CHILLBATCH
Batchwater Chillers

AC2003-6007

USER MANUAL

Air Cooled
Greywater Chiller

www.amgeo.com

AMERICAN GEOTHERMAL

MADE IN U.S.A.

General System Info

MODEL NUMBER:
SERIAL NUMBER:
JOB NUMBER:

TONS	20	30	40	50	60
MODEL	AC2003T	AC3005T	AC4005T	AC5007T	AC6007T
SYSTEM VOLTAGE					
Nominal	460 VAC	460 VAC	460 VAC	460 VAC	460 VAC
Range	414-506	414-506	414-506	414-506	414-506
FREQUENCY	60 HZ	60 HZ	60 HZ	60 HZ	60 HZ
PHASE	3 PH	3 PH	3 PH	3 PH	3 PH
MIN CIRCUIT AMPACITY	50 AMP	69 AMP	95 AMP	111 AMP	130 AMP
MAX DUAL ELEMENT FUSE	60 AMP	80 AMP	100 AMP	125 AMP	150 AMP
LOCKED ROTOR AMPACITY	168.2	234	211	242.4	293.3
SERVICE FACTOR	10%	10%	10%	10%	10%
CONTROL VOLTAGE					
Contactor	120 VAC	120 VAC	120 VAC	120 VAC	120 VAC
Controller	24 VAC	24 VAC	24 VAC	24 VAC	24 VAC
MIN WATER TEMPERATURE	35°	35°	35°	35°	35°
410A REFRIGERANT					
Each Circuit	10 lbs.	14 lbs.	23 lbs.	32 lbs.	21 lbs.
Total Max Charge	28 lbs.	28 lbs.	46 lbs.	64 lbs.	42 lbs.

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UNAUTHORIZED SERVICE WILL VOID WARRANTY

American Geothermal • 1037 Old Salem Rd. • Murfreesboro, TN 37129 • 615-890-6985 • F: 615-890-6926 • www.amgeo.com

WARNING

PROPER PHASING OF THE ELECTRICAL POWER IS CRITICAL FOR CORRECT OPERATION OF THIS EQUIPMENT.

DRAIN UNIT AND ALL LINES PRIOR TO STORAGE

UNAUTHORIZED SERVICE WILL VOID WARRANTY

Sequence of Operation

1. 480 VAC power turned on with system switches (outside of cabinet) in “off” position. Thermostats need to be powered; this will allow the crankcase heaters to warm up the oil in the bottom of the compressors. **12 hours minimum required.**
2. Verify that the water valves on the circulating line are open and there is a minimum of 4’ of water in the storage tank.
3. After the compressors are hot, turn on the outside system switches. The water pump should start producing water pressure of about 30 psi. This should close the flow switch, lighting the small green light on the outside of cabinet.
4. When the thermostat reaches 4ºF above the set point (system switch is in the cooling position) the circulating pump will start. The pressure will close the flow switch, and light the green light. The compressors will start sequencing in when the 5 minute timers have timed out.

   NOTE: If system is running on a generator or power needs to be shut off, turn the system off BEFORE shutting off the power source. Failure to do this could cause faults and other issues with the unit.

20–30 Ton Chillers

When the ambient temperature reaches 80°F the fans will start to come on line. If the ambient temperature drops below 80°F, one fan could shut down on each refrigerant circuit. When the thermostat reaches the set point, the pump will shut down; opening the flow switch and closing the liquid line solenoid causing the compressor to pump down. When the refrigerant on the low side reaches 58 psi the compressors will shut down waiting for the next thermostat call.

40-60 Ton Chillers

When the refrigerant pressure reaches 444 psi the fans will start to come on line. If the pressure drops to 255 psi then one fan might shut down on each refrigerant circuit. When the thermostat reaches the set point, then the pump will shut down, opening the flow switch, closing the liquid line solenoid causing the compressor to pump down. When the refrigerant on the low side reaches 78 psi the compressors will shut down waiting for the next thermostat call.

Preventive Maintenance on Chillers

- Clean coils as required (air)
- Clean coils as required (water, if poor or high mineral content)
- Check and tighten all electrical connections looking for corrosion or heating of wire or jacket
- Check contacts on compressor contactors on 6 month schedule

Motors & Compressors

- Check and clean condensing fan blades
- Check refrigeration charge and superheat on 6 month schedule
- Check refrigeration line for vibration, chaffing or signs of oil leaking
- Check default and operating lights for bulb failure
- Use megohmeters test in compressors and fans to see if failure can be predicted

FREEZE PROTECTION

To prevent water lines and coils from freezing unit must be drained

If equipped with heat tape:

- The separate 120 vac breaker must be turned on or a power cord must be plugged in to the heat tape plug on the smaller unit.
- The heat tape is wrapped around water lines and inside boxes where coils are located
- Heat tape is of self - regulating type.

If unit to be shut down and transported to freezing conditions:

- Antifreeze of correct strength should be added to the water circuit of the unit
- The plug on the pump **must** be removed to protect the pump

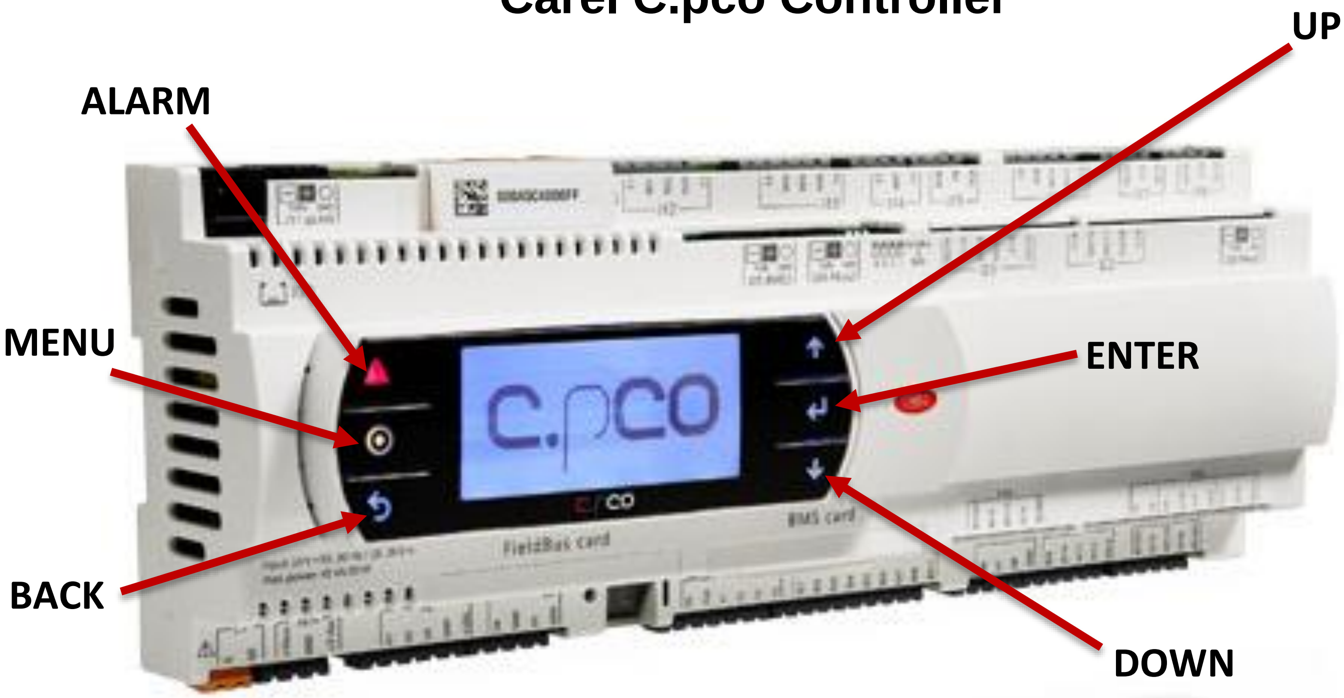
Chiller Start Up

Before starting the chiller the following steps should be completed.

Before turning the system switch to the on position, follow the directions as given.

1. Put main line power to the chiller (460V). Controller should power up and screen should be on.
2. The chiller should sit for 24 hours. This is very important; the oil inside compressors must be warmed before starting. (If this is not done damage to compressors may occur.)

Carel C.pco Controller



The C.pco controller is responsible for controlling fluid temperatures & fluid pressures. If a fault should occur, the system will shut down and the screen will flash with possible issues and solutions. Navigate through the screens of the C.pco by pressing the UP and DOWN arrow keys located on the keypad to the right of the screen. By pressing the BACK key, the controller will default to the main screen. Refer to the diagram above.

Basic navigation is controlled using the UP and DOWN button on the controller. After cycling through all pages the user will be returned to the Home Page. To access the menu options press the MENU button. This is used to set additional setpoints and internal system settings. Pressing the ALARM button will take the user to the alarm display screen.

The following pages describe specific functionality of individual screens within the controller.

