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 (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 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

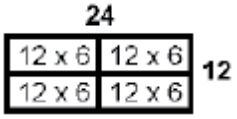
When a size is not listed there are a couple ways to do an engineered estimate. Airflow principles permit you to utilize existing sizes to determine sizes not shown.

Method 1: Use nearest nominal size table entry. If a 14x14 is not given, but a 20x10 is, since 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 in^2 (nominal area of 14x14)
X1 = 180 in^2 (nominal area of 18x10)
X2 = 200 in^2 (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:

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.

Recommended Noise Criteria and Face Velocity Ranges are on page 6

S Series - Wall Mount, Horizontal Flow

IP/METRIC DATA: 1/2" SLOT WIDTH, CONTINUOUS SLOT

	IP Data					Metric Data										
	Air Flow	Press Ps	1-Way Throw	2-Way Throw	NC	Air Flow	Press Ps	1-Way Throw	2-Way Throw	Octave Band, dB					
	CFM/ft	"WG	ft	ft		L/s/m	Pa	m	m	2	3	4	5	6	7
1 Slot	5	0.004	1 - 2 - 7		-	8	1.1	0.2 - 0.6 - 2.2		37	24	24	12	-	-
	13	0.030	6 - 9 - 18		26	20	7.4	1.7 - 2.8 - 5.4		48	44	42	33	26	23
	17	0.051	8 - 12 - 20		32	26	12.7	2.5 - 3.7 - 6.2		51	49	47	39	32	28
	21	0.078	10 - 15 - 23		36	33	19.3	3.0 - 4.5 - 6.8		53	53	51	44	37	32
	29	0.148	14 - 19 - 26		43	45	36.9	4.2 - 5.7 - 8.0		57	60	57	51	44	38
2 Slots	10	0.004	2 - 4 - 12	1 - 3 - 8	10	15	1.1	0.5 - 1.2 - 3.5	0.4 - 0.9 - 2.5	40	27	27	15	-	-
	22	0.021	9 - 13 - 23	6 - 9 - 16	26	34	5.3	2.6 - 3.9 - 7.0	1.8 - 2.8 - 5.0	49	43	42	33	25	23
	28	0.035	11 - 16 - 26	8 - 12 - 18	31	43	8.6	3.3 - 5.0 - 7.9	2.3 - 3.5 - 5.6	51	48	46	38	31	27
	34	0.051	13 - 20 - 29	9 - 14 - 20	35	53	12.7	4.0 - 6.0 - 8.7	2.8 - 4.3 - 6.2	54	52	50	42	35	31
	46	0.093	18 - 24 - 33	13 - 17 - 24	41	71	23.2	5.4 - 7.2 - 10.1	3.8 - 5.1 - 7.2	57	58	55	49	42	36
3 Slots	15	0.004	3 - 6 - 15		12	23	1.1	0.8 - 1.8 - 4.6		37	21	21	-	-	-
	31	0.019	10 - 16 - 27		27	48	4.7	3.2 - 4.8 - 8.3		50	44	42	33	25	23
	39	0.030	13 - 20 - 31		31	60	7.4	4.0 - 6.0 - 9.3		52	48	46	38	31	28
	47	0.043	16 - 24 - 34		35	73	10.8	4.8 - 7.2 - 10.2		54	52	50	42	35	31
	63	0.078	21 - 28 - 39		41	98	19.3	6.5 - 8.4 - 11.9		58	58	55	49	42	36
4 Slots	20	0.004	3 - 8 - 18	2 - 5 - 13	13	31	1.1	1.0 - 2.3 - 5.5	0.7 - 1.6 - 3.9	43	30	30	18	-	11
	40	0.018	12 - 18 - 31	9 - 13 - 22	27	62	4.4	3.7 - 5.5 - 9.4	2.6 - 3.9 - 6.7	51	44	43	34	26	24
	50	0.028	15 - 23 - 35	11 - 16 - 25	32	77	6.9	4.6 - 6.9 - 10.6	3.3 - 4.9 - 7.5	53	49	47	39	31	28
	60	0.040	18 - 27 - 38	13 - 19 - 27	36	93	9.9	5.5 - 8.2 - 11.6	3.9 - 5.8 - 8.2	55	52	50	43	35	32
	80	0.070	24 - 31 - 44	17 - 22 - 31	41	124	17.5	7.4 - 9.4 - 13.4	5.2 - 6.7 - 9.4	58	58	56	49	42	37
5 Slots	25	0.004	4 - 9 - 21		14	39	1.1	1.2 - 2.8 - 6.3		44	31	31	19	11	12
	49	0.017	14 - 20 - 34		28	76	4.2	4.1 - 6.2 - 10.5		51	45	43	34	26	25
	61	0.026	17 - 25 - 38		32	94	6.5	5.1 - 7.7 - 11.7		54	49	47	39	31	29
	73	0.038	20 - 30 - 42		36	113	9.4	6.1 - 9.0 - 12.8		56	53	51	43	36	32
	97	0.066	27 - 34 - 48		42	150	16.5	8.1 - 10.4 - 14.7		59	59	56	49	42	37
6 Slots	30	0.004	5 - 10 - 23	3 - 7 - 16	15	46	1.1	1.4 - 3.2 - 7.0	1.0 - 2.2 - 5.0	45	32	32	20	12	13
	58	0.016	15 - 22 - 37	10 - 16 - 26	28	90	4.1	4.5 - 6.8 - 11.4	3.2 - 4.8 - 8.0	52	45	44	35	27	25
	72	0.025	18 - 28 - 42	13 - 20 - 29	33	111	6.3	5.6 - 8.4 - 12.7	4.0 - 5.9 - 9.0	54	50	48	39	32	29
	86	0.036	22 - 32 - 46	16 - 23 - 32	37	133	9.0	6.7 - 9.8 - 13.9	4.7 - 6.9 - 9.8	56	53	51	43	36	32
	114	0.064	29 - 37 - 52	21 - 26 - 37	42	177	15.8	8.9 - 11.3 - 16.0	6.3 - 8.0 - 11.3	60	59	57	50	42	38
7 Slots	35	0.004	5 - 12 - 25		16	54	1.1	1.6 - 3.5 - 7.6		44	29	29	17	-	11
	65	0.015	16 - 23 - 40		28	101	3.8	4.7 - 7.1 - 12.0		52	45	44	34	27	25
	80	0.023	19 - 29 - 44		33	124	5.7	5.8 - 8.7 - 13.4		55	49	48	39	31	29
	95	0.032	23 - 34 - 48		36	147	8.1	6.9 - 10.3 - 14.6		57	53	51	43	35	32
	125	0.056	30 - 39 - 55		42	194	14.0	9.1 - 11.8 - 16.7		60	58	56	49	42	37
8 Slots	40	0.004	6 - 13 - 27	4 - 9 - 19	16	62	1.1	1.7 - 3.9 - 8.2	1.2 - 2.7 - 5.8	46	33	33	21	13	14
	74	0.015	17 - 25 - 42	12 - 18 - 30	29	115	3.8	5.1 - 7.6 - 12.9	3.6 - 5.4 - 9.1	53	46	44	35	27	26
	91	0.023	21 - 31 - 47	15 - 22 - 33	33	141	5.7	6.3 - 9.4 - 14.3	4.4 - 6.6 - 10.1	55	50	48	39	32	29
	108	0.032	24 - 36 - 51	17 - 26 - 36	37	167	8.0	7.4 - 11.0 - 15.5	5.2 - 7.8 - 11.0	57	53	51	43	36	33
	142	0.056	32 - 41 - 59	23 - 29 - 41	42	220	13.8	9.8 - 12.6 - 17.8	6.9 - 8.9 - 12.6	60	59	57	49	42	38

