Lecture -6-

The general procedure for use of Table 11-2 is as follows:
1. Determine the air-flow requirements and the room size.
2. Select the number, location, and type of diffuser to be used.
3. Determine the room characteristic length.
4. Select the recommended throw-to-length ratio from Table 11-2.
5. Calculate the throw.
6. Select the appropriate diffuser from catalog data such as those in Tables 11-3, 11-4, 11-5, or 11-6.
7. Make sure any other specifications are met (noise, total pressure, etc.).

Ex: The room shown in Figure (1) is part of a single-story office building located in the central United States. A perimeter air-distribution system is used. The air quantity required for the room is **250 cfm**. Select diffusers for the room based on cooling.

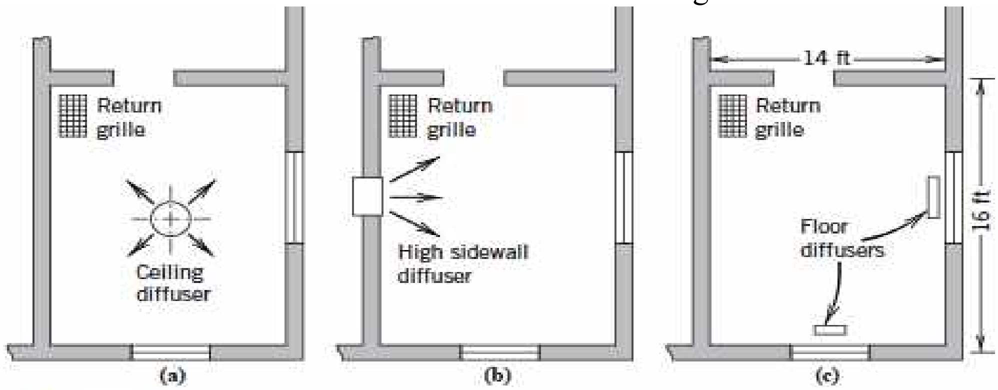

Figure 1 **Plan view of a room showing location of different types of outlets.**

Solution:.
Diffusers of the type shown in **Table 11-3** should be used for this application.

A diffuser should be placed under each window in the floor near the wall (Figure *c*) because the room has two exposed walls. This will promote mixing with the warm air entering through the window. The total air quantity is **divided equally** between the two diffusers (**250/2=<u>125 cfm</u>**). If we assume that the room has an 8 ft ceiling and a room cooling load of 40 Btu/(hr-ft2), **the room characteristic length is 8 ft (16/2).**

Table 11-2 gives a **throw-to-length ratio of 1.3** for a straight vane diffuser. Then

$$\frac{x50}{L} = 1.3 \rightarrow \frac{x50}{8} = 1.3 \rightarrow \underline{x50 = 10.4\text{ ft}}\ \text{(throw=blow)}$$

From **Table 11-3, <u>a 4 × 12 in.</u>** diffuser with **<u>125 cfm</u>** has a throw (blow), corrected for length, between

$$x50 = 13\left(\frac{3}{4}\right) = 9.7\text{ ft} \quad \text{and} \quad x50 = 17\left(\frac{3}{4}\right) = 12.7\text{ ft}$$

because 125 cfm lies between 111 cfm and 139 cfm.
The NC is quite acceptable and is between **<u>12 and 18</u>**, uncorrected for length. The total pressure required by the diffuser is between 0.036 and 0.057 in. wg and is about

$$\Delta P = (125/111)^2 \times (0.036) = \underline{\mathbf{0.046\ in.\ wg}}$$

An acceptable solution is listed as follows:

Size, in.	Capacity, cfm	Throw, ft	NC	ΔP_0, in. wg
4 × 12	125	10.5	<15	0.046

The loss in total pressure for the diffuser is an important consideration. The value shown above would be acceptable for a light commercial system.

Table 11-1 Characteristic Room Length for Several Diffusers

Diffuser Type	Characteristic Length L
High sidewall grille	Distance to wall perpendicular to jet
Circular ceiling diffuser	Distance to closet wall or intersecting air jet
Sill grille	Length of room in direction of jet flow
Ceiling slot diffuser	Distance to wall or midplane between outlets
Light troffer diffusers	Distance to midplane between outlets plus distance from ceiling to top of occupied zone
Perforated, louvered ceiling diffusers	Distance to wall or midplane between outlets

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Table 11-2 Air Diffusion Performance Index (ADPI) Selection Guide

