

Liebert CSU 3000™

Installation Manual - Mainframe Cooling Systems, 60 Hz



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PRODUCT MODEL INFORMATION

Table 1 Model Number Designation

DS		065	A		-	A	
DS =	Single Module 5 Ton	Nominal Capacity in Thousand BTU/H	A =	Air Cooled		A =	460/3/60
DD =	Dual Module 5 Ton		W =	Water Cooled		B =	575/3/60
CS =	Single Module 7-1/2, 10, 12, 15 Ton		G =	Glycol Cooled		C =	208/3/60
CD =	Dual Module 7-1/2, 10, 12, 15 Ton		L =	Glycool		D =	230/3/60
AS =	Alternate Water Source Module					F =	380/3/50
CT =	Triple Module 20, 30, 37 Ton					G =	415/3/50
					M =	380/415/3/50	
					J =	200/3/50	

Table 2 Systems

Tonnage	Air Cooled	Water Cooled	Glycol Cooled	Glycool
5	DS065A/DD130A	DS072W/DD144W	DS057G/DD114G	
7-1/2	CS091A/CD182A	CS101W/CD202W	CD085G/CD170G	CD170L
10	CS109A/CD218A	CS121W/CD242W	CS102G/CD204G	CD204L
12	CS135A/CD270A	CS151W/CD302W	CS126G/CD252G	CD252L
15	CS181A/CD362A	CS200W/CD400W	CS168G/CD336G	
20	CT327A	CT363W	CT306G	
30	CT543A	CT600W	CT504G	
37	CT663A	CT702W	CT621G	



NOTE

Refer to **Table 16** for Alternate Water Source model numbers

1.0 PRELIMINARY CONSIDERATIONS

1.1 Computer Room Preparation

Before proceeding with installation, check the following items to guarantee that the unit will be installed to factory specifications.

1. The specified electrical service must be available at the unit location.
2. There must be ample clearance in the front and on the sides.
3. On air cooled units, all refrigerant piping from the chiller to the condenser must be connected with proper vibration isolation.

The raised floor in modern computer rooms is used to conceal piping and electrical cables and as an air distribution plenum for the computer air conditioning system. It is important not to restrict the airflow. Whenever possible, run cables and piping parallel with the airflow and never stack piping.

1.2 Equipment Inspection

After the chiller unit and condenser/drycooler have arrived, inspect all items for visible or concealed damage. Immediately report any damage to the carrier and file a damage claim.

2.0 INSTALLATION OF INDOOR UNIT

2.1 Location Considerations

1. If the raised floor has already been installed, the unit should be moved on rubber tire dollies or on a minimum of three rollers placed under the unit to support its weight. If the raised floor has not been installed, an accessory floor stand can be provided.
2. Prior to making piping connections, make sure the unit is adequately supported and will not have to be moved in any direction after the connections have been made.
3. Provide 34" (864mm) on both sides and front of 7-1/2 - 37 ton units to permit routine service. The front and left side of 2-1/2 - 5 ton units must have 34" (864 mm) of service clearance.

Figure 1 5 Ton Chiller With Floorstand

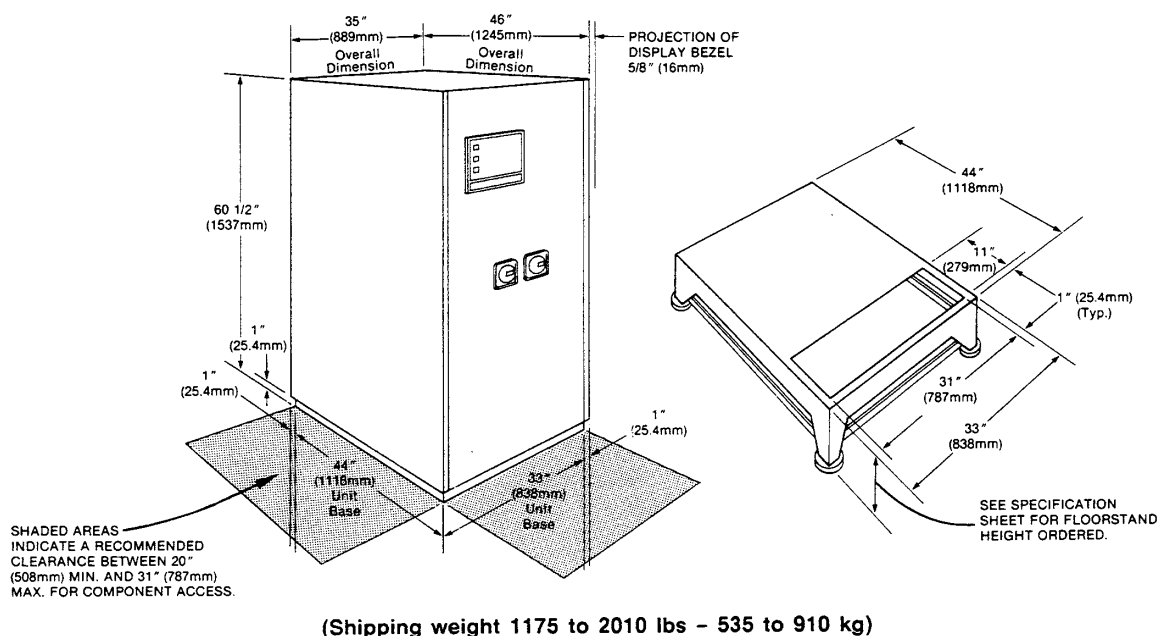
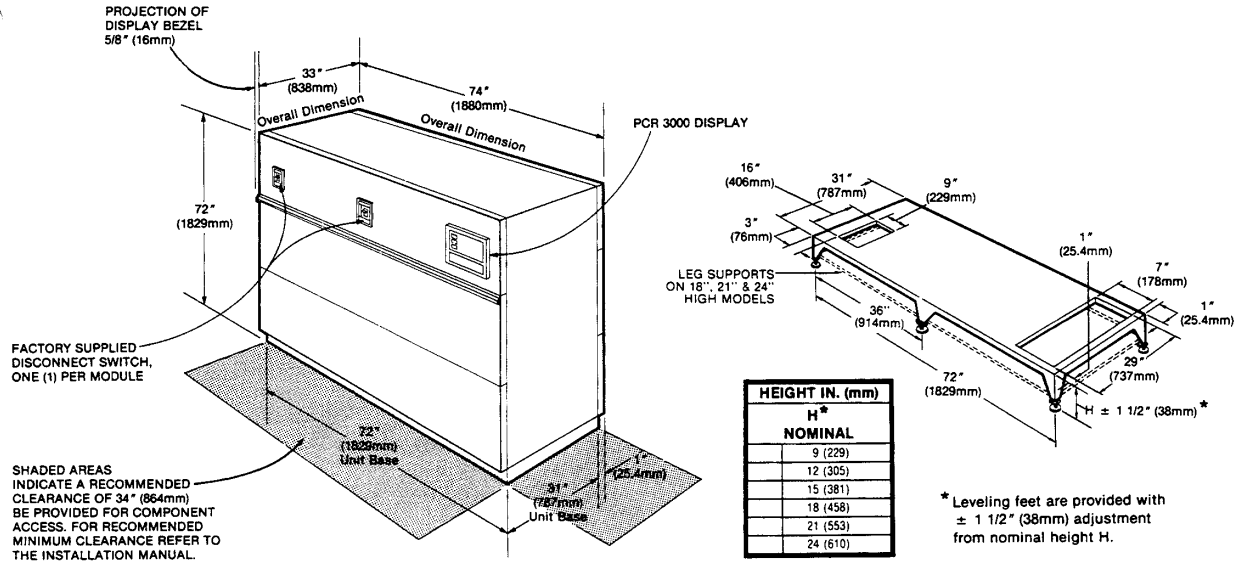
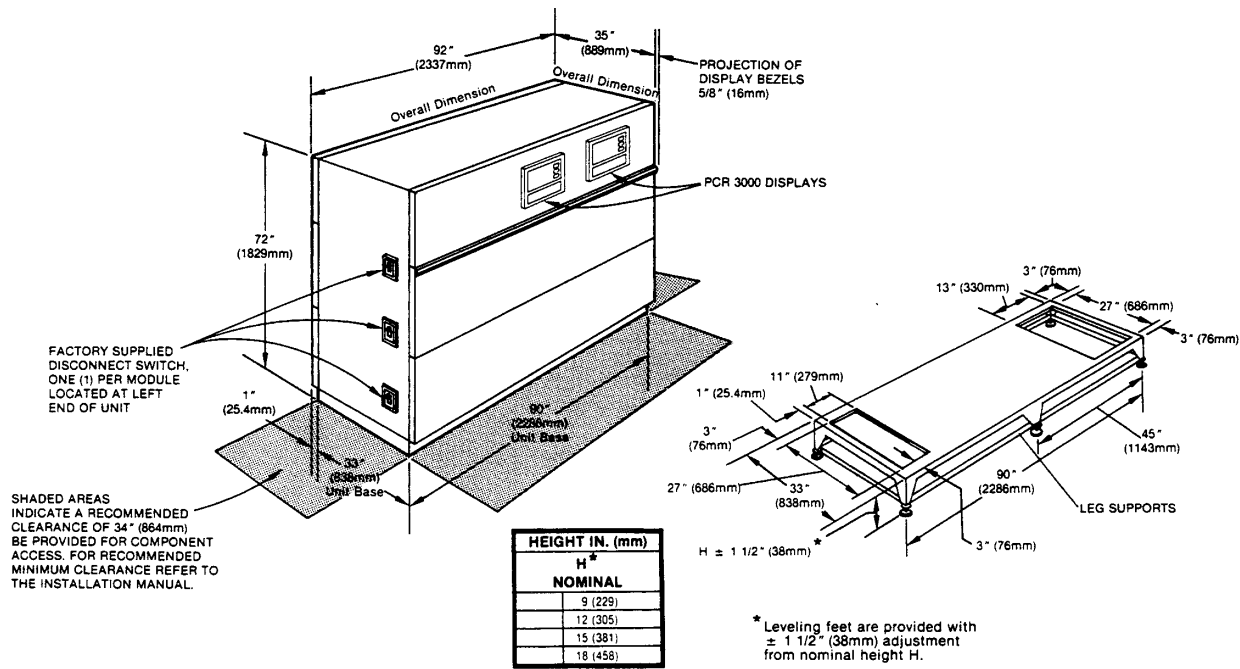


Figure 2 7-1/2 – 15 Ton Chiller with Floorstand



(Shipping weight 1340 to 2490 lbs – 610 to 1130 kg)

