IOM 610

Installation
Operation and
Maintenance
Information

REMOTE AIR COOLED CONDENSERS

MODELS CDS-001 Thru 012 (Standard Speed)
MODELS CDL-001 Thru 009 (Low Speed)
MODELS WCS-015 Thru 212 (Standard Speed)
MODELS WCL-013 Thru 196 (Low Speed)

Table of Contents

Witt • 221 S. Berry St. • P. O. Box 1030 • Brea, CA 92622-1030 • (800) 288-9488 FAX (714) 529-3217

FAN MOTORS, BLADES, AND GUARDS

Condenser Model	Fan Data		Fan Guards	Motor Data				Notes
	Part No.	Dia.		Voltage	HP	RPM	Part No.	
CDS 001-002	8221022	18"	8397006	208-230/460/1/60	1/2 PSC	1140	8216006	*Can be used with P-66*
CDS 004-012	8221023	22"	8397007	208-230/460/1/60	1/2 HP	1140	8216006	*Can Be used with P-66*
CDS 001-002	8221022	18"	8397006	208-230/460/3/60	1/2 PSC	1140	8216007	
CDS 004-012	8221023	22"	8397007	208-230/460/3/60	1/2 HP	1140	8216007	
CDL 001-002	8221022	18"	8397006	208-230/460/1/60	1/4 PSC	825	8216076	
CDL 003-009	8221023	22"	8397007	208-230/460/1/60	1/4 HP	825	8216075	
CDL 001-002	8221022	18"	8397006	208-230/460/3/60	1/4 PSC	825	8216076	
CDL 003-009	8221023	22"	8397007	208-230/460/3/60	1/4 HP	825	8216075	
WCS 015-022	8221047	26"	8397010	208-230/460/1/60	1 HP	1140	8216098	
WCS 015-022	8221047	26"	8397010	208-230/460/3/60	1 1/2 HP	1140	8216099	
WCS 025-212	8221151	30"	8397044	208-230/460/3/60	1 1/2 HP	1140	8216099	
WCS 025-212	8221047	26"	8397010	208-230/460/1/60	1 HP	1140	8216098	*Fan Speed Control Only*
WCS 015-022	8221047	26"	8397010	575/3/60	1 1/2 HP	1140	119228000	*575 Volt Option*
WCS 025-212	8221151	30"	8397044	575/3/60	1 1/2 HP	1140	119228000	*575 Volt Option*
WCS 015-022	8221047	26"	8397010	208-230/460/3/60	1 1/2 HP	1140	116351000	*TENV Motor*
WCS 025-212	8221151	30"	8397044	208-230/460/3/60	1 1/2 HP	1140	116351000	*TENV Motor*
WCL 013-018	8221047	26"	8397010	208-230/460/3/60	1 1/2 HP	825	8216100	
WCL 023-196	8221152	30"	8397044	208-230/460/3/60	1 1/2 HP	825	8216100	

CONTROL PANEL COMPONENTS

Description	Part Number	Condenser Model Numbers
Contactor 24V. Coil	8219028	
Contactor 115V. Coil	8219002	All
Contactor 208-230V. Coil	8219018	Models
Contactor 460V. Coil	8219012	
Ambient (Temp) Control	8219006	WCS 015-212 WCL 013-196
Pressure Control	8219003	CDS 008-012 CDL 006-009
PENN P-66 Fan Speed Control	8219427	WCS 015-212 (All P-66 Fans are 26") CDS 001-012(P-66 Fans are 18" and 22")
HOFFMAN Fan Speed Control		WCS 015-212 (All HOFFMAN Fans are 26")
208-230 V.	8218778	CDS 001-012(HOFFMAN Fans are 18" and 22")
460 V.	8218777	
Fuse Block 208-230V. (FRN)	8218068	All 208-230V. Models
Fuse Block 460V. (LP-CC)	8219732	All 460V. Models
4 AMP FRN	8218848	CDS 001-012 208-230V 1 Phase
3 AMP FRN	8218839	CDS 001-012 208-230V 3 Phase
2.5 AMP LP-CC	8219717	CDS 001-012 460V 1 Phase
2.0 AMP LP-CC	8219715	CDS 001-012 460V 3 Phase
2 AMP FRN	8218843	CDL 001-009 208-230V 1 and 3 Phase
1.4 AMP LP-CC	8219714	CDL 001-009 460V 1 and 3 Phase
9 AMP FRN	8218845	WCS 015-212 208-230V 3 Phase, ** WCL 013-196 208-230V 3 Phase, **
7 AMP LP-CC	8219726	WCS 015-212 460V 3 Phase, ** WCL 013-196 460V 3 Phase, **
20 AMP FRN	8218069	WCS 015-212 208-230V 3 Phase, *** WCL 013-196 208-230V 3 Phase, ***
12 AMP LP-CC	8219730	WCS 015-212 460V 3 Phase, *** WCL 013-196 460V 3 Phase, ***
6 AMP FRN	8218840 ¥	WCS 015-212 208-230V 1 Phase, **
12 AMP FRN	8218201 ¥	WCS 015-212 460V 1 Phase, **
4.5 AMP LP-CC	8219721 ¥	WCS 015-212 208-230V 1 Phase, ***
8 AMP LP-CC	8219727	WCS 015-212 460V 1 Phase, ***

*** Individual Fusing*

**** Paired Fusing*

¥ These fuses are used with the Single Phase Motor (8216098) Used primarily with the P-66 and/or the 26" fan (8219047)

GENERAL SAFETY INFORMATION

1. Installation and maintenance are to be performed only by qualified personnel who are familiar with this type of equipment.
2. Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
3. Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
4. Make sure all power sources are disconnected before any service work is done on units.

INSPECTION

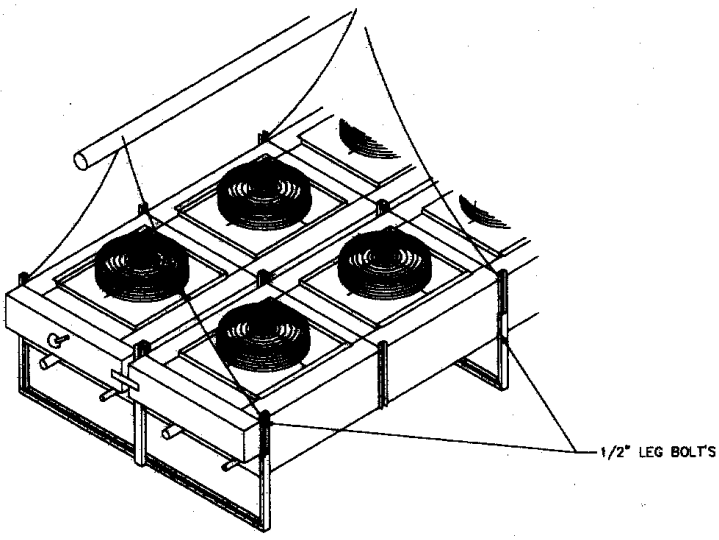
Check all items against the bill of lading to make sure all crates or cartons have been received. If there is any damage, report it immediately to the carrier and file a claim. Make sure the voltage on the unit nameplate agrees with the power supply available.

UNIT ASSEMBLY

Unit models CDS-001 through 012 (CDL-001 through 009) can be assembled for either horizontal or vertical airflow. The mounting stand is shipped unassembled with each unit. Fasteners and assembly instructions are included. It is a simple procedure to assemble the stand to the unit for either vertical or horizontal airflow.

Vertical airflow unit models WCS-015 (WCL-013) and larger are shipped (unless otherwise specified) with the legs in place, but telescoped to a shortened length, and with the unit in its normal operating position. Refer to the section on rigging on this page for instructions on extending the legs to their normal length.

Horizontal airflow unit models WCS-015 (WCL-013) and larger are shipped the same as the vertical airflow models above. In addition, auxiliary legs for horizontal discharge are bolted to the shipping skids for field mounting.



RIGGING

Leave the units in the carton or on the skid until they are as close as possible to the installation location. The method of rigging depends on the size of the unit. Models CDS-001 through 012 (CDL-001 through 009) may be lifted into position by grasping underneath the cabinet or by using the lifting holes in the mounting stand. Never lift any of the units by the headers or return bends.

