TABLE 1. FLOW OF STEAM IN PIPES

Flow of Steam in Pipes

P = Loss in Pressure in Lbs.
d = Inside Diameter of Pipe in Inches
L = Length of Pipe in Feet
D = Weight of 1 Cu. Ft. of Steam
W = Lbs. of Steam per Min

$$W = 87.0\sqrt{\frac{PDd^5}{\left(1+\frac{3.6}{d}\right)L}}$$

$$P = 0.000132\left(1+\frac{3.6}{d}\right)\frac{W^2L}{Dd^5}$$

Pressure Loss in Ozs.	Col. 1 $87.0\sqrt{\frac{P}{100}}$	Pipe Size Nominal	Pipe Size Actual Internal Diameter	Internal Area of Pipe Sq. Ins.	Col. 2 $\sqrt{\frac{d^5}{1+\frac{3.6}{d}}}$	Steam Press. by Gage	Col. 3 $\sqrt{D}$	Length of Pipe in Feet	Col. 4 $\sqrt{\frac{100}{L}}$
0.25	1.088	1	1.049	0.864	0.536	-1.0*	0.187	20	2.240
0.50	1.538	1¼	1.380	1.496	1.178	-0.5*	0.190	40	1.580
1.00	2.175	1½	1.610	2.036	1.828	0.0	0.193	60	1.290
2	3.076	2	2.067	3.356	3.710	0.3	0.195	80	1.120
3	3.767	2½	2.469	4.788	6.109	1.3	0.201	100	1.000
4	4.350	3	3.068	7.393	11.183	2.3	0.207	120	0.912
5	4.863	3½	3.548	9.887	16.705	5.3	0.223	140	0.841
6	5.328	4	4.026	12.730	23.631	10.3	0.248	160	0.793
7	5.755	4½	4.506	15.947	32.134	15.3	0.270	180	0.741
8	6.152	5	5.047	20.006	43.719	20.3	0.290	200	0.710
10	6.878	6	6.065	28.886	71.762	30.3	0.326	250	0.632
12	7.534	7	7.023	38.743	106.278	40.3	0.358	300	0.578
14	8.138	8	7.981	50.027	149.382	50.3	0.388	350	0.538
16	8.700	9	8.941	62.786	201.833	60.3	0.415	400	0.500
20	9.727	10	10.020	78.854	272.592	75.3	0.452	450	0.477
24	10.655	12	12.000	113.098	437.503	100.3	0.507	500	0.447
28	11.509	14	13.250	137.880	566.693	125.3	0.557	600	0.407
32	12.304	16	15.250	182.655	816.872	150.3	0.603	700	0.378
40	13.756					175.3	0.645	800	0.354
48	15.069					200.3	0.685	900	0.333
80	19.454							1000	0.316
160	27.512							1200	0.289
320	38.908							1500	0.258
480	47.652							2000	0.224

Column 1 × 2 × 3 × 4 = lb. of steam per minute that will flow through a straight pipe for a given condition.

Example.—1 oz. drop — 2 in. pipe — 1.3 lb. press. — 100 ft. equivalent length:

2.175 × 3.710 × 0.201 × 1 = 1.6219 lb. per min.
1.6219 × 60 × 4 = 389.3 sq. ft. equivalent radiation.

Table 1 does not allow for entrained water in low-pressure steam, condensation in covered pipe and roughness in commercial pipe as found in practice.

*1 lb. per sq. in. gage = 2.04 in. Vacuum, Mercury Column.

water hammer, or store water in some parts of the system. The velocity at which such disturbance takes place depends upon the size of the pipe, its location (whether, vertical or horizontal), its pitch and the quantity of water flowing counter to the steam.

Unusual Conditions

Under this heading are the character and class of the building, the periodicity of use and the degree of normal temperature to be attained at the beginning of each period of use.

In public buildings, schools, offices, places of assemblage, and such buildings (where the occupants are normally at rest) the building should be heated to its required temperature at the beginning of each period of use. In some buildings (especially offices, schools and public buildings), the time between heating periods is relatively short; whereas in others (such as churches, theaters and places of assemblage), these periods are comparatively long. In other buildings, where the occupants are moving about, it is not always necessary for the building to be heated to the required temperature at the beginning of its period of use. In all cases heat given off by machinery, occupants and illumination, also the heat absorbed by the contents of the building should be taken into account.

GENERAL DATA ON PIPE SIZE TABLES

The following Tables 1 to 20 have been compiled for use in designing all types of steam heating systems, and may be used, by those experienced in the profession, with satisfactory results. The following general principals should be followed:

1. The initial pressure should not exceed 16 oz. gage.
2. It is recommended that the drop in pressure in the mains and riser to the farthest radiator should not exceed 1 oz. per 100 ft. of straight pipe or its equivalent length, with a lower rate of drop for systems with long runs.*
3. In small installations, such as residences, where the longest actual runs is seldom over 200 ft. and where the firing periods extend over several hours, resulting in boiler pressure, fluctuating from zero to about 1 lb., the total pressure drop should not exceed 2 oz. for gravity systems. In large buildings, where boilers are under the constant care of a fireman and a uniform pressure is maintained, and where the water line difference will permit, the total drop in pressure may range from 3 to 8 oz. depending upon the equivalent length of the longest run.
4. The total allowable drop in pressure depends upon (*a*) the water line difference, (*b*) the equivalent length of main and riser from the boiler to the farthest radiator, and (*c*) the regularity of the pressure maintained at the boiler or source of steam supply.
5. The water line difference or distance between the water line of the boiler and the low point of steam main and dry return main should be not less than 24 in., because of the heavy drop in pressure from condensation in heating up a cold system. This difference should be increased 2 in. for every ounce pressure drop in the system. If the total pressure drop were 6 oz., the water line difference should be 6 × 2 + 24 or 36 in.
6. There should be a nearly uniform drop in pressure between the source of steam supply and the farthest radiator on every riser. Care should be taken however, to see that the maximum allowable velocity for smooth operation is not exceeded.
7. In using this method of proportioning a system, care must be exercised to see that *no* pipe carrying condensate *counter* to the steam, is loaded to a capacity above the maximum for the particular part of a system in question as shown in Tables 4, 5 and 8 to 16.

*This rule applies only when the amount of radiation on any riser does not exceed the values in Tables 4 and 5.