Figure 3 20 – 37 Ton Chiller with Floorstand



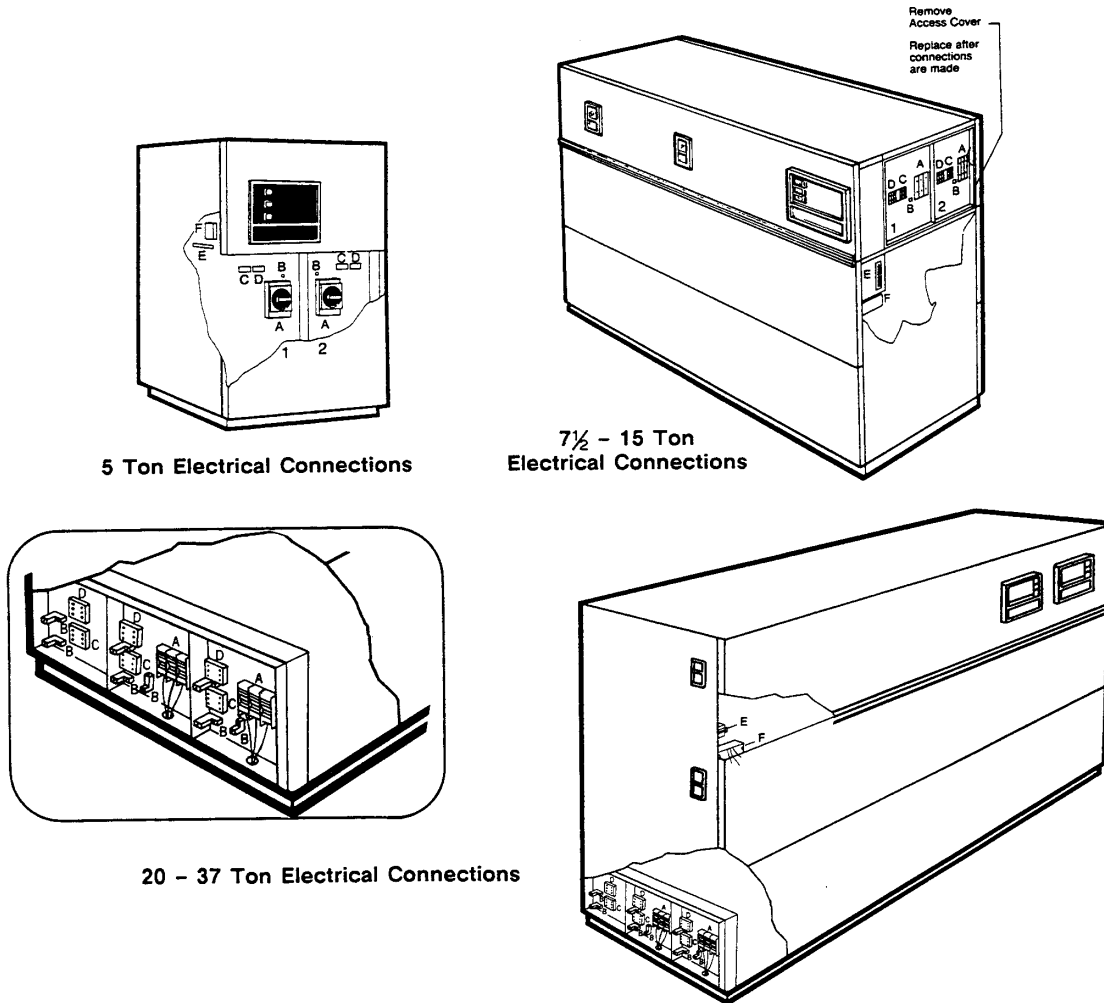
(Shipping weight 2570 to 3740 lbs – 1170 to 1700 kg)

2.2 Electrical Connections

2.2.1 Line Voltage

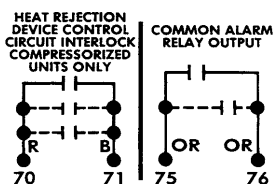
See **Figure 4** for connection locations.

Figure 4 Electrical Connections



- A = High voltage, three-phase supply to chiller (One connection is standard. The second connection shown is optional).
- B = Ground lug
- C = High voltage, from remote heat rejection
- D = Lee-Temp, single-phase (air cooled only)
- E = Remote shutdown (Mod. 1/Mod. 2), remote Alarm N.O. contact, remote alarm Indication (see **Table 3**)
- F = Low Voltage interlock to water circuit (water cooled only) See

Figure 5 Connector F Details (see Figure 4)



Field Wiring Connections

- Loads connected at pigtails must not exceed 3 amps, 120VAC, wire per local codes.
- See system diagram for complete circuit details
- One or more contact sets may be provided.

2.3 Piping Considerations

All piping below the elevated floor must be located so that it offers the least resistance to airflow. Careful planning of the piping layout under the raised floor is required to prevent the airflow from being blocked in any portion of the room. When installing piping in the subfloor, it is recom-

mended that the pipes be mounted horizontally on the same plane, rather than stacked one above the other on support brackets. This affords the least resistance to airflow under the raised floor. Wherever possible, run the pipes parallel to the airflow.

2.4 Coolant Supply Piping

Each module is equipped with isolating valves on the supply and return piping so that each chiller module can be shut off for service without affecting the operation of the other module(s).

The 5 ton models have 3/4" F.N.P.T. connections. Each 7-1/2 – 37 ton capacity chiller contains two 2-1/8" O.D. copper connections (one for supply and one for return) for hard piping or for installing optional header kits. Insulate all external piping with Armaflex type FR insulation or equal.

2.4.1 Hard Piping

To make hard piping connections, remove the insulation from the supply and return headers. Cut off the end of each header. Solder a 2-1/8" coupling on the cut end of the header and make piping connections to the Coolant Distribution Unit (CDU).

2.4.2 Coolant Connection Options

Several optional kits are available for connecting the CSU3000 chiller to the computer CDU. These options include:

- Header Kits
- Hose Kits
- Coupling Kits

Refer to **8.0 - Appendix B – Coolant Connection Options** for details of the optional coolant connection kits.

2.4.3 Make-up Water Connections

Some systems include a factory supplied water make-up valve. Piping a water line to the water make-up manifold is a customer option on these systems. Refer to the submittal drawings for your units.

2.5 Filling the Coolant Circuit



NOTE

Make sure that all hoses or pipes from the chiller to the CDU are in place and connected. It is strongly recommended that hose bibs (not supplied by Liebert), be placed on supply and return lines during installation.

Follow the computer manufacturer's recommendations and instructions for coolant water quantities and filling procedures.



NOTE

Some systems include a factory supplied water make-up valve on the expansion tank. These systems require a filling and air bleeding procedure detailed on a label near the expansion tank. If your system has a fill procedure label, follow those instructions.

For systems that do not include a factory supplied water make-up valve, open the expansion tank fill port and pump distilled or city water through the return line hose bib. For distilled water, use a transfer pump. This will force trapped air to the top of the system and out the port. If filling from the return line is impossible, a funnel must be used to fill at the expansion tank fill port. Allow time for trapped air to escape.

2.6 Expansion Tank

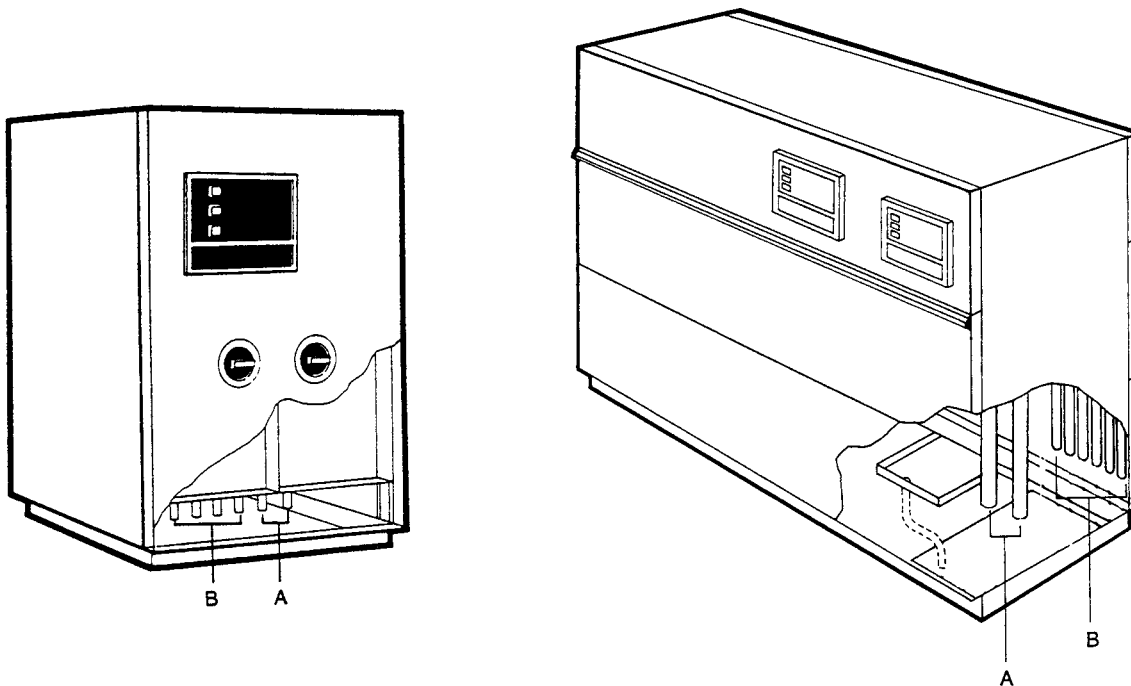
For any system that includes a ride-thru thermal storage tank or a long piping run (more than 22 gallons), a customer supplied, field installed expansion tank is necessary. Refer to **9.0 - Appendix C - Expansion Tank**.



CAUTION

An expansion tank is required for these systems to prevent excessive pressure in the coolant system during thermal expansion.

Figure 6 Piping Connections



5 Ton Piping Connections

7½ – 37 Ton Piping Connections
(20 – 37 Ton Used for Illustration)

Table 4 Piping Connections

Connection	5 Ton	7-1/2 – 15 Ton	20 – 37 Ton
Air Cooled (B)			
-Hot Gas Line	5/8" O.D. Cu.	1-1/8" O.D. Cu.	1-1/8" O.D. Cu.
-Liquid Line	1/8" O.D. Cu.	5/8" O.D. Cu.	5/8" O.D. Cu.
(One pair per module)		(7-1/2 Ton – 1/2" O.C. Cu.)	(37 Ton – 7/8" O.D. Cu.)
Water (B) ¹			
-Supply/Return	1-1/8" O.D. Cu.	2-1/8" O.D. Cu.	2-1/8" O.D. Cu.
Glycol (B) ¹			
-Supply/Return	1-1/8" O.D. Cu.	1-3/8" O.D. Cu.	1-3/8" O.D. Cu.
(One pair per module)		(same size for Glycol)	
Computer Coolant (A) Supply/Return ^{1,2}	(2) 3/4" FNPT	(1) 2-1/8" O.D. Cu.	(1) 2-1/8" O.D. Cu.
Drain (pan under pump)	1/2" O.D. Cu.	1/2" O.D. Cu.	3/4" O.D. Cu.
Make-up Water Automatic Fill Valve	N/A	N/A	1/2" Compression

1. Connection sizes only. Customer piping sizes are to be determined based on length of run, height differences, and other considerations.

2. Refer to **8.0 - Appendix B - Coolant Connection Options** for optional connection kits: heater kits, hose kits, and coupling kits.

3.0 AIR COOLED MODELS

3.1 Condensor Location

Situate the air-cooled condenser(s) for maximum security and maintenance accessibility. Avoid ground level sites with public access or areas that contribute to heavy snow or ice accumulations. Utilize centrifugal condensers whenever interior building locations must be used. To ensure an adequate air supply, it is recommended that condensers be located in a clean air area, away from loose dirt and foreign matter that may clog the coil. In addition, condensers should not be located in the vicinity of steam, hot air or fume exhausts. Condensers should not be located closer than 3 feet (1 meter) from a wall, obstruction or adjacent unit.

