

Engineering Data



Using the Engineering Data

For most of the models & sizes we've done the calculations for you.
CFM = volume of air flow in cubic feet per minute

421

Face Velocity		300	400	500	600	700	800
Pressure Loss		.006	.010	.016	.022	.031	.040
4x10 Ak .170	CFM	50	70	85	100	120	135
	Spread	4.5	5.0	6.5	7.5	9.0	10.0
	Throw	4.0	6.0	8.0	10.0	11.0	12.5

Terminal velocity of 50 fpm

821-defl A

Face Velocity		400	500	600	700	800
Pressure Loss		.010	.016	.022	.031	.040
24 x 8 Ak 1.045	CFM	420	525	625	730	835
	Throw	17.0	21.0	25.0	29.0	33.0

Terminal velocity is 75 fpm

Face Velocity = speed of air at the face of diffuser in feet per minute (FPM)

Ak = net area in square feet. This is the lab measured area across the face when air is mechanically forced through the opening.

Free Area (if given) = daylight area (in²) of blade openings. Free area is typically only required on natural / gravity movement of air, non-mechanically forced, as in free area needed for combustion air requirements on heating equipment. Use the Ak value (*144 to get to in²) if the free area has not been calculated, but is needed for a given size/model grille requiring free area for combustion.

Equation of Airflow: CFM = Ak (ft²) x Face Velocity (fpm)

Example from 421 table above: 100 = .17 x 600 _ numbers are often rounded

Sizing a Supply

Determine the amount of CFM (air volume) needed for each supply outlet. This should be done by room heating and cooling load requirements from various design manuals (ACCA Man J, ASHRAE Fundamentals Hndbk) and then followed by the duct design and layout.

Face Velocity - H&C recommends sizing a supply outlet in the range of 500 to 800 fpm face velocity (700 being a common target). The upper end of this range will create better mixing of room air and longer throws, which is what the typical forced air system is intended to do. However, the Pressure resistance and Noise must be taken into consideration depending upon the application. In some instances, greater face velocity is allowed because the pressure and noise can be accommodated.

Pressure Loss (inches of w.c.) – the selection of the face velocity must consider the associated pressure loss that deals with each relative model. An increase in face velocity creates more pressure resistance against the blower's delivery of air volume. The velocity ranges given previously will, in most cases, have minor effect on the blower's overall performance given the entire duct system losses that it will encounter.

Noise – an increase in face velocity will create more noise. The tables below show NC design guidelines and also face velocity ranges if NC values have not been tabulated.

Application	Recommended Face Velocities
Broadcasting Studios	<500 FPM
Residences	500 to 750 FPM
Apartments	500 to 750 FPM
Churches	500 to 750 FPM
Hotel Guestrooms	500 to 750 FPM
Legitimate Theaters	500 to 1000 FPM
Private Offices, acoustically treated	500 to 1000 FPM
Private Offices, not treated	1000 to 1250 FPM
Motion Picture Theaters	1000 to 1250 FPM
General Offices	1250 to 1500 FPM
Stores, upper floors	1500 FPM
Stores, main floors	1500 FPM
Industrial Buildings	1500 to 2000 FPM

	Communication Environment	Typical Occupancy
< NC 25	Extremely quiet environment; suppressed speech is quite audible; suitable for acute pickup of all sounds.	Broadcasting studios, concert halls, music rooms.
NC 30	Very quiet office; suitable for large conferences; telephone use satisfactory.	Residences, theaters, libraries, executive offices, directors rooms.
NC 35	Quiet office; satisfactory for conference at a 15-foot table; normal voice 10 to 30 feet; telephone use satisfactory.	Private offices, schools, hotel guestrooms, courtrooms, churches, hospital rooms.
NC 40	Satisfactory for conferences at a 6- to 8-foot table; normal voice 6 to 12 feet; telephone use satisfactory.	General office, labs, dining rooms.
NC 45	Satisfactory for conferences at a 4- to 5-foot table; normal voice 3 to 6 feet; raised voice 6 to 12 feet; telephone use occasionally difficult.	Retail stores, cafeterias, lobby areas, large drafting and engineering offices, reception areas.
> NC 50	Unsatisfactory for conference of more than two or three persons; normal voice 1 to 2 feet; raised voice 3 to 6 feet; telephone use slightly difficult.	Computer rooms, stenographic pools, print machine rooms, process areas.

Sizing a Return

Air volume going back to the air handler (fan) must equal what is supplied from the air handler. Therefore the total CFM capacity of the return grilles must equal or exceed the total CFM capacity of all the supply diffusers.

Keeping face velocity low

- Returns should be at 400-600 fpm maximum
- Filter Returns should be at 450 fpm maximum
- *ACCA recommends 300 max for filter grilles and 500 max for non-filter grilles.
- The rule of thumb is 2 cfm per square inch of filter size. See table below.
- Low velocity reduces noise, especially on stamped face grilles (672/673); fixed-bar grilles can handle more velocity without noise (94A/96AFB/RH45/RHF45/RCB).
- A single point return cannot be oversized like a supply. The system will not be affected adversely, only improved. *This does not apply to multiple return locations where balancing is more critical to pull in relevant amounts from each room.
- Static pressure is also reduced. Pressure works against & reduces blower delivery volume (cfm)
- Noise is not expected from a return.

