# WATER MEASUREMENT USING TWO INCH (50 mm) DRAIN TESTS

## INTRODUCTION

A hydrant or other large-volume flow test is necessary for proper water supply evaluation. When it is not possible to conduct a proper water test at the desired interval or there are no other means to test a private water supply, a drain test using one or more two inch (50 mm) drains can be used as an interim procedure for measuring the water supply available at a facility.

## LIMITATIONS

A two inch (50 mm) drain test can be used with reasonable accuracy to estimate the water supply available at the test point. The test cannot be accurately extrapolated to larger flows, other risers, or other areas of the facility. The main reason for this is due to the unknown friction loss through an alarm or other type of check valve at low flows. Under these conditions, the valve may only partially open and result in “flutter” or “chatter,” and the friction loss may be greater than when larger flows pass through the system. As a result, water test results made by this method will generally be poorer and thus more conservative than those made from hydrants. However, the results are generally acceptable when the flow achieved in this type of test is close to the actual demand of the system.

The following limitations or parameters are necessary when using 2 in. (50 mm) drain tests as a means of measuring water availability:

- The drain(s) must be 2 in. (50 mm) and free of internal corrosion.
- The discharge outlet(s) must be either a reasonably well-reamed 2 in. (50 mm) pipe or a 2 in. (50 mm) 45° elbow, discharging freely to atmosphere. This would include an air-gap device which allows full flow without backup.
- The drain(s) must discharge to safe location where no water damage will result when the drain valve is fully opened.
- The riser gauge must be accurate, and must be tapped into the riser (or alarm check valve), **not** the drain line.
- Fire pumps, jockey pumps, and/or booster pumps must be shut off during this test if the intent is to test the municipal water supply. **Appropriate impairment precautions as outlined in *OVERVIEW* and PRC.1.1.0 must be taken**.

**TABLE 1**
**Equivalent Length Computations**

| Fitting | Equivalent Length (ft) |
|---|---|
| Angle valve | 29 |
| Globe valve | 58 |
| Gate valve | 1 |
| 90° Elbow | 5 |
| 45° Elbow | 2 |
| Tee where flow turns | 10 |
| Cross where flow turns | 10 |

**SI Units**: 1 m = 0.305 ft

## METHOD

To make a water test from a 2 in. (50 mm) drain, the following procedure should be used:

- Determine the equivalent length of the 2 in. (50 mm) drain from the sprinkler riser to the outlet. Equivalent lengths for several common drain line fittings are shown in Table 1.
- Examine the discharge outlet to be sure it is 2 in. (50 mm) and either reasonably well reamed or provided with a 45° elbow.
- Open the drain valve **wide**, and allow it to flow until the pressure on the riser gauge(s) stabilizes. Check visually for full discharge at the outlet. Record the residual pressure and close the drain valve.
- Using Figure 1, read horizontally across at the riser gauge residual pressure to the curve indicating the equivalent length of the drain. It is acceptable to interpolate where necessary. A vertical line from this intersection will indicate the flow from the drain.

The curves in Figure 1 have been developed by calculation and test. By following the above instructions and the parameters previously indicated, it is possible to establish a flow with an accuracy that is within acceptable limits ($\pm$ 5%).

When using this method, care must be taken to be sure that:

- A **true** static pressure is recorded. Artificially high pressures, such as those of “jockey” or excess-pressure pumps or those trapped by check valves, must be bled off to get this true static pressure.
- A **true** residual or flowing pressure is recorded. The reading must not be taken until this pressure has stabilized. This could take a considerable length of time in many systems.

While it is possible to develop a reasonably accurate flow test using one 2 in. (50 mm) drain, even greater accuracy will result from the flowing of 2 or more drains simultaneously, provided the drains are not cross connected.

## EXAMPLE

**PROBLEM**: Determine the water supply available for the two riser plant arranged as shown in Figure 2. The drain on riser “A” consists of 8 ft (2.4 m) of 2 in. (50 mm) pipe, 1-2 in. (50 mm) angle valve, 1-2 in. (50 mm) elbow, and a 45° elbow on the discharge outlet. The drain on riser “B” consists of 22 ft (6.7 m) of 2 in. (50 mm) pipe, 1-2 in. (50 m) angle valve, 3-2 in. (50 mm) elbows, and a 45° elbow on the discharge outlet.

