Table 10.... Capacity and Sizing Table—Second Story

For Warm Air and Return Air Stack, Branch, and Registers

Equiv. Length of Fittings and Registers	Horizontal Length Furnace to Register: Ducts[a]	Horizontal Length Furnace to Register: Insulated Attic Ducts	Second Story Room Heat Loss—Btuh						
Col. a	Col. b	Col. c	Col. d	Col. e	Col. f	Col. g	Col. h	Col. i	Col. j
Up to 70 Eq Ft	Up to 7	Up to 5	6,300	10,900	14,000	17,000	21,800	28,000	70,000
	8–12	6–9	5,700	10,000	13,000	15,900	20,000	26,000	65,000
	13–17	10–13	5,200	9,200	12,100	14,900	18,400	24,200	60,500
	18–25	14–18	4,800	8,500	11,400	13,900	17,000	22,400	57,000
	26–35	19–25	4,100	7,300	10,000	12,400	14,600	20,000	50,000
	36–45	26–35	3,500	6,400	8,800	11,100	12,800	17,600	44,000
	46–55	36–45	3,100	5,600	7,800	9,900	11,200	15,600	39,000
	.....	46–55	2,800	5,000	6,800	9,000	10,000	13,600	34,000
71 to 100 Eq Ft	Up to 7	Up to 5	5,000	9,000	11,900	14,800	18,000	23,900	59,500
	8–12	6–9	4,600	8,200	11,000	13,900	16,400	22,000	55,000
	13–17	10–13	4,300	7,600	10,300	13,000	15,200	20,600	51,500
	18–25	14–18	4,000	7,100	9,600	12,200	14,200	19,200	48,000
	26–35	19–25	3,400	6,200	8,400	10,800	12,400	16,800	42,000
	36–45	26–35	3,000	5,400	7,500	9,600	10,800	15,000	37,500
	46–55	36–45	4,700	4,700	6,700	8,500	9,400	13,400	33,500
	.....	46–55	2,300	4,200	6,000	7,500	8,400	12,000	30,000
101 to 130 Eq Ft	Up to 7	Up to 5	4,200	7,700	10,400	13,000	15,400	21,700	52,200
	8–12	6–9	3,900	7,200	9,700	12,100	14,400	19,400	48,400
	13–17	10–13	3,700	6,700	9,000	11,300	13,400	18,000	45,300
	18–25	14–18	3,500	6,200	8,400	10,600	12,400	16,800	42,300
	26–35	19–25	3,000	5,400	7,400	9,400	10,800	14,800	37,000
	36–45	26–35	2,600	4,700	6,500	8,300	9,400	13,000	32,500
	46–55	36–45	2,400	4,100	5,800	7,400	8,200	11,600	29,000
	.....	46–55	2,000	3,600	4,800	6,500	7,200	9,600	24,000
131 to 165 Eq Ft	Up to 7	Up to 5	3,800	6,800	9,100	11,400	13,600	18,200	45,500
	8–12	6–9	3,500	6,300	8,400	10,500	12,600	16,800	42,000
	13–17	10–13	3,200	5,800	7,900	9,800	11,600	15,800	39,600
	18–25	14–18	3,000	5,500	7,400	9,200	11,000	14,800	36,800
	26–35	19–25	2,700	4,800	6,300	8,100	9,600	12,600	32,200
	36–45	26–35	2,300	4,200	5,700	7,200	8,400	11,400	28,200
	46–55	36–45	1,900	3,400	4,500	5,800	6,800	9,000	22,800
	.....	46–55	1,800	3,300	4,300	5,400	6,600	8,600	21,500
166 to 200 Eq Ft	Up to 7	Up to 5	3,500	6,100	8,200	10,300	12,200	16,400	41,000
	8–12	6–9	3,200	5,700	7,600	9,500	11,400	15,200	38,300
	13–17	10–13	2,900	5,300	7,100	8,900	10,600	14,200	35,800
	18–25	14–18	2,700	5,000	6,700	8,300	10,000	13,400	33,400
	26–35	19–25	2,500	4,400	5,700	7,400	8,800	11,400	29,000
	36–45	26–35	2,100	3,900	5,100	6,500	7,800	10,200	25,800
	46–55	36–45	1,900	3,400	4,500	5,800	6,800	9,000	22,800
	.....	46–55	1,500	2,800	3,500	4,700	5,600	7,000	17,500
Combination Number			41	42	43	44	45	46	47
Stacks[b]: No. (in paren.) and Size			(1) 10x3¼	(1) 10x3¼	(1) 12x3¼	(1) 14x3¼	(2) 10x3¼	(2) 12x3¼	—
Rectangular Branch Size Round Branch Size (Diam)			3x8 5	4x8 6	5x8 7	6x8 8	8x8 9	10x8 10	15x8 12
Number of Joist Spaces and Minimum Depth-Return Air			1 at 3	1 at 3	1 at 4	1 at 5	1 at 6 or 2 at 3	1 at 7 or 2 at 4	1 at 9 or 2 at 5
Registers: Low Wall, High Wall or Baseboard:			10x6	10x6	12x6	14x6	(2)10x6 or (1) 24x6	(2)12x6 or (1) 30x6	—
Registers: Floor, Warm Air			8x10	8x10	9x12	9x12 or longer	10x12	12x14	—
Registers: Floor, Return Air			6x10 or 4x14	6x10 or 4x14	6x12 or 6x14	6x14	6x30	6x30	8x30
Trunk Duct Increase, Inches			1	2	3	4	5	7	12

