HART COOLEY®
BY duravent

Using the Engineering Data

For most of the models & sizes we've done the calculations for you.

421

Face Velocity		300	400	500	600	700	800
Pressure Loss		.006	.010	.016	.022	.031	.040
4x10	CFM	50	70	85	100	120	135
Ak	Spread	4.5	5.0	6.5	7.5	9.0	10.0
.170	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
4x10 Ak	CFM	420	525	625	730	835
1.045	Throw	17.0	21.0	25.0	29.0	33.0

Terminal velocity of 75 fpm

CFM = volume of air flow in cubic feet per minute

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 (in^2) 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 in^2) 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 (ft^2) 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 applica-

tion. 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, in most cases, will 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.

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

Engineering Data

*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).
• You really can't oversize a single point return like you can with 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)
• No one expects noise from a return.
Location
• Returns should be put in stagnant air locations that need to be reconditioned.

Filter Size		Area (in²)	Ton (cfm)	Filter Size		Area (in²)	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)

- 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 the 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. $Y = Y1 + [\{(X - X1) * (Y2-Y1)\} / (X2 - X1)]$ 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 $Y = 600 + [\{(196 – 180) * (640 – 600)\} / (200 – 180)] =$
$600 + [\{16 * 40\} / 20] = 600 + 32 = 632$ 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:

24		
12 x 6	12 x 6	12
12 x 6	12 x 6	12

CFM for larger sizes:
If 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.