

The following issue of TechNotes has been written by Roland Asp, C.E.T., Manager of Installation Standards for the NFSA. Roland serves on the Technical Committee on Residential Sprinkler Systems.

## Installation Standards for Residential Fire Sprinkler Systems in One- and Two-Family Dwellings

There appears to be confusion in multiple jurisdictions regarding the appropriate installation standards as they apply to stand-alone and multipurpose residential fire sprinkler systems in one- and two-family homes. For clarification, these types of systems are defined in NFPA 13D as follows:

**Stand-Alone Sprinkler System:** a sprinkler system where the above ground piping serves only the fire sprinklers. Note, for stand-alone systems a single common water service may provide service to both fire sprinkler and domestic systems.

**Multipurpose Piping Sprinkler System:** a piping system serving both domestic needs (in excess of 1 fixture) and fire sprinklers from a common piping system.

There are two major installation guidelines to install these residential systems: NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, and Section P2904 of the International Residential Code (IRC) which is titled *Dwelling Unit Fire Sprinkler Systems*.

There are those who erroneously believe that the NFPA 13D standard is limited to stand-alone systems and P2904 is limited to multipurpose systems. This is not true and is concerning as certain jurisdictions are not permitting multipurpose systems to be installed in accordance with NFPA 13D.

NFPA 13D is appropriate for both stand-alone and multipurpose systems. In fact, references to multipurpose systems are found throughout this standard. For example, section 3.3.11.3 defines multipurpose systems and section 6.3 of this standard is titled; *Multipurpose Systems*, and gives specific guidance on appropriate water supplies for these types of systems.

P2904 of the IRC is also appropriate for both stand-alone systems and multipurpose systems. This is explicitly stated in section P2904.1, "*Section 2904 shall apply to stand-alone and multipurpose wet-pipe sprinkler systems that do not include the use of antifreeze.*" In the same section is the following statement: "*The design and installation of residential fire sprinkler systems shall be in accordance with NFPA 13D or Section 2904, which shall be considered equivalent to NFPA 13D.*"

It is important to note that P2904 specifically states that residential sprinkler systems (in one- and two family dwellings) shall be in accordance with NFPA 13D or P2904. If these systems (whether



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multiple purpose or stand-alone) were limited to the requirements of P2904 only, some important options to contractors and to homeowners will be lost.

The main "option" that would be lost is the NFPA 13D methods of pipe sizing. P2904 notes that the pipe sizing shall be in accordance with the prescriptive pipe sizing method or by hydraulic calculations in accordance with NFPA 13D. However, if NFPA 13D not allowed, we would be limited to the prescriptive pipe sizing method only. This method (which is also acceptable in 13D) is a simplified method that may lead to increased pipe diameters and it also makes it difficult to use different pipe sizes throughout the system. NFPA 13D gives additional options to size the pipe including:

- (1) The simplified calculation method of 10.4.4, which can only be used for connections to a city water main of at least 4 in. (100 mm) in diameter
- (2) The prescriptive pipe sizing method of 10.4.9
- (3) The hydraulic calculation procedure for NFPA 13
- (4) The manufacturer's listed installation instructions

These additional methods of pipe sizing outlined in NFPA 13D provides flexibility and in many cases, will lead to smaller pipe sizes that cost less, a benefit to the homeowner. Again, it must be noted that P2904 does allow the NFPA 13D methods although not all authorities having jurisdiction (AHJs) are recognizing this allowance.

There are other differences as well, for example, NFPA 13D provides guidance on installing residential sprinklers in sloped and beam ceilings and P2904 does not. Sloped and beam ceilings were, in the past, included in the listing of the sprinklers but this is no longer the case. Current editions of NFPA 13D outline five ceiling configurations, including sloped and beamed ceilings, that are acceptable for the two-sprinkler design when using all residential sprinklers. P2904 states only that "*Where the sprinkler manufacturer specifies different criteria for ceiling configurations that are not smooth, flat and horizontal, the required flow rate for that room shall comply with the sprinkler manufacturer's instructions*". The sprinkler listings and instructions no longer specifically mention sloped or beamed ceilings and without this specific guidance, it may be difficult to convince AHJs that residential sprinklers are permitted to be installed with these ceiling configurations. NFPA 13D does have guidelines while P2904 does not.