[a] Uninsulated ducts in heated spaces and insulated ducts in unheated spaces.

[b] Note: For return air a 14x3¼ in. stud space may be used instead of 10x3¼ in. stack. Where 12x3¼ in. or 14x3¼ in. stack is required, a 14x3¼ in. stud space may be used only when inside of stud space is smooth and without protruding plaster keys. The number of joist spaces for combination 47 is based on 2x8 joists. One space may be used with 2x10 joists.

The limiting factor for a duct combination is the stack capacity.

Table 11.... Selection of Bonnet Temperature, Register Temperature and Register Delivery (CFM)[a, b]

(For Buildings Having a Heat Loss between 120,000 and 350,000 BTU/Hr.)

Register Delivery Volume in CFM per 1000 BTU per Hr.

Temp. of Bonnet °F	Linear Distance from Bonnet to Register, in Feet																							
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
110	108[a]	107	106	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	90	89	89	88	88	87
22.1	23.1[b]	23.6	24.2	25.4	26.0	26.6	27.3	28.0	28.8	29.6	30.5	31.5	32.3	33.3	34.6	35.9	37.3	38.6	38.6	39.9	39.9	41.3	41.3	42.7
120	118	116	114	112	111	109	108	106	105	103	102	101	100	99	98	97	96	95	94	93	92	91	90	90
18.4	19.0	19.6	20.3	21.1	21.6	22.5	23.1	24.2	24.8	26.0	26.6	27.3	28.0	28.8	29.6	30.5	31.5	32.3	33.3	34.6	35.9	37.3	38.6	38.6
130	128	126	123	121	119	117	115	113	111	110	108	107	105	104	103	102	101	99	98	97	96	95	94	93
15.9	16.4	16.9	17.6	18.1	18.7	19.3	20.0	20.7	21.6	22.1	23.1	23.6	24.8	25.4	26.0	26.6	27.3	28.8	29.6	30.5	31.5	32.3	33.3	34.6
140	137	134	131	129	126	124	122	120	118	116	114	112	110	109	107	106	105	103	102	101	100	99	98	97
14.0	14.6	15.1	15.7	16.2	16.9	17.3	17.9	18.4	19.0	19.6	20.3	21.1	22.1	22.5	23.6	24.2	24.8	26.0	26.6	27.3	28.0	28.8	29.6	30.5
150	147	143	140	137	134	131	129	127	124	122	120	118	116	114	112	110	109	107	106	105	103	102	101	100
12.6	12.9	13.5	14.0	14.6	15.1	15.7	16.2	16.6	17.3	17.9	18.4	19.0	19.6	20.3	21.1	22.1	22.5	23.6	24.2	24.8	26.0	26.6	27.3	28.0
160	156	152	149	145	142	139	136	133	130	128	126	123	121	119	117	115	113	112	110	108	107	106	104	103
11.4	11.8	12.3	12.7	13.2	13.7	14.2	14.8	15.3	15.9	16.4	16.9	17.6	18.1	18.7	19.3	20.0	20.7	21.1	22.1	23.1	23.6	24.2	25.4	26.0
170	166	161	157	153	150	146	143	140	137	134	131	128	126	124	122	120	118	116	114	112	110	109	107	106
10.5	10.8	11.3	11.7	12.2	12.6	13.1	13.5	14.0	14.6	15.1	15.7	16.4	16.9	17.3	17.9	18.4	19.0	19.6	20.3	21.1	22.1	22.5	23.6	24.2
180	175	170	166	161	157	153	150	146	143	140	137	135	131	128	126	124	122	120	118	116	115	113	111	110
9.7	10.0	10.5	10.8	11.3	11.7	12.2	12.6	13.1	13.5	14.0	14.6	14.9	15.7	16.4	16.9	17.3	17.9	18.4	19.0	19.6	20.0	20.7	21.6	22.1
190	184	179	174	169	165	160	156	153	149	145	142	139	136	133	130	128	126	124	121	119	117	115	113	112