C.pco User Interface Pages

Home Page:

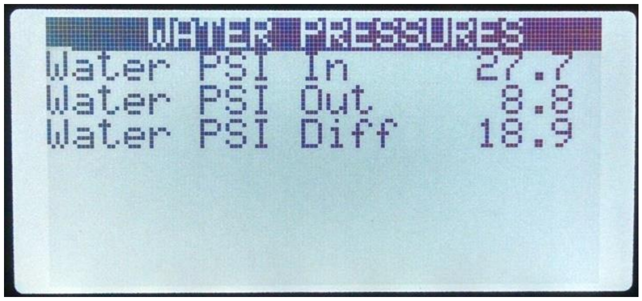
The Home Page is the default screen for the controller. After initial startup, this will be the first page displayed. At any point while navigating throughout the interface the user may press the BACK button to access this page.

From this screen the user can view the current Tank Temperature, Tank Temperature Setpoint (SP), and Ambient Temperature. The tank temperature setpoint can be adjusted by pressing ENTER, using the up and down arrows to adjust the value, and pressing ENTER again to save the changes. Additionally, there are two indicators at the bottom of the page that show whether each circuit (Ckt) is on or off.

Water Temperature:

The Water Temperature page displays info regarding inlet and out water temperature as well as staging conditions. As the water leaving the chiller gets colder, the unit will begin to turn off stages that are no longer necessary. Staging setpoints can be adjusted from the Water Temp Setpoints page in the password protected Manual Setpoints menu item. These setpoints should only be changed after consulting American Geothermal. 615-890-6985.

Water Pressures:



The Water Pressures page shows information about the inlet water pressure, outlet water pressure, and the differential pressure between the inlet and outlet.

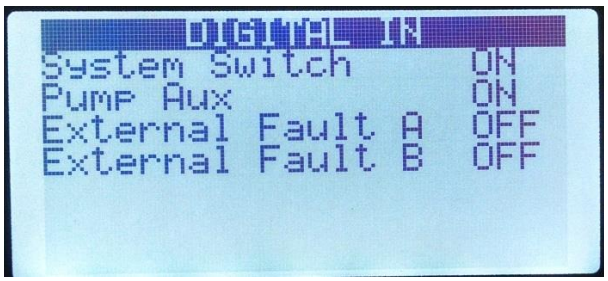
Circuit A/B Info:

The Circuit A and Circuit B Info pages display information about each inidividual circuit. This data is very important for service and is a good indicator of how effectively the system is operatinig. For for systems without electronic expansion valves, these screens will appear as they do above. For systems that include electronic expansion valves, these pages will show additional information such as super heat, suction temperature, and expansion valve position.

Relay Out:

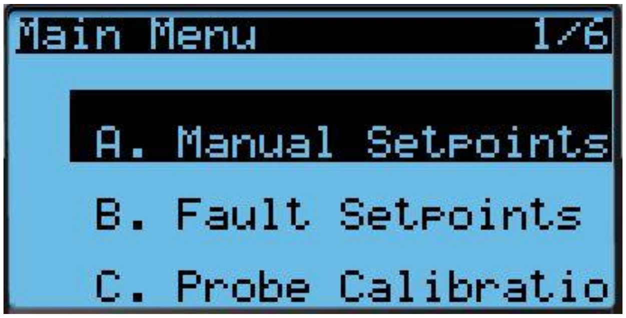
The Relay Out page shows which relays are closed or open on the controller. The relays enable or disable external systems such as pumps, compressor staging, fans, fault lights and dilution valves. “ON” indicates that the controller is calling for an action.

Digital In:



The Digital In page shows which digital inputs are receiving a signal from and external system. “ON” indicates that the input is receiving a signal.

Main Menu:



The Main Menu is accessed by pressing the MENU button. Each of the menu items contains setpoints and settings to customize system operation. Each item is password protected for the user's safety. Changing some settings incorrectly can cause the unit to run incorrectly and even cause serious damage. Any damage cuased to the system due to unauthorized changing of internal settings will void the system warranty. To exit the Main Menu press the BACK button.

CONTACT AMERICAN GEOTHERMAL (615) 890-6985 BEFORE ATTEMPTING TO ACCESS ANY OF THE MENU ITEMS!

Faults:

Pressing the ALARM button will bring the user to the fault screen. Any alarms or faults will appear on this screen. The number of current faults is indicated by the number in the top right hand corner of the screen. Any fault may be reset once its condition is clear and the reset the switch is activated. The reset switch is a small toggle switch inside of the electrical panel located to left of the controller. Contact American Geothermal for any additional assistance with faults or alarms.

DRAWN BY:	DRAWING NUMBER:	REV DATE:
BICKFORD S.	AC-PAN-41c	01282016
UNIT SERIES	REVISION:	SHEET: SHEET 1 OF 1

20-60 Ton Chiller (Carel)

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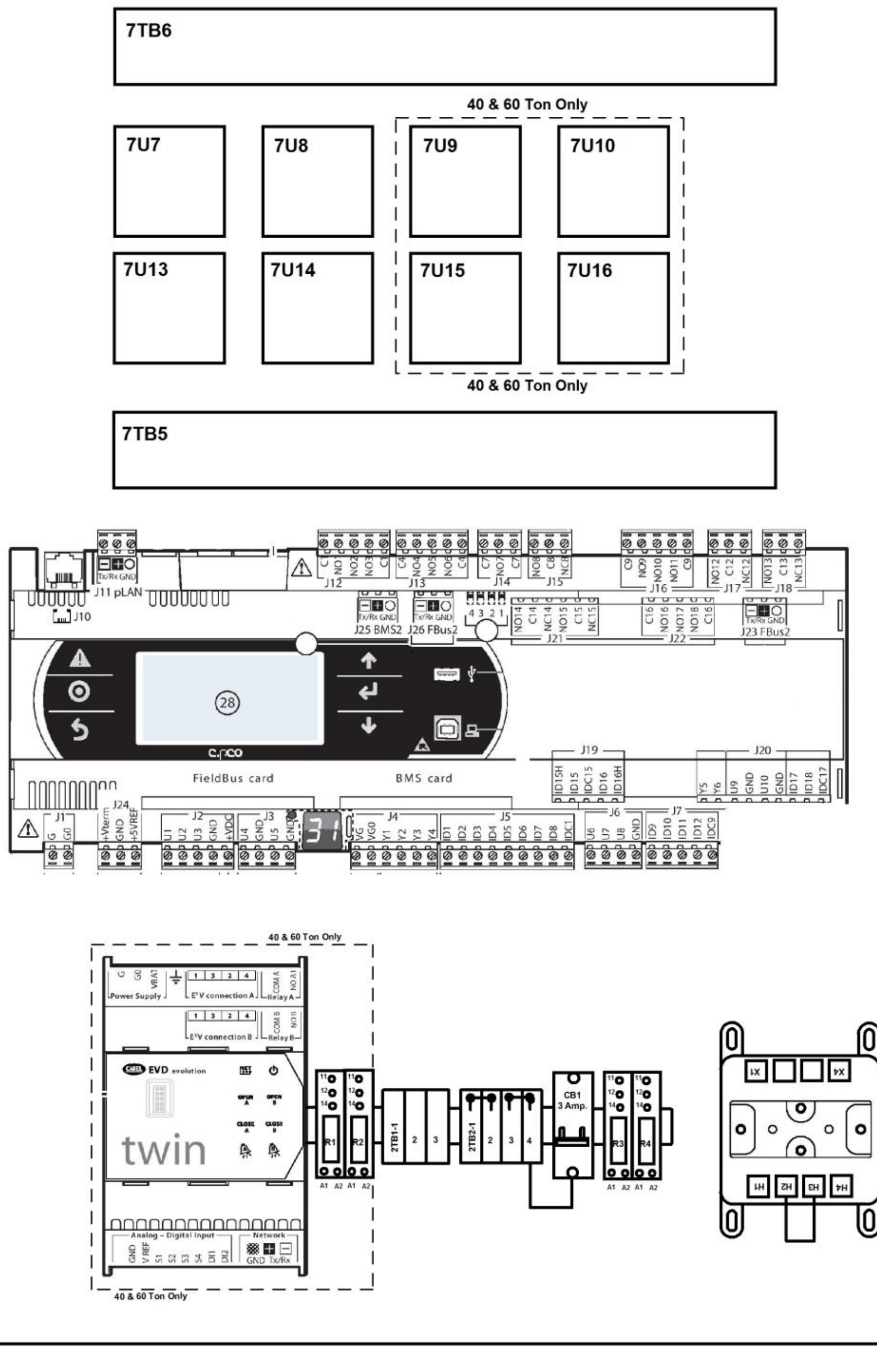

