LSBC

Air-Cooled Condensers & Fluid Coolers

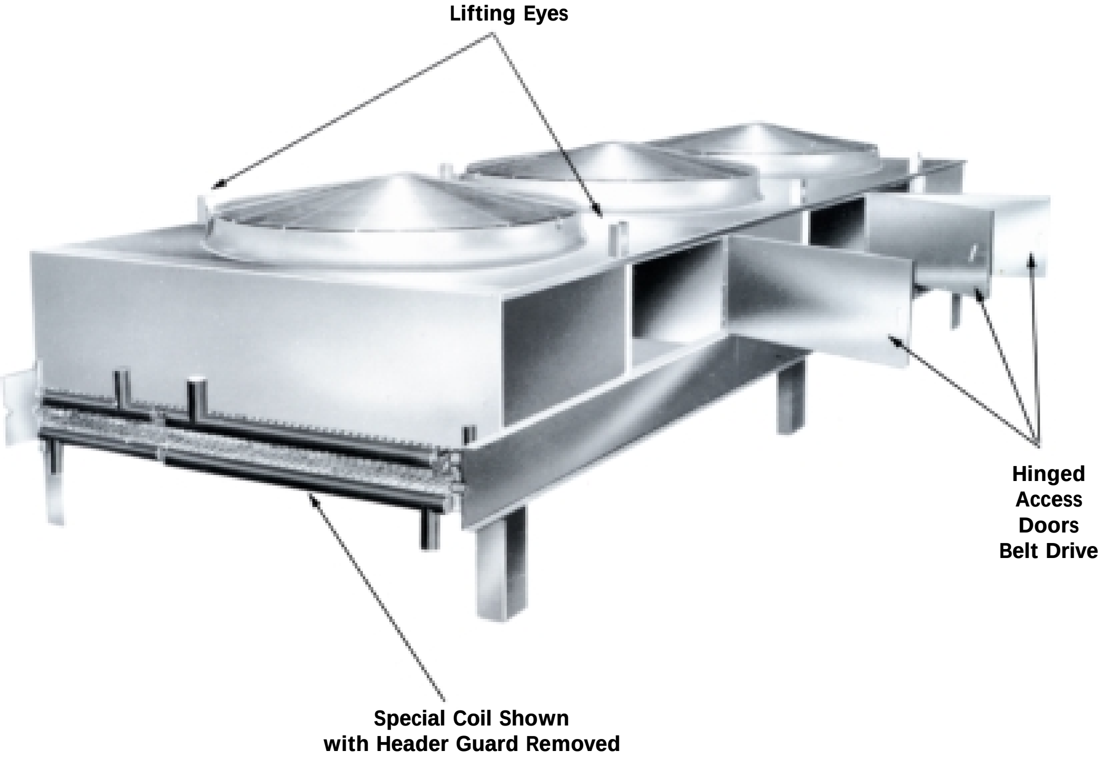
DUNHAM-BUSH®

Form No. 7011R

INTRODUCTION

Dunham-Bush LSBC air-cooled condensers offer advancements in both design and performance. The principle advantages are lower silhouette, factory installed options, heavy gauge construction, optimum heat transfer surface and reduced sound levels. Units are available with both direct and belt drive fans and can be used on low, commercial and high temperature applications for refrigeration or air conditioning.

The low silhouette design also provides for ease of installation and service. All components of these units have been pre-matched and tested to provide a long system life.



Dunham-Bush Reserves the Right to Make Changes in Specifications and Design without Notice.

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NOMENCLATURE

LSBC 110 D AN N N N N N Q

Low Silhouette Basic Condenser

Nominal Condenser Tons at 30°F TD

Direct Drive - (D)
Belt Drive - (B)

LSBC	Unit	Motor(1)	Code
040D to 110D and 035B to 190B	200/3/60 230/3/60 460/3/60	200/3/60 230/3/60 460/3/60	(AK) (AN) (AR)
005D to 035D	200/208-230/1/50/60 400/460/1/50/60 200/208-130/3/50/60 400/460/3/50/60	200/208-230/1/50/60 400/460/1/50/60 200/208-130/1/50/60 400/460/1/50/60	(BR) (BS) (BU) (BV)
040D to 110D	200/3/60 230/3/60	200/1/60 230/1/60	(BL) (BM)

Note: (1) Refer to Tables 6, 7 and 8 on page 17

Type of Starter/Head Pressure Control
(N) Standard None
(E) Starter Panel Only
(F) Starter panel w/Fan Cycling (1) Refrig. Circuit
(G) Starter Panel w/Fan Cycling (2) Refrig. Circuits
(H) Starter Panel w/Variable Speed (1) Refrig. Circuit
(J) Starter Panel w/Variable Speed (2) Refrig. Circuits

Maintenance
(N) Standard None
(7) Extra Circuits

Multiple Circuits
(N) Standard None (1 or 2 per catalog)
(8) Disconnect Switch

Disconnect Switch
(N) Standard None
(B) Disconnect Switch

Low Ambient Lockout Thermostat
(N) Standard None
(9) L.A. Lockout T'Stat

Special Options (Fluid Cooler, etc.)

STANDARD FEATURES

Casing

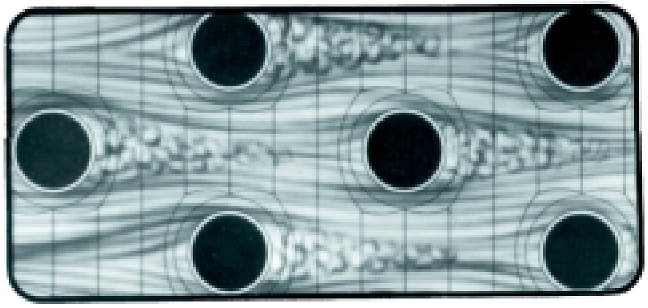
All casings are constructed of sheet steel coated with 1-1/4 oz. per square foot galvanizing with standard spangle. In addition, all external steel casing parts have special zinc chromate coating for added protection. Structural members are 8 and 12 gauge for extra rigidity. All fans are separated by full width and height partitions for additional reinforcing. The partitions (baffles) also prevent air bypass during fan cycling.

Condenser Coil

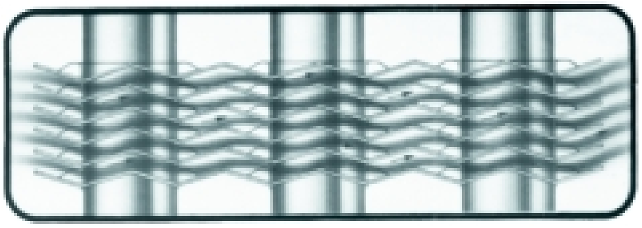
Dunham-Bush Wave Fin® and 'W' Fin type coils assure maximum efficiency of heat transfer between the circulating refrigerant and air. All fins are aluminum, and have full self spacing collars which are mechanically bonded to, and completely cover the copper tubing. The staggered tube design improves the coil thermal efficiency and eliminates by-passing of air around the tubes.

Coils are suitable for R-22 and HFC refrigerants. They are brazed with inert gas in the tubes, and are tested after fabrication to 400 lbs. per square inch, dehydrated, evacuated and sealed. All headers and connections are copper, and sized for minimum pressure drop. Connections are located to obtain equalized coil distribution. All standard belt drive units and direct drive units size 040D and larger, have equal dual circuits, headers and connections.

Staggered Tubes



Wave-Fin Air Flow



Fans

Direct Drive - Fans are aluminum with spiders cadmium plated for corrosion protection. The entire fan deck is recessed below top of unit, on 4, 6 and 8 fan models, to limit sound transmission, and insure the lowest possible installed height.

Belt Drive - Fans are zinc coated steel with gold iridite finish. Large diameter fans, having low tip speeds, are used to achieve minimum sound levels.

Fan Guards

Direct Drive - All recessed fans are covered by a single flat grille for a streamline appearance.

Belt Drive - Each fan has a domed type grille for maximum rigidity. All guards have minimum spacing between heavy gauge steel wire, finished with zinc plating and gold iriditing.

Motors

Direct Drive - Single phase motors are specially designed permanent split capacitor type with splashproof enclosures, inherent protection and special ventilation ports. Three phase motors are identical to single phase except they do not require split capacitors for starting. All direct drive motors have sealed permanently lubricated ball bearings. The steel shafts are coated with a corrosion resistant material and specially designed slingers are provided to prevent moisture from reaching the bearings.

Belt Drive - Motors for belt driven fans are NEMA-T Frame, open drip proof type and are protected within the enclosure. Motor bearings are sealed, grease lubricated with fittings and are of the ball bearing type. All motors are mounted on adjustable bases for ease of maintaining belt tension. Each fan is driven by its own motor for additional reliability and all V-belt drives are supplied with cast iron pulleys. Bearings are heavy duty pillow block type and widely spaced on an extended mounting plate for maximum rigidity. All bearings are pre-lubricated and supplied with fittings for lubrication and extended service.

Electrical Panel

All motors are factory wired in a raceway or conduit to a terminal strip in a rainproof panel. Optional controls and panels are available.

Serviceability

All belt drive units are provided with large hinged access doors to assure ease of inspection, preventive maintenance and service. Refer to page 2.

Installation

All units (except for 2 and 3 fan direct drive models) are supplied with 8 gauge lifting eyes located on the top panel, the need for spreader bars is thereby eliminated. Rigging time and cost are reduced to a minimum, and the chance of casing damage is virtually eliminated. Refer to page 2.

OPTIONS: FACTORY INSTALLED

Coils

Multi-Circuiting - All condenser coils can be multi-circuited to handle multiple compressors. The circuit capacity and method of calculating the number of condenser circuits required is shown on page 10.

Fin Material and Coating - All condenser coils are available with copper fins and special coatings for corrosive atmospheres (Polycoat, Heresite). Consult your local Dunham-Bush representative for selection and details.

Special Applications - Dunham-Bush air cooled condensers can be built for a variety of heat transfer applications, and can be specifically circuited and controlled for maximum service and efficiency. Special condensers can be built for the following applications.

1. Oil coolers for compressors and engines.
2. Glycol coolers for process cooling or condensing. See page 11.
3. De-Superheaters for use with evaporative condensers (to reduce scaling of upper tubes due to high superheat temperatures).
4. Coding of non-corrosive liquids.
5. Cooling jacket water for compressors and engines.

Consult your local Dunham-Bush representative for selection and details.

Bearings

Extended Lube Lines - Grease fittings can be located on outside of belt drive unit casing to permit lubrication while unit remains in operation.

Electrical

Starter Panel - Includes factory mounted and wired fan motor contactor(s). Motor overloads and reset are also factory mounted and wired, except on single phase motors which have inherent overload protection.

Fused Disconnect - Can be factory mounted on condenser, and wired to terminal strip or contactor(s) in starter panel.

Low Ambient Head Pressure Controls

General - To insure proper system operation, the condensing temperature and pressure must be maintained within certain limits. An air cooled condenser's capacity is directly proportional to the temperature difference (TD) between the entering air dry bulb temperature, and the condensing temperature. Selection of a condenser is normally based on a TD established for the summer outdoor design dry bulb temperature. Therefore, a fall or rise in ambient temperature will result in an equal decrease or increase in condensing temperature. Low condensing temperatures (pressures) will cause an insufficient pressure differential across the expansion valve, and in effect starve the evaporator.

Low ambient head pressure controls, applied properly, can assure operation of air cooled condensers in ambient temperatures down to -20°F. The following methods of control are available to prevent excessively low head pressures during low ambient conditions.

Fan Cycling - All units, except single fan type, can be provided with head pressure controls which sequence fan motors in response to coil condensing pressure.

All controls are factory mounted and wired. A starter panel is included with this option. Refer to page 6 for ambient limitations and requirements for single and two compressor operation.

Belt Drive Fan Cycling - All belt drive type units can be supplied with fan cycling to maintain adequate head pressure control for lower ambient conditions. Single fan units are supplied with one pressure switch to cycle the fan on and off. Two and three fan units are provided, one or two pressure switches respectively. Fan(s) are sequenced in response to coil condensing pressure. All controls are factory mounted and wired and a starter panel is included. Refer to Table 1 for ambient limitations and requirements for single and two compressor operation.

Direct Drive Fan Cycling and Solid State Variable Speed Control - The variable speed control is available for use on direct drive models size 030D and larger. A single pressure actuated speed control is used on units with three fans. Units with 4, 6 and 8 fans (which have two equal refrigerant circuits) have two variable speed controllers provided to operate the two motors at the header end of the unit.

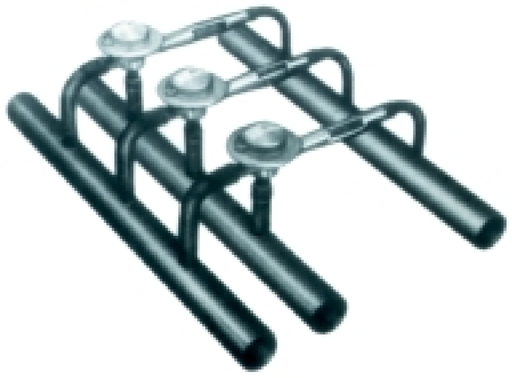
Use of the variable speed control option requires the fan cycling and starter panels also be used. An expansion valve capable of controlling over a wide range of net available pressures drops and reduced loads, and a 90 second low pressure time delay switch are also required, remote from the condenser. The valve and pressure switch must be furnished by others.

ACCESSORY: FACTORY ASSEMBLED

Connection Manifold - Condensers supplied dual circuited as standard, can be provided with a manifold for single circuiting.

Head Pressure Control

Flooding Type - Head pressure control valves and piping, can be built as subassemblies at the factory; piping manifold connections are designed to match the condenser connections. The assembly can be located in the equipment room for quick connection to compressor unit with receiver (receiver is not included as part of the assembly, but is available as a ship loose option). If the receiver is located at the condenser site, it must be insulated, heated for operation during low ambient temperatures, and shielded from the sun to prevent the receiver ambient temperature from approaching the condensing temperature. Refer to page 7 for ambient limitations and operation.



NOTE: Various manufacturer's valves may be used.

Floodback Head Pressure Control Valves

Head Pressure Control

Table No. 1 Minimum Operating Ambient Temperatures °F

Type Unit (No. Of Fans)	Type Head Pressure Control	100% Load				75% Load				50% Load				25% Load			
		°TD				°TD				°TD				°TD			
		30	25	20	15	30	25	20	15	30	25	20	15	30	25	20	15
Any	None	60	65	70	75	58	62	65	69	65	68	70	73	73	74	75	77
One (2)	Flooding	-20°F															
Two or Four	Fan	36	45	54	63	40	46	53	60	53	58	62	67	67	69	71	74
	Variable Speed(s)	0°F															
	Flooding	-20°F															
Three or Six	Fan	25	28	40	53	25	34	43	52	43	49	55	62	62	65	68	71
	Variable Speed(s)	0°F															
	Flooding	-20°F															
Eight	Fan	25	25	29	45	25	25	35	46	35	43	49	58	58	61	65	69
	Variable Speed(s)	0°F															
	Flooding	-20°F															

No. Fans	Model Nos.
One	035, 040, 045, 055B
Two	065, 070, 080, 090, 100B
Three	110, 125, 140, 155, 170, 190B
Four	040, 045, 050, 055D
Six	070, 080D
Eight	090, 110D

NOTES:

(1) Table is based on maintaining 90°F Condensing Temperature for 100% load and 80°F for 75%, 50% and 25% loads using Refrigerant R22.