Install condensers in a level position to assure proper refrigerant flow and oil return. For roof installation, mount condensers on steel supports in accordance with local codes. To minimize sound and vibration transmission, mount steel supports across load bearing walls. For ground installation, a concrete pad is sufficient to provide adequate support. Condenser legs have mounting holes for securing the condenser to the steel supports or concrete pad.

3.2 Electrical Connections

3.2.1 Line Voltage

Line voltage electrical service is supplied from the indoor unit. The optional disconnect switch is factory supplied and mounted in the electrical panel.

3.2.2 Lee–Temp/Flood Back Head Pressure Control Condensers

Lee–Temp/Flood Back Head Pressure Control condensers require a separate power supply for the heated receivers. This power supply is connected to the electrical connection box on the end of the receiver.

3.3 Refrigerant Piping

Install all refrigeration piping with high temperature brazed joints. Prevailing good refrigeration practices should be employed for piping supports, leak testing, dehydration and charging of the refrigeration circuits. Isolate the refrigeration piping from the building with vibration isolating supports.

Place traps in the hot gas lines on vertical risers every 40 feet (12.2 meters) in elevation. These traps collect condensed refrigerant and refrigerant oil during the off cycle of the unit and protect the flow of refrigerant oil during operation.



NOTE

For piping runs in a conditioned air space, refrigerant can condense in the off module discharge line(s). This could cause a high head pressure condition when the compressor for that module is activated. The problem can be minimized by the addition of a check valve on the discharge line. However, to ensure that this condition never arises, strap or braze discharge lines together and insulate as a single item. If that is not feasible, install heater tape rated at 300°F (149°C) or higher around the discharge line(s) and insulate.



NOTE

Factory approval is required whenever a refrigerant piping run exceeds 200 feet (60 meters) equivalent length or when condensers must be located more than 30 feet (9 meters) below the level of the evaporator. Total discharge line pressure drop must not exceed 10 PSIG (69 kPa).

Table 5 Recommended Line Sizes – O.D. Copper

	65A 130A		91A 182A		109A 218A		135A 270A		181A 362A		327A		543A		663A	
	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line	Hot Gas Line	Liq. Line
50ft. (15m)	5/8	1/2	7/8*	5/8	7/8*	5/8	1-1/8*	7/8	1-1/8	7/8	7/8*	5/8	1-1/8	7/8	1-3/8	7/8
100 ft. (30m)	7/8	5/8	1-1/8*	5/8	1-1/8*	5/8	1-1/8	7/8	1-3/8	7/8	1-1/8*	5/8	1-1/8	7/8	1-5/8	7/8
150 ft. (45m)	7/8	5/8	1-1/8*	3/4	1-1/8*	7/8	1-1/8	7/8	1-3/8	7/8	1-1/8*	3/4	1-3/8	7/8	1-5/8	1-1/8

*On unloader equipped systems, use one trade size smaller. Recommended line sizes must be used for proper oil return.

Figure 7 1, 2, & 3 Fan Direct Drive Air Cooled Condensers

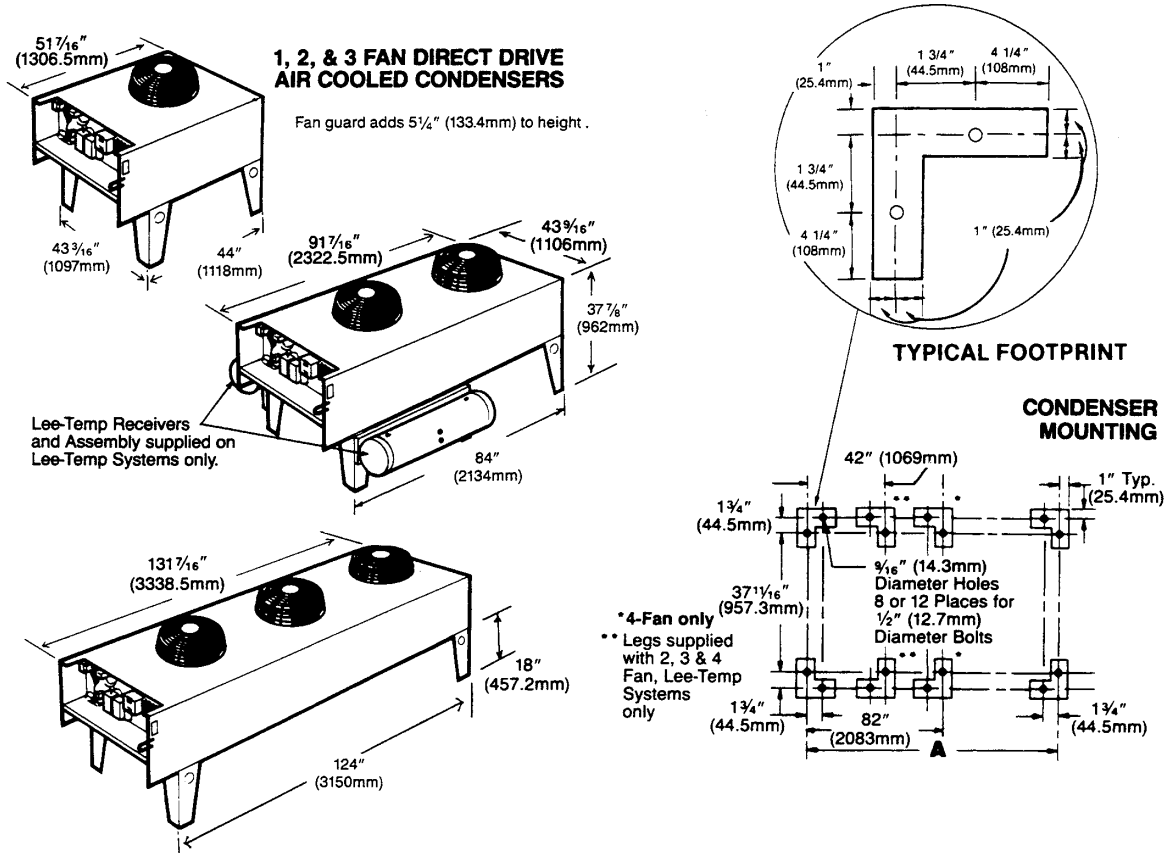


Table 6 Condenser Sizes and Piping Connections

Model	Number of Fans	Connection Sizes (ODS)		Net Weights lbs. (kg.)	A Dimension in. (mm)
		Hot Gas (in)	Liquid (in)		
CSC065	1	7/8	5/8	295 (134)	42 (1067)
CSC083L	1	7/8	5/8	295 (134)	42 (1067)
CSC086	1	7/8	5/8	315 (143)	42 (1067)
CSC097	1	1-1/8	5/8	335 (152)	42 (1067)
CSC104L	1	1-1/8	5/8	315 (143)	42 (1067)
CSC107C	1	1-1/8	5/8	335 (152)	42 (1067)
CSC108	1	1-1/8	5/8	355 (161)	42 (1067)
CSC130	2	1-1/8	7/8	425 (193)	82 (2083)
CSC165L	2	1-1/8	7/8	425 (193)	82 (2083)
CSC175	2	1-1/8	7/8	495 (225)	82 (2083)
CSC205L	2	1-1/8	7/8	495 (225)	82 (2083)

Table 6 Condenser Sizes and Piping Connections

Model	Number of Fans	Connection Sizes (ODS)		Net Weights lbs. (kg.)	A Dimension in. (mm)
		Hot Gas (in)	Liquid (in)		
CSC216	2	1-1/8	7/8	635 (288)	82 (2083)
CSC217C	2	1-1/8	7/8	515 (236)	82 (2083)
CSC251L	3	1-1/8	7/8	500 (227)	122 (3099)
CSC258	3	1-1/8	7/8	670 (304)	122 (3099)
CSC291	3	1-3/8	1-1/8	780 (354)	122 (3099)
CSC308L	3	1-5/8	1-1/8	670 (304)	122 (3099)
CSC330L	4	1-5/8	1-3/8	780 (354)	162 (4115)
CSC360	4	1-3/8	1-1/8	815 (370)	162 (4115)
CSC415L	4	2-1/8	1-3/8	815 (370)	162 (4115)
CST480C	4	2-1/8	1-3/8	1025 (465)	162 (4115)

3.4 Lee-Temp/Flood Back Head Pressure Control

The Lee-Temp/Flood Back Head Pressure Control system consists of a modulating head pressure control valve and insulated receivers with heater pads that sustain operation at ambient temperatures as low as -30°F (-34.4°C).

3.4.1 Piping

Make sure that the head pressure control valve is installed with the refrigerant flow in the proper direction. When soldering or brazing the valves, it is very important that the internal parts be protected by wrapping the valve with a damp cloth to keep the valve temperature below 250°F (121°C).

3.4.2 Dehydration

1. Open all of the disconnect switches.
2. Pull all fuses except the transformer fuses.
3. Jumper the Flow Switch. Turn the disconnects ON.
4. Use the temperature control (at minimum setting) to energize the solenoid valves.
5. Connect refrigeration gauges to the suction and discharge service valves of the compressor(s).
6. Attach a "jumper" hose from the roto-lock fitting on the outlet of the receiver and the Schrader fitting on the liquid header of the condenser. Front seat the roto-lock valve approximately 2 turns.
7. Open all service valves.
8. Charge the circuit to 150 PSIG (1034 kPa) with dry nitrogen containing a tracer of Freon. Check for leaks.
9. After completion of the leak testing, release the test pressure and pull a vacuum on both circuits.
10. After 4 hours, check the gauge readings and if they have not changed, purge with Freon.
11. Pull a second vacuum of 500 microns (29.9 in. Hg), leave for 2 hours and recheck gauges.
12. Pull a third vacuum as in step 11.

3.4.3 Charging

1. Make certain that the unit is OFF. Remove the jumper from the Flow Switch.
2. Connect a set of manifold gauges to the refrigerant drum and to the receiver at the roto-lock valve. Purge the hoses of noncondensables.
3. Open the roto-lock valve and fill the receiver with liquid refrigerant. Refer to **3.4.4 - Refrigerant Level**.
4. Close the roto-lock valve and disconnect gauges.
5. Start the compressor and recheck the refrigerant level. If the level has dropped, recharge the circuit with vapor through the suction port of the compressor.
6. Replace all fuses.
7. Connect the refrigerant charging hose to the suction port of the compressors and purge with Freon.
8. Turn the Temperature Control to the minimum setting to confirm that the solenoid valve and compressor are energized.
9. Charge with vapor in accordance with **3.4.4**.

3.4.4 Refrigerant Level

On each receiver at the condenser are two refrigerant level sight glasses. Refrigerant level varies with the outside temperature.

Check refrigerant level after the unit has been on for at least 15 minutes.