Models WCS-015 (WCL-013) and larger are provided with lifting eyes located in the top of the leg extensions above the fan panel. Refer to Figure 1. The actual method of rigging depends on the type of rigging equipment available, the size of the unit and where the unit is to be located. It is up to the judgement of the rigger to decide the best way to handle each unit. The spreader bar used should be at least as long as the distance between the lifting eyes.

Extending the Legs — This operation can be done either on the ground prior to hoisting or when poised above the final mounting location. Hoist the unit slightly so as to take the weight of the unit off of the legs. Remove the four 1/2" bolts that hold each leg in the telescoped position. Raise the unit to 18" above the ground thus allowing the leg extensions to drop down to their normal operating position, exposing the new set of mounting holes. Re-install the bolts in the mounting holes—tighten securely.

UNIT LOCATION

General

These units are designed for outdoor applications. If a unit is mounted indoors, provisions must be made to insure that discharge air is not recirculated into the unit. If the unit is ducted, the duct must not add more than 0.1 inch W.G. to the static pressure imposed on the fans.

Horizontal Airflow Units

Units should be installed with coil side facing the prevailing winds. If strong, variable winds are common, it is recommended that a wind deflector (by others) be used on the discharge side of the unit. Maintain at least 24 inches between the face of the coil and an obstruction such as another unit or a wall. If the unit discharges towards a wall, space the unit at least 60 inches from the wall. If several units are installed in the same area, make sure that discharge air from one does not become intake air for another.

Vertical Airflow Units

Units should be located no closer than the width of the unit to an obstruction such as a wall or another unit. Keep the inlet air area around each unit clear to avoid restricting the airflow to the unit.

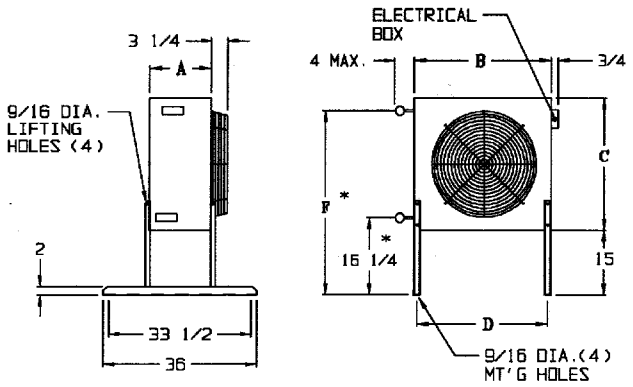
UNIT INSTALLATION

Make sure all units are installed level to insure proper drainage of liquid refrigerant and oil. When units are installed on a roof, they must be mounted on support beams that span load walls. Ground mounted units should be installed on concrete pads. See Pages 4 and 5 for dimensions.

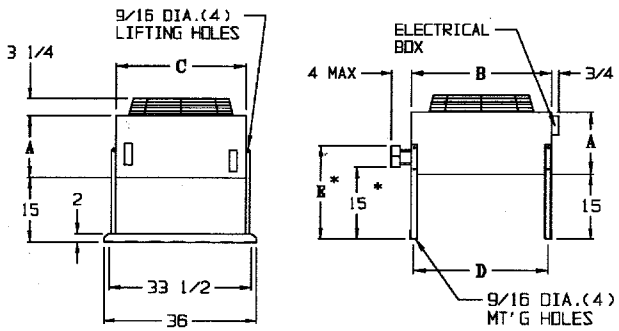
Dimensional Data

CDS 001 thru 005
CDL 001 thru 004

Horizontal Discharge

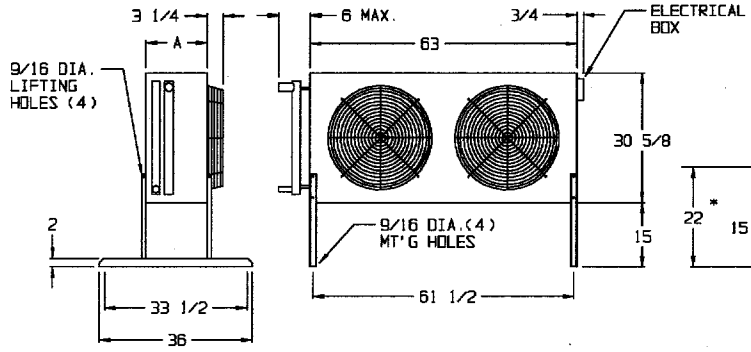


Vertical Discharge

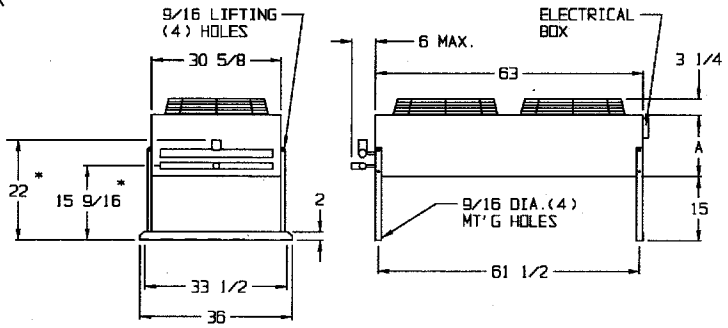


CDS 008 thru 012
CDL 006 thru 009

Horizontal Discharge



Vertical Discharge



Dimensions in Inches

Unit Size		No.							Weight (Lbs.)	
CDS	*CDL*	*Fans*	*A*	*B*	*C*	*D*	*E*	*F*	*Net*	*Shipping*
001	001	1	12 9/16	28	25 5/8	26 1/2	15	40	109	153
002	002	1	12 9/16	28	25 5/8	26 1/2	16 1/2	40	121	165
004	003	1	14 1/2	33	30 5/8	31 1/5	16 1/2	45	144	188
005	004	1	14 1/2	33	30 5/8	31 1/2	17 1/2	45	160	204
008	006	2	14 1/2	--	--	--	--	--	234	303
010	008	2	14 1/2	--	--	--	--	--	259	328
012	009	2	15 3/4	--	--	--	--	--	283	352

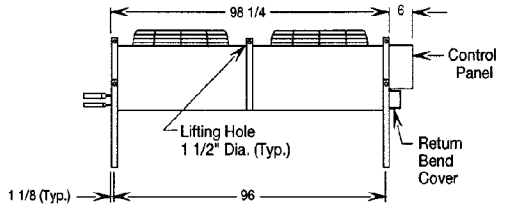
UNIT WEIGHTS

Single Fan-Width Units			
Unit Size		Fan	Approx. Net
WCS	WCL	Config.	Weight (Lbs.)
015	013		510
016	014		518
020	017		536
022	018		555
025	023	1 x 2	580
028	027		630
031	030		650
—	031		710
036	034		730
041	039		900
046	041	1 x 3	930
050	049		1010
053	051		1135
059	055	1 x 4	1201
065	058		1327
069	063		1360
077	069		1582
081	077	1 x 5	1654
084	—		1676
088	082		1698
096	092		2002
098	095	1 x 6	2030
105	099		2052

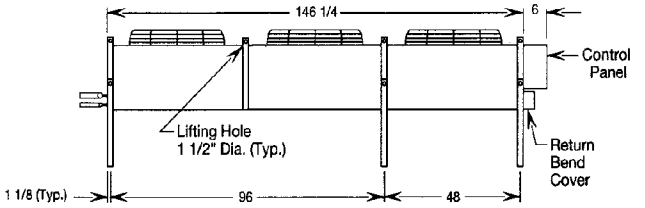
Double Fan-Width Units			
Unit Size		Fan	Approx. Net
WCS	WCL	Config.	Weight (Lbs.)
047	043		1080
054	052		1130
060	056	2 x 2	1190
066	059		1300
070	064		1330
075	068		1560
080	076		1650
085	—	2 x 3	1710
090	086		1740
099	091		1870
106	098		1910
108	103		2180
121	111	2 x 4	2300
132	118		2530
140	127		2590
154	138		2980
162	155	2 x 5	3110
170	—		3140
177	164		3080
193	183		3730
200	190	2 x 6	3770
212	196		3820

Dimensional Data

FAN CONFIG.