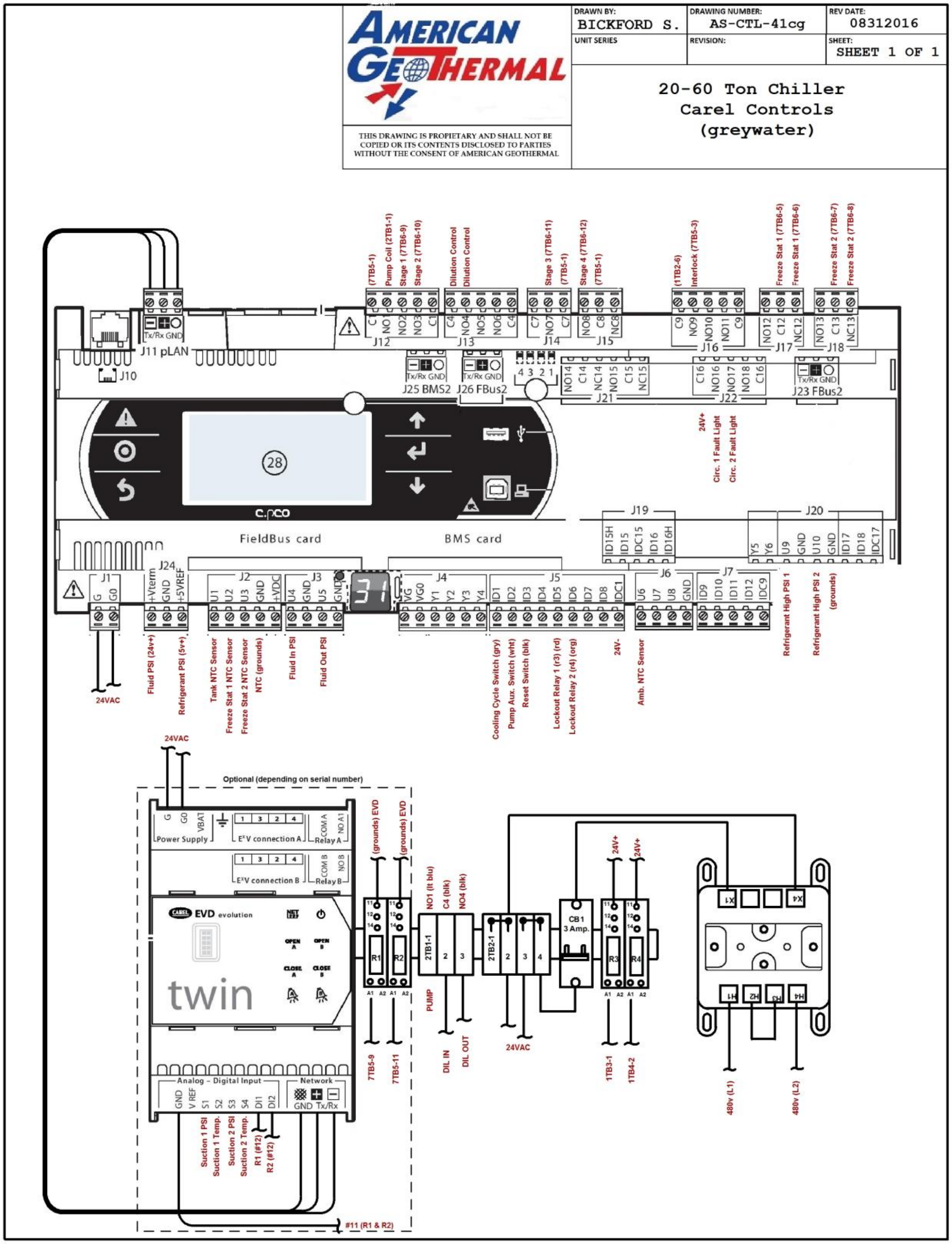

DRAWN BY: BICKFORD S.
DRAWING NUMBER: AS-CTL-41cg
REV DATE: 08312016
UNIT SERIES
REVISION:
SHEET: SHEET 1 OF 1
AMERICAN GEOTHERMAL
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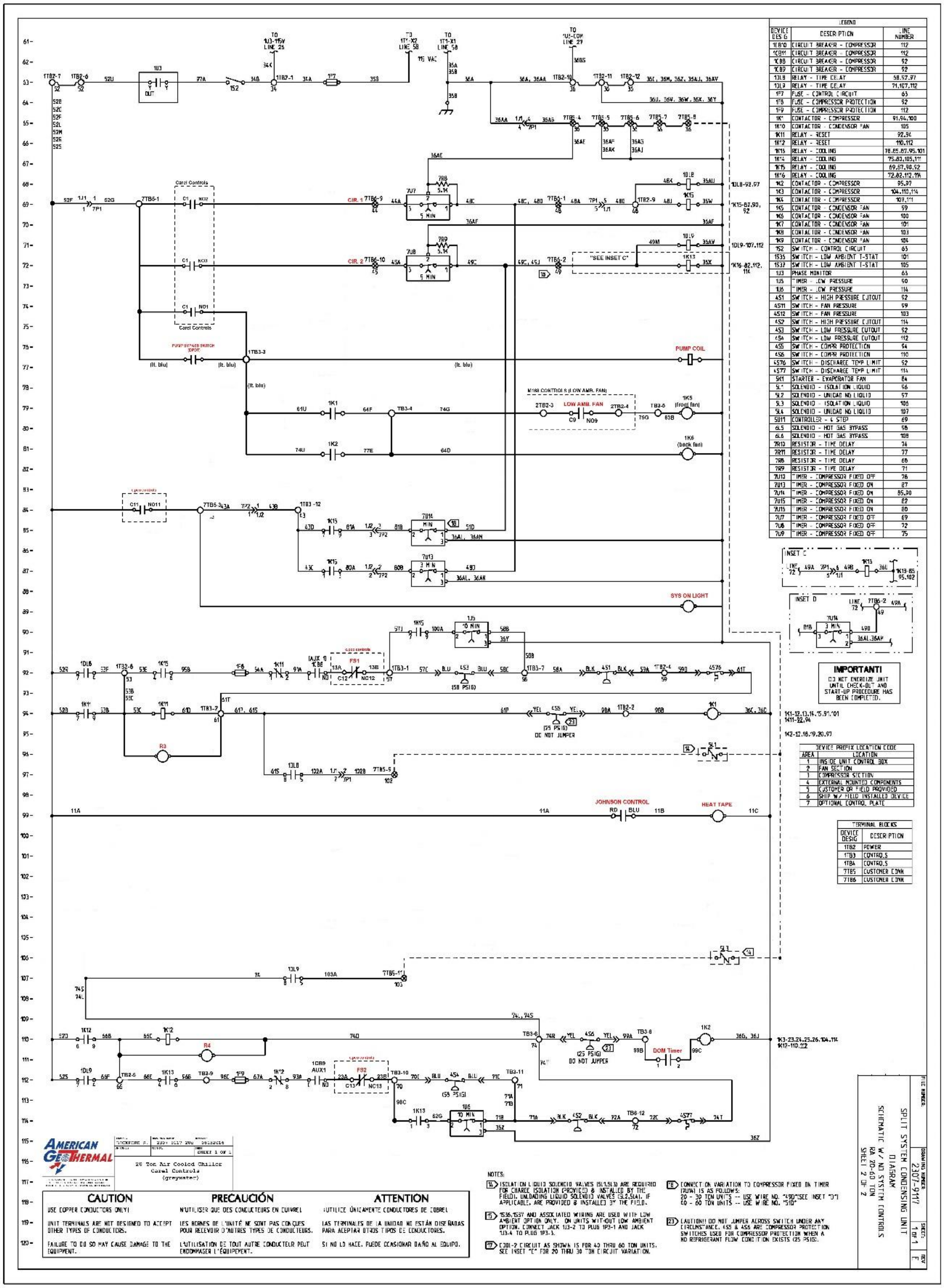