40°F (4.5°C) and below	40°F to 60°F (4.5°C to 15.5°C)	60°F (15.5°C) and above
Bottom sight glass is 3/4 full	Bottom sight glass is full	Top sight glass is 3/4 full

Figure 8 Lee-Temp/Flood Back Head Pressure Control

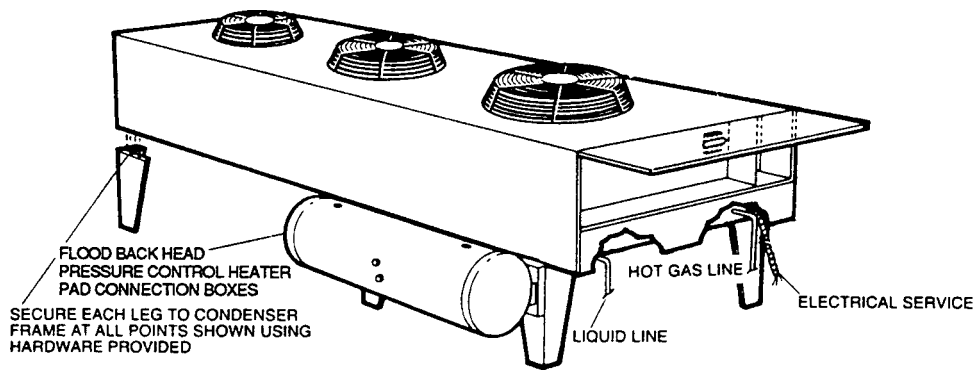


Table 7 Unit Refrigerant Charge

Model	Charge	
	lbs.	(kg)
DS065A	4.0	(1.8)
CS091A	6.0	(2.7)
CS109A	6.0	(2.7)

Table 7 Unit Refrigerant Charge

Model	Charge	
	lbs.	(kg)
DD130A (per module)	4.0	(1.8)
CS135A	8.0	(3.6)
CD182A (per module)	6.0	(2.7)
CS181A	10.0	(4.5)
CD218A (per module)	6.0	(2.7)
CD270A (per module)	8.0	(3.6)
CT327A (per module)	6.0	(2.7)
CD362A (per module)	10.0	(4.5)
CT543A (per module)	10.0	(4.5)
CT663A (per module)	12.0	(5.4)

Table 8 Lee-Temp Condenser Refrigerant Charge (includes Receiver)

Model	Charge	
	lbs.	(kg)
CSC065	27	(12.2)
CSC083L	27	(12.2)
CSC086	39	(17.7)
CSC097	54	(24.5)
CSC104L	39	17.7
CSC107L	55	24.9
CSC108	66	(29.9)
CSC130	53	(24.0)
CSC165L	53	24.0
CSC175	76	(34.5)
CSC205L	76	34.5
CSC216	126	(57.2)
CSC217L	102	46.3
CSC251L	75	(34.0)
CSC258	113	(51.3)
CSC291	150	(68.0)
CSC308L	113	(51.3)
CSC330L	101	(45.8)
CSC360	149	(67.6)
CSC415L	149	67.6
CST480C	120	54.4

Table 9 Liquid Line Charge lbs./10 ft. (kg./3m)

Line Size O.D. Cu.	Charge
1/2"	0.73 (0.33)
5/8"	1.17 (0.52)
7/8"	2.44 (1.09)
1-1/8"	4.16 (1.86)
1-3/8"	6.33 (2.83)
1-5/8"	8.70 (3.89)

3.4.5 Materials Supplied

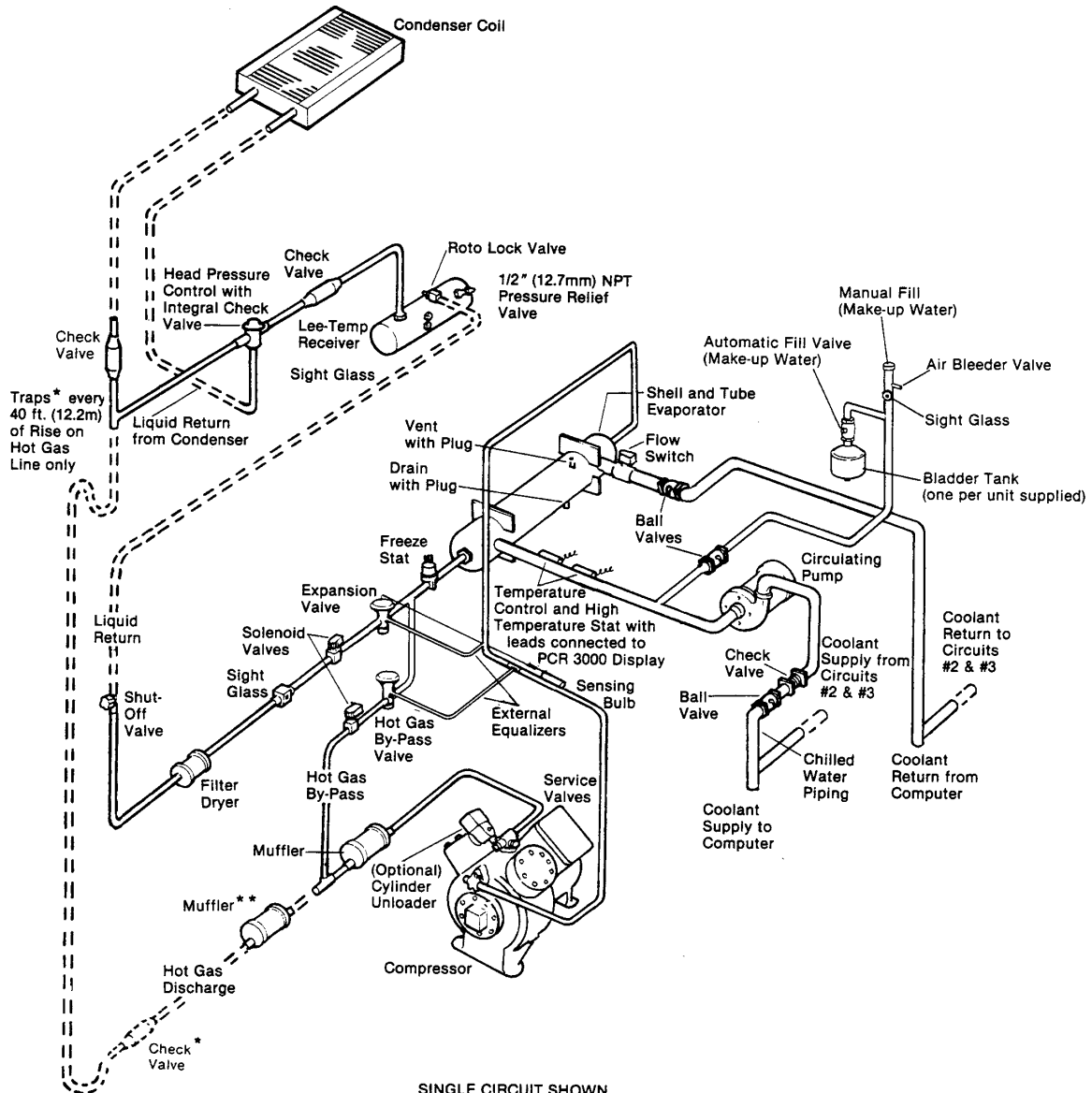
1. Built in pre-wired condenser control box.
2. Air cooled condenser.
3. Piping access cover to be reinstalled when piping is complete.
4. Bolts – 4 per leg 3/8" x 5/8"
5. Condenser legs – 4 on 1 fan; 5 on 2 and 3 fan; 7 on 4 fan.
6. Lee-Temp/Flood Back Head Pressure Control:
 - a. Insulated storage receiver.
 - b. Piping assembly including head pressure control valve with integral check valve and roto-lock adapter.
 - c. Roto-lock outlet valve.
 - d. Pressure relief valve.
 - e. Liquid level sight glass – 2 per receiver.
 - f. Check valve.
7. Bolts – Lee-Temp/Flood Back Head Pressure Control 3/8" x 1" (6 per receiver).



NOTE

Lee-Temp/Flood Back Head Pressure Control heater pads require a continuous electrical source of 200/208/230V from the CSU3000 unit.

Figure 9 Air Cooled General Arrangement Drawing



NOTES: 1. When unit is operating below 30% of Full Capacity, double Discharge Risers are required. Consult factory for proper selection.
 2. Strap all discharge lines together and insulate as single item if discharge lines are in conditioned space.

SINGLE CIRCUIT SHOWN
 ————— FACTORY PIPING
 - - - - - OPTIONAL PIPING
 : : : : : FIELD PIPING

* Components are not supplied by Liebert but are recommended for proper circuit operation and maintenance
 ** Components supplied by Liebert and must be field installed.

NOTE: The piping schematic is for a 20-37 ton unit. See the engineering submittal drawings for your specific model.

4.0 GLYCOL COOLED MODELS

4.1 Drycooler Locations

Locate the drycooler(s) for maximum security and maintenance accessibility. Avoid ground-level sites with public access or areas which contribute to heavy snow or ice accumulations. To achieve an adequate air supply, it is recommended that drycoolers be placed in a clean air area, away from loose dirt and foreign matter that may clog the coil. In addition, drycoolers should not be situated in the vicinity of steam, hot air or fume exhausts. Finally, drycoolers should not be located closer than 3 feet (1 meter) from a wall, obstruction or adjacent unit.

4.2 Drycooler Installation

For roof installation, mount drycoolers on steel supports in accordance with regional and national codes. To minimize sound and vibration transmission, position steel supports across load bearing walls and I-beams. For ground installation, a concrete pad is an acceptable foundation. Drycooler legs possess mounting holes for securing the drycooler to steel supports or a concrete pad.

4.3 Electrical Connections

4.3.1 Line Voltage

Line voltage electrical service is supplied from the indoor unit. The disconnect switch is factory supplied and mounted in the electric panel.

4.3.2 Pump and Drycooler

All wiring to the pump and drycooler from the control box should be completed in accordance with the electrical schematic on the inside lid of the drycooler control box and with local and national codes.

4.4 Glycol Piping

It is recommended that manual shut-off valves be installed at the supply and return line to each indoor unit and drycooler. This permits routine service and emergency isolation of the unit.

Floor drains with wet traps and sensors for a water detection system should be installed near the base of the unit or below the elevated floor.

When the glycol returns from the drycooler (or condenser) it is cooler than the room temperature. If the glycol temperature is cooler than the dew point for the room temperature and humidity, condensation takes place. The chart below lists dew points for the most probable ambient conditions. To minimize the possibility of condensation on the return and supply lines, determine the minimum glycol temperature and if it is less than the dew point temperature for the most likely ambient conditions, insulate the supply and return lines.



NOTE

Galvanized pipe must not be used in glycol systems.

Table 10 Room Dew Point Temperature

Dry Bulb °F (°C)	Wet Bulb °F (°C)	Rel. Hum. (%)	Dew Point* °F (°C)
70 (21.1)	57.2 (14.0)	45	41.1 (5.0)
70 (21.1)	58.5 (14.7)	50	50.5 (10.3)
72 (22.2)	58.9 (14.9)	45	50.0 (10.0)
72 (22.2)	60.0 (15.5)	50	52.4 (11.3)
75 (23.8)	61.2 (16.2)	45	52.4 (11.3)
75 (23.8)	62.5 (16.9)	50	55.0 (12.7)

*Minimum glycol temperature before condensation will occur.

4.5 Preparation of Glycol Solution

Typical ethylene glycol manufacturers and suppliers are DuPont (Telar), Union Carbide (Ucar Thermofluid 17) or Dow Chemical Co. These glycols are supplied with an inhibitor and do not contain an anti-leak formula.