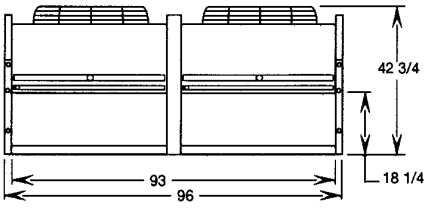


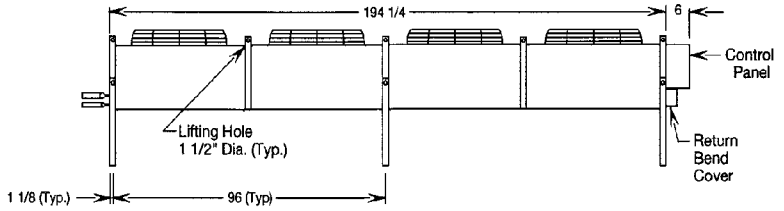
1 X 2
2 X 2



1 X 3
2 X 3

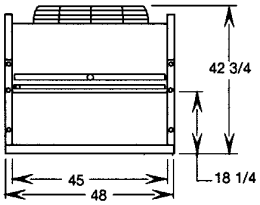
END VIEW—Double Fan-Width Models

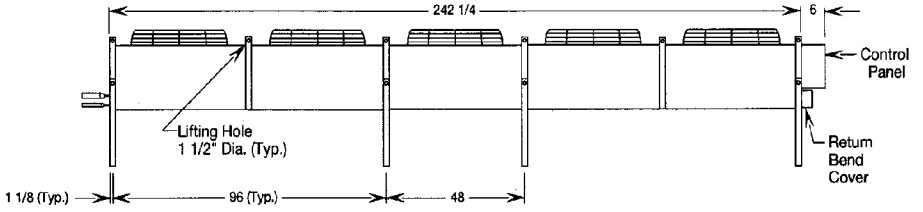




1 X 4
2 X 4

END VIEW—Single Fan-Width Models





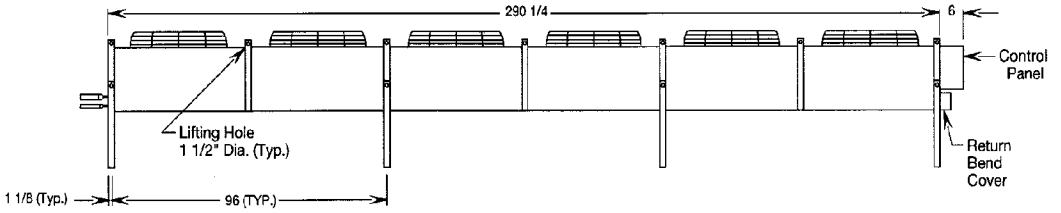
1 X 5
2 X 5

NOTES

Mounting legs are retracted for shipping purposes and must be lowered into position for unit installation.

Control panel can be mounted at opposite end if required.

Units are available for horizontal air discharge—contact factory for details.



1 X 6
2 X 6

Piping Recommendations

Witt offers the following general guidelines for routing and sizing lines to air-cooled condensers. For further information please consult the ASHRAE Guide or other accepted piping handbooks.

Discharge Lines

Consider the following three issues when designing and sizing discharge lines.

1. Pressure Drop

Lines should be sized for a reasonable pressure drop. Pressure drop increases the required horsepower per ton of refrigeration and decreases the compressor capacity.

It is normal practice not to exceed a pressure drop corresponding to a 2° F change in the saturation temperature of the refrigerant. Table 1 shows discharge line capacities for pressure drop equivalent to 2° F per 100 feet of line. It can be converted to capacity based on a 1° F equivalent drop per 100 feet by using the factor given below the table.

2. Oil Trapping

Lines must be sized and routed so that oil is carried through the system. Normally, sizing according to Table 1 will be satisfactory. However, when the condenser is located at a higher level than the compressor, it may be necessary to take special precautions, especially if the system is designed to operate at reduced compressor capacity.

A vertical hot gas line sized to transport oil at minimum load conditions may have excessive pressure drop at full load. If this is the case, a double hot gas riser, as shown in Figure 2 should be used. Size riser Number 1 for the minimum load condition. Size riser Number 2 so that the combined cross-sectional area of both risers is equal to the cross-sectional area of a single riser having acceptable pressure drop at full load.

Install a trap between the two risers, as shown in Figure 2. During partial load, the trap will fill up with oil until riser Number 2 is sealed off. Keep the trap as small as possible to limit its oil holding capacity.

3. Compressor Head Protection

Discharge lines should be designed to prevent condensed refrigerant and oil from draining back to the compressor during off cycles. Use the following guidelines.

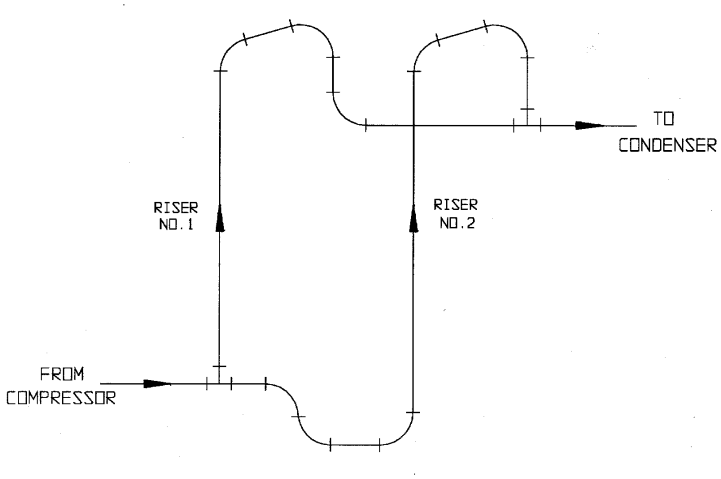
a. The highest point in the discharge line should be above the highest point in the condenser coil. A purge valve should be located at this point.
b. The hot gas line should loop to the floor if the condenser is located above the compressor, especially if the hot gas riser is long.
c. If the condenser is located where the ambient temperature could be higher than the ambient at the compressor location, a check valve should be installed in the hot gas line.
d. A check valve should be installed in each discharge line of a multiple compressor arrangement to prevent refrigerant from an active compressor from condensing on the heads of an idle compressor.

Table 1: Discharge Line Sizing

Line Size (O.D.) Type L Tubing	*Discharge Line Capacity * (MBH @ Evaporator)*					
	R-22			*R-404A, 507*		
	Suction Temperature					
	-40	*0*	*40*	*-40*	*0*	*40*
1/2	13	14	15	10	11	12
5/8	24	26	28	18	22	23
7/8	65	70	73	48	54	60
1 1/8	132	140	149	97	110	122
1 3/8	230	246	260	169	192	212
1 5/8	364	388	412	268	302	336
2 1/8	752	803	852	552	625	694
2 5/8	1325	1412	1500	972	1103	1220
3 1/8	2112	2252	2393	1544	1753	1942
3 5/8	3134	3343	3551	2293	2602	2881

** Based on pressure drop equivalent to 2° F. per 100 equivalent feet of line. For 1° F. per 100 feet, multiply table value by 0.683*

Figure 2: Double Hot Gas Riser



Liquid Lines

Receiver-to-expansion valve liquid lines can generally be sized for pressure drop equivalent to a 1° F to 2° F change in saturation temperature. If there is substantial sub cooling, or the line is short, it can be sized at the high end of this range. If the opposite is true, a more conservative selection should be made.

A receiver, if used in the system, should be located below the condenser and the condenser-to-receiver liquid line must be sized to allow free drainage from the condenser to the receiver. This line should be sized so the velocity does not exceed 100 FPM.

Generous sizing of this liquid (condensate) line is especially important if the receiver is exposed at any time to a warmer ambient temperature than the condenser. It must be large enough for the liquid to flow to the receiver and at the same time allow venting of refrigerant vapor in the opposite direction back to the condenser. The receiver can become vapor-locked under these conditions if the re-evaporated gas is not allowed to flow back to the condenser for re-condensation.

All liquid (condensate) lines should be free of any traps or loops.

Table 2 shows liquid line capacity in evaporator MBH. Line sizing is shown for both condenser-to-receiver lines and receiver-to-expansion valve lines. All capacities are for 100 equivalent feet of tubing. The selections based on pressure drop are for an equivalent to a 2° F change in saturation temperature. They can be converted to capacities based on a 1° F equivalent drop by using the factor given below the table.