Terminal Device	Room Load, Btu/hr-ft^2	x_{50}/L^a for Maximum ADPI	Maximum ADPI	For ADPI Greater Than	Range of x_{50}/L^a
High sidewall grilles	80 (252)	1.8	68	—	—
	60 (189)	1.8	72	70	1.5–2.2
	40 (126)	1.6	78	70	1.2–2.3
	20 (63)	1.5	85	80	1.0–1.9
Circular ceiling diffusers	80 (252)	0.8	76	70	0.7–1.3
	60 (189)	0.8	83	80	0.7–1.2
	40 (126)	0.8	88	80	0.5–1.5
	20 (63)	0.8	93	90	0.7–1.3
Sill grille, Straight vanes	80 (252)	1.7	61	60	1.5–1.7
	60 (189)	1.7	72	70	1.4–1.7
	40 (126)	1.3	86	80	1.2–1.8
	20 (63)	0.9	95	90	0.8–1.3
Sill grille, Spread vanes	80 (252)	0.7	94	90	0.6–1.5
	60 (189)	0.7	94	80	0.6–1.7
	40 (126)	0.7	94	—	—
	20 (63)	0.7	94	—	—
Ceiling slot diffusers (for $T_{100}/L)^a$	80 (252)	0.3	85	80	0.3–0.7
	60 (189)	0.3	88	80	0.3–0.8
	40 (126)	0.3	91	80	0.3–1.1
	20 (63)	0.3	92	80	0.3–1.5
Light troffer diffusers	60 (189)	2.5	86	80	<3.8
	40 (126)	1.0	92	90	<3.0
	20 (63)	1.0	95	90	<4.5
Perforated and louvered ceiling diffusers	11–51 (35–160)	2.0	96	90	1.4–2.7
				80	1.0–3.4

[a]For SI units, $x_{0.25}/L$ and $T_{0.5}/L$

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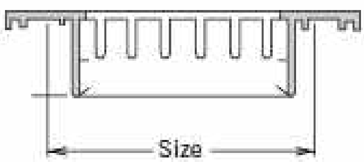
Table 11-3 Performance Data for a Typical Linear Diffuser

Size, in.	Area, ft²/ft	Total Pressure, in. wg	Flow, cfm/ft	NC[b]	Throw,[a] ft Min.	Mid.	Max.
2	0.055	0.009	22	—	1	1	1
		0.020	33	—	4	4	4
		0.036	44	12	7	7	7
		0.057	55	18	9	9	10
		0.080	66	23	11	11	12
		0.109	77	27	13	14	16
		0.143	88	31	14	16	18
		0.182	99	34	15	17	20
		0.225	110	37	17	19	21
4	0.139	0.009	56	—	3	3	3
		0.020	83	—	9	9	9
		0.036	111	12	13	13	13
		0.057	139	18	16	16	17
		0.080	167	23	20	20	21
		0.109	195	27	22	23	24
		0.143	222	31	24	25	26
		0.182	250	34	27	27	27
		0.225	278	37	30	30	30
6	0.221	0.009	88	—	5	5	5
		0.020	133	—	10	10	10
		0.036	177	13	15	15	15
		0.057	221	19	18	18	18
		0.080	265	24	23	23	23
		0.109	310	28	25	25	25
		0.143	354	32	28	28	28
		0.182	398	35	31	31	31
		0.225	442	38	32	32	32

Active Length, ft	Multiplier Factor for Throw Value at Terminal Velocity, ft/min 150	100	50
1	0.5	0.6	0.7
10 or continuous	1.6	1.4	1.2



Active Length, ft	NC Correction	Active Length, ft	NC Correction
1	−10	10	0
2	−7	15	+2
4	−4	20	+3
6	−2	25	+4
8	−1	30	+5

[a]Minimum throw values refer to a terminal velocity of 150 ft/min, middle to 100 ft/min, and maximum to 50 ft/min, for a 4 ft active section with a cooling temperature differential of 20 F. The multiplier factors listed at the bottom are applicable for other lengths.
[b]Based on a room absorption of 80 dB referred to 10^{-12} W, and a 10 ft active section.
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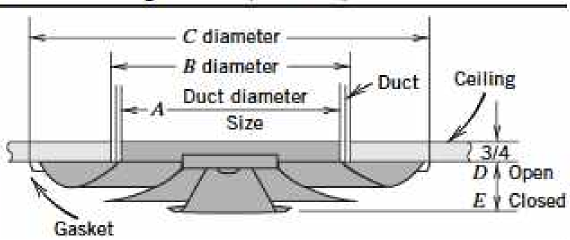
Table 11-4 Performance Data for a Typical Round Ceiling Diffuser

