

HVAC Engineer Aptitude Exam

1. How many BTU's are in one ton of air conditioning?

- a. 500
- b. 12,000
- c. 15,000
- d. 3,412

2. What is the cfm required for a 20 ΔT and a sensible load of 60,000 btu/hr?

- a. 1,250
- b. 500
- c. 2,780 $\text{cfm} = \text{room sensible load} / (1.08 \times \Delta T)$
- d. 5,460

Psychometric Chart attached for questions 3, 4, and 5.

3. What is the dew point for a dry bulb temperature of 89°F and a wet bulb temperature of 67°F?

- a. 55°
- b. 62°
- c. 50°
- d. 58°

4. What is the relative humidity of air at 72°F db and 60°F wb?

- a. 40%
- b. 30%
- c. 50%
- d. 25%

5. What is the sensible heat ratio (SHR) for a total heat load of 7.5 ton and a latent heat load of 1 ton?

- a. 0.87
- b. 0.13
- c. 1.15
- d. 0.50

6. What is a typical velocity across a cooling coil?

- a. 750 FPM
- b. 300 FPM
- c. 500 FPM
- d. 1,000 FPM

Optimizing airflow is vital. Insufficient airflow leads to inadequate cooling and dehumidification, while excessive airflow increases energy usage and filter consumption, risking water carryover off the coil.

7. What is a typical velocity across an exterior intake air louver?
- a. 500 FPM Higher airflow can lead to water intrusion
 - b. 2,000 FPM
 - c. 1,000 FPM
 - d. 50 FPM
8. What is a typical btu per square foot of heating load for an office building?
- a. 15
 - b. 200
 - c. 50
 - d. 1
9. Packaged air conditioning units have nominal flow rates (cfm) per ton of:
- a. 50 cfm/ton
 - b. 400 cfm/ton +/- 5%
 - c. 1,000 cfm/ton
 - d. 250 cfm/ton
10. Supply air duct sized using the equal friction method uses which pressure drop factor?
- a. 1.05"/100'
 - b. 0.1"/100'
 - c. 0.2"/100"
 - d. 1.00"/100'
11. A typical design noise level for an office space would be:
- a. NC-5
 - b. NC-50
 - c. NC-30 NC-30 to NC-40 refers to the Noise Criteria (NC) curves, which are utilized to evaluate indoor noise levels. A lower NC value indicates a quieter room, but it also comes at a higher cost.
 - d. NC-0
12. Water piping for HVAC use is sized using which pressure drop factor?
- a. 1 ft hd/100'
 - b. 10 ft hd/100'
 - c. 20 ft hd/100'
 - d. 4 ft hd/100'
13. What do HVAC Title 24 calculations show compliance for?
- a. Energy Usage
 - b. Seismic Restraint
 - c. Water Meter Data
 - d. Vibration Isolation

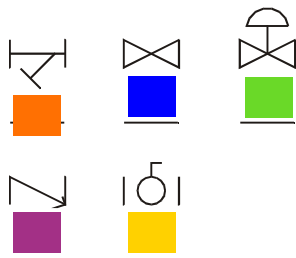
14. What would the flow of chilled water be for a coil that had a ΔT of 12° and a load of 36,000 BTU?

- a. 1 gpm
- b. 10 gpm
- c. 6 gpm $Q = (8.33 \text{ lb} \times \text{gpm} \times 60) \times 1.0 \times \Delta T$
- d. 18 gpm

15. What would the btu output of a hot water coil if the flow were 10 gpm with a ΔT of 30° ?

- a. 150,000 $Q = 500 \times \text{gpm} \times \Delta T$
- b. 100,000
- c. 5,000
- d. 500,000

16. Match the symbol with the device name:



- a. Control Valve
- b. Ball Valve
- c. Strainer
- d. Gate Valve
- e. Check Valve

17. What do these abbreviations stand for?

- a. PRV pressure reducing valve
- b. CWS cold water supply
- c. HHW heating hot water
- d. VAV variable air volume
- e. SAG supply air grille
- f. CHW chilled water
- g. RPBP reduced pressure backflow prevention

18. Refer to the attached fan model comparison curves for the same duty. Which fan would you consider to be the best model for the most future flexibility?

