DUNHAM-BUSH®

Products That Perform...By People Who Care

FORM NO: MS0105B

CEILING CONCEALED FAN COIL UNIT

50/60 Hz

CR-CB SERIES
CR-CBP SERIES
CR-CBD SERIES

200 CFM TO 1600 CFM

INDOOR CEILING CONCEALED FANCOIL UNIT

GENERAL DESCRIPTION

The ceiling concealed fancoil units are of low noise, light weight, compact and low height construction. It is specially designed to cater for today's low ceiling height residence, offices, light commercial applications and new or existing building air-conditioning. All fancoils units are completely factory packaged with blower fan, motor, chilled water coil, circuited and terminated pipe connections. All fancoils are completely factory assembled and ready for field installation.

CASING

All fancoil units are constructed from minimum 1.0 mm thickness galvanized steel sheet and bonderized. All casing panels supports are formed or bent to provide a sturdy and rigid construction which eliminate "drumming" and assures "vibration-free" operation. Casing panels are internally insulated with 6mm (density 35kg/m^3) polyethylene (PE) foam, tightly fitted with gasket on rigid frame to guard against leaks of conditioned air. Casing panels are easily removable for access to internal components for service and repair.

MOTORS

Motors are permanent split capacitor type with built-in thermal overload protection. Vibration transmission is eliminated by the use of resilient motor mount. Motors are supplied with permanently lubricated, maintenance- free sealed ball bearing. Each motor is provided with a minimum of 3 speed selection. Motor leads are terminated with terminal cover for easy electrical connection.

FAN WHEELS AND HOUSING

The light weight double-width, double inlet, forward-curved centrifugal fan wheels are dynamically balanced to provide low sound levels, vibration-free operation, even air distribution and minimum power requirement.

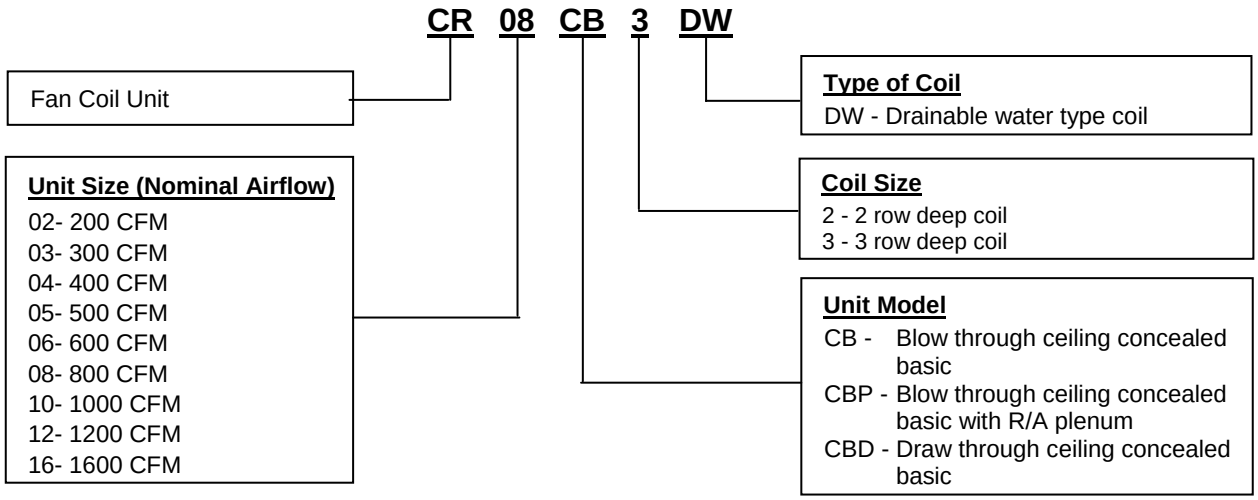
COILS

All fancoils units consist of staggered row of ½" O.D. copper tubes of minimum wall thickness 0.016 inch, mechanically expanded into die-found corrugated aluminium fins of thickness 0.006 inch. All coils are leak tested at 450 psig air pressure and are suitable for up to 300 psig working pressure.

CONDENSATE DRAIN PAN

All condensate drain pan are constructed from minimum 1.0 mm thick galvanized. The drain pan is externally insulated with minimum 5.0 mm thick fire–retardant PE foam insulation.

PRODUCT NOMENCLATURE



AN EXAMPLE OF SELECTION PROCEDURE

To select a CR – CB chilled water fancoil based on following requirements.

Total cooling capacity = 18200 Btu/hr
Sensible cooling capacity = 11500 Btu/hr
Air on coil temp. = 78ºFDB/ 67ºFWB
Supply air cfm = 510 at 0.05 inch WG ESP
Chilled water inlet temp. = 43ºF
Chilled water flowrate = 3.64 USGPM

Step 1

Refer to Table 1, select the fancoil which has nominal cooling capacities and cfm which are close to requirements. In this case CR 06-3R is selected.
Nominal total cooling capacity = 20700 Btu/hr
Nominal sensible cooling capacity = 13960 Btu/hr

Step 2

Refer to Table 2, determine total capacity correction factor FT at entering water temperature of 43°F and entering air wet bulb temperature of 67°F,
FT = 1.05

Step 3

Calculate $\frac{SH}{TH} = \frac{11500}{18200} = 0.63$

The ratio is < 0.91 indicating wet coil condition.