Size, in.	Neck Velocity, ft/min	Velocity Pressure, in. wg	Total Pressure, in. wg	Flow Rate, cfm	Radius of Diffusion,[a] ft			NC[b]
					Min.	Mid.	Max.	
6	400	0.010	0.026	80	2	2	4	—
	500	0.016	0.041	100	2	3	5	—
	600	0.023	0.059	120	2	4	6	14
	700	0.031	0.079	140	3	4	7	19
	800	0.040	0.102	160	3	5	8	23
	900	0.051	0.130	180	4	5	9	26
	1000	0.063	0.161	200	4	6	10	30
	1200	0.090	0.230	235	5	7	11	35
8	400	0.010	0.033	140	2	4	6	—
	500	0.016	0.052	175	3	4	7	15
	600	0.023	0.075	210	4	5	9	21
	700	0.031	0.101	245	4	6	10	26
	800	0.040	0.130	280	5	7	11	31
	900	0.051	0.166	315	5	8	13	34
	1000	0.063	0.205	350	6	9	14	37
	1200	0.090	0.292	420	7	11	17	44
10	400	0.010	0.027	220	3	4	7	—
	500	0.016	0.043	270	3	5	8	11
	600	0.023	0.062	330	4	6	10	17
	700	0.031	0.084	380	5	7	11	21
	800	0.040	0.108	435	5	8	13	26
	900	0.051	0.138	490	6	9	15	30
	1000	0.063	0.170	545	7	10	16	33
	1200	0.090	0.243	655	8	12	20	39
12	400	0.010	0.026	315	3	5	8	—
	500	0.016	0.042	390	4	6	10	11
	600	0.023	0.060	470	5	7	12	17
	700	0.031	0.081	550	6	8	13	22
	800	0.040	0.105	630	6	10	15	26
	900	0.051	0.134	705	7	11	17	30
	1000	0.063	0.166	785	8	12	19	33
	1200	0.090	0.236	940	10	14	23	39
18	400	0.010	0.030	710	5	7	12	—
	500	0.016	0.048	885	6	9	15	15
	600	0.023	0.069	1060	7	11	18	21
	700	0.031	0.093	1240	9	13	21	26
	800	0.040	0.120	1420	10	15	24	30
	900	0.051	0.153	1590	11	17	27	34
	1000	0.063	0.189	1770	12	19	30	37
	1200	0.090	0.270	2120	15	22	36	43

Table 11-4 Performance Data for a Typical Round Ceiling Diffuser *(continued)*

Dimensions				
Size *A*	*B*	*C*	*D*	*E*
6	$6\frac{1}{2}$	$11\frac{1}{8}$	$1\frac{3}{4}$	$1\frac{1}{8}$
8	$8\frac{1}{2}$	$14\frac{3}{4}$	$2\frac{1}{8}$	$1\frac{1}{2}$
10	$10\frac{1}{2}$	$18\frac{1}{4}$	$2\frac{7}{8}$	$2\frac{1}{8}$
12	$12\frac{1}{2}$	22	$3\frac{1}{8}$	$2\frac{3}{8}$
24	$24\frac{1}{2}$	$43\frac{1}{4}$	$7\frac{3}{4}$	$6\frac{5}{8}$



[a]Minimum radii of diffusion are to a terminal velocity of 150 ft/min, middle to 100 ft/min, and maximum to 50 ft/min.

[b]The NC values are based on a room absorption of 18 dB referred to 10^{-13} W (8 dB referred to 10^{-12} W).

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Table 11-5 Performance Data for an Adjustable-Type, High Sidewall Diffuser

Sizes, in.	A_c, ft²	Flow, Rate, cfm	Veloc., ft/min	Veloc. Press., in. wg	Total Pressure, in. wg 0°	22½°	45°	NC	Defl., deg	Throw, ft Min.	Mid.	Max.
8 × 4	0.18	70	400	0.010	0.017	0.019	0.029	—	0	6	8	15
7 × 5,									22½	5	6	12
6 × 6									45	3	4	8
10 × 4,	0.22	90						—	0	7	10	17
8 × 5,									22½	6	8	14
7 × 6									45	3	5	9
12 × 4,	0.26	105						—	0	7	11	19
10 × 5,									22½	6	9	15
8 × 6									45	4	5	9
16 × 4,	0.34	135						—	0	8	12	21
12 × 5,									22½	6	10	17
10 × 6									45	4	6	11
18 × 4,	0.39	155						—	0	9	13	23
14 × 5,									22½	7	10	18
12 × 6,									45	4	6	11
8 × 4,	0.18	90	500	0.016	0.028	0.031	0.047	—	0	7	11	17
7 × 5,									22½	6	9	14
6 × 6									45	4	5	9
10 × 4,	0.22	110						—	0	8	12	19
8 × 5,									22½	6	10	15
7 × 6									45	4	6	10
12 × 4,	0.26	130						—	0	9	13	21
10 × 5,									22½	7	10	17
8 × 6									45	4	7	10
16 × 4,	0.34	170						—	0	10	15	24
12 × 5,									22½	8	12	19
10 × 6									45	5	8	11
18 × 4,	0.39	195						—	0	11	16	25
14 × 5,									22½	9	13	20
12 × 6,									45	5	8	13