Location

Filter Size	Area (in ²)	Ton (cfm)	Filter Size	Area (in ²)	Ton (cfm)		
12	12	144	n/a	20	20	400	2 (800)
12	20	240	1 (400)	20	25	500	2.5 (1000)
12	24	288	1.5 (600)	20	30	600	3 (1200)
12	30	360	1.5 (600)	20	36	720	3 (1200)
14	14	196	1 (400)	24	24	576	3 (1200)
14	20	280	1.5 (600)	24	30	720	3 (1200)
14	24	336	1.5 (600)	24	36	864	4 (1600)
14	30	420	2 (800)	25	25	625	3 (1200)
16	20	320	1.5 (600)	30	30	900	4 (1600)
16	24	384	2 (800)	30	36	1080	5 (2000)

- Returns should be put in stagnant air locations that need to be reconditioned.
 - High for cooling mode (hot air rises)
 - Low for heating mode (cold air falls)
 - Both modes, choose a primary season
- Returns should not be near a supply register's throw range. If at all possible place the return at an opposite corner of the room.

Room Air Movement

- Returns do NOT have much effect on a room's air movement, regardless of face velocity. They only grab air about a duct diameter away from the face. Most of the room air movement is done by the supplies.

Unlisted Sizes—Engineering Data

When a size is not listed there are a couple ways to do an engineered estimate. Airflow principles permit you to utilize existing sizes to determine sizes not shown.

Method 1: Use nearest nominal size table entry. If a 14x14 is not given, but a 20x10 is, since these two sizes have an approximate equal core area (196 and 200) the table entry for a 20x10 can be used to approximate what the 14x14 grille would perform to.

Method 2: A more exact method would be to do interpolation process between two listed sizes. If 14x14 is not given, but 18x10 and 20x10 are, then this equation will get more exact 14x14 data. $Y = Y1$

Recommended Noise Criteria and Face Velocity Ranges are on page 6

+ $\left[\frac{(X - X1) * (Y2 - Y1)}{(X2 - X1)} \right]$ where:

Y = unknown CFM or throw that is being computed for 14x14

Y1 = CFM or throw of listed 18x10 (for ex 600 cfm)

Y2 = CFM or throw of listed 20x10 (for ex 640 cfm)

X = 196 in² (nominal area of 14x14)

X1 = 180 in² (nominal area of 18x10)

X2 = 200 in² (nominal area of 20x10)

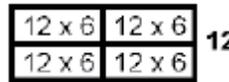
Using equation above computes $Y = 600 + \left[\frac{(196 - 180) * (640 - 600)}{(200 - 180)} \right] =$

$600 + \left[\frac{16 * 40}{20} \right] = 600 + 32 = 632$ cfm for Y

Method 3: Sizes beyond the table (smaller or larger) can have their CFM or Throw determined by using listed sizes by the following:

CFM for larger sizes:

If **24** looking for 24x6 or 24x12 cfm that is not listed, using the listed 12x6 cfm and doubling it or quadrupling it will give the answer for the 24x6 and 24x12, respectively.



CFM for smaller sizes:

If looking for a 6x6 cfm that is not listed, using the listed 12x6 cfm and halving it will give the answer for a 6x6.

Throw:

Double the size and CFM, multiply the throw by 1.5

Quadruple the size and CFM, multiply the throw by 2

Half the size and CFM, multiply the throw by .67

One quarter the size and CFM, multiply the throw by .5

*Pressure loss, face velocity and noise criteria will all remain the same relative to the listed size used to determine the larger or smaller sizes not shown.



RE5, RED5, REF5 Series Return Air Registers and Grilles
 Performance based on nominal sizes shown in bold

