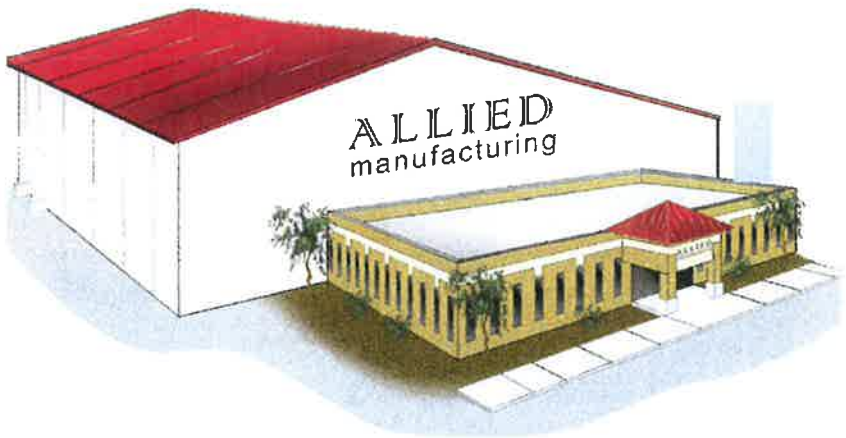
Room Air Distribution

Copyright © Carrier Corp. 2017

Carrier
turn to the experts

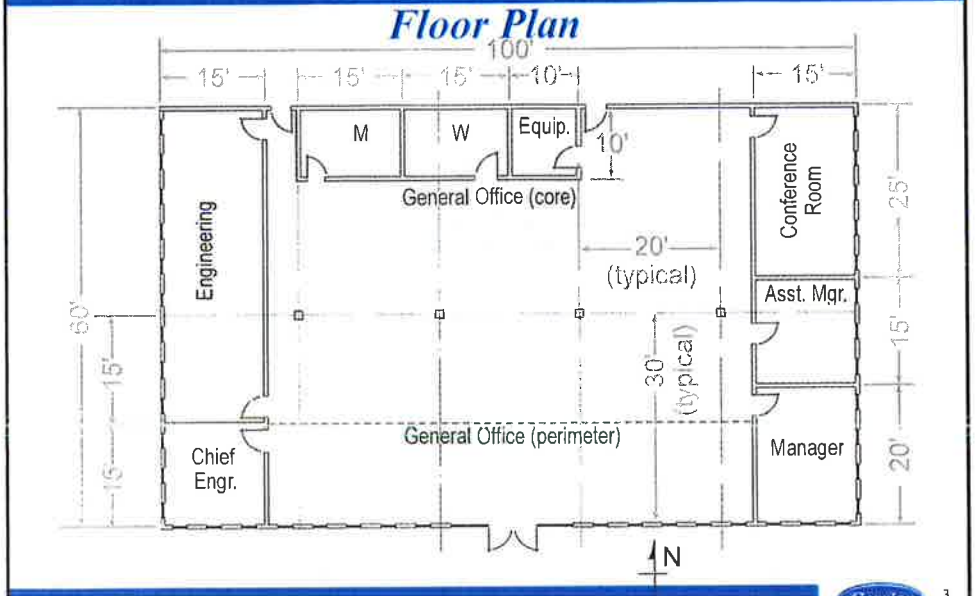
Project - Manufacturing Office



Copyright © Carrier Corp. 2017

Carrier
turn to the experts

Manufacturing Offices

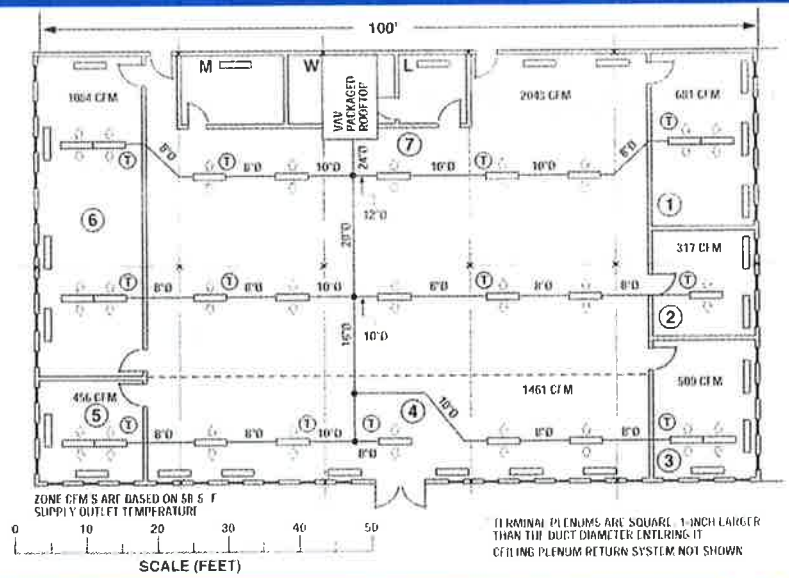


Copyright © Carrier Corp. 2017

Carrier turn to the experts

3

Air Distribution Example

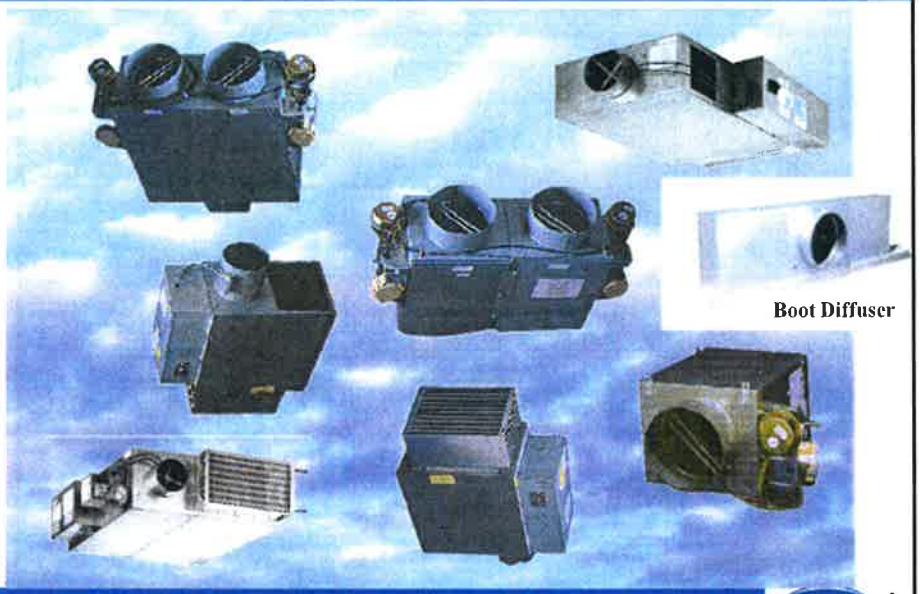


Copyright © Carrier Corp. 2017

Carrier turn to the experts

4

VAV Boxes

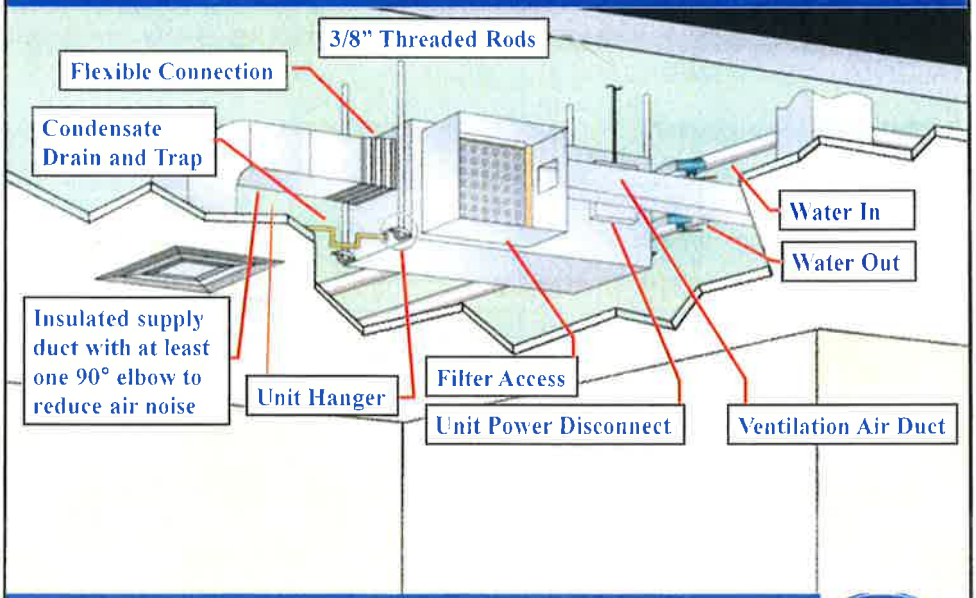


Copyright © Carrier Corp. 2017

Carrier
Turn to the experts

5

Typical FCU Installation



Copyright © Carrier Corp. 2017

Carrier
Turn to the experts

6

Room Air Velocities

OCCUPIED ZONE ROOM AIR VELOCITIES

ROOM AIR VELOCITY (Fpm) *(m/s)*	REACTION	RECOMMENDED APPLICATION
0 - 16 *(0.08)*	Complaints about stagnant air	None
25 *(0.13)*	Ideal design – favorable	All Commercial Applications
25 - 50 *(0.25)*	Probably favorable but 50 fpm is approaching tolerable velocity for seated persons	All Commercial Applications
65 *(0.33)*	Unfavorable – light papers are blown off a desk	
75 *(0.38)*	Upper limits for people moving about slowly – favorable	Retail and Dept. Store
75 - 300 *(1.52)*	Some factory air conditioning installations – favorable	Factory air conditioning higher velocities for spot cooling

Copyright © Carrier Corp. 2017

10 pa $\xrightarrow{\times 2}$ 20 pa

500 cmH $\xrightarrow{\sqrt{2}}$ 0.41 × 500 cmH

$p \propto v^2$

Air Distribution System

Plan Symbols

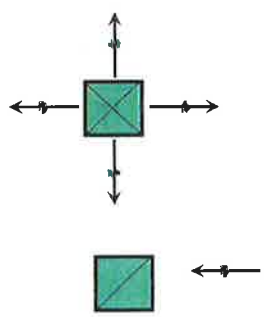
Positive Pressure (supply)



Negative Pressure (return or e xhaust)