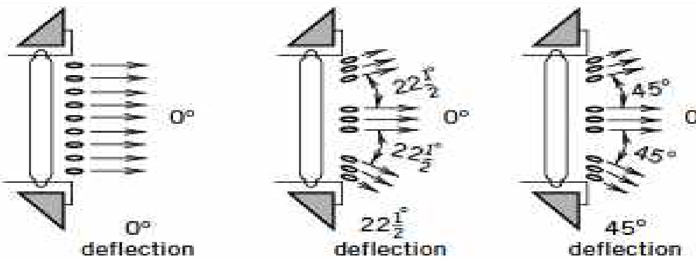
continues

Table 11-5 Performance Data for an Adjustable-Type, High Sidewall Diffuser *(continued)*

Sizes, in.	A_c, ft²	Flow, Rate, cfm	Veloc., ft/min	Veloc. Press., in. wg	Total Pressure, in. wg 0°	22½°	45°	NC	Defl., deg	Throw, ft Min.	Mid.	Max.
8 × 4,	0.18	110	600	0.022	0.038	0.043	0.064	10	0	9	13	19
7 × 5,									22½	7	10	15
6 × 6									45	4	7	10
10 × 4,	0.22	130						10	0	9	15	21
8 × 5,									22½	7	12	17
7 × 6									45	5	7	10
12 × 4,	0.26	155						11	0	10	16	23
10 × 5,									22½	8	13	18
8 × 6									45	5	8	11
16 × 4,	0.34	205						12	0	12	19	26
12 × 5,									22½	10	15	21
10 × 6									45	6	9	13
18 × 4,	0.39	235						13	0	13	19	28
14 × 5,									22½	10	15	22
12 × 6,									45	7	10	14
8 × 4,	0.18	125	700	0.030	0.052	0.058	0.088	15	0	10	15	20
7 × 5,									22½	8	12	16
6 × 6									45	5	7	10
10 × 4,	0.22	155						15	0	11	16	23
8 × 5,									22½	9	13	18
7 × 6									45	6	8	11
12 × 4,	0.26	180						16	0	12	17	24
10 × 5,									22½	10	14	19
8 × 6									45	6	9	12
16 × 4,	0.34	240						17	0	14	20	28
12 × 5,									22½	11	16	22
10 × 6									45	7	10	14
18 × 4,	0.39	275						18	0	15	22	30
14 × 5,									22½	12	18	24
12 × 6,									45	8	11	15
8 × 4,	0.18	145	800	0.040	0.069	0.078	0.117	19	0	11	16	22
7 × 5,									22½	9	13	18
6 × 6									45	6	8	11
10 × 4,	0.22	175						19	0	13	17	24
8 × 5,									22½	10	14	19
7 × 6									45	6	9	12
12 × 4,	0.26	210						20	0	14	19	26
10 × 5,									22½	11	15	21
8 × 6									45	7	9	13
16 × 4.	0.34	270						21	0	16	22	30

Table 11-5 Performance Data for an Adjustable-Type, High Sidewall Diffuser *(continued)*

Sizes, in.	A_S, ft²	Flow, Rate, cfm	Veloc., ft/min	Veloc. Press., in. wg	Total Pressure, in. wg 0°	22½°	45°	NC	Defl., deg	Throw, ft Min.	Mid.	Max.
10 × 4,	0.22	220						25	0	16	19	27
8 × 5,									22½	13	15	22
7 × 6									45	8	10	13
12 × 4,	0.26	260						26	0	17	21	19
10 × 5,									22½	14	17	23
8 × 6									45	8	11	15
16 × 4,	0.34	340						27	0	20	24	33
12 × 5,									22½	16	19	26
10 × 6									45	10	12	17
18 × 4,	0.39	390						28	0	21	26	36
14 × 5,									22½	17	21	29
12 × 6,									45	11	13	18



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Example 2: Suppose the room of Figure 1 is located in the southern latitudes where overhead systems are recommended. Select a round ceiling diffuser system and a high sidewall system. Also select a return grille.

Given: 250 cfm air quantity Required:
Select a round ceiling diffuser, select high sidewall grille, and select a return grille.