See Table 3 for the weight of refrigerant in liquid, suction and discharge lines.

Multiple Condensers

Often two condensers, or two sections of the same condenser, are piped in parallel to the same refrigeration system. It is important that the sections or units have the same, or nearly the same, capacity so that the pressure \drop through each is equal. The piping should be arranged so that the lengths of runs and bends to each are equal on both the inlet and outlet of the condensers. A drop leg should be included from each liquid outlet of sufficient height to prevent backup of liquid into one coil. This will overcome any difference in pressure drop that may exist between the two coils.

Routing of Piping

Piping should be routed to avoid excessive strain on system components or the piping itself. Discharge lines must be supported with rigid pipe supports to prevent transmission of vibration and movement of the line. The discharge line should be well supported near the condenser hot gas connection. Use offsets in inter-connecting lines between two condensers and provide isolation where pipes pass through building walls or floors.

Table 2: Liquid Line Sizing

Line Size (O.D.) Type L Tubing	*Net Refrigerating Effect (MBH)*			
	Condenser To Receiver Piping †		*Receiver To Exp. Valve Piping **	
	R-22	*R-404A Δ*	*R-22*	*R-404A Δ*
1/2	28	18	64	42
5/8	44	28	118	79
7/8	94	59	319	208
1 1/8	158	100	650	424
1 3/8	242	151	1136	738
1 5/8	342	215	1801	1166
2 1/8	595	373	3742	2424
2 5/8	918	576	-	-
3 1/8	1310	821	-	-
3 5/8	1774	1111	-	-

† Based on 100 FPM refrigerant velocity.
Δ Use R-404A sizing for R-502 & 507.
** Based on refrigerant pressure drop equivalent to 2° F. per 100 equivalent feet of line. For 1° F. per 100 feet, multiply table value by 0.683.*

Table 3: Weight of Refrigerant *

Line Size O.D.	*Liquid Line 110° F.*		*Suction Line 40° F.*	*Suction Line -20° F.*	*Discharge Line 115° F.*	
	R-22	*R-404A R-507*	*R-22*	*R-404A R-507*	*R-22*	*R-404A R-507*
5/8	11.3	9.7	0.3	0.2	0.8	0.7
7/8	23.4	24.2	0.5	0.4	1.7	1.4
1 1/8	40.0	41.5	0.9	0.7	2.9	2.5
1 3/8	60.5	62.8	1.3	1.1	4.3	3.7
1 5/8	85.0	83.0	1.8	1.6	6.1	5.2
2 1/8	150.0	155.0	3.3	2.8	10.7	9.2
2 5/8	232.0	240.0	5.0	4.3	16.6	14.3
3 1/8	330.0	340.0	7.2	6.1	23.6	20.3
3 5/8	446.0	461.0	9.7	8.3	31.9	27.4

** Pounds per 100 Ft. of Type L tubing*
R-134a: Multiply R-22 charge by 1.01

Flooded Condenser Control Option And Refrigerant Charge Calculations

This completely automatic system always maintains a minimum preset pressure.

The Witt Flooded Condenser Control System maintains adequate condensing pressure during periods of low outdoor ambient temperatures by flooding the condenser with liquid refrigerant. Flooding reduces the amount of coil surface that is available for condensing.

Operation
The system consists of a modulating three-way valve controlled by refrigerant discharge pressure. A fall in ambient temperature causes a corresponding fall in discharge pressure. The valve modulates allowing discharge gas to flow to the receiver, creating a higher pressure at the condenser outlet. This higher pressure reduces the flow out of the condenser, causing liquid refrigerant to back up in the coil. This flooding of the condenser reduces the available condensing surface and raises the condensing pressure so that adequate high-side pressure is maintained.

Figure 3: Flooded Condenser Valve Piping

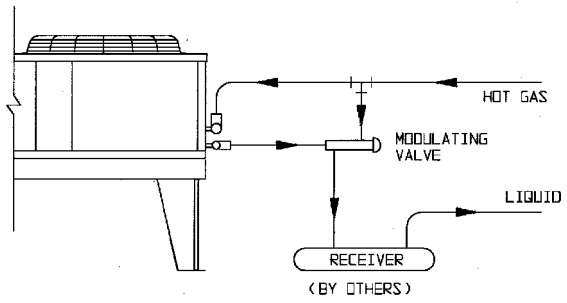


Table 4: Head Pressure Control Valve Capacity

Control Valve			Valve Capacity R-22				
WITT Part No.	Qty	Conn Size ODF	Evaporator Temperature 40	20	0	-20	-40
8356118	1	7/8	162	159	154	150	144
8356121	1	1 3/8	406	397	386	375	361
8356121	2	1 3/8	812	794	772	750	722

Control Valve			Valve Capacity R-404A, 507				
WITT Part No.	Qty	Conn Size ODF	Evaporator Temperature 40	20	0	-20	-40
8356118	1	7/8	104	100	94	88	82
8356121	1	1 3/8	276	264	248	233	218
8356121	2	1 3/8	552	528	496	466	436

Valve Selection
Select valve from Table 4 based on:
a) Refrigerant type
b) Evaporator temperature
c) Net refrigeration effect at the evaporator

Figure 3 shows typical field piping to the valve. If the evaporator capacity requires the use of two valves, they must be piped in parallel.

Application and Refrigerant Charge Requirements
A larger receiver and additional refrigerant are required for systems with flooded condenser control. The receiver can be conveniently installed directly under the condenser. However, if the system will be operated at ambient temperatures below 55° F, the receiver should be heated or located in a warm area. In this situation, a check valve must be installed in the line between the receiver and the valve. This prevents refrigerant migration from the receiver to the condenser.

The amount of additional refrigerant charge is based on the lowest expected winter operating temperature and the design TD. To determine the total required condenser charge, multiply the standard unit operating charge from Table 6, by the appropriate factor from Table 5. In addition to the condenser charge, the operating charges of the evaporator, receiver and refrigerant lines must be added to determine the total system refrigerant charge. The pump-down capacity (80% of full capacity) of the receiver must be at least equal to the total system charge.

If Flooded Condenser Control is used on a system with a compressor having capacity reduction, the amount of reduction must be taken into account when determining the refrigerant charge. The capacity reduction lowers the design TD, so the system requires more charge to maintain adequate condensing pressure.

Before obtaining a factor from Table 5, the design TD must be corrected by multiplying it by the percentage that reduced capacity is of full capacity.

For example, if the reduced capacity is 50% of the full capacity, a design TD of 20° would be reduced to 10°. The correction factor from Table 5 would have to be based on 10° TD.

Refrigerant Charge - Single Section Unit
Given:
A WCS-054 condenser with a standard R-404A charge of 15.7 lbs.(see Table 6). The unit has a design TD of 10° F. and will operate at minimum ambient of 0° F.

Solution:
The standard charge must be multiplied by a correction factor of 4.6 as shown in Table 5. Therefore, the required charge is 15.7 x 4.6 = 72.2 lbs. If the compressor used on the system had 50% capacity reduction, the correction factor from Table 5 would have to be for 5° TD or 4.8.

Refrigerant Charge - Multi-Section Unit

Given:

A WCS-016 condenser split into 2 sections. One section has 22 face tubes of R-404A at a 10° TD and the other section has 14 face tubes of R-22 at a 15° TD. The unit will operate at a minimum ambient of 10° F.

Solution:

To calculate the winter charge for each section, the number of face tubes must be multiplied by the charge per face tube from Table 6 and the correction factor from Table 5.

For the R-404A section:
22 face tubes x 0.15 lb./face tube x 4.5 = 14.9 lb.

For the R-22 section:
14 face tubes x 0.17 lb./face tube x 4.3 = 10.2 lb.

If the compressors have capacity reduction, this must be taken into consideration, as in the example for a Single Section Condenser.

Refrigerant Charge—With Fan Cycling

Use the following procedure to calculate the refrigerant charge correction factor when Fan Cycling and Flooded Condenser Controls work together. This factor will be used (instead of the factor from Table 5) when calculating refrigerant charge as shown above.