(2) Fan Cycling is not available for single fan units.

(3) Minimum is 50% load when unit is used with two compressors and minimum ambient is determined by compressor with maximum unloading.

OPERATION

General - Dunham-Bush recommends that ambient thermostat be installed by customer to prevent system operation below minimum temperatures in above table. The lead compressor circuit is always on the left when looking at header end.

For a condenser to operate below the minimum ambient temperature listed opposite "ANY" in Table No. 1, automatic head pressure controls must be provided to maintain pressure in the liquid line to the expansion valve. See Table No. 1 above for appropriate head pressure control selection. Any unit operating at an ambient lower than 45°F should have a 60 second timer over-ride on low pressure switch for start-up.

Fan Cycling - The standard actuating control is a pressure switch, or switches, controlled by the pressure in the condenser coil. The sensing line, between the switch(es) and coil, is factory installed. When unit is used with two equal compressors and circuits, two pressure switches are used on each fan. See "Multi-Circuited Condensers" when more than two compressors and circuits are used or when unequal compressors and circuits are used.

Belt Drive Fan Cycling - Units with multiple fans have a pressure switch for each fan. As the head pressure falls, the pressure switches will shut off their respective fans as required. When a multiple fan unit is used with two equal compressors and circuits, two pressure switches must be used for each fan. The second compressor must be interlocked electrically and cannot load more than the lead compressor.

Direct Drive Fan Cycling And Variable Speed Fan Control - This option is used on multiple fan units size 030D and larger. Pressure switches are used to control those fans not equipped with variable speed controls. As the head pressure drops, the pressure switches will shut off the respective fans as required. If the head pressure continues to fall, the variable speed fan control will begin to modulate to maintain a constant condensing temperature of 95°F when using refrigerant R-22. Four, six and eight fan models are furnished with two motor speed controllers.

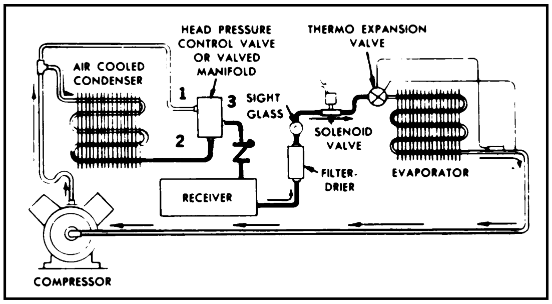
Multi-Circuited Condensers - The indiscriminate use of ambient thermostats for cycling fans on multi-circuited condensers is not recommended. System compressor(s) protection is not adequately afforded, in all cases, nor can expected individual circuit performance be assured under all ambient conditions and circuit loading.

Multiple pressure switches, actuated by pressure in the condenser coil, can be provided to cycle fans on select multi-circuited applications. However, prior approval must be secured from the Factory Application Engineering Department, due to variations in multi-circuited system design. Condenser flooding is the recommended method of head pressure control for multi-circuited condensers.

Each compressor circuit must be provided with its own head pressure control valve(s). Refer to Fig. A and related paragraphs for a functional description of flooding control.

Flooding - Figure A illustrates a typical installation schematic. During normal ambient conditions, refrigerant liquid from the condenser enters port ‘2’ and leaves through port ‘3’ to the liquid receiver. When the receiver pressure drops below the valve setting, the valve modulates and permits discharge gas to enter port '1'.

Figure A



When the receiver is installed in an area where the temperature varies between the condenser and the receiver, a check valve should be installed in the liquid drain line from the condenser to the receiver.

Metering discharge gas into the liquid produces a higher pressure at the condenser outlet, thus reducing the flow and allowing a level of condensed liquid to rise in the condenser. Flooding the condenser with liquid reduces the available condenser surface, and in effect increases the operating temperature difference. This method of control makes it possible to operate the condenser in ambient temperatures down to -20°F.

SELECTION DATA

Temperature Differential

Condenser TD (Temperature Differential) is the difference in temperature between the ambient air and the condensing temperature.

The selection of the condenser TD is very important because of the effect on compressor and system performance. With the use of R-22 and the higher pressure differentials the limiting factor is the discharge temperature of the gas at the compressor. The maximum permissible discharge temperature of the gas leaving a compressor is 270°F. Above this temperature, lubricating oil tends to vaporize, break down, and oxidize. This increases acidity causing sludge formation, discharge plate failure on reciprocating compressors and, in the case of hermetic compressors, an eventual breakdown of the motor insulation and consequent burnout.

For example, at suction pressure of 7.5 lbs. (-25° saturated suction temp.) and 40° entering temperature (65° superheat) and 105° condensing, the discharge temperature is 234°. If the same entering conditions prevail and the discharge pressure is 280.7 lbs. (125° sat. condensing) using 30°TD, actual discharge temperature is 280°F, exceeding the 270°F maximum permissible. The logical selection of TD for this condition is 15°. Conditions based on R-22 refrigerant.

Other advantages of maintaining low discharge pressures by keeping the TD between 15° and 20° are:

a. **Power Savings Plus Increased Capacity**
   A reduction of condensing temperature from 125, to 105° reduces the power consumption for equal tonnage by approximately 11%.
   At the same time the compressor capacity is increased by approximately 12%.
   The power savings justify the use of larger condensers -- plus improved compressor performance and minimum maintenance and service.

b. **High Ambient Areas**
   Air Cooled Condensers can be used in high ambient areas when temperatures exceed 95°F but TD should be kept to 20°. This is especially important on low temperature systems when considerable superheat can be expected in the suction gas to the compressor.

Unit Selection (Computer)

Consult factory for LSBC condenser computer selection program.

Unit Selection (Manual)

Standard selection tables are based on the total heat rejection at various TD's. Tables are set up for TD's of 20°, 25°, 20°, 15° and 1°F.

The total heat rejection of the condenser is the total of the low side capacity of the compressor, or net refrigeration at the evaporators, plus that portion of the energy input from the compressor motor that goes into the refrigerant gas.

The most accurate estimate of heat rejection is by the use of compressor performance curves giving low side capacity and input energy expressed either in KW input to a semi-hermetic compressor or horsepower input to open compressors.

The formulas are as follows:

a. Reciprocating Hermetic Compressors:
   Total Heat Rejection =
      Low Side Capacity + (KW X .9 X 3416) =
      Low Side Capacity + (KW X 3075)

b. Reciprocating Open Compressors:
   Total Heat Rejection =
      Low Side Capacity + (BHP X .9 X 2550) =
      Low Side Capacity + (BHP X 2295)

Conversion Factors

Acceptable total heat calculations can also be obtained by using conversion factors given in the following tables for the particular type compressor—open or semi-hermetic reciprocating type.

Refer to Dunham-Bush compressor catalogs for operating limits. Consideration should be given to pull down conditions as this may notably affect condenser selection.

Condenser Selection Example:

Example A:

Find the heat rejection and select a condenser for the following conditions, using R-22 refrigerant:

> A semi-hermetic compressor operating at +10°F suction and 115°F condensing temperature has a capacity of 280 MBH with 34.9 KW input.

Total Heat Rejection = 280,000 + (34.9 x 3075) = 387 MBH. The closest LSBC Condenser is Model No. 050D which has a capacity of 410 MBH at 20° TD assuming a 95°F ambient.

Example B:

If in the above example the kW input was not know, and a condenser must be selected at same conditions, Table 3 gives a multiplier of 1.45 to be applied to the low side capacity:

Total Heat Rejection = 280 x 1.45 = 406 MBH
The selection would be the same Model No. 050D.

Corrections For Altitude

Because heat transfer in an air cooled condenser is a function of air mass flow, the capacity of a condenser decreases as the altitude is increased. To compensate for this, the condensers should be selected for higher capacity in accordance with the following table. From the table, select the factor associated with the altitude and multiply the basic calculated total heat of rejection by the factor and select the condenser using the corrected total heat of rejection.

Altitude Correction Factors

Altitude	Factor
Sea Level	1.00
2000 Ft.	1.05
4000 Ft.	1.10
6000 Ft.	1.15
8000 Ft.	1.20

SELECTION DATA (CONT.)

TABLE 2 — Open Compressor Factors

Saturated Suction	Saturated Discharge Temperature — °F					
Temperature — °F	95	105	115	125	135	146
-40	1.56	1.58	1.65			
-30	1.50	1.54	1.60			
-20	1.45	1.49	1.54	1.60		
-10	1.40	1.44	1.49	1.54	1.68	
0	1.35	1.39	1.43	1.48	1.53	
10	1.30	1.34	1.38	1.43	1.48	
20	1.26	1.29	1.33	1.37	1.43	1.49
30	1.21	1.25	1.28	1.32	1.38	1.55
40	1.18	1.20	1.23	1.28	1.33	1.39
50	1.13	1.16	1.18	1.23	1.29	1.34

TABLE 3 — Semi-Hermetic Compressor Features

Saturated Suction	Saturated Discharge Temperature — °F					
Temperature — °F	95	105	115	125	135	146
-40	1.64	1.67	1.74			
-30	1.58	1.62	1.68			
-20	1.52	1.56	1.62	1.68		
-10	1.47	1.51	1.56	1.62		
0	1.42	1.46	1.50	1.55	1.60	
10	1.36	1.41	1.45	1.50	1.55	
20	1.32	1.35	1.40	1.44	1.50	1.56
30	1.29	1.31	1.35	1.39	1.45	1.51
40	1.24	1.26	1.29	1.34	1.40	1.46
50	1.19	1.21	1.24	1.29	1.35	1.41

CAPACITY RATINGS

Direct Drive Models*

Refrigerant R-22					
Model	Total Heat Rejection—MBH				
No.	Temperature Difference (TD) —°F				
LSBC	30	25	20	15	1
005D	83	69	55	41	2.75
010D	122	100	81	61	4.05
015D	160	132	107	80	5.35
020D	250	208	166	125	8.30
025D	277	230	185	138	9.25
030D	315	263	210	160	10.50
035D	387	323	258	193	12.90
040D	475	395	316	238	15.8
045D	562	468	374	281	18.7
050D	616	512	410	308	20.5
055D	656	545	436	328	21.8
070D	830	690	552	415	27.6
080D	984	820	666	492	32.8
090D	1105	920	736	552	36.8
110D	1306	1098	870	653	43.5

* 'D' type 60 Hz units are available with 2 and 3 fan models only, but must be derated by 10%.

Belt Drive Models**

Refrigerant R-22					
Model	Total Heat Rejection—MBH				
No.	Temperature Difference (TD) —°F				
LSBC	30	25	20	15	1
035B	448	372	298	224	14.9
040B	515	428	342	258	17.1
045B	562	468	374	281	18.7
055B	670	558	446	335	22.3
065B	757	630	504	378	25.2
070B	860	715	572	430	28.6
080B	938	780	624	469	31.2
090B	1094	910	728	547	36.4
100B	1206	1005	804	603	40.2
110B	1286	1070	856	643	42.8
125B	1494	1245	996	747	49.8
140B	1688	1405	1124	844	56.2
155B	1849	1540	1232	924	61.6
170B	2063	1718	1374	1032	68.7
190B	2251	1875	1500	1126	75.0

** 'B' type 50 Hz units are available with higher RPM sheaves, which may require the next larger size motors. Consult factory for selection and details. If standard motor and drive are used, unit must be de-rated by 15%.

▨ For Application qualifications governing the use of this data, refer to Paragraph ‘B’, Page 8, entitled ‘High Ambient’ areas.

MULTI-CIRCUITING OF CONDENSERS

Air Cooled Condensers may be furnished with multiple circuits when required. The limitations, as to the number of tube passes available, and the heat rejection capacity for each tube pass. Each circuit, which can be one or more tube passes, is provided with headers and/or circuit connections by the factory. These are properly sized for the heat rejection capacity specified.

A multi-circuited Low Silhouette Air Cooled Condenser is actually a number of individual condensers using a common enclosure and common fan(s). It is necessary to convert the operating conditions of the several condensers to a basis of heat rejection to select the proper model.

Tables 2 and 3 give multipliers which may be used to convert the cooling temperatures, to the heat rejection rating at the Design Condensing Temperature. The sum of the heat rejections of the several circuits must be less than the total heat rejection of the condenser given in the capacity ratings at the selected design TD. The heat rejection capacities given in Table 4 are per circuit and per °F and must be multiplied by the design TD selected to determine total heat rejection per circuit.

If total number of passes in the condenser selected exceeds the number of passes required, spare circuits may be provided for future use. As an alternative, the unused passes may be added to those circuits which would benefit by the provision of extra condenser surface and consequent lower operating head pressure.

Table 4 — Multi-Circuiting Data — R-22 (1)

Direct Drive Units

Condenser Model No. LSBC	Std. No. of Tube Circuits Available	Heat Rejection Btuh/Circuit - °F
005(1)	6	458
010(1)	14	289
015(1)	14	382
020(1)	18	461
025(1)	20	463
030(1)	22	477
035(1)	26	496
040	18	878
045	24(2)	779
050	18	1139
055	24(2)	896
070	16	1725
080	22	1491
090	28	1314
110	28	1554

Belt Drive Units

Condenser Model No. LSBC	Std. No. of Tube Circuits Available	Heat Rejection Btuh/Circuit - °F
035	18	828
040	24(2)	712
045	18	1039
055	24(2)	929
065	16	1575
070	20	1430
080	22(2)	1418
090	28	1300
100	28(2)	1436
110	28	1529
125	36(2)	1383
140	42	1338
155	42	1467
170	56	1227
190	56	1339

(1) These units are single circuited as standard. All other units are two circuited as standard.

(2) These units are available with 56 tube circuits on special order. Minimum loading 24,000 BTUH/circuit at 125°F C.T.

Sample Selection (See Table at Right)

Condensing Temp. .... 115°
Ambient Temp .... 95°
Temp Differential (TD)...... 20°
Total Heat Rejection ....290,094 BTUH
Total Tube Circuits Required 22
Compressor ... Semi-Hermetic
Condenser ....Direct-Drive
Refrigerant..................... R-22

Circuit No.	Suction Temp. °F	Compressor Capacity @ Design Condensing Temperature BTU/HR	X	Capacity Factor Per Table No. 3		Heat Rejection @ 115°F Condensing Temperature	Required Heat Rejection Ht. Rej./Circ.- °F x 20°F (TD)	=	No. Tube Circuits Req'd	No. Tube Circuits Selected
1	20	10,100	X	1.40	=	14,140	14,140 15,580	=	.91	1
2	20	11,000	X	1.40	=	15,400	15,400 15,580	=	.99	1
3	20	15,000	X	1.40	=	21,000	21,000 15,580	=	1.35	2
4	-20	15,700	X	1.62	=	25,434	25,434 15,580	=	1.63	2
5	-20	11,800	X	1.62	=	19,116	19,116 15,580	=	1.23	2
6	25	27,500	X	1.37	=	27,675	27,675 15,580	=	2.42	3
7	35	63,400	X	1.32	=	83,820	83,820 15,580	=	5.38	6
8	25	20,500	X	1.37	=	28,085	28,085 15,580	=	1.80	2
9	30	10,600	X	1.34	=	14,204	14,204 15,580	=	.91	1
10	20	22,300	X	1.40	=	31,220	31,220 15,580	=	2.00	2
		Total Unit Heat Rejection			=	290,094	Total Passes required			22

MULTI-CIRCUITING OF CONDENSERS (CONT.)