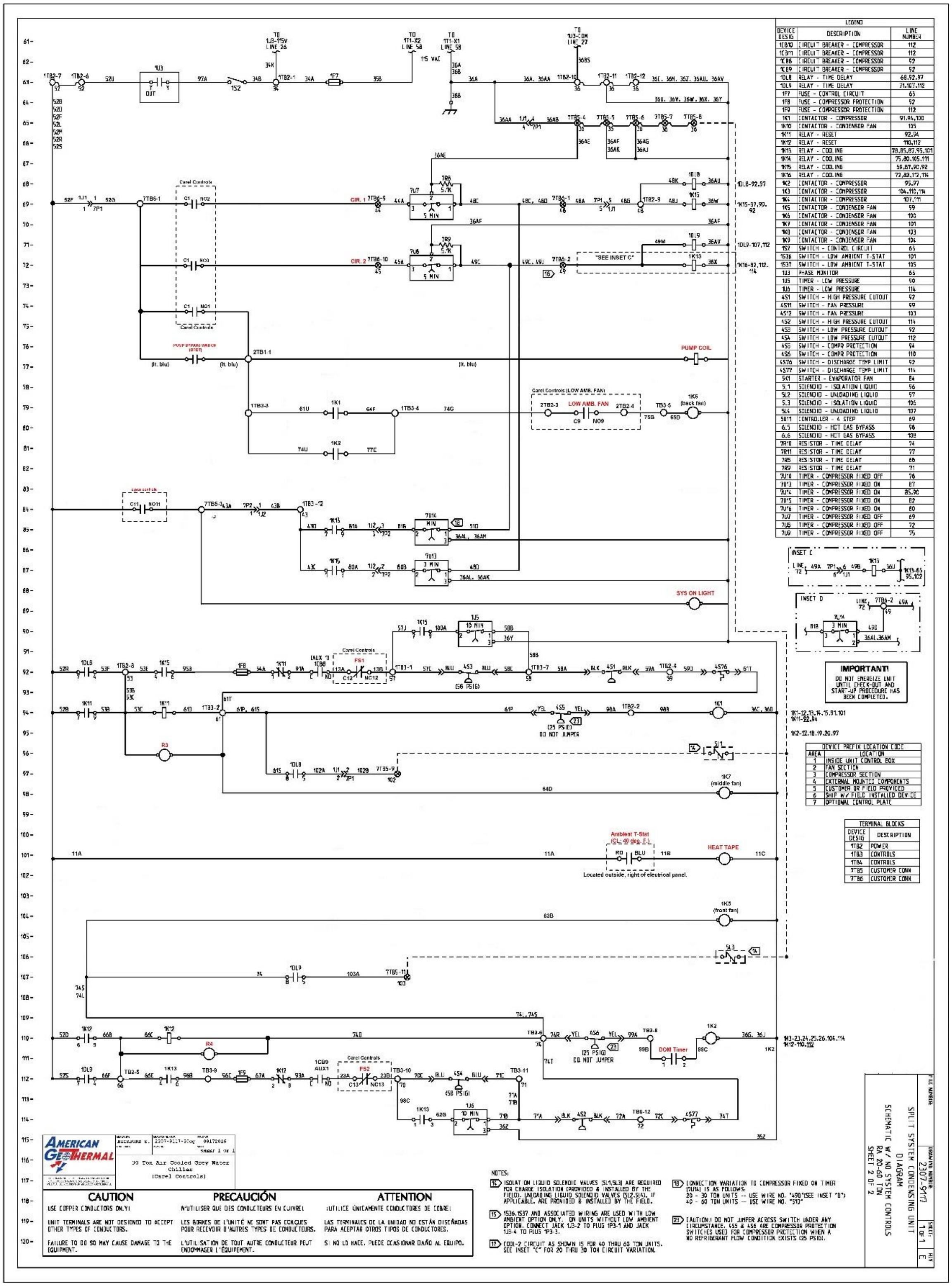
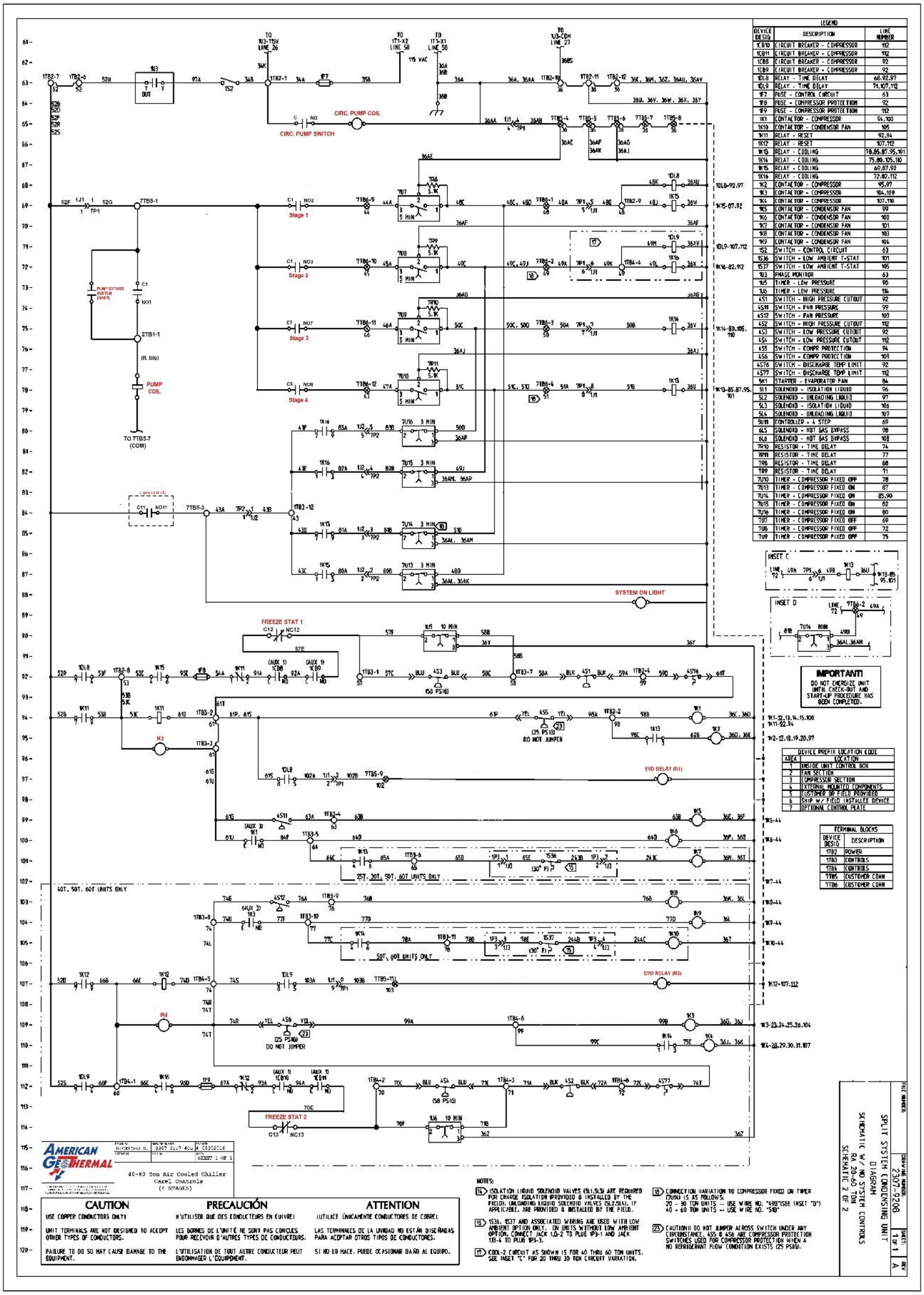
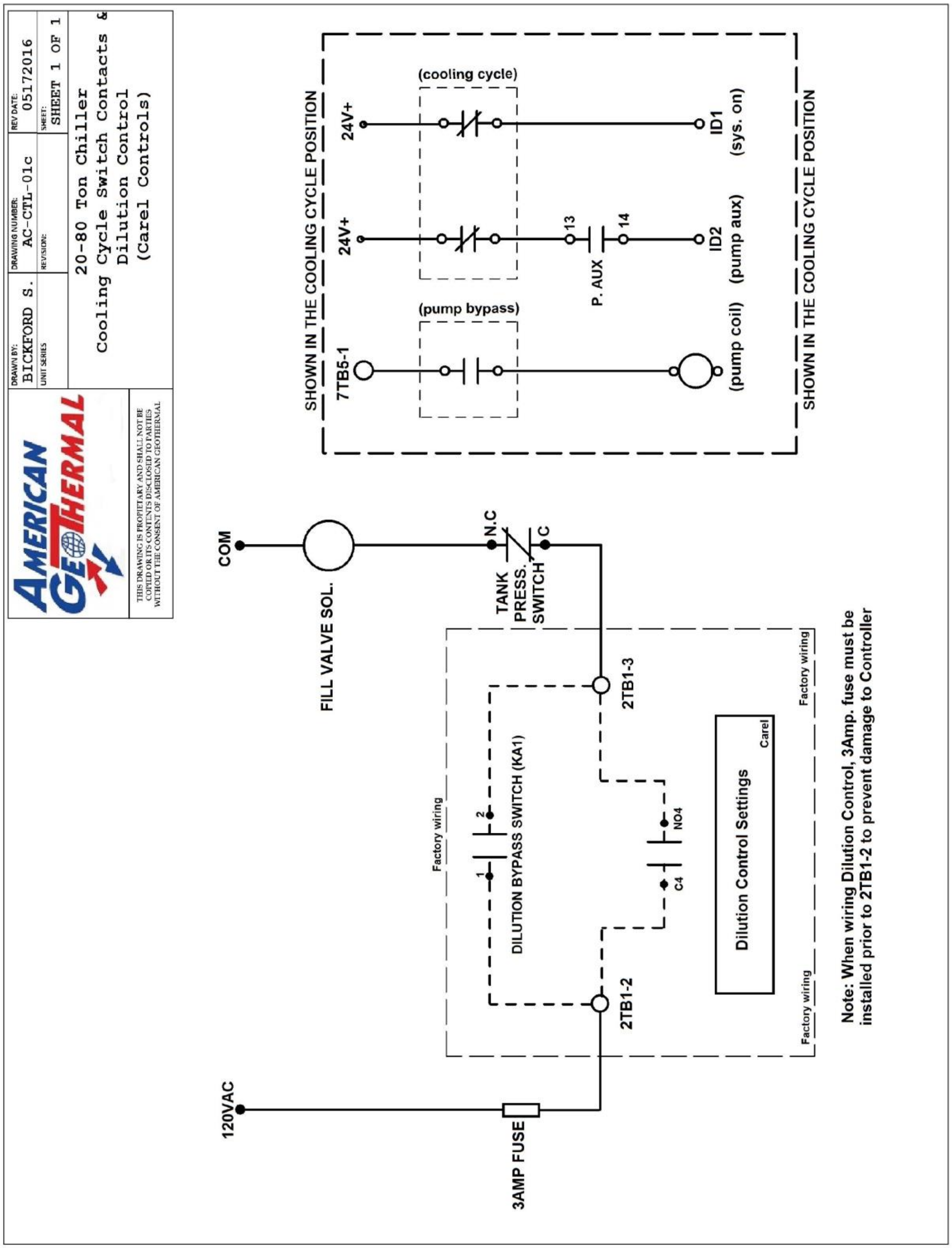
20-60 Ton Chiller
Carel Controls
(greywater)
24VAC
Optional (depending on serial number)
twin