Given:

Model WCS-075 Condenser
20° F. Design TD
-10° F. Minimum Ambient
100% Compressor Capacity

Solution:

1. Find the TD that would occur when operating at the minimum ambient for fan cycling. Table 8 (page 10) states that 40° minimum ambient will produce 90° condensing temperature under the given conditions for fan cycling alone, and with no fan speed control.
   90° - 40° = 50° TD
2. Find the TD that would produce a 90° condensing temperature when operating at -10° ambient.
   90° - (-10°) = 100° TD
3. The TD correction factor is the TD at design ambient (-10°) divided by the TD at the minimum ambient for fan cycling alone.
   Correction Factor = 100° TD ÷ 50° TD = 2.0
4. Refer to the Fan Cycling Charge Factor table below for a Charge Correction Factor equal to 3.0 opposite the TD factor of 2.0.

Fan Cycling Charge Factors

Correction Factors		Correction Factors	
T.D.	Charge	T.D.	Charge
1.0	1.0	4.0	4.0
1.5	2.4	4.5	4.1
2.0	3.0	5.0	4.2
2.5	3.3	5.5	4.3
3.0	3.6	6.0	4.4
3.5	3.8	6.5	4.5

Apply this factor to the procedures on Page 8 to calculate the refrigerant charge for a condenser equipped with both Flooded and Fan Cycling Controls.

Table 5: Refrigerant Charge Correction Factor

Low Ambient Flooded Condenser

Mimimum Ambient Temp ° F.	Design T.D.					
	30	25	20	15	10	5
60	1.0	1.6	2.3	3.0	3.7	4.3
50	2.0	2.5	3.0	3.5	4.0	4.5
40	2.6	3.0	3.4	3.8	4.2	4.6
30	3.0	3.3	3.7	4.0	4.3	4.7
20	3.3	3.6	3.9	4.1	4.4	4.7
10	3.5	3.8	4.0	4.3	4.5	4.8
0	3.7	3.9	4.1	4.3	4.6	4.8
-10	3.8	4.0	4.2	4.4	4.6	4.8
-20	3.9	4.1	4.3	4.5	4.6	4.8

** Based on 90° F. Condensing Temperature*

Table 6: Standard Refrigerant Charge

Unit Size		Number Face Tubes Avail-able	R-22 †		R-404A & 507	
			Lbs. Per Face Tube	Lbs. Total Unit	Lbs. Per Face Tube	Lbs. Total Unit
SINGLE FAN-WIDTH MODELS						
CDS	CDL					
001	001	20	0.02	0.45	0.02	0.39
002	002		0.05	0.90	0.04	0.77
004	003	24	0.05	1.20	0.04	1.03
005	004		0.08	1.95	0.07	1.68
008	006		0.11	2.60	0.09	2.24
010	008		0.16	3.80	0.14	3.27
012	009		0.22	5.30	0.19	4.56
WCS	WCL					
015	013	36	0.17	6.10	0.15	5.25
016	014		0.17	6.10	0.15	5.25
020	017		0.25	9.10	0.22	7.83
022	018		0.25	9.10	0.22	7.83
025	023		0.17	6.22	0.15	5.35
028	027		0.26	9.32	0.22	8.02
031	030		0.26	9.32	0.22	8.02
—	031		0.35	12.43	0.30	10.69
036	034		0.35	12.43	0.30	10.69
041	039		0.38	13.62	0.33	11.71
046	041		0.38	13.62	0.33	11.71
050	049		0.50	18.06	0.43	15.53
053	051		0.50	18.13	0.43	15.59
059	055		0.50	18.13	0.43	15.59
065	058		0.67	24.20	0.58	20.81
069	063		0.67	24.20	0.58	20.81
077	069		1.17	42.02	1.00	36.13
081	077		1.56	56.02	1.34	48.18
084	—		1.56	56.02	1.34	48.18
088	082		1.56	56.02	1.34	48.18
096	092		1.87	67.19	1.61	57.78
098	095		1.87	67.19	1.61	57.78
105	099		1.87	67.19	1.61	57.78
DOUBLE FAN-WIDTH MODELS						
WCS	WCL					
047	043	72	0.17	12.06	0.14	10.37
054	052		0.25	18.20	0.22	15.65
060	056		0.25	18.20	0.22	15.65
066	059		0.34	24.12	0.29	20.74
070	064		0.34	24.12	0.29	20.74
075	068		0.25	18.13	0.22	15.59
080	076		0.38	27.23	0.33	23.42
085	—		0.38	27.23	0.33	23.42
090	086		0.38	27.23	0.33	23.42
099	091		0.50	36.26	0.43	31.18
106	098		0.50	36.26	0.43	31.18
108	103		0.50	36.26	0.43	31.18
121	111		0.50	36.26	0.43	31.18
132	118		0.67	48.40	0.58	41.62
140	127		0.67	48.40	0.58	41.62
154	138		1.17	84.03	1.00	72.27
162	155		1.56	112.04	1.34	96.35
170	—		1.56	112.04	1.34	96.35
177	164		1.56	112.04	1.34	96.35
193	183		1.87	134.38	1.61	115.57
200	190		1.87	134.38	1.61	115.57
212	196		1.87	134.38	1.61	115.57

† R-134A: Multiply R-22 charge by 1.01

FAN CYCLING CONTROL

The Witt Fan Cycling Control system allows fans to be cycled off in sequence.

The cycling of condenser fans provides an automatic means of maintaining condensing pressure control at low ambient air temperature conditions. It also results in substantial fan motor power savings in lower ambients. Either ambient sensing thermostats or pressure controls can be employed.

Fan cycling control (with ambient temperature thermostat) can also be used in conjunction with the Flooded Condenser Head Pressure Control Option to greatly reduce the required operating charge typical of flooded condenser operation. See Pages 8 and 9 for refrigerant charge calculations.

Table 7 shows how the fans are cycled. The fan, or fans, nearest the header end of the unit run continuously.

Multi-Fan Units

The fan cycling control package consists of a weatherproof enclosure, fan contactors and either ambient thermostat(s) or pressure control(s). The enclosure is factory mounted and completely factory wired. Power must be supplied from a fused disconnect switch to the power circuit terminal block; control circuit power must be supplied to the control terminal block. See Figures 4, 5 and 6 for wiring diagrams.

Table 8 shows the minimum ambient temperature for units equipped with fan cycling controls based on design TD and percent compressor capacity.

Fan cycling thermostat and pressure control setpoints are shown in Tables 9 and 10. These setpoints are only general guidelines and may have to be varied for individual installations.

Table 7: Fan Cycling Arrangement

Total Number Of Unit Fans	*Number of Fans Cycled Per Control*
2	1
3	1, 1
4	1 pair
6	1 pair, 1 pair
8	1 pair, 1 pair, 1 pair
10	2 pairs, 1 pair, 1 pair
12	2 pairs, 2 pairs, 1 pair

Table 8: Minimum Ambient Temperature With Fan Cycling Control

Unit Size		*Total Fans Per Unit*	*TD*	*Minimum Amb. Temp. - ° F. At Percent Compressor Capacity Shown*							
				Less Fan Speed Control				*With Fan Speed Control*			
CDS WCS	*CDL WCL*			*100%*	*75%*	*50%*	*25%*	*100%*	*75%*	*50%*	*25%*
			30	35	39	42	56	12	22	31	50
008-035	006-033	2	25	45	46	47	58	25	31	38	54
			20	54	53	52	61	38	41	44	57
047	043	4	15	63	60	56	63	51	51	51	60
054-070	052-064	4	10	72	66	61	65	64	61	57	64
040	038	3	30	15	24	32	51	-15	1	18	44
045-049	042-048	3	25	27	33	38	54	3	14	26	48
			20	40	42	45	57	20	28	35	53
075-106	068-098	6	15	52	51	51	60	38	41	44	57
			10	65	61	57	64	55	54	53	61
			30	-2	11	24	47	-25	-15	7	39
			25	13	22	31	51	-15	1	18	44
108-140	103-127	8	20	28	33	39	54	6	17	28	49
			15	44	45	47	58	27	33	39	54
			10	59	57	54	62	48	49	50	60
			30	-17	0	16	43	-25	-25	- 2	34
			25	1	13	25	48	-25	-10	10	40
154-177	138-164	10	20	19	26	34	52	- 6	8	22	46
			15	36	40	43	57	18	26	34	52
			10	54	53	52	61	42	44	46	58
			30	-20	-10	10	40	-25	-25	- 8	31
			25	-10	5	20	45	-25	-18	5	38
193-212	183-196	12	20	10	20	30	50	-14	2	18	44
			15	30	35	40	55	12	22	31	51
			10	50	50	50	60	38	41	44	57

Based on approximately 90° F. condensing temperature at 100% capacity; 80° F. condensing temperature at 75% capacity; 70° F. condensing temperature at 50% and 25% capacity.