AN EXAMPLE OF SELECTION PROCEDURE

Step 4

Refer to Table 5, corrected cfm for CR 06CB - 3 at 0.05 inch WG ESP (high speed)

= 580 × 0.93 (wet coil)

= 539 cfm (which meets requirement of 510 cfm)

= 90% of nominal cfm

Step 5

Refer to Table 3, and interpolate to obtain FC and FB factors. At 90% of nominal airflow for CR 06CB - 3

FC = 0.93

FB = 0.145

Step 6

Refer to Table 4, at flowrate of 3.6 USGPM

PD = 3.8 ft wg

FV = 0.998

Step 7

Therefore, corrected total cooling capacity

= 20700 × FT × FC × FV

= 20700 × 1.05 × 0.93 × 0.998

= 20173 Btu/hr

Step 8

To calculate leaving air wet bulb temperature

Total capacity $= 4.51 \times cfm \times (h_{\text{ent. air}} - h_{\text{leaving air}})$

$20173 = 4.51 \times 539 \times (31.62 - h_{\text{leaving air}})$

$h_{\text{leaving}} = 23.32$

Therefore, leaving air wet bulb temperature = 55.2°F

Step 9

To calculate sensible cooling capacity

Leaving air dry bulb temperature

= L_{vg} WG + F_B (Ent. DB – Ent WB)

= 55.2 + 0.145 (78 – 67)

= 56.8ºF

Therefore, sensible cooling capacity

= 1.08 × cfm (Ent DB – L_{vg} DB)

= 1.08 × 539 × (78 – 56.8)

= 12340 Btu/hr

Step 10

From step 1 to 9, the unit selected, i.e. CR 06CB - 3 gives

Total capacity = 20173 Btu/hr > 18200 Btu/hr as specified

Sensible capacity = 12340 Btu/hr > 11500 Btu/hr as specified

Cfm = 539 > 510 as specified

Therefore, CR 06CB - 3 selected meets the specified requirements.

Table 1 : NOMINAL COOLING PERFORMANCE 1/2 O.D. CHILLED WATER COIL

Model	Nominal CFM	Row	80º FDB/67º FWB Air On Coil			
			Total Capacity Btu/Hr	Sensible Capacity Btu/Hr	US GPM	P.D. FT WG
CR 02	200	2 R	5900	4060	1.21	1.4
		3 R	8000	5290	1.54	3.1
CR 03	300	2 R	8400	5610	1.87	3.5
		3 R	11200	7240	2.27	7.3
CR 04	400	2 R	10900	7530	2.26	5.4
		3 R	13000	8960	2.71	1.8
CR 05	500	2 R	12100	8660	2.74	1.3
		3 R	16100	10790	3.10	2.6
CR 06	600	2 R	15100	10660	3.33	2.1
		3 R	20700	13960	4.23	5.0
CR 08	800	2 R	21000	14720	4.37	4.1
		3 R	27100	16670	5.73	3.7
CR 10	1000	2 R	26800	18360	5.52	7.0
		3 R	34200	23240	6.90	5.9
CR 12	1200	2 R	31200	21450	6.40	9.7
		3 R	40200	27370	8.09	8.2
CR 16	1600	2 R	38900	27480	8.27	3.9
		3 R	53700	36270	10.89	8.6

Note : Nominal capacities based on 45ºF chilled water entering water temperature and water temperature rise of 10ºF.