Arrow indicates air flow direction



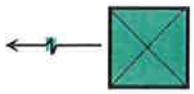
Copyright © Carrier Corp. 2017

Air Distribution System

Plan Symbols

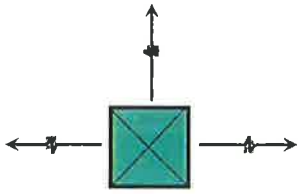
Flow patterns

1-way

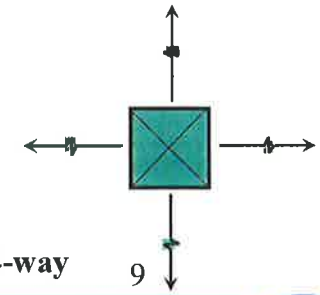


2-way





3-way



4-way

9

Copyright © Carrier Corp. 2017

Air Distribution System

Plan Symbols

T **Thermostat**



Double Line



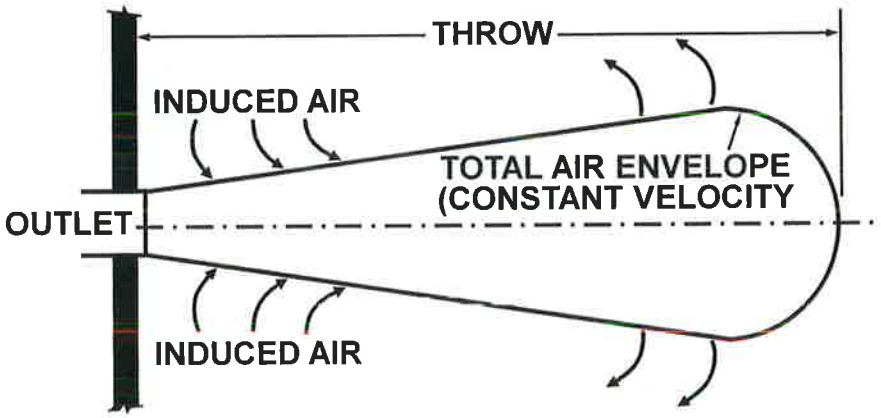
Smoke/Fire Damper



Single Line

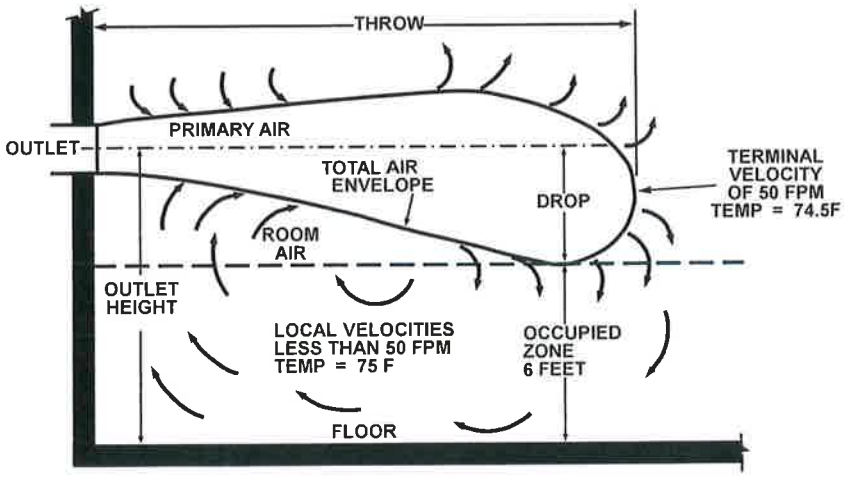
Copyright © Carrier Corp. 2017

ISOTHERMAL JET



Copyright © Carrier Corp. 2017

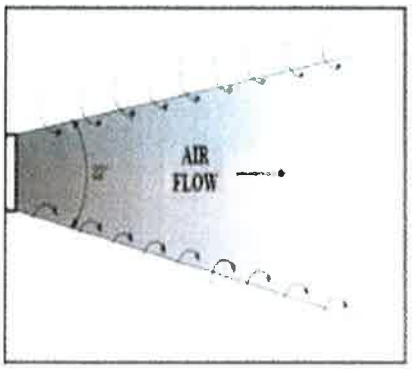
NON-ISOTHERMAL JETS – FREE SPACE



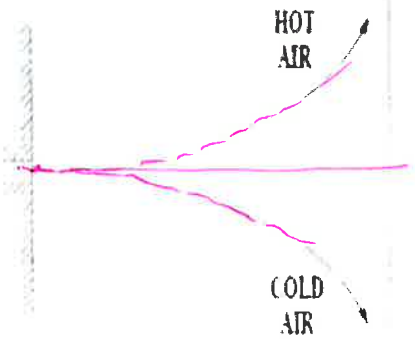
Copyright © Carrier Corp. 2017

Air Distribution Profile

Isothermal



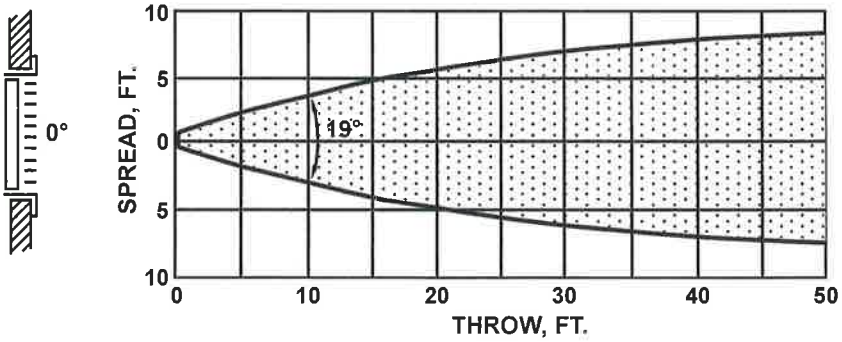
Not Isothermal



Copyright © Carrier Corp. 2017

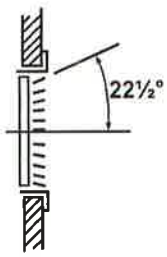
SPREAD VS. VANE SETTING

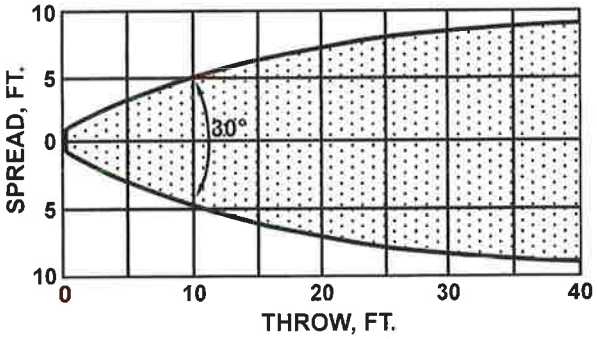
-vane agle to regulate the spread, distance etc.



