

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)

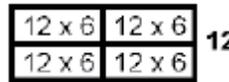
Using equation above computes $Y = 600 + \left[\frac{(196 - 180) * (640 - 600)}{(200 - 180)} \right] =$

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

REN4

Neck Velocity		180	220	300	350	400	450	500	580	650	700
6" Diameter Ak .430	CFM	35	45	60	70	80	90	100	115	130	135
	Ps	.002	.003	.004	.006	.008	.010	.012	.015	.020	.022
	NC	<20	<20	<20	<20	<20	<20	20	22	26	30
	Throw	3.0	3.5	4.5	5.5	6.5	7.5	8.0	9.0	11.0	11.0
8" Diameter Ak .530	CFM	65	75	105	120	140	155	175	200	225	245
	Ps	.002	.003	.006	.008	.010	.013	.016	.021	.027	.032
	NC	<20	<20	<20	<20	<20	22	25	30	35	38
	Throw	4.0	5.0	6.0	7.0	8.5	9.5	11.0	12.0	13.0	15.0
10" Diameter Ak .620	CFM	100	120	165	190	220	245	275	315	355	380
	Ps	.003	.005	.009	.011	.015	.019	.024	.031	.040	.045
	NC	<20	<20	<20	<20	20	23	27	33	35	39
	Throw	4.0	5.5	7.0	8.0	9.5	11.0	12.0	13.0	15.0	16.0
12" Diameter Ak .700	CFM	140	175	235	275	315	355	395	455	510	550
	Ps	.005	.007	.013	.018	.023	.029	.036	.048	.061	.071
	NC	<20	<20	<20	<20	21	24	27	33	36	40
	Throw	4.5	5.5	7.0	8.0	10.0	11.0	12.0	14.0	15.0	17.0
14" Diameter Ak .750	CFM	190	235	320	375	430	480	535	620	695	750
	Ps	.007	.011	.020	.027	.036	.044	.055	.074	.094	.107
	NC	<20	<20	<20	<20	24	28	32	39	45	48
	Throw	4.5	5.5	7.0	8.5	10.0	11.0	12.0	14.0	16.0	17.0

Note: The use of a balancing hood is recommended to balance the system.

NC is based on 10dB room attenuation (Re: 10⁻¹² watts) ASHRAE 36-72.
Terminal Velocity of 75 FPM

RENPS, RENPS 56, ARENPS, PDS

Neck Velocity		300	400	500	600	700	800	900	1000	1100
6" Diameter An .200	CFM	60	80	100	120	140	160	180	200	220
	Ps	.008	.011	.017	.024	.032	.042	.054	.066	.080
	NC	<20	<20	<20	<20	24	27	32	36	38
	Throw	1.0	2.0	3.0	3.0	4.0	4.0	5.0	5.0	6.0
8" Diameter An .350	CFM	105	140	175	210	245	280	310	350	385
	Ps	.008	.011	.017	.024	.034	.043	.054	.068	.083
	NC	<20	<20	<20	<20	20	24	27	30	34
	Throw	2.0	3.0	4.0	4.0	5.0	6.0	7.0	8.0	8.5
10" Diameter An .540	CFM	165	220	270	325	385	430	490	550	600
	Ps	.008	.012	.017	.024	.032	.043	.056	.068	.082
	NC	<20	<20	<20	<20	24	29	33	36	39
	Throw	2.0	3.0	4.0	5.0	5.0	6.0	7.0	8.0	9.0
12" Diameter An .780	CFM	230	310	390	470	550	610	700	780	870
	Ps	.009	.016	.026	.037	.050	.065	.080	.100	.125
	NC	<20	<20	<20	<20	23	26	31	34	37
	Throw	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0
14" Diameter An 1.070	CFM	315	430	535	640	750	855	960	1090	1200
	Ps	.009	.016	.026	.037	.050	.065	.083	.125	.150
	NC	<20	<20	<20	<20	30	35	39	43	45
	Throw	3.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0

Note: The use of a balancing hood is recommended to balance the system.

NC is based on 10dB room attenuation (Re: 10⁻¹² watts) ASHRAE 36-72.
Terminal Velocity of 75 FPM An = Neck Area in Sq. Ft.

