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GAS PIPELINE CALCULATION SIZING

Using CPC Pipe Sizing Table (Natural Gas)

This handout will guide you through the basic, most common methods for sizing a natural gas piping system for residential or commercial application. There are other methods available for sizing these systems by either a complex formulaic method described in the California Plumbing Code, or the system can be engineered by a qualified professional.

The information below is paraphrased from the California Plumbing Code and is provided as an aid.

Sizing of Gas Piping Systems.

Gas piping systems shall be of such size and so installed as to provide a supply of gas to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

Required Gas Supply.

Volume. The hourly volume of gas required at each piping outlet shall be taken as not less than the maximum hourly rating as specified by the manufacturer of the appliance or appliances to be connected to each such outlet.

Where the rating of the gas appliance(s) to be installed is unknown, Table 1 shall be permitted to be used to estimate requirements of typical appliances.

To obtain the cubic feet per hour of gas required, divide the input of the appliances by the average Btu (kW.h) heating value per cubic foot of the gas. The average Btu per cubic foot is 1,100.

Longest Length Method.

The size of each section of gas piping shall be determined using the total length of piping from the meter to the most remote outlet and the load of that section (see calculation example in "Figure A" use steps 1- 6 below:

Sizing of Piping Sections To determine the size of each section of pipe in any system using piping specific table*, and proceed as follows:

1. Measure the length of the pipe from the gas meter location to the most remote outlet on the system.
2. Locate that total length in the left-hand column of sizing table*, or the next longer distance where the table does not give the exact length.
3. Starting at the most remote outlet, find in the row just selected the gas demand for the outlet. Where the exact figure of demand is not shown, choose the next larger figure in the row.
4. At the top of this column will be found the correct size of pipe.
5. Using this same row, proceed in a similar manner for each section of pipe serving this outlet. For each section of pipe, determine the total gas demand supplied by that section.
6. Size each section of branch piping not previously sized by measuring the distance from the gas meter location to the most remote outlet in that branch and follow the procedures of steps 2, 3, 4, and 5 above. Size branch piping in the order of their distance from the meter location, beginning with the most distant outlet not previously sized.

TABLE 1**APPROXIMATE GAS INPUT FOR TYPICAL APPLIANCES**

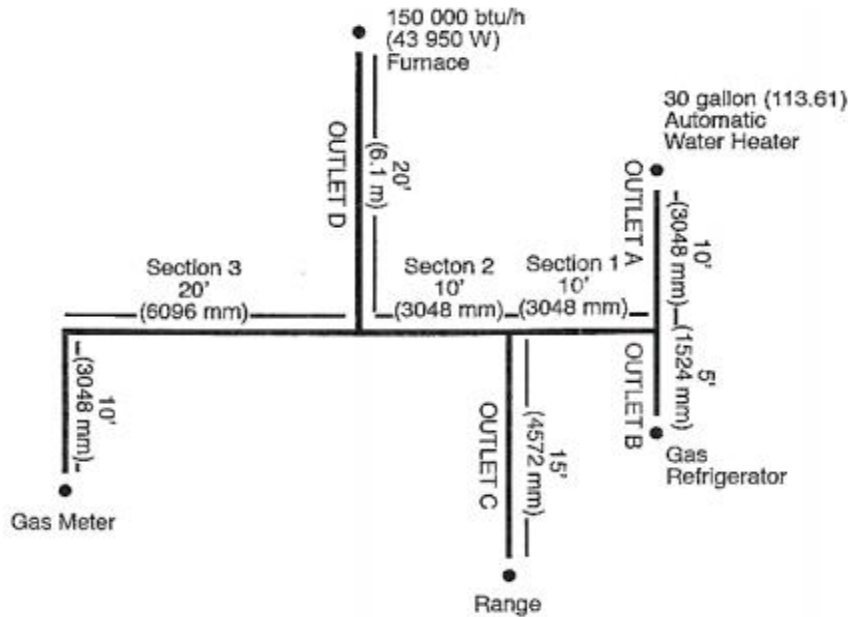
APPLIANCE	INPUT Btu/h. (Approx.)	Cubic Feet of Gas Per Hour
<u>Space Heating Units</u>		
Warm air furnaces:		
Single family	100,000	91
Multifamily, per unit	60,000	55
Hydronic boilers:		
Single family	100,000	91
Multifamily, per unit	60,000	55
<u>Space and Water-Heating Units</u>		
Hydronic boilers:		
Single family	120,000	109
Multifamily, per unit	75,000	68
<u>Water-Heating Appliances</u>		
Water heater, automatic:		
Storage 30 to 40 gal. tank	35,000	32
Water heater, automatic		
Storage 50 gal. tank	50,000	45
Water heater, automatic instantaneous:		
Capacity at 2 gal./minute	142,800	130
Capacity at 4 gal./minute	285,000	259
Capacity at 6 gal./minute	428,400	389
Water heater, domestic		
Circulation or side-arm	35,000	32
<u>Cooking Appliances</u>		
Range, freestanding, domestic	65,000	59
Built-in oven/ broiler, domestic	25,000	23
Built-in counter-top range, domestic	40,000	36
<u>Other Appliances</u>		
Clothes dryer, domestic	35,000	32
Gas fireplace – direct vent	40,000	36
Gas log unit	80,000	73
Barbecue	40,000	36
Gas Refrigerator	3,000	2