Copyright © Carrier Corp. 2017

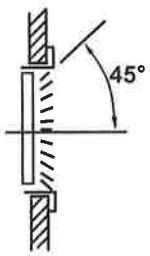
SPREAD VS. VANE SETTING

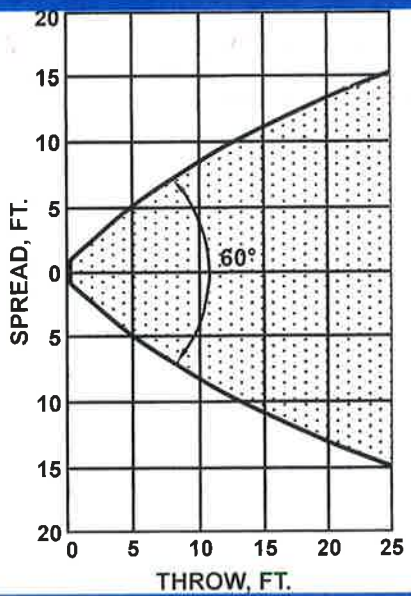




Copyright © Carrier Corp. 2017

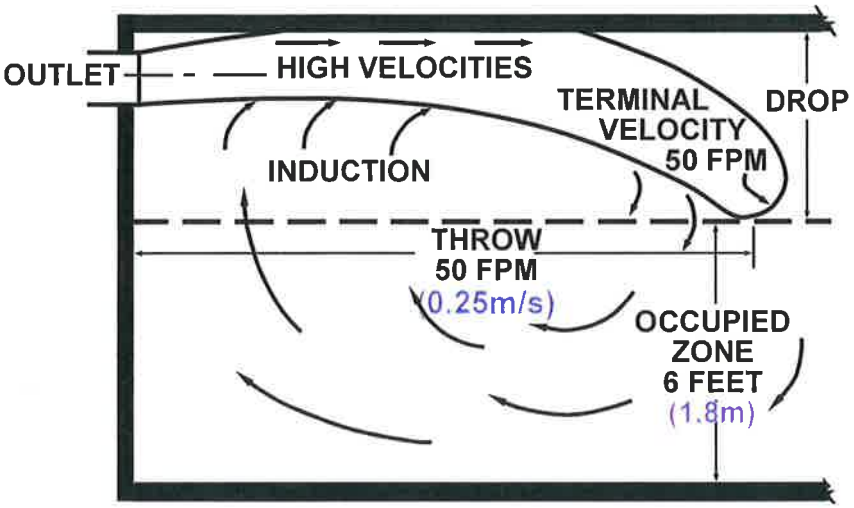
SPREAD VS. VANE SETTING





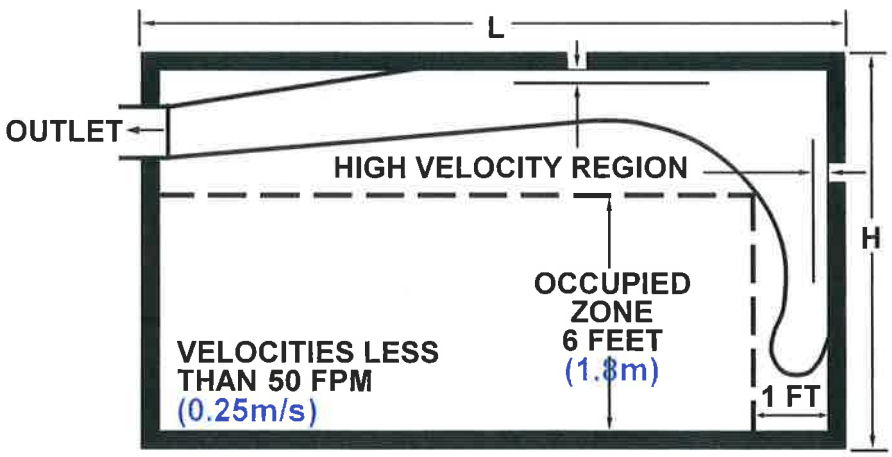
Copyright © Carrier Corp. 2017

EFFECT OF WALLS AND CEILINGS



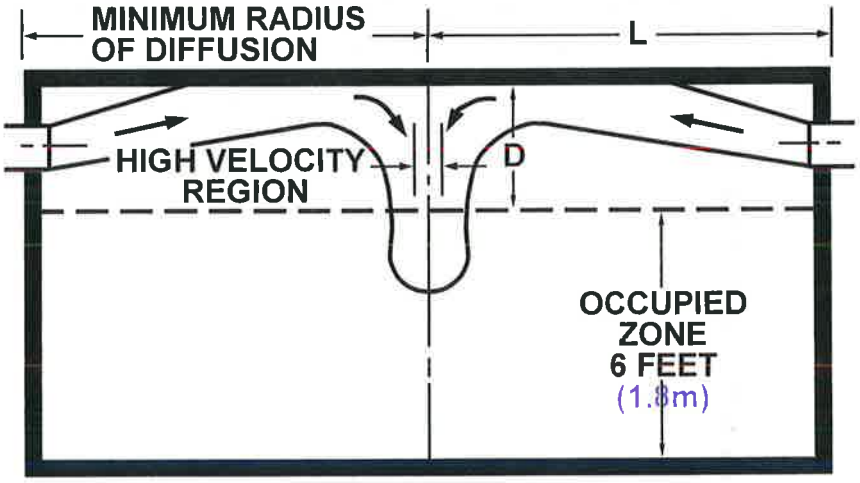
Copyright © Carrier Corp. 2017

THROW AND DROP FOR CONFINED SPACES



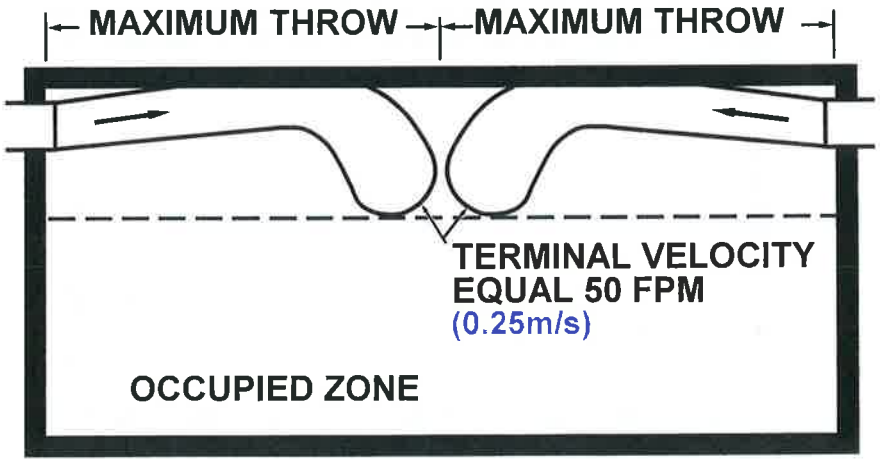
Copyright © Carrier Corp. 2017

IMPACT OF OPPOSING JETS



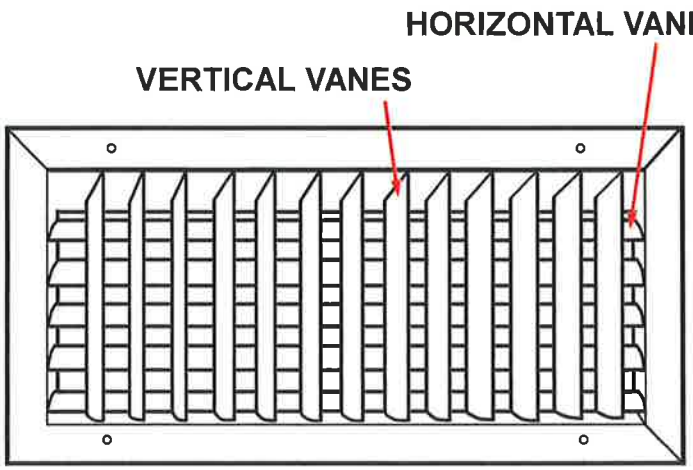
Copyright © Carrier Corp. 2017

MAXIMUM DISTANCE