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. Odd numbered slots for 2-Way data have been intentionally left blank. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

Engineering Data

HART COOLEY

S Series - Ceiling Mount, Vertical Flow with Pattern Controller

IP/METRIC DATA: 1/2" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data									
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB						
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7	
1 Slot	5	0.003	1 - 2 - 5	-	8	0.6	0.3 - 0.6 - 1.5	-	-	-	-	-	-	
	35	0.127	12 - 14 - 20	**15**	54	31.5	3.5 - 4.3 - 6.1	43	39	30	16	11	-	
	50	0.259	14 - 17 - 24	**24**	78	64.4	4.2 - 5.2 - 7.3	50	46	39	22	17	-	
	65	0.437	16 - 19 - 27	**30**	101	108.8	4.8 - 5.9 - 8.3	54	52	45	27	21	14	
	95	0.933	19 - 23 - 33	**40**	147	232.4	5.8 - 7.1 - 10.0	61	60	54	34	27	20	
2 Slots	10	0.003	1 - 3 - 7	-	16	0.6	0.4 - 1.0 - 2.3	-	-	-	-	-	-	
	60	0.093	15 - 19 - 26	**14**	93	23.2	4.5 - 5.6 - 8.0	43	38	30	16	12	-	
	85	0.187	18 - 22 - 31	**23**	132	46.5	5.5 - 6.7 - 9.5	50	46	38	23	17	-	
	110	0.313	21 - 25 - 36	**30**	171	77.9	6.2 - 7.6 - 10.8	54	51	44	27	21	14	
	160	0.662	25 - 30 - 43	**39**	248	164.8	7.5 - 9.2 - 13.0	61	59	53	34	27	20	
3 Slots	15	0.003	2 - 4 - 9	-	23	0.6	0.5 - 1.2 - 2.8	-	-	-	-	-	-	
	85	0.083	17 - 22 - 31	**15**	132	20.7	5.3 - 6.7 - 9.5	44	39	30	17	13	-	
	120	0.165	21 - 26 - 37	**24**	186	41.2	6.5 - 8.0 - 11.3	50	46	38	23	18	11	
	155	0.276	24 - 30 - 42	**30**	241	68.7	7.4 - 9.1 - 12.8	55	52	44	28	22	15	
	225	0.582	29 - 36 - 51	**39**	349	144.8	8.9 - 10.9 - 15.5	62	59	53	34	28	21	
4 Slots	20	0.003	2 - 5 - 11	-	31	0.6	0.6 - 1.4 - 3.2	13	-	-	-	-	-	
	110	0.078	20 - 25 - 36	**16**	171	19.5	6.0 - 7.6 - 10.8	45	39	31	18	13	-	
	155	0.155	24 - 30 - 42	**24**	241	38.7	7.4 - 9.1 - 12.8	51	47	39	24	19	12	
	200	0.259	28 - 34 - 48	**31**	310	64.4	8.4 - 10.3 - 14.6	56	52	45	28	23	16	
	290	0.544	33 - 41 - 58	**40**	450	135.3	10.1 - 12.4 - 17.6	62	60	53	35	28	21	
5 Slots	25	0.003	2 - 5 - 12	-	39	0.6	0.7 - 1.6 - 3.6	14	-	-	-	-	-	
	125	0.065	20 - 27 - 38	**15**	194	16.1	6.1 - 8.1 - 11.5	44	38	30	17	13	-	
	175	0.127	26 - 32 - 45	**23**	272	31.5	7.9 - 9.6 - 13.6	50	46	37	23	18	11	
	225	0.209	29 - 36 - 51	**29**	349	52.1	8.9 - 10.9 - 15.5	55	51	43	28	22	15	
	325	0.437	35 - 43 - 61	**39**	505	108.8	10.7 - 13.1 - 18.6	61	59	52	34	28	21	
6 Slots	30	0.003	3 - 6 - 13	-	47	0.6	0.8 - 1.8 - 4.0	15	-	-	-	-	-	
	150	0.065	22 - 29 - 42	**16**	233	16.1	6.7 - 8.9 - 12.6	45	39	30	18	14	-	
	210	0.127	28 - 35 - 49	**24**	326	31.5	8.6 - 10.6 - 14.9	51	46	38	24	19	12	
	270	0.209	32 - 39 - 56	**30**	419	52.1	9.8 - 12.0 - 16.9	55	52	44	28	23	16	
	390	0.437	39 - 47 - 67	**39**	605	108.8	11.8 - 14.4 - 20.4	62	59	53	35	29	22	
7 Slots	35	0.003	3 - 6 - 14	-	54	0.6	0.9 - 1.9 - 4.3	13	-	-	-	-	-	
	185	0.072	25 - 33 - 46	**18**	287	18.0	7.6 - 9.9 - 14.0	46	41	32	19	15	-	
	260	0.143	32 - 39 - 55	**26**	404	35.5	9.6 - 11.8 - 16.6	53	48	40	26	21	14	
	335	0.237	36 - 44 - 62	**33**	520	59.0	10.9 - 13.3 - 18.9	57	54	46	30	24	17	
	485	0.496	43 - 53 - 75	**42**	753	123.6	13.1 - 16.0 - 22.7	64	61	55	37	30	23	
8 Slots	40	0.003	3 - 7 - 15	-	62	0.6	0.9 - 2.1 - 4.6	16	-	-	-	-	-	
	200	0.065	25 - 34 - 48	**17**	310	16.1	7.7 - 10.3 - 14.6	46	40	32	19	15	-	
	280	0.127	33 - 40 - 57	**25**	435	31.5	10.0 - 12.2 - 17.2	52	48	40	25	20	13	
	360	0.209	37 - 45 - 64	**32**	559	52.1	11.3 - 13.8 - 19.6	57	53	45	30	24	17	
	520	0.437	45 - 55 - 77	**41**	807	108.8	13.6 - 16.6 - 23.5	63	61	54	36	30	23	

