

TABLE 3. PERFORMANCE REQUIREMENTS OF WATER METERS*

SIZE IN.	NORMAL TEST-FLOW LIMITS GPM	MINIMUM TEST-FLOW GPM
$\frac{3}{8}$	1 to 20	$\frac{1}{8}$
$\frac{1}{2}$	2 to 34	$\frac{1}{4}$
$\frac{3}{4}$	3 to 53	$\frac{3}{8}$
1	5 to 100	1
2	8 to 160	2
3	16 to 315	4
4	28 to 500	7
6	48 to 1,000	12

* American Water Works Association Standards:
Registration. The registration on the meter dial shall indicate the quantity recorded to be not less than 98 percent nor more than 102 percent of the water actually passed through the meter while it is being tested at rates of flow within the specified limits herein under normal test flow limits: There shall be not less than 90 percent of the actual flow recorded when a test is made at the rate of flow set forth under minimum test flow.

The water demand for hose bibbs or other large demand fixtures taken off the building main is frequently the cause of inadequate water supply to the upper floor of a building. This condition may be prevented by sizing the distribution system so that the pressure drops from the street main to all fixtures are the same. It is good practice to maintain the building main of ample size (not less than 1 in. where possible) until all branches to hose bibbs have been connected. Where the street main pressure is excessive and a pressure reducing valve is used to prevent water hammer or excessive pressure at the fixtures, it is frequently desirable to connect hose bibbs ahead of the reducing valve.

The principles involved in sizing either up-feed or down-feed systems are the same. The principal difference in procedure is that in the down-feed system, the difference in elevation between the house tank and the fixtures provides the pressure required to overcome pipe friction.

Procedure for Sizing Cold Water Systems

The recommended procedure for sizing piping systems is outlined in following paragraphs 1 to 6, inclusive.

1. Draw a sketch of the main lines, risers, and branches, and indicate the fixtures to be served. Indicate the rate of flow of each fixture.

TABLE 4. ALLOWANCE IN EQUIVALENT LENGTH OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS

DIAMETER OF FITTING IN.	EQUIVALENT LENGTH OF PIPE FOR VARIOUS FITTINGS						
	90 Deg Standard Elb Ft	45 Deg Standard Elb Ft	90 Deg Side Tee Ft	Coupling or Straight Run of Tee Ft	Gate Valve Ft	Globe Valve Ft	Angle Valve Ft
$\frac{3}{8}$	1	0.6	1.5	0.3	0.2	8	4
$\frac{1}{2}$	2	1.2	3	0.6	0.4	15	8
$\frac{3}{4}$	2.5	1.5	4	0.8	0.5	20	12
1	3	1.8	5	0.9	0.6	25	15
1 $\frac{1}{4}$	4	2.4	6	1.2	0.8	35	18
1 $\frac{1}{2}$	5	3	7	1.5	1.0	45	22
2	7	4	10	2	1.3	55	28
2 $\frac{1}{2}$	8	5	12	2.5	1.6	65	34
3	10	6	15	3	2	80	40
3 $\frac{1}{2}$	12	7	18	3.6	2.4	100	50
4	14	8	21	4.0	2.7	125	55
5	17	10	25	5	3.3	140	70
6	20	12	30	6	4	165	80

- Using Table 2, compute the demand weights of the fixtures in fixture units.
- Determine the total demand in fixture units and, using Fig. 1 or Fig. 2, find the expected demand in gallons per minute.
- Determine the equivalent length of pipe in the main lines, risers, and branches. Since the sizes of the pipes are not known, the exact equivalent length for various fittings, etc., cannot be made. Add the equivalent lengths, starting at the street main and proceeding along the service line, the main line in the building, and up the riser to the top fixture of the group served.
- Determine the average minimum pressure in the street main and the minimum pressure required for the operation of the topmost fixture. This latter pressure should be 8 to 15 psi.
- Calculate, by means of Equation 1, the approximate design value of the average pressure drop per 100 ft of pipe in the equivalent length determined in paragraph 4.

$$p = [P - 0.43H - 10] \frac{100}{L} \quad (1)$$

where

p = average pressure loss per 100 ft of equivalent length of pipe, psi.

P = pressure in street main, psig.

TABLE 5. EQUIVALENT LENGTHS OF IRON PIPE TO GIVE SAME LOSS AS SPECIAL FITTINGS AND APPARATUS

FITTING APPARATUS	NOMINAL DIAMETER OF PIPE—INCHES			
	$\frac{1}{2}$	$\frac{3}{4}$	1	1 $\frac{1}{2}$
30-gal Vertical hot-water tank, $\frac{3}{4}$ in. pipe...	4	17	56	—
30-gal Horizontal hot-water tank, $\frac{3}{4}$ in. pipe	1.2	5	16	—
Water meters (No valves included)				
$\frac{1}{2}$ in. with $\frac{1}{2}$ in. connections	6.7	28	90	—
$\frac{3}{4}$ in. with $\frac{3}{4}$ in. connections	4.8	20	64	—
$\frac{1}{2}$ in. with $\frac{3}{4}$ in. connections	3.4	14	45	—
1 in. with 1 in. connections	—	9	30	115
$\frac{1}{2}$ in. with 1 in. connections	—	4.4	14	54
Water softener	—	50-200	—	—

H = height of highest fixture above street main, feet.

L = equivalent length determined in paragraph 4, feet.

If the system is of the down-feed supply from a gravity tank, the height of water in the tank, converted to pounds per square inch by multiplying by 0.43, replaces the street main pressure, and the term $0.43H$ in Equation 1 is added instead of subtracted in calculating the term p . In this case, H will be the vertical distance of the fixture below the bottom of the tank.

7. From the expected rate of flow, determined as in paragraph 3, and the value of p , calculated as in paragraph 6, choose the sizes of pipe from Figs. 3, 4 or 5.

Example 2. Assume a minimum street main pressure of 55 psig; a height of topmost fixture above street main of 50 ft; a developed pipe length from water main to highest fixture of 100 ft; a total load on the system of 50 fixture units; and that the water closets are flush-valve operated. Find the required size of supply main.

Solution. From Fig. 2 the estimated peak demand is found to be 51 gpm. From Table 3 it is evident that several sizes of meters would adequately measure this flow. For a trial computation choose the $1\frac{1}{2}$ in. meter. From Fig. 6 the pressure drop through a $1\frac{1}{2}$ in. disc-type meter for a flow of 51 gpm is found to be 6.5 psi.

Then the pressure drop available for overcoming friction in pipes and fittings is $55 - (15 + 50 \times 0.43 + 6.5) = 12$ psi.

At this point it is necessary to make some estimate of the equivalent pipe length of the fittings on the direct line from the street main to the highest fixture. The exact equivalent length of the various fittings cannot now be determined since the pipe sizes of the building main, riser, and branch leading to the highest fixture are not known as yet, but a first approximation is necessary in order to make a tentative selection of pipe sizes. If the computed pipe sizes differ from those used in determining the equivalent length of pipe fittings, a recalculation will be necessary, using