PUMP COIL
SYS ON LIGHT
JOHNSON CONTROL
HEAT TAPE
LOW AMB. FAN
DOM Timer
IMPORTANT!
CAUTION
PRECAUCIÓN
ATTENTION


LEGEND
IMPORTANT! DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED.
PUMP COIL
SYS ON LIGHT
HEAT TAPE
DOM Timer
Carel Controls
Located outside, right of electrical panel.
30 Ton Air Cooled Grey Water Chiller (Carel Controls)
CAUTION
USE COPPER CONDUCTORS ONLY!
UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.
FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.
PRECAUCIÓN
N'UTILISER QUE DES CONDUCTEURS EN CUIVRE!
LES BORNES DE L'UNITÉ NE SONT PAS CONCUES POUR RECEVOIR D'AUTRES TYPES DE CONDUCTEURS.
L'UTILISATION DE TOUT AUTRE CONDUCTEUR PEUT ENDOMMAGER L'ÉQUIPEMENT.
ATTENTION
¡UTILICE ÚNICAMENTE CONDUCTORES DE COBRE!
LAS TERMINALES DE LA UNIDAD NO ESTÁN DISEÑADAS PARA ACEPTAR OTROS TIPOS DE CONDUCTORES.
SI NO LO HACE, PUEDE OCASIONAR DAÑO AL EQUIPO.
NOTES:
16 ISOLATION LIQUID SOLENOID VALVES (SL1,SL3) ARE REQUIRED FOR CHARGE ISOLATION (PROVIDED & INSTALLED BY THE FIELD). UNLOADING LIQUID SOLENOID VALVES (SL2,SL4), IF APPLICABLE, ARE PROVIDED & INSTALLED BY THE FIELD.
15 1S36,1S37 AND ASSOCIATED WIRING ARE USED WITH LOW AMBIENT OPTION ONLY. ON UNITS WITHOUT LOW AMBIENT OPTION, CONNECT JACK 1J3-2 TO PLUG 1P3-1 AND JACK 1J3-4 TO PLUG 1P3-3.
17 COOL-2 CIRCUIT AS SHOWN IS FOR 40 THRU 60 TON UNITS. SEE INSET "C" FOR 20 THRU 30 TON CIRCUIT VARIATION.
18 CONNECTION VARIATION TO COMPRESSOR FIXED ON TIMER (7U14) IS AS FOLLOWS:
20 - 30 TON UNITS -- USE WIRE NO. "49D"(SEE INSET "D")
40 - 60 TON UNITS -- USE WIRE NO. "51D"
23 CAUTION! DO NOT JUMPER ACROSS SWITCH UNDER ANY CIRCUMSTANCE. 4S5 & 4S6 ARE COMPRESSOR PROTECTION SWITCHES USED FOR COMPRESSOR PROTECTION WHEN A NO REFRIGERANT FLOW CONDITION EXISTS (25 PSIG).
SPLIT SYSTEM CONDENSING UNIT
DIAGRAM
SCHEMATIC W/ NO SYSTEM CONTROLS
RA 20-60 TON
SHEET 2 OF 2
2307-9117


CIRC. PUMP COIL
CIRC. PUMP SWITCH
Stage 1
Stage 2
Stage 3
Stage 4
PUMP COIL
TO 7TB5-7 (COM)
SYSTEM ON LIGHT
FREEZE STAT 1
FREEZE STAT 2
EVD RELAY (R1)
EVD RELAY (R2)
DO NOT JUMPER
40T, 50T, 60T UNITS ONLY
INSET C
INSET D
IMPORTANT!
DO NOT ENERGIZE UNIT UNTIL CHECK-OUT AND START-UP PROCEDURE HAS BEEN COMPLETED.
LEGEND
DEVICE PREFIX LOCATION CODE
TERMINAL BLOCKS
AMERICAN GEOTHERMAL
40-60 Ton Air Cooled Chiller
Carel Controls
(4 STAGES)
SPLIT SYSTEM CONDENSING UNIT
SCHEMATIC W/ NO SYSTEM CONTROLS
DIAGRAM
SCHEMATIC 2 OF 2
2307-9208
CAUTION
USE COPPER CONDUCTORS ONLY!
UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.
FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.
PRECAUCIÓN
ATTENTION
NOTES:


DRAWN BY:
BICKFORD S.
UNIT SERIES
DRAWING NUMBER:
AC-CTL-01c
REVISION:
REV DATE:
05172016
SHEET:
SHEET 1 OF 1
20-80 Ton Chiller
Cooling Cycle Switch Contacts &
Dilution Control
(Carel Controls)
AMERICAN GEOTHERMAL
THIS DRAWING IS PROPRIETARY AND SHALL NOT BE COPIED OR ITS CONTENTS DISCLOSED TO PARTIES WITHOUT THE CONSENT OF AMERICAN GEOTHERMAL
SHOWN IN THE COOLING CYCLE POSITION
7TB5-1
(pump bypass)
(pump coil)
24V+
(cooling cycle)
P. AUX
13
14
ID2
(pump aux)
24V+
ID1
(sys. on)
SHOWN IN THE COOLING CYCLE POSITION
COM
FILL VALVE SOL.
N.C
C
TANK
PRESS.
SWITCH
2TB1-3
Factory wiring
DILUTION BYPASS SWITCH (KA1)
1
2
C4
NO4
Dilution Control Settings
Carel
2TB1-2
120VAC
3AMP FUSE
Note: When wiring Dilution Control, 3Amp. fuse must be installed prior to 2TB1-2 to prevent damage to Controller

DRAWN BY: BICKFORD S.	DRAWING NUMBER: AC-TANK-02	REV DATE: 07242014
UNIT SERIES	REVISION:	SHEET: SHEET 1 OF 3

20-120 Ton Chiller Dilution Control (20-120 Ton)

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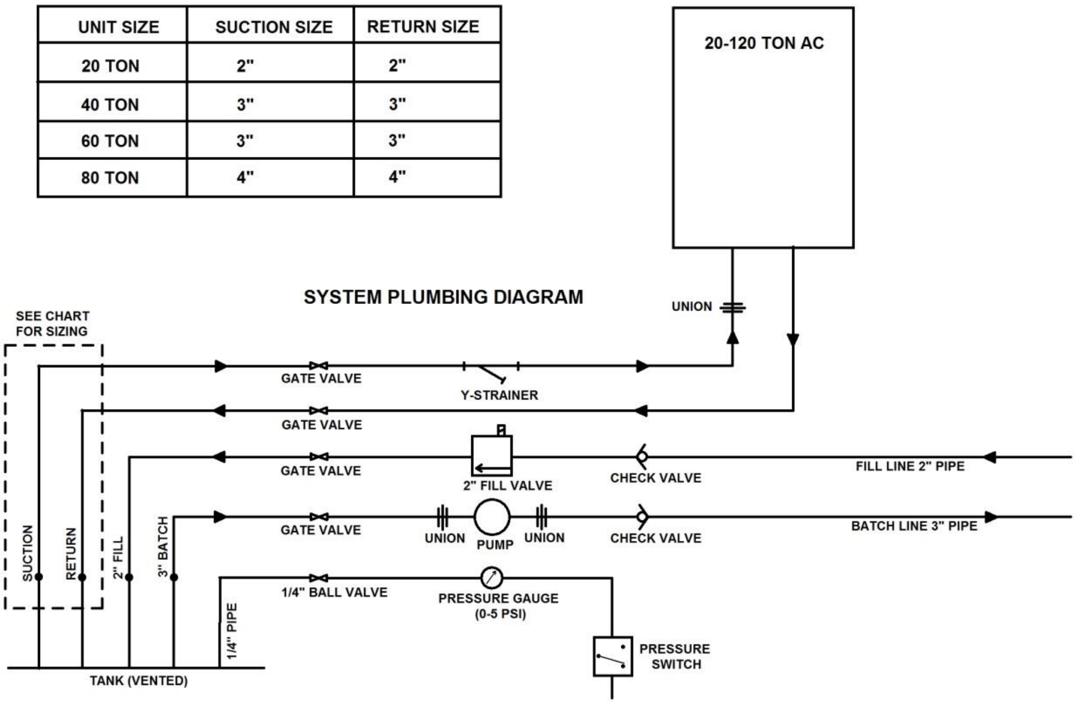
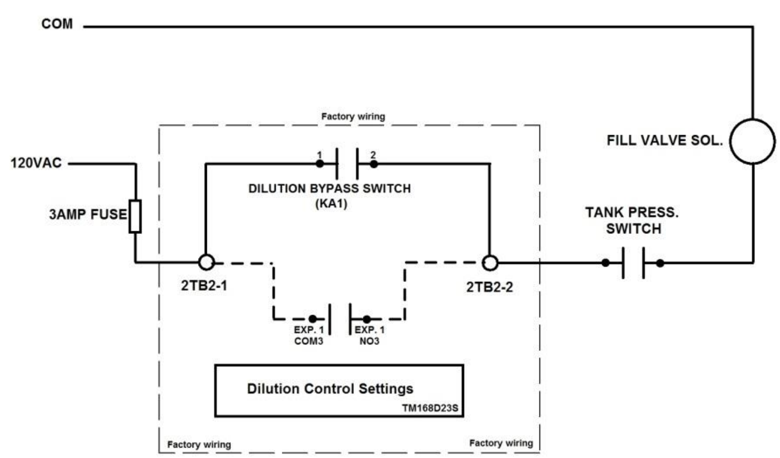
UNIT SIZE	SUCTION SIZE	RETURN SIZE
20 TON	2"	2"
40 TON	3"	3"
60 TON	3"	3"
80 TON	4"	4"