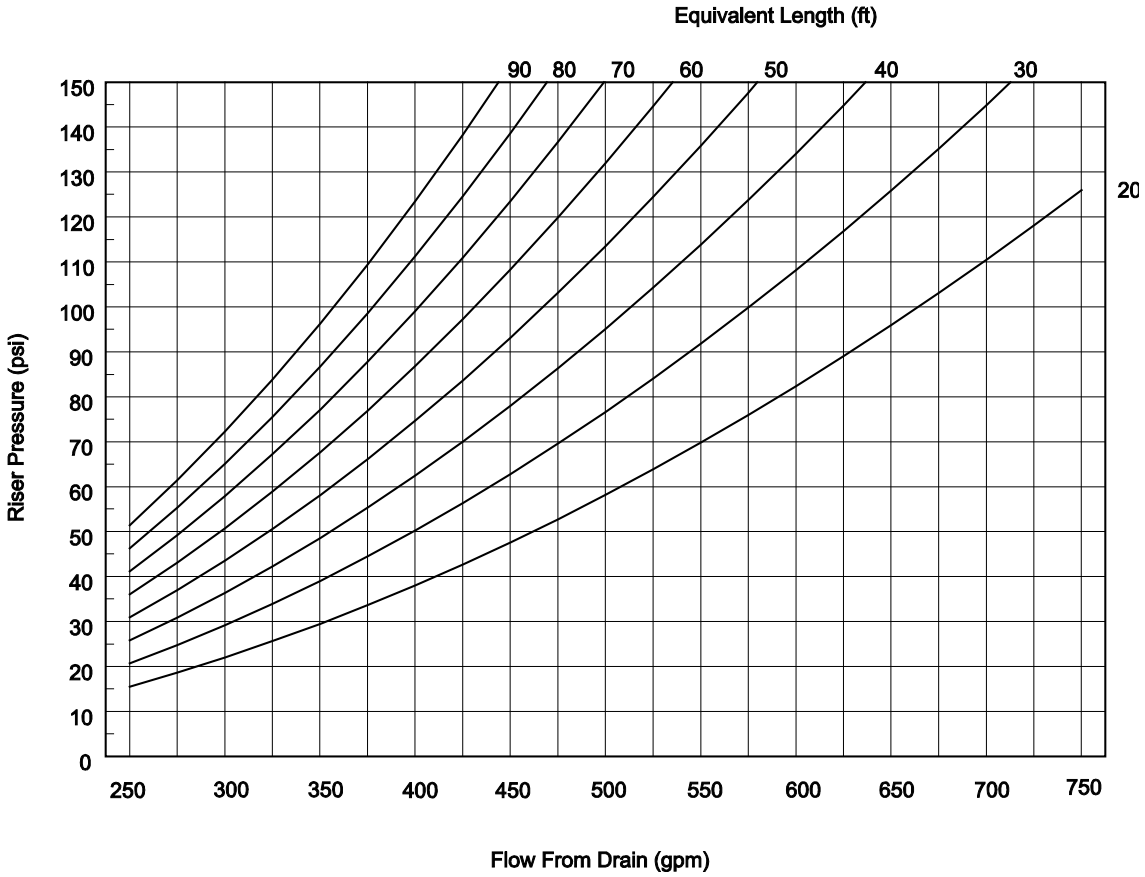


**Figure 1**. Flow Through 2 in. (50 mm) Drains.
**SI Units**: 1 bar = 0.069 psi; 1 L = 3.78 gal.

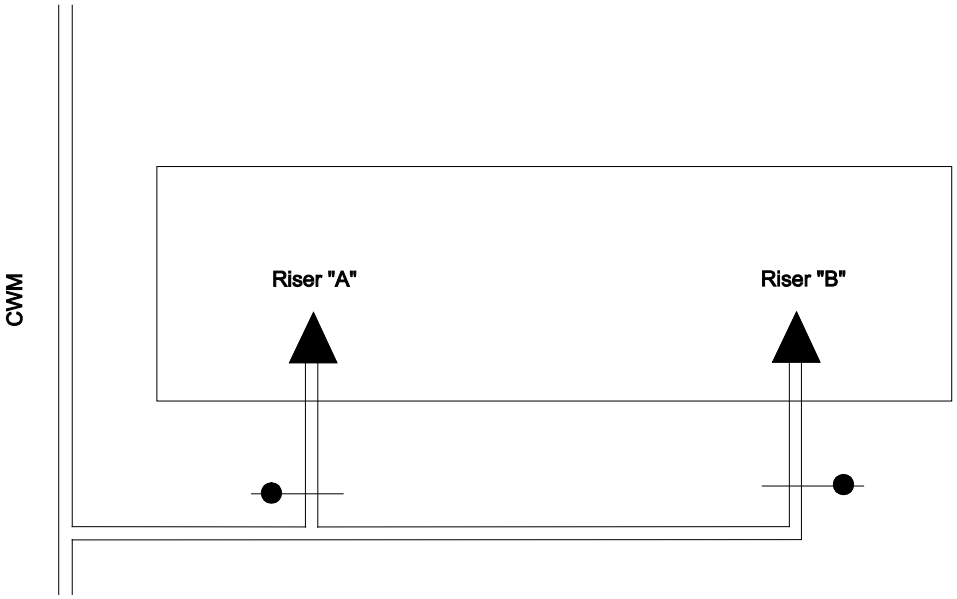


**Figure 2**. Example Riser Layout.

A drain test at riser “A” results in a static of 100 psi (6.8 bar) and a residual pressure of 86 psi (5.8 bar).

While the drain on riser “A” is open, the drain on riser “B” is opened also. The resulting residual pressures are 64 psi (4.3 bar) at Riser “A” and 70 psi (4.8 bar) at Riser “B.”

Find the amount of water being discharged in gpm, and plot the water test.

**Answer**: The equivalent lengths of the drains must first be determined. These are:

| | **Drain “A”** | **Drain “B”** |
|---|---|---|
| Length of | | |
| 2 in. (50 mm) pipe | 8 | 22 |
| 1 Angle valve | 29 | 29 |
| 90° elbows | (1) 5 | (3) 15 |
| 45° elbows | 2 | 2 |
| TOTALS | 44 | 68 |

Using the drain test at riser “A” alone, with the residual pressure of 86 psi at the equivalent length of 44 ft (13 m), the flow from drain “A” is 450 gpm (1700 L/m).

Next, using simultaneous flows from “A” and “B”, the flow at “A” = 390 gpm (1470 L/m), the flow at “B” (with equivalent length of 68') = 335 gpm (1270 L/m). Thus the total flow is 725 gpm (2740 L/m).

Using riser “A” for the point of static-residual pressure in both cases results in the following 2 points on the water supply curve:

| | |
|---|---|
| (1) S = 100 psi (6.9 bar) | (2) S = 100 psi (6.9 bar) |
| R = 86 psi (5.9 bar) | R = 64 psi (4.4 bar) |
| Flow 450 gpm (1700 L/m) | Flow 725 gpm (2740 L/m) |

These points will plot as a straight line on $N^{1.85}$ semiexponential graph paper as shown in Figure 3.

## BACKGROUND

For any given flow through a 2 in. (50 mm) drain on a sprinkler system, the pressure on the riser gauge will be greater than the pressure at the outlet by the amount of friction loss between the two points and the elevation difference. This elevation difference is usually only a couple of feet (meters) and results in only a minimal pressure difference and is ignored for simplicity.

In addition, the total pressure at the riser gauge is slightly higher than the normal pressure indicated by the gauge due to the velocity pressure within the riser. With the stipulation that the gauge be placed on the riser, the velocity pressure will be minimal (approximately one psi [0.065 bar]). This is also ignored to eliminate a trial and error solution to the problem. Placement of the gauge on the 2 in. (50 mm) drain will introduce significant error if velocity pressure is not taken into account.