STEP 1—Each compressor system must be assigned a circuit number. The factory will arrange the condenser connections in the assigned numerical sequence (left to right when facing header end).

STEP 2—Indicate the specified Suction Temperature for each compressor circuit.

STEP 3—Indicate the specified Heat Rejection capacity, at the design condensing temperature, for each circuit. For this example, the Heat Rejection of each circuit has been calculated by the method outlined on page 4, utilizing Table No. 3.

STEP 4—Determine the Total Heat Rejection by adding the sum of the circuit capacities. Referring to Capacity Ratings on page 5, model LSBC 040D has the total capacity required (316 MBH). When the circuit requirements were calculated, it was found that 22 tube circuits were required, and model LSBC 040D had only 18 tube circuits available. Therefore, select model LSBC 045D having a total capacity of 374 MBH and 24 tube circuits available. Its capacity per tube circuit at 20° TD is:

(779 BTUH/Tube Circuit - °F) (20° TD) =
15,580 BTUH/Tube Circuit

Divide the specified Heat Rejection capacity per circuit (step 3), by the actual condenser heat rejection capacity per tube circuit. This equals the number of tube circuits required per compressor circuit specified.

Since only 22 tube circuits are required and 24 are available, the two extra tube circuits may be used for future installations, or as additional surface on a critical circuit.

APPLICATION DATA: FLUID COOLERS

Closed Circuit Dry Fluid Coolers

The LSBC propeller fan unit is also available for applications as a closed circuit dry fluid cooler. Capacities are as shown below for 35% ethylene glycol solution. Contact factory for other types of circuiting, flow rates, fluids or conditions of service.

UNIT SELECTION (Computer) - Consult factory for LSBC Fluid Cooler Selection Program.

Direct Drive Units

Unit Model	GPM	Capacity (MBH)	Connection Size Inches MPT
Half Circuited			
005D	14	64	3/4
010D	16	86	1
015D	15	98	1
020D	18	135	1
025D	20	158	1
030D	22	181	1 1/4
035D	25	217	1 1/4
040D	46	305	1 1/4
045D	40	328	1 1/4
050D	42	331	1 1/2
055D	36	346	1 1/2
070D	55	488	2
080D	49	509	2
090D	49	536	2
Full Circuited			
045D	106	417	2 1/2
055D	98	468	2 1/2
080D	132	717	2 1/2
110D	119	865	2 1/2

Belt Drive Units

Unit Model	GPM	Capacity (MBH)	Connection Size Inches MPT
Half Circuited			
035B	46	292	1 1/4
040B	40	309	1 1/4
045B	42	332	1 1/2
055B	36	348	1 1/2
065B	55	465	2
070B	55	497	2
080B	49	505	2
090B	49	532	2
100B	43	516	2
110B	47	562	2
Full Circuited			
040B	106	379	2 1/2
055B	98	474	2 1/2
080B	132	686	2 1/2
100B	119	813	2 1/2
125B	113	928	(2) 2 1/2
170B	100	1072	(2) 2 1/2
190B	100	1103	(2) 2 1/2

NOTES:

1. Unit capacities @ 35% ethylene glycol solution, 90°F entering dry bulb, 120°F entering glycol and 15 ft. H_2O pressure drop.
2. Connections on same end as standard condenser. Connection sizes may change as flow rate or circuiting changes.

INSTALLATION

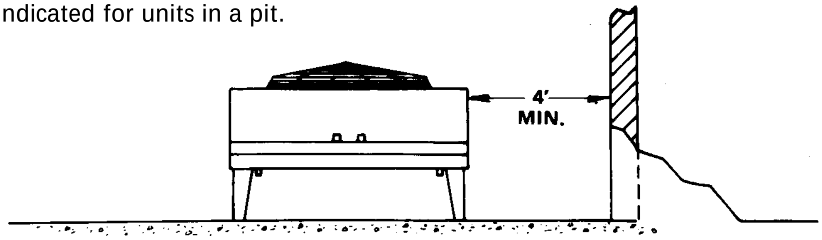
Space and Location Requirements

The most important consideration which must be taken into account when deciding upon the location of air cooled equipment is the provision for a supply of ambient air to the condenser, and removal of heated air from the condenser area. Where this essential requirement is not adhered to, it will result in higher condensing temperatures, which cause poor operation and possible eventual failure of equipment. Units must not be located in the vicinity of steam, hot air, or fume exhausts.

Another consideration which must be taken is that the unit should be mounted away from noise sensitive spaces and must have adequate support to avoid vibration and noise transmission into the building. Units should be mounted over corridors, utility areas, rest rooms and other auxiliary areas where sound levels are not an important factor. Sound and structural consultants should be retained for recommendations.

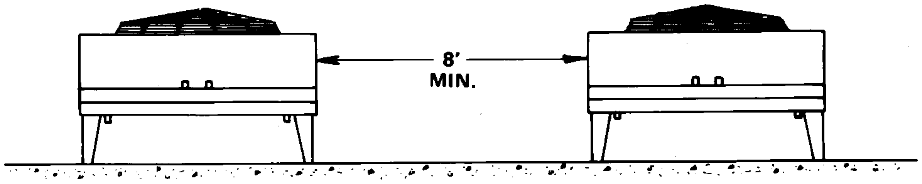
Walls Or Obstructions

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access, all sides of the unit must be a minimum of four feet away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. Overhead obstructions are not permitted. When the unit is in an area where it is enclosed by three walls, the unit must be installed as indicated for units in a pit.



Multiple Units

For units placed side by side, the minimum distance between units is 8 feet. If units are placed end to end, the minimum distance between units is 4 feet.



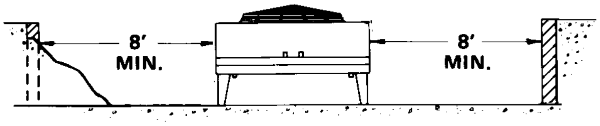
Units in Pits

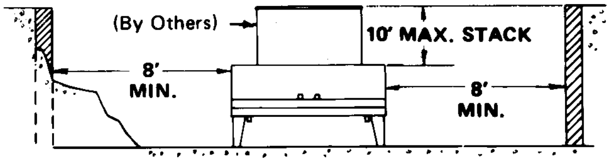
The top of the unit should be level with the top of the pit, and side distance increased to 8 feet.

If top of the unit is not level with the top of pit, discharge cones or stacks must be used to raise discharge air to the top of the pit. This is a minimum requirement.

Stacks cannot be used on direct drive units. Belt drive units must be reinforced internally to support the weight of stacks, and larger fan motors may be required.

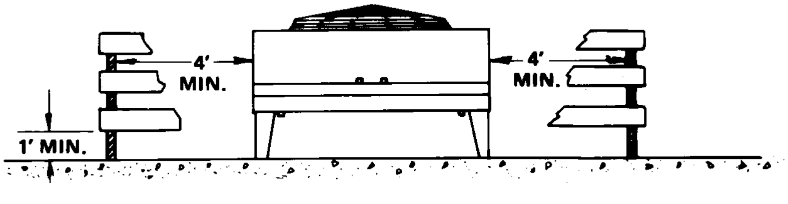
Contact your local Dunham-Bush representative for details.





Decorative Fences

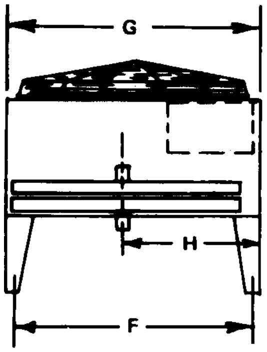
Fences must have 50% free area, with a 1 foot undercut, a 4 foot minimum clearance, and it must not exceed the top of unit. If these requirements are not met, unit must be installed as indicated for "Units in a Pit".

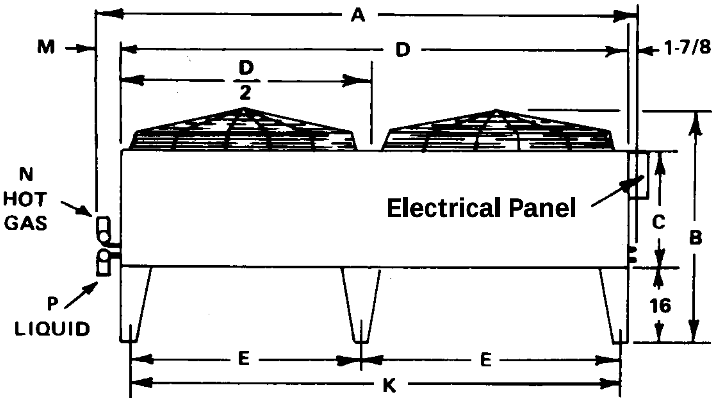


Dimensions: Direct Drive

Models: LSBC 061D, 141D, 142D

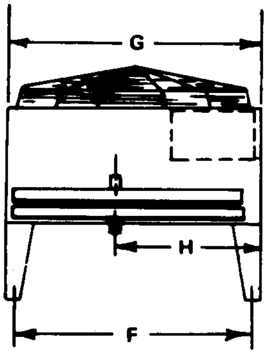
MODEL NO.	A	B	C	D	E	F	G	H	K	M	CONN. (ODS) N Hot Gas	CONN. (ODS) p Liquid
LSBC 005D	49-15/16	42-9/16	21-9/16	44-3/16	--	22-7/8	24-3/8	14	42-11/16	3-7/8	7/8	5/8
LSBC 010D	58-3/16	42-9/16	21-9/16	52-3/16	--	26-7/8	28-3/8	15	50-11/16	4-1/8	7/8	5/8
LSBC 015D	72-3/16	42-9/16	21-9/16	66-3/16	32-11/32	26-7/8	28-3/8	15	--	4-1/8	1-1/8	7/8

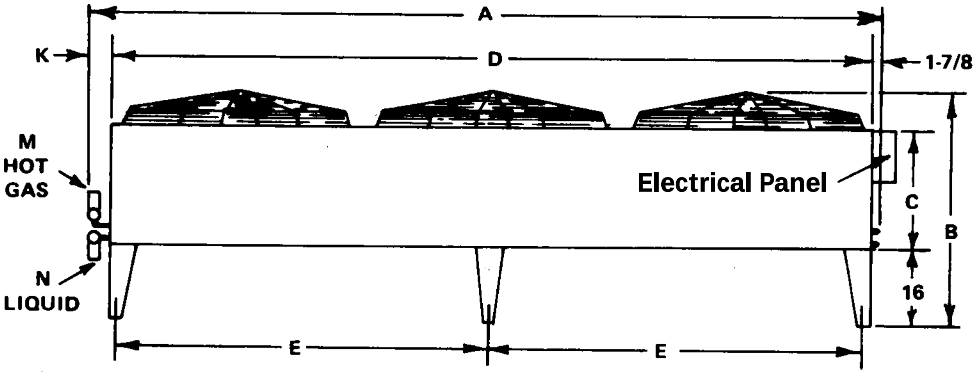




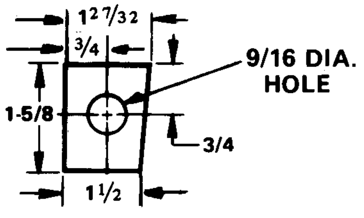
Models: LSBC 183D, 202D, 222D, 261D

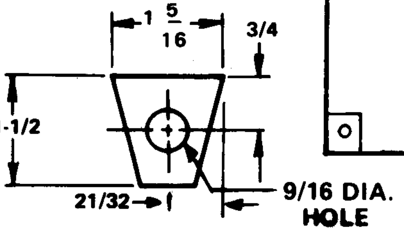
MODEL NO.	A	B	C	D	E	F	G	H	K	CONN. (ODS) M Hot Gas	CONN. (ODS) N Liquid
LSBC 020D	86-7/16	43-13/16	22-13/16	80-3/16	39-11/32	34-7/8	36-3/8	19	4-3/8	1-1/8	7/8
LSBC 025D	86-7/16	43-13/16	22-13/16	80-3/16	39-11/32	38-7/8	40-3/8	21	4-3/8	1-3/8	1-1/8
LSBC 030D	86-7/16	43-13/16	22-13/16	80-3/16	39-11/32	42-7/8	44-3/8	23	4-3/8	1-3/8	1-1/8
LSBC 035D	92-7/16	43-13/16	22-13/16	86-3/16	42-11/32	50-7/8	52-3/8	27	4-3/8	1-3/8	1-1/8

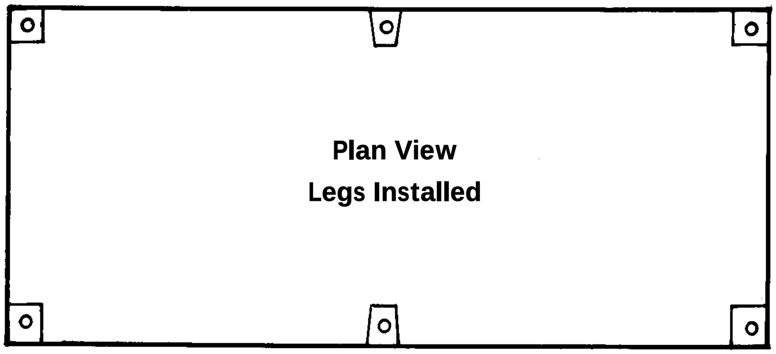




Typical Leg Mounting LSBC 061D, 141D, 142D, 183D, 202D, 222D, 261D



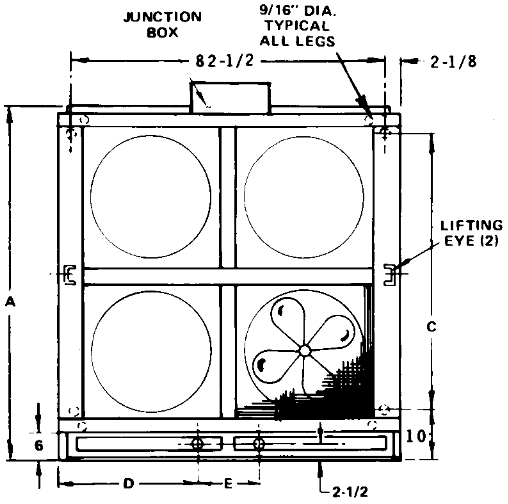




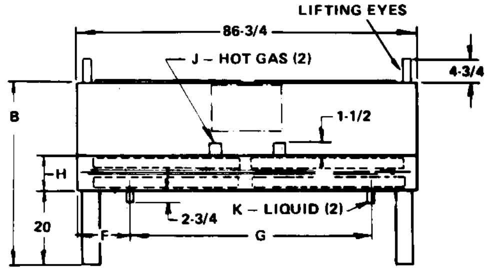
NOTES: Refer to page 12 for unit location and space requirements.
All dimensions are in inches and are approximate.
Contact factory for certified drawings.

