Water flowing in pipes is retarded by friction, the extent of which depends upon the velocity; this amount of friction is very great and is the cause of unsatisfactory service when pipes are too small. The amount of head necessary to overcome this friction is known as the friction head, which is usually expressed in feet. It is also known as pressure drop, usually expressed in lbs. per sq. in. per 100 ft. of pipe.

The source of water supplies for most buildings is below the fixtures and comes from street mains which deliver water at varying pressures on various floors; the pressure necessary to raise water from the point of entry or supply to the uppermost fixture is called the static pressure, if referred to in pounds, and the amount of elevation in feet is called the static head; the total pressure needed to discharge a given quantity of water is the pressure necessary to overcome friction in the pipes (when horizontal) plus the static pressure when the discharge is higher than the supply.

Pipes may be sized for giving any desired pressure drop per 100 ft. of run by using Table 5, from 5 lb. up to 150 lb. per sq. in. (column 4), and any pipe sizes from ¾ in. to 4 in. If the length of pipe under consideration is longer or shorter than 100 ft., the pressure drop will be proportionately greater or less than the pressure drop used. For instance, if the pressure drop is 10 lb. for 100 ft. of run, it will be 20 lb. for 200 ft. and only 5 lb. for 50 ft. of length. If the total pressure drop on 300 ft. of pipe should not exceed 15 lb., use the 5 lb. per 100 ft. pressure table—see column 4 Table 5.

Table 5, column 1, gives the vertical rise in feet to any fixture up to 150 ft. in height; column 2, gives the static head in lb. per sq. in. corresponding with the vertical rise, while column 3 gives the static head plus 15 lb. which appears to be desirable for the top floor of a building having fixtures located not more than 50 ft. away from the main riser.

The pressures shown in column 3 do not include any allowance for friction in the main riser and these values would be greater by 1 lb. for every 10 ft. on the basis of a 10 lb. pressure drop per 100 ft.

The underlying principle involved in determining the proper pipe sizes for mains, risers and branches is to so regulate the sizes of these pipes that they will carry the maximum amount of water required of them and absorb by friction and static head, all the pressure at the source and still deliver water at the fixture in sufficient quantity but at a pressure practically equalling zero or slightly above except that due to velocity of flow through the fixture.

The accompanying Table 1 gives the amount of water in gallons which should flow per minute for the number of fixtures indicated of each different type, together with the branch pipe size necessary to carry this amount of water with a pressure drop of 30 lb. per 100 ft. of run.

The volume of water required per fixture is reduced as the number of fixtures in each group is increased, to take care of the factor of probable use.

TABLE 2. SIZES OF WATER SUPPLY BRANCHES

Fixture	Number of Fixtures 1	2	4	8	12	16
Water Closet	½	¾	1	1¼	1½	1½
With Tanks	1	1¼	1½	1½	2	2
With Flush Valves						
Urinals	½	¾	1	1¼	1¼	1¼
With Tanks	1	1¼	1¼	1½	1½	2
With Flush Valves						
Lavatories and Washing Sinks	½	½	¾	1	1	1¼
Per bibb	¾	1	1¼	1½	2	2
Bath Tubs	½	¾	1¼	1½	1½	2
8 in. Shower						
Slop and Acid, Manufacturing and Laundry Sinks, per bibb	¾	1	1¼	1½	1½	2

TABLE 3. WATER RISERS FOR MANUFACTURING BUILDINGS, LOFT BUILDINGS, APARTMENT HOUSES, HOTELS

Estimate gallons per minute by Table 1—Table of Supply Sizes for Fixtures, and assume the amount so determined is 100 gal.

Take 60 per cent for top floor. For each lower floor add 60 per cent of its total and deduct 10 per cent of the combined floors above, down to 40 per cent but not below.

Thus:

			Pipe size with 10 lb. drop
10th floor	100 gals.	60% = 60	2"
10 & 9	200 x .60	90% = 108	2½"
10 & 9 & 8	300 x .60	80% = 144	2½"
10 to 7 incl.	400 x .60	70% = 168	3"
10 " 6 "	500 x .60	60% = 180	3"
10 " 5 "	600 x .60	50% = 180	3"
10 " 4 "	700 x .60	40% = 184	3"
10 " 3 "	800 x .60	40% = 192	3"
10 " 2 "	900 x .60	40% = 216	3"
10 " 1 "	1000 x .60	40% = 240	3"

Select from Table 5 pipe size for pressure drop selected, using preferably 10 lb. drop per 100 ft.

TABLE 4. FOR RESIDENCES

Use Table 1 and for the main supply use 25 per cent of total of gallons used by fixtures and then take pipe size from Table 5 on a basis of 10 lb. pressure drop per 100 ft. or less if water supply pressure is less than 50 lb.

The pressure drop of 30 lb. per 100 ft. of run will give satisfactory results for branches on the top floor but a higher pressure drop can be used on floors below corresponding with the pressures as given in Table 5 which show that for a building 100 ft. in height, a pressure drop of 100 lb. can be used on the fixture branches and that for a building 50 ft. in height, a pressure drop of 75 lb. can be used on the fixture branches; Table 1, however, can be used with safety on any of the floors but will give pipe sizes larger than necessary for the lower floors in a very tall building.