

Water Calcs Guide:

Equation for determining rated capacity

$$Q_R = Q_F \left(\frac{H_R^{0.54}}{H_F^{0.54}} \right)$$

Set $Q_R = 1000 \text{ GPM}$ to find H_R , which equals the pressure drop from static to residual pressure @1000 GPM (this is because that is what Q_R is set to).

$Q_F = \text{Flow rate measured during test}$

$H_F = \text{Actual pressure drop measured during the test (Static – Actual Residual)}$

taken from monitoring hydrant

There is an alternative way to do this calculation, finding Q_R and setting the H_R , pressure drop, from static to a residual pressure of 20psi. 20 psi is the minimum pressure allowed lower pressures would begin to cause negative pressures potentially allowing cross contamination to occur.

However, we like to determine the residual pressure at 1000 gpm because it makes subsequent calculations easier and consistent.

Example

$Q_F = 1187 \text{ GPM}$ (Flow rate measured during test)

$Q_R = 1000 \text{ GPM}$

$H_R = 104 - X_{1000}$

$H_F = 104 - 70$

$H_F = 34 \text{ psi}$

$Q_R = Q_F \left(\frac{H_R^{0.54}}{H_F^{0.54}} \right)$

$1000 = 1187 \left(\frac{(104 - X_{1000})^{0.54}}{34^{0.54}} \right)$

$X_{1000} = X_{Static} - \sqrt[0.54]{\left[\left(\frac{Q_R}{Q_F} \right) \cdot H_F^{0.54} \right]}$

$X_{1000} = 104 - \sqrt[0.54]{(0.842 \cdot 6.71)}$

$X_{1000} = 104 - \sqrt[0.54]{5.656}$

$X_{1000} = 104 - 24.75$

$X_{1000} = 79.25$

METRO WATER SERVICES
Two Hydrant Test Results Summary
System Services Division (SSD)
Business Unit: 666610 Work Order #: 2982940

Date of Test: 11/8/16
Job Location: Frensh Street
Cross Street: Wescott LN
Request Date: 10/19/16

Hydrant #1 - Flowing Hydrant
MWS ID: 10613
Static Pressure: 95 psi
Flow Pressure (P100): 50 psi
Time ON: 10:05 AM
Time OFF: 10:20 AM

Hydrant Outlet Coefficient: 0.9
Hydrant Outlet Diameter: 2.5 inches
This corresponds to a flowrate of 1187 gpm (Using the Orifice Eqn. (4.7.3 of NFPA 291))

Hydrant #2 - Monitoring Hydrant
MWS ID: 10612
Static Pressure: 104 psi
Residual Pressure: 70 psi
Time ON: []
Time OFF: []

Calculation of available fire flow at 20 psi as required by Table H.5.1 of the NFPA 1 Uniform Fire Code 2004 Edition (Using the pressure relational equation - A.10.1.2 of NFPA 291)
With a 20 psi residual pressure at Hydrant #2, the available flow in the main at Hydrant #2 is: **1,534 gpm**

MWS is providing these instantaneous readings for informational purposes only and cannot guarantee that it represents actual hydrant flow conditions over any period of time.

System Residual Pressure at Hydrant #2 vs Calculated Flow at Hydrant #1
Graph showing System Residual Pressure (psi) on the y-axis (0 to 2,000) and Residual Pressure (psi) on the x-axis (0 to 100). The curve shows a decreasing trend from approximately 2,000 psi at 0 residual pressure to about 500 psi at 100 residual pressure.

Now that we have the pressure available at 1000 gpm. We want to know what losses can be expected for a new development to determine if fire flow is acceptable for the proposed hydrants.

Water Calcs Guide:

Typical losses: Friction Loss, Elevation Loss (if the proposed hydrant is lower in elevation than the elevation of the flowing hydrant, it would be a gain), Minor Loss or Losses due to fittings or local losses.

Most minor losses are negligible.

Calculating Friction Losses also referred as Head Loss: Hazen-Williams.

Requires the Hazen Williams roughness coefficient C

$$h_f = \frac{10.44 * L_{ft} * Q_{gpm}^{1.85}}{C^{1.85} * d_{in}^{4.87}}$$

$Q = 1000 \text{ gpm}$ (the flow rate should stay consistent through the calculations)

$C = \text{Roughness Coefficient}$ always use $C = 130$ for new pipe (C decreases with age of pipe)

$d = \text{diameter of proposed main (in")}$

$L = \text{Length of proposed main (ft) to proposed hydrant}$

Then find the elevation difference from monitoring hydrant to proposed. Convert difference in FT to PSI. Feet (of H2O) X 0.4333 = PSI

The net gain/loss in PSI is subtracted (so Friction losses will also need to be converted to PSI), from the Residual pressure at 1000 gpm to determine the residual pressure of the proposed hydrant.

Example: $X_{1000} = 79.25$

Net gain/loss (PSI) is subtracted from the residual pressure of the proposed hydrant

$$h_f = 7.25 \text{ ft} = 3.15 \text{ psi}$$

$$\Delta Z = 30 \text{ ft} = 12.9 \text{ psi}$$

Proposed Hydrant Pressure @1000gpm

$$= 79.25 - 3.15 - 12.9 = 63.2 \text{ psi}$$