

TABLE 1. FLOW OF STEAM IN PIPES

P = loss in pressure in pounds per square inch.
 D = inside diameter of pipe in inches.
 L = length of pipe in feet.
 d = weight of 1 cu ft of steam.
 W = pounds of steam per hour.

$$W = 5220 \sqrt{\frac{Pd^4}{\left(1 + \frac{3.6}{D}\right)L}}$$

$$P = 0.000000367 \left(1 + \frac{3.6}{D}\right) \frac{W^2 L}{dD^5}$$

PRESSURE LOSS IN OUNCES	COL. 1	PIPE SIZE		INTERNAL AREA OF PIPE SQ INCHES	COL. 2	STEAM PRESS. PSIG	COL. 3	LENGTH OF PIPE IN FEET	COL. 4	
	$5220 \sqrt{\frac{P}{100}}$	Nominal	Actual Internal Diameter		$\sqrt{\frac{D^5}{1 + \frac{3.6}{D}}}$		$\sqrt{d}$		$\sqrt{\frac{100}{L}}$	
0.25	65.28	1	1.049	0.864	0.536	-1.0 ^a	0.187	20	2.240	
0.50	92.28	1¼	1.380	1.496	1.178	-0.5 ^a	0.190	40	1.580	
1.00	130.5	1½	1.610	2.036	1.828	0.0	0.193	60	1.290	
2	184.6	2	2.067	3.356	3.710	0.3	0.195	80	1.120	
3	226.0	2½	2.469	4.788	6.109	1.3	0.201	100	1.000	
4	261.0	3	3.068	7.393	11.183	2.3	0.207	120	0.912	
5	291.8	3½	3.548	9.887	16.705	5.3	0.223	140	0.841	
6	319.7	4	4.026	12.730	23.631	10.3	0.248	160	0.793	
7	345.3	4½	4.506	15.947	32.134	15.3	0.270	180	0.741	
8	369.1	5	5.047	20.006	43.719	20.3	0.290	200	0.710	
10	412.7	6	6.065	28.886	71.762	30.3	0.326	250	0.632	
12	452.0	7	7.023	38.743	106.278	40.3	0.358	300	0.578	
14	488.3	8	7.981	50.027	149.382	50.3	0.388	350	0.538	
16	522.0	9	8.941	62.786	201.833	60.3	0.415	400	0.500	
20	583.6	10	10.020	78.854	272.592	75.3	0.452	450	0.477	
24	639.3	12	12.000	113.098	437.503	100.3	0.507	500	0.447	
28	690.5	14	13.250	137.880	566.693	125.3	0.557	600	0.407	
32	738.2	16	15.250	182.655	816.872	150.3	0.603	700	0.378	
40	825.4	Column 1 × 2 × 3 × 4 = lb of steam per hour that will flow through a straight pipe for a given condition. Example 1: 1 oz drop - 2 in. pipe - 1.3 lb press. - 100 ft equivalent length: $130.5 \times 3.710 \times 0.201 \times 1 = 97.2$ lb per hour. $97.2 \times 4^b = 388.8$ sq ft equivalent radiation.					175.3	0.645	800	0.354
48	904.1						200.3	0.685	900	0.333
80	1167.2								1000	0.316
160	1650.7								1200	0.289
320	2334.5	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.							1500	0.258
480	2859.1								2000	0.224

^aPounds per square inch gage = 2.04 in. Vacuum, Mercury Column.^bThe factor 4 is the approximate equivalent in square feet of steam radiation of 1 lb of steam per hour.

factor is the velocity permissible without interfering with the condensate flow. A.S.H.V.E. Research Laboratory experiments limit this to the capacities given in Table 2 for horizontal pipes at varying grades.

Maximum Velocity

The capacity of a steam pipe in any part of a steam system depends upon the quantity of condensation present, the direction in which the condensate is flowing, and the pressure drop in the pipe. Where the quantity of condensate is limited and is flowing in the same direction as the steam, only the pressure drop need be considered. When the condensate must flow against the steam, even in limited quantity, the velocity of the steam must not exceed limits above which the disturbance between the steam and the counter-flowing water may produce objectionable sounds, such as water hammer, or may result in the retention of

TABLE 2. COMPARATIVE CAPACITY OF STEAM LINES AT VARIOUS PITCHES FOR STEAM AND CONDENSATE FLOWING IN OPPOSITE DIRECTIONS^a

Pitch of Pipe in Inches per 10 Ft. Velocity in Ft per Sec.

PITCH OF PIPE	¼ IN.		½ IN.		1 IN.		1½ IN.		2 IN.		3 IN.		4 IN.		5 IN.	
Pipe Size Inches	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.	Capacity	Max. Vel.
Capacity Expressed in Square Feet E D R																
¼	25.0	12	30.3	14	37.3	18	40.4	19	42.5	20	46.1	21	47.5	22	49.3	23
1½	45.8	12	52.6	15	63.0	17	70.0	20	75.2	22	83.0	23	87.9	25	90.2	26
1½	104.9	18	117.2	20	133.0	23	144.5	25	154.0	27	165.0	28	172.6	29	178.2	31
2	142.6	18	159.0	21	181.0	23	196.5	25	209.3	27	224.0	28	234.8	30	242.6	31
2	236.0	19	263.5	20	299.5	23	325.5	25	346.5	27	371.5	28	388.4	29	401.1	30
Capacity Expressed in Pounds per Hour																
¼	6.3	12	7.6	14	9.3	18	10.1	19	10.6	20	11.5	21	11.9	22	12.3	23
1½	11.5	12	13.2	15	15.8	17	17.5	20	18.8	22	20.8	23	22.0	25	22.6	26
1½	26.2	18	29.3	20	33.3	23	36.1	25	38.5	27	41.3	28	43.2	29	44.6	31
2	35.7	18	39.8	21	43.3	23	49.1	25	52.3	27	56.0	28	58.7	30	60.7	31
2	59.0	19	65.9	20	74.9	23	81.4	25	86.6	27	92.4	28	97.1	29	100.3	30

^aData from AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS Research Laboratory.

water in certain parts of the system until the steam flow is reduced sufficiently to permit the water to pass. The velocity at which such disturbances take place is a function of (1) the pipe size, whether the pipe runs horizontally or vertically, (2) the pitch of the pipe if it runs horizontally, (3) the quantity of condensate flowing against the steam, and (4) freedom of the piping from water pockets which under certain conditions act as a restriction in pipe size.

Reaming Important

Three factors of uncertainty always exist in determining the capacity of any steam pipe. The first is variation in manufacture, which apparently cannot be avoided. The second is the care used in reaming the ends of the pipe after cutting. The effect of both of these factors increases as the pipe size decreases. According to A.S.H.V.E. Research Laboratory tests, either of these factors may affect the capacity of a 1-in. pipe as much as 20 per cent. The third factor is the uniformity in grading the pipe line.