TABLE 8. DETERMINATION OF FREE AREA AND TOTAL PRESSURE LOSS OF REGISTER FOR NO DEFLECTION OF AIR[a,b,c,d,e]

Register Free Air in Square Inches (Upper value in each group)
Pressure Loss in Inches of Water Column (Lower value in each group)

CFM	Distance from Register to Opposite Wall									CFM	Distance from Register to Opposite Wall						
	19–21	22–24	25–27	28–30	31–34	35–39	40–49	50–59	60–69		35–39	40–49	50–59	60–69	70–79	80–89	
				A	B								A′	B′			
190[f]–209	62 0.02	47 0.03	37 0.04	30 0.06	24 0.09	18 0.15				660–699	210 0.02	143 0.03	95 0.07	69 0.12	49 0.22		
210–229	76 0.02	58 0.02	45 0.04	36 0.05	29 0.08	22 0.12				700–739	236 0.02	160 0.03	107 0.06	77 0.11	54 0.21		
230–249		69 0.02	53 0.03	43 0.04	34 0.07	26 0.11				740–779	262 0.02	179 0.03	119 0.06	86 0.10	61 0.18		
250–269		81 0.02	63 0.03	50 0.04	40 0.06	31 0.09	21 0.18			780–819	291 0.02	198 0.03	132 0.05	95 0.09	67 0.17		
270–299		93 0.02	73 0.02	59 0.03	47 0.05	36 0.08	24 0.16			820–859	320 0.02	218 0.03	145 0.05	105 0.08	74 0.15		
300–339			95 0.02	77 0.03	61 0.04	46 0.06	32 0.12			860–899	352 0.02	240 0.02	160 0.04	115 0.08	81 0.14		
340–379			120 0.02	97 0.02	77 0.03	59 0.05	40 0.10			900–939	385 0.01	262 0.02	175 0.04	126 0.07	89 0.13		
380–419				119 0.02	95 0.03	73 0.04	50 0.08			940–979	419 0.01	285 0.02	190 0.04	137 0.07	97 0.12		
420–459				149 0.02	114 0.03	88 0.04	60 0.07			980–1019	455 0.01	309 0.02	206 0.04	148 0.06	105 0.11		
460–499				171 0.02	136 0.02	105 0.03	71 0.06			1020–1059	493 0.01	335 0.02	223 0.03	161 0.06	113 0.11		
500–539					160 0.02	123 0.03	84 0.05			1060–1099	530 0.01	361 0.02	241 0.03	173 0.06	123 0.10		
540–579					186 0.02	143 0.02	97 0.05	65 0.09	47 0.17	1100–1139	571 0.01	388 0.02	258 0.03	186 0.05	132 0.09	93 0.17	
580–619					213 0.02	164 0.03	111 0.04	74 0.08	54 0.15	1140–1179		416 0.02	277 0.03	199 0.05	141 0.08	100 0.16	
620–659						180 0.02	127 0.04	85 0.07	61 0.14	1180–1219		446 0.02	297 0.03	214 0.04	151 0.08	107 0.15	
								A	B	1220–1259		476 0.02	317 0.03	228 0.04	161 0.07	116 0.14	
										1260–1299		507 0.01	338 0.02	243 0.04	172 0.07	122 0.13	
										1300–1339		539 0.01	359 0.02	258 0.04	183 0.07	130 0.12	
										1340–1379			382 0.02	274 0.04	195 0.07	138 0.12	
										1380–1419			403 0.02	290 0.03	206 0.06	146 0.12	
										1420–1459				308 0.03	218 0.06	155 0.10	
										1460–1500				324 0.03	230 0.06	163 0.10	
														A′	B′		

[a] If register selected based on distance from register to opposite wall is unsatisfactory on account of size or pressure loss, it is permissible to shift one or more spaces left or right in the tables to obtain a more suitable register. If requirements fall in blank space, select two registers in place of one and divide CFM capacity between the two registers.

[b] Total pressure (static plus velocity) loss is based on FLAT FACE ADJUSTABLE BAR TYPE and does NOT include stackhead.

[c] Values on the right of line A and A′ should not be used in applications such as churches, auditoriums, and concert halls.

[d] Values on right of line B and B′ should not be used in applications such as residential work, motion picture theaters, court rooms and schools.

[e] For floor and baseboard registers where a velocity of approximately 300 FPM is used, the free area = $\frac{\text{CFM} \times 144}{300}$ or approximately, $\frac{\text{CFM.}}{2}$ Assume a pressure loss of .01.

[f] For any volume under 190 CFM use Table 7.

TABLE 9. SUGGESTED BONNET PRESSURE

Inches of water

Total CFM Through Any One Duct	Suggested Bonnet Pressure In. Water	Total CFM Through Any One Duct	Suggested Bonnet Pressure In. Water
800–1000	0.10	3500 to 5000	0.15
1000–1200	0.10	5000 to 7500	0.25
1200–1800	0.10	7500 to 10,000	0.375
1800–2400	0.13	10,000 to 12,000	0.500
2400 to 3500	0.14	12,000 to 14,000	0.750

WARM AIR CEILING PANEL SYSTEMS

Warm air ceiling panel heating systems utilize a false ceiling suspended 3¼ in. from the ceiling joists which have previously been covered on the bottom with sheets of plasterboard. Special hangers are used to suspend the false ceiling or heating panel from the joists. Steel supporting rods are installed through these hangers and metal lath is attached to the rods. The lath is then plastered to a thickness of ¾ in., making a completely sealed air space above the ceiling. Warm air is delivered to this sealed space through a standard warm air duct, installed in the usual manner. The air is then circulated over the entire ceiling being guided by sheet-metal baffles. After the air has passed over the ceiling, it is returned to the furnace through a return air duct for reheating. The system is closed, and no air is introduced into the heated space from the panel. (See also Chapter 24, Panel Heating.)

Because a warm air ceiling panel system involves a different type of ceiling construction, its installation is practically limited to new construction. Only automatically-fired and thermostatically-controlled furnace-blower units may be used with this system. The standard automatic heating controls consisting of a room thermostat, temperature limit control, blower control (fan switch), and primary control are all that are required. While warm air ceiling panel heating has particular advantages in one-story utility room houses, it can be just as effectively installed in one- and two-story houses with basements.

Complete design and installation procedure is given[8] in Manual 7-A of the *National Warm Air Heating and Air Conditioning Association.*

WARM AIR PERIMETER SYSTEMS

Perimeter heating is a method of heating residential and commercial buildings, with or without basements, in which warm air is (a) conveyed under the floor to warm the floor surface and (b) introduced into the rooms, preferably under the windows, at or near the floor, and delivered upward in diffused pattern blanketing the outside walls. The return air is collected through one or more grilles located high on the interior sidewalls or in the ceiling. Suggested procedures[9] for the design and installation of warm air perimeter heating systems are given in Manuals 4 and 10 and in the accompanying work sheets[10] of the *National Warm Air Heating and Air Conditioning Association.*

The furnace may be either the down-flow or the conventional up-flow type. For basement-less houses the down-flow type is preferred since it requires a minimum amount of floor area and ductwork, and eliminates