E

19. Refer to the attached pump curve for the 4BC pump. If the flow was increased to 840 gpm, (from pt. 1 to pt. 2) with no change in RPM, what would the resultant discharge head be?

- a. 60
- b. 52

- c. 30
d. 65
20. What information is required for HVAC load calculations for glazing?
- a. U Value
b. R Value
c. Transmissivity
d. Shading Coefficient (SC)
e. A & D
21. What does the transfer function method pertain to?
- a. Duct Sizing
b. Pipe Sizing
c. Building Load Analysis
d. Title 24
22. At what slope should steam supply piping be run?
- a. 1/4" per 10 ft
b. 1/2" per foot
c. no slope
d. 1/4" per foot
23. What pipe is appropriate for steam condensate piping?
- a. Type M Copper
b. Schedule 10 Steel
c. Schedule 80 Steel
d. 316 Stainless
24. What material ductwork is appropriate for fume hood exhaust?
- a. Aluminum
b. Ductboard
c. Stainless Chosen for its corrosion and chemical resistance
d. Copper
25. What do the following acronyms stand for?
- | | | |
|----|-----|--|
| a. | DDC | <u>direct digital control</u> |
| b. | BMS | <u>building management system</u> |
| c. | Di | <u>digital input</u> |
| d. | Ao | <u>analog output</u> |
| e. | PLC | <u>programmable logic controller</u> |
| f. | ASC | <u>application specific controller</u> |
| g. | LAN | <u>local area network</u> |

26. A programmable controller will have this type of signal to connect with the following devices.
Choose from Ai, Ao, Di, Do

Temp. Sensor Ai

Smoke Detector Di

Control Valve Do

Cooling Stage I Di

27. What is the best level of control referred to as?

- a. P
- b. **PID**
- c. PD
- d. Digital
- e. Pneumatic

28. How many btu's are in a boiler horsepower?

- a. **33,470**
- b. 3,412
- c. 550
- d. 150,000

29. What does the equation $4.5 \times \text{cfm} \times \Delta h$ result in?

- a. Sensible Load
- b. Latent Load
- c. **Total Load**
- d. Entropy
- e. Enthalpy

30. Using UPC Table 1215.2(5) for medium pressure natural gas attached, how long can a 2" pipe delivering a load of 5,000 cfh run?

- a. **800 feet**
- b. 700 feet
- c. 650 feet
- d. 1,500 feet

31. Using UPC 610.4 (attached) for water over 60 psi, how many fixture units can a 1 1/2" meter on a 2" supply system deliver at a distance of 600 feet?

- a. **187**
- b. 51
- c. 26
- d. 64

32. What happens when a pump does not have enough NPSH?

- a. Over Pumping
- b. Laminar Flow
- c. Cavitation
- d. Not Pumping So Hard

33. What do SMACNA standards govern?

- a. Piping
- b. Sheet Metal
- c. Seismic Restraint
- d. Plumbing
- e. B & C

34. Name a manufacturer for the following equipment:

- a. Rooftop Package AC Unit
- b. Air Handler Trane, Carrier, York, Lennox, Daikin
- c. Water Closet Trane, Carrier, Daikin, Lennox, Rheem
- d. Roof Drains Kohler, American Standard, Toto, Gerber, Mansfield
- e. VAV Box Johnson Controls, Honeywell, Titus, Price Industries, Krueger
- f. Air Diffuser Titus, Price Industries, Krueger, Johnson Controls, Nailor Industries
- g. DDC Control System Siemens, Honeywell, Johnson Controls, Schneider Electric, Delta Controls

35. What is the AutoCAD command for drawing text?

DT (single-line text) and MT (multiline text)

36. What are OSNAPS for in AutoCAD?

They're drawing tools that enable snapping to specific object locations, such as center, tangent, midpoint, etc., by toggling on different snap options.