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

S Series - Ceiling Mount, Vertical Flow with No Pattern Controller

IP/METRIC DATA: 1/2" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data									
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB						
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7
1 Slot	5	0.001	0 - 1 - 3	-	8	0.3	0.1 - 0.3 - 1.0	-	-	-	-	-	-
	55	0.162	11 - 14 - 20	18	85	40.3	3.5 - 4.2 - 6.0	48	38	34	20	-	-
	80	0.342	14 - 17 - 24	26	124	85.2	4.2 - 5.1 - 7.2	55	45	41	26	15	-
	105	0.590	16 - 19 - 27	32	163	146.8	4.8 - 5.8 - 8.3	60	49	46	30	19	11
	155	1.285	19 - 23 - 33	41	240	320.0	5.8 - 7.1 - 10.0	67	56	53	36	25	17
2 Slots	10	0.001	1 - 2 - 5	-	15	0.3	0.2 - 0.5 - 1.6	-	-	-	-	-	-
	90	0.108	15 - 18 - 25	17	139	27.0	4.4 - 5.4 - 7.7	48	38	34	20	-	-
	130	0.226	17 - 21 - 30	25	201	56.3	5.3 - 6.5 - 9.2	54	44	40	26	15	-
	170	0.386	20 - 24 - 35	31	263	96.2	6.1 - 7.4 - 10.5	59	49	45	30	19	12
	250	0.836	24 - 30 - 42	40	387	208.1	7.4 - 9.0 - 12.8	66	55	52	36	24	17
3 Slots	15	0.001	1 - 2 - 7	-	23	0.3	0.3 - 0.7 - 2.1	-	-	-	-	-	-
	115	0.079	16 - 20 - 28	16	178	19.6	5.0 - 6.1 - 8.7	47	37	33	19	-	-
	165	0.162	20 - 24 - 34	24	255	40.3	6.0 - 7.3 - 10.4	53	43	39	25	14	-
	215	0.275	22 - 28 - 39	30	333	68.4	6.8 - 8.4 - 11.8	58	48	44	29	18	11
	315	0.590	27 - 33 - 47	39	488	146.8	8.3 - 10.1 - 14.3	65	54	51	35	24	16
4 Slots	20	0.001	1 - 3 - 8	-	31	0.3	0.4 - 0.8 - 2.4	11	-	-	-	-	-
	150	0.075	19 - 23 - 33	17	232	18.7	5.7 - 7.0 - 9.9	47	38	33	20	-	-
	215	0.155	22 - 28 - 39	25	333	38.5	6.8 - 8.4 - 11.8	54	44	40	26	15	-
	280	0.262	26 - 31 - 44	31	434	65.3	7.8 - 9.5 - 13.5	59	49	45	30	19	12
	410	0.562	31 - 38 - 54	40	635	139.9	9.4 - 11.6 - 16.3	66	55	52	36	25	17
5 Slots	25	0.001	1 - 3 - 9	-	39	0.3	0.4 - 1.0 - 2.7	12	-	-	-	-	-
	185	0.073	21 - 26 - 36	18	286	18.2	6.3 - 7.8 - 11.0	48	39	34	21	11	-
	265	0.150	25 - 31 - 43	26	410	37.4	7.6 - 9.3 - 13.1	55	45	41	26	16	-
	345	0.255	28 - 35 - 49	32	534	63.4	8.7 - 10.6 - 15.0	59	49	45	31	20	13
	505	0.546	34 - 42 - 60	40	782	135.9	10.5 - 12.8 - 18.1	66	56	52	36	25	18
6 Slots	30	0.001	2 - 4 - 10	-	46	0.3	0.5 - 1.1 - 3.0	13	-	-	-	-	-
	210	0.066	22 - 27 - 38	18	325	16.3	6.8 - 8.3 - 11.7	48	39	34	21	11	-
	300	0.134	27 - 33 - 46	25	465	33.3	8.1 - 9.9 - 14.0	54	45	40	26	16	-
	390	0.226	30 - 37 - 52	31	604	56.3	9.2 - 11.3 - 15.9	59	49	45	30	20	13
	570	0.483	37 - 45 - 63	40	883	120.2	11.1 - 13.6 - 19.3	66	55	52	36	25	18
7 Slots	35	0.001	2 - 4 - 11	-	54	0.3	0.5 - 1.2 - 3.3	11	-	-	-	-	-
	235	0.060	23 - 29 - 41	18	364	15.0	7.1 - 8.7 - 12.4	48	39	34	21	11	-
	335	0.123	28 - 34 - 49	25	519	30.5	8.5 - 10.4 - 14.8	54	45	40	26	16	-
	435	0.207	32 - 39 - 55	31	674	51.4	9.7 - 11.9 - 16.8	59	49	45	30	20	13
	635	0.440	39 - 47 - 67	40	983	109.6	11.7 - 14.4 - 20.3	66	55	52	36	25	18
8 Slots	40	0.001	2 - 4 - 12	-	62	0.3	0.6 - 1.3 - 3.5	14	-	-	-	-	-
	260	0.057	25 - 30 - 43	18	403	14.1	7.5 - 9.2 - 13.0	48	39	34	21	11	-
	370	0.114	29 - 36 - 51	25	573	28.5	9.0 - 11.0 - 15.5	54	45	40	26	16	-
	480	0.193	34 - 41 - 58	31	743	47.9	10.2 - 12.5 - 17.7	59	49	45	30	20	13
	700	0.410	41 - 50 - 70	40	1084	102.0	12.3 - 15.1 - 21.3	66	55	52	36	25	18