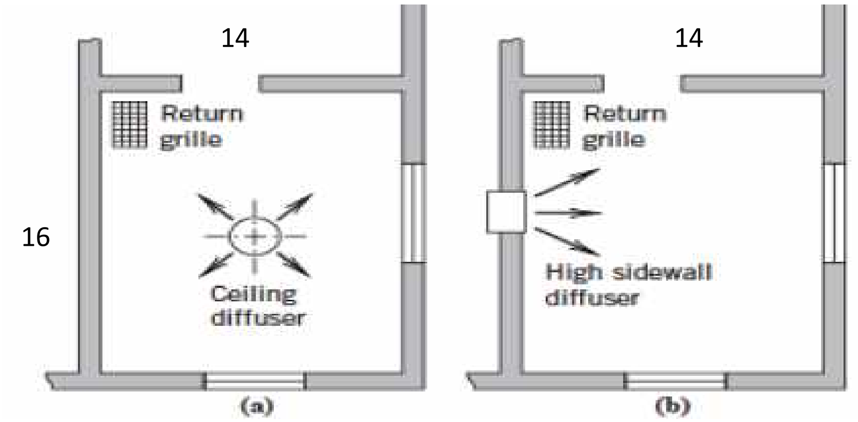


Figure 1

Solution: The data of Table 11.1 with information from Table 11.2 and 11.4 will be used to select a **ceiling diffuser**. The characteristic length is 7 or 8 ft and the throw-to-length ratio is 0.8; then

$$x_{50}/L = 0.8 \quad \rightarrow \quad x_{50}=0.8\times(7)=5.6 \text{ ft}$$

Using correction factor: $x_{50}=5.6/0.75=7.5$

The best choice would be

Size, in	Throw, ft	NC	ΔP_0, in. wg
10	7 ½	10	0.035

The throw is larger than desired, but the throw-to-length ratio is within the range to give a minimum *ADPI* of 76 percent. **Figure 1a** shows this application.

A high sidewall diffuser may be selected from Table 11.2. In this case the throw-to-length ratio should be about 1.8 and the characteristic length is 14 ft; then

$$x_{50}/L = 1.8 \quad \rightarrow \quad x_{50}=1.8\times(14)=25.2 \text{ ft}$$

At 240 cfm, pressure drop at 22 ½ degree spread would be 0.058:
At 250 cfm, pressure drop at 22 ½ degree spread would be acceptable

$$\Delta P = \left(\frac{250}{240}\right)^2 \times 0.058 = 0.063\ in.wg$$

The best choice would be

Size, in	Throw, ft	NC	ΔP_0, in. wg
16 x4 12 x 5 10 x 6	**25**	18	0.063

RETURN GRILLES

Velocities thru return grilles depend on (1) the static pressure loss allowed and (2) the effect on occupants or materials in the room. In determining the pressure loss, computations should be based on the free velocity thru the grille, not on the face velocity, since the orifice coefficient may approach 0.7. In general the following velocities may be used (see table 1-7):

Table 1-7 Recommended return velocities for different applications.

GRILLE LOCATION	FPM OVER GROSS AREA
Commercial	
Above occupied zone	800 and above
Within occupied zone not near seats	600-800
Within occupied zone near seats	400-600
Door or wall louvers	500-1000
Undercutting of doors	600*
Industrial	800 and above
Residential	400

*Thru undercut area

Table 11.6 Performance Data for One Type of Return Grille

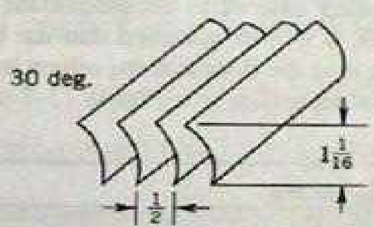
A_c, ft²	Sizes, in.		200	300	400	500	600	700	800
		Core Velocity, fpm	200	300	400	500	600	700	800
		Velocity Pressure, in. wg	0.002	0.006	0.010	0.016	0.023	0.031	0.040
		Static Pressure, in. wg	−0.011	−0.033	−0.055	−0.088	−0.126	−0.170	−0.22
0.34	16 × 4 10 × 6	cfm NC[a]	70	100	135 13	170 20	205 25	240 30	270 33
0.39	18 × 4 12 × 6	cfm NC	80	115	155 14	195 21	235 26	275 31	310 34
0.46	20 × 4 14 × 6 10 × 8	cfm NC	90	140	185 15	230 22	275 27	320 32	370 35
0.52	24 × 4 16 × 6	cfm NC	105	155	210 16	260 23	310 28	365 33	415 36
0.60	28 × 4 18 × 6 12 × 8	cfm NC	120	180	240 17	300 24	360 29	420 34	480 37
0.69	30 × 4 20 × 6 14 × 8 12 × 10	cfm NC	140	205	275 17	345 24	415 29	485 34	550 37
0.81	36 × 4 22 × 6 16 × 8 14 × 10	cfm NC	160	245 10	325 18	405 25	485 30	565 35	650 38
0.90	40 × 4 26 × 6 18 × 8 16 × 10 12 × 12	cfm NC	180	270 11	360 19	450 26	540 31	630 36	720 39
1.07	48 × 4 30 × 6 18 × 10 14 × 12	cfm NC	215	320 12	430 20	535 27	640 32	750 37	855 40
1.18	34 × 6 24 × 8 20 × 10 16 × 12	cfm NC	235	355 13	470 21	590 28	710 33	825 38	945 41
1.34	60 × 4 36 × 6 18 × 12 16 × 14	cfm NC	270	400 13	535 21	670 28	805 33	940 38	1070 41
1.60	30 × 8 24 × 10 22 × 12 18 × 14	cfm NC	320	480 14	640 22	800 29	960 34	1120 39	1280 42