37. What are x references for in AutoCAD?

They refer to external references, such as .dwg or .png files, that are attached or inserted into a .dwg file.

38. What two components do you typically find in closed hydronic systems (CHW, HHW) that you do not find in an open system (CDW)?

In closed hydronic systems (CHW, HHW), two components typically present are a Pressure Reducing Valve (PRV) and an air vent. These components are not found in an open system (CDW).

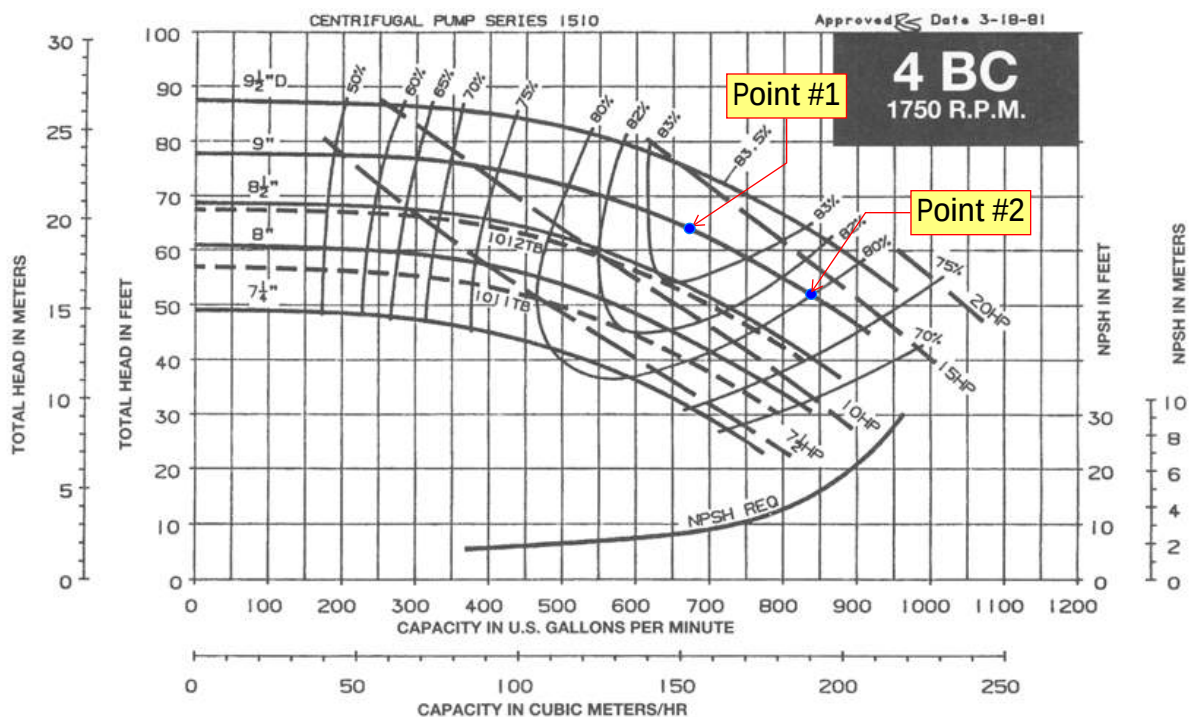
39. What is the maximum relative humidity you should have in a duct system to avoid condensation?

- a. 50% Recommended to avoid ductwork sweating and ensure your health and comfort.
- b. 70%
- c. 85%
- d. 95%