Table 11 Glycol Concentration

% Glycol by Volume	0	10	20	30	40	50
Freezing Point °F °C	32 (0)	25 (-3.9)	16 (-8.9)	5 (-15.0)	-10 (-23.3)	-32 (-35.5)
Apparent Specific Gravity @ 50°F (10°C)	1.000	1.014	1.028	1.042	1.057	1.071



NOTE

Automotive anti-freeze is unacceptable and must not be used in the unit.

Commercial ethylene glycol, when pure, is generally less corrosive to the common metals of construction than water itself. Aqueous solutions of these glycols (mixed with water), however, assume the corrosivity of the water from which they are prepared and may become increasingly corrosive with use if not properly inhibited.

There are two basic groups of corrosion control chemicals. They are classified as corrosion inhibitors or environmental stabilizers. The corrosion inhibitors form a surface barrier that protects the metals from attack. Environmental stabilizers, while not corrosion inhibitors in the strict sense of the word, decrease corrosion probability by stabilizing the overall environment. An alkaline buffer, such as borax, is a simple example, since its prime purpose is to maintain an alkaline condition (pH above 7) thus minimizing the corrosive effect of the solution on metals.

The water quality must be regarded, because water from some sources contains corrosive elements that reduce the effectiveness of the corrosion control mixture. Preferably, soft surface water that is low in chloride and sulfate ion content (less than 100 parts per million) should be used. Before an inhibited glycol solution is charged into a new or old system, remove residual contaminants such as sludge, rust, brine deposits, oil etc. so that the inhibitor functions properly. It is recommended to avoid the use of strong acid cleaners; however, if they are required, inhibited acids

should be used. In any event, make sure that the cleaning agent is completely expelled before charging with glycol.

Table 12 Chiller Glycol Volume Approximate gallons (liters) Maximum¹ per Module

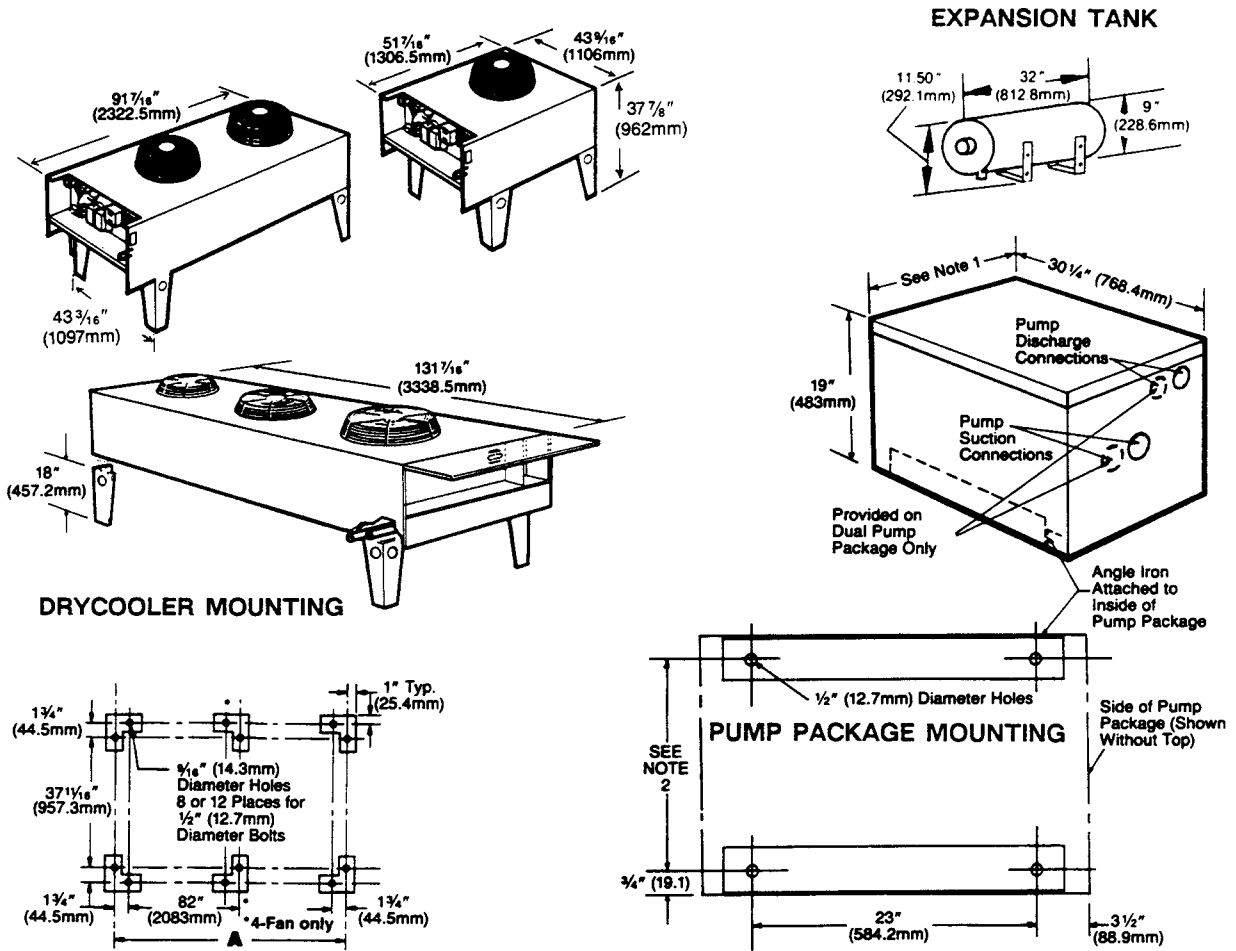
Model	No. Modules	Glycol ² Cooled	Glycool ³ / Free Cool
57G	1	1.3 (4.9)	—
114G	2	1.3 (4.9)	—
85G	1	2.7 (10.2)	8.2 (31.0)
170G	2	2.7 (10.2)	8.2 (31.0)
102G	1	2.7 (10.2)	8.2 (31.0)
204G	2	2.7 (10.2)	8.2 (31.0)
126G	1	2.7 (10.2)	8.2 (31.0)
252G	2	2.7 (10.2)	8.2 (31.0)
168G	1	3.1 (11.7)	—
336G	2	3.1 (11.7)	—
306G	3	2.7 (10.2)	—
504G	3	3.1 (11.7)	—
621 G	3	3.1 (11.7)	—

1. Does not include drycooler (see **Table 14**) for field piping volumes.
2. Includes one condenser and internal piping
3. Includes one evaporator, one condenser and internal piping.

Table 13 Volume in Standard Type L Copper Piping

Diameter (in.)		Volume	
Outside	Inside	gal/ft.	l/m
1/2	0.430	0.008	0.01
5/8	0.545	0.012	0.15
3/4	0.666	0.018	0.22
7/8	0.785	0.025	0.31
1-1/8	1.025	0.043	0.53
1-3/8	1.265	0.065	0.81
1-5/8	1.505	0.092	1.15
2-1/8	1.985	0.161	2.00
2-5/8	2.465	0.248	3.08
3-1/8	2.945	0.354	4.40
3-5/8	3.425	0.479	5.95
4-1/8	3.905	0.622	7.73

Figure 10 1, 2, & 3 Fan Direct Drive Drycoolers



- Notes:
1. Single pump packages are 17-1/4" (438.2 mm) wide. Dual pump packages are 32-1/4" (819.2 mm) wide.
 2. Mounting holes are 15-3/8" (391.3 mm) apart on single pump packages and 30-3/8" (772.3 mm) apart on dual pump packages.
 3. Connections sizes apply to primary pump supplier.

Table 14 Drycooler Data

Model No.	No. of Fans	Weight		Drycooler Conn. Sizes (Suct & Disc.) in.	A Dimension		Coil Internal Volume	
		lbs.	(kg)		in.	(mm)	gal.	(l)
-069	1	410	(186)	1-1/4	42	(1067)	2.4	(9.2)
-092	1	430	(195)	1-1/2	42	(1067)	3.7	(13.9)

Table 14 Drycooler Data

Model No.	No. of Fans	Weight		Drycooler Conn. Sizes (Suct & Disc.) in.	A Dimension		Coil Internal Volume	
		lbs.	(kg)		in.	(mm)	gal.	(l)
-109	1	450	(204)	2	42	(1067)	4.9	(18.6)
-112	1	470	(213)	2	42	(2083)	5.8	(22.0)
-139	2	505	(256)	2	82	(2083)	4.8	(18.2)
-174	2	605	(274)	2	82	(2083)	6.9	(26.2)
-225	2	685	(310)	2	82	(3099)	11.1	(42.2)
-260	3	826	(375)	2	122	(3099)	10.0	(37.8)
-310	3	886	(402)	2	122	(3099)	13.1	(50.0)
-350	3	946	(429)	2	122	(3099)	20.0	(75.6)
-466*	4	1280	(580)	2-1/2	162	(4115)	22.0	(83.3)

*Model not pictured

Table 15 Glycol Pump Data*

Pump		Pump Suction Connection in.	Pump Discharge Connection In.
h.p.	Hz		
3/4	60	1-1/4	3/4
1-1/2	60	1-1/4	3/4
2	60	1-1/4	3/4
3	60	1-1/2	1
5	60	1-1/2	1-1/4
CS3	60	1-1/4	3/4
CS5	60	1-1/4	3/4
1-1/2	50	1-1/4	3/4
2	50	1-1/4	3/4
3	50	1-1/2	1-1/4

*Connection sizes apply to primary pump supplier.

5.0 WATER COOLED MODELS

5.1 Piping

When the condenser water source is of poor quality, provide cleanable filters in the supply line. These filters trap water particles and extend the service life of the water cooled condenser. When required, the water cooled condenser may be cleaned by inserting a cleaning rod in the tubes or with an acid cleaner (depending on model ordered or room restrictions).

5.2 Water Regulating Valves

The water regulating valves automatically regulate the amount of fluid necessary to remove the heat from the refrigeration system, enabling more fluid to flow when load conditions are high and less fluid when load conditions are low.

The valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to refrigeration discharge pressure and adjusting screw.

The valves may be adjusted with a standard refrigeration service valve wrench or screw driver.