Table 2: TOTAL CAPACITY CORRECTION FACTOR FT

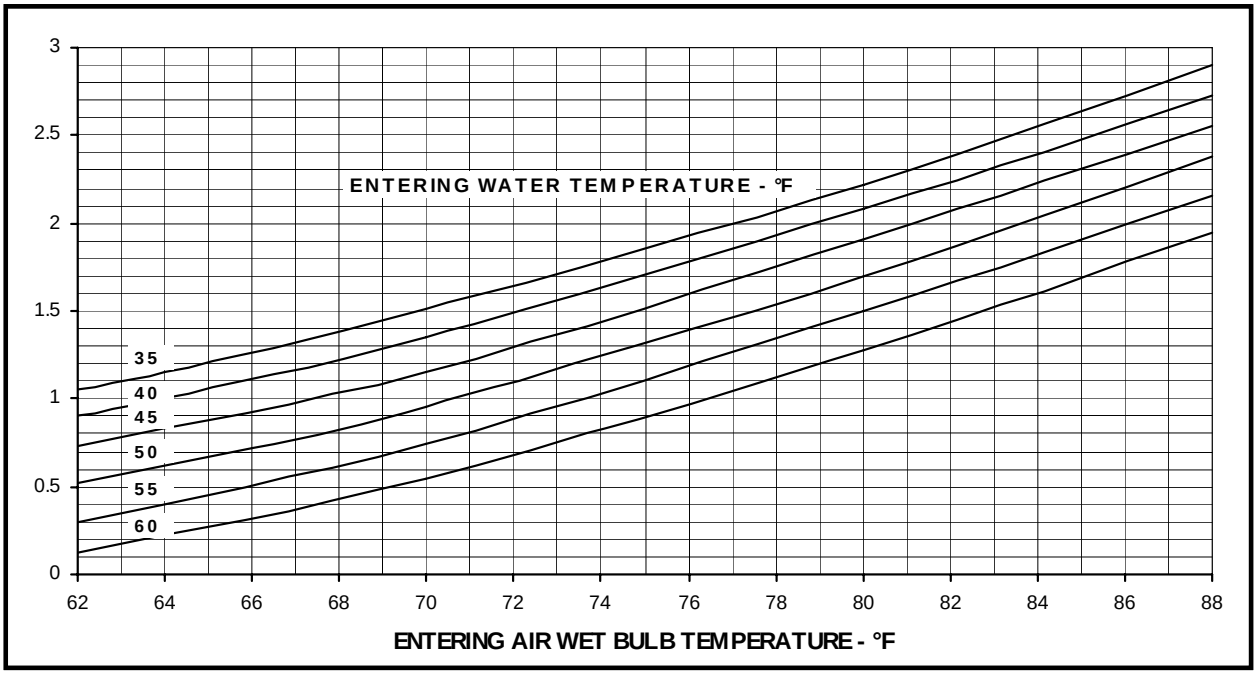


TABLE 3: TOTAL CAPACITY CORRECTION FACTORS (FC) AND BYPASS FACTORS (FB) AT PERCENTAGE OF NOMINAL AIR FLOW

Model		2 Row Deep Coil					3 Row Deep Coil				
		120%	100%	80%	60%	50%	120%	100%	80%	60%	50%
CR 02	FC	1.15	1.0	0.88	0.75	0.69	1.13	1.0	0.88	0.75	0.69
	FB	0.26	0.24	0.23	0.21	0.19	0.14	0.13	0.11	0.09	0.08
CR 03	FC	1.11	1.0	0.87	0.76	0.68	1.12	1.0	0.86	0.71	0.63
	FB	0.28	0.26	0.23	0.21	0.20	0.15	0.13	0.11	0.1	0.08
CR 04	FC	1.10	1.0	0.91	0.87	0.78	1.14	1.0	0.87	0.72	0.63
	FB	0.31	0.28	0.25	0.23	0.21	0.18	0.15	0.13	0.11	0.90
CR 05	FC	1.11	1.0	0.89	0.75	0.68	1.12	1.0	0.86	0.68	0.64
	FB	0.32	0.29	0.26	0.23	0.22	0.19	0.16	0.13	0.11	0.10
CR 06	FC	1.11	1.0	0.83	0.71	0.64	1.12	1.0	0.86	0.71	0.63
	FB	0.32	0.29	0.26	0.23	0.21	0.18	0.16	0.13	0.11	0.90
CR 08	FC	1.11	1.0	0.87	0.74	0.67	1.12	1.0	0.86	0.71	0.68
	FB	0.32	0.28	0.26	0.24	0.22	0.19	0.46	0.13	0.11	0.10
CR 10	FC	1.11	1.0	0.87	0.74	0.67	1.12	1.0	0.86	0.72	0.63
	FB	0.32	0.3	0.26	0.23	0.22	0.19	0.16	0.14	0.11	0.10
CR 12	FC	1.11	1.0	0.88	0.75	0.68	1.12	1.0	0.87	0.72	0.63
	FB	0.35	0.31	0.28	0.26	0.23	0.21	0.18	0.15	0.12	0.11
CR 16	FC	1.11	1.0	0.88	0.75	0.68	1.12	1.0	0.88	0.72	0.63
	FB	0.34	0.31	0.28	0.24	0.22	0.21	0.18	0.15	0.12	0.10

TABLE 4 : COIL WATER SIDE PRESSURE DROP (FT WG) AND VELOCITY CORRECTION FACTOR (FV)

CR 02						CR 03						CR 04					
2 Row			3 Row			2 Row			3 Row			2 Row			3 Row		
GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV
0.61	0.4	0.998	0.94	1.3	0.991	1.27	1.8	0.985	1.67	4.3	0.997	1.66	3.2	0.988	2.11	1.2	0.995
0.91	0.8	0.999	1.24	2.1	0.996	1.57	2.6	0.994	1.97	5.7	0.999	1.96	4.2	0.995	2.41	1.5	0.998
1.21	1.4	1.000	1.54	3.1	1.000	1.87	3.5	1.000	2.27	7.3	1.000	2.26	5.4	1.000	2.71	1.8	1.000
1.51	2.0	1.007	1.84	4.2	1.003	2.17	4.5	1.008	2.57	9.0	1.002	2.56	6.6	1.013	3.01	2.20	1.001