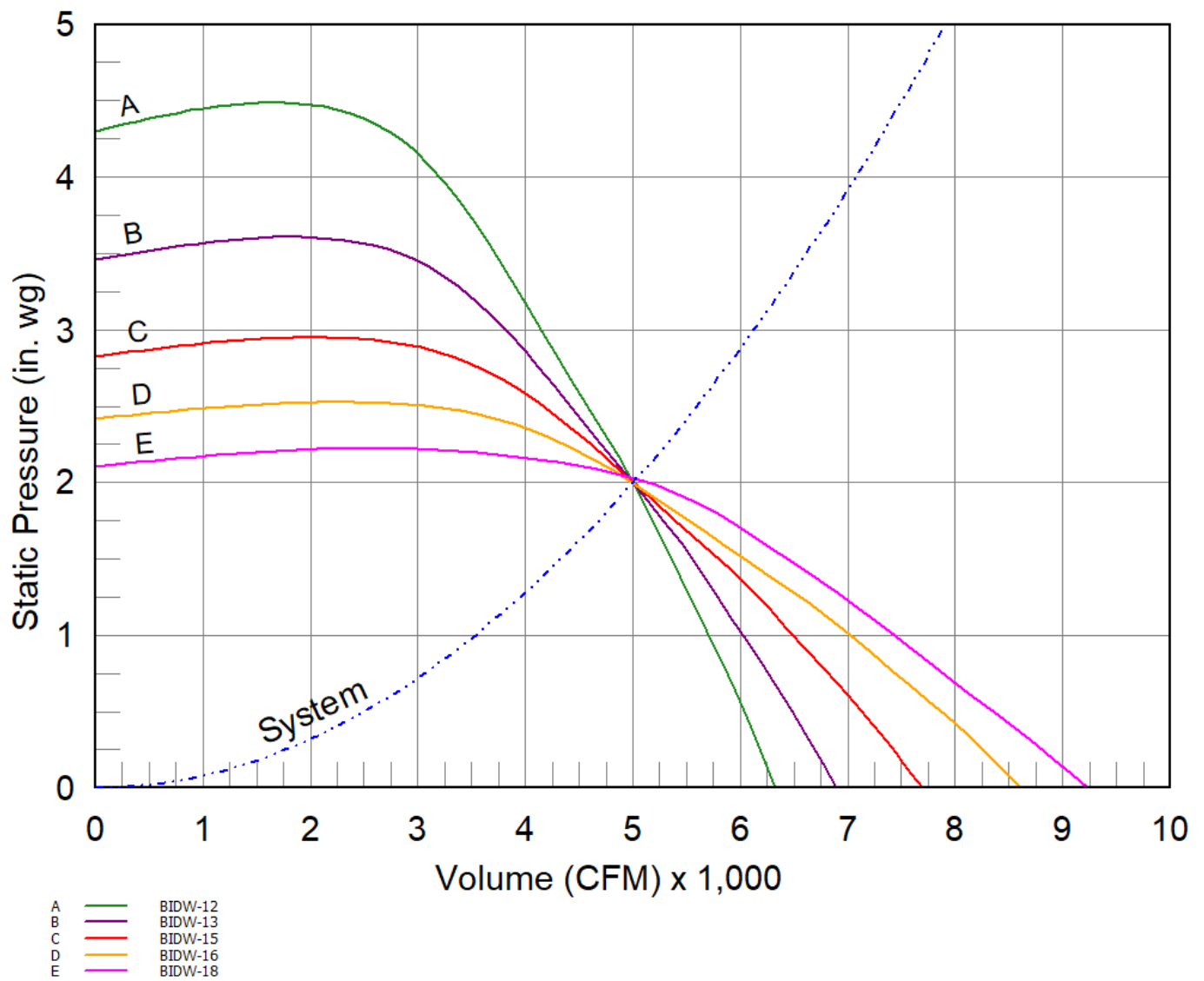
40. What is the typical depth of a thermal zone (from the perimeter wall) in an open area?

