NFPA 291 HYDRANT FLOW TESTING

Fire Flow Testing and Marking of Hydrants
4.2 Procedure

- Tests should be made during period of ordinary demand.
- One hydrant, designated the RESIDUAL hydrant, is chosen to be the hydrant where the normal static pressure will be observed with the other hydrants in the group closed, and where the residual pressure will be observed with the other hydrants flowing.
FIGURE 4.3.4

Suggested Test Layout for Hydrants.
SECTION 4.3.6

• To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25 percent, or to flow the total demand necessary for fire-fighting purposes.
4.5 Test Procedure

4.5.1 In a typical test, the 200 psi (14 bar) gauge is attached to one of the 2½ in. (65 mm) outlets of the residual hydrant using the special cap.

4.5.2 The cock on the gauge piping is opened, and the hydrant valve is opened full.

4.5.3 As soon as the air is exhausted from the barrel, the cock is closed.

4.5.4 A reading (static pressure) is taken when the needle comes to rest.

4.5.5 At a given signal, each of the other hydrants is opened in succession, with discharge taking place directly from the open hydrant butts.

4.5.6 Hydrants should be opened one at a time.

4.5.7 With all hydrants flowing, water should be allowed to flow for a sufficient time to clear all debris and foreign substances from the stream(s).

4.5.8 At that time, a signal is given to the people at the hydrants to read the pitot pressure of the streams simultaneously while the residual pressure is being read.

4.5.9 The final magnitude of the pressure drop can be controlled by the number of hydrants used and the number of outlets opened on each.

4.5.10 After the readings have been taken, hydrants should be shut down slowly, one at a time, to prevent undue surges in the
4.6 Pitot Readings

4.6.5 The air chamber on the pitot tube should be kept elevated.
4.6.6 Pitot readings of less than 10 psi (0.7 bar) and more than 30 psi (2.1 bar) should be avoided, if possible.
4.6.7 Opening additional hydrant outlets will aid in controlling the pitot reading.
4.6.8 With dry barrel hydrants, the hydrant valve should be wide open to minimize problems with underground drain valves.
4.6.9 With wet barrel hydrants, the valve for the flowing outlet should be wide open to give a more streamlined flow and a more accurate pitot reading. (See Figure 4.6.9.)

4.7 Determination of Discharge.
4.7.1 At the hydrants used for flow during the test, the discharges from the open outlets are determined from measurements of the diameter of the outlets flowed, the pitot pressure (velocity head) of the stream as indicated by the pitot gauge readings, and the coefficient of the outlet being flowed as determined from Figure 4.7.1.
4.7.2 If flow tubes (stream straighteners) are being utilized, a coefficient of 0.95 is suggested unless the coefficient of the tube is known.
### Table 4.10.1(a) Theoretical Discharge Through Circular Orifices (U.S. Gallons of Water per Minute)

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TWO HYDRANT FLOW TEST WITH A CALIBRATED FLOW DEVICE

Main Capacity Flow Test

Two-hydrant flow test
A Main Capacity Test evaluates the water supply of the fire main at the location of the test hydrant. The information derived from this test is used by city planners and contractors to consider the water supply for general use and fire sprinkler systems.

Setup
At the test hydrant (pressure hydrant, static/residual hydrant):
1. Attach gauge cap to test hydrant. Tighten all other caps.
2. Open test hydrant, vent air from hydrant body through the valve on the gauge cap assembly. Close it when air is vented.

At the flow hydrant
1. Set the Little Hose Monster™ with gauge to the Pitotless Nozzle™ in an appropriate location for flowing water.
3. Attach hydrant gate valve to the hydrant.
4. Tighten other caps.
5. Attach the hose to the Pitotless Nozzle and Little Hose Monster assembly.

Conduct the test
1. Record static pressure reading from gauge cap, (Test Hydrant)
2. Open flow hydrant fully.
3. When the flow-rate stabilizes,
   a. Record nozzle pressure from the remote reader, (Flow Hydrant)
   b. Record the residual pressure reading from the gauge cap, (Test Hydrant)

At this point, the test is complete.
4. Slowly close Flow Hydrant, Remove test equipment from hydrant. Replace and tighten cap, if the hydrant is a dry barrel type, note that water drains properly from the hydrant.
5. Record the number of minutes that water was flowing. This can be used to account for the amount of water used during the flow test.

At the test hydrant
6. Close the hydrant, Remove gauge cap and replace hydrant cap. If the hydrant is a dry barrel type, note that water drains properly from the hydrant.
HOSE FRICTION LOSS

How much is the friction loss when I use a hose?

There is friction loss when flowing through a hose, but in a hydrant flow test, it doesn't matter. The purpose of a hydrant flow test is to evaluate the water supply, or the flow rate that will be available when the system is brought down to 20 psi residual.

A hydrant flow test requires three measurements: static pressure, residual pressure, and test flow rate. The reading from the gauge cap on the residual hydrant gives you static pressure and residual pressure. The Pterolass Nozzle™ or Hose Monster® give you the test flow rate.

The friction loss created in the hose results in a lower test flow rate and a greater residual pressure. This will not affect the predicted flow at 20 psi as long as there is a sufficient drop in static-to-residual pressure. NFPA 2011, 4.3.6, 2016 recommends a drop of at least 50% from static to residual pressure. AWWA M17 recommends a drop of at least 10 psi from static to residual pressure.