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

Engineering Data

HART COOLEY

S Series - Wall Mount, Horizontal Flow

IP/METRIC DATA: 3/4" SLOT WIDTH, CONTINUOUS SLOT

	IP Data					Metric Data										
	Air Flow	Press Ps	1-Way Throw	2-Way Throw	NC	Air Flow	Press Ps	1-Way Throw	2-Way Throw	Octave Band, dB					
	CFM/ft	"WG	ft	ft		L/s/m	Pa	m	m	2	3	4	5	6	7
1 Slot	5	0.003	1 - 1 - 6		-	8	0.8	0.2 - 0.4 - 1.7		26	12	-	-	-	-
	15	0.030	6 - 10 - 19		14	23	7.4	1.7 - 3.0 - 5.8		40	34	31	19	-	-
	20	0.053	9 - 13 - 22		21	31	13.2	2.6 - 4.0 - 6.7		43	40	37	28	19	14
	25	0.083	11 - 16 - 25		27	39	20.7	3.3 - 4.9 - 7.5		46	45	43	34	26	19
	35	0.163	15 - 21 - 29		35	54	40.5	4.6 - 6.2 - 8.8		50	52	50	44	36	27
2 Slots	10	0.003	1 - 3 - 10	1 - 2 - 7	-	16	0.8	0.4 - 0.9 - 3.2	0.3 - 0.6 - 2.2	29	15	-	-	-	-
	30	0.030	10 - 16 - 27	7 - 11 - 19	17	47	7.4	3.2 - 4.7 - 8.2	2.2 - 3.4 - 5.8	43	37	34	22	13	11
	40	0.053	14 - 21 - 31	10 - 15 - 22	25	62	13.2	4.2 - 6.3 - 9.4	3.0 - 4.5 - 6.7	46	43	40	31	22	17
	50	0.083	17 - 25 - 35	12 - 17 - 25	30	78	20.7	5.3 - 7.5 - 10.6	3.7 - 5.3 - 7.5	49	48	46	37	29	22
	70	0.163	24 - 29 - 41	17 - 21 - 29	39	109	40.5	7.2 - 8.8 - 12.5	5.1 - 6.2 - 8.8	53	55	53	47	39	30
3 Slots	15	0.003	2 - 4 - 13		-	23	0.8	0.6 - 1.2 - 4.1		26	-	-	-	-	-
	45	0.030	13 - 20 - 33		19	70	7.4	4.1 - 6.1 - 10.0		45	39	36	24	15	12
	60	0.053	18 - 27 - 38		27	93	13.2	5.4 - 8.1 - 11.6		48	45	42	33	24	19
	75	0.083	22 - 30 - 43		32	116	20.7	6.8 - 9.1 - 12.9		51	50	47	39	31	24
	105	0.163	29 - 36 - 50		41	163	40.5	8.8 - 10.8 - 15.3		55	56	55	49	41	32
4 Slots	20	0.003	2 - 5 - 16	2 - 4 - 11	-	31	0.8	0.7 - 1.6 - 4.8	0.5 - 1.1 - 3.4	32	18	12	-	-	-
	60	0.030	16 - 24 - 38	11 - 17 - 27	21	93	7.4	4.8 - 7.2 - 11.6	3.4 - 5.1 - 8.2	46	40	37	25	17	14
	80	0.053	21 - 31 - 44	15 - 22 - 31	28	124	13.2	6.4 - 9.4 - 13.4	4.6 - 6.7 - 9.4	49	46	43	34	25	20
	100	0.083	26 - 35 - 49	19 - 25 - 35	34	155	20.7	8.0 - 10.6 - 14.9	5.7 - 7.5 - 10.6	52	51	49	40	32	25
	140	0.163	34 - 41 - 58	24 - 29 - 41	42	217	40.5	10.2 - 12.5 - 17.7	7.2 - 8.8 - 12.5	56	58	56	50	42	33
5 Slots	25	0.003	3 - 6 - 18		-	39	0.8	0.8 - 1.8 - 5.5		33	19	13	-	-	-
	75	0.030	18 - 27 - 43		22	116	7.4	5.5 - 8.2 - 12.9		47	41	38	26	17	15
	100	0.053	24 - 35 - 49		29	155	13.2	7.3 - 10.6 - 14.9		50	47	44	35	26	21
	125	0.083	30 - 39 - 55		35	194	20.7	9.1 - 11.8 - 16.7		53	52	50	41	33	26
	175	0.163	38 - 46 - 65		43	272	40.5	11.4 - 14.0 - 19.8		57	59	57	51	43	34
6 Slots	30	0.003	3 - 7 - 20	2 - 5 - 14	-	47	0.8	0.9 - 2.1 - 6.1	0.7 - 1.5 - 4.3	34	19	13	-	-	-
	90	0.030	20 - 30 - 47	14 - 21 - 33	23	140	7.4	6.1 - 9.1 - 14.2	4.3 - 6.4 - 10.0	48	42	39	27	18	15
	120	0.053	27 - 38 - 54	19 - 27 - 38	30	186	13.2	8.1 - 11.6 - 16.4	5.7 - 8.2 - 11.6	51	48	45	36	27	22
	150	0.083	33 - 43 - 60	24 - 30 - 43	35	233	20.7	10.1 - 12.9 - 18.3	7.2 - 9.1 - 12.9	54	53	50	42	34	27
	210	0.163	41 - 50 - 71	29 - 36 - 50	44	326	40.5	12.5 - 15.3 - 21.6	8.8 - 10.8 - 15.3	58	59	58	52	44	35
7 Slots	35	0.003	3 - 8 - 22		-	54	0.8	1.0 - 2.3 - 6.6		33	17	-	-	-	-
	101	0.028	21 - 31 - 49		22	157	6.9	6.4 - 9.6 - 15.0		48	42	38	27	18	15
	134	0.049	28 - 40 - 57		30	208	12.1	8.5 - 12.2 - 17.3		51	48	45	35	26	22
	167	0.076	35 - 45 - 64		35	259	18.8	10.5 - 13.7 - 19.3		54	52	50	41	33	27
	233	0.147	43 - 53 - 75		43	362	36.6	13.2 - 16.1 - 22.8		58	59	58	51	43	34
8 Slots	40	0.003	4 - 8 - 23	3 - 6 - 17	-	62	0.8	1.1 - 2.5 - 7.1	0.8 - 1.8 - 5.0	35	21	15	-	-	-
	112	0.026	22 - 33 - 52	15 - 23 - 37	22	174	6.5	6.6 - 10.0 - 15.8	4.7 - 7.1 - 11.2	48	42	38	26	17	15
	148	0.045	29 - 42 - 60	20 - 30 - 42	29	230	11.3	8.8 - 12.9 - 18.2	6.2 - 9.1 - 12.8	51	48	45	35	26	21
	184	0.070	36 - 47 - 67	25 - 33 - 47	35	286	17.5	10.9 - 14.3 - 20.3	7.7 - 10.1 - 14.3	54	52	50	41	32	26
	256	0.136	45 - 56 - 79	32 - 39 - 56	43	397	33.8	13.8 - 16.9 - 23.9	9.8 - 11.9 - 16.9	58	59	57	50	42	34

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. Odd numbered slots for 2-Way data have been intentionally left blank. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

