NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
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TechNotes

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The following issue of TechNotes has been written by Robert (Bob) Upson, Manager of Engineering Services for the National Fire Sprinkler Association.

Dry pipe systems account for about 10 percent of all sprinkler systems reported in structure fire data; a distant second behind wet pipe systems with 87 percent (Ahrens 2017, 3). While having the virtue of being inherently resistant to issues caused by freezing, dry pipe systems are not without disadvantages. First and foremost, much of the compressed air or nitrogen holding the traditional differential dry valve closed must be exhausted from the system before water can reach open sprinklers to be discharged on a fire. **NFPA 13**,Standard for the Installation of Sprinkler Systems, has historically dealt with this delay in water delivery time in new systems in two ways: Larger design areas for sprinkler demand calculations and maximum limits on the time water is expected to reach the most hydraulically remote sprinkler on the system.

The requirement to use a 30 percent larger design area for dry pipe systems (NFPA 13, 19.3.3.2.5) is based on the assumption that the hypothetical design fire will have grown during the time it takes water to fill the pipes and will require more sprinklers to open to achieve control of the fire. Experience has shown that a single sprinkler on a wet pipe system contains or extinguishes a fire 80% of the time. That figure drops to 67 percent for sprinklers on dry pipe systems (Ahrens 2017, 5); supporting the assumption that dry pipe systems should be designed with the expectation that more sprinklers are likely to open in a fire event.

The second means of limiting water delivery times has been addressed either indirectly with rules based on the total volume of the system or directly by setting explicit maximum permissible water delivery times to the most remote sprinkler on the system. Smaller systems are excused from set water delivery times on the premise that exhausting their small volume will not take an excessive amount of time. Larger systems are limited by set water delivery times. The refinement of **NFPA 13**'s current system size and water delivery requirements has taken place over a hundred years and is beyond the scope of this article which will focus on existing dry pipe systems only.

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Presented by Mark Hopkins, P.E., Vice President of Engineering

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Water Delivery Times in Existing Dry Pipe Systems

> *"Given the wide range of acceptable water delivery times, it is not the intent of NFPA 25 to reverify any specific time limits with the full flow trip test. Rather, it is the intent of NFPA 25 to reveal substantial delays for the water delivery time of dry pipe systems, since significant differences from one test to another are an indication of possible operational problems with the system." (Klaus and Hart 2016, p. 458)*

The requirements for existing systems encountered by fire protection contractors are typically those found in **NFPA 25**, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (NFPA 25), as referenced by both the **NFPA** Fire Code (NFPA 1, 13.3.3.2) and the **ICC** International Fire Code (IFC, 901.6.1).

> **13.3.3.2** A sprinkler system installed in accordance with this Code shall be inspected, tested, and maintained in accordance with NFPA 25.

> **901.6.1** Standards. Fire protection systems shall be inspected, tested and maintained in accordance with the referenced standards listed in Table 901.6.1.

Table 901.6.1
FIRE PROTECTION SYSTEM MAINTENANCE STANDARDS

SYSTEM	STANDARD
...	
Water-based fire protection systems	NFPA 25
...	

A common misconception is that **NFPA 25** limits water delivery time to 60 seconds. The reality is that it does not set any specific time limit for water delivery time. What it does require is a comparison of the current water delivery time as measured during trip tests required by section **13.4.5 Dry Pipe Valves/Quick-Opening Devices** (NFPA 25, 13.4.5.2.5) and the original water delivery time from the system acceptance test as required by section **14.3 Obstruction Investigation and Prevention** (NFPA 25 2017, 14.3.1(15)). If the water delivery time has increased by 50 percent since the acceptance test, an obstruction investigation is triggered for the whole system.

> **13.4.5.2.5** A tag or card that shows the date on which the dry pipe valve was last tripped, and the name of the person and organization conducting the test, shall be attached to the valve.
>
> **13.4.5.2.5.1** Separate records of initial air and water pressure, tripping air pressure, and dry pipe valve operating conditions shall be maintained on the premises for comparison with previous test results.
>
> **13.4.5.2.5.2** Records of dry pipe valve tripping time and water transit delivery time to the inspector's test

connection shall be maintained for full flow trip tests.

14.3.1* An obstruction investigation shall be conducted for system or yard main piping wherever any of the following conditions exist:
....
(15) A 50 percent increase in the time it takes water to travel to the inspector's test connection from the time the valve trips during a full flow trip test of a dry pipe sprinkler system when compared to the original system acceptance test

The problem with this approach is that it assumes that the records of the original acceptance test have been maintained by the system's owner(s) and are available as required by section **4.3 Records** (NFPA 25, 4.3.3 - 4.3.5).

4.3.3* Records shall be maintained by the property owner.
4.3.4 As-built system installation drawings, hydraulic calculations, original acceptance test records, and device manufacturer's data sheets shall be retained for the life of the system.
4.3.5 Subsequent records shall be retained for a period of 1 year after the next inspection, test, or maintenance of that type required by the standard.

The reality, however, is that records of the original acceptance test water delivery times are often not available. This is not grounds for a deficiency, but it is a reason for concern. Absent a baseline water delivery time, there is no way to monitor the system's water delivery performance in strict compliance with the standard. **NFPA 25** does not provide a ready remedy for situations where the water delivery seems greater than desirable but there is no baseline information available for comparison. An alternative method for assessing water delivery sufficiency is outside the scope of **NFPA 25** but should be developed on a case by case basis by the concerned stakeholders.

Ultimately, although it is outside the scope of **NFPA 25**, the system is expected to perform as originally designed as required by both the **NFPA** (NFPA 1, 13.3.3.1) and ICC (IFC, 901.4) model fire codes and enforced by the AHJ.

13.3.3.1 A sprinkler system installed in accordance with this Code shall be properly maintained to provide at least the same level of performance and protection as designed. The owner shall be responsible for maintaining the system and keeping it in good working condition.

901.4 Installation. Fire protection systems shall be maintained in accordance with the original installation standards for that system. Required systems shall be extended, altered or augmented as necessary to maintain and continue protection where the building is altered, remodeled or added to. Alterations to fire protection systems shall be done in accordance with applicable standards.

Given a strict interpretation of the applicable codes and

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standards, a system owner or designee with no original acceptance records available could find it necessary to recalculate the system volume and research the requirements of the adopted edition of **NFPA 13** in effect when the system was originally accepted in order to determine the maximum permissible water delivery time as an alternative baseline to records of the original acceptance test data. However, the intent of the code is to ensure that the systems works as designed and accepted; not to impose onerous requirements on the owner. It should be possible for the stakeholders to reach agreement on the condition of the system and determine a new alternative benchmark time to be used going forward as a reference for future **NFPA 25** testing and documentation.

This new alternative benchmark should be determined using whatever prior test data is available with special attention to the trends over time seen in water delivery times. If the times are relatively stable, and there is reasonable certainty that the system is not obstructed, then the oldest available time could be used in lieu of the original acceptance test time. If there is little or no testing history, a conservative alternative that an AHJ might choose is to require an obstruction investigation based on the absence of a meaningful baseline water delivery time benchmark. If the investigation shows the system to be in good working order without significant obstructions, the most current water delivery time could then become the benchmark going forward. This is ultimately a decision that will have to be discussed and approved by the AHJ.

References

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