For SI units: 1 Btu per hour = .0293 W

***Maximum gas demand of outlet A = 31 CFH (35,000 btu/hr divided by 1100 btu per cubic foot**

FIGURE A

SAMPLE SCHEMATIC DRAWING



Method for determining correct pipe sizing per 1216.1.1:

- (1) Compute CFM demand for all appliances

Maximum gas demand of outlet A:

$$32 \text{ cubic feet per hour (from Table 1).} \quad 35,000\text{BTU}/1,100 \text{ BTU}^2 = 32$$

Maximum gas demand of outlet B:

$$3 \text{ cubic feet per hour (from Table 1).} \quad 3000/1,100 = 3$$

$$65,000/1,100 = 59$$

Maximum gas demand of outlet C:

$$59 \text{ cubic feet per hour (from Table 1).}$$

Maximum gas demand of outlet D:

$$136 \text{ cubic feet per hour [150,000 Btu/hour divided by 1100 Btu per cubic foot].}$$

- (2) Determine the length of pipe from the gas meter to the most remote outlet (outlet A) is 60 feet.

$$\text{Sec 1 (10)} + \text{Sec 2 (10)} + \text{Sec 3 (30)} = 60$$

- (3) Using the length in feet column row marked 60 feet in Table 2* for type of pipe:

Outlet A, supplying 32 cubic feet per hour, requires ½ inch pipe.

Section 1, supplying outlets A and B, or 35 cubic feet per hour requires ½ inch pipe.

Section 2, supplying outlets A, B, and C, or 94 cubic feet per hour requires ¾ inch pipe.

Section 3, supplying outlets A, B, C, and D, or 230 cubic feet per hour, requires 1 inch pipe.