DIMENSIONS: DIRECT DRIVE

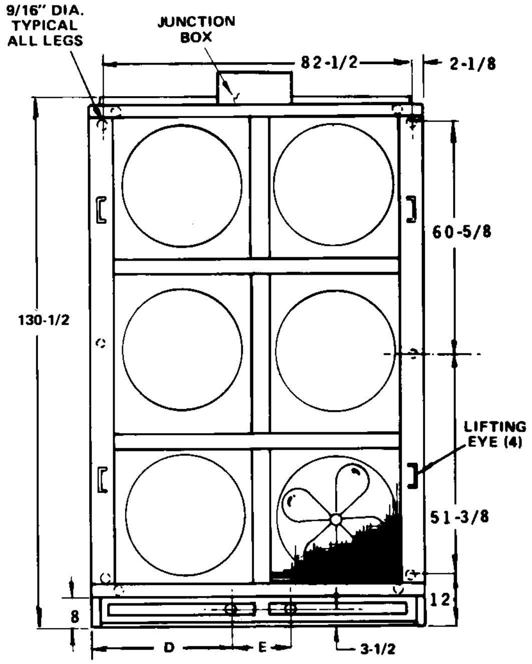
MODEL NO.	A	B	C	D	E	F	G	H	CONN. (ODS) M Hot Gas	CONN. (ODS) N Liquid
LSBC 040D	68-1/2	49	52	32-3/8	18-1/2	12-7/8	65-1/2	10	1-3/8	1-3/8
LSBC 045D	68-1/2	49	52	34-5/8	14	8-1/8	69	10	1-3/8	1-3/8
LSBC 050D	88-1/2	49	72	43-3/8	18-1/2	12-7/8	65-1/2	10	1-3/8	1-3/8
LSBC 055D	88-1/2	49	72	34-5/8	14	8-1/8	69	10	1-3/8	1-3/8
LSBC 070D	--	50-5/16	--	31-1/2	21	7	75	11-15/16	1-5/8	1-5/8
LSBC 080D	--	50-5/16	--	32-3/4	19-1/2	6-1/2	77-1/2	11-15/16	1-5/8	1-5/8
LSBC 090D	--	50-5/16	--	34	16-1/2	4-3/4	78	11-15/16	1-5/8	1-5/8
LSBC 110D	--	50-5/16	--	35	14-1/2	5-1/2	78	11-15/16	2-1/8	2-1/8



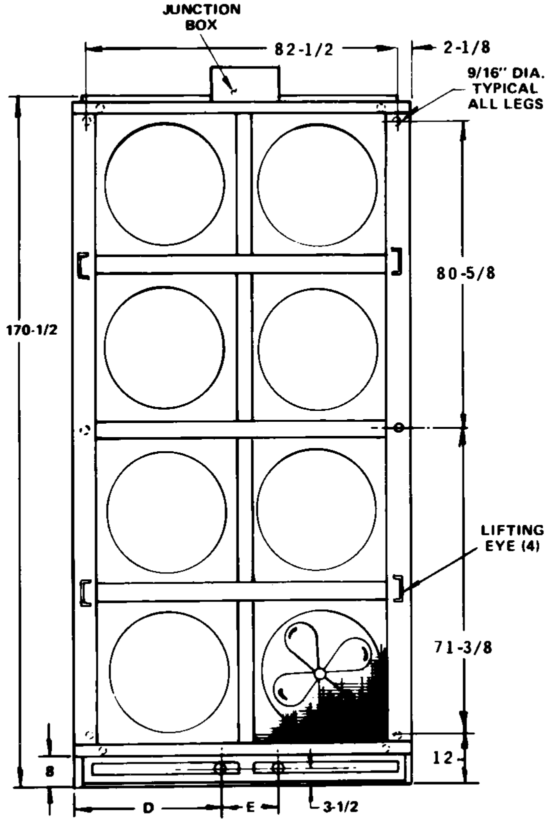
LSBC-181D, 241D, 182D & 242D



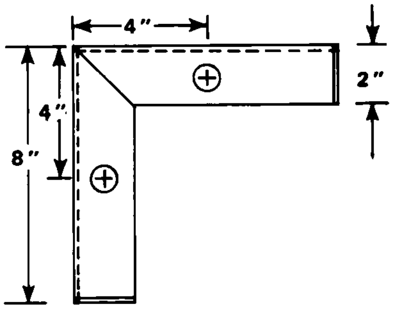
END VIEW ALL MODELS



LSBC- 161D & 221D



LSBC- 281D & 282D

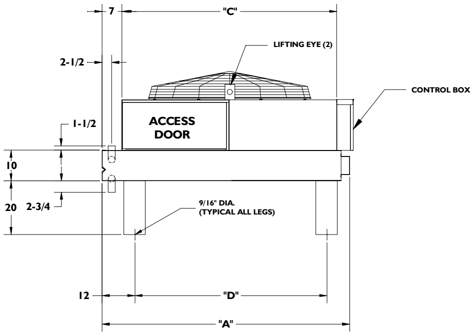


TYPICAL LEG MOUNTING HOLES

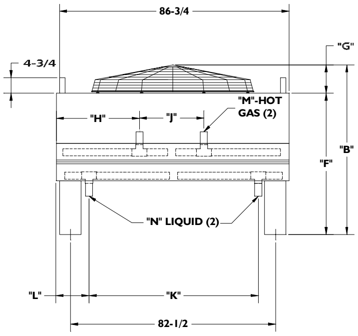
NOTES: Refer to page 12 for unit location and space requirements.
All dimensions are in inches and are approximate.
Contact factory for certified drawings.

DIMENSIONS: BELT DRIVE

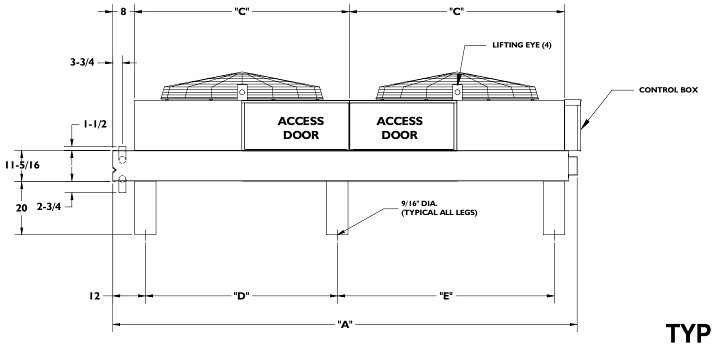
MODEL NO.	A	B	C	D	E	F	G	H	J	K	L	CONN. (ODS)	
												M Hot Gas	N Liquid
LSBC 035B	68-1/2	59-3/4	60	52	--	49	10-3/4	32-3/8	18-1/2	65-1/2	12-7/8	1-3/8	1-3/8
LSBC 040B	68-1/2	59-3/4	60	52	--	49	10-3/4	34-5/8	14	69	8-1/8	1-3/8	1-3/8
LSBC 045B	88-1/2	59-3/4	80	72	--	49	10-3/4	32-3/8	18-1/2	65-1/2	12-7/8	1-3/8	1-3/8
LSBC 055B	88-1/2	59-3/4	80	72	--	49	10-3/4	34-5/8	14	69	8-1/8	1-5/8	1-3/8
LSBC 065B	130-1/2	61-1/16	60	51-3/8	60-5/8	50-5/16	10-3/4	31-1/2	21	75	7	1-5/8	1-3/8
LSBC 070B	130-1/2	61-1/16	60	51-3/8	60-5/8	50-5/16	10-3/4	34	16-1/2	77	5-1/4	1-5/8	1-3/8
LSBC 080B	130-1/2	61-1/16	60	51-3/8	60-5/8	50-5/16	10-3/4	32-3/4	19-1/2	77-1/2	6-1/2	1-5/8	1-5/8
LSBC 090B	170-1/2	61-1/16	80	71-3/8	80-5/8	50-5/16	10-3/4	34	16-1/2	78	4-3/4	1-5/8	1-5/8
LSBC 100B	170-1/2	61-1/16	80	71-3/8	80-5/8	50-5/16	10-3/4	35	14-1/2	78	5-1/2	2-1/8	2-1/8
LSBC 110B	190-1/2	61-1/16	60	51-3/8	69-1/4	50-5/16	10-3/4	35	14-1/2	78	4-3/4	2-1/8	2-1/8
LSBC 125B	190-1/2	61-1/16	60	51-3/8	69-1/4	50-5/16	10-3/4	33	20	69	8-1/2	2-1/8	2-1/8
LSBC 140B	250-1/2	62-5/16	80	71-3/8	89-1/4	50-5/16	12	33-3/4	20	77	5-1/2	2-1/8	2-1/8
LSBC 155B	250-1/2	62-5/16	80	71-3/8	89-1/4	50-5/16	12	31-1/2	23	77	5-1/2	2-5/8	2-5/8
LSBC 170B	250-1/2	62-5/16	80	71-3/8	89-1/4	50-5/16	12	31-1/2	23	75	6-1/4	2-5/8	2-5/8
LSBC 190B	250-1/2	62-5/16	80	71-3/8	89-1/4	50-5/16	12	31-1/2	23	75	6-1/4	2-5/8	2-5/8

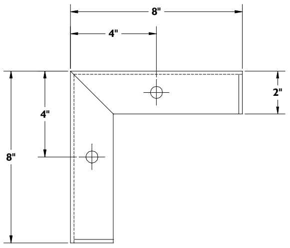


LSBC - 181B, 241B, 182B & 242B



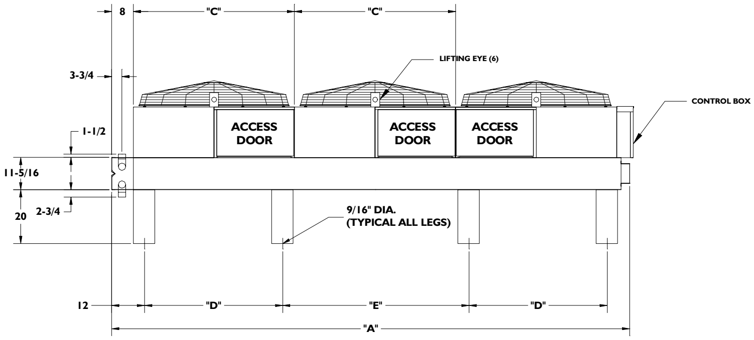
END VIEW ALL MODELS





TYPICAL LEG MOUNTING HOLES

LSBC - 161B, 201B, 221B, 281B & 282B



LSBC - 283B, 361B, 421B, 561B & 562B

NOTES: Refer to page 12 for unit location and space requirements.
All dimensions are in inches and are approximate.
Contact factory for certified drawings.

OPERATING REFRIGERANT CHARGE

Table 5 - Refrigerant Operating Charge (R-22)

UNIT MODEL LSBC	Standard Operating Charge—Lbs. R-22	Refrigerant Charge for Flooding Head Pressure Control - Lbs.		
		40° Ambient	0° Ambient	-20° Ambient
		R-22	R-22	R-22
005D	3.5	8.0	10.9	13.4
010D	4.8	10.9	14.9	18.3
015D	6.0	13.8	18.9	23.3
020D	9.3	21.3	29.2	35.9
025D	10.5	24.0	32.8	40.4
030D	11.5	26.4	36.1	44.5
035D	14.6	33.4	45.7	56.2
040D	17.2	39.3	53.9	66.3
045D	22.6	51.6	70.7	87.1
050D	22.4	51.2	70.1	86.3
055D	29.5	67.4	92.3	114
070D	26.5	60.7	83.2	102
080D	52.0	119	163	201
090D	51.7	118	162	200
110D	69.6	159	218	269
035B	17.2	39.3	53.9	66.3
040B	22.6	51.6	70.7	87.1
045B	22.4	51.2	70.1	86.3
055B	29.5	67.4	92.3	114
065B	26.5	60.7	83.2	102
070B	38.9	89.1	122	150
080B	52.0	119	163	201
090B	51.7	118	162	200
100B	69.6	159	218	269
110B	59.0	135	185	228
125B	77.8	178	244	300
140B	77.6	178	243	299
155B	79.0	181	248	305
170B	104	238	326	401
190B	104	238	326	401

See Note 6, page 17

Operating Refrigerant Charge:

The operating refrigerant charge of a remote air cooled condenser system is the sum of the refrigerant charge in the following system components: hot gas discharge line, suction line, liquid line, evaporator coil, remote air cooled condenser coil, and receiver when supplied.

Table 5 indicates the operating charge of Dunham-Bush Remote Air Cooled Condensers. Since the flooded type head pressure control valve(s) causes refrigerant to log in the condenser to reduce its effective surface, additional refrigerant is required in the system to compensate for this action.

During the operating cycle of a refrigeration system with a receiver, there will be some liquid refrigerant in the receiver. This is known as the receiver operating charge, and must be added to the system refrigerant operating charge. Generally this approximates 20% of the receiver pump down capacity.

Liquid Receiver:

The liquid receiver should be sized so that the total system operating charge, as determined previously, will occupy no more than 80% of its internal volume. The system refrigerant charge should be equal to, or less than, the pumpdown capacity of the receiver.

The liquid receiver should be located as close as practical to the remote air cooled condenser. If located outdoors, it must be shielded from the direct rays of the sun at all times.