Copyright © Carrier Corp. 2017

DOUBLE DEFLECTION GRILLE

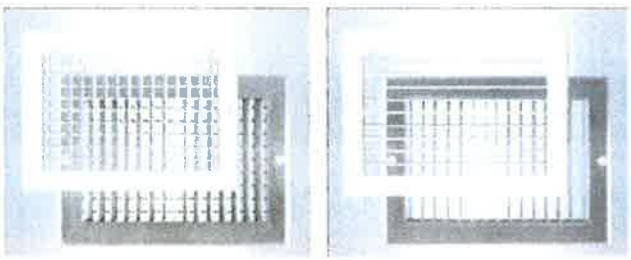


FACE VIEW

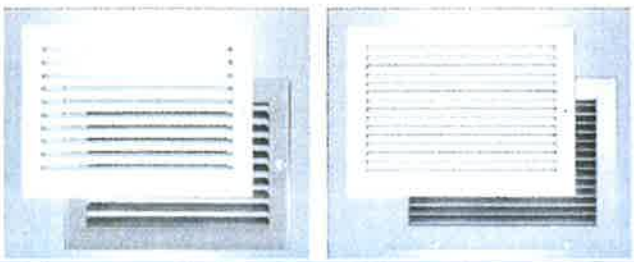
Copyright © Carrier Corp. 2017

LOUVERED GRILLES

Louvered Face – Supply Air

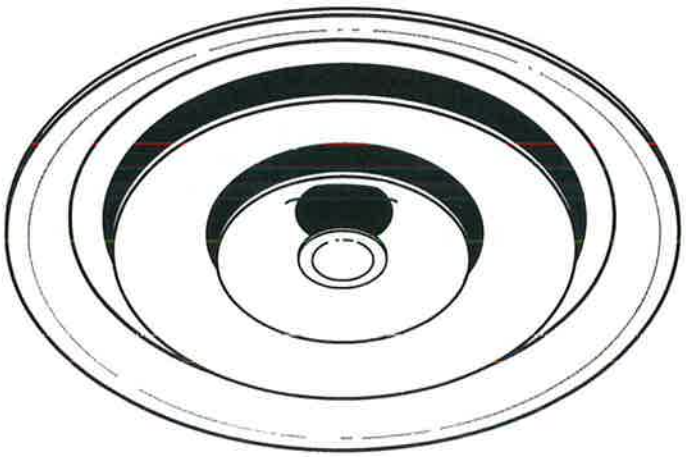


Louvered Face – Return Air



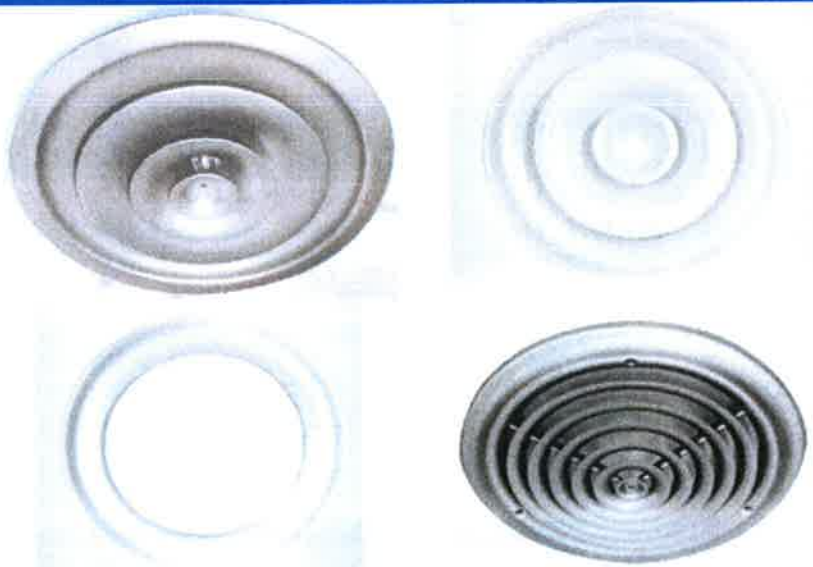
Copyright © Carrier Corp. 2017

ROUND



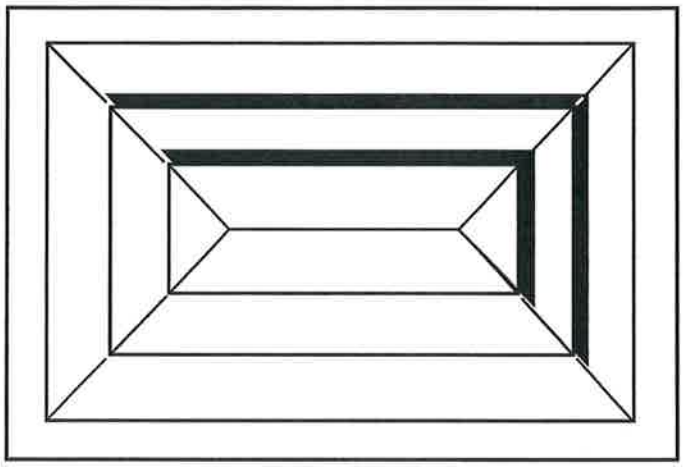
Copyright © Carrier Corp. 2017

ROUND



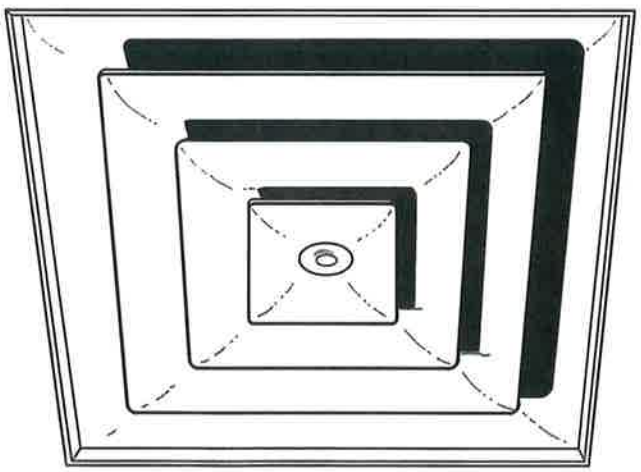
Copyright © Carrier Corp. 2017

RECTANGULAR



Copyright © Carrier Corp. 2017

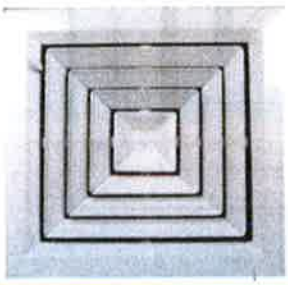
SQUARE

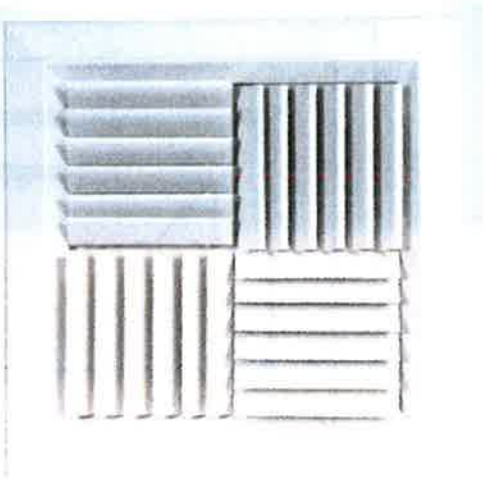