- a. 5 feet
- b. 15 feet This zone is influenced by solar radiation, internal loads, day-lighting, and is considered significant for both summer and winter conditions.
- c. 18 feet
- d. 24 feet

Pump curve for Question #19



Fan curves for Question #18





ASHRAE PSYCHROMETRIC CHART NO.1

NORMAL TEMPERATURE

SEA LEVEL

BAROMETRIC PRESSURE: 29.921 in. MERCURY

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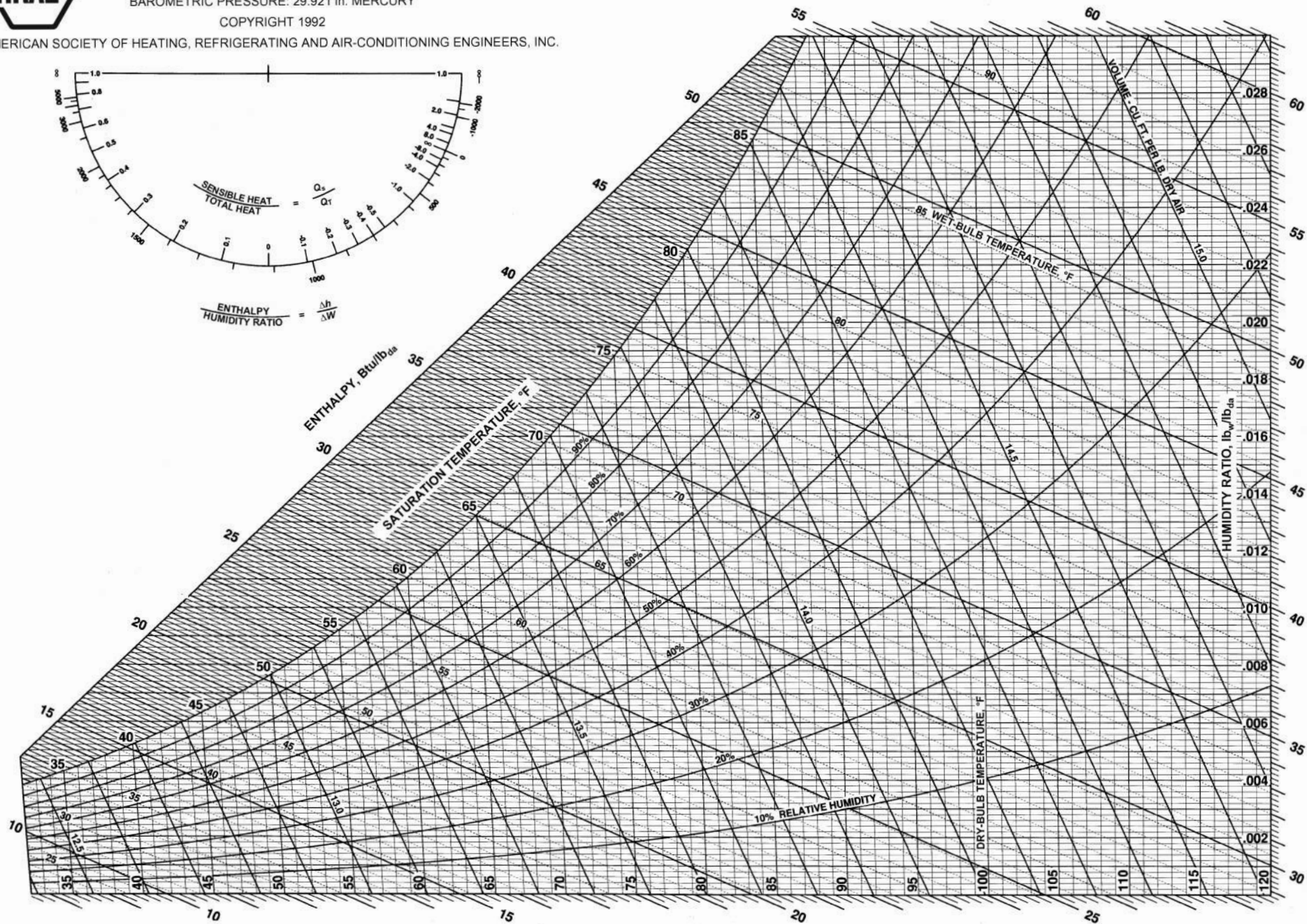