S Series - Ceiling Mount, Vertical Flow with Pattern Controller

IP/METRIC DATA: 3/4" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data									
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB						
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7
1 Slot	20	0.032	6 - 10 - 15	-	31	8.1	1.9 - 2.9 - 4.6	28	23	18	12	-	-
	70	0.397	16 - 20 - 28	22	109	99.0	5.0 - 6.1 - 8.6	50	45	37	28	21	14
	95	0.732	19 - 23 - 33	28	147	182.3	5.8 - 7.1 - 10.0	55	50	42	32	24	18
	120	1.168	21 - 26 - 37	33	186	290.8	6.5 - 8.0 - 11.3	59	54	46	35	27	20
	170	2.344	26 - 31 - 44	40	264	583.7	7.8 - 9.5 - 13.4	65	60	51	40	31	24
2 Slots	30	0.018	7 - 10 - 19	-	47	4.5	2.1 - 3.1 - 5.6	26	21	16	11	-	-
	110	0.245	21 - 25 - 36	21	171	61.1	6.2 - 7.6 - 10.8	48	43	37	28	21	14
	150	0.456	24 - 29 - 42	27	233	113.6	7.3 - 8.9 - 12.6	54	49	42	32	24	18
	190	0.732	27 - 33 - 47	32	295	182.3	8.2 - 10.0 - 14.2	58	53	45	35	27	21
	270	1.478	32 - 39 - 56	39	419	368.1	9.8 - 12.0 - 16.9	64	59	51	40	31	25
3 Slots	40	0.014	8 - 11 - 21	-	62	3.6	2.3 - 3.5 - 6.5	21	15	11	-	-	-
	160	0.231	25 - 30 - 43	22	248	57.5	7.5 - 9.2 - 13.0	50	45	38	29	22	16
	220	0.436	29 - 36 - 50	28	342	108.6	8.8 - 10.8 - 15.3	55	50	43	34	26	19
	280	0.707	33 - 40 - 57	33	435	175.9	10.0 - 12.2 - 17.2	59	54	47	37	29	22
	400	1.442	39 - 48 - 68	41	621	359.1	11.9 - 14.6 - 20.6	65	61	52	42	33	26
4 Slots	50	0.013	8 - 12 - 24	-	78	3.2	2.5 - 3.8 - 7.3	26	21	16	11	-	-
	200	0.203	28 - 34 - 48	22	310	50.5	8.4 - 10.3 - 14.6	50	45	38	30	23	16
	275	0.383	32 - 40 - 56	29	427	95.5	9.9 - 12.1 - 17.1	55	50	43	34	26	20
	350	0.621	37 - 45 - 63	34	543	154.6	11.1 - 13.6 - 19.3	59	54	47	37	29	23
	500	1.267	44 - 54 - 76	41	776	315.6	13.3 - 16.3 - 23.0	66	61	53	42	33	27
5 Slots	60	0.018	9 - 13 - 26	-	93	4.5	2.7 - 4.0 - 8.0	26	21	17	12	-	-
	240	0.292	30 - 37 - 53	23	373	72.7	9.2 - 11.3 - 16.0	50	45	38	30	23	17
	330	0.552	36 - 44 - 62	29	512	137.5	10.8 - 13.2 - 18.7	56	51	44	34	27	20
	420	0.894	40 - 49 - 69	34	652	222.7	12.2 - 14.9 - 21.1	60	55	47	38	30	23
	600	1.825	48 - 59 - 83	41	931	454.4	14.6 - 17.9 - 25.2	66	61	53	42	34	27
6 Slots	70	0.011	9 - 14 - 28	-	109	2.8	2.9 - 4.3 - 8.6	26	21	17	12	-	-
	270	0.164	32 - 39 - 56	22	419	40.9	9.8 - 12.0 - 16.9	50	45	38	30	23	17
	370	0.308	38 - 46 - 65	28	574	76.8	11.4 - 14.0 - 19.8	55	50	43	34	27	20
	470	0.498	42 - 52 - 74	33	730	123.9	12.9 - 15.8 - 22.3	59	54	47	38	30	23
	670	1.011	51 - 62 - 88	41	1040	251.9	15.4 - 18.9 - 26.7	65	60	53	42	34	27
7 Slots	80	0.011	10 - 15 - 30	-	124	2.6	3.0 - 4.6 - 9.1	24	19	15	11	-	-
	310	0.159	34 - 42 - 60	23	481	39.6	10.5 - 12.8 - 18.1	50	45	39	31	24	17
	425	0.299	40 - 49 - 70	29	660	74.5	12.3 - 15.0 - 21.2	56	51	44	35	27	21
	540	0.483	45 - 56 - 79	34	838	120.2	13.8 - 16.9 - 24.0	60	55	47	38	30	24
	770	0.982	54 - 67 - 94	41	1195	244.4	16.5 - 20.2 - 28.6	66	61	53	43	34	28
8 Slots	90	0.010	11 - 16 - 32	-	140	2.6	3.2 - 4.8 - 9.6	27	22	18	13	-	-
	330	0.138	36 - 44 - 62	22	512	34.4	10.8 - 13.2 - 18.7	49	44	38	30	24	17
	450	0.257	42 - 51 - 72	28	699	63.9	12.6 - 15.5 - 21.9	55	50	43	34	27	21
	570	0.412	47 - 57 - 81	33	885	102.5	14.2 - 17.4 - 24.6	59	54	47	38	30	23
	810	0.832	56 - 68 - 96	40	1257	207.1	16.9 - 20.7 - 29.3	65	60	52	42	34	27

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

Engineering Data

HART COOLEY

S Series - Ceiling Mount, Vertical Flow with No Pattern Controller

IP/METRIC DATA: 3/4" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data									
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB						
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7
1 Slot	10	0.002	1 - 1 - 5	-	16	0.5	0.2 - 0.4 - 1.5	-	-	-	-	-	-
	70	0.100	12 - 16 - 22	16	109	25.0	3.6 - 4.8 - 6.8	46	37	32	25	17	-
	100	0.205	15 - 19 - 27	23	155	51.1	4.7 - 5.7 - 8.1	53	44	38	30	20	11
	130	0.347	17 - 21 - 30	30	202	86.3	5.3 - 6.5 - 9.2	58	49	42	33	23	14
	190	0.740	21 - 26 - 37	39	295	184.3	6.4 - 7.9 - 11.1	65	56	49	38	27	18
2 Slots	20	0.002	1 - 3 - 8	-	31	0.5	0.4 - 1.0 - 2.5	13	-	-	-	-	-
	130	0.087	17 - 21 - 30	18	202	21.6	5.3 - 6.5 - 9.2	48	39	34	27	19	-
	185	0.175	21 - 26 - 36	25	287	43.7	6.3 - 7.8 - 11.0	55	46	40	32	23	13
	240	0.295	24 - 29 - 41	32	373	73.5	7.2 - 8.8 - 12.5	59	50	44	35	25	16
	350	0.628	29 - 35 - 50	41	543	156.4	8.7 - 10.7 - 15.1	66	57	50	40	29	20
3 Slots	30	0.002	2 - 5 - 11	-	47	0.5	0.6 - 1.4 - 3.3	-	-	-	-	-	-
	180	0.074	21 - 25 - 36	18	279	18.4	6.3 - 7.7 - 10.8	48	39	35	28	20	-
	255	0.148	24 - 30 - 42	26	396	36.9	7.4 - 9.1 - 12.9	55	46	40	32	23	14
	330	0.248	28 - 34 - 48	32	512	61.8	8.5 - 10.4 - 14.7	60	50	44	36	26	17
	480	0.525	34 - 41 - 58	41	745	130.7	10.2 - 12.5 - 17.7	66	57	51	41	30	21
4 Slots	40	0.002	3 - 6 - 13	-	62	0.5	0.8 - 1.8 - 3.9	16	-	-	-	-	-
	210	0.057	22 - 27 - 38	17	326	14.1	6.8 - 8.3 - 11.7	47	38	34	27	20	-
	295	0.112	26 - 32 - 46	24	458	27.8	8.0 - 9.8 - 13.9	53	44	39	32	23	14
	380	0.185	30 - 37 - 52	30	590	46.1	9.1 - 11.1 - 15.7	58	49	43	35	26	17
	550	0.388	36 - 44 - 62	39	854	96.5	10.9 - 13.4 - 18.9	65	56	49	40	30	21
5 Slots	50	0.002	3 - 7 - 15	-	78	0.5	0.9 - 2.1 - 4.5	17	-	-	-	-	-
	270	0.060	25 - 31 - 44	19	419	14.9	7.7 - 9.4 - 13.3	49	40	35	28	21	11
	380	0.118	30 - 37 - 52	26	590	29.5	9.1 - 11.1 - 15.7	55	46	41	33	24	15
	490	0.197	34 - 42 - 59	32	761	49.0	10.3 - 12.6 - 17.9	60	51	45	36	27	18
	710	0.413	41 - 50 - 71	41	1102	103.0	12.4 - 15.2 - 21.5	66	57	51	41	31	22
6 Slots	60	0.002	4 - 8 - 16	-	93	0.5	1.1 - 2.4 - 5.0	18	-	-	-	-	-
	300	0.051	27 - 33 - 46	18	466	12.8	8.1 - 9.9 - 14.0	48	39	35	28	21	11
	420	0.100	31 - 38 - 54	25	652	25.0	9.5 - 11.7 - 16.5	54	45	40	33	24	15
	540	0.166	36 - 44 - 62	31	838	41.4	10.8 - 13.3 - 18.8	59	50	44	36	27	18
	780	0.347	43 - 52 - 74	40	1211	86.3	13.0 - 15.9 - 22.5	66	56	50	41	31	22
7 Slots	70	0.002	4 - 9 - 18	-	109	0.5	1.2 - 2.7 - 5.4	16	-	-	-	-	-
	350	0.051	29 - 35 - 50	19	543	12.8	8.7 - 10.7 - 15.1	49	40	35	29	21	12
	490	0.100	34 - 42 - 59	26	761	25.0	10.3 - 12.6 - 17.9	55	46	41	33	25	16
	630	0.166	38 - 47 - 67	32	978	41.4	11.7 - 14.3 - 20.3	59	50	45	37	28	18
	910	0.347	46 - 57 - 80	40	1413	86.3	14.1 - 17.2 - 24.3	66	57	51	41	32	22
8 Slots	80	0.002	4 - 10 - 19	-	124	0.5	1.3 - 2.9 - 5.9	19	11	-	-	-	-
	380	0.046	30 - 37 - 52	19	590	11.5	9.1 - 11.1 - 15.7	48	39	35	29	21	12
	530	0.090	35 - 43 - 61	25	823	22.4	10.7 - 13.1 - 18.6	54	46	41	33	25	16
	680	0.148	40 - 49 - 69	31	1056	36.9	12.1 - 14.9 - 21.0	59	50	45	36	28	18
	980	0.308	48 - 59 - 83	40	1521	76.6	14.6 - 17.9 - 25.3	66	57	50	41	32	22