Copyright © Carrier Corp. 2017

SQUARE







Copyright © Carrier Corp. 2017

Linear Slot Diffusers

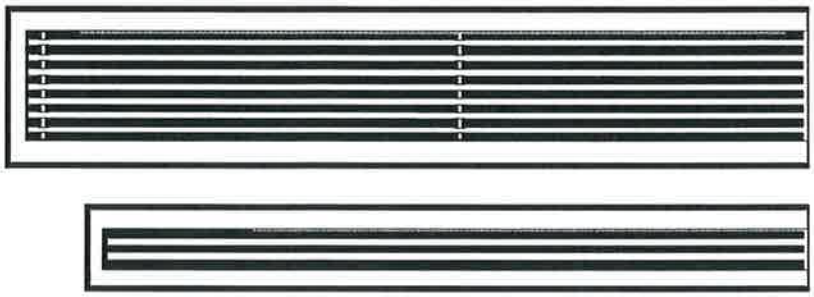






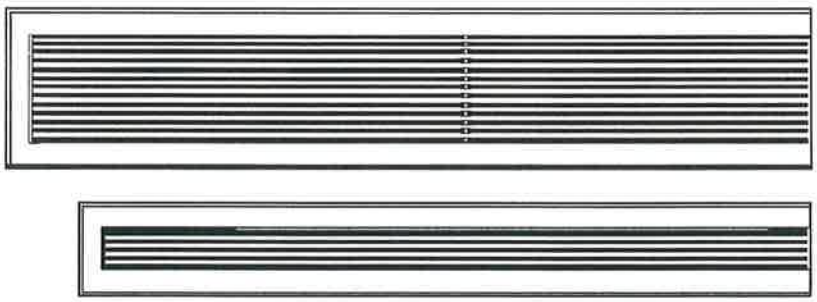
Copyright © Carrier Corp. 2017

½" SPACING



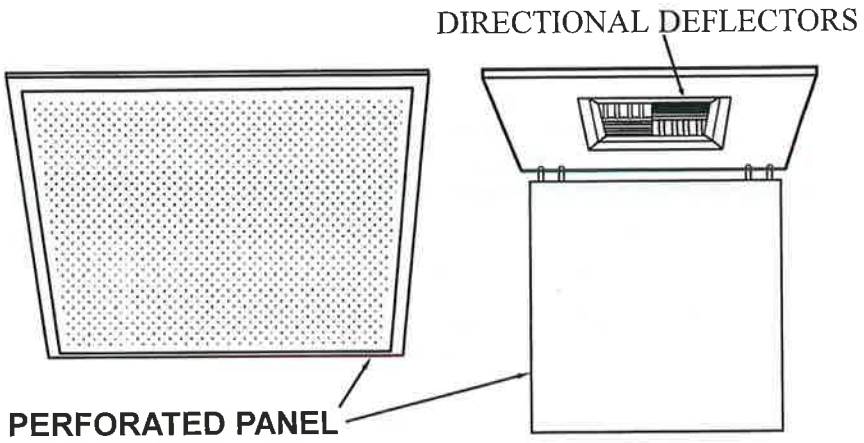
Copyright © Carrier Corp. 2017

¼" SPACING



Copyright © Carrier Corp. 2017

Perforated Ceiling Diffusers



Copyright © Carrier Corp. 2017

Perforated Ceiling Diffusers

PERFORATED CEILING DIFFUSERS



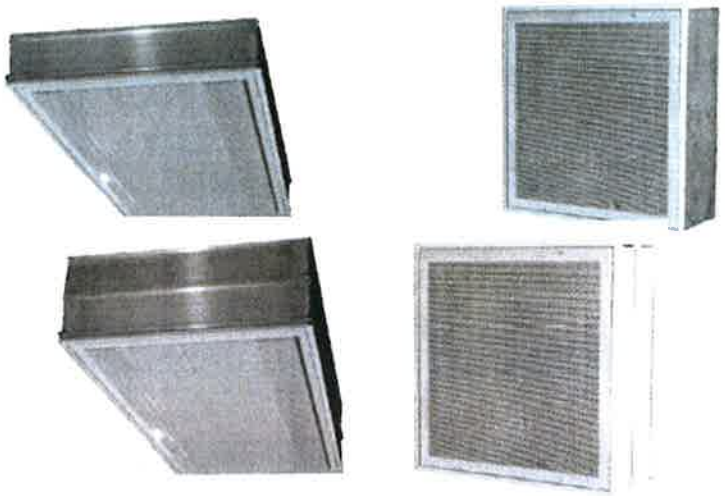




Copyright © Carrier Corp. 2017

Laminar Flow Diffuser

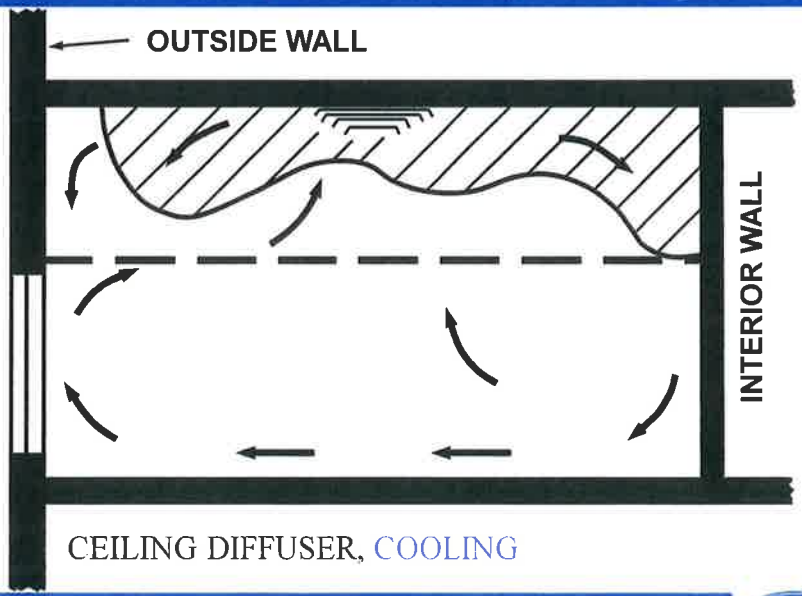
- hospital operating rooms and clean rooms