TABLE 1216.2(1)
SCHEDULE 40 METALLIC PIPE [NFPA 54: TABLE 6.2(b)]^{1, 2}

														GAS: NATURAL	
														INLET PRESSURE: LESS THAN 2 psi	
														PRESSURE DROP: 0.5 in. w.c. ← <i>conservative</i>	
														SPECIFIC GRAVITY: 0.60	
PIPE SIZE (inch)															
NOMINAL:	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12	
ACTUAL ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065	7.981	10.020	11.938	
LENGTH (feet)	CAPACITY IN CUBIC FEET OF GAS PER HOUR														
10	172	360	678	1390	2090	4020	6400	11 300	23 100	41 800	67 600	139 000	252 000	399 000	
20	118	247	466	957	1430	2760	4400	7780	15 900	28 700	46 500	95 500	173 000	275 000	
30	95	199	374	768	1150	2220	3530	6250	12 700	23 000	37 300	76 700	139 000	220 000	
40	81	170	320	657	985	1900	3020	5350	10 900	19 700	31 900	65 600	119 000	189 000	
50	72	151	284	583	873	1680	2680	4740	9660	17 500	28 300	58 200	106 000	167 000	
60	65	137	257	528	791	1520	2430	4290	8760	15 800	25 600	52 700	95 700	152 000	
70	60	126	237	486	728	1400	2230	3950	8050	14 600	23 600	48 500	88 100	139 000	
80	56	117	220	452	677	1300	2080	3670	7490	13 600	22 000	45 100	81 900	130 000	
90	52	110	207	424	635	1220	1950	3450	7030	12 700	20 600	42 300	76 900	122 000	
100	50	104	195	400	600	1160	1840	3260	6640	12 000	19 500	40 000	72 600	115 000	
125	44	92	173	355	532	1020	1630	2890	5890	10 600	17 200	35 400	64 300	102 000	
150	40	83	157	322	482	928	1480	2610	5330	9650	15 600	32 100	58 300	92 300	
175	37	77	144	296	443	854	1360	2410	4910	8880	14 400	29 500	53 600	84 900	
200	34	71	134	275	412	794	1270	2240	4560	8260	13 400	27 500	49 900	79 000	
250	30	63	119	244	366	704	1120	1980	4050	7320	11 900	24 300	44 200	70 000	
300	27	57	108	221	331	638	1020	1800	3670	6630	10 700	22 100	40 100	63 400	
350	25	53	99	203	305	587	935	1650	3370	6100	9880	20 300	36 900	58 400	
400	23	49	92	189	283	546	870	1540	3140	5680	9190	18 900	34 300	54 300	
450	22	46	86	177	266	512	816	1440	2940	5330	8620	17 700	32 200	50 900	
500	21	43	82	168	251	484	771	1360	2780	5030	8150	16 700	30 400	48 100	
550	20	41	78	159	239	459	732	1290	2640	4780	7740	15 900	28 900	45 700	
600	19	39	74	152	228	438	699	1240	2520	4560	7380	15 200	27 500	43 600	
650	18	38	71	145	218	420	669	1180	2410	4360	7070	14 500	26 400	41 800	
700	17	36	68	140	209	403	643	1140	2320	4190	6790	14 000	25 300	40 100	
750	17	35	66	135	202	389	619	1090	2230	4040	6540	13 400	24 400	38 600	
800	16	34	63	130	195	375	598	1060	2160	3900	6320	13 000	23 600	37 300	
850	16	33	61	126	189	363	579	1020	2090	3780	6110	12 600	22 800	36 100	
900	15	32	59	122	183	352	561	992	2020	3660	5930	12 200	22 100	35 000	
950	15	31	58	118	178	342	545	963	1960	3550	5760	11 800	21 500	34 000	
1000	14	30	56	115	173	333	530	937	1910	3460	5600	11 500	20 900	33 100	
1100	14	28	53	109	164	316	503	890	1810	3280	5320	10 900	19 800	31 400	
1200	13	27	51	104	156	301	480	849	1730	3130	5070	10 400	18 900	30 000	
1300	12	26	49	100	150	289	460	813	1660	3000	4860	9980	18 100	28 700	
1400	12	25	47	96	144	277	442	781	1590	2880	4670	9590	17 400	27 600	
1500	11	24	45	93	139	267	426	752	1530	2780	4500	9240	16 800	26 600	
1600	11	23	44	89	134	258	411	727	1480	2680	4340	8920	16 200	25 600	
1700	11	22	42	86	130	250	398	703	1430	2590	4200	8630	15 700	24 800	
1800	10	22	41	84	126	242	386	682	1390	2520	4070	8370	15 200	24 100	
1900	10	21	40	81	122	235	375	662	1350	2440	3960	8130	14 800	23 400	
2000	NA	20	39	79	119	229	364	644	1310	2380	3850	7910	14 400	22 700	

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m³/h, 1 pound-force per square inch = 6.8947 kPa, 1 inch water column = 0.249 kPa

Notes:

¹ Table entries are rounded to 3 significant digits.

² NA means a flow of less than 10 ft³/h (0.283 m³/h).

FUEL GAS PIPING

TABLE 1216.2(20)
POLYETHYLENE PLASTIC PIPE [NFPA 54-12: TABLE 6.2(u)]*

									GAS: NATURAL									
									INLET PRESSURE: LESS THAN 2 psi									
									PRESSURE DROP: 0.5 in. w.c.									
									SPECIFIC GRAVITY: 0.60									
									PIPE SIZE (inch)									
NOMINAL OD:	½	¾	1	1 ¼	1 ½	2	3	4										
DESIGNATION:	SDR 9.3	SDR 11	SDR 11	SDR 10	SDR 11	SDR 11	SDR 11	SDR 11	SDR 11									
ACTUAL ID:	0.660	0.860	1.077	1.328	1.554	1.943	2.864	3.682										
LENGTH (feet)	CAPACITY IN CUBIC FEET OF GAS PER HOUR																	
10	201	403	726	1260	1900	3410	9450	18 260										
20	138	277	499	865	1310	2350	6490	12 550										
30	111	222	401	695	1050	1880	5210	10 080										
40	95	190	343	594	898	1610	4460	8630										
50	84	169	304	527	796	1430	3950	7640										
60	76	153	276	477	721	1300	3580	6930										
70	70	140	254	439	663	1190	3300	6370										
80	65	131	236	409	617	1110	3070	5930										
90	61	123	221	383	579	1040	2880	5560										
100	58	116	209	362	547	983	2720	5250										
125	51	103	185	321	485	871	2410	4660										
150	46	93	168	291	439	789	2180	4220										
175	43	86	154	268	404	726	2010	3880										
200	40	80	144	249	376	675	1870	3610										
250	35	71	127	221	333	598	1660	3200										
300	32	64	115	200	302	542	1500	2900										
350	29	59	106	184	278	499	1380	2670										
400	27	55	99	171	258	464	1280	2480										
450	26	51	93	160	242	435	1200	2330										
500	24	48	88	152	229	411	1140	2200										