SYSTEM PLUMBING DIAGRAM





INTEGRALS

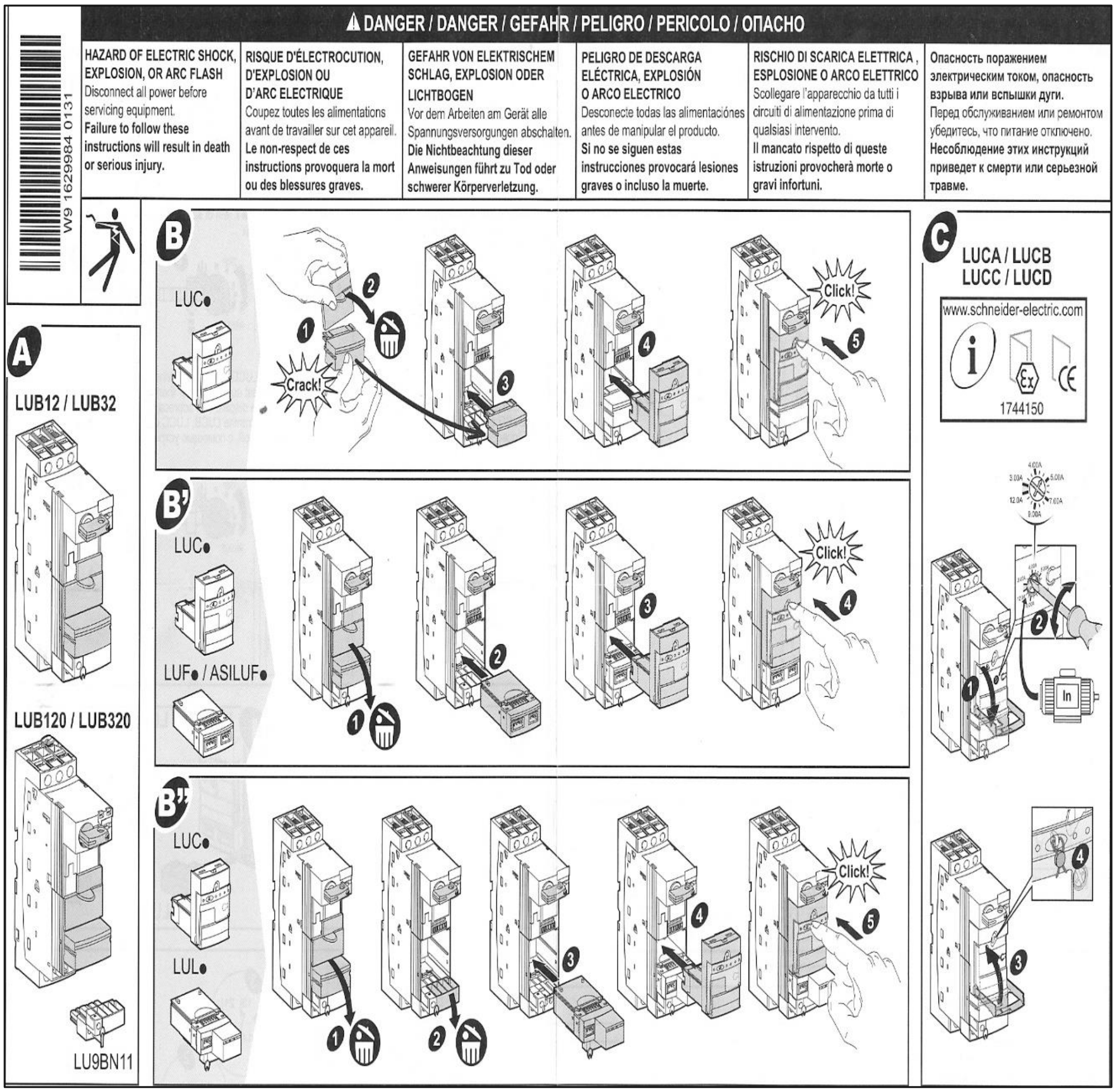
In a compact, well-engineered motor controller, you are given a combination of capabilities by the integral self-protected starter. It combines short circuit, as well as, contactor and dual-function overload relay for coordinated circuit protection.

A unique operating mechanism, of separating the moving contacts from the inertia of the magnet, allows the integral to use the same set of contacts for both short circuit and contactor functions. Contactor and short circuit functions are entirely independent of one another.

Optional isolator contacts allow complete control system testing without energizing any loads and can be padlocked open for maintenance safety. The integral starter provides complete status indication locally. Auxiliary contact blocks can be added to multiply the interlocking and signaling capability of each integral starter.

Advantages
The integral starter is the smallest self-protector starter in the industry (10 hp and 480 VAC). It is a combination starter that meets the requirements of U: 508, category E for self-protected controllers. As a contactor, the integral 32 starter has a minimum life expectancy of 1.5 million operations. Even after interrupting 100x rated current ten times, the contactor has a minimum expected life of 500,000 operations at rated load. Wiring is made easier, only requiring six power wire connections, resulting in fewer potential field problems. After interrupting short circuit faults, no damage to contactor or overload relay will occur. This is verified by UL to meet “Type 2” coordinated protection per IEC 947-4-1.

Pump & Compressor Starter & Overload



Unit Description

All air cooled condensing units are designed for outdoor installations with vertical air discharge. These units may be installed on a flat roof or placed on a concrete slab at ground level.

Before shipment, each unit is leak-tested, evacuated, a **Nitrogen** holding charge is added, and the controls are tested for proper operation.

The condenser coils are aluminum fin, bonded to copper tubing. Copper-fin coils are optional. Louvered condenser grilles for coil protection are standard.
Direct-drive, vertical discharge condenser fans are provided with built-in current and overload protection.

For "Shipwith" items, refer to the Unit Component "Layout" and "Shipwith" Locations illustration.

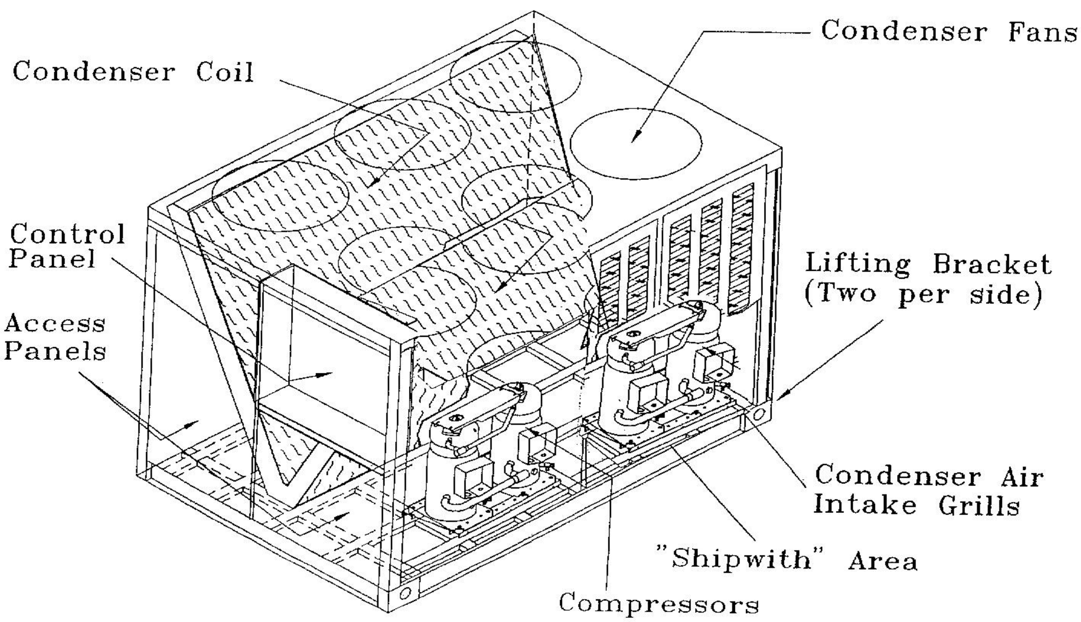
If low ambient operation is required, low ambient dampers are available as a field or factory installed option.

These units may be order with one of the following options:

No System Controls (Field provided controls required)
Constant Volume Controls
Supply Air Temperature Control (VAV applications)
EVP Chiller Controls

Basic unit components include:
Manifolded Scroll Compressors
Intertwined condenser coils
Condenser fans (number based on unit size)
Discharge service valve (one per circuit)
Liquid line service valve (one per circuit)

Unit Component Layout and "Shipwith" Locations
(60 Ton Unit Illustrated)



Unit Inspection

As soon as the unit arrives at the job site

[ ] Verify that the nameplate data matches the data on the sales order and bill of lading (including electrical data).

[ ] Verify that the power supply complies with the unit nameplate specifications.

[ ] Visually inspect the exterior of the unit, including the roof, for signs of shipping damage.