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

S Series - Wall Mount, Horizontal Flow

IP/METRIC DATA: 1" SLOT WIDTH, CONTINUOUS SLOT

	IP Data					Metric Data										
	Air Flow	Press Ps	1-Way Throw	2-Way Throw	NC	Air Flow	Press Ps	1-Way Throw	2-Way Throw	Octave Band, dB					
	CFM/ft	"WG	ft	ft		L/s/m	Pa	m	m	2	3	4	5	6	7
1 Slot	5	0.003	0 - 1 - 4		-	8	0.7	0.1 - 0.3 - 1.3		17	-	-	-	-	-
	25	0.066	10 - 15 - 25		17	39	16.3	3.0 - 4.6 - 7.5		40	36	33	24	14	-
	35	0.129	14 - 21 - 29		25	54	32.0	4.3 - 6.2 - 8.8		44	42	41	33	24	16
	45	0.213	18 - 23 - 33		31	70	52.9	5.5 - 7.1 - 10.0		48	47	46	39	32	23
	65	0.444	23 - 28 - 40		40	101	110.4	7.0 - 8.5 - 12.0		53	55	55	49	43	33
2 Slots	10	0.003	1 - 2 - 9	1 - 2 - 6	-	16	0.7	0.3 - 0.7 - 2.6	0.2 - 0.5 - 1.9	20	-	-	-	-	-
	44	0.051	14 - 21 - 33	10 - 15 - 23	17	68	12.7	4.2 - 6.3 - 9.9	3.0 - 4.5 - 7.0	41	36	33	23	13	-
	61	0.098	19 - 27 - 38	14 - 19 - 27	25	95	24.3	5.8 - 8.3 - 11.7	4.1 - 5.8 - 8.2	46	43	41	32	23	16
	78	0.160	25 - 31 - 43	17 - 22 - 31	31	121	39.8	7.5 - 9.3 - 13.2	5.3 - 6.6 - 9.3	49	47	46	38	31	22
	112	0.329	30 - 37 - 52	21 - 26 - 37	40	174	82.0	9.1 - 11.2 - 15.8	6.5 - 7.9 - 11.2	54	55	54	48	42	32
3 Slots	15	0.003	1 - 3 - 12		-	23	0.7	0.4 - 0.9 - 3.6		17	-	-	-	-	-
	65	0.049	17 - 26 - 40		18	101	12.3	5.3 - 7.9 - 12.0		43	37	34	24	15	-
	90	0.094	24 - 33 - 47		26	140	23.5	7.3 - 10.0 - 14.2		47	44	42	33	24	17
	115	0.154	30 - 37 - 53		32	179	38.4	9.2 - 11.3 - 16.0		50	49	48	40	32	24
	165	0.318	36 - 45 - 63		41	256	79.1	11.1 - 13.6 - 19.2		55	56	56	49	43	33
4 Slots	20	0.003	2 - 4 - 14	1 - 3 - 10	-	31	0.7	0.5 - 1.1 - 4.3	0.4 - 0.8 - 3.1	23	-	-	-	-	-
	80	0.042	19 - 28 - 44	13 - 20 - 31	18	124	10.5	5.8 - 8.7 - 13.4	4.1 - 6.1 - 9.4	43	37	34	24	13	-
	110	0.079	26 - 36 - 52	18 - 26 - 36	25	171	19.8	7.9 - 11.1 - 15.7	5.6 - 7.8 - 11.1	47	43	41	32	23	16
	140	0.129	33 - 41 - 58	23 - 29 - 41	31	217	32.0	10.1 - 12.5 - 17.7	7.1 - 8.8 - 12.5	50	48	47	39	30	23
	200	0.262	40 - 49 - 69	28 - 35 - 49	40	310	65.3	12.2 - 14.9 - 21.1	8.6 - 10.6 - 14.9	55	55	55	48	41	32
5 Slots	25	0.003	2 - 4 - 16		-	39	0.7	0.6 - 1.3 - 4.9		24	-	-	-	-	-
	95	0.038	20 - 31 - 48		17	147	9.4	6.2 - 9.3 - 14.6		43	37	34	23	13	-
	130	0.071	28 - 40 - 56		25	202	17.7	8.5 - 12.0 - 17.0		47	43	41	32	22	16
	165	0.114	36 - 45 - 63		31	256	28.5	10.8 - 13.6 - 19.2		51	48	46	38	30	22
	235	0.232	43 - 53 - 75		40	365	57.7	13.2 - 16.2 - 22.9		56	55	54	47	40	31
6 Slots	30	0.003	2 - 5 - 18	2 - 3 - 13	-	47	0.7	0.7 - 1.5 - 5.4	0.5 - 1.0 - 3.8	25	11	-	-	-	-
	110	0.035	22 - 33 - 52	15 - 23 - 36	17	171	8.8	6.6 - 9.9 - 15.7	4.7 - 7.0 - 11.1	43	37	34	23	13	-
	150	0.066	30 - 43 - 60	21 - 30 - 43	25	233	16.3	9.0 - 12.9 - 18.3	6.4 - 9.1 - 12.9	48	43	41	31	22	15
	190	0.105	38 - 48 - 68	27 - 34 - 48	31	295	26.2	11.5 - 14.6 - 20.6	8.1 - 10.3 - 14.6	51	48	46	38	29	22
	270	0.213	47 - 57 - 81	33 - 40 - 57	40	419	52.9	14.2 - 17.4 - 24.5	10.0 - 12.3 - 17.4	56	55	54	47	40	31
7 Slots	35	0.003	2 - 5 - 19		-	54	0.7	0.7 - 1.6 - 5.9		24	-	-	-	-	-
	125	0.033	23 - 35 - 55		17	194	8.3	7.0 - 10.5 - 16.7		44	37	34	23	12	-
	170	0.062	31 - 45 - 64		25	264	15.4	9.6 - 13.8 - 19.5		48	43	41	31	22	15
	215	0.099	40 - 51 - 72		31	334	24.7	12.1 - 15.5 - 21.9		51	48	46	38	29	21
	305	0.199	50 - 61 - 86		40	473	49.6	15.1 - 18.4 - 26.1		56	55	54	47	39	31
8 Slots	40	0.003	3 - 6 - 21	2 - 4 - 15	-	62	0.7	0.8 - 1.8 - 6.3	0.6 - 1.2 - 4.5	26	12	-	-	-	-
	140	0.032	24 - 37 - 58	17 - 26 - 41	18	217	8.0	7.4 - 11.1 - 17.7	5.2 - 7.8 - 12.5	44	37	34	23	12	-
	190	0.059	33 - 48 - 68	23 - 34 - 48	25	295	14.7	10.0 - 14.6 - 20.6	7.1 - 10.3 - 14.6	48	44	41	31	22	15
	240	0.094	42 - 54 - 76	29 - 38 - 54	31	373	23.5	12.7 - 16.4 - 23.1	9.0 - 11.6 - 16.4	51	48	46	37	29	21
	340	0.190	52 - 64 - 91	37 - 45 - 64	40	528	47.2	15.9 - 19.5 - 27.5	11.2 - 13.8 - 19.5	56	55	54	47	39	31