HEPA filters to be located in the supply diffuser

Copyright © Carrier Corp. 2017

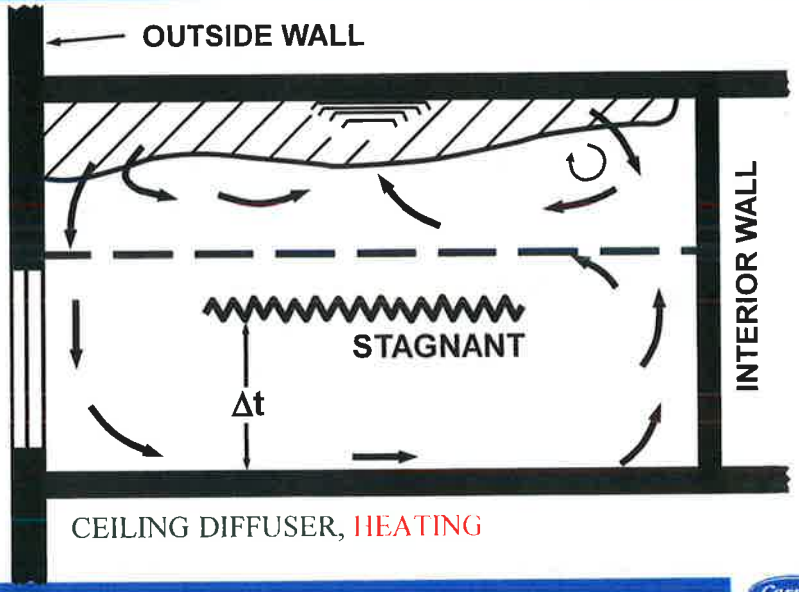
Distribution Profile – Cooling Load



CEILING DIFFUSER, COOLING

Copyright © Carrier Corp. 2017

Distribution Profile – Heating Load



CEILING DIFFUSER, HEATING

Copyright © Carrier Corp. 2017

Discharge Air Velocity

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 *(5.08 m/s)*
Undercutting of Doors	600
INDUSTRIAL	800 and above
RESIDENTIAL	400

Copyright © Carrier Corp. 2017

Types of Outlets

OUTLET TYPE	CFM/SQ. FT. FLOOR AREA	AIR CHANGES PER HOUR	OUTLET Δt RANGE
GRILLE/REGISTER	3 - 6	7	15 - 25
SLOT DIFFUSER	4 - 10	12	20 - 25
PERFORATED PANEL	5 - 15	18	20 - 25
CEILING DIFFUSER	5 - 25	30	20 - 35

Copyright © Carrier Corp. 2017

RECOMMENDED OUTLET VELOCITIES

APPLICATION	TERMINAL VELOCITY (FPM)
Broadcast studios	300-500
Residences	500-750
Apartments	500-750
Churches	500-750
Hotel bedrooms	500-750
Legitimate theaters	500-750
Private offices, accoustically treated	500-750
Private offices, not treated	500-800
Motion picture theaters	1000
General offices *(5.08 m/s)*	1000-1250 ←
Department stores, upper floors	1500
Depatment stores, main floor	2000

Copyright © Carrier Corp. 2017

Diffuser Selection

Diffuser Selection Criteria

- Air flow
- Throw
- Noise Criteria (NC) Level
- Appearance

Copyright © Carrier Corp. 2017

Diffuser Selection

Air Flow

Throw

NC Level

Performance Data TXS & TXR

24 x 24 Module Size

Duct Size			300	400	500	600	700	800	1000	1200	1400
	Face Velocity, FPM		300	400	500	600	700	800	1000	1200	1400
	Vel. Press., In. W.G.		.006	.010	.016	.023	.031	.040	.063	.090	.123
	Tot. Press., In. W.G.		.010	.018	.027	.040	.054	.070	.110	.157	.215
	Flow Rate, CFM		40	55	70	80	95	110	135	165	190
5" RD	NC		—	—	14	19	23	27	33	38	42
	Throw, Ft	4-WAY	1-2-4	2-2-5	2-3-6	2-4-7	3-5-7	3-6-8	5-8-9	6-7-10	6-7-10
		3-WAY	1-2-4	2-3-5	2-3-7	2-4-8	3-5-9	4-6-10	5-7-10	6-8-12	6-9-13
		2-WAY	1-2-5	2-3-6	2-4-8	3-5-10	4-6-12	4-7-12	6-8-13	7-10-14	7-10-15
		1-WAY	2-3-6	2-4-8	3-5-9	4-6-10	5-7-11	6-8-13	6-9-13	8-10-14	9-10-15
	Tot. Press., In. W.G.		.013	.021	.034	.048	.065	.084	.132	.189	.258
	Flow Rate, CFM		60	80	100	120	140	160	200	235	275
	NC		—	—	17	22	26	30	36	41	45
6" RD	Throw, Ft	4-WAY	1-2-4	2-3-5	3-3-7	3-4-8	3-5-9	3-6-9	5-7-10	6-8-10	7-8-11
		3-WAY	1-2-4	2-3-6	3-3-8	3-4-9	3-5-10	4-6-10	5-8-11	6-9-13	7-10-14
		2-WAY	1-2-5	2-3-7	3-4-9	3-5-10	4-6-11	4-7-12	6-8-14	7-10-15	8-11-17
		1-WAY	2-3-6	3-4-9	3-5-11	4-6-11	5-8-12	6-9-13	7-10-15	9-10-16	10-12-17
	Tot. Press., In. W.G.		.014	.023	.037	.053	.071	.092	.145	.207	.283
	Flow Rate, CFM		80	105	135	160	190	215	270	320	375
	NC		—	13	25	24	28	32	38	43	47
7" RD or 6 x 6	Throw, Ft	4-WAY	1-2-5	2-3-6	3-4-9	3-5-10	4-6-10	4-8-11	6-9-12	8-10-13	9-10-14
		3-WAY	1-2-5	2-4-7	3-4-10	3-5-11	4-6-12	5-8-13	6-10-14	7-11-16	9-12-17
		2-WAY	1-2-6	2-4-9	3-5-11	4-6-12	5-8-14	5-9-15	7-11-17	9-13-18	10-14-20
		1-WAY	2-4-8	3-5-11	4-6-12	5-8-13	6-10-14	8-11-15	9-12-17	11-13-18	12-14-20
	Tot. Press., In. W.G.		.014	.024	.038	.055	.075	.096	.151	.216	.295
	Flow Rate, CFM		105	140	175	210	245	280	350	420	490
	NC		—	17	23	28	32	36	42	47	51
8" RD	Throw, Ft	4-WAY	1-2-6	2-4-8	4-4-10	4-6-11	4-7-12	5-8-12	6-10-13	8-11-14	9-12-16
		3-WAY	1-2-6	2-4-8	4-5-11	4-6-12	5-7-13	5-9-14	7-11-16	9-13-18	10-13-19
		2-WAY	1-2-7	2-5-10	4-6-12	4-7-14	5-8-15	6-10-17	8-12-19	10-14-21	12-16-22
		1-WAY	2-4-9	4-6-12	5-7-13	6-9-14	7-10-15	8-12-17	10-13-19	12-14-21	13-16-22

Copyright © Carrier Corp. 2017

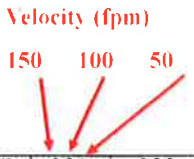
Diffuser Selection

Throw:

Distance of air movement

Avoid

- **Gaps and overlap**
- **Obstructions/deflectors**



Throw, Ft.	4-WAY	1-2-4	2-3-5	3-3-7
	3-WAY	1-2-4	2-3-6	3-3-8
	2-WAY	1-2-5	2-3-7	3-4-9
	1 WAY	2-3-6	3-4-9	3-5-11