continues

Table 11.6 Performance Data for One Type of Return Grille *(continued)*

A_c, ft²	Sizes, in.	Core Velocity, fpm	200	300	400	500	600	700	800
		Velocity Pressure, in. wg	0.002	0.006	0.010	0.016	0.023	0.031	0.040
		Static Pressure, in. wg	−0.011	−0.033	−0.055	−0.088	−0.126	−0.170	−0.220
1.80	48 × 6, 36 × 12, 30 × 10, 24 × 12	cfm	360	540	720	900	1080	1260	1440
		NC		15	23	30	35	40	43
2.08	60 × 6, 40 × 8, 36 × 10, 30 × 12, 24 × 14, 20 × 16	cfm	415	625	830	1040	1250	1460	1660
		NC		16	24	31	36	41	44
2.45	48 × 8, 26 × 14, 24 × 16	cfm	490	735	980	1220	1470	1720	1960
		NC		17	25	32	37	42	45
2.78	36 × 12, 30 × 14, 26 × 16, 24 × 18	cfm	555	835	1110	1390	1670	1950	2220
		NC		18	26	33	38	43	46
3.11	40 × 12, 36 × 14, 30 × 16, 24 × 20	cfm	620	935	1240	1560	1870	2180	2490
		NC		19	27	34	39	44	47
3.61	48 × 12, 36 × 16, 24 × 24	cfm	720	1080	1440	1800	2170	2530	2890
		NC		20	28	35	40	45	48

[a]Based on a room absorption of 8 dB, with respect to 10^{-12} watts, and one return.



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Example: Small store dimensions: 32 × 23 × 16 ft
Ceiling – flat
Load – equally distributed
Air quantity – 2000 cfm
Temp difference – 25 F
Find: Number of outlets, Size of outlets,

Solution:
-The minimum blow is 75% of the room width for the given condition of equally distributed heat load. Therefore, the minimum blow necessary is: 23 × 0.75= 17.3 ft

- The maximum blow is the width of the room =32 ft
- The blow of 17.5 to 34 ft.
- No. of outlets= $\frac{2000}{500} = 4$
- nominal size 24 in. x 6 in