GENERAL & ELECTRICAL DATA

Table 6—Single Phase Unit with Single Phase Motors

Model No. LSBC	Fans		Motors		Unit FLA		Unit Fuse Size		Unit Ampacity		Ship Wt. Lbs.
	No.	Dia.	No.	HP	200/50 208/230/60	400/50 460/60	200/50 299/239/60	400/50 460/60	200/50 299/239/60	400/50 460/60	
005D	2	18	2	1/2	7.2	3.6	10	5	8.1	4.1	360
010D	2	22	2	1/2	7.2	3.6	10	5	8.1	4.1	430
015D	2	22	2	1/2	7.2	3.6	10	5	8.1	4.1	480
020D	3	24	3	1/2	10.8	5.4	15	10	11.7	5.9	600
025D	3	24	3	1/2	10.8	5.4	15	10	11.7	5.9	720
030D	3	24	3	3/4	12.6	5.7	20	10	13.7	6.2	760
035D	3	24	3	3/4	12.6	5.7	20	10	13.7	6.2	840

Table 7—Three Phase Unit with Single Phase Motors

Model No. LSBC	Fans		Motors		Unit FLA		Unit Fuse Size		Unit Ampacity		Ship Wt. Lbs.
	No.	Dia.	No.	HP	200/50 208/230/60	400/50 460/60	200/50 299/239/60	400/50 460/60	200/50 299/239/60	400/50 460/60	
*050D	2	18	2	1/2	6.2	3.1	10	5	7.0	3.5	360
*010D	2	22	2	1/2	6.2	3.1	10	5	7.0	3.5	430
*015D	2	22	2	1/2	6.2	3.1	10	5	7.0	3.5	480
*020D	3	24	3	1/2	6.2	3.1	10	5	7.0	3.5	600
*025D	3	24	3	1/2	6.2	3.1	10	5	7.0	3.5	720
030D	3	24	3	3/4	7.3	3.1	12	5	8.2	3.7	760
035D	3	24	3	3/4	7.3	3.1	12	5	8.2	3.7	840
040D	4	26	4	3/4	11.1	NA	15	NA	12.1	NA	1035
045D	4	26	4	3/4	11.1	NA	15	NA	12.1	NA	1105
050D	4	26	4	3/4	11.1	NA	15	NA	12.1	NA	1135
055D	4	26	4	3/4	11.1	NA	15	NA	12.1	NA	1290
070D	6	26	6	3/4	14.5	NA	20	NA	15.5	NA	2010
080D	6	26	6	3/4	14.5	NA	20	NA	15.5	NA	2300
090D	8	26	8	3/4	21.8	NA	30	NA	22.7	NA	2600
110D	8	26	8	3/4	21.8	NA	30	NA	22.7	NA	2875

Table 8—Three Phase Unit with Three Phase Motors

Model No. LSBC	Fans		Motors		Unit FLA			Unit Fuse Size			Unit Ampacity			Ship Wgt. Lbs.
	No.	Dia.	No.	HP	200/50 208/230/60	400/50 460/60	200/50 200/230/60	400/50 460/60	200/50 200/230/60	400/50 460/60	200/ 208/60	200/50 230/60	400/50 460/60	
040	4	26	4	3/4	12.0	12.0	5.6	15	15	15	12.8	12.8	6.0	1035
045	4	26	4	3/4	12.0	12.0	56.	15	15	15	12.8	12.8	6.0	1105
050	4	26	4	3/4	12.0	12.0	56.	15	15	15	12.8	12.8	6.0	1135
055	4	26	4	3/4	12.0	12.0	56.	15	15	15	12.8	12.8	6.0	1290
070	6	26	6	3/4	18.0	18.0	8.4	25	25	15	18.8	18.8	8.9	2010
080	6	26	6	3/4	18.0	18.0	8.4	25	25	15	18.8	18.8	8.9	2300
090	8	26	8	3/4	24.0	24.0	11.2	30	30	15	24.8	24.8	11.6	2600
110	8	26	8	3/4	24.0	24.0	11.2	30	30	15	24.8	24.8	11.6	2875
035	1	54	1	3	11.0	9.6	4.8	20	15	15	13.8	12.0	6.0	1035
040	1	54	1	3	11.0	9.6	4.8	20	15	15	13.8	12.0	6.0	1105
045	1	54	1	3	11.0	9.6	4.8	20	15	15	13.8	12.0	6.0	1135
055	1	54	1	3	11.0	9.6	4.8	20	15	15	13.8	12.0	6.0	1290
065	2	54	2	3	22.0	19.2	9.6	30	20	15	24.8	21.6	10.8	2010
070	2	54	2	3	22.0	19.2	9.6	30	30	15	24.8	21.6	10.8	2135
080	2	54	2	3	22.0	19.2	9.6	30	20	15	24.8	21.6	10.8	2300
090	2	54	2	3	22.0	19.2	9.6	30	30	15	24.8	21.6	10.8	2600
100	2	54	2	3	22.0	19.2	9.6	30	30	15	24.8	21.6	10.8	2875
110	3	54	3	3	33.0	28.8	14.4	45	40	20	35.8	31.2	15.6	2905
125	3	54	3	3	33.0	28.8	14.4	45	40	20	35.8	31.2	15.6	3460
140	3	60	3	3	33.0	28.8	14.4	45	40	20	35.8	31.2	15.6	3720
†155	3	60	3	5	52.5	45.6	22.8	60	60	30	56.9	49.4	24.7	3945
170	3	60	3	3	33.0	28.8	14.4	45	40	20	35.8	31.2	15.6	4430
†190	3	60	3	5	52.5	45.6	22.8	60	60	30	56.9	49.4	24.7	4465
† -	-	-	3	7-1/2	75.9	66.0	33.0	90	90	40	82.2	71.5	35.8	-

NOTES: * Motors on these units are suitable for 208V or 230V only. Motors on other units in this column are suitable for 200V or 230V only.

(1) 50 Hz ‘D’ units are available only on 2 and 3 fan models but must be derated for 50 Hz per page 7.
Full capacity 50 Hz ‘B’ units are available by using next larger size 60 Hz motor derated for 50 Hz.
† Model 155 B and 190 B are available with 7 1/2 HP 60 Hz motor.

(2) Ampacity is minimum circuit ampacity as required by National Electric Code. If local codes take precedence, they must be used for calculating ampacity.

(3) All fuses are based on dual element type which are suitable for motor starting current.

(4) All motors suitable for voltages listed ± 10%. Exact voltage must be specified on order.

(5) Unit FLA, use size and ampacity are for condenser fan motors only.

(6) LSBC Models 065-110 D and 065-190 B have dual circuited condenser coils. Refrigerant charge shown in table is total charge. Individual circuit charge is half of value shown.

GENERAL & ELECTRICAL DATA (CONT.)

Start-up Of Refrigeration Systems With Air Cooled Condensers

Short cycling of compressors can occur when receiver pressure is too low to provide a positive liquid flow to the thermal expansion valve and/or when compressor cannot build up head pressure fast enough to establish minimum operating conditioning.

Conditions which may cause the problem are:

a. Receiver located outdoors in an ambient of 50°F or lower and not provided with auxiliary heat.
b. Systems with prolonged off time where receiver pressure can equalize or become low.
c. When provisions for head pressure control have not been provided and system operates below the ambient temperatures outlined in Table No. 1 of this catalog.

To avoid short cycling at startup, the following precautions should be taken:

a. All receivers located outdoors should be insulated and provided with thermostatically controlled heaters to maintain the receiver temperature about 60°F. Also, a check valve should be installed between the condenser and receiver.
b. Provide 60 second time delay switch, wired in parallel with the low pressure switch on the compressor. This will permit the compressor to operate until receiver pressures is increased to maintain adequate pressure in the liquid line to feed the thermal expansion valve.
c. Head Pressure Controls must be provided when the system has to operate below the ambient temperature outlined in Table No. 1 of this catalog.

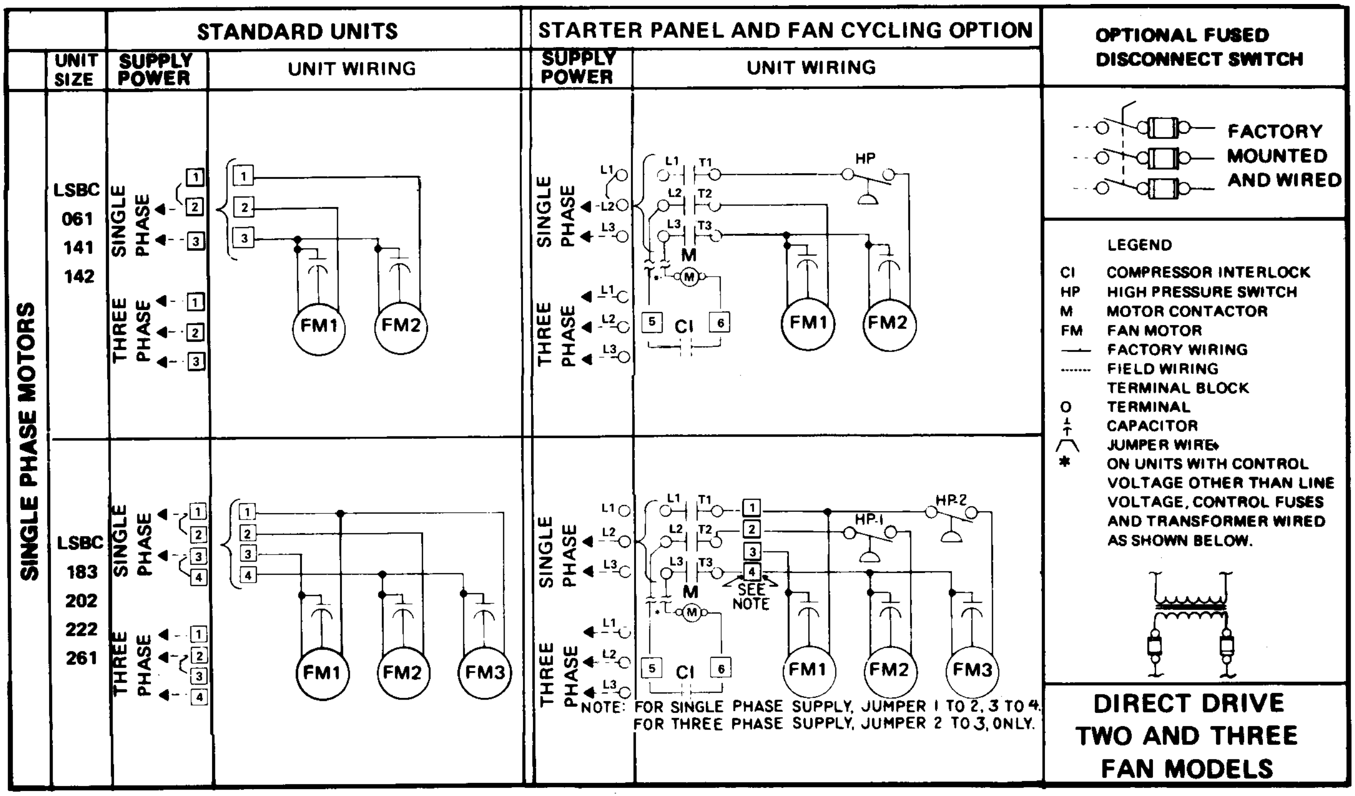
Electrical Diagrams— "Packaged" Air Cooled Condensers

The electrical diagrams show the factory installed wiring and electrical components for basic systems and for various methods of head pressure controls described herein.

For all condensers, disconnect switches are shown as factory installed options. These should be ordered with the condenser to complete the "package".

Refer to tables on page 17 for electrical data, which gives the operating characteristics for units used on both direct and belt driven types of condensers. The column which shows unit ampacity is a guide to assist the electrical contractor to correctly size the main feeders to the condenser.

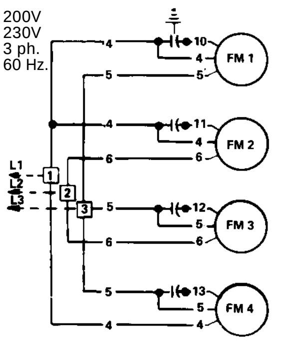
WIRING DIAGRAMS—DIRECT DRIVE CONDENSERS



NOTE: FOR SINGLE PHASE SUPPLY, JUMPER 1 TO 2, 3 TO 4.
FOR THREE PHASE SUPPLY, JUMPER 2 TO 3, ONLY.

WIRING DIAGRAMS—DIRECT DRIVE CONDENSERS

STANDARD UNIT WIRING



LSBC 181D, 241D, 182D, 242D
SINGLE PHASE MOTORS

STARTER PANEL † WIRING & FAN CYCLING †

INSTALL DUAL ELEMENT FUSED DISCONNECT†
READ UNIT NAMEPLATE FOR MIN. FIELD WIRE
AMPACITY & MAX. FUSE SIZE

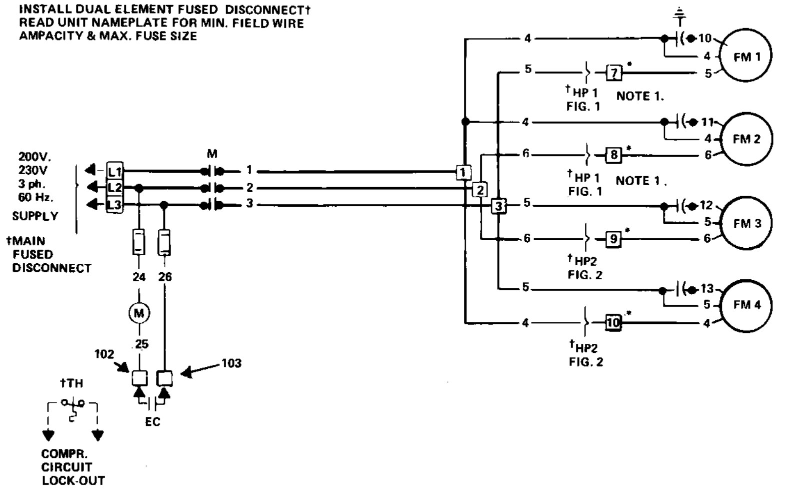
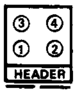


FIG. 4
FAN LOCATION



CIR. #1 CIR.#2

LEGEND

EC	-	EXTERNAL CONTROL
FM	-	FAN MOTOR
M	-	CONTACTOR
TH	-	LOW AMBIENT LOCK-OUT†
☐		TERMINAL BLOCK & NO.
○		TERMINAL
– – –		FIELD WIRING
——		FACTORY WIRING
•☐		TERMINAL BLOCK WITH FAN CYCLING ONLY†
HP	-	PRESS. SWITCH†

FIG. 1 FAN CYCLING† WIRING

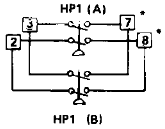
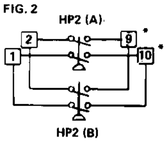
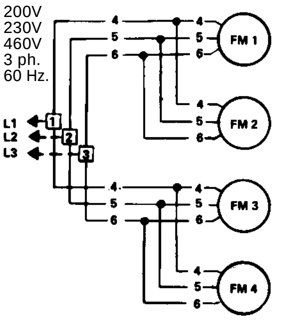


FIG. 2



HP (A) ON 1 CIRC. COND.
HP (A) & (B) ON 2 CIRC. COND.
TERM. BLOCKS ☐† INCLUDED

WIRING DIAGRAM
DIRECT DRIVE UNITS
1ϕ FAN MOTORS (4)
STANDARD UNIT AND
STARTER PANEL WIRING



LSBC 181D, 241D, 182D, 242D
THREE PHASE MOTORS

STARTER PANEL† WIRING & FAN CYCLING†

INSTALL DUAL ELEMENT FUSED DISCONNECT†
READ UNIT NAMEPLATE FOR MIN. FIELD WIRE
AMPACITY & MAX. FUSE SIZE

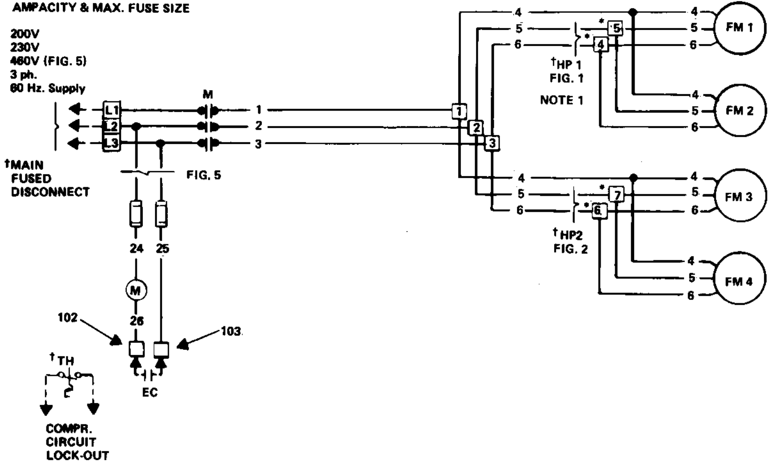
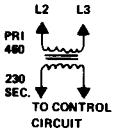