To illustrate that friction loss does not have an effect on the predicted flow rate:

1. **Test #1** measures the test flow through an open hydrant nozzle with a hand-held pritot.
   - Static: 85 psi
   - Residual: 60 psi
   - Pilot: 39 psi
   - Test flow: 1007 GPM

   Predicted flow at 20psi = 1087 GPM

2. **Test #2** measures the test flow through 2½” x 10’ hose and the 2½” Hose Monster.
   - Static: 85 psi
   - Residual: 70 psi
   - Pilot: 20 psi
   - Test flow: 764 GPM

   Predicted flow at 20 psi = 1087 GPM

- Static pressure is equal in both tests. Flow test equipment does not affect static pressure.
- Test flow in Test #2 is less than in Test #1 because of the friction loss in 10’ of hose.
- Residual pressure in Test #2 is greater than in Test #1. The friction loss in the hose causes a back pressure which increases residual pressure. The higher residual pressure compensates for the lower test flow rate.
- Both flow tests result in a predicted flow at 20 psi that is equal. Test points from both tests fall on the same line of the graph.

In summary, the Test Flows will be different, but the difference will not affect the flow test. The Hose Monster and hose will result in a lower test flow rate and a higher residual pressure. When all data is considered, the flow tests result in the same predicted flow rates.
WATER DATA WORKSHEET

1. Project: ____________________________
2. Project Location: ____________________________
3. Water District: ____________________________
4. Water District Address: ____________________________
5. Water District Phone: ____________________________
   Employee: ____________________________
6. Date And Time Of Phone Conversation: ____________________________
7. E.P.P.
   Employee: ____________________________
8. A. Hydrant #: ____________________________ Static: ____________________________ Rev/Pitol: ____________________________ GPM: ____________________________
   B. Hyd/Riser #: ____________________________ Static: ____________________________ Res/Pitol: ____________________________ GPM: ____________________________
   C. Hyd/Riser #: ____________________________ Static: ____________________________ Res/Pitol: ____________________________ GPM: ____________________________
9. Date And Time Of Flow Test(s): ____________________________
10. Type Of Hydrant Butt: ____________________________
    Play Pipe Used: Yes/No Orifice Size: ____________________________
11. Elevation Of Test Hydrant In Relation To Finish Floor Of Building: ____________________________
12. Size Of Main In Street: A) ____________________________ B) ____________________________ C) ____________________________
13. Type Of Main In Street: A) ____________________________ B) ____________________________ C) ____________________________
14. Approximate Age Of Underground Main: ____________________________
15. Main(s) Circulating Or Dead End: ____________________________
16. Distance Of Test Hydrant(s) from Bldg: ____________________________
17. Size Of Main Into Bldg: ____________________________
18. Type Of Main Into Bldg: ____________________________
19. Backflow Requirements For This Water District: ____________________________
20. Do You Know Of Any Reason Why The Test Data You Have Just Given Might Not Reflect Current Conditions? ____________________________
21. Are There Any Planned Waterworks Changes Which Might Affect Water Volume And/or Pressure In This Area? ____________________________
WATER DATA WORKSHEET 2

22. Is There A Standpipe On This System?______ If Yes:__________
   ___________________________________________________________
   A. What Are The Water Levels In Tank?_________________________
   B. What Is The Water Level Currently?_________________________
   C. How Is The Standpipe Filled?_______________________________
   D. Are The Pumps Set To Run Automatically Based On Water
      Pressure?_________________________________________________
   E. Are The Pumps Set To Operate Based On The Time Of
      Day?_______________________________________________________
   F. What Is The Rating On The Pump(s) That Supply The
      System?___________________________________________________

23. Is The System Supplied By Pump(s) Only?______ If Yes:
   ___________________________________________________________
   A. What Are The Cut-In And Cut-Out Pressure On The
      Pump(s)?_________________________________________________
   B. What Is The GPM Rating Of The Pump(s)?_____________________
   C. What Elevation Are The Pumps At?___________________________
   D. At The Time Of The Flow Test Are The Pumps Set For Normal
      Operation?_________________________________________________

24. Is There Any Protocol In Place That In The Advent Of A Fire The Fire
    Department Contacts The Water District To Increase Pressure & Flow Of The
    System?_____________________________________________________

25. Is This System Cross-Connected With Any Other Water District System That
    Could Affect Pressure & Flow?_________________________________

26. Are There Any Pressure Regulating Valves In The System That Could Affect The
    Flow Test?__________________________________________________

27. Are There Any Seasonal Variations In The System That Would Affect The
    Pressure & Flow Of The Flow
    Test?_______________________________________________________
HYDRANT TESTING PITFALLS

• WATER GUAGES NOT CALIBRATED
• INSUFFICIENT PRESSURE DROP ON RESIDUAL HYDRANT
• ELEVATION DIFFERENTIAL BETWEEN TEST AND RESIDUAL HYDRANT NOT RECORDED
• HYDRANT BUTT TYPE NOT DETERMINED
• HYDRANT TEST WORK SHEET INCOMPLETE
QUESTIONS