TABLE 1215.2(5)
SCHEDULE 40 METALLIC PIPE [NFPA 54: TABLE 6.2(f)]*



						GAS: NATURAL			
						INLET PRESSURE: 3.0 psi			
						PRESSURE DROP: 2.0 psi			
						SPECIFIC GRAVITY: 0.60			
	PIPE SIZE (inch)								
NOMINAL:	½	¾	1	1¼	1½	2	2½	3	4
ACTUAL ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026
LENGTH (feet)	CAPACITY IN CUBIC FEET OF GAS PER HOUR								
10	2350	4920	9270	19 000	28 500	54 900	87 500	155 000	316 000
20	1620	3380	6370	13 100	19 600	37 700	60 100	106 000	217 000
30	1300	2720	5110	10 500	15 700	30 300	48 300	85 400	174 000
40	1110	2320	4380	8990	13 500	25 900	41 300	73 100	149 000
50	985	2060	3880	7970	11 900	23 000	36 600	64 800	132 000
60	892	1870	3520	7220	10 800	20 800	33 200	58 700	120 000
70	821	1720	3230	6640	9950	19 200	30 500	54 000	110 000
80	764	1600	3010	6180	9260	17 800	28 400	50 200	102 000
90	717	1500	2820	5800	8680	16 700	26 700	47 100	96 100
100	677	1420	2670	5470	8200	15 800	25 200	44 500	90 800
125	600	1250	2360	4850	7270	14 000	22 300	39 500	80 500
150	544	1140	2140	4400	6590	12 700	20 200	35 700	72 900
175	500	1050	1970	4040	6060	11 700	18 600	32 900	67 100
200	465	973	1830	3760	5640	10 900	17 300	30 600	62 400
250	412	862	1620	3330	5000	9620	15 300	27 100	55 300
300	374	781	1470	3020	4530	8720	13 900	24 600	50 100
350	344	719	1350	2780	4170	8020	12 800	22 600	46 100
400	320	669	1260	2590	3870	7460	11 900	21 000	42 900
450	300	627	1180	2430	3640	7000	11 200	19 700	40 200
500	283	593	1120	2290	3430	6610	10 500	18 600	38 000
550	269	563	1060	2180	3260	6280	10 000	17 700	36 100
600	257	537	1010	2080	3110	5990	9550	16 900	34 400
650	246	514	969	1990	2980	5740	9150	16 200	33 000
700	236	494	931	1910	2860	5510	8790	15 500	31 700
750	228	476	897	1840	2760	5310	8470	15 000	30 500
800	220	460	866	1780	2660	5130	8180	14 500	29 500
850	213	445	838	1720	2580	4960	7910	14 000	28 500
900	206	431	812	1670	2500	4810	7670	13 600	27 700
950	200	419	789	1620	2430	4670	7450	13 200	26 900
1000	195	407	767	1580	2360	4550	7240	12 800	26 100
1100	185	387	729	1500	2240	4320	6890	12 200	24 800
1200	177	369	695	1430	2140	4120	6570	11 600	23 700
1300	169	353	666	1370	2050	3940	6290	11 100	22 700
1400	162	340	640	1310	1970	3790	6040	10 700	21 800
1500	156	327	616	1270	1900	3650	5820	10 300	21 000
1600	151	316	595	1220	1830	3530	5620	10 000	20 300
1700	146	306	576	1180	1770	3410	5440	9610	19 600
1800	142	296	558	1150	1720	3310	5270	9320	19 000
1900	138	288	542	1110	1670	3210	5120	9050	18 400
2000	134	280	527	1080	1620	3120	4980	8800	18 000

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

* Table entries are rounded to 3 significant digits.