FIG. 4
FAN LOCATION

CIR. #1 CIR.#2

FIG. 5
CONTROL TRANSFORMER WIRING



LEGEND

EC	-	EXTERNAL CONTROL
FM	-	FAN MOTOR
M	-	CONTACTOR
TH	-	LOW AMBIENT LOCK-OUT†
☐		TERMINAL BLOCK & NO.
– – –		FIELD WIRING
——		FACTORY WIRING
•☐		TERMINAL BLOCK WITH FAN CYCLING ONLY†
HP		PRESS. SWITCH†

FIG. 1 FAN CYCLING† WIRING

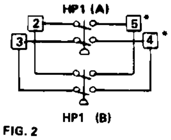
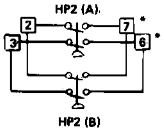


FIG. 2



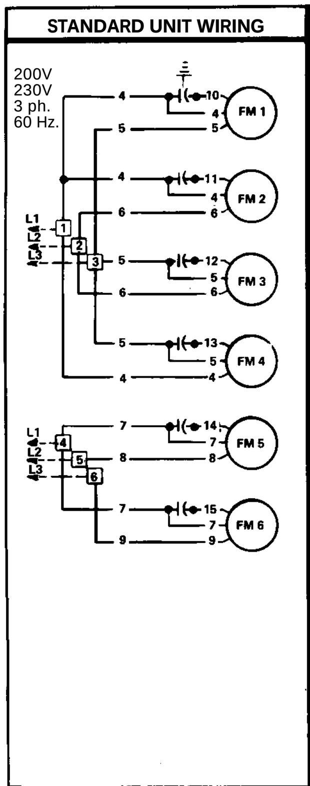
HP (A) ON 1 CIRC. COND.
HP (A) & (B) ON 2 CIRC. COND.
TERM. BLOCKS ☐† INCLUDED

WIRING DIAGRAM
DIRECT DRIVE UNITS
3ϕ FAN MOTORS (4)
STANDARD UNIT AND
STARTER PANEL WIRING

NOTE:
1. HP1 is set to allow the head pressure to rise to an acceptable level before starting FM 1 and 2. It is nto intended to cycle the fans.
   †Optional unless otherwise specified.
2. Do not use the above wiring diagrams to troubleshoot a unit. Refer to the wiring diagram on the unit.

WIRING DIAGRAMS—DIRECT DRIVE CONDENSERS

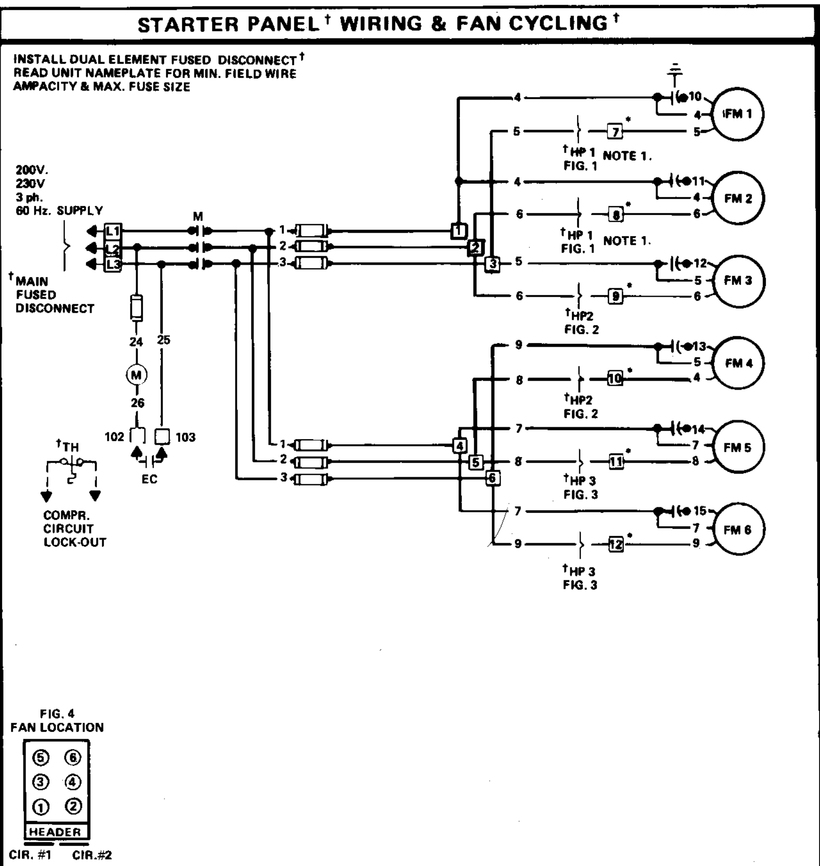
STANDARD UNIT WIRING



LSBC 161D & 221D
SINGLE PHASE MOTORS

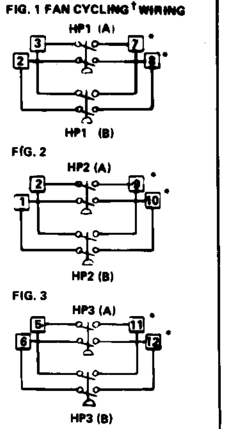
STARTER PANEL† WIRING & FAN CYCLING†

INSTALL DUAL ELEMENT FUSED DISCONNECT†
READ UNIT NAMEPLATE FOR MIN. FIELD WIRE
AMPACITY & MAX. FUSE SIZE



LEGEND
EC - EXTERNAL CONTROL
FM - FAN MOTOR
M - CONTACTOR
TH - LOW AMBIENT LOCK-OUT†
□ TERMINAL BLOCK & NO.
● TERMINAL
- - - FIELD WIRING
—— FACTORY WIRING
•□ TERMINAL BLOCK WITH FAN CYCLING ONLY†
HP - PRESS. SWITCH†

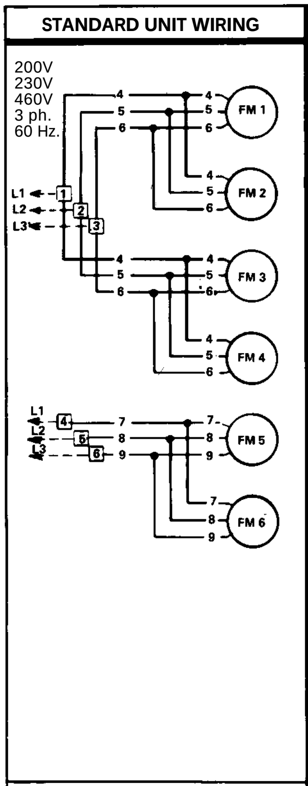
FIG. 1 FAN CYCLING† WIRING



HP (A) ON 1 CIRC. COND.
HP (A) & (B) ON 2 CIRC. COND.
TERM. BLOCKS □* INCLUDED

WIRING DIAGRAM
DIRECT DRIVE UNITS
1ϕ FAN MOTORS (6)
STANDARD UNIT AND
STARTER PANEL WIRING

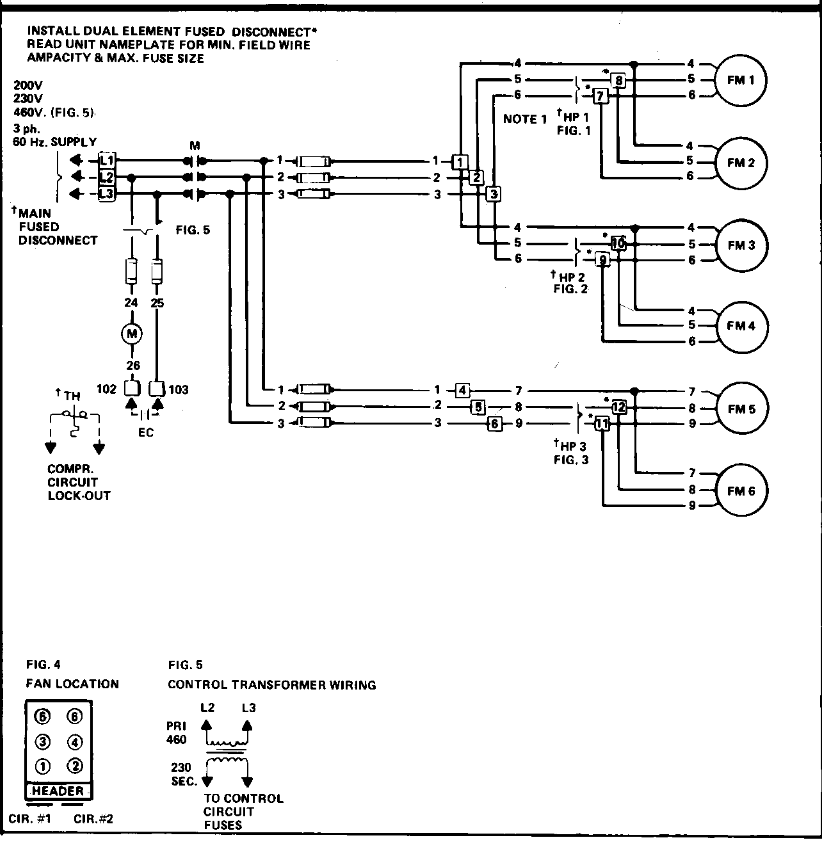
STANDARD UNIT WIRING



LSBC 161D & 221D
THREE PHASE MOTORS

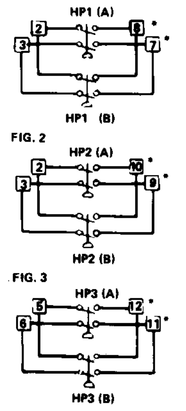
STARTER PANEL† WIRING & FAN CYCLING†

INSTALL DUAL ELEMENT FUSED DISCONNECT*
READ UNIT NAMEPLATE FOR MIN. FIELD WIRE
AMPACITY & MAX. FUSE SIZE



LEGEND
EC - EXTERNAL CONTROL
FM - FAN MOTOR
M - CONTACTOR
TH - LOW AMBIENT LOCK-OUT†
□ TERMINAL BLOCK & NO.
- - - FIELD WIRING
—— FACTORY WIRING
•□ TERMINAL BLOCK WITH FAN CYCLING ONLY†
HP - PRESS. SWITCH†