Table 9A: Fan Cycling Thermostat Settings

Unit Size	*Total Fans Per Unit*	*Design TD*	*Thermostat Setpoint—°F*		
			Fan 2 Or 2A & 2B	*Fan 3 Or 3A & 3B*	*Fans 4A & 4B*
CDS008-012		30	60	-	-
CDL006-009	2	25	65	-	-
WCS015-035		20	70	-	-
WCL013-038		15	75	-	-
WCS047, 054-070	4	10	80	-	-
WCL043, 052-064		30	47	60	-
WCS040-045, 099	3	25	54	65	-
WCL038-042, 098		20	61	70	-
WCS075-106	6	15	69	75	-
WCL068-098		10	76	80	-
		30	35	51	60
WCS108-140		25	45	58	65
	8	20	54	64	70
WCL103-127		15	63	71	75
		10	72	77	80

Table 9B: Fan cycling Thermostat Settings

Unit Size		*Total Fans per Unit*	*Design TD*	*Thermostat Setpoint—°F*		
				Fans 2A & 2B	*Fans 3A & 3B 10-Fan Unit OR 3A, 3B, 4A, 4B 12-Fan Unit*	*Fans 4A, 4B, 5A, 5B 10-Fan Unit 0R 5A, 5B, 6A, 6B 12-Fan Unit*
WCS	*WCL*					
			30	25	43	60
			25	36	51	65
154-177	138-164	10	20	45	59	70
			15	57	67	75
			10	68	74	80
			30	15	47	60
			25	27	54	65
193-212	183-196	12	20	40	61	70
			15	52	69	75
			10	65	76	80

NOTES:
Thermostat set point is the temperature at which the fan(s) will shut off on a fall in ambient temperature. Fan(s) will restart when the ambient rises approximately 3° to 4° F. above the setpoint.

Setpoints shown will maintain a minimum of approximately 90° F. condensing temperature based on 100% compressor capacity.

Table 10A: Fan Cycling Pressure Control Settings

Unit Size	Total Fans Per Unit	Design TD	Refrg. Type	Pressure Control Settings					
				Fan 2 OR 2A & 2B		Fan 3 OR 3A & 3B		Fans 4A & 4B	
				Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In
CDS008-012		30	22	170	250	-	-	-	-
CDL006-009			404A*	190	275				
WCS015-035		25	22	170	235	-	-	-	-
WCL013-033	2		404A*	190	260				
		20	22	170	225	-	-	-	-
			404A*	190	240				
WCS047, 054-070	4	15	22	170	210	-	-	-	-
WCL043, 052-064			404A*	190	230				
		10	22	170	200	-	-	-	-
			404A*	190	220				
		30	22	170	275	180	285	-	-
WCS040-045, 049			404A*	190	295	200	305		
		25	22	170	255	180	265	-	-
WCL038-042, 048	3		404A*	190	275	200	285		
		20	22	170	235	180	245	-	-
			404A*	190	255	200	265		
	6	15	22	170	215	180	225	-	-
WCS075-106			404A*	190	235	200	245		
WCL068-098		10	22	170	205	180	215	-	-
			404A*	190	225	200	235		
		30	22	160	290	170	300	180	310
			404A*	180	285	190	305	200	315
		25	22	160	270	170	280	180	290
WCS108-140			404A*	180	290	190	300	200	310
WCL103-127	8	20	22	160	250	170	260	180	270
			404A*	180	270	190	280	200	290
		15	22	160	225	170	235	180	245
			404A*	190	245	190	255	200	265
		10	22	160	205	170	215	180	225
			404A*	190	225	190	235	200	245

Table 10B: Fan Cycling Pressure Control Settings

WCL	WCL	Total Fans Per Unit	Design TD	Refrg. Type	Pressure Control Settings					
					Fans 2A & 2B		Fans 3A & 3B (10-Fan Units) OR 3A, 3B, 4A, 4B (12-Fan Unit)		Fans 4A, 4B, 5A, 5B (10-Fan Units) OR 5A, 5B, 6A, 6B (12-Fan Units)	
					Cut-Out	Cut-In	Cut-Out	Cut-In	Cut-Out	Cut-In
			30	22	160	305	170	315	180	325
				404A*	180	330	190	340	200	350
			25	22	160	270	170	280	180	290
				404A*	180	305	190	315	200	325
154-177	138-164	10	20	22	160	255	170	265	180	275
				404A*	180	280	190	290	200	300
			15	22	160	125	170	135	180	145
				404A*	180	230	190	240	200	250
			10	22	160	215	170	225	180	235
				404A*	180	230	190	240	200	250
			30	22	160	320	170	330	180	340
				404A*	-	-	190	295	200	305
			25	22	160	285	170	295	180	305
				404A*	180	310	190	320	200	330
193-212	183-196	12	20	22	160	260	170	270	180	280
				404A*	180	285	190	295	200	305
			15	22	160	235	170	245	180	255
				404A*	190	255	190	265	200	275
			10	22	160	215	170	225	180	235
				404A*	190	235	190	245	200	255

NOTE: Setpoints shown will maintain a minimum of approximately 90° F. condensing temperature.

Table 11: Fan and Motor Data

Unit Size		Fan Data						Motor Data †					
				Total CFM		Sound Levels*		Nom. HP		Minimum Circuit Ampacity			
	Qty	Dia (In)		1140 RPM	825 RPM	1140 RPM	825 RPM	1140 RPM	825 RPM	208-230 1 ø	208-230 3 ø	460 3 ø	575 3 ø
SINGLE FAN-WIDTH MODELS													
CDS	CDL												
001	001	1	18	3100	2540								
002	002	1	18	2750	2040			1/2	1/4	15.0	15.0	15.0	15.0
004	003	1	22	3850	2850								
005	004	1	22	3700	2740								
008	006	2	22	7700	5700			1/2	1/4	15.0	15.0	15.0	15.0
010	008	2	22	7400	5480								
012	009	2	22	7000	5110								
WCS	WCL												
015	013	2		15700	11600								
016	014	2	26	15600	11400			1 1/2	1 1/2	15.0 Δ	15.0	15.0	15.0
020	017	2		15400	11500								
022	018	2		15300	11300								
025	023	2		23000	20600	66.0	61.0				15.0	15.0	
028	027	2		22450	20600	66.0	61.0				15.0	15.0	
031	030	2		21900	19800	66.0	61.0				15.0	15.0	
—	031	2		—	19100	—	61.0				15.0	15.0	
036	034	2		20700	18100	66.0	61.0				15.0	15.0	
041	039	3		33675	30900	67.0	62.5				21.1	15.0	
046	041	3		32850	29700	67.0	62.5				21.1	15.0	
050	049	3		32050	28650	67.0	62.5				21.1	15.0	
053	051	4		44900	41200	68.0	63.0				27.6	15.0	
059	055	4	30	43800	39600	68.0	63.0	1 1/2	1 1/2	NA	27.6	15.0	15.0
065	058	4		42400	38200	68.0	63.0				27.6	15.0	
069	063	4		41400	36200	68.0	63.0				27.6	15.0	
077	069	5		54750	49500	68.5	63.5				34.1	17.3	
081	077	5		54350	49125	68.5	63.5				34.1	17.3	
084	—	5		53000	—	68.5	—				34.1	17.3	
088	082	5		51750	45250	68.5	63.5				34.1	17.3	
096	092	6		66350	58950	69.0	64.0				40.6	20.6	
098	095	6		64100	57300	69.0	64.0				40.6	20.6	
105	099	6		62100	54300	69.0	64.0				40.6	20.6	
DOUBLE FAN-WIDTH MODELS													
WCS	WCL												
047	043	4		46000	41200	68.0	63.0				27.6	15.0	15.0
054	052	4		44900	41200	68.0	63.0				27.6	15.0	15.0
060	056	4		43800	39600	68.0	63.0				27.6	15.0	15.0
066	059	4		42400	38200	68.0	63.0				27.6	15.0	15.0
070	064	4		41400	36200	68.0	63.0				27.6	15.0	15.0
075	068	6		69000	61800	69.0	64.0				40.6	20.6	15.0
080	076	6		67350	61800	69.0	64.0				40.6	20.6	15.0
085	—	6		67000	—	69.0	—				40.6	20.6	15.0
090	086	6		65700	59400	69.0	64.0				40.6	20.6	15.0
099	091	6	30	64100	57300	69.0	64.0	1 1/2	1 1/2	N/A	40.6	20.6	15.0
106	098	6		62100	54300	69.0	64.0				40.6	20.6	15.0
108	103	8		89800	82400	70.0	64.5				53.6	27.2	19.8
121	111	8		87600	79200	70.0	64.5				53.6	27.2	19.8
132	118	8		84800	76400	70.0	64.5				53.6	27.2	19.8
140	127	8		82800	72400	70.0	64.5				53.6	27.2	19.8
154	138	10		109500	99000	71.0	66.0				66.6	33.8	24.6
162	155	10		108700	98250	71.0	66.0				66.6	33.8	24.6
170	—	10		106000	—	71.0	—				66.6	33.8	24.6
177	164	10		103500	90500	71.0	66.0				66.6	33.8	24.6
193	183	12		132700	117900	71.5	67.0				79.6	40.4	29.4
200	190	12		128200	114600	71.5	67.0				79.6	40.4	29.4
212	196	12		124200	108600	71.5	67.0				79.6	40.4	29.4