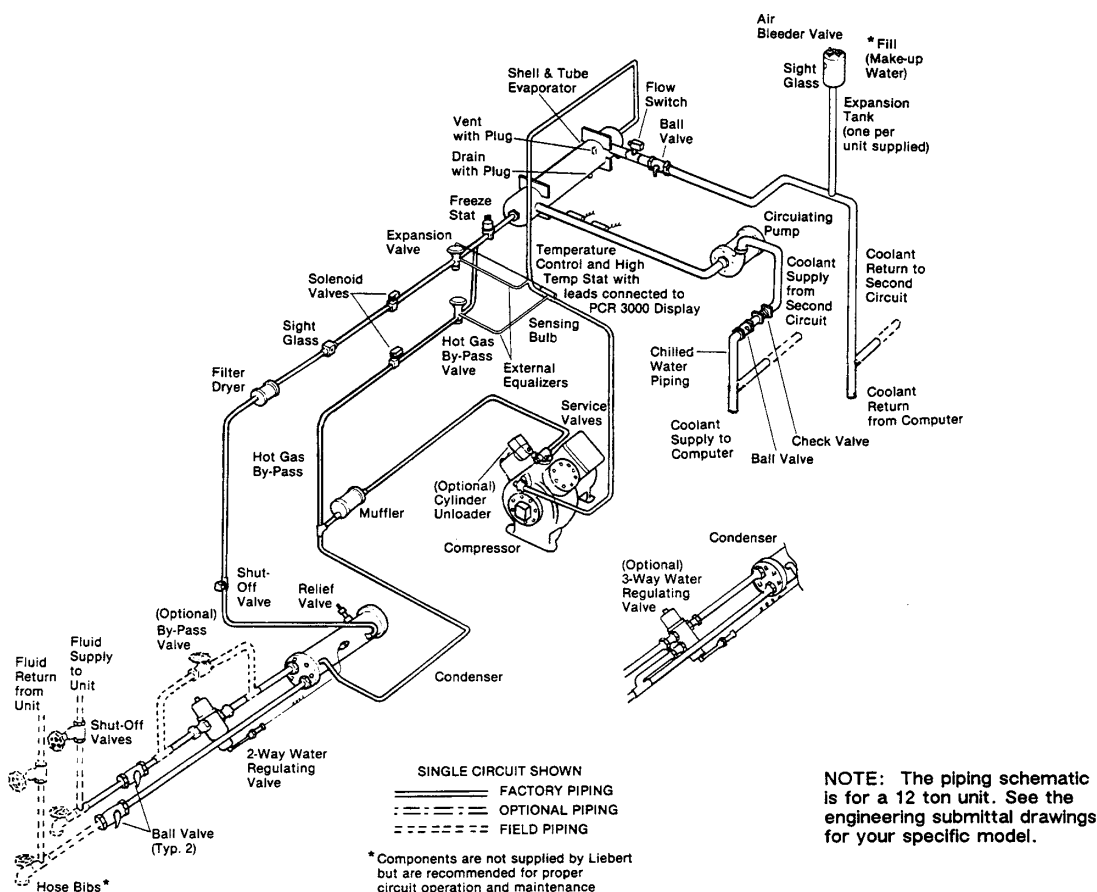
5.2.1 To Lower Head Pressure Setting

Turn the square adjusting screw clockwise until the high pressure gauge indicates the desired setting.

5.2.2 To Raise Head Pressure Setting

Turn adjusting screw counter-clockwise until desired setting is obtained.

Figure 13 Water Cooled General Arrangement Drawing



5.3 Alternate Water Source (7-1/2 – 12 Ton Capacity Models Only)

The (optional) Alternate Water Source Module replaces one of the refrigeration modules and permits the utilization of an existing chilled water system. The temperature control system and the chiller continue to monitor leaving water temperature and water flow. Automatic switchover to the refrigeration system is provided.

It is recommended that manual service shut-off valves be installed at the supply and return line to each unit. This permits routine service and emergency isolation of the unit.

To prevent condensation, supply and return lines to the AWS module must be insulated.

5.3.1 Operation

The AWS module control box contains three aquastats. The first is the low temp stat. It will shut the active module(s) down if there is a drop in the leaving water temperature. The second aquastat is the high temp stat which shuts down the module(s) if the temperature rises. The third aquastat is the temperature controller. If there is a rise in water temperature, the controller activates the proportioning valve actuator motor and permits the building chilled water to flow through the heat exchanger. As the water temperature drops the valve starts closing.

5.3.2 AWS 3000 Motorized Valve

The AWS 3000 utilizes a Proportioning motorized valve to activate the water valve. The temperature controller sets the water valve in accordance with the cooling needs of the heat exchanger.

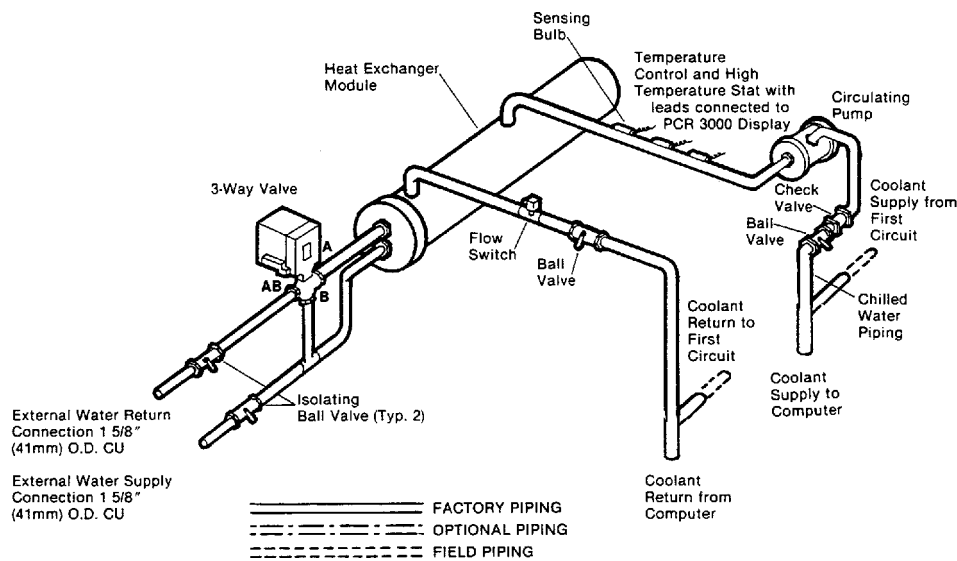
5.3.3 Motor Operation Check

Voltage at terminals 9 and 11 in the AWS module electric box should read 24 VAC. Turn the temperature controller counter-clockwise to open the valve, clockwise to close it.

Table 16 Standard Dual DX/Alternate Water Source Models

	Air	Water	Glycol
Standard Dual DX Model	CD 182A	CD 202W	CD 170G
	CD 218A	CD 242W	CD 204G
	CD 270A	CD 302W	CD 252G
Alternate Water Source Model	AS 181A	AS 201W	AS 169G
	AS 217A	AS 241W	AS 203G
	AS 269A	AS 301W	AS 251G

Figure 14 Alternate Water Source Module General Arrangement Drawing



6.0 COMPONENT ADJUSTMENT

6.1 Pressure Switches

The low pressure switch sets the minimum refrigerant pressure required to start the compressor (cut-in). It will also stop the compressor if refrigerant pressure drops below the cut-out setting. Therefore, the low pressure switch requires two settings: 1) cut-in and 2) differential (cut-in minus differential = cut-out). They should be set in accordance with the chart below.

The high pressure switch sets the maximum discharge pressure of the compressor. If pressure should rise to the set point, it will simultaneously shut down the compressor and activate the Sentinel 3000/Alarm Monitor (see Sentinel 3000/Alarm Monitor in the Operation and Maintenance Manual.) The high pressure switch should be set in accordance with the chart below.

Table 17 Pressure Switch Settings – p.s.i. (kPa)

Switch	Set Point	Differential
Low Pressure (CS/CD/CT)	65 (450)	12 (80)
Low Pressure (DS/DD)	65 (450)	10 (70)
High Pressure (All)	360 (2480)	—

6.2 Control Adjustments

The following sections describe the locations and individual adjustments of each of the control elements. For more information, consult the Operation and Maintenance Manual.

6.3 Aquastat Adjustment

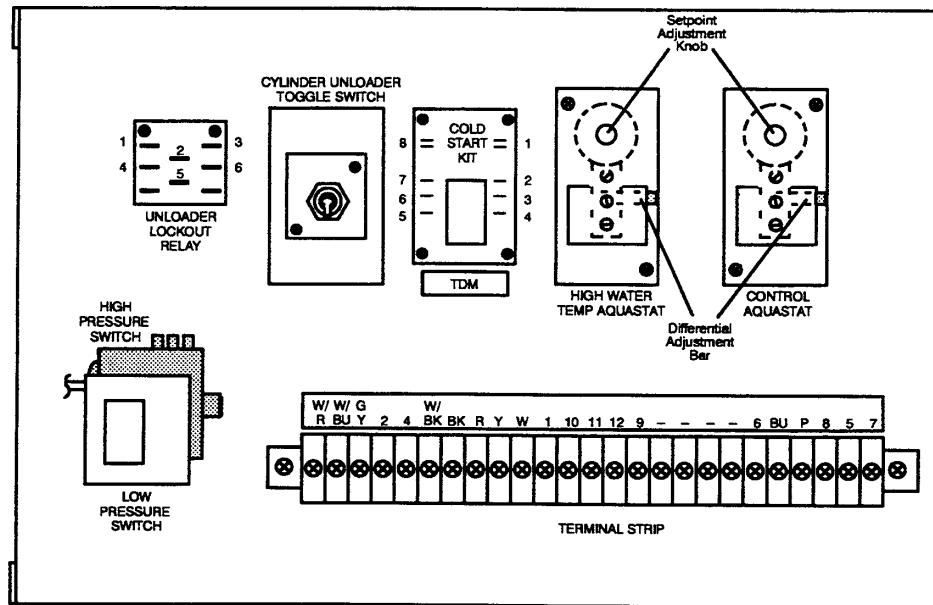
The control aquastats for each module are located in the module control box. Each aquastat can have two settings: 1) setpoint and 2) differential. The setpoint is the point at which the switch will close. The differential sets the temperature drop required to open the switch. The setpoint adjustment knob is visible through the aquastat cover. The cover must be removed, however, to set the differential. When provided, the differential adjustment bar is located on the lower right-hand side of the switch. See **Figure 15**.

Table 18 Recommended* Aquastat Settings – °F (°C)

Aquastat	Setpoint	Differential
Temp Control	52 (11.1)	3 (1.7)
High Water Temp	60 (15.6)	3 (1.7)

*Some applications may require different setpoints and differentials. Consult factory for assistance, if required.

Figure 15 Control Box (with Optional Unloader Components)



6.4 Capacity Selection Switches

Each module may be equipped with a dual or triple capacity toggle switch that will reduce the cooling capacity of the unit from the full rated capacity. For example, on a 5 ton unit the capacity can be changed to 2-1/2 tons by changing the capacity selector switch.

Consult your submittal specifications to determine if your unit has this feature. It is standard on 5 ton units and may be optional on others. The following table shows the various options.

Table 19 Capacity Selection Switch Options

Tonnage	Capacity Levels
5	2
7-1/2	1 or 2
10 – 30	1, 2 or 3
37	1

On 5 ton models the switches are located on the right side of the PCR 3000 monitor panel. They are marked Module 1 and Module 2. On all other units the switches are located in the module control box. On units that have one cylinder unloader per module, each toggle switch position is marked High Capacity and Low Capacity. On units that have two cylinder unloaders per module, the switch positions are marked High Capacity, Medium Capacity and Low Capacity. The capacity of each module may be selected independently but to provide for switchover in the event of a failure of the lead module(s), it is necessary to select the same capacity for each module.

6.5 Cylinder Unloader

The capacity increase is accomplished by de-energizing cylinder unloader(s) on the heads of each compressor. When the cylinder unloader is activated, the effective capacity of the compressor is reduced to approximately 1/2, 1/3 or 2/3 depending on model and selector switch settings. Deactivating the unloader(s) returns the compressor to full capacity.