9.1	9.4	9.8	10.1	10.6	10.9	11.4	11.8	12.2	12.7	13.2	13.7	14.2	14.7	15.3	15.9	16.4	16.9	17.3	18.1	18.7	19.3	20.0	20.7	21.1
200	193	187	182	176	171	167	163	158	154	151	147	144	140	138	135	132	129	127	125	122	120	118	116	114
8.6	8.9	9.2	9.6	9.9	10.4	10.7	11.1	11.6	12.1	12.4	12.9	13.4	14.0	14.4	14.9	15.5	16.2	16.6	17.2	17.9	18.4	19.0	19.6	20.3

[a] Register temperature, Fahrenheit. (Use upper value in each group.)

[b] Register delivery volume in cubic feet per minute per 1000 Btu. (Use lower value in each group.)

[c] Register delivery volumes in column 1 are for zero length of duct.

B. *Return air branches.*
   a. Select a low value of actual duct loss obtained from step b under item A for the suction loss of return duct system.
   b. Proceed in sizing return air branches by the same method described for the warm air branches.

C. *Trunk ducts for warm air and return air sides of system.*
   a. Add air volumes of branches to be handled by each trunk duct.
   b. The friction loss per 100 ft of trunk duct is determined by taking the smaller of the two values for friction loss for the two ducts meeting at the junction.
   c. Determine trunk duct size by using an air friction chart, volume (cfm), and pressure drop per 100 ft of trunk duct.

8. Selection of Blower.
   A. Determine total cfm air delivery (the sum of all branch cfm values).
   B. Determine static pressure requirement.
      a. For furnace-blower combination units it is the sum of bonnet pressure and suction pressure.
      b. For blowers separately selected from the furnace it is the sum of bonnet pressure, suction pressure, filter loss, casing loss, losses through air washers, coils, and other devices.

9. Selection of Furnace.
   A. Determine register delivery (the sum of room Btu losses).
   B. Determine bonnet capacity.
      Bonnet capacity = (total cfm) × (temperature rise) × 1.089.
   C. Determine allowance for pick-up load. For buildings which are heated intermittently, such as churches and auditoriums, it is customary to add from 10 to 25 percent extra furnace capacity for warming of the structure.

AUTOMATIC CONTROLS

Air stratification, high bonnet temperatures, excessive flue gas temperatures, and heat overrun or lag in a properly designed system, can be largely eliminated through proper care in the planning and installation of the control system.[39] Best results are obtained when the fan is operated as continuously as possible, coupled with frequent, short cycles of burner operation. Controls usually employed are;

1. A *room thermostat* located in the occupied space at a point where there is good air circulation and where the temperature is representative of the area being controlled. It is the