** Sound pressure ratings in dBA 30 feet from condenser*

† Refer to Page 13 for individual fan motor amp ratings.

Δ Single Phase — 1140 RPM only (1 HP). 825 RPM not available

Fan Speed Control Options

Available only with Fan Cycling Control Option.

Designed to enhance the performance of the Fan Cycling Control Option by reducing the RPM and air volume of the lead (header end) fan motor(s) after all other (lag) fans have cycled off. The lead fan(s) must run continuously, even in the lowest ambient temperature. By reducing their CFM, adequate head pressure can be maintained at lower ambients without resorting to flooded-condenser head pressure control. See Table 9 for minimum ambient temperatures.

Pressure Controlled Fan Speed

Includes Penn P-66 Speed Controller, 24 volt transformer, single phase fan motor and pressure line piped from the last return bend in the circuit opposite the header end to the speed control. Double fan-width models require two controllers for the two lead fan motors. All components are factory mounted and wired. Controller decreases fan motor RPM as head pressure decreases.

Temperature Controlled Fan Speed

Includes Hoffman Speed Controller and single phase fan motor. Double fan-width models require one controller for the two lead fan motors. All components are factory mounted. Controller sensing element is mounted on the last return bend in the circuit, opposite the header end. Controller decreases fan motor RPM as liquid temperature decreases.

Table 12: Motor Amps

1140 RPM		
1/2 HP	208-230/1/60	2.5 a.
	208-230/3/60	2.0 a.
	460/3/60	1.0 a.
	575/1/60	1.0 a.
1 HP	208-230/1/60	4.9 a.
	208-230/3/60	4.0 a.
	460/3/60	2.0 a.
	575/3/60	1.7 a.
1 1/2 HP	208-230/1/60	N/A
	208-230/3/60	6.5 a.
	460/3/60	3.3 a.
	575/3/60	2.4 a.

825 RPM		
1/4 HP	208-230/1/60	1.4 a.
	208-230/3/60	1.1 a.
	460/3/60	0.6 a.
	575 Volt.	N/A
1/2 HP	208-230/1/60	2.7 a.
	208-230/3/60	2.2 a.
	460/3/60	1.1 a.
	575 Volt.	N/A
1 1/2 HP	208-230/1/60	N/A
	208-230/3/60	6.5 a.
	460/3/60	3.3 a.
	575 Volt.	N/A

FIELD WIRING

IMPORTANT: All wiring must be done in accordance with applicable codes and local ordinances.

Wiring Options

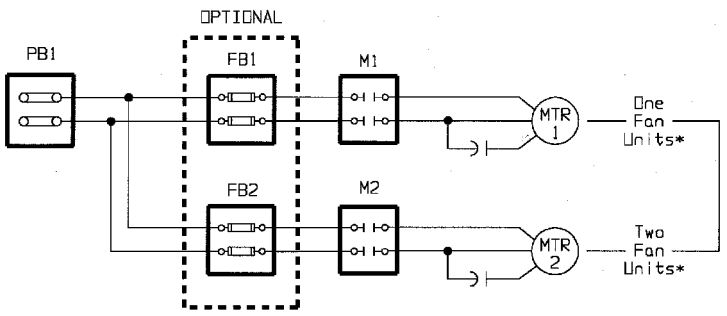
Standard units are furnished with the motor leads terminated in a single weatherproof enclosure located opposite the header end on the unit. A terminal block is provided on units RCS-075 through 106 (RCL-068 through 098).

When the fan cycling control option is ordered, the units are furnished with contactors, power circuit terminal block (except on single fan units), fan cycling controls, a control terminal block and motor fusing, if specified. The components are installed in a weatherproof enclosure that is factory mounted and completely wired. See Figures 3, 4 and 5 for wiring details.

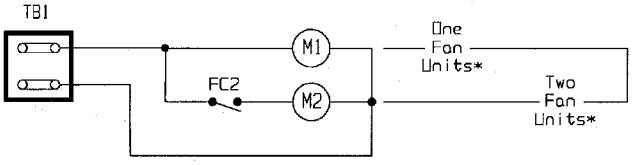
Figure 4

CDS-001 thru CDS-038, 1 - Phase Units
CDL-001 thru CDL-029, 1 - Phase Units

Power Circuit
(208-230 Volts)



Control Circuit



* Refer to Table 11 (Page 12) for model number vs. number of fans.

Legend

FB1 - FB3 . . . . . .Fuse Blocks
FC2 - FC3 . . . . . .Fan Cycling Controls
M1 - M3 . . . . . .Fan Motor Contactors
MTR1 - MTR3 . . . . . .Fan Motors
TB1 . . . . . .Control Terminal Block
PB1 . . . . . .Power Terminal Block

Notes

1. *Motor 1 is always located at the header end of the unit.*
2. *PB1 is not furnished on single fan units.*
3. *Field control wiring connections are made to terminal block TB1.*
4. *Contactor holding coils can be furnished in most voltages, including 24, 115, 208-230 or 460 volts.*
5. *Fan cycling controls FC2 and FC3 can be furnished either as ambient temperature controls or pressure controls.*

TYPICAL WIRING — THREE PHASE UNITS

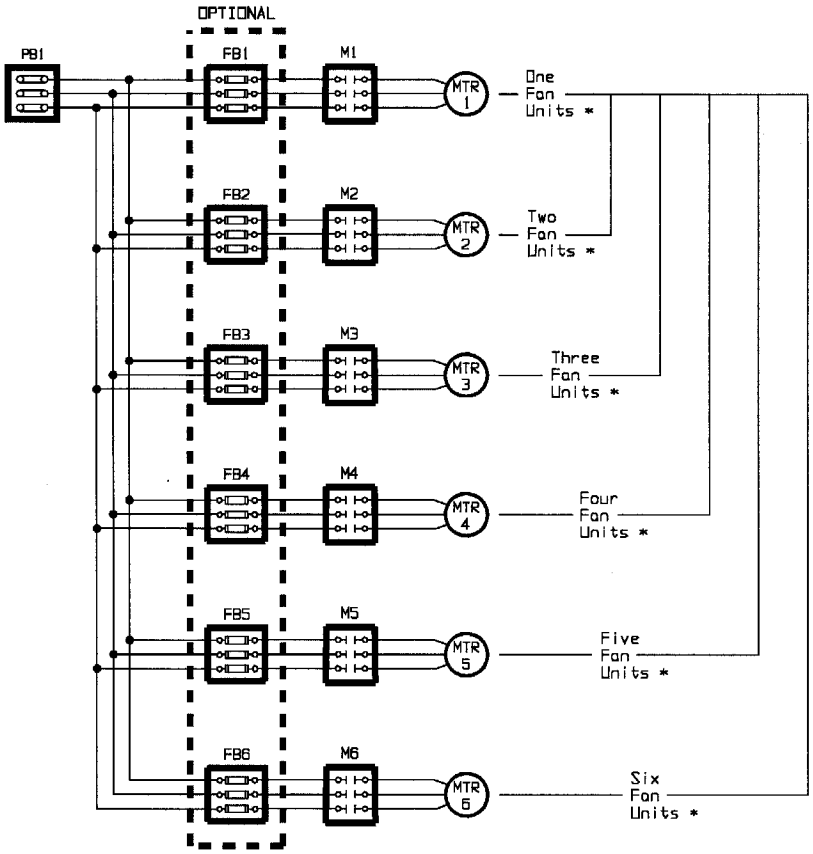
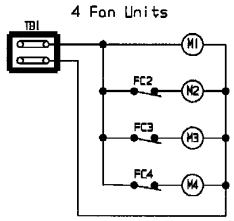
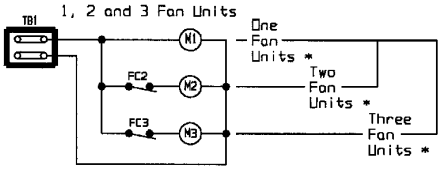
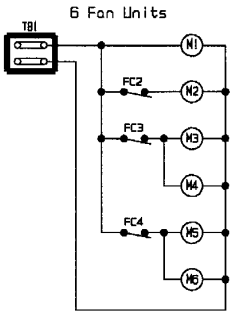