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. Odd numbered slots for 2-Way data have been intentionally left blank. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

Engineering Data

HART COOLEY

S Series - Ceiling Mount, Vertical Flow with Pattern Controller

IP/METRIC DATA: 1" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data									
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB						
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7
1 Slot	5	0.002	1 - 1 - 4	-	8	0.4	0.2 - 0.4 - 1.4	-	-	-	-	-	-
	75	0.339	17 - 21 - 29	19	116	84.4	5.2 - 6.3 - 8.9	47	41	36	29	22	12
	110	0.729	21 - 25 - 36	26	171	181.5	6.2 - 7.6 - 10.8	54	48	42	34	26	17
	145	1.266	24 - 29 - 41	32	225	315.3	7.2 - 8.8 - 12.4	59	53	46	38	29	20
	215	2.784	29 - 35 - 50	40	334	693.3	8.7 - 10.7 - 15.1	66	60	52	43	34	24
2 Slots	10	0.002	1 - 2 - 6	-	16	0.4	0.3 - 0.6 - 2.0	-	-	-	-	-	-
	130	0.254	22 - 27 - 39	20	202	63.4	6.8 - 8.3 - 11.8	47	41	36	30	23	14
	190	0.544	27 - 33 - 47	27	295	135.4	8.2 - 10.0 - 14.2	54	48	42	35	28	18
	250	0.941	31 - 38 - 54	32	388	234.3	9.4 - 11.5 - 16.3	59	53	47	39	31	21
	370	2.061	38 - 46 - 65	40	574	513.3	11.4 - 14.0 - 19.8	66	60	53	44	35	26
3 Slots	15	0.002	1 - 3 - 8	-	23	0.4	0.4 - 0.8 - 2.4	-	-	-	-	-	-
	175	0.205	26 - 32 - 45	20	272	51.0	7.9 - 9.6 - 13.6	47	41	36	31	24	14
	255	0.435	31 - 38 - 54	27	396	108.4	9.5 - 11.6 - 16.5	54	48	42	36	28	18
	335	0.751	36 - 44 - 62	32	520	187.0	10.9 - 13.3 - 18.9	59	53	47	39	31	21
	495	1.640	44 - 53 - 75	40	768	408.3	13.2 - 16.2 - 22.9	66	60	53	44	36	26
4 Slots	20	0.002	1 - 3 - 9	-	31	0.4	0.4 - 0.9 - 2.8	-	-	-	-	-	-
	220	0.182	29 - 36 - 50	20	342	45.4	8.8 - 10.8 - 15.3	47	41	37	31	24	15
	320	0.385	35 - 43 - 61	27	497	96.0	10.6 - 13.0 - 18.4	54	48	43	36	29	19
	420	0.664	40 - 49 - 69	32	652	165.3	12.2 - 14.9 - 21.1	59	53	47	40	32	22
	620	1.447	49 - 60 - 84	40	963	360.3	14.8 - 18.1 - 25.7	66	60	53	45	36	27
5 Slots	25	0.002	2 - 3 - 10	-	39	0.4	0.5 - 1.1 - 3.2	-	-	-	-	-	-
	265	0.169	32 - 39 - 55	21	411	42.1	9.7 - 11.9 - 16.8	47	42	37	32	25	15
	385	0.357	38 - 47 - 67	27	598	88.9	11.7 - 14.3 - 20.2	54	48	43	37	29	19
	505	0.614	44 - 54 - 76	32	784	153.0	13.4 - 16.4 - 23.2	59	53	47	40	32	23
	745	1.337	53 - 65 - 93	40	1157	333.0	16.2 - 19.9 - 28.1	66	60	53	45	37	27
6 Slots	30	0.002	2 - 4 - 11	-	47	0.4	0.5 - 1.2 - 3.5	-	-	-	-	-	-
	300	0.151	34 - 42 - 59	21	466	37.5	10.3 - 12.6 - 17.9	47	41	37	32	25	15
	435	0.317	41 - 50 - 71	27	675	78.8	12.4 - 15.2 - 21.5	54	48	43	37	29	20
	570	0.544	47 - 57 - 81	32	885	135.4	14.2 - 17.4 - 24.6	59	53	47	40	32	23
	840	1.181	57 - 69 - 98	40	1304	293.9	17.2 - 21.1 - 29.9	66	60	53	45	37	27
7 Slots	35	0.002	2 - 4 - 12	-	54	0.4	0.6 - 1.3 - 3.8	-	-	-	-	-	-
	345	0.146	36 - 45 - 63	21	536	36.4	11.1 - 13.5 - 19.1	48	42	37	32	25	16
	500	0.307	44 - 54 - 76	28	776	76.5	13.3 - 16.3 - 23.0	54	48	43	37	30	20
	655	0.527	50 - 61 - 87	32	1017	131.3	15.2 - 18.7 - 26.4	59	53	47	41	33	23
	965	1.145	61 - 74 - 105	40	1498	285.0	18.5 - 22.6 - 32.0	66	60	54	46	37	28
8 Slots	40	0.002	2 - 4 - 13	-	62	0.4	0.6 - 1.4 - 4.0	-	-	-	-	-	-
	380	0.136	38 - 47 - 66	21	590	33.8	11.6 - 14.2 - 20.1	47	42	37	32	26	16
	550	0.285	46 - 56 - 80	28	854	70.9	14.0 - 17.1 - 24.2	54	48	43	37	30	20
	720	0.488	53 - 64 - 91	32	1118	121.5	16.0 - 19.6 - 27.7	59	53	47	41	33	23
	1060	1.057	64 - 78 - 110	40	1646	263.3	19.4 - 23.7 - 33.6	66	60	54	46	37	28