FIG. 1 FAN CYCLING† WIRING

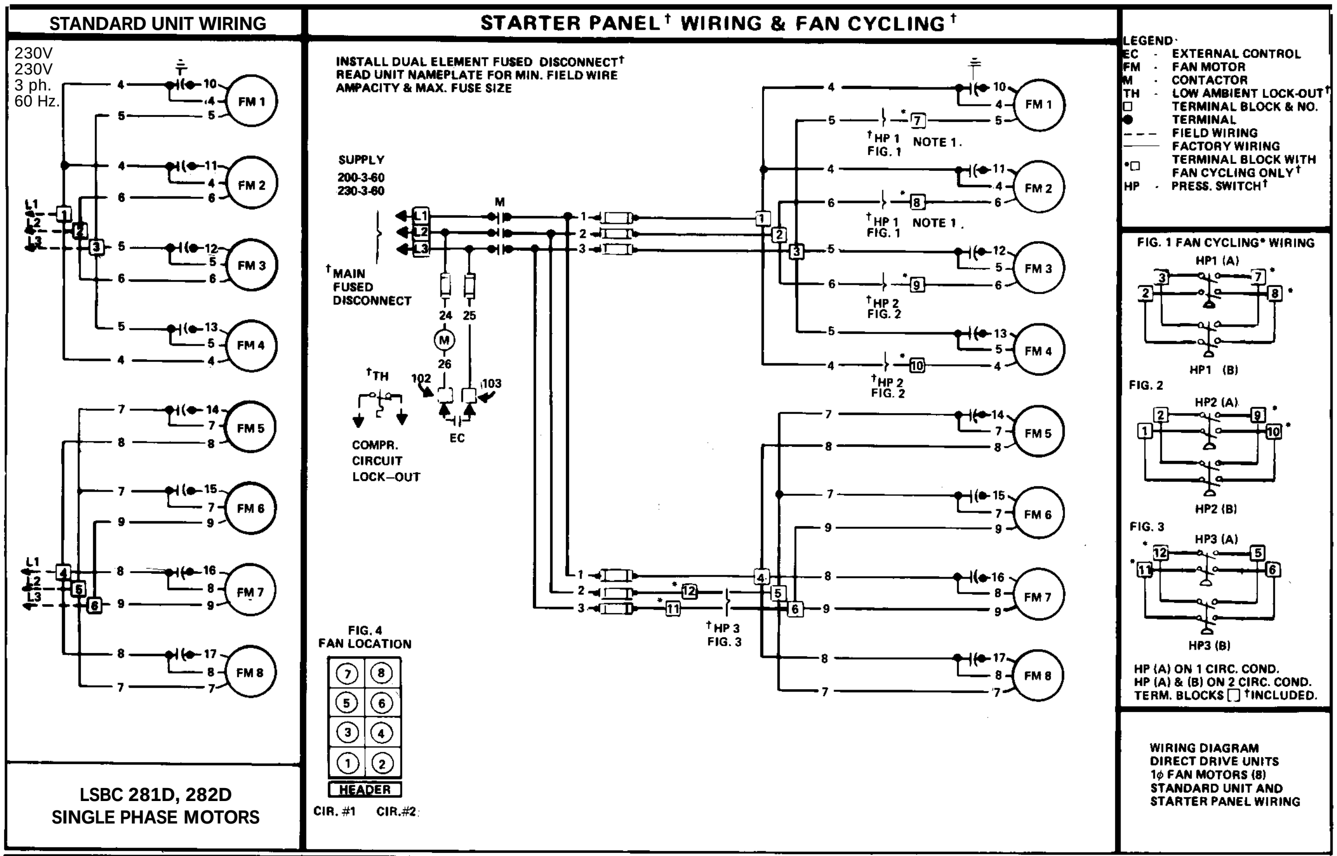


HP (A) ON 1 CIRC. COND.
HP (A) & (B) ON 2 CIRC. COND.
TERM. BLOCKS □† INCLUDED

WIRING DIAGRAM
DIRECT DRIVE UNITS
1ϕ FAN MOTORS (6)
STANDARD UNIT AND
STARTER PANEL WIRING

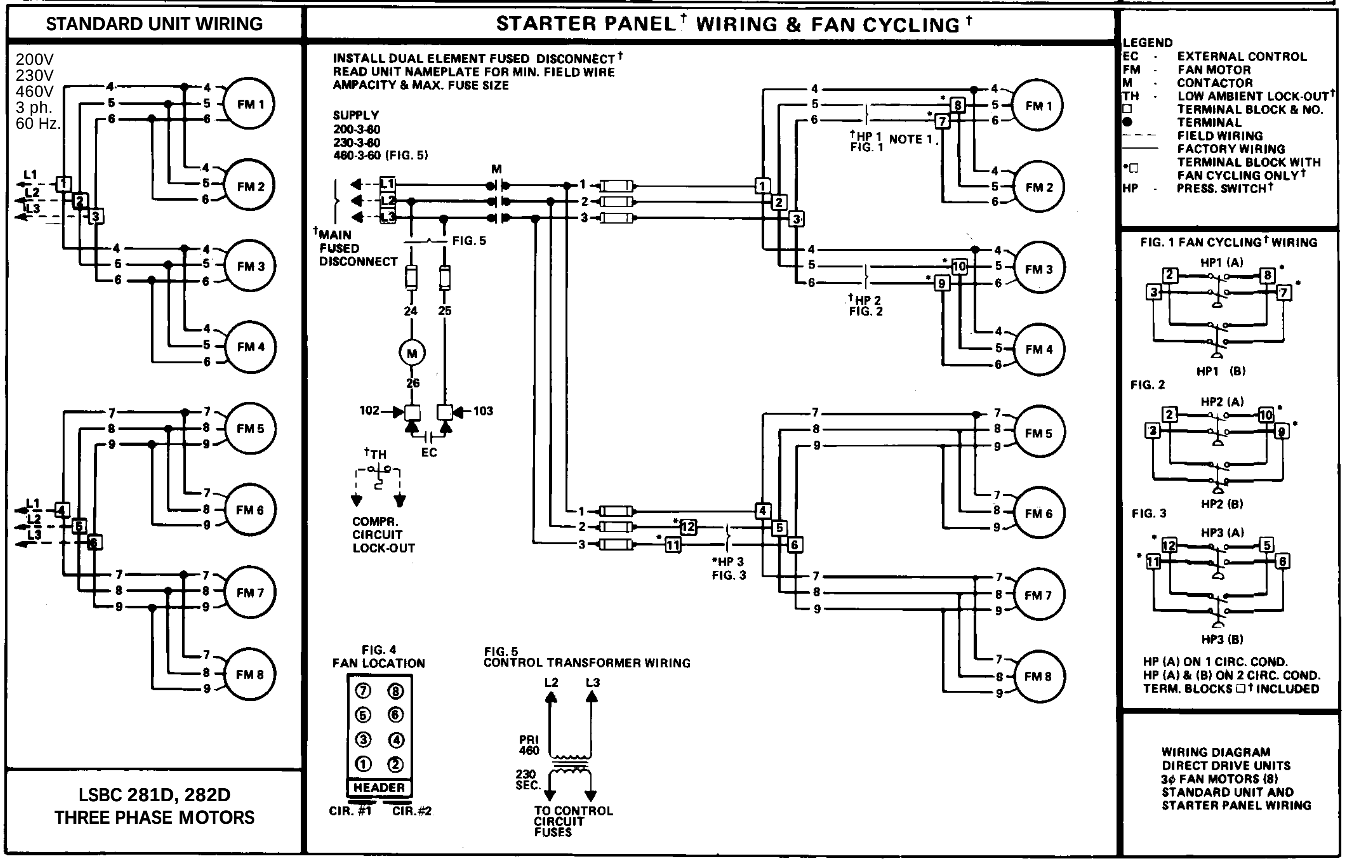
NOTE:
1. HP1 is set to allow the head pressure to rise to an acceptable level before starting FM 1 and 2. It is nto intended to cycle the fans.
   †Optional unless otherwise specified.
2. Do not use the above wiring diagrams to troubleshoot a unit. Refer to the wiring diagram on the unit.

WIRING DIAGRAMS—DIRECT DRIVE CONDENSERS



LSBC 281D, 282D
SINGLE PHASE MOTORS

WIRING DIAGRAM
DIRECT DRIVE UNITS
1φ FAN MOTORS (8)
STANDARD UNIT AND
STARTER PANEL WIRING

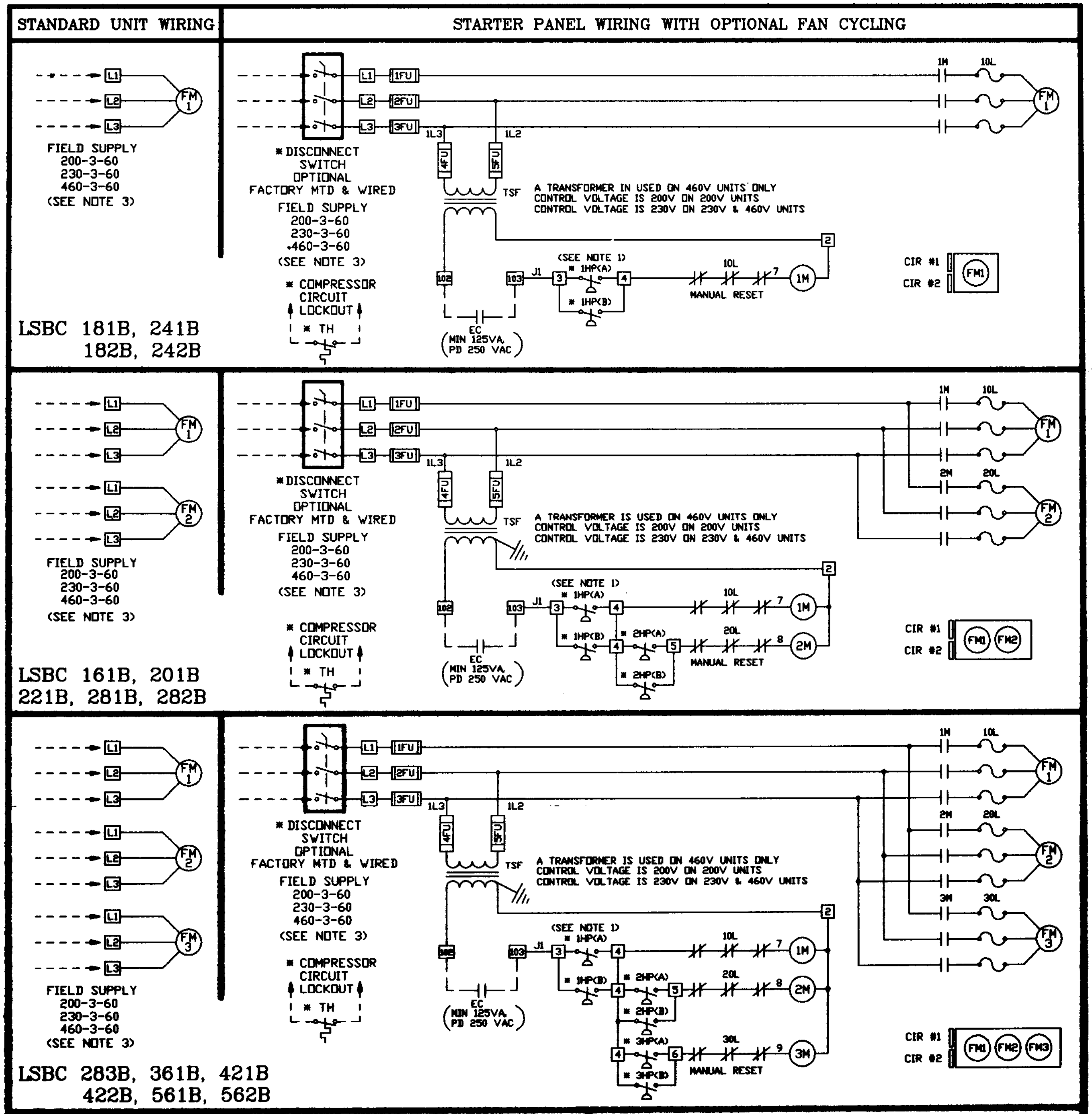


LSBC 281D, 282D
THREE PHASE MOTORS

WIRING DIAGRAM
DIRECT DRIVE UNITS
3φ FAN MOTORS (8)
STANDARD UNIT AND
STARTER PANEL WIRING

NOTE:
1. HP1 is set to allow the head pressure to rise to an acceptable level before starting FM 1 and 2. It is not intended to cycle the fans. † Optional unless otherwise specified.
2. Do not use the above wiring diagrams to troubleshoot a unit. Refer to the wiring diagram on the unit.

WIRING DIAGRAMS—BELT DRIVE CONDENSERS



NOTES:

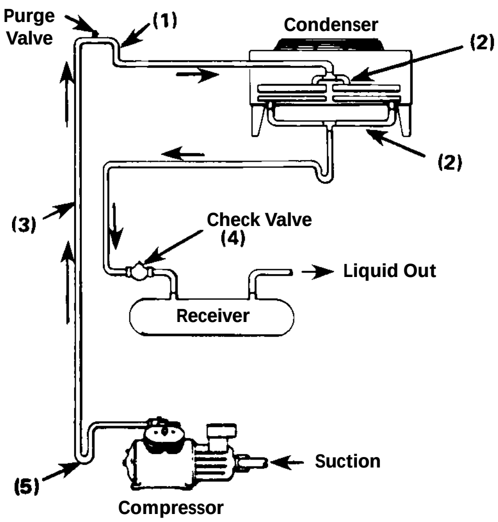
1. HP1 IS SET TO ALLOW THE HEAD PRESSURE TO RISE TO AN ACCEPTABLE LEVEL BEFORE STARTING FM1. IT IS NOT INTENDED TO CYLCE THE FAN. HP(A) CYCLES FAN(S) FROM CIR #1 HP(B) CYCLES FAN(S) FROM CIR #2
2. DO NOT USE ABOVE WIRING DIAGRAMS TO TROUBLESHOOT A UNIT. REFER TO THE WIRING DIAGRAM IN THE UNIT.
3. ALL FIELD WIRING TO BE IN ACCORDANCE WITH NEC, STATE, AND LOCAL CODES. USE 75C COPPER CONDUCTORS ONLY.

LEGEND

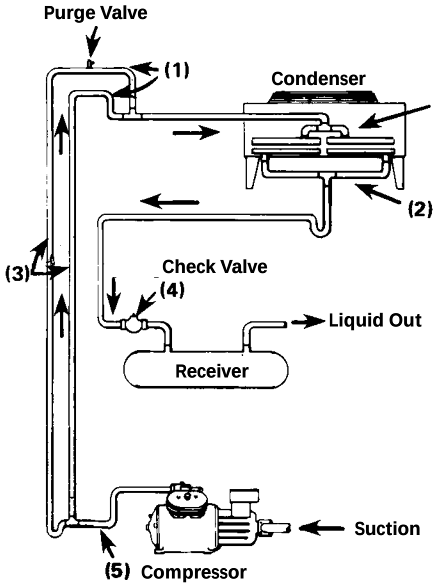
M	MOTOR STARTER	FU	FUSES
OL	OVERLOAD RELAY (MANUAL RESET)	FM	FAN MOTOR
EC	EXTERNAL CONTACTS BY CUSTOMER	———	FACTORY WIRING
HP	FAN SWITCH, CLOSE ON PRESSURE RISE	- - - -	FIELD WIRING
TH	LOW AMBIENT LOCKOUT THERMOSTAT		
*	OPTIONAL UNLESS OTHERWISE SPECIFIED		

Typical System Piping Details

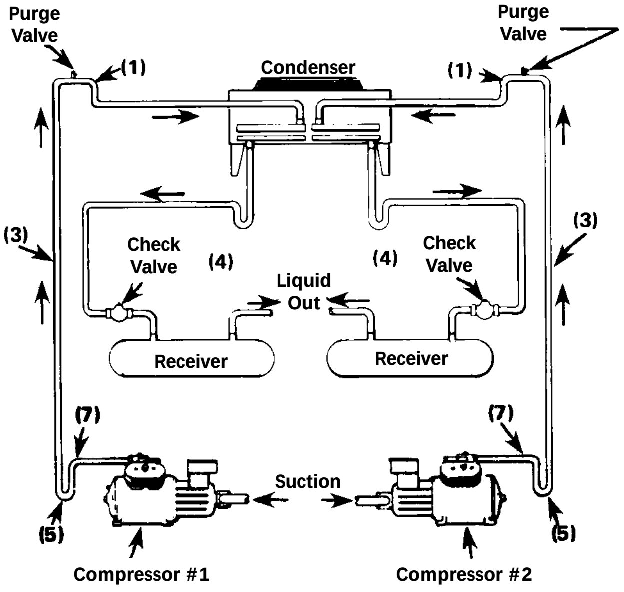
Dual Coil Condenser—One Compressor No Capacity Control



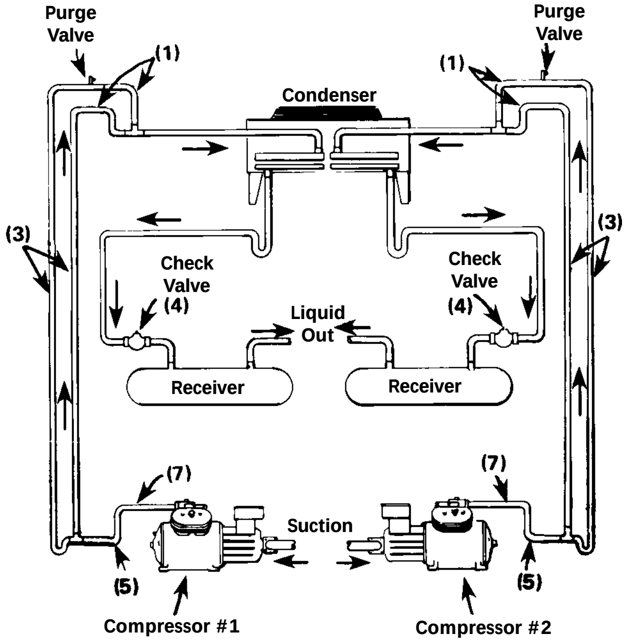
Dual Coil Condenser—One Compressor With Capacity Control



Dual Coil Condenser—Two Compressors No Capacity Control



Dual Coil Condenser—Two Compressors With Capacity Control



NOTES:

(1) "Over Traps" on top of risers must not be less than 6 inches.

(2) Refer to page 26 for Optional Connection Manifold sizes (if applicable)

(3) When vertical lift exceeds 20 feet, insert close-coupled traps in riser at every 10 feet. See page 24 for trap and other piping details.

(4) Receiver check valves are not necessary unless receiver is heated or in an ambient warmer than the condenser ambient.