CR 05						CR 06						CR 08					
2 Row			3 Row			2 Row			3 Row			2 Row			3 Row		
GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV
2.14	0.8	0.994	2.5	1.8	0.995	2.73	1.5	0.989	3.63	3.8	0.998	3.77	3.2	0.994	5.13	3.1	0.997
2.44	1.0	0.998	2.8	2.2	0.997	3.03	1.7	0.993	3.93	4.4	0.999	4.07	3.6	0.997	5.43	3.4	0.998
2.74	1.3	1.000	3.1	2.6	1.000	3.33	2.1	1.000	4.23	5.0	1.000	4.37	4.1	1.000	5.73	3.7	1.000
3.04	1.5	1.005	3.4	3.1	1.001	3.63	2.4	1.018	4.53	5.6	1.001	4.77	4.8	1.003	6.03	4.1	1.001

CR 10						CR 12						CR 16					
2 Row			3 Row			2 Row			3 Row			2 Row			3 Row		
GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV	GPM	P.D	FV
4.92	5.8	0.998	6.3	5.0	0.997	5.8	8.20	0.998	7.49	7.2	0.998	7.67	3.5	0.997	10.28	7.8	0.991
5.22	6.4	0.999	6.6	5.4	0.999	6.1	9.0	0.999	7.79	7.7	0.999	7.97	3.7	0.998	10.59	8.2	0.999
5.52	7.0	1.000	6.9	5.9	1.000	6.4	9.7	1.000	8.09	8.2	1.000	8.27	3.9	1.000	10.89	8.6	1.000
5.82	7.7	1.007	7.2	6.3	1.006	6.7	10.5	1.009	8.39	8.8	1.001	8.57	4.2	1.001	11.19	9.0	1.001

TABLE 5 : AIR FLOW (CFM) VS EXTERNAL STATIC PRESSURE

Model Size	ROW	E S P (Inch WG)					
		0	0.05	0.10	0.15	0.20	0.25
CR 02	2 R	290	270	245	220	195	170
	3 R	280	260	235	210	185	160
CR 03	2 R	365	350	315	290	255	235
	3 R	355	335	310	280	250	230
CR 04	2 R	450	425	390	360	320	295
	3 R	435	410	375	345	310	285
CR 05	2 R	570	530	490	445	400	360
	3 R	550	540	470	430	385	355
CR 06	2 R	645	600	550	500	450	410
	3 R	630	580	535	485	435	400
CR 08	2 R	845	790	740	680	630	575
	3 R	810	760	710	650	605	555
CR 10	2 R	1015	960	910	810	740	680
	3 R	985	935	890	790	720	660
CR 12	2 R	1185	1110	1035	950	865	795
	3 R	1150	1080	1005	925	840	770
CR 16	2 R	1560	1465	1360	1225	1150	1055
	3 R	1520	1425	1325	1220	1120	1025

Notes : a.) For CB, CBD, CBP models – use above table and allow for air resistance through filters, duct and grilles.
b.) Above airflow under dry coil conditions at high fan speed.
c.) For wet coil conditions (when SH/TH < 0.91), airflow is 93% of dry coil condition.
d.) Medium and low speed air delivery is approximately 80% and 60% of high speed air delivery.

TABLE 6 : SOUND POWER LEVEL (RE : 10^{-12} WATTS) AT ESP OF 0.10" WG

Model Size	Speed	Octave Band Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
CR 02	Hi	30	36	37	44	49	45	37	30
	Med	28	33	34	41	46	42	34	29
	Low	28	31	32	40	43	41	30	28
CR 03	Hi	31	38	39	45	50	47	38	31
	Med	30	35	37	43	45	44	36	31
	Low	29	34	35	41	44	42	33	30
CR 04	Hi	32	39	40	48	51	48	39	31
	Med	30	36	38	46	49	45	37	30
	Low	30	34	36	44	47	43	35	30
CR 05	Hi	33	38	41	46	49	45	38	31
	Med	31	35	40	44	46	43	36	30
	Low	30	34	39	43	45	42	35	30
CR 06	Hi	30	35	36	45	48	46	37	30
	Med	30	33	35	43	45	44	35	29
	Low	29	31	33	40	42	41	33	28
CR 08	Hi	34	39	42	47	51	47	39	34
	Med	31	36	40	45	48	44	36	32
	Low	30	34	39	44	47	43	35	31
CR 10	Hi	34	40	43	49	52	48	41	35
	Med	32	38	42	47	50	45	38	32
	Low	31	36	41	45	48	44	36	31
CR 12	Hi	36	42	45	48	53	48	40	36
	Med	34	40	43	46	51	45	40	33
	Low	33	39	42	44	50	44	40	32
CR 16	Hi	36	43	47	47	52	50	41	38
	Med	33	40	45	45	50	47	39	36
	Low	33	39	43	44	49	45	38	34

TO CALCULATE ROOM NC LEVEL

In designing sound requirements based on noise criteria (NC) levels, the sound power levels should be converted to NC levels. Sound energy is absorbed by room surfaces and furnishing and is further dissipated by diffusion into space. The room absorption effect as calculated following the procedure described in ASHRAE GUIDE provides a method to determine the sound pressure levels required in obtaining NC levels. Table 7 provides typical room absorption effects.

To determine the NC level of a unit, subtract the room absorption effect from the sound power levels for all octave bands and plot the resulting sound pressure values on an NC curve. The NC curve is determined by octave band yielding the highest NC value.