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m³/h, 1 pound-force per square inch = 6.8947 kPa, 1 inch water column = 0.249 kPa

* Table entries are rounded to 3 significant digits.

FUEL GAS PIPING

TABLE 1216.2(8)
SEMI-RIGID COPPER TUBING [NFPA 54-12: TABLE 6.2(i)]^{1, 2}

		GAS: NATURAL								
		INLET PRESSURE: LESS THAN 2 psi								
		PRESSURE DROP: 0.5 in. w.c.								
		SPECIFIC GRAVITY: 0.60								
		TUBE SIZE (inch)								
NOMINAL:	K & L:	¼	⅜	½	⅝	¾	1	1¼	1½	2
	ACR:	⅜	½	⅝	¾	⅞	1½	1¾	—	—
OUTSIDE:		0.375	0.500	0.625	0.750	0.875	1.125	1.375	1.625	2.125
INSIDE: ³		0.305	0.402	0.527	0.652	0.745	0.995	1.245	1.481	1.959
LENGTH (feet)		CAPACITY IN CUBIC FEET OF GAS PER HOUR								
10	27	55	111	195	276	590	1060	1680	3490	
20	18	38	77	134	190	406	730	1150	2400	
30	15	30	61	107	152	326	586	925	1930	
40	13	26	53	92	131	279	502	791	1650	
50	11	23	47	82	116	247	445	701	1460	
60	10	21	42	74	105	224	403	635	1320	
70	NA	19	39	68	96	206	371	585	1220	
80	NA	18	36	63	90	192	345	544	1130	
90	NA	17	34	59	84	180	324	510	1060	
100	NA	16	32	56	79	170	306	482	1000	
125	NA	14	28	50	70	151	271	427	890	
150	NA	13	26	45	64	136	245	387	806	
175	NA	12	24	41	59	125	226	356	742	
200	NA	11	22	39	55	117	210	331	690	
250	NA	NA	20	34	48	103	186	294	612	
300	NA	NA	18	31	44	94	169	266	554	
350	NA	NA	16	28	40	86	155	245	510	
400	NA	NA	15	26	38	80	144	228	474	
450	NA	NA	14	25	35	75	135	214	445	
500	NA	NA	13	23	33	71	128	202	420	
550	NA	NA	13	22	32	68	122	192	399	
600	NA	NA	12	21	30	64	116	183	381	
650	NA	NA	12	20	29	62	111	175	365	
700	NA	NA	11	20	28	59	107	168	350	
750	NA	NA	11	19	27	57	103	162	338	
800	NA	NA	10	18	26	55	99	156	326	
850	NA	NA	10	18	25	53	96	151	315	
900	NA	NA	NA	17	24	52	93	147	306	
950	NA	NA	NA	17	24	50	90	143	297	
1000	NA	NA	NA	16	23	49	88	139	289	
1100	NA	NA	NA	15	22	46	84	132	274	
1200	NA	NA	NA	15	21	44	80	126	262	
1300	NA	NA	NA	14	20	42	76	120	251	
1400	NA	NA	NA	13	19	41	73	116	241	
1500	NA	NA	NA	13	18	39	71	111	232	
1600	NA	NA	NA	13	18	38	68	108	224	
1700	NA	NA	NA	12	17	37	66	104	217	
1800	NA	NA	NA	12	17	36	64	101	210	
1900	NA	NA	NA	11	16	35	62	98	204	
2000	NA	NA	NA	11	16	34	60	95	199	

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m³/h, 1 pound-force per square inch = 6.8947 kPa, 1 inch water column = 0.249 kPa

Notes:

¹ Table entries are rounded to 3 significant digits.

² NA means a flow of less than 10 ft³/h (0.283 m³/h).

³ Table capacities are based on Type K copper tubing inside diameter (shown), which has the smallest inside diameter of the copper tubing products.