NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
The Voice of the Fire Sprinkler Industry

TechNotes

Editor - Roland Asp, CET | #464 | 05/25/2021

This issue of Technotes was written by Vince Powers, NFSA's ITM Specialist.

Top Tech Qualifying Test Closes Friday!

The 2021 competition will take place during the NFSA's Annual Seminar and North American Fire Sprinkler Expo® which is scheduled for October 5-7, 2021 at The Cosmopolitan in Las Vegas.

The Top Tech Competition is a fun but challenging competition that pits the top sprinkler layout technicians against each other in a game show type tournament with the purpose of finding the best fire sprinkler layout technician.

Go to **www.nfsa.org/toptech** to register for the qualifying exam. The exam is made up of three sections. **All three must be completed by noon on May 28, 2021.** There is an overnight processing period after registering for the test so registrations must be completed by May 27, 2021 in order to access the exam by May 28, 2021.

Evaluating Fire Pump Tests

A fire pump assembly is one of the most expensive and important systems in fire protection. NFPA 25, the Standard for Inspection, Testing, and Maintenance of Water Based Fire Protection Systems requires that the system be properly maintained. An important portion of maintenance is an annual full flow test. There are several inspections, testing, and maintenance (ITM) items that can be found in Chapter 8, but for this article the focus is on annual flow testing.

Flow Testing Requirements

Section 8.3 of the 2020 edition of NFPA 25 is where the testing requirements start. There are two tests required: the no-flow (churn) test and the annual flow test. Diesel driven fire pumps are required to be churn tested for thirty minutes per week while electric driven fire pumps must be churn tested for ten minutes per month. There are four exceptions outlined in Section 8.3.1.2.1 that require an electric driven pump to be run weekly. Annual flow testing requirements in Section 8.3.3 state that the fire pump shall be tested at three points: no-flow (churn), 100% (rated), and 150% (peak flow). Variable speed fire pumps must be

tested at seven points: churn, 25%, 50%, 75%, 100%, 125%, and 150%. The variable speed pump assembly will require two fire pump tests. First at the seven points as stated above then use the bypass switch on the controller to defeat the variable speed option and flow test the fire pump again at churn, 100%, and 150%. This will test the variable speed option as well as the three test points for the data plate.

Testing Methods

There are three methods of flowing water to obtain the flow points required for the annual flow test. First, the most common is the use of hose streams. There are many alternatives to using diffusers and play pipes when using this method such as attaching nozzles directly to the test header valves. For example, there have been situations where in lieu of having to use long runs of hose for a 1,500 GPM fire pump, the contractor attached a six-inch pipe to where the test header would be then used a UL listed measuring device at the end of the pipe run to verify flow volume. The second method is the use of a flow meter to drain or back to the suction reservoir. The third method is when the flow meter is piped back to the suction side of the fire pump (closed loop metering). This method is only permitted to be used for two years, once every three years methods one or two must be used. When using the third method attention must be paid to verify the water temperature does not raise enough to damage equipment.

Testing Equipment

There are few limitations to what equipment can be used to test fire pumps. The general requirement is that the pressures and volumes are achieved. It is important to ensure that you are using quality equipment such as calibrated gauges and that the flow testing equipment is not faulty. This can lead to inaccurate information and failing fire pump results. Section 8.3.3.5 outlines testing equipment and below is a link to a blog regarding calibration of gauges and other testing equipment.

Check out the NFSA Blog "**Tis the Season for Calibration**".

Evaluation of Test Results

Section 8.3.7 sets the requirements for evaluating the results of the fire pump flow tests. The results must be within 95% of the fire pump data plate or manufacturer's unadjusted field test curve.

To determine if the fire pump is within 95%, we must subtract the suction pressure from the discharge pressure then divide by the data plate supplied PSIG for each flow condition. For example, we will use the following data plate and flow test numbers to determine if we are meeting the requirement of Section 8.3.7.

For this example, our flow test numbers recorded during the test will be:

	Suction PSIG	Discharge PSIG	Speed (RPM)	Volume (GPM)
Churn	50 PSI	166 PSI	1767	0
100%	48 PSI	144 PSI	1752	1500
150%	42 PSI	118 PSI	1748	2250

To determine net pressure, subtract suction pressure from discharge pressure then divide by rated pressure.

Churn 166 PSI-50 PSI= 116 PSI then divide by 118 PSI (max psi from data plate) = .98 or 98%

100% 144 PSI-48 PSI=96 PSI then divide by 100 PSI (rated psi from data plate) = .96 or 96%

150% 118 PSI-42 PSI=76 PSI then divide by 80 PSI (1.5 cap psi from data plate) =.95 or 95%

As we can see from the example the fire pump results are with-in 95% of the data plate information.