TABLE 7 : TYPICAL ROOM ABSORPTION EFFECTS

Room Type	Octave Band						
	2	3	4	5	6	7	8
	Center Frequency (HZ)						
	125	250	500	1000	2000	4000	8000
Soft : Executive office	4	8	11	12	11	11	11
Medium : Apr. & motel	3	7	8	9	9	9	9
Hard : Hospital	0	1	3	4	4	5	6

Sample calculations

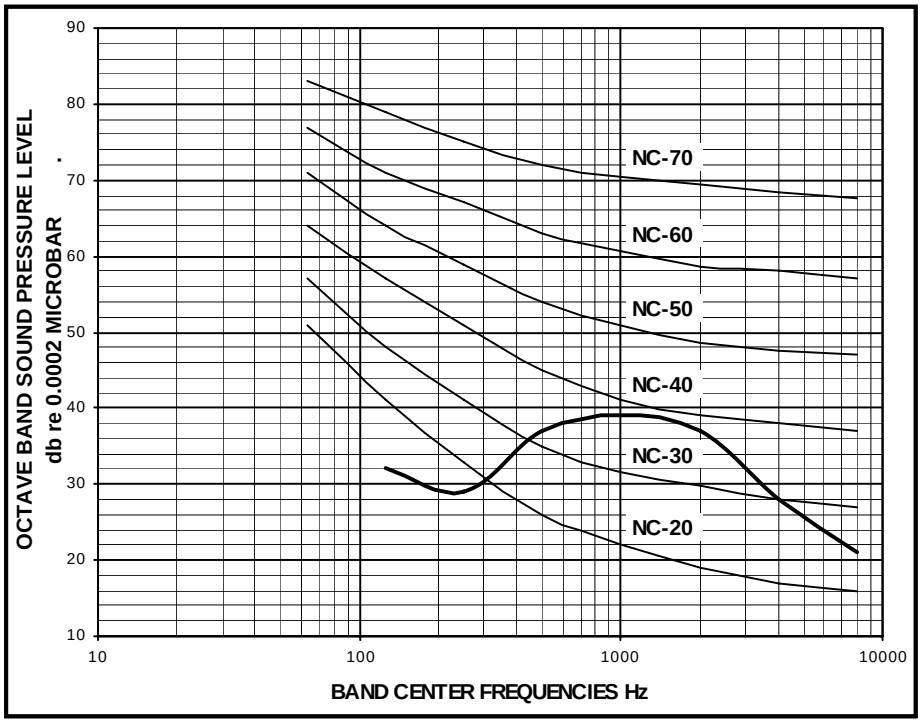
The procedure for calculating the NC level of given application as follows : -

1) Using table 6, tabulated sound power data by octave band for the model and unit size selected.
2) Select the proper room effect by octave band and substract from item as per table 7 respectively.
3) Plot the resulting sound pressure values on an octave band analysis chart.
4) Compare the plot with NC curve super – imposed on the chart. For example, the sound pressure level of CR 06 CB unit operating at high speed in an average model room is as follows : -

TABLE 8 : OCTAVE BAND ANALYSIS

Octave band	2	3	4	5	6	7	8
Center frequency	125	250	500	1000	2000	4000	8000
Unit PWL	35	36	45	48	46	37	30
Room effect	3	7	8	9	9	9	9
Sound pressure level	32	29	37	39	37	28	21

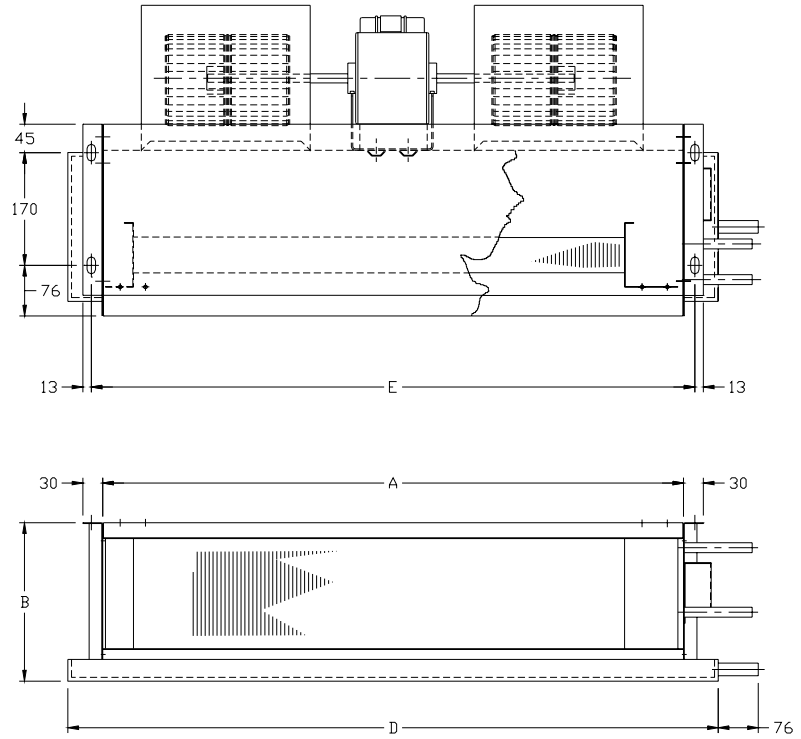
A plot of above data on an octave band analysis chart shows the sound level is NC 37.