Another difference between NFPA 13D and P2904 is regarding protection from freezing. NFPA 13D gives the user five options for ensuring the system does not experience freezing when piping must be installed in areas subject to freezing temperatures:

- (1) Properly insulated wet pipe system
- (2) Listed dry pipe or preaction system
- (3) Antifreeze (with some very specific limitations)
- (4) Dry sprinklers (either standard spray or residential) fed from the wet pipe system
- (5) Listed heat tracing

P2904 limits freeze protection to an insulated wet pipe systems or dry sprinklers fed from wet pipe systems. P2904 does not allow antifreeze, listed dry pipe system or listed heat tracing. These additional options (when used in compliance with NFPA 13D requirements) give the contractor and homeowner some very useful tools in preventing their systems from freezing which provides more flexibility and may result in potential cost savings.

Another example of the differences between the two documents are the rules for attics and concealed spaces that contain fuel fired equipment. P2904 requires a single sprinkler above the fuel fired equipment regardless of the location of the attic or concealed space.

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By contrast, NFPA 13D would only require a sprinkler above the fuel fired equipment if it was located below or on the same level as the dwelling unit. NFPA does not require a sprinkler in an attic (with fuel fired equipment) that is located above the dwelling unit and P2904 does. This is a substantial difference and cost increase due to the difficulty of preventing freezing if the pipe needs to be run in an unheated attic.

There are numerous other differences between the two documents but in the end, it is important to note that P2904 specifically states that NFPA 13D is considered equivalent and should be an available option for all types of residential systems (one- and two-family), both stand-alone and multipurpose systems.

There are also similarities between the two installation standards that are not universally applied. Here are two requirements common to both that are often missed:

**Static Water Pressure:** Both NFPA 13D and P2904 only require the static water pressure for use in sizing the piping. Residual pressure is not mandated as the limited flow generated by two sprinklers flowing will have a negligible effect of the strength of the water supply (as long as the city main is 4 inches or larger). This means that a hydrant flow test will often not be required when sizing the pipe on these residential systems. This may be a cost savings as there are many jurisdictions around the country that charge for hydrant flow tests. As one of the goals of these residential systems is affordability, this cost savings is not inconsequential. The allowance to use the static water pressure only is found in the 2016 edition of NFPA 13D in section 10.1.2 and is found in the 2015 edition of the International Residential Code in the Step 1 of the calculation procedures listed in section P2904.6.2.2.

**Domestic water allowance:** NFPA 13D and P2904 do not require that a domestic allowance be added to sprinkler demand in the hydraulic or pipe sizing calculations when the system is serving a single dwelling unit. NFPA 13D does however require 5 gpm be added when a system is serving more than one dwelling unit. This allowance is found in the 2016 edition of NFPA 13D in section 6.5.2 and in the 2015 edition of the IRC in section in P2904.6. These sections read as follows:

NFPA 13D:

*6.5.2. In common water supply connections serving more than one dwelling unit, 5 gpm (20 L/min) shall be added to the sprinkler system demand to determine the size of common piping and the size of the total water supply requirements where no provision is made to prevent flow into the domestic water system upon operation of a sprinkler.*

P2904:

*P2904.6 Pipe sizing. "... The flow required to supply the plumbing fixtures shall not be required to be added to the sprinkler design flow."*

This is an important statement in both standards. Adding the domestic flow to the pipe size calculation will result in larger pipe sizes and increased costs. There are jurisdictions that do require that the pipe and water meter be sized to accommodate a simultaneous flow of both the sprinklers and the domestic fixtures. As this is not a requirement of either the IRC or NFPA 13D; this practice needs to be discouraged as it will affect both multipurpose systems and stand-alone systems using a common service that feeds both the domestic use and the stand-alone fire sprinkler system.

It is essential for the fire sprinkler industry to continue to promote residential sprinkler systems and to educate all in the life safety benefits of these systems. At the same time, it is vital that these systems are installed properly. We need to convey that NFPA 13D is

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appropriate for use in both stand-alone and for multipurpose residential fire sprinkler systems. NFPA 13D in many applications can be a more comprehensive installation document that will give the installer greater options in dealing with the often complicated situations found in today's homes.

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