[ ] Check for material shortages. Refer to the Component Layout and Shipwith Location illustration.

If the job site inspection of the unit reveals damage or material shortages, file a claim with the carrier immediately. Specify the type and extent of the damage on the "bill of lading" before signing.

[ ] Visually inspect the internal components for shipping damage as soon as possible after delivery and before it is stored. Do not walk on the sheet metal base pans.

⚠ WARNING:

NO STEP SURFACE!

FOR ACCESS TO COMPONENTS, THE BASE SHEET METAL SURFACE MUST BE REINFORCED.

Bridging between the unit's main supports may consist of multiple 2 by 12 boards or sheet metal grating.

Failure to comply can cause severe personal injury or death from falling.

[ ] If concealed damage is discovered, notify the carrier's terminal of damage immediately by phone and by mail. Concealed damage must be reported within 15 days.

Request an immediate joint inspection of the damage by the carrier and the consignee. Do not remove damaged material from the receiving location. Take photos of the damage, if possible. The owner must provide reasonable evidence that the damage did not occur after delivery.

[ ] Notify the appropriate Trane office before installing or repairing a damaged unit.

Unit Clearances

Figure 3-1 illustrates the minimum operating and service clearances for either a single, multiple, or pit application. These clearances are the minimum distances necessary to assure adequate serviceability, cataloged unit capacity, and peak operating efficiency.

Providing less than the recommended clearances may result in condenser coil starvation or recirculation of hot condenser air.

Locate the unit as close to the applicable system support equipment as possible to minimize refrigerant piping lengths.

Allow adequate clearance at one end of the chiller to pull the evaporator tubes and for; water and refrigerant piping connections, space to perform service procedures, i.e. read gauges, thermometers, and operate water system valves.

Unit Dimensions & Weight Information

Overall unit dimensional data for each unit is illustrated in Figure 3-2A.

A Center-of-Gravity illustration and the dimensional data for the unit is shown in Figure 3-3.

Table 3-1A lists the typical operating and point loading weights for the unit.

EVP chiller barrel mounting footprints and overall dimensional data is illustrated in Figure 3-2B.

Table 3-1B lists the typical EVP operating weights and general data.

Foundation

If the unit is installed at ground level, elevate it above the snow line. Provide concrete footings at each support location or a slab foundation for support. Refer to Table 3-1A for the unit operating and point loading weights when constructing the footing foundation.

Anchor the unit to the footings or slab using hold down bolts or isolators. Isolators should be installed to minimize the transmission of vibrations into the building. Refer to the "Unit Isolation" section for spring or rubber isolator installation instructions.

Unit Dimensions & Weights

Figure 5. 20-ton air-cooled condensing unit

NOTES:
1. SEE CONNECTION DRAWING FOR CONNECTION LOCATION AND SIZES.
2. LOW AMBIENT DAMPER ONLY COMES WITH SELECTED UNIT .
3. FRONT OF UNIT CLEARANCE 72" . BACK OF UNIT CLEARANCE 48" . LEFT AND RIGHT SIDE OF UNIT CLEARANCE 42".

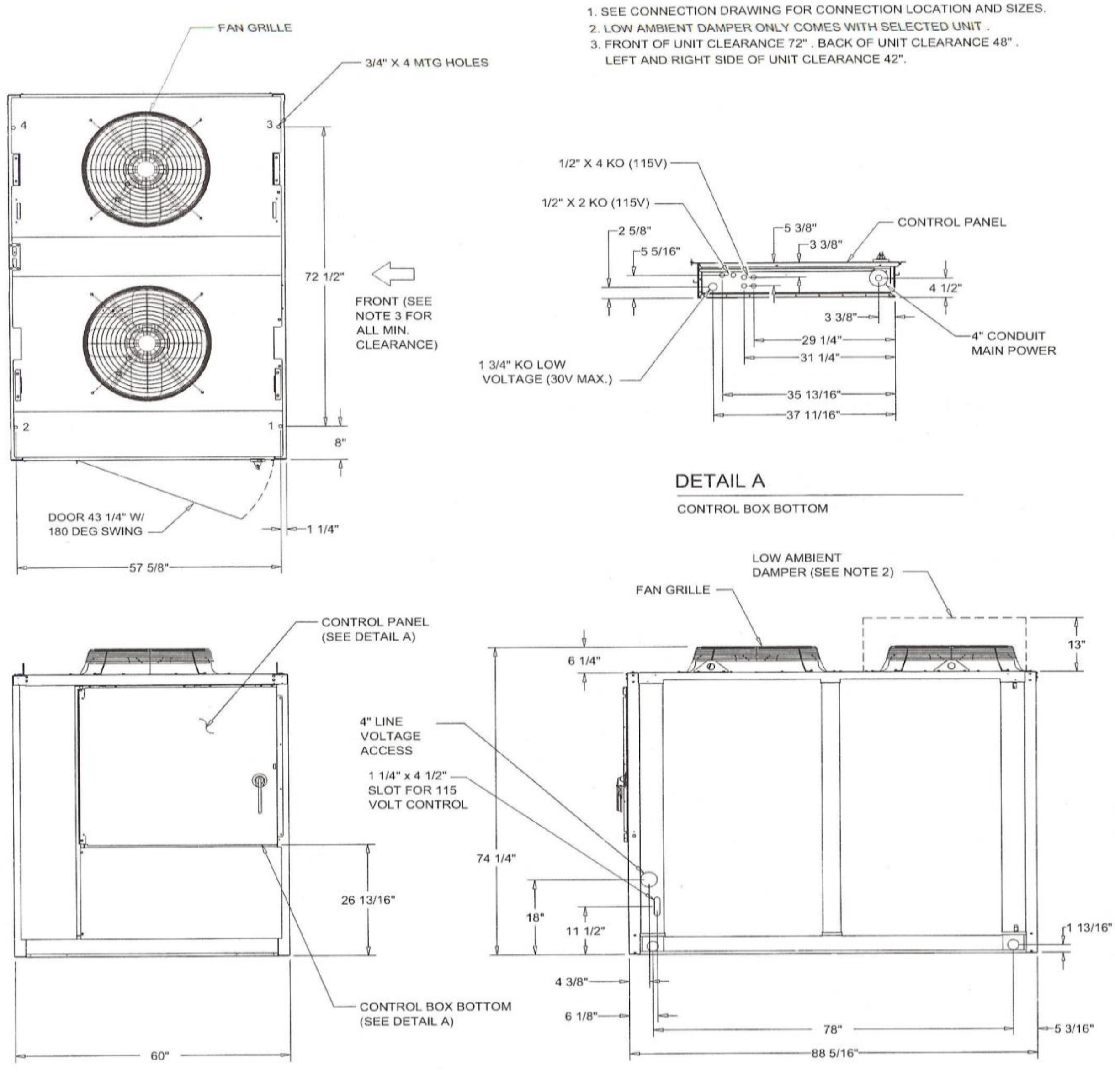
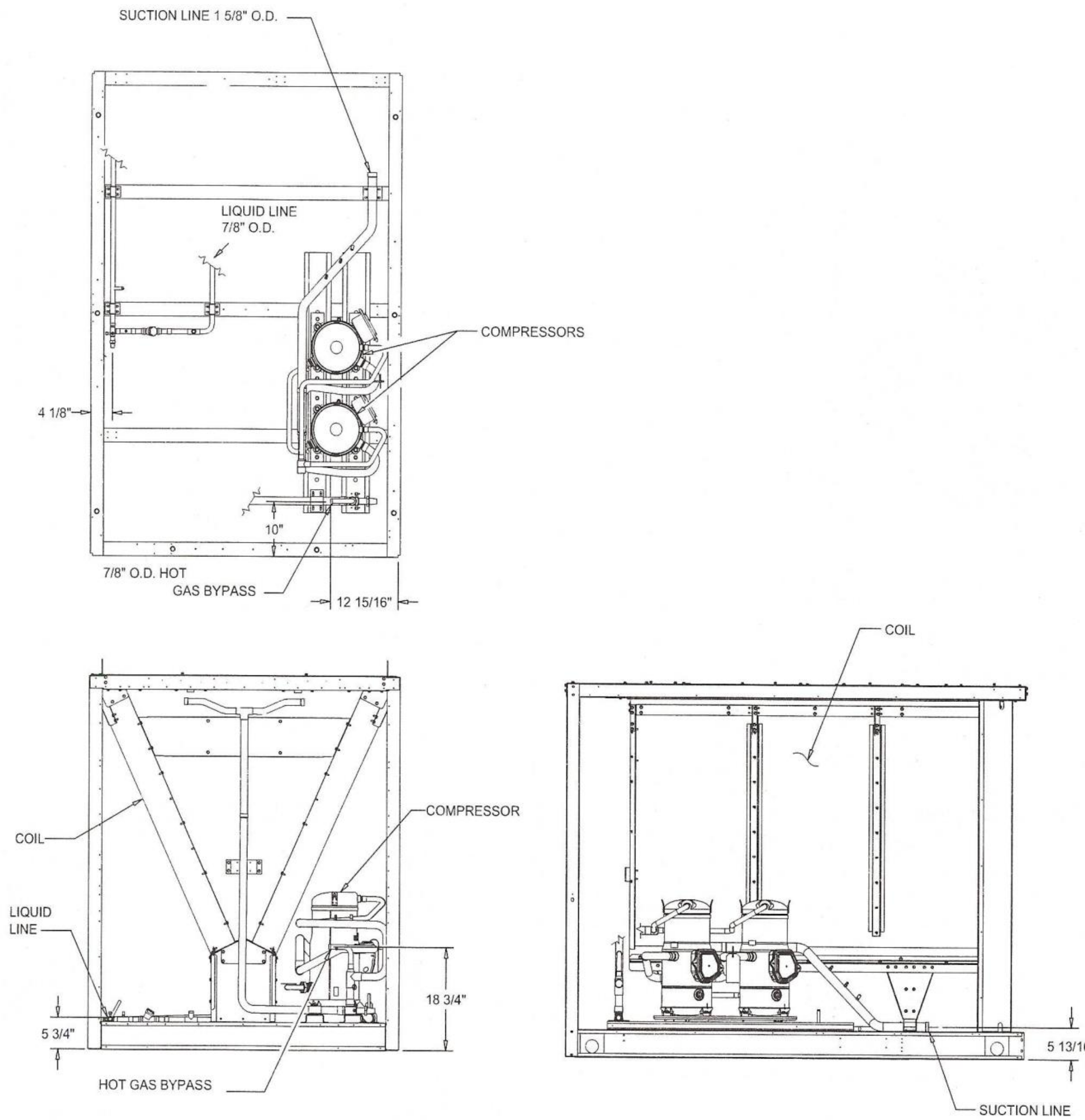