In order to be able to measure the water supply available by using a 2 in. drain test, it is necessary to determine the drain flow ($Q_D$), for a given pressure at the riser ($P_R$).

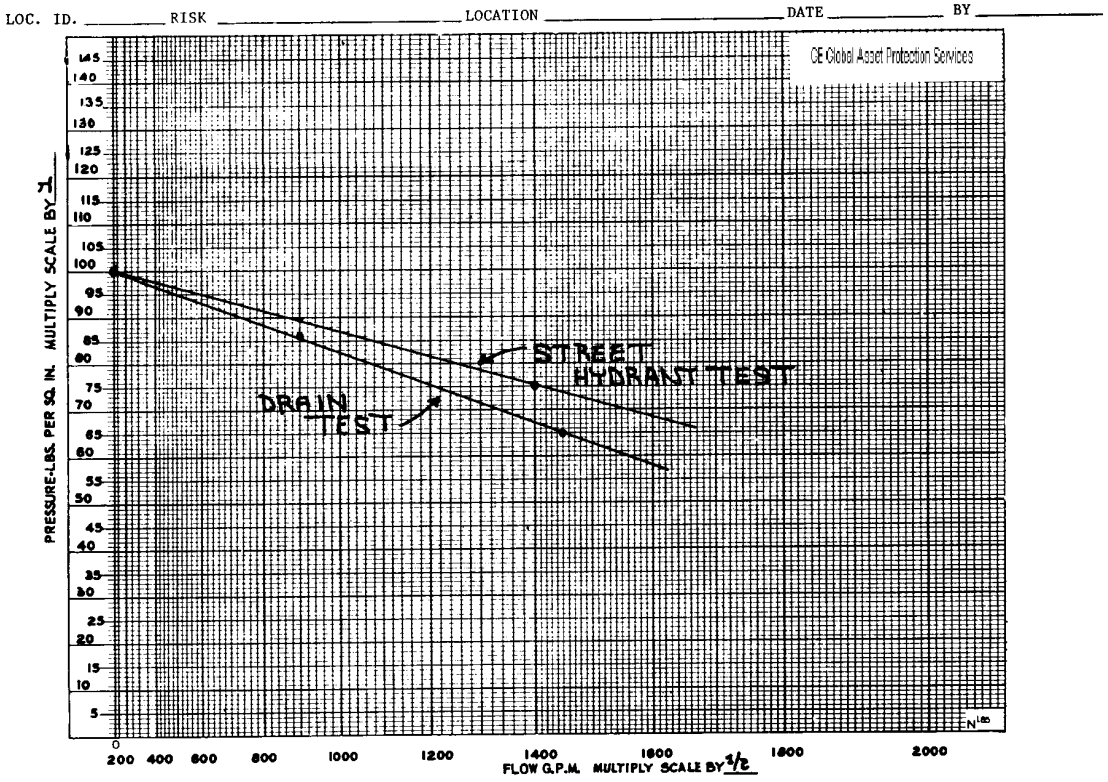


**Figure 3**. Straight-Line Graph For Water Supplies.

Tests were conducted to determine the outlet coefficients for typical 2 in. (50 mm) drain configurations. These were found to be approximately 0.9 for a reamed 2 in. (50 mm) outlet, and 0.85 for either an unreamed 2 in. (50 mm) outlet or discharge through the outlet on a 45° elbow.

Using the more conservative coefficient of 0.85 and hydraulic tables or formulas, the outlet pressure for a given flow can be calculated.

In order to relate this information to the riser gauge (*P*), it is necessary to determine the friction loss in the 2 in. (50 mm) pipe between the outlet and the riser. To do this, a C factor of 120 was used for the pipe, and various equivalent lengths of pipe were used to develop friction losses for various flows. The friction loss plus the outlet pressure equals the riser pressure.

The flow vs. riser pressure curves for several equivalent lengths are plotted in Figure 1 for easy reference and can be used to determine the drain flow by knowing only the riser gauge reading and the equivalent length and outlet configuration of the 2 in. (50 mm) drain.