k= $\frac{2000}{32\times16} = 3.9$

TABLE 1-8 – WALL OUTLET RATINGS, FOR COOLING ONLY

For Flat Ceilings

OUTLET VELOCITY		250 FPM					375 FPM					500 FPM					750 FPM				
STATIC PRESSURE STANDARD OUTLET		Str 8 = .01, 22½° = .01 45° = .01					Str 8 = .013, 22½° = .015 45° = .019					Str 8 = .024, 22½° = .028 45° = .035					Str 8 = .051, 22½° = .061 45° = .08				
STATIC PRESSURE WITH METERING PLATE		Str 8 = .01, 22½° = .015 45° = .028					Str 8 = .024, 22½° = .043 45° = .065					Str 8 = .061, 22½° = .082 45° = .118					Str 8 = .175, 22½° = .19 45° = .27				
Nom. Size of Outlet (and Free Area)	Vane Setting	Air Quantity (cfm)	Blow (ft)	Temp Diff (F) 15 Min Clg Ht	20	25	Air Quantity (cfm)	Blow (ft)	Temp Diff (F) 15 Min Clg Ht	20	25	Air Quantity (cfm)	Blow (ft)	Temp Diff (F) 15 Min Clg Ht	20	25	Air Quantity (cfm)	Blow (ft)	Temp Diff (F) 15 Min Clg Ht	20	25
8 x 4 (16.9)	Straight	30	3.5	6.5	7.0	7.0	44	7.0	7.5	7.5	8.0	59	10.0	7.5	8.0	8.5	89	17.0	8.5	9.0	9.0
	22½°		2.5	6.5	6.5	6.5		5.1	6.5	7.0	7.0		7.5	7.0	7.5	7.5		13.0	7.5	7.5	8.0
	45°		1.8	6.0	6.0	6.5		3.5	6.5	6.5	7.0		5.0	6.5	6.5	7.0		9.0	6.5	7.0	7.0
10 x 4 (21.7)	Straight	37	3.5	6.5	7.0	7.5	57	7.4	7.5	7.5	8.0	75	10.5	7.5	8.0	8.5	112	18.0	8.5	9.0	9.0
	22½°		2.5	6.5	6.5	7.0		5.5	6.5	7.0	7.0		8.0	7.0	7.5	7.5		13.0	7.5	8.0	8.0
	45°		1.8	6.0	6.0	6.5		3.7	6.5	6.5	7.0		5.4	6.5	6.5	7.0		9.0	6.5	7.0	7.0
12 x 4 (24.6)	Straight	44	3.5	6.5	7.0	7.5	68	7.5	7.5	7.5	8.0	91	11.0	8.0	8.0	8.5	136	18.0	8.5	9.0	9.5
	22½°		2.5	6.5	6.5	7.0		5.5	7.0	7.0	7.5		8.1	7.0	7.5	7.5		13.0	7.5	8.0	8.5
	45°		1.8	6.0	6.5	6.5		3.9	6.5	6.5	7.0		5.5	6.5	7.0	7.0		9.0	6.5	7.0	7.0
16 x 4 (35.9)	Straight	61	3.7	7.0	7.0	7.5	92	7.9	7.5	7.5	8.0	122	11.0	8.0	8.0	8.5	183	19.0	8.5	9.0	9.5
	22½°		2.7	6.5	6.5	7.0		6.0	7.0	7.0	7.5		8.1	7.0	7.5	7.5		14.0	7.5	8.0	8.5
	45°		2.0	6.0	6.5	6.5		4.0	6.5	6.5	7.0		5.5	6.5	7.0	7.0		10.0	6.5	7.0	7.5
20 x 4 (45.5)	Straight	77	4.0	7.0	7.0	7.5	115	8.0	7.5	8.0	8.0	154	11.5	8.0	8.0	8.5	231	20.0	8.5	9.0	9.5
	22½°		3.0	6.5	6.5	7.0		6.0	7.0	7.0	7.5		8.5	7.5	7.5	8.0		15.0	7.5	8.0	8.5
	45°		2.0	6.0	6.5	6.5		4.0	6.5	6.5	7.0		6.0	6.5	7.0	7.0		10.0	6.5	7.0	7.5
24 x 4 (55.0)	Straight	93	4.1	7.0	7.0	7.5	139	8.0	7.5	8.0	8.0	185	11.5	8.0	8.0	8.5	278	20.0	8.5	9.0	10.0
	22½°		3.1	6.5	7.0	7.0		6.0	7.0	7.0	7.5		8.5	7.5	7.5	8.0		15.0	7.5	8.0	8.5
	45°		2.0	6.0	6.5	6.5		4.0	6.5	6.5	7.0		6.0	6.5	7.0	7.0		10.6	6.5	7.0	7.5
30 x 4 (68.3)	Straight	116	4.2	7.0	7.0	7.5	175	8.0	7.5	8.0	8.0	233	12.0	8.0	8.0	8.5	349	21.0	8.5	9.5	10.0
	22½°		3.1	6.5	7.0	7.0		6.0	7.0	7.5	7.5		9.0	7.5	7.5	8.0		16.0	7.5	8.0	8.5