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6

S Series - Ceiling Mount, Vertical Flow with No Pattern Controller

IP/METRIC DATA: 1" SLOT WIDTH, CONTINUOUS SLOT

	IP Data				Metric Data								
	Air Flow	Press Ps	Vertical Throw	NC	Air Flow	Press Ps	Vertical Throw	Octave Band, dB					
	CFM/ft	"WG	ft		L/s/m	Pa	m	2	3	4	5	6	7
1 Slot	5	0.000	0 - 0 - 1	-	8	0.1	0.0 - 0.1 - 0.4	-	-	-	-	-	-
	85	0.082	14 - 17 - 24	15	132	20.5	4.2 - 5.1 - 7.2	46	37	32	23	13	-
	125	0.178	17 - 20 - 29	23	194	44.3	5.0 - 6.2 - 8.7	53	44	37	29	17	-
	165	0.310	19 - 23 - 33	30	256	77.2	5.8 - 7.1 - 10.0	58	49	42	32	20	11
	245	0.684	23 - 28 - 40	39	380	170.2	7.1 - 8.7 - 12.2	65	56	48	38	24	15
2 Slots	10	0.000	0 - 1 - 3	-	16	0.1	0.1 - 0.2 - 0.9	-	-	-	-	-	-
	150	0.064	18 - 22 - 31	16	233	16.0	5.5 - 6.8 - 9.6	47	38	33	25	14	-
	220	0.138	22 - 27 - 38	24	342	34.3	6.7 - 8.2 - 11.6	54	45	38	30	19	-
	290	0.239	25 - 31 - 44	31	450	59.6	7.7 - 9.4 - 13.3	59	49	43	34	22	12
	430	0.527	31 - 38 - 53	40	668	131.1	9.4 - 11.5 - 16.2	66	56	49	39	26	16
3 Slots	15	0.000	1 - 1 - 5	-	23	0.1	0.2 - 0.4 - 1.5	-	-	-	-	-	-
	205	0.053	21 - 26 - 37	17	318	13.2	6.5 - 7.9 - 11.2	47	38	33	25	15	-
	300	0.114	26 - 31 - 45	24	466	28.4	7.8 - 9.6 - 13.5	54	45	39	30	19	-
	395	0.197	30 - 36 - 51	31	613	49.2	9.0 - 11.0 - 15.5	59	49	43	34	22	13
	585	0.433	36 - 44 - 62	40	908	107.8	10.9 - 13.4 - 18.9	66	56	49	40	27	17
4 Slots	20	0.000	1 - 2 - 6	-	31	0.1	0.2 - 0.5 - 2.0	-	-	-	-	-	-
	260	0.048	24 - 29 - 41	17	404	12.0	7.3 - 8.9 - 12.6	47	38	34	26	16	-
	380	0.103	29 - 35 - 50	25	590	25.6	8.8 - 10.8 - 15.2	54	45	39	31	20	-
	500	0.178	33 - 41 - 58	31	776	44.3	10.1 - 12.4 - 17.5	59	50	43	35	23	13
	740	0.390	40 - 49 - 70	40	1149	97.1	12.3 - 15.0 - 21.3	66	57	49	40	27	18
5 Slots	25	0.000	1 - 2 - 8	-	39	0.1	0.3 - 0.6 - 2.4	-	-	-	-	-	-
	305	0.042	26 - 32 - 45	17	473	10.6	7.9 - 9.7 - 13.7	47	38	34	26	16	-
	445	0.090	31 - 38 - 54	24	691	22.5	9.5 - 11.7 - 16.5	54	45	39	31	20	11
	585	0.156	36 - 44 - 62	31	908	38.8	10.9 - 13.4 - 18.9	59	50	43	35	23	14
	865	0.341	44 - 53 - 76	40	1343	84.9	13.3 - 16.3 - 23.0	66	56	49	40	27	18
6 Slots	30	0.000	1 - 2 - 9	-	47	0.1	0.3 - 0.7 - 2.8	-	-	-	-	-	-
	350	0.039	28 - 34 - 48	17	543	9.7	8.4 - 10.3 - 14.6	47	38	34	26	16	-
	510	0.082	34 - 41 - 58	24	792	20.5	10.2 - 12.5 - 17.7	54	45	39	31	21	11
	670	0.142	38 - 47 - 67	31	1040	35.4	11.7 - 14.3 - 20.2	59	50	43	35	23	14
	990	0.310	47 - 57 - 81	40	1537	77.2	14.2 - 17.4 - 24.6	66	56	49	40	28	18
7 Slots	35	0.000	1 - 3 - 10	-	54	0.1	0.3 - 0.8 - 3.1	-	-	-	-	-	-
	395	0.036	30 - 36 - 51	17	613	9.0	9.0 - 11.0 - 15.5	47	38	34	26	17	-
	575	0.077	36 - 44 - 62	24	893	19.1	10.8 - 13.3 - 18.7	54	45	39	31	21	11
	755	0.133	41 - 50 - 71	31	1172	33.0	12.4 - 15.2 - 21.5	59	50	44	35	24	14
	1115	0.289	50 - 61 - 86	40	1731	72.0	15.1 - 18.5 - 26.1	66	56	50	40	28	19
8 Slots	40	0.000	1 - 3 - 11	-	62	0.1	0.4 - 0.9 - 3.5	-	-	-	-	-	-
	440	0.034	31 - 38 - 54	18	683	8.6	9.5 - 11.6 - 16.4	47	38	34	26	17	-
	640	0.073	38 - 46 - 65	24	994	18.2	11.4 - 14.0 - 19.8	54	45	40	32	21	12
	840	0.126	43 - 53 - 75	31	1304	31.3	13.1 - 16.0 - 22.7	59	50	44	35	24	15
	1240	0.274	52 - 64 - 91	40	1925	68.1	15.9 - 19.5 - 27.5	66	57	50	41	28	19

NOTES: Throw values are given for terminal velocities of 150, 100, and 50 FPM (0.75, 0.50, and 0.25 m/s). Throw values are given for isothermal conditions and a 4' (1219) length. For other lengths, see correction charts below. NC values are based on octave band 2 - 7 sound power levels minus a room absorption of 10dB, re10^{-12} Watts. Dash in space denotes a NC or dB value of less than 10. Data was obtained from tests conducted in accordance with ANSI/ASHRAE Standard 70, ISO Standard 5219, and ISO Standard 3741. Pressures are for diffuser section only. Plenums will add to the sound level and pressure drop. Keep inlet velocities below 800 FPM to reduce plenum generated sound levels and pressure drop. See selection software for performance data not shown, including octave band data.

NC Addition For Length					
Length, ft	2	4	6	8	10
Length, m	0.6	1.2	1.8	2.4	3.0
Supply	-2	0	+2	+3	+5
Return with Blades	0	+3	+5	+6	+8

Throw Multiplier for Length					
Length, ft	2	4	8	10	12
Length, m	0.6	1.2	2.4	3.0	3.6
Correction	0.7	0	1.5	1.7	1.8

Recommended Noise Criteria and Face Velocity Ranges are on page 6