Noise criteria curves for specifying the design level in terms of the maximum permissible sound pressure level for each frequency band.

DIMENSIONAL DATA

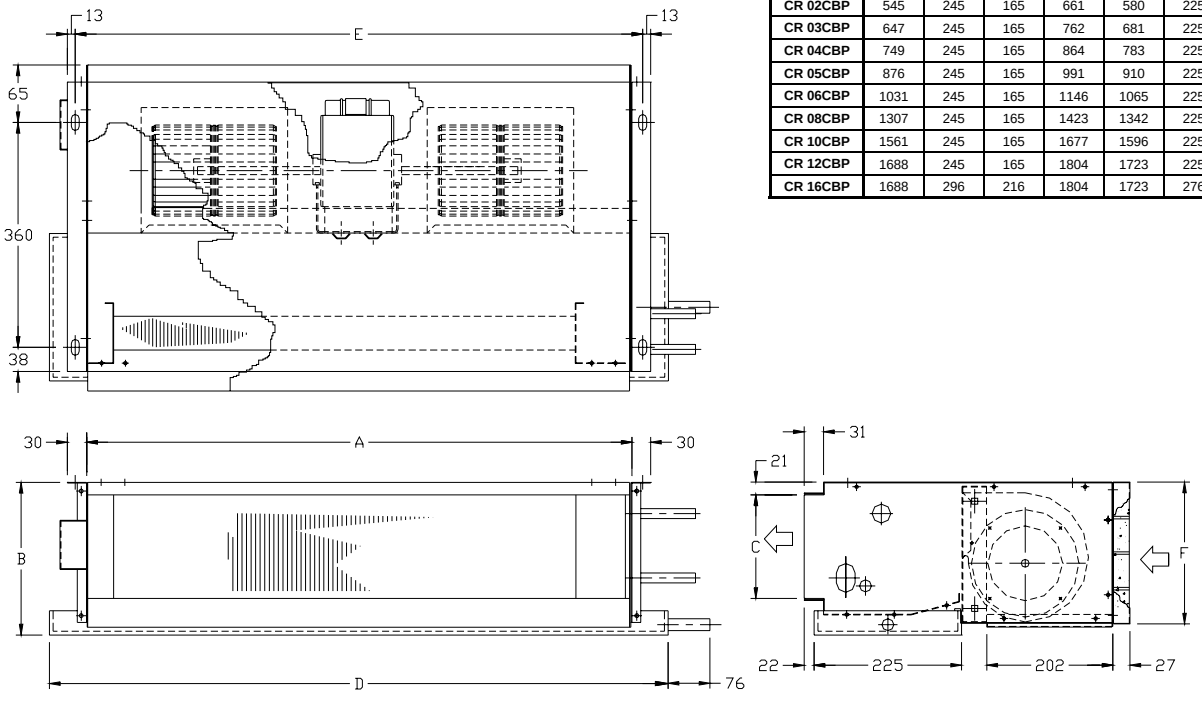
CR 02, 03, 04, 05, 06, 08, 10, 12, 16CB



MODEL	A	B	C	D	E
CR 02CB	545	245	165	661	580
CR 03CB	647	245	165	762	681
CR 04CB	749	245	165	864	783
CR 05CB	876	245	165	991	910
CR 06CB	1031	245	165	1146	1065
CR 08CB	1307	245	165	1423	1342
CR 10CB	1561	245	165	1677	1596
CR 12CB	1688	245	165	1804	1723
CR 16CB	1688	296	216	1804	1723

NOTE : ALL DIMENSIONS ARE IN MM.