Nominal Duct Size (in.)	Nominal Duct Area sq. ft	Core Area sq. ft	Core Velocity Velocity Pressure 1x1x1 Neg. Ps ½x½x½ Neg. Ps	300		400		500		600		700		800		1000		1200		1400				
				0.006	0.01	0.016	0.022	0.031	0.04	0.054	0.073	0.096	0.15	0.216	0.294	NC 20	NC 30	NC 40	NC 20	NC 30	NC 40	NC 20	NC 30	NC 40
				0.013	0.024	0.037	0.053	0.073	0.095	0.148	0.213	0.29												
6x6	0.25	0.19	Airflow, cfm NC	57 -	76 -	95 -	114 10	133 17	152 22	190 31	228 39	266 45												
8x6	0.33	0.26	Airflow, cfm NC	78 -	104 -	130 -	156 10	182 17	208 22	260 31	312 39	364 45												
10x6	0.42	0.34	Airflow, cfm NC	102 -	136 -	170 -	204 11	238 17	272 23	340 32	408 39	476 46												
8x8	0.44	0.37	Airflow, cfm NC	111 -	148 -	185 -	222 11	259 17	296 23	370 32	444 39	518 46												
12x6	0.50	0.41	Airflow, cfm NC	123 -	164 -	205 -	246 11	287 18	328 23	410 32	492 40	574 46												
14x6	0.58	0.48	Airflow, cfm NC	144 -	192 -	240 -	288 11	336 18	384 23	480 32	576 40	672 46												
16x6			Airflow, cfm	171	228	285	342	399	456	570	684	798												
12x8	0.67	0.57	Airflow, cfm NC	-	-	-	12	18	23	32	40	46												
10x10	0.69	0.59	Airflow, cfm NC	177 -	236 -	295 -	354 12	413 18	472 23	590 33	708 40	826 46												
18x6	0.75	0.63	Airflow, cfm NC	189 -	252 -	315 -	378 12	441 18	504 24	630 33	756 40	882 46												
20x6			Airflow, cfm	216	288	360	432	504	576	720	864	1008												
12x10	0.83	0.72	Airflow, cfm NC	-	-	-	12	18	24	33	40	46												
22x6	0.92	0.77	Airflow, cfm NC	231 -	308 -	385 -	462 12	539 18	616 24	770 33	924 40	1078 47												
24x6			Airflow, cfm	264	352	440	528	616	704	880	1056	1232												
12x12	1.00	0.88	Airflow, cfm NC	-	-	-	12	18	24	33	40	47												
30x6			Airflow, cfm	333	444	555	666	777	888	1110	1332	1554												
18x10	1.25	1.11	Airflow, cfm NC	-	-	-	13	19	24	34	41	47												
14x14	1.36	1.22	Airflow, cfm NC	366 -	488 -	610 -	732 13	854 19	976 24	1220 34	1464 41	1708 47												
36x6			Airflow, cfm	405	540	675	810	945	1080	1350	1620	1890												
18x12	1.50	1.35	Airflow, cfm NC	-	-	-	13	19	24	34	41	47												
22x10	1.53	1.37	Airflow, cfm NC	411 -	548 -	685 -	822 13	959 19	1096 25	1370 34	1644 41	1918 47												
30x8			Airflow, cfm	447	596	745	894	1043	1192	1490	1788	2086												
24x10	1.67	1.49	Airflow, cfm NC	-	-	-	13	19	25	34	41	47												
42x6			Airflow, cfm	477	636	795	954	1113	1272	1590	1908	2226												
18x14	1.75	1.59	Airflow, cfm NC	-	-	-	13	19	25	34	41	47												
16x16	1.78	1.62	Airflow, cfm NC	486 -	648 -	810 -	972 13	1134 19	1296 25	1620 34	1944 41	2268 48												
24x12			Airflow, cfm	546	728	910	1092	1274	1456	1820	2184	2548												
18x16	2.00	1.82	Airflow, cfm NC	-	-	-	13	19	25	34	41	48												
18x18	2.25	2.07	Airflow, cfm NC	621 -	828 -	1035 -	1242 13	1449 19	1656 25	2070 34	2484 41	2898 48												
24x14	2.33	2.14	Airflow, cfm NC	642 -	856 -	1070 -	1284 13	1498 20	1712 25	2140 34	2568 42	2996 48												
30x12	2.50	2.29	Airflow, cfm NC	687 -	916 -	1145 -	1374 13	1603 20	1832 25	2290 34	2748 42	3206 48												
24x16	2.67	2.46	Airflow, cfm NC	738 -	984 -	1230 -	1476 13	1722 20	1968 25	2460 34	2952 42	3444 48												
20x20	2.78	2.57	Airflow, cfm NC	771 -	1028 -	1285 -	1542 13	1799 20	2056 25	2570 34	3084 42	3598 48												
36x12	3.00	2.75	Airflow, cfm NC	825 -	1100 -	1375 -	1650 14	1925 20	2200 25	2750 34	3300 42	3850 48												
30x16			Airflow, cfm	933	1244	1555	1866	2177	2488	3110	3732	4354												
24x20	3.33	3.11	Airflow, cfm NC	-	-	-	14	20	25	35	42	48												
22x22	3.36	3.14	Airflow, cfm NC	942 -	1256 -	1570 -	1884 14	2198 20	2512 25	3140 35	3768 42	4396 48												
42x12			Airflow, cfm	966	1288	1610	1932	2254	2576	3220	3864	4508												
36x14	3.50	3.22	Airflow, cfm NC	-	-	-	14	20	26	35	42	48												
24x22	3.67	3.43	Airflow, cfm NC	1029 -	1372 -	1715 -	2058 14	2401 20	2744 26	3430 35	4116 42	4802 48												
30x18	3.75	3.50	Airflow, cfm NC	1050 -	1400 -	1750 -	2100 14	2450 20	2800 26	3500 35	4200 42	4900 48												

• Static pressures are negative, in inches of water, measured per ANSI/ASHRAE Standard 70-2006

• NC based on room absorption of 10dB, re 10⁻¹² watts, measured per ANSI/ASHRAE Standard 70-2006