Laws of Affinity

What if the results were not favorable and below the 95%? In the 2017 edition, Section 8.3.7.1.3 states that velocity and pressure adjustments shall be applied to net pressure and flow to determine compliance with Section 8.3.7.2.3(2), which is the requirement to meet 95% of the data plate or manufacturer's unadjusted curve. It is important to note the 2017 edition because Section 8.3.7.1.3 was introduced as a new section and in the 2020 edition the requirements changed. The 2020 edition states that the test results must meet 95% of the name plate without adjusting for net pressure and flow, as well as requiring that the affinity laws must be applied to achieve 100 percent of rated flow. The National Fire Sprinkler Association will be submitting a Tentative Interim Amendment to correct this oversight for the 2020 edition.

Let us apply affinity laws to an example to meet the 95% as required in the 2017 edition. Using the same example above but change the results for this example.

	Suction PSIG	Discharge PSIG	Speed (RPM)	Volume (GPM)
Churn	50 PSI	166 PSI	1767	0
100%	48 PSI	142 PSI	1740	1485
150%	42 PSI	116 PSI	1738	2235

Subtract suction pressure from discharge pressure then divide by rated pressure. In this example, the fire pump test results are below the required 95% of the fire pump data plate at both 100% and 150%.

Churn 166 PSI -50 PSI= 116 PSI then divide by 118 PSI (max psi from data plate) = .98 or 98%
100% 142 PSI-48 PSI=94 PSI then divide by 100 PSI (rated psi from data plate) = .94 or 94%
150% 116 PSI-42PSI=74 PSI then divide by 80 PSI (1.5 cap psi from data plate) =.93 or 93%

Affinity Law:

$$Q2 = Q1\left(\frac{N2}{N1}\right)$$

$$Pn2 = Pn1\left(\frac{N2}{N1}\right)^2$$

Where:
Q2= Flow through the pump at the second speed (New flow in GPM)
Q1= Flow through the pump at the first speed (GPM from field test)
N2= Second speed (data plate in RPM)
N1= First speed (speed from field test in RPM)
Pn2= Net pressure created by the pump at the second speed (New pressure in PSI)
Pn1= Net pressure created by the pump at the first speed (PSI from field test)

Using the affinity laws above adjust for net pressure and flow to find the new results.

100% test result adjustments
142 PSI-48 PSI=94 PSI at 1740 RPM and 1485 GPM
1485 GPM (1760 RPM/1740 RPM) =(Q2) 1502 GPM
94 PSI (1760 RPM/ 1740 RPM)^2=(Pn2) 96 PSI. Divide 96 PSI by 100 PSI (100% rated pressure) = 96%

150% Test result adjustments
116 PSI-42PSI=74 PSI at 1738 RPM and 2225 GPM
2225 GPM (1760 RPM/1738 RPM) = (Q2) 2253 GPM
74 PSI (1760 RPM/1738 RPM)^2= (Pn2) 76 PSI. Divide 76 PSI by 80 PSI (150% rated pressure) = 95%

After applying affinity laws, the pump results are still with in the 95% of rated pump net pressure and flow, as required by NFPA 25. If the fire pump is flowing the required GPM and meeting the required RPM but not achieving the rated PSI, there is something wrong and the fire pump assembly will have to be investigated further for the cause of degradation. Chapter 8 of NFPA 25 does not provide specific procedures on how to conduct fire pump testing or how to evaluate the results. Conducting some research as well as reading Supplement 1 of the NFPA 25 handbook will assist in how to properly conduct and evaluate the fire pump testing. Using calibrated testing equipment as well as undamaged hoses and flow measuring devices provide the building owner with consistent and accurate test data.

Layout Technician Training

Not ready for Top Tech yet? Check out NFSA's Layout Technician Training class. This class will get you started on the path to a productive, successful layout technician. The training class covers sprinkler selection, sprinkler spacing and location, obstructions to sprinklers, water supplies (public mains, tanks and pumps), hydraulic calculation of sprinkler systems, and standpipe system layout and calculation. Don't miss out on the opportunity to bring this highly requested training class into your office!

Layout Technician Training - Virtual Training Class

August 10 - Sept 2, 2021

November 2 - December 2, 2021

More Information

Blended Learning Layout Technician Virtual Practicum

August 25 - Sept 2, 2021

November 17 - December 2, 2021

More Information

New EOD Process

Starting on July 15, 2020, the NFSA has a new EOD process where members can submit questions, track the progress, and view their EOD cases. The step by step process is detailed in **TechNotes #442**.

National Fire Sprinkler Association
514 Progress Dr, Ste A,
Linthicum Heights, MD 21090
1-800-683-NFSA (6372)

Contact Us