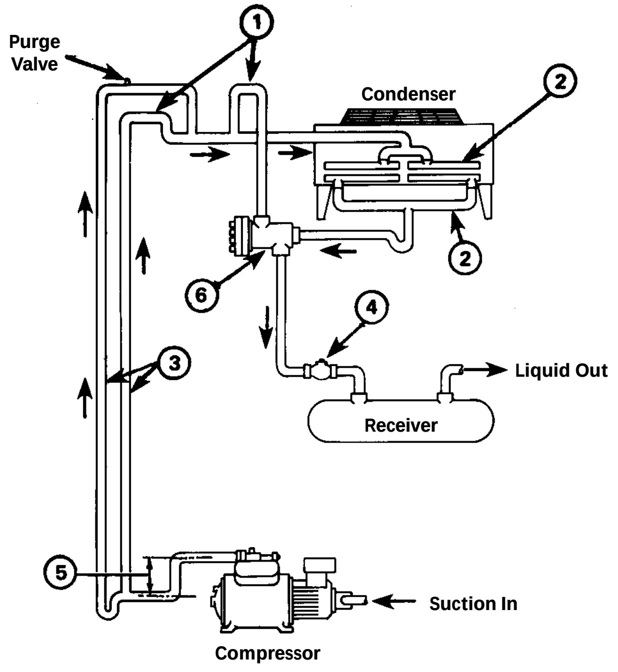
(5) Trap at compressor should be a minimum of 18 inches.

(6) Head pressure control valves or manifold may be installed in equipment room and connected to hot gas and drain lines.

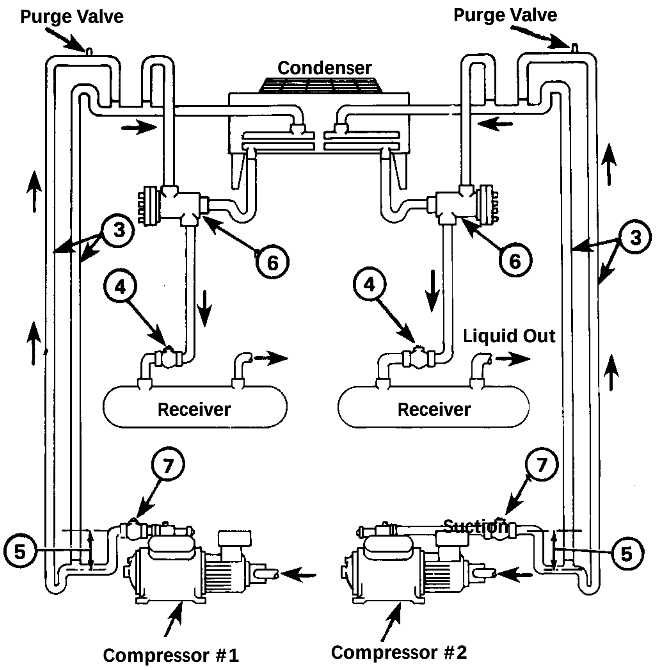
(7) If multiple compressors are utilized with a single evaporator, a discharge check valve must be utilized.

TYPICAL SYSTEM PIPING DETAILS (CONT.)

Dual Coil Condenser—One Compressor With Capacity and Head Pressure Control



Dual Coil Condenser—Two Compressors With Capacity and Head Pressure Controls on Each Compressor

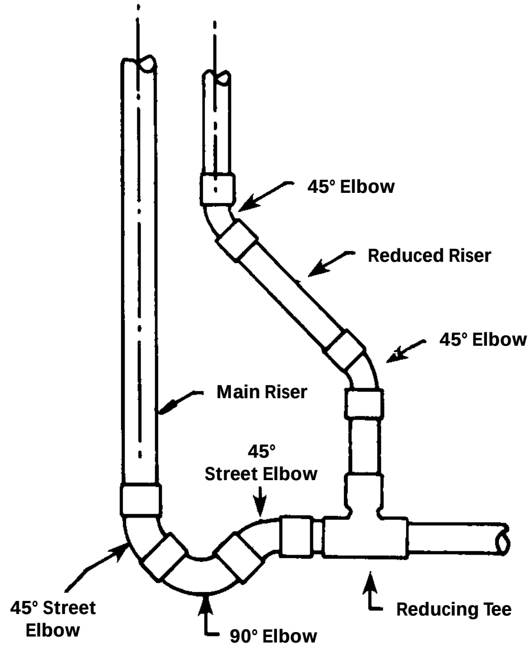


NOTES:

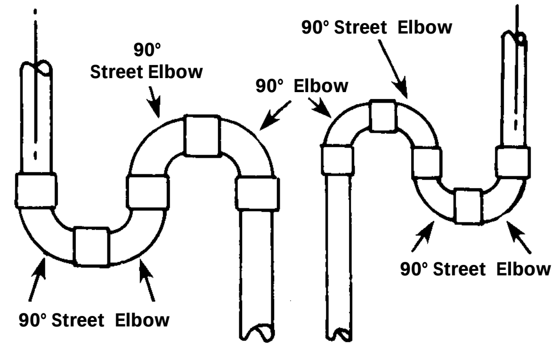
(1) "Over Traps" on top of risers must not be less than 6 inches.
(2) Refer to page 25 for Optional Connection Manifold sizes (if applicable)
(3) When vertical lift exceeds 20 feet, insert close-coupled traps in riser at every 10 feet. See below and page 25 for trap and other piping details.
(4) Receiver check valves are not necessary unless receiver is heated or in an ambient warmer than the condenser ambient.
(5) Trap at compressor should be a minimum of 18 inches.
(6) Head pressure control valves or manifold may be installed in equipment room and connected to hot gas and drain lines.
(7) If multiple compressors are utilized with a single evaporator, a discharge check valve must be utilized.

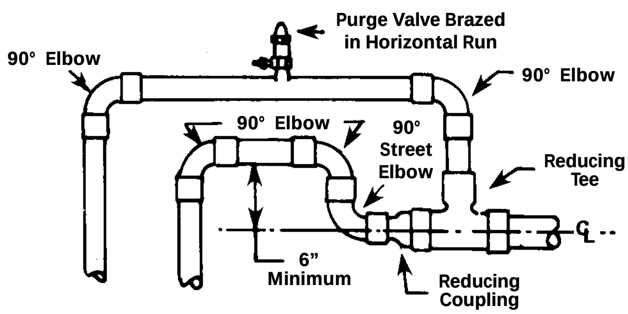
RISER PIPING DETAILS

Base of Dual Risers



Lift Traps
Lift of Over Twenty Feet
(see note 3 above)





REFRIGERANT LINE SIZES

Hot Gas Risers

Compressor to air cooled condensers - for 100° to 120°F discharge saturated temperatures - type 'ACD' copper tubing.

R-22 *Tons	Pipe Size No Capacity Control	Pipe Sizes 50% Capacity Control (**)	Pipe Sizes Down to 20% System Capacity	(†)
5	1 1/8"	(2) 7/8"	5/8"	7/8"
10	1 3/8"	(2) 1 1/8"	7/8"	1 1/8"
15	1 5/8"	(2) 1 1/8"	7/8"	1 1/8"
20	1 5/8"	(2) 1 3/8	1 1/8"	1 3/8"
25	2 1/8"	(2) 1 3/8	1 1/8"	1 5/8"
30	2 1/8"	(2) 1 5/8"	1 1/8"	1 5/8"
35	2 1/8"	(2) 1 5/8"	1 3/8"	1 5/8"
40	2 1/8"	(2) 1 5/8"	1 3/8"	1 5/8"
50	2 5/8"	(2) 2 1/8"	1 3/8"	2 1/8"
60	2 5/8"	(2) 2 1/8"	1 5/8"	2 1/8"
70	2 5/8"	(2) 2 1/8"	1 5/8"	2 1/8"
80	2 5/8"	(2) 2 1/8"	1 5/8"	2 1/8"
90	3 1/8"	(2) 2 1/8"	1 5/8"	2 5/8"
100	3 1/8"	(2) 2 5/8"	1 5/8"	2 5/8"
125	3 1/8"	(2) 2 5/8"	2 1/8"	2 5/8"
150	3 5/8"	(2) 2 5/8"	3 1/8"	1 5/8"

* Tons = Total Compressor Capacity/12,000
** Trap one of these risers
† Trap this riser

NOTES:

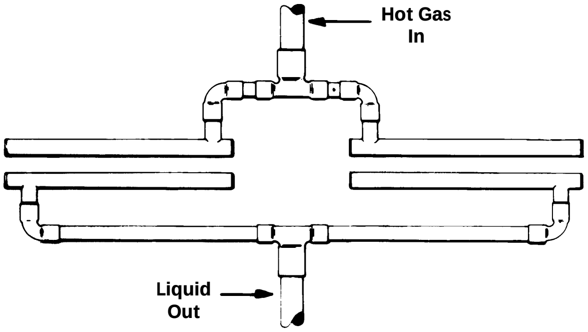
1. All risers selected for less than 2 PSI per 100 equivalent feet and will provide gas velocities sufficient to entrain and lift oil to condensers.
2. All pipe sizes are O.D.
3. Liquid lines are sized for 100 equivalent feet or less.

Liquid Line Sizes Condenser to Receiver

Net Evaporator Capacity	R-22
3,000	1/4
4,500	3/8
6,500	3/8
8,500	3/8
12,000	3/8
18,000	1/2
24,000	1/2
30,000	1/2
36,000	5/8
42,000	5/8
48,000	5/8
54,000	5/8
60,000	3/4
72,000	3/4
90,000	7/8
120,000	1 1/8
150,000	1 1/8
180,000	1 1/8
210,000	1 1/8
240,000	1 3/8
300,000	1 3/8
360,000	1 5/8
420,000	2 1/8
480,000	2 1/8
540,000	2 1/8
600,000	2 1/8
660,000	2 5/8
720,000	2 5/8
780,000	2 5/8
840,000	2 5/8
900,000	3 1/8
960,000	3 1/8
1,020,000	3 1/8
1,080,000	3 1/8
1,200,000	3 1/8
1,500,000	3 5/8
1,800,000	3 5/8

Connection Manifold

Model No. LSBC	Hot Gas	Liquid Line	Model No. LSBC	Hot Gas	Liquid Line
035B	2-1/8	1-5/8	090B	2-5/8	2-5/8
040B	2-1/8	1-5/8	100B	2-5/8	2-5/8
045B	2-1/8	1-5/8	110B	2-5/8	2-5/8
055B	2-1/8	2-1/8	125B	3-1/8	3-1/8
065B	2-5/8	2-1/8	140B	3-1/8	3-1/8
070B	2-5/8	2-1/8	155B	3-5/8	3-1/8
080B	2-5/8	2-1/8	170B	3-5/8	3-1/8
			190B	3-5/8	3-5/8



ENGINEERING SPECIFICATIONS

General
Furnish and install, as indicated on plans, Air Cooled Condensers as manufactured by Dunham-Bush.

Casing
All casings shall be sheet steel coated with 1-1/4 oz. per square foot galvanizing with standard spangle. All external galvanized parts shall be coated with zinc chromate for added protection. All structural members shall not be less than 8 or 12 gauge for extra rigidity. All fans shall be separated by full width and height partitions for additional reinforcing.

Condenser Coil
All coils shall be high efficiency type with wave type plate fins mechanically bonded and covering all staggered tubes. All headers and connections shall be copper; they shall be sized and located for minimum pressure drop and equalized coil distribution.

(Optional) Condenser coil shall be multi-circuited as indicated on plans.

(Optional) All dual headered condenser coils shall be provided with a connection manifold as indicated on plans.

(Optional) All condenser coils shall have copper (or specially coated) fins.

All coils shall be suitable for use with R-22 (optional -- oil, glycol, water or other non-corrosive liquid) and be tested to 400 lbs. per square inch, dehydrated, evacuated and soldered closed against contamination.

Fans
Direct Drive—Fans shall be aluminum, with cadmium plated spiders, and the entire fan deck shall be recessed below top of unit, on 4, 6 and 8 fan models.

Belt Drive—Fans shall be zinc coated steel with gold iridite finish. They shall be large diameter type, having low tip speed to achieve minimum sound levels.

Fan Guards
Direct Drive—all recessed fans shall be covered by a flat grille for a streamline appearance.

Belt Drive—Each fan shall have a domed type grille for maximum rigidity.

Motors
Direct Drive—All motors shall be PSC type (except three phase motors), and shall have splash-proof enclosures, inherent protection and special ventilation ports.

All direct drive motors shall have sealed permanently lubricated ball bearings. The shaft and slingers shall have a protective coating, to prevent moisture from reaching bearings. Refer to schedule on plans for electrical characteristics.

Belt Drive—Motors for belt driven fans shall be NEMA 'T' Frame, open drip-proof ball bearing type, and shall be protected within the enclosure. Motor bearings shall be sealed, grease lubricated and provided with fittings. Each motor shall be mounted on an adjustable base for ease of maintaining belt tension. Each fan shall be driven by its own motor. No more than one fan per motor shall be allowed. All 'V' Belt drives shall be supplied with cast iron pulleys.

Bearings shall be heavy duty, pillow block type and widely spaced on extended mounting plate for maximum rigidity.

All bearings shall be pre-lubricated and supplied with fittings for lubrication and extended service.

(Optional) Extended lube lines shall be provided with grease fittings, located outside the casing, to permit lubrication while the unit remains in operation

Electrical Panel
All motors shall be factory wired in a raceway or conduit, to a terminal strip located in a rain-proof junction box.

(Optional) Starter panel shall include factory mounted and wired fan motor contactors. Three phase motor overloads and reset shall be factory mounted and wired. Single phase motors shall have inherent overload protection.

(Optional) Fused disconnect switch shall be factory mounted on condenser and wired to starter panel.

Head Pressure Controls
(Optional) Fan Cycling - All units (except single fan type) shall be provided with head pressure controls which sequence fan motors in response to coil condensing pressure. All controls shall be factory mounted and wired in a rain-proof starter panel.

(Optional) Belt Drive Fan Cycling - All belt drive units shall be supplied with fan cycling to maintain adequate head pressure control during low ambient conditions. The fans shall be sequenced in response to coil condensing pressure. All controls shall be factory mounted and wired to a starter panel.

(Optional) Direct Drive Fan Cycling and Variable Motor Speed Control - Units with 3 or more direct drive fans shall be supplied with a combination of fan cycling and variable motor speed control(s) to maintain adequate head pressure control during low ambient conditions. The fans, including those with variable motor speed controls, shall be sequenced in response to coil condensing pressure. All controls shall be factory mounted and wired to a starter panel.

(Accessory) Flooding - Control valve(s) and piping shall be factory built as a sub-assembly, with piping connections to match the condenser connections. Control valve(s) shall maintain adequate head pressure by backing up liquid refrigerant into the condenser coil.

Refer to schedule on plans for minimum operating ambient temperature conditions of system.

Installation
All units except 2 and 3 fan direct drive models, shall be provided with eight gauge lifting eyes. They shall be located on the top panel to provide for ease of rigging and reduced chance of casing damage.

Serviceability
All belt drive units shall be provided with large hinged access doors for ease of inspection, preventative maintenance and service.

- Notes -

DUNHAM-BUSH®

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