	45°		2.1	6.0	6.5	6.5		4.0	6.5	6.5	7.0		6.0	6.5	7.0	7.0		11.0	7.0	7.0	7.5
36 x 4 (83.5)	Straight	140	4.4	7.0	7.5	7.5	210	8.0	7.5	8.0	8.0	279	12.0	8.0	8.5	9.0	420	21.0	9.0	9.5	10.0
	22½°		3.3	6.5	7.0	7.0		6.0	7.0	7.5	7.5		9.0	7.5	7.5	8.0		16.0	7.5	8.5	8.5
	45°		2.2	6.0	6.5	6.5		4.0	6.5	6.5	7.0		6.0	6.5	7.0	7.0		11.0	7.0	7.0	7.5
8 x 6 (26.5)	Straight	52	5.0	7.5	7.5	8.0	77	9.5	8.0	8.0	8.5	103	13.0	8.5	9.0	9.0	155	24.0	8.5	10.0	10.5
	22½°		3.8	7.0	7.0	7.5		7.0	7.0	7.5	8.0		10.0	7.5	8.0	8.5		18.0	8.0	8.5	9.5
	45°		2.5	6.0	6.5	6.5		4.8	6.5	7.0	7.0		6.0	7.0	7.0	7.5		13.0	7.0	7.5	8.0
10 x 6 (34.0)	Straight	66	5.5	7.5	8.0	8.0	98	10.0	8.0	8.5	9.0	131	15.0	9.0	9.5	10.0	196	27.0	10.0	10.5	11.5
	22½°		4.1	7.0	7.5	7.5		7.5	7.5	8.0	8.5		11.0	8.0	8.5	9.0		20.0	8.5	9.0	10.0
	45°		2.8	6.5	7.0	7.0		5.0	7.0	7.0	7.5		7.0	7.0	7.5	7.5		14.0	7.5	7.5	8.0
12 x 6 (41.6)	Straight	80	6.0	7.5	8.0	8.5	119	11.0	8.0	9.0	9.5	159	15.0	9.0	9.5	10.0	238	28.0	10.0	11.0	11.5
	22½°		4.5	7.0	7.5	7.5		8.1	7.5	8.0	8.5		11.0	8.0	8.5	9.0		21.0	9.0	9.5	10.0
	45°		3.0	6.5	7.0	7.0		5.5	7.0	7.0	7.5		7.0	7.0	7.5	7.5		14.0	7.5	8.0	8.0
16 x 6 (56.6)	Straight	107	6.2	8.0	8.0	8.5	161	12.0	8.5	9.0	9.5	214	16.0	9.5	10.0	10.5	321	30.0	11.0	11.5	12.5
	22½°		4.7	7.0	7.5	7.5		9.0	8.0	8.0	8.5		12.0	8.5	9.0	9.5		22.0	9.5	10.0	10.5
	45°		3.2	6.5	7.0	7.0		6.0	7.0	7.0	7.5		8.0	7.5	7.5	8.0		15.0	7.5	8.0	8.5
20 x 6 (71.5)	Straight	135	6.6	8.0	8.5	9.0	202	12.0	9.0	9.5	10.0	269	17.0	9.5	10.0	11.0	403	32.0	11.5	12.0	13.0
	22½°		5.0	7.5	7.5	8.0		9.0	8.0	8.5	9.0		13.0	8.5	9.0	9.5		24.0	9.5	10.0	11.0
	45°		3.2	7.0	7.0	7.5		6.6	7.0	7.5	7.5		9.0	7.5	8.0	8.0		16.0	8.0	8.5	9.0
24 x 6 (86.5)	Straight	162	7.0	8.0	8.5	9.0	243	13.0	9.0	9.5	10.0	324	18.0	10.0	10.5	11.0	486	33.0	12.0	12.5	13.0
	22½°		5.1	7.5	8.0	8.0		10.0	8.0	8.5	9.0		13.0	8.5	9.0	10.0		25.0	10.0	10.5	11.0
	45°		3.5	7.0	7.0	7.5		6.5	7.0	7.5	8.0		9.0	7.5	8.0	8.5		17.0	8.0	8.5	9.1
30 x 6 (109.0)	Straight	203	7.0	8.5	8.5	9.5	304	13.0	9.0	10.0	10.5	406	19.0	10.0	11.0	11.5	609	34.0	12.0	12.5	13.5
	22½°		3.4	7.5	8.0	8.0		10.0	8.0	9.0	9.0		14.0	9.0	9.5	10.0		25.0	10.0	10.5	11.5
	45°		3.5	7.0	7.0	7.5		6.5	7.5	7.5	8.0		10.0	7.5	8.0	8.5		17.0	8.0	9.0	9.0
36 x 6 (131.3)	Straight	245	7.1	8.5	9.0	9.5	368	13.0	9.5	10.0	10.5	490	19.0	10.0	11.0	12.0	735	35.0	12.0	13.0	14.0
	22½°		5.5	7.5	8.0	8.5		10.0	8.5	9.0	9.5		14.0	9.0	9.5	10.0		26.0	10.0	10.5	11.5
	45°		3.5	7.0	7.5	7.5		6.5	7.5	8.0	8.0		10.0	8.0	8.0	8.5		18.0	8.5	9.0	9.5
K FACTOR																					
Max Cfm/Sq Ft Outlet Wall Area		29.0					19.0					14.0					9.6				
Min Cfm/Sq Ft Outlet Wall Area		8.7					5.7					4.2					2.9				