PDS

AFPD, HVS/HVS R6, FPD/FPD R6, FPD3/FPD3 R6

Neck Velocity		400	500	600	700	800	900	1000	1200	1400	1600
6" Diameter An .200 Ak .780	CFM	80	100	120	135	155	175	195	235	275	315
	Ps	.008	.012	.017	.021	.028	.035	.043	.063	.086	.112
	NC	<20	<20	<20	<20	<20	<20	20	25	30	35
	Throw	2.0	3.0	3.0	3.5	4.0	4.5	5.0	6.0	7.0	8.0
8" Diameter An .350 Ak .920	CFM	140	175	210	245	280	315	350	420	490	560
	Ps	.010	.015	.022	.029	.038	.049	.060	.086	.117	.150
	NC	<20	<20	<20	<20	20	25	30	35	40	45
	Throw	3.5	4.5	5.5	6.5	7.0	8.0	9.0	10.5	12.5	14.5
10" Diameter An .540 Ak 1.200	CFM	220	270	325	380	435	490	545	655	765	870
	Ps	.014	.021	.030	.041	.054	.068	.084	.122	.167	.212
	NC	<20	<20	<20	<20	25	30	35	40	45	50
	Throw	5.5	7.0	8.5	10.0	11.0	12.5	14.0	17.0	19.5	22.0
12" Diameter An .780 Ak 1.650	CFM	315	390	470	550	630	705	785	940	1100	1255
	Ps	.015	.023	.033	.045	.060	.072	.094	.132	.180	.230
	NC	<20	<20	<20	<20	30	35	40	45	50	55
	Throw	6.0	7.5	9.0	10.5	12.0	13.5	15.0	18.0	21.0	24.0
14" Diameter An 1.070 Ak 2.060	CFM	430	535	640	750	855	960	1070	1285	1500	1710
	Ps	.023	.036	.051	.071	.093	.115	.140	.205	.277	.350
	NC	<20	<20	<20	<20	30	35	40	45	50	55
	Throw	6.5	8.0	9.5	11.5	13.0	14.5	16.0	19.0	22.5	25.0

Terminal Velocity of 75 FPM

An = Neck Area in Sq. Ft.

NC = Noise Criteria based on 10dB room absorption (Re: 10⁻¹² watts).

Neck Velocity		300	400	500	600	700	800	900	1000	1200
6" Diameter An .200	CFM	60	80	100	120	135	155	175	195	235
	Ps	.007	.013	.020	.029	.037	.048	.062	.076	.110
	NC	<20	<20	<20	<20	21	24	28	33	37
	Throw	4.0	6.0	7.0	8.0	10.0	11.0	13.0	14.0	16.0
8" Diameter An .350	CFM	105	140	175	210	245	280	315	350	420
	Ps	.011	.019	.030	.043	.059	.077	.097	.120	.173
	NC	<20	<20	<20	<20	22	27	31	35	40
	Throw	6.0	8.0	10.0	11.5	13.0	14.5	16.0	18.0	21.0
10" Diameter An .540	CFM	165	220	270	325	380	435	490	545	655
	Ps	.015	.026	.040	.046	.076	.100	.125	.150	.225
	NC	<20	<20	<20	<20	21	27	33	37	45
	Throw	8.5	11.0	14.0	16.5	19.0	22.0	25.0	27.0	30.0
12" Diameter An .780	CFM	235	315	395	470	550	630	705	785	940
	Ps	.016	.029	.045	.068	.086	.113	.140	.170	.250
	NC	<20	<20	<20	<20	25	32	35	38	44
	Throw	10.0	13.0	16.5	19.5	22.0	25.0	27.0	30.0	34.0
14" Diameter An 1.070	CFM	320	430	535	640	750	855	960	1070	1285
	Ps	.021	.037	.057	.082	.112	.145	.180	.225	.320
	NC	<20	<20	<20	<20	26	31	36	40	44
	Throw	11.0	15.0	19.0	22.5	26.0	29.0	32.0	35.0	39.0

Notes: The use of a balancing hood is recommended to balance the system.

NC is based on 10dB room attenuation (Re: 10⁻¹² watts) ASHRAE 36-72.
Terminal Velocity of 75 FPM

DPD/DPD R6, ADPD

Neck Velocity		400	500	600	700	800	900	1000	1200	1400	1600
6" Diameter An .200 Ak .279	CFM	80	100	120	135	155	175	195	235	275	315
	Ps	.006	.010	.014	.018	.023	.030	.037	.054	.073	.096
	NC	<20	<20	<20	<20	<20	20	25	30	35	40
	Throw	1.0	2.0	2.0	2.5	3.0	3.5	4.0	4.5	5.5	6.5
8" Diameter An .350 Ak .354	CFM	140	175	210	245	280	315	350	420	490	560
	Ps	.010	.015	.022	.029	.038	.049	.060	.086	.117	.150
	NC	<20	<20	<20	<20	20	25	30	35	40	45
	Throw	2.5	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0
10" Diameter An .540 Ak .400	CFM	220	275	325	380	435	490	545	655	765	875
	Ps	.014	.021	.030	.041	.054	.068	.084	.122	.167	.212
	NC	<20	<20	<20	<20	20	25	30	35	40	45
	Throw	4.0	5.5	6.5	8.0	9.0	10.5	11.5	14.5	17.0	20.0
12" Diameter An .780 Ak .397	CFM	315	395	470	550	630	705	785	945	1100	1260
	Ps	.015	.023	.033	.045	.060	.072	.094	.132	.180	.230
	NC	<20	<20	<20	<20	30	35	40	45	50	55
	Throw	5.5	7.0	8.5	10.0	11.5	13.0	14.5	17.5	20.5	24.0
14" Diameter An 1.070 Ak .393	CFM	430	535	640	750	855	960	1070	1280	1500	1710
	Ps	.023	.036	.051	.071	.093	.115	.140	.205	.277	.350
	NC	<20	<20	<20	<20	30	35	40	45	50	55
	Throw	7									