aside from relocated drops, can and cannot be isolated. What needs to be understood is that the intent of the committee is that the isolation of existing pipe from new modifications must be complete; no pipe apart from the new work should ever be subjected to pressure over 175 psi.

> "We never intend for existing pieces of equipment (pipe, fittings, sprinklers, valves, etc.) to be subjected to pressure in excess of 175 psi. The equipment is just not rated for pressure above 175 and if you put a pressure of more than 175 on the equipment, you are violating its pressure rating and creating a potentially dangerous situation. When equipment is brand new, it can be subjected to 200 psi for a very short period of time. But after the equipment has been in service for any length of time, it would be a mistake to subject it to any pressure in excess of its maximum pressure rating (which is typically 175 psi)." (EOD Response, March 28, 2014 by a former member and Secretary of the NFPA Technical Committee on Sprinkler System Installation Criteria. Note that this is the opinion of the individual and has not been processed as a Formal Interpretation and should not be considered the official position of the NFPA or its Committee.)

From an AHJ's perspective it may seem prudent to test sections added or modified to an existing system by isolating the new work along with some adjacent existing work using the control valves provided in the sprinkler system; "reasonably isolated" but still exposing existing pipe to excessive test pressures. The flaw in this approach is that it exposes existing pipe and fittings to more pressure than they are expected to withstand by the standard.

From a contractor's perspective, including parts of the system that the contractor didn't install or modify to a potentially damaging test is a potential and unnecessary liability. From that perspective, the preferred – and standard compliant – test method would be to isolate all modified pipe and fittings for testing even if it requires inserting additional blanks or control valves for the duration of the hydrostatic test. After the 200 psi test of the isolated sections, the blanks or valves would be removed and the new

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sections attached to the existing system. Those final connections would reasonably be subject to a hydrostatic test at no more than the system working pressure.

It is interesting to note that the portions of NFPA 13 being discussed here do not eliminate the requirement for a hydrostatic test when modifications can't be isolated or if the modification affects less than 20 sprinklers. In these cases, the hydrostatic test still needs to occur. The issue is the water pressure on the system during the test. In these cases, the test occurs at the system working pressure. During the test, the contractor still needs to be monitoring the system for a couple of hours looking for drops in pressure and leakage from the modified portions of the system.

In summary, hydrostatic test requirements are dictated by the extent of the work and the ability to isolate it from the pre-existing system. Significant modifications, as determined by the number of sprinklers affected, require a 200 psi test provided they can be isolated. Minor modifications and those parts of additions and significant modifications that cannot be isolated are subject to system working pressure testing only. Isolation should be complete between existing and new or modified parts of the sprinkler system. If this level of isolation cannot be accomplished, the only testing required is at the system working pressure.

requests for assistance.