CR 02, 03, 04, 05, 06, 08, 10, 12, 16CBP

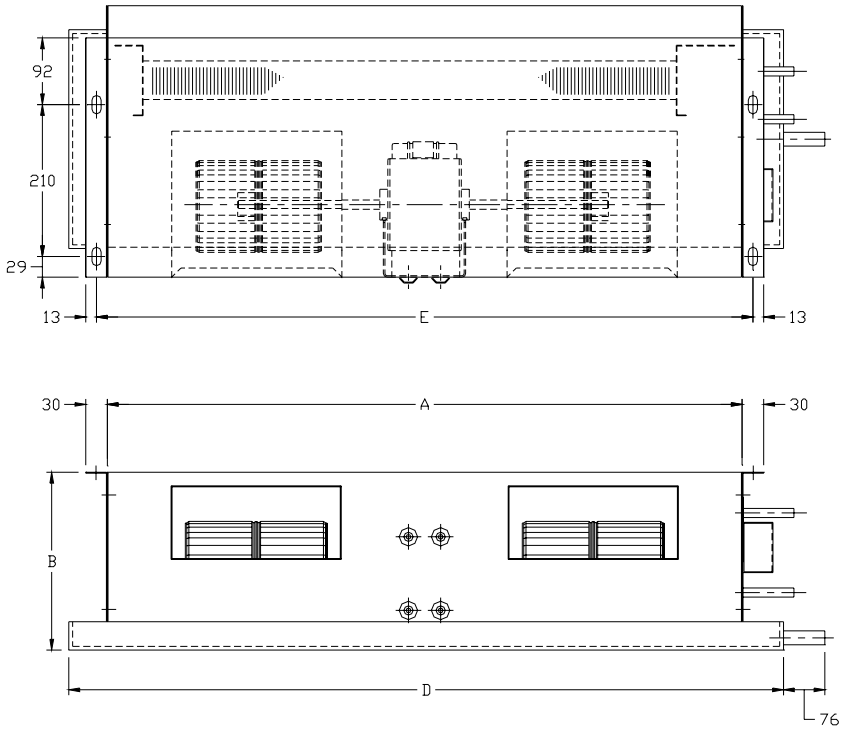


MODEL	A	B	C	D	E	F
CR 02CBP	545	245	165	661	580	225
CR 03CBP	647	245	165	762	681	225
CR 04CBP	749	245	165	864	783	225
CR 05CBP	876	245	165	991	910	225
CR 06CBP	1031	245	165	1146	1065	225
CR 08CBP	1307	245	165	1423	1342	225
CR 10CBP	1561	245	165	1677	1596	225
CR 12CBP	1688	245	165	1804	1723	225
CR 16CBP	1688	296	216	1804	1723	276

NOTE: ALL DIMENSIONS ARE IN MM.

DIMENSIONAL DATA

CR 02, 03, 04, 05, 06, 08, 10, 12, 16CBD



MODEL	A	B	C	D	E
CR 02CBD	545	245	183	661	580
CR 03CBD	647	245	183	762	681
CR 04CBD	749	245	183	864	783
CR 05CBD	876	245	183	991	910
CR 06CBD	1031	245	183	1146	1065
CR 08CBD	1307	245	183	1423	1342
CR 10CBD	1561	245	183	1677	1596
CR 12CBD	1688	245	183	1804	1723
CR 16CBD	1688	296	233	1804	1723

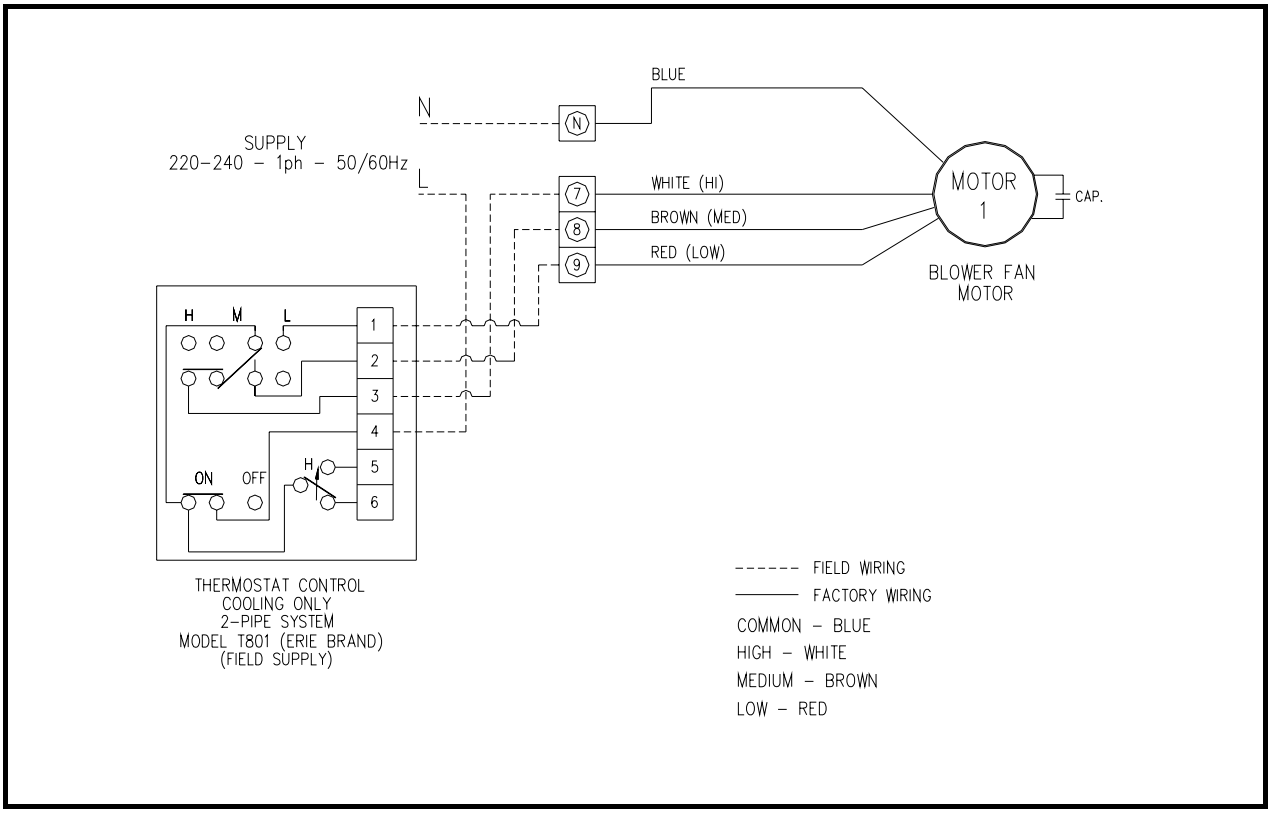
NOTE: ALL DIMENSIONS ARE IN MM.