Figure 5 — Single Fan-Width Units

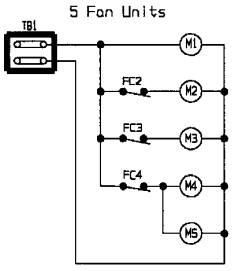
Power Wiring







Control Wiring



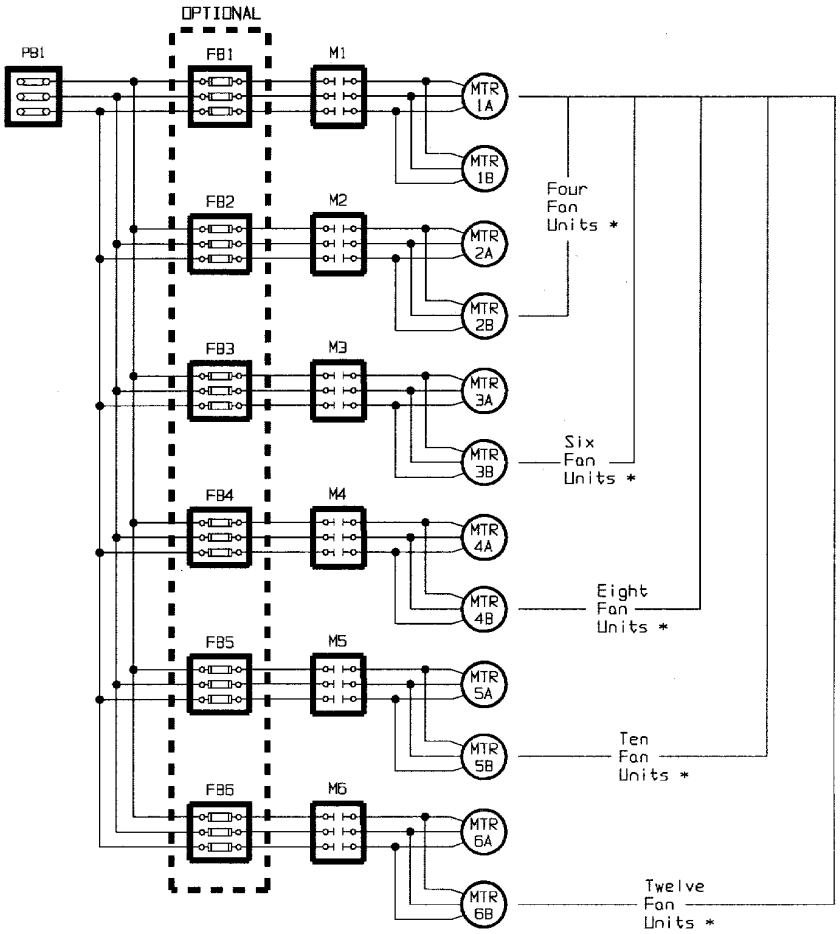
Legend

FB1—FB6 . . . . . .Fuse Blocks
FC2—FC4 . . . . . .Fan Cycling Controls
M1—M6 . . . . . .Fan Motor Contactors
MTR1—MTR6 . . . . . .Fan Motors
TB1 . . . . . .Control Terminal Block
PB1 . . . . . .Power Terminal Block

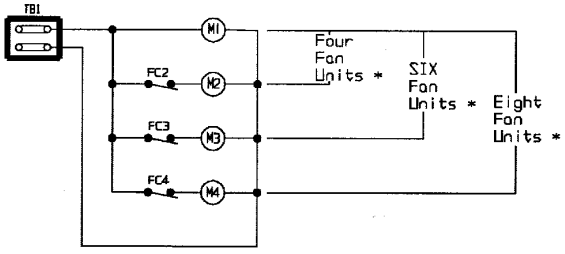
Notes

1. Motor 1 is always located at the header end of the unit.
2. Field control wiring connections are made to terminal block TB1.
3. Contactor holding coils can be furnished in most voltages, including 24, 115, 208-230 or 460 volts.
4. Fan cycling controls FC2 through FC4 can be furnished either as ambient temperature controls or pressure controls.

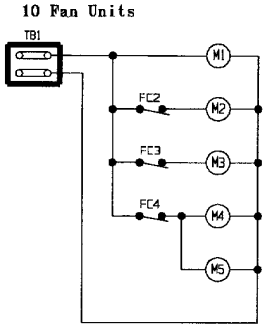
Figure 6 — Double Fan Width Units

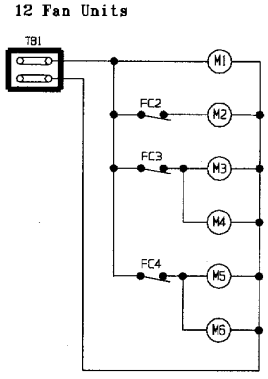


Power Wiring



Control Wiring





Legend

FB1—FB6 . . . . . .Fuse Blocks
FC2—FC4 . . . . . .Fan Cycling Controls
M1—M6 . . . . . .Fan Motor Contactors
MTR1—MTR6 . . . . . .Fan Motors
TB1 . . . . . .Control Terminal Block
PB1 . . . . . .Power Terminal Block

Notes

1. Motor 1 is always located at the header end of the unit.
2. Field control wiring connections are made to terminal block TB1.
3. Contactor holding coils can be furnished in most voltages, including 24, 115, 208-230 or 460 volts.
4. Fan cycling controls FC2 through FC4 can be furnished either as ambient temperature controls or pressure controls.

UNIT START-UP

Before starting the refrigeration system, check the following items.

1. Make sure the condenser is wired as shown in the Field Wiring section of this bulletin and in accordance with applicable codes and local ordinances.
2. Make sure all electrical connections are tight.
3. Make sure the piping to the condenser is in accordance with the Refrigerant Piping information section of this bulletin and good piping practice.
4. Make sure all motors are mounted securely and all fan setscrews are tight.
5. Make sure all fans rotate freely.
6. Make sure the unit is located so that it has free access for proper air flow, see the Unit Location section of this bulletin.
7. After start-up, make sure all fans are rotating in the proper direction. Fans should draw air through the coil.

MAINTENANCE

General

CDS and CDL units require very little maintenance. Regular maintenance should include cleaning the surface of the coil and checking to make sure that all electrical connections are tight. All motors have permanently sealed ball bearings which do not require any maintenance.

"Flip-Top" Units

Cleaning the coil or servicing the fans or motors is easier on units provided with "flip-top" fan panels because they can be raised by removing five bolts with self-retained nuts. The panels are hinged and provided with pivoting rods that hold them securely in the upright position. With the panels raised, the coil can be cleaned by washing it down from the top. Also, access to the fans and motors is greatly improved.

SERVICE RECORD

DATE	*MAINTENANCE PERFORMED*	*COMPONENTS REQUIRED*