6.6 Thermostatic Expansion Valve

6.6.1 Operation

The thermostatic expansion valve performs one function. It keeps the evaporator supplied with enough refrigerant to satisfy load conditions. It does not effect compressor operation. Proper valve operation can be determined by measuring superheat. If too little refrigerant is being fed to the evaporator, the superheat will be high; if too much refrigerant is being supplied, the superheat will be low. The correct superheat setting is between 10 and 13°F (5.6 to 7.2°C) differential.

6.6.2 Adjustment

To determine superheat:

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the gauge pressure at the compressor suction valve.
3. Add the estimated pressure drop between the bulb location and the suction valve.
4. Convert the sum of the two pressures to the equivalent temperature.
5. Subtract this temperature from the actual suction line temperature. The difference is superheat.

To adjust the superheat setting, proceed as follows:

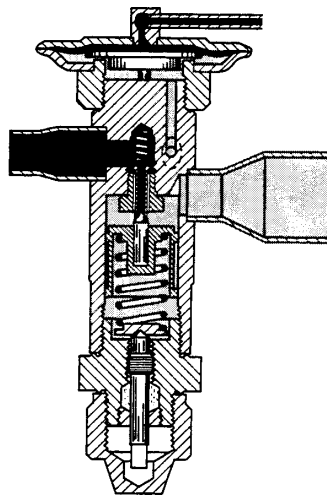
1. Remove the valve cap at the bottom of the valve.
2. Turn the adjusting stem counter-clockwise to lower the superheat.
3. Turn the adjusting stem clockwise to increase the superheat.



NOTE

Make no more than one turn of the stem at a time. As long as thirty minutes may be required for the new balance to take place.

Figure 16 Typical Valve Cross Section



6.7 Hot Gas Bypass Valve

6.7.1 Operation

The hot gas bypass is inserted between the compressor discharge line and the outlet side of the expansion valve.

When the system is operating at full capacity, the valve remains closed. If the load on the evaporator decreases and evaporator temperature falls below the set temperature, the internal evaporator pressure decreases. When this happens, discharge gas pressure will overcome valve spring

pressure and some hot gas will mix with the liquid discharge of the expansion valve, increasing evaporator temperature and pressure and closing the hot gas bypass valve.

The leaving water temperature requirement will determine the hot gas bypass valve setting as well as the compressor suction gauge pressure.

6.7.2 Adjustment

After calculating the desired leaving water temperature, the following procedure should be used to adjust the hot gas bypass valve:

1. Install suction and discharge pressure gauges on the compressor to monitor refrigeration.
2. Set the capacity selector switch if it is provided.
3. Set the control thermostat; labeled 1CS and 2CS (and 3CS on 20 and 30 ton units) on the schematic at 3°F (1.7°C) below required leaving water temperature. Measure the leaving water temperature by strapping a thermometer to the leaving water header.



NOTE

Compressor and/or cylinder unloader(s) should not cycle off and on to match the constant computer load. Each circuit should be adjusted independently.

4. Adjust the hot gas solenoid valve to maintain the proper leaving water temperature.
 - a. Remove the TOP adjusting nut from the valve.
 - b. Insert an Allen wrench in the brass hole, at the top of the valve in the adjusting port and turn CLOCKWISE if a HIGHER leaving water temperature is required and counterclockwise if a lower leaving water temperature is required.
 - c. After obtaining the leaving water temperature required, reinstall the adjusting nut tightly on the valve making sure that there are no leaks.
 - d. Let the system operate for approximately 10 to 15 minutes to make sure that the suction pressure is within the range desired (longer if ride-through storage tank is used).

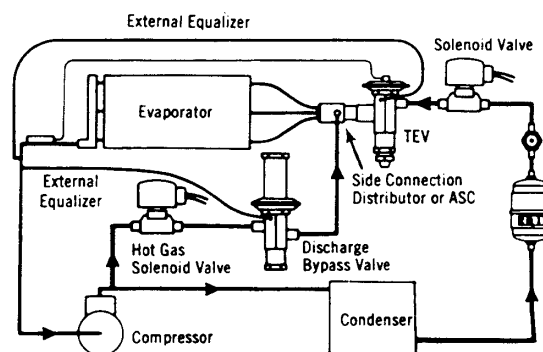


NOTE

There is a fluctuation of 3 to 6 lbs. of the suction pressure due to the differential on the hot gas bypass.

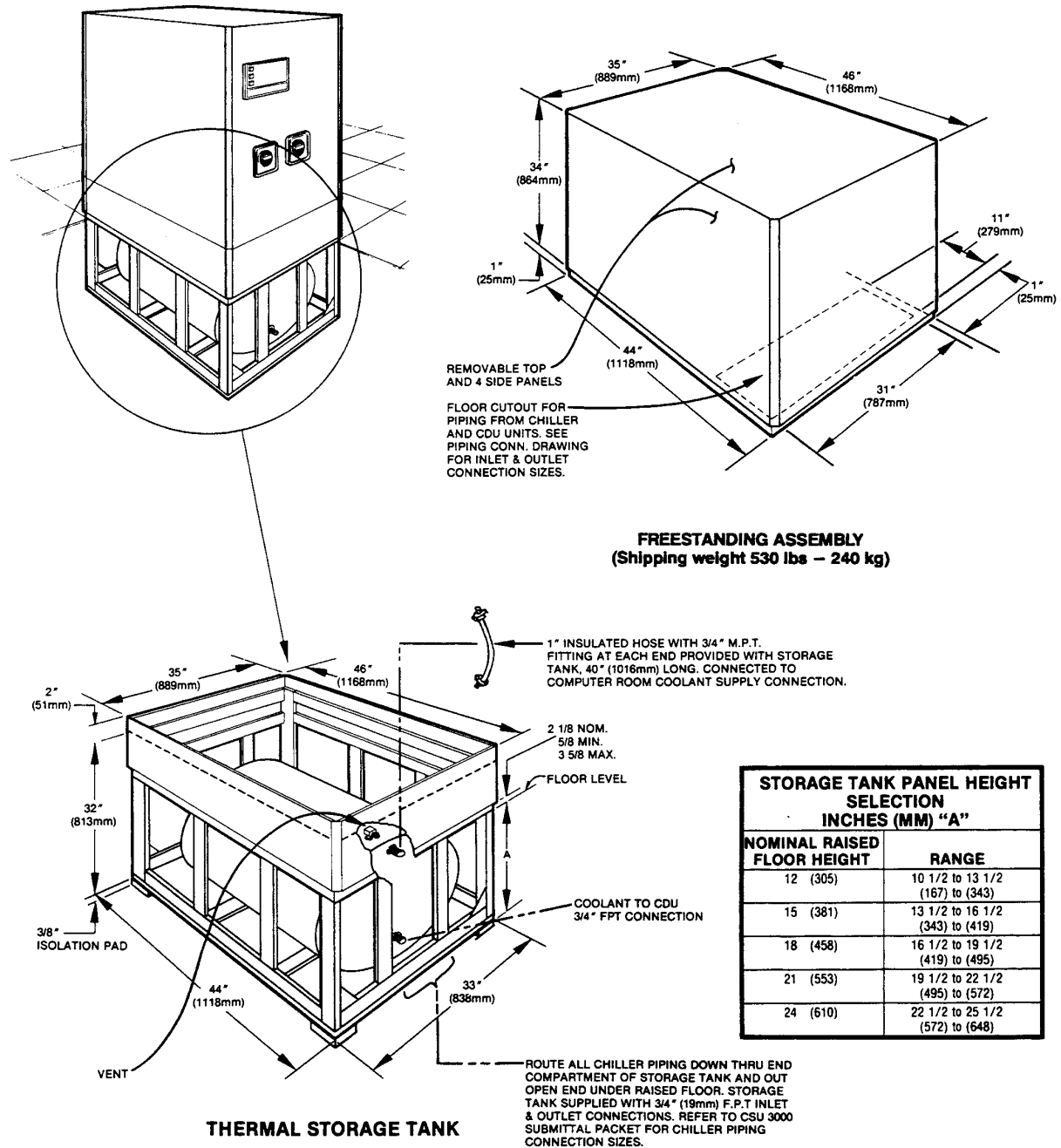
5. Re-adjust the control thermostat to the required leaving water temperature, typically 52°F (11.1°C).

Figure 17 Hot Gas Bypass



7.0 APPENDIX A – RIDE-THROUGH STORAGE TANK DATA

Figure 18 Ride-Through Storage Tank Data



NOTE: Ride-Thru Storage Tank capacity is 75 gallons (283.9 liters).



NOTE

Refer to 9.0 - Appendix C – Expansion Tank for expansion tank requirements

8.0 APPENDIX B – COOLANT CONNECTION OPTIONS

8.1 ES9000 Connection Kits (for IBM¹ ES/9000² Mainframes)

8.1.1 ES9000 Single Unit Header Kit

This kit is required for all 7-1/2 – 37 ton models using ES series Hose Kits or Coupling Pair Kit. The ES9000 Header Kit consists of 2 underfloor headers (one for supply and one for return) that sweat connect to the 2-1/8" O.D. copper connections on the chiller. Cut each header to required length. Each header provides two 2" M.N.P.T. underfloor connections for the optional ES series Hose Kits or ES9000 Coupling Pair Kit.

8.1.2 ES230/260 and ES430/460 Hose Kits

All hoses are 1-1/2" I.D. insulated hose with a 2" M.N.P.T. connection on one end of each hose and a 2" F.N.P.T. connection on the other end. The ES230 Hose Kit includes 2 hoses 30 ft. (9m) in length. The ES430 Hose Kit includes 4 hoses 30 ft. (9 m) in length. The ES260 and ES460 Hose Kits include 2 or 4, respectively, hoses 60 ft. (18 m) in length. Check with the computer installation instructions for the number of hoses required.

The 2" F.N.P.T. coupling on one end of each hose connects to the 2" M.N.P.T. fitting on the ES9000 Single Unit Header Kit. Use a commercial grade type sealant on all threaded fittings.

The 2" M.N.P.T. fitting at the other end of each hose connects to the ES9000 Coupling Pair Kit that provides suitable connections to the IBM ES9000 series Coolant Distribution Unit (CDU).

8.1.3 ES9000 Coupling Pair Kit

The ES9000 Coupling Pair Kit includes IBM specified 2" male and female coupling assemblies. Each coupling assembly includes a 2" ball valve and a 1/4" drain valve. These assemblies thread directly, using 2" F.N.P.T. connections, to the ES series hose kits, the ES9000 Single Unit Header Kit, or field supplied piping. The IBM specified 2" couplings quick-connect to the companion fittings on the Coolant Distribution Unit (CDU).

8.2 RR Connection Kits (for IBM 3090³ and Earlier Mainframes)

8.2.1 RR4.75 Single Unit Header Kit

This kit (or RR830) is required for all 7-1/2 – 37 ton models using RR series Hose Kits. The RR4.75 Single Unit Header Kit includes two underfloor headers (one for supply and one for return) that sweat connect to the 2-1/8" O.D. copper connections on the chiller. Cut each header to required length. Each header provides four 3/4" F.N.P.T. connections for the optional RR series Hose Kits.

8.2.2 RR830 Underfloor Header Kit

The RR830 Underfloor Header Kit is designed for the connection of two chillers to two CDUS.

The RR830 kit consists of two header assemblies (one for supply and one for return). Each header provides two 2-1/8" O.D. copper connections for hard piping to each chiller header.

Each RR830 header provides four 3/4" F.N.P.T. connections for the optional RR series Hose Kits.