**TABLE 610.4
FIXTURE UNIT TABLE FOR DETERMINING WATER PIPE AND METER SIZES**

METER AND STREET SERVICE (inches)	BUILDING SUPPLY AND BRANCHES (inches)	MAXIMUM ALLOWABLE LENGTH (feet)														
		40	60	80	100	150	200	250	300	400	500	600	700	800	900	1000
PRESSURE RANGE – 30 to 45 psi ¹																
¾	½ ²	6	5	4	3	2	1	1	1	0	0	0	0	0	0	0
¾	¾	16	16	14	12	9	6	5	5	4	4	3	2	2	2	1
¾	1	29	25	23	21	17	15	13	12	10	8	6	6	6	6	6
1	1	36	31	27	25	20	17	15	13	12	10	8	6	6	6	6
¾	1¼	36	33	31	28	24	23	21	19	17	16	13	12	12	11	11
1	1¼	54	47	42	38	32	28	25	23	19	17	14	12	12	11	11
1½	1¼	78	68	57	48	38	32	28	25	21	18	15	12	12	11	11
1	1½	85	84	79	65	56	48	43	38	32	28	26	22	21	20	20
1½	1½	150	124	105	91	70	57	49	45	36	31	26	23	21	20	20
2	1½	151	129	129	110	80	64	53	46	38	32	27	23	21	20	20
1	2	85	85	85	85	85	85	82	80	66	61	57	52	49	46	43
1½	2	220	205	190	176	155	138	127	120	104	85	70	61	57	54	51
2	2	370	327	292	265	217	185	164	147	124	96	70	61	57	54	51
2	2½	445	418	390	370	330	300	280	265	240	220	198	175	158	143	133
PRESSURE RANGE – 46 to 60 psi ¹																
¾	½ ²	7	7	6	5	4	3	2	2	1	1	1	0	0	0	0
¾	¾	20	20	19	17	14	11	9	8	6	5	4	4	3	3	3
¾	1	39	39	36	33	28	23	21	19	17	14	12	10	9	8	8
1	1	39	39	39	36	30	25	23	20	18	15	12	10	9	8	8
¾	1¼	39	39	39	39	39	39	34	32	27	25	22	19	19	17	16
1	1¼	78	78	76	67	52	44	39	36	30	27	24	20	19	17	16
1½	1¼	78	78	78	78	66	52	44	39	33	29	24	20	19	17	16
1	1½	85	85	85	85	85	85	80	67	55	49	41	37	34	32	30
1½	1½	151	151	151	151	128	105	90	78	62	52	42	38	35	32	30
2	1½	151	151	151	151	150	117	98	84	67	55	42	38	35	32	30
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	83	80
1½	2	370	370	340	318	272	240	220	198	170	150	135	123	110	102	94
2	2	370	370	370	370	368	318	280	250	205	165	142	123	110	102	94
2	2½	654	640	610	580	535	500	470	440	400	365	335	315	285	267	250
PRESSURE RANGE – Over 60 psi ¹																
¾	½ ²	7	7	7	6	5	4	3	3	2	1	1	1	1	1	0
¾	¾	20	20	20	20	17	13	11	10	8	7	6	6	5	4	4
¾	1	39	39	39	39	35	30	27	24	21	17	14	13	12	12	11
1	1	39	39	39	39	38	32	29	26	22	18	14	13	12	12	11
¾	1¼	39	39	39	39	39	39	39	39	34	28	26	25	23	22	21
1	1¼	78	78	78	78	74	62	53	47	39	31	26	25	23	22	21
1½	1¼	78	78	78	78	78	74	65	54	43	34	26	25	23	22	21
1	1½	85	85	85	85	85	85	85	85	81	64	51	48	46	43	40
1½	1½	151	151	151	151	151	151	130	113	88	73	51	51	46	43	40
2	1½	151	151	151	151	151	151	142	122	98	82	64	51	46	43	40
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
1½	2	370	370	370	370	360	335	305	282	244	212	187	172	153	141	129
2	2	370	370	370	370	370	370	370	340	288	245	204	172	153	141	129
2	2½	654	654	654	654	654	650	610	570	510	460	430	404	380	356	329

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm, 1 pound-force per square inch = 6.8947 kPa

Notes:

¹ Available static pressure after head loss.

² Building supply, not less than ¾ of an inch (20 mm) nominal size.