Copyright © Carrier Corp. 2017

Carrier
Turn to the Experts

Diffuser Layout

Select diffuser layout

Regular pattern

Uniform coverage

Avoid "short circuiting" with exhaust/return registers

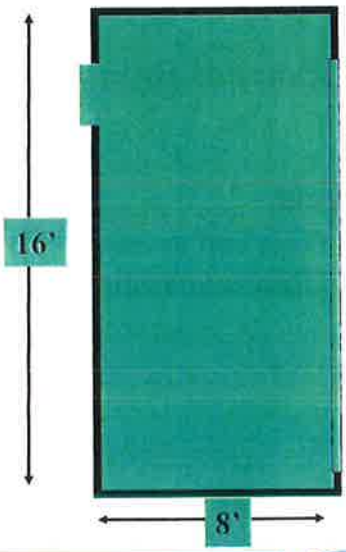
Copyright © Carrier Corp. 2017

Carrier
Turn to the Experts

Diffuser Layout Example

Office space with overhead cooling supply

NC level 35



Copyright © Carrier Corp. 2017

Diffuser Layout Example

Cooling Qs = 8,600 Btuh @ 77°F

Supply air temperature @ 54°F

$$CFM_{clg} = \frac{Qs}{(1.08 \times \Delta T)}$$

=8,600/(1.08 x 23)=346 CFM

Copyright © Carrier Corp. 2017

Diffuser Layout Example

Define Pattern

346 Cfm

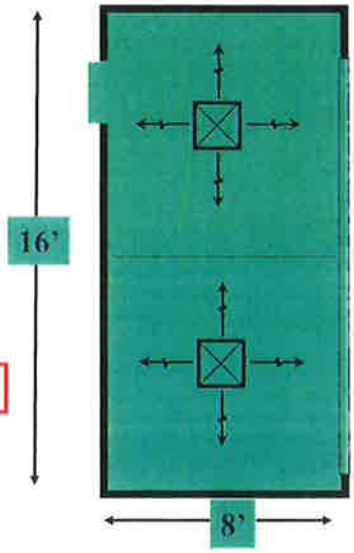
Round up to 0 or 5 cfm

1@350 cfm 2-way

2@175=350 cfm 4-way

3@115=345 cfm 3-way

4@90=360 cfm 2-way



Copyright © Carrier Corp. 2017

Carrier
Turn to the experts

Diffuser Selection

NC 35

Air Flow

Throw

Select
8" Rd
4-way

Performance Data TXS & TXR

24 x 24 Module Size

Duct Size	Neck Velocity, FPM		300	400	500	600	700	800	1000	1200	1400
	Vel. Press., In. W.G.		.006	.010	.016	.023	.031	.040	.063	.090	.123
	Loc. Press., In. W.G.		.010	.018	.028	.040	.054	.070	.110	.157	.215
5" RD	Flow Rate, CFM		40	85	70	80	95	110	135	165	190
	NC		—	—	14	19	23	27	33	38	42
	Throw, Ft	4-WAY	1-2-4	2-3-5	3-3-6	3-4-7	3-5-8	3-6-9	3-7-10	6-7-10	6-7-10
		3-WAY	1-2-4	2-3-5	3-3-7	3-4-8	3-5-9	4-6-10	5-7-10	6-8-12	6-9-13
		2-WAY	1-2-5	2-3-6	3-4-8	3-5-10	4-6-10	4-7-12	6-8-13	7-10-14	7-10-15
		1-WAY	1-2-6	2-4-8	3-5-9	4-6-10	5-7-11	6-8-13	6-9-13	8-10-14	9-10-15
	Tot. Press., In. W.G.		.013	.021	.034	.048	.065	.084	.130	.185	.256
	Flow Rate, CFM		60	90	100	120	140	160	200	235	275
6" RD	NC		—	—	17	22	25	30	36	41	45
	Throw, Ft	4-WAY	1-2-4	2-3-5	3-3-7	3-4-8	3-5-8	3-6-9	5-7-10	6-8-10	7-8-11
		3-WAY	1-2-4	2-3-6	3-3-8	3-4-9	3-5-10	4-6-10	5-8-11	6-9-12	7-10-14
		2-WAY	1-2-5	2-3-7	3-4-9	3-5-10	4-6-11	4-7-12	6-9-14	7-10-15	8-11-17
		1-WAY	1-2-6	2-4-8	3-5-11	4-6-11	5-8-12	6-9-13	7-10-15	9-10-16	10-12-17
	Tot. Press., In. W.G.		.014	.023	.037	.053	.071	.092	.145	.203	.283
	Flow Rate, CFM		80	105	135	160	190	215	270	320	375
7" RD or 6 x 6	NC		—	15	19	24	28	32	38	43	47
	Throw, Ft	4-WAY	1-2-5	2-3-6	3-4-9	3-5-10	4-6-10	4-8-11	6-9-12	8-10-13	9-10-14
		3-WAY	1-2-5	2-4-7	3-4-10	3-5-11	4-6-12	5-8-12	6-10-14	7-11-16	9-12-17
		2-WAY	1-2-6	2-4-9	3-5-11	4-6-12	5-8-14	5-9-15	7-11-17	9-13-18	10-14-20
		1-WAY	2-4-8	3-5-11	4-6-12	5-8-13	6-10-14	8-11-15	9-12-17	11-13-18	12-14-20
	Tot. Press., In. W.G.		.014	.024	.039	.055	.075	.096	.151	.216	.295
	Flow Rate, CFM		105	140	175	210	245	280	350	420	490
8" RD	NC		—	17	23	28	32	36	42	47	51
	Throw, Ft	4-WAY	1-3-6	2-4-8	4-4-10	4-6-11	4-7-12	5-8-12	6-10-13	8-11-14	9-12-16
		3-WAY	1-3-6	2-4-8	4-5-11	4-6-12	5-7-13	5-9-14	7-11-16	9-13-16	10-13-15
		2-WAY	1-3-7	2-5-10	4-6-12	4-7-14	5-8-15	6-10-17	8-12-19	10-14-21	12-16-22
		1-WAY	2-4-9	4-6-12	5-7-13	6-9-14	7-10-15	8-12-17	10-13-19	12-14-21	13-16-21