8.2.3 RR230/260 and RR430/460 Hose Kits

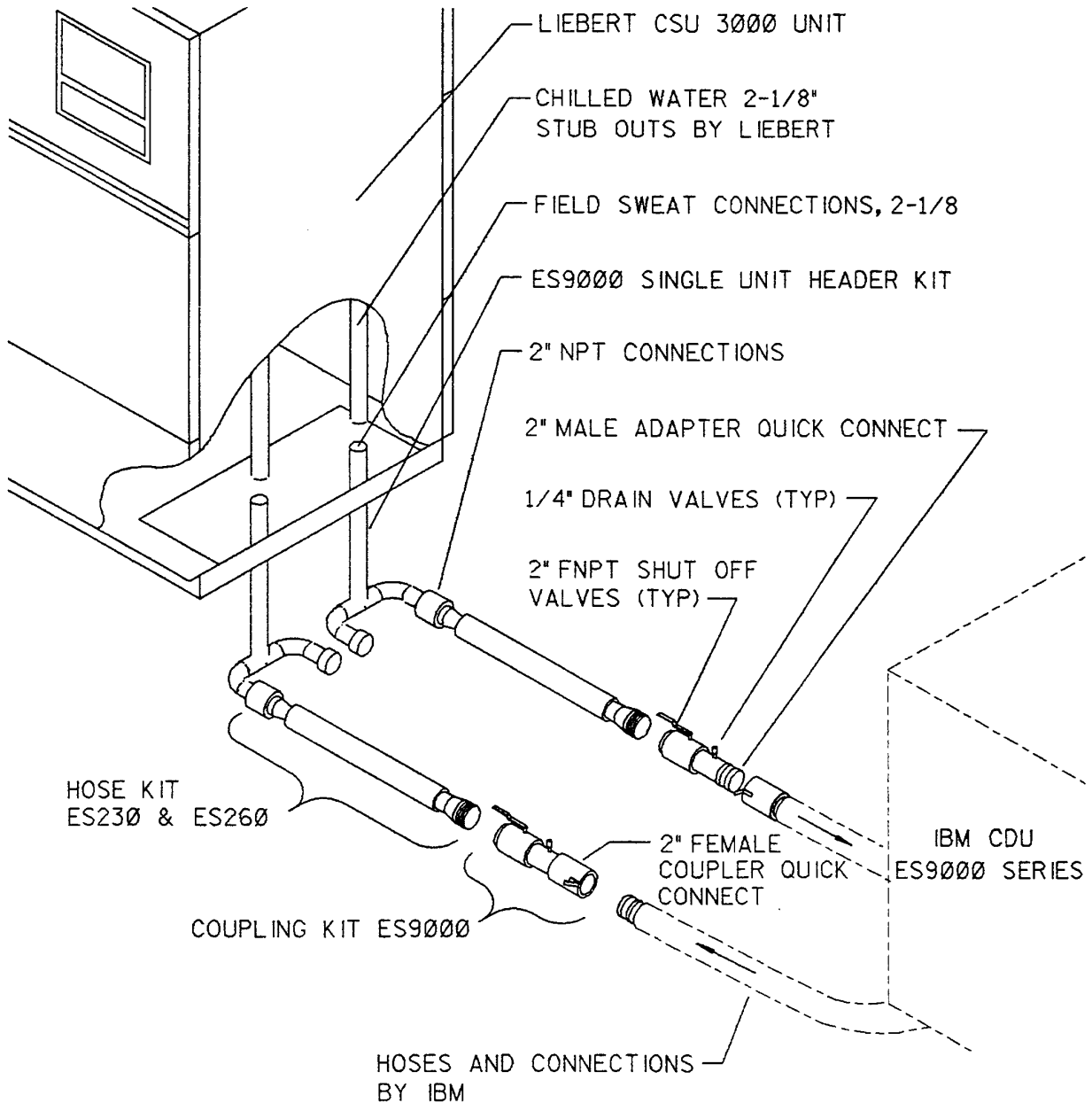
All hoses are 1" I.D. insulated hose. The RR230 Hose Kit consists of two hoses, 30 ft. (9 m) in length. The RR430 Hose Kit consists of four hoses 30 ft. (9 m) in length. RR260 and RR460 Hose Kits are 60 ft. (18 m) in length. Check with the computer installation instructions for the number of hoses required. Fittings for connections to the chiller supply and return lines are provided in 5 ton units, and on the RR4.75 or RR830 Header Kits for 7-1/2 – 37 ton units.

1. IBM is a trademark of International Business Machines Corporation
2. IBM ES/9000 is a trademark of International Business Machines Corporation
3. IBM 3090 is a trademark of International Business Machines Corporation

Remove the factory-installed plugs from each connection and install the NPT/hose fittings from one end of each hose.

At the other end of each hose is a quick-connect fitting that connects directly to the coolant distribution unit (CDU). The hose can be cut to length and clamped over a barbed hose fitting installed in the chiller supply and return connections or headers (optional). Make certain that the supply hoses to each CDU are connected to the supply header and that the return hoses to each CDU are connected to the return header.

Figure 19 Optional ES Series Connection Kits



NOTE:

1. TWO HOSE KIT SHOWN (1 SUPPLY, 1 RETURN)
 ES9000 HEADER KIT , SUITABLE FOR
 4 HOSE KIT ES430, ES460 (2 SUPPLY, 2 RETURN)

Figure 20 Optional RR4.75 Single Unit Header Kit

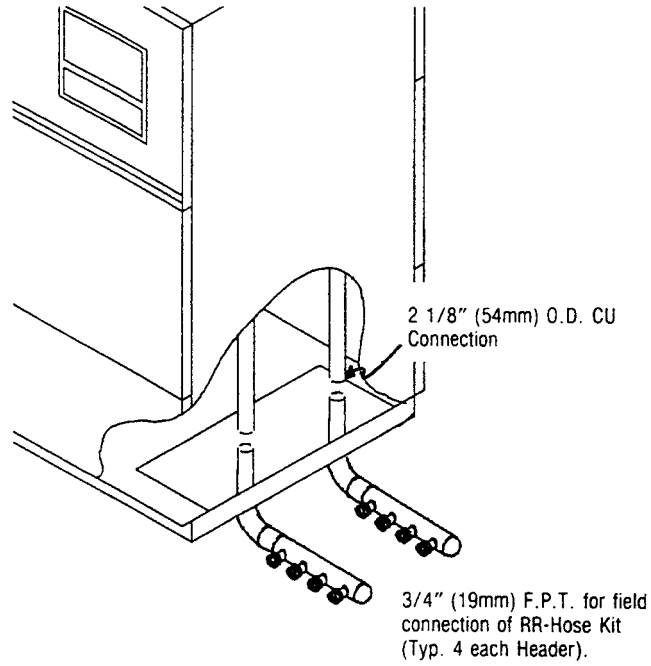


Figure 21 Optional RR830 Underfloor Header Kit

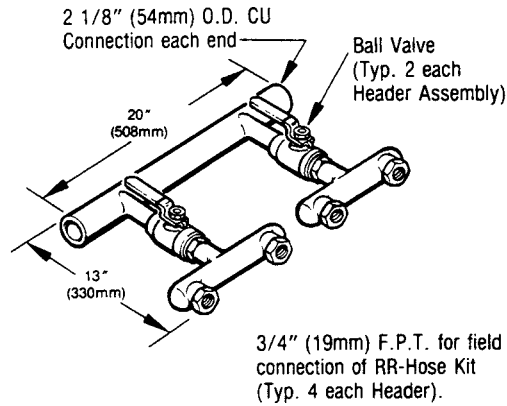
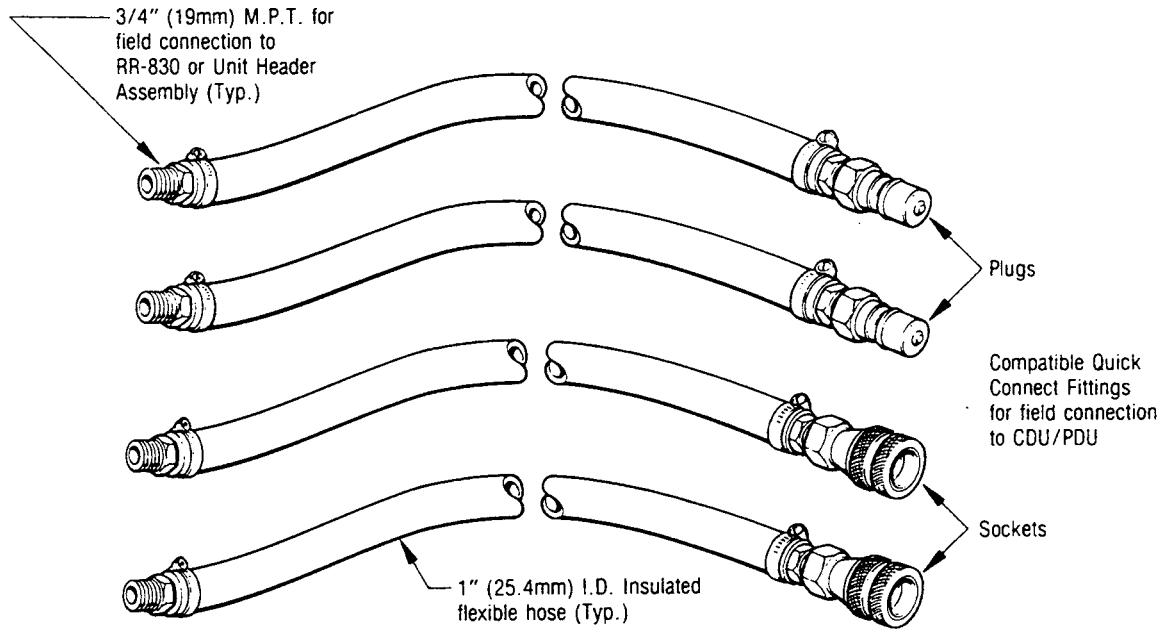


Figure A Optional RR Series Hose Kits



9.0 APPENDIX C – EXPANSION TANK

For any system that includes a ride-thru thermal storage tank or a long piping run (more than 22 gallons), a customer supplied, field installed expansion tank is necessary.



CAUTION

An expansion tank is required for these systems to prevent excessive pressure in the coolant system during thermal expansion.

Currently two types of expansion tanks are factory installed in the unit. These tanks are not large enough to handle the large piping/tank volumes. Some chillers currently have a plain copper tank installed. On these systems the additional expansion tank must be located the high point in the system to allow for air venting.

A selection table is shown below for various system volumes. The tanks were selected based on a worst case expansion of 40°F fill, and a maximum coolant temperature of 100°F. These tanks have the required total volume and raised (bladder) volume. Amtrol tank models are shown, though a comparable vendor may be used. Refer to manufacturers instructions for installation and maintenance.

Table 20 Various System Volumes

Tank and Piping Volume (Gallons)	Amtrol Expansion Tank Model	
	Water	40% Glycol
50	ST-5	ST-12
100	ST-12	ST-25V
200	ST-25V	ST-30V
500	ST-42V	ST-60V
1000	ST-80V	ST-180V

On larger chillers, a small bladder-type tank is factory installed. On these systems, the additional expansion tank must be installed at the CSU3000 fill header.

Please call your Liebert supplier if you require assistance.

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