ELECTRICAL DATA (220-240V – 1PH – 50/60Hz)

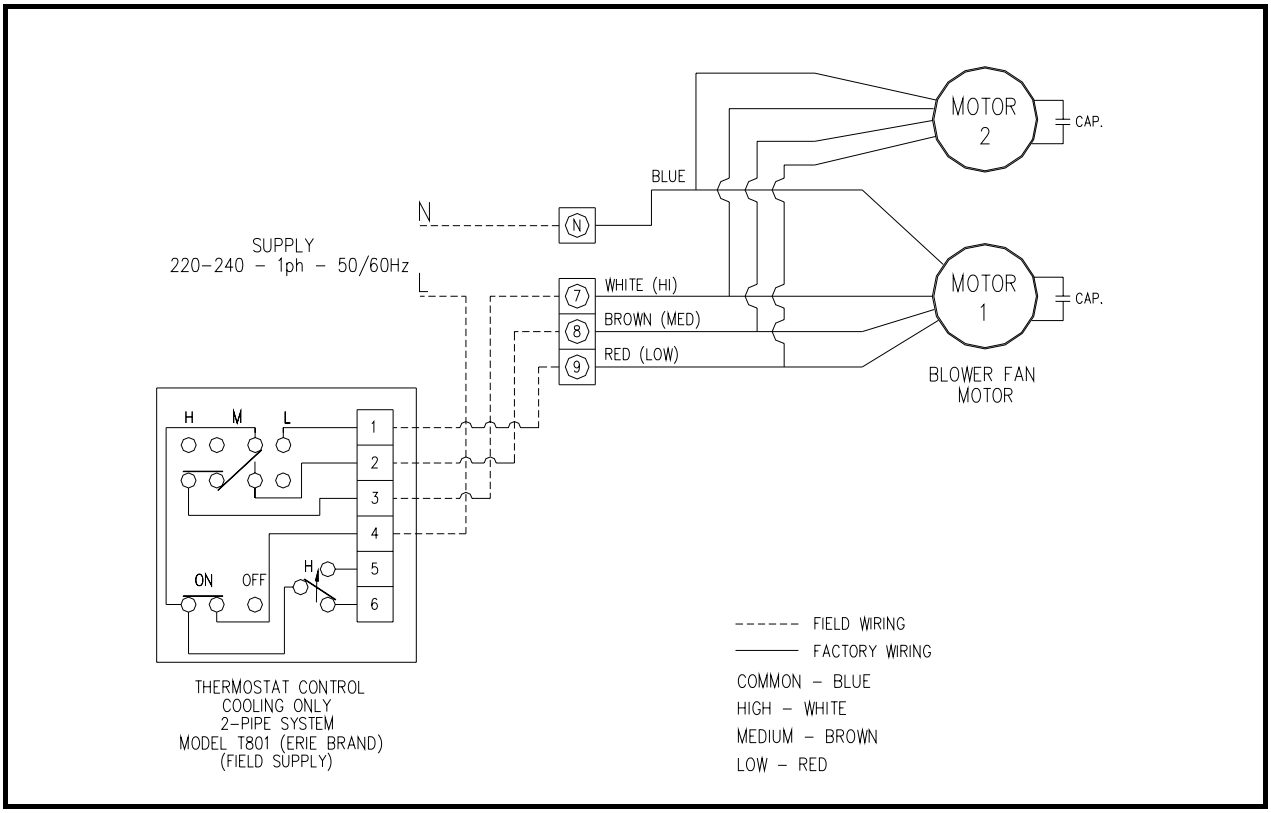
Unit Size		02	03	04	05	06	08	10	12	16
Hi	Amps	0.35	0.40	0.42	0.50	0.57	0.60	0.68	1.10	1.14
	Watts Input	85	90	100	120	137	150	161	261	274
Med	Amps	0.25	0.30	0.33	0.40	0.44	0.50	0.55	0.88	0.88
	Watts Input	60	65	78	100	105	120	131	209	210
Low	Amps	0.2	0.20	0.25	0.25	0.27	0.35	0.4	0.65	0.54
	Watts Input	50	50	55	55	62	80	92	151	124

TYPICAL WIRING DIAGRAM

CR 02, 03, 04, 05, 06, 10 CB/ CBD/ CBP



CR 12, 16 CB/ CBD/ CBP



OPTIONAL ACCESSORIES

1. a.) Extended drain pan.
   b.) Drip pan (Supply loose for field installation).
2. Hot water heating coil [maximum up to 4 rows (Cooling + Heating)].
3. Electrical heater (Metal blower wheel is incorporated with electric heater).
4. Metal blower wheel.
5. 5 speed fan motor
6. PC Board control module.
7. Air filter.

DUNHAM-BUSH®

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