Copyright © Carrier Corp. 2017

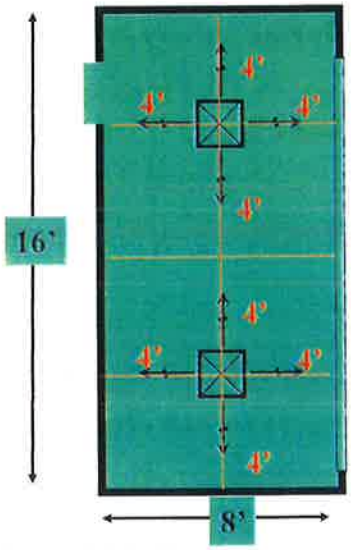
Carrier
Turn to the experts

Diffuser Layout Example

Define Pattern

346 Cfm

2@175=350 cfm 4-way



Copyright © Carrier Corp. 2017

Return Register Selection

Selection Criteria

- Air flow
- Noise Criteria (NC) Level
- Appearance

Copyright © Carrier Corp. 2017

Return Register Selection

Air Flow

NC Level

Return Grille & Register Performance

Core Style 25R Steel, 30° Louvers

Core Area Square Feet	Nominal Size												
				Core Velocity	400	500	600	700	800	900	1000	1100	1200	1300
				Free Area	010	015	022	031	040	050	060	071	082	105
				Neg. SP	042	067	094	129	165	212	260	317	379	444
15	7x4			CFM	60	75	90	105	120	135	150	165	180	195
	6x5			NC	–	–	–	15	20	25	29	33	36	39
18	8x4	6x6		CFM	72	90	108	126	144	162	180	198	216	234
	7x5			NC	–	–	11	17	22	26	30	34	38	41
22	10x4	7x6		CFM	88	110	132	154	176	198	220	242	264	286
	8x5			NC	–	–	12	18	23	28	32	36	39	42
26	12x4	8x6		CFM	104	130	156	182	208	234	260	286	312	338
	10x5			NC	–	–	13	19	24	29	33	37	40	43
30	14x4			CFM	120	150	180	210	240	270	300	330	360	390
				NC	–	–	14	20	25	30	34	38	41	44
34	16x4	10x6		CFM	136	170	204	238	272	306	340	374	408	442
	12x5			NC	–	–	15	21	26	31	35	39	42	45
38	18x4	12x6		CFM	150	195	234	273	312	351	390	429	468	507
	14x5	8x8		NC	–	–	16	22	27	32	36	40	43	46
46	20x4	14x6		CFM	184	230	276	322	368	414	460	506	552	598
	16x5	10x8		NC	–	10	17	23	29	33	37	41	44	48
52	24x4	16x6		CFM	208	260	312	364	416	468	520	572	624	676
	18x5			NC	–	11	18	24	29	34	38	42	45	48
60	28x4	18x6	10x10	CFM	240	300	360	420	480	540	600	660	720	780
	20x5	12x8		NC	–	12	19	25	31	35	39	43	46	49
69	30x4	20x6	12x10	CFM	276	345	414	483	552	621	690	759	828	897
	24x5	14x8		NC	–	13	20	26	32	36	40	44	47	51
81	36x4	22x6	14x10	CFM	324	405	486	567	648	729	810	891	972	1053
	28x5	16x8		NC	–	14	21	28	33	37	41	45	49	52
90	40x4	26x6	16x10	CFM	360	450	540	630	720	810	900	990	1080	1170
	30x5	18x8	12x12	NC	–	15	22	28	34	38	42	46	49	52
107	48x4	30x6	14x12	CFM	428	535	642	749	856	963	1070	1177	1284	1391
	36x5	16x10		NC	–	16	24	30	35	39	43	47	51	54

Copyright © Carrier Corp. 2017

Carrier turn to the experts

Return Register Layout

Avoid

- **Short circuiting with supply diffusers**
- **Locating in visually obtrusive location**

Copyright © Carrier Corp. 2017

Carrier turn to the experts

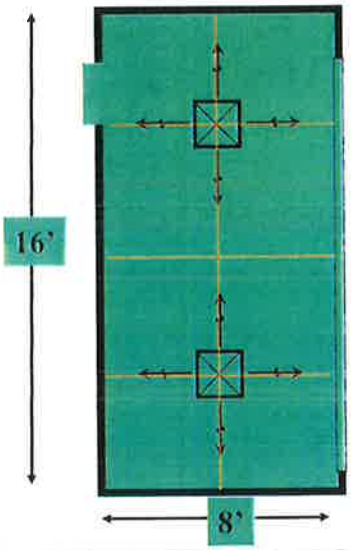
Return Register Layout

Define Pattern

Supply=350 cfm

Return

1@350=350 cfm



Copyright © Carrier Corp. 2017

Return Register Selection

Air Flow 350 cfm

NC Level 35

Select
10" x 8"
350 cfm
NC 27db

Return Grille & Register Performance

Core Style 25R Steel, 30 Louvers

Core Area Square Feet	Nominal Size			Core Vel	400	500	600	700	800	900	1000	1100	1200	1300
				Vel. Press	010	016	022	031	040	050	062	075	090	105
				Neg. SP	042	067	094	130	169	212	262	317	379	444
15	7x4			CFM	60	75	90	105	120	135	150	165	180	195
	6x5			NC	—	—	—	15	22	25	29	33	36	39
18	8x4	6x6		CFM	72	90	108	126	144	162	180	198	216	234
	7x5			NC	—	—	11	17	22	26	30	34	38	41
22	10x4	7x6		CFM	88	110	132	154	176	198	220	242	264	286
	8x5			NC	—	—	12	18	23	28	32	36	39	42
26	12x4	8x6		CFM	104	130	156	182	208	234	260	286	312	338
	10x5			NC	—	—	13	19	24	29	33	37	40	43
30	14x4			CFM	120	150	180	210	240	270	300	330	360	390
				NC	—	—	14	20	25	30	34	38	41	44
34	16x4	10x6		CFM	136	170	204	238	272	306	340	374	405	442
	12x5			NC	—	—	15	21	26	31	35	39	42	45
39	18x4	12x6		CFM	156	195	234	273	312	351	390	429	468	507
	14x5	8x6		NC	—	—	16	22	27	32	36	40	43	46
45	20x4	14x6		CFM	184	230	276	322	368	414	460	506	552	598
	16x5	10x8		NC	—	10	17	23	28	33	37	41	44	48
52	24x4	16x6		CFM	208	260	312	364	416	468	520	572	624	676
	18x5			NC	—	11	18	24	29	34	38	42	45	48
60	28x4	18x6	10x10	CFM	240	300	360	420	480	540	600	660	720	780
	20x5	12x8		NC	—	12	19	25	31	35	39	43	46	50
69	30x4	20x6	12x10	CFM	276	345	414	483	552	621	690	759	828	897
	24x5	14x8		NC	—	13	20	26	32	36	40	44	47	51
81	36x4	22x6	14x10	CFM	324	405	486	567	648	729	810	891	972	1053
	28x5	16x8		NC	—	14	21	28	33	37	41	45	49	52
90	40x4	26x6	16x10	CFM	360	450	540	630	720	810	900	990	1080	1170
	30x5	18x8	12x12	NC	—	15	22	28	34	38	42	46	49	52
107	48x4	30x6	14x12	CFM	428	535	642	749	856	963	1070	1177	1284	1391
	36x5	18x10		NC	—	16	24	30	35	39	43	47	51	54

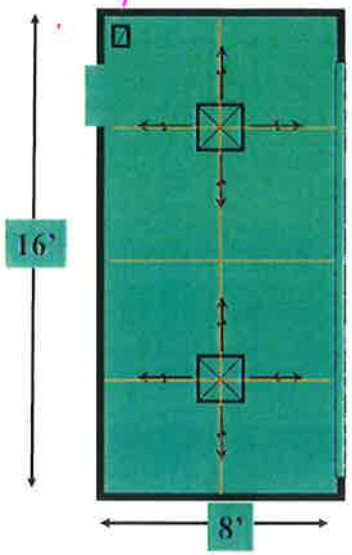
Copyright © Carrier Corp. 2017

Return Register Layout

Define Pattern

Supply=350 cfm

Return
1@350=350 cfm
10" x 8"
NC 27db



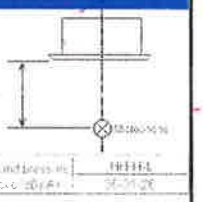
Copyright © Carrier Corp. 2017

4-way Air Discharge

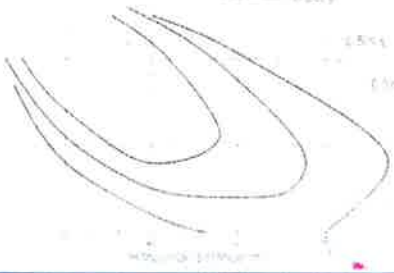
Cassette Type

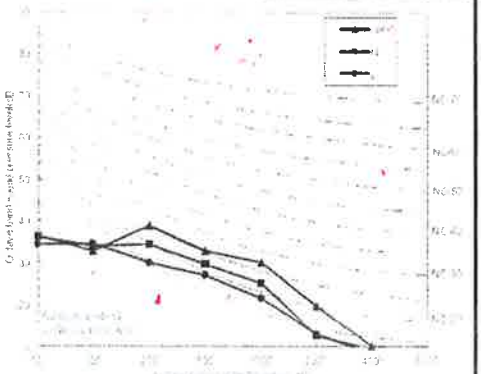


MMU-AP0242H/AP0272H



MMU-AP0242H/AP0272H/AP0302H





Copyright © Carrier Corp. 2017