Figure 6. 20-ton air-cooled condensing unit (connections)



Unit Dimensions & Weights

Figure 7. 25- and 30-ton air-cooled condensing unit

NOTES:

1. SEE CONNECTION DRAWING FOR CONNECTION LOCATION AND SIZES.
2. LOW AMBIENT DAMPER ONLY COMES WITH SELECTED UNIT .
3. FRONT OF 25 AND 30 UNIT CLEARANCE 72" . BACK OF 25 UNIT CLEARANCE 48". BACK OF 30 UNIT CLEARANCE 72" . LEFT AND RIGHT SIDE OF 25 AND 30 UNIT CLEARANCE 42".

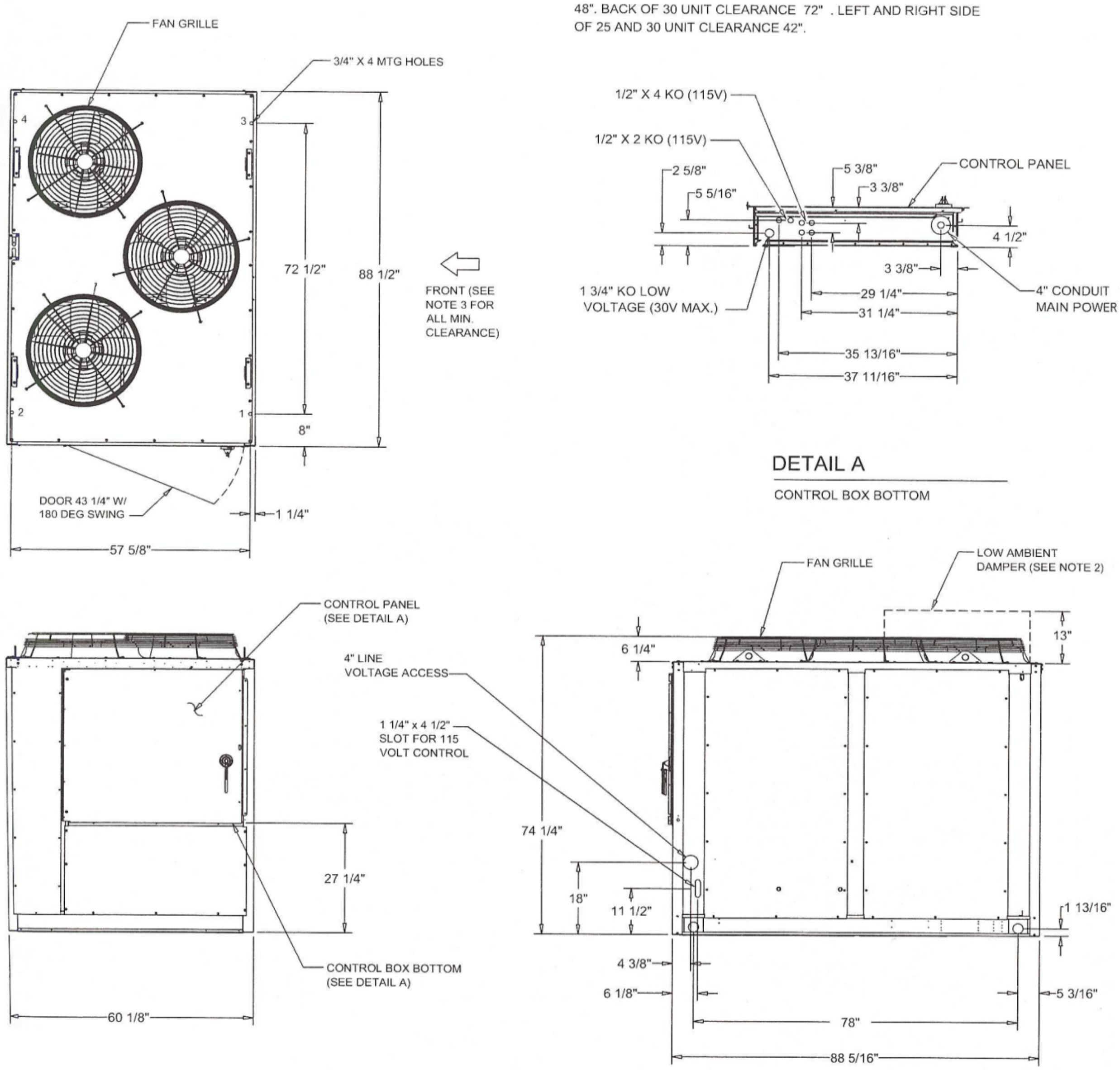


Figure 8. 25- and 30-ton air-cooled condensing unit (connections)

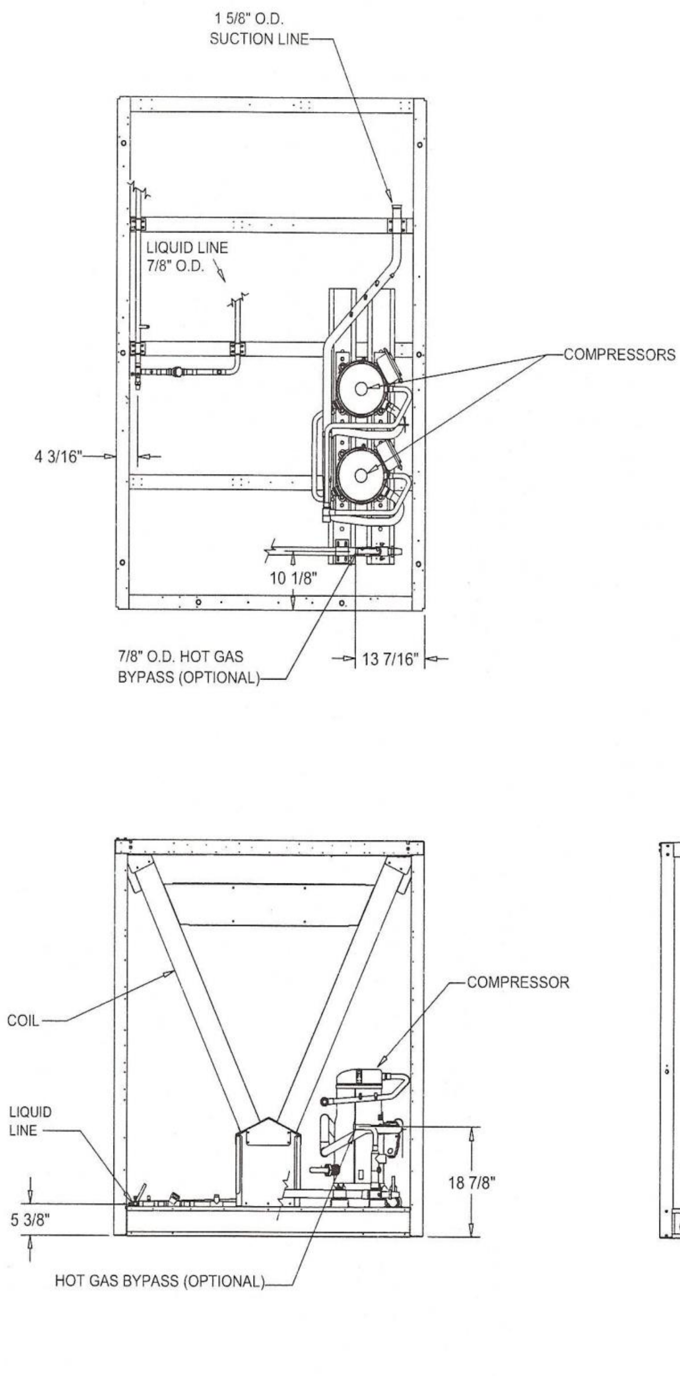


Figure 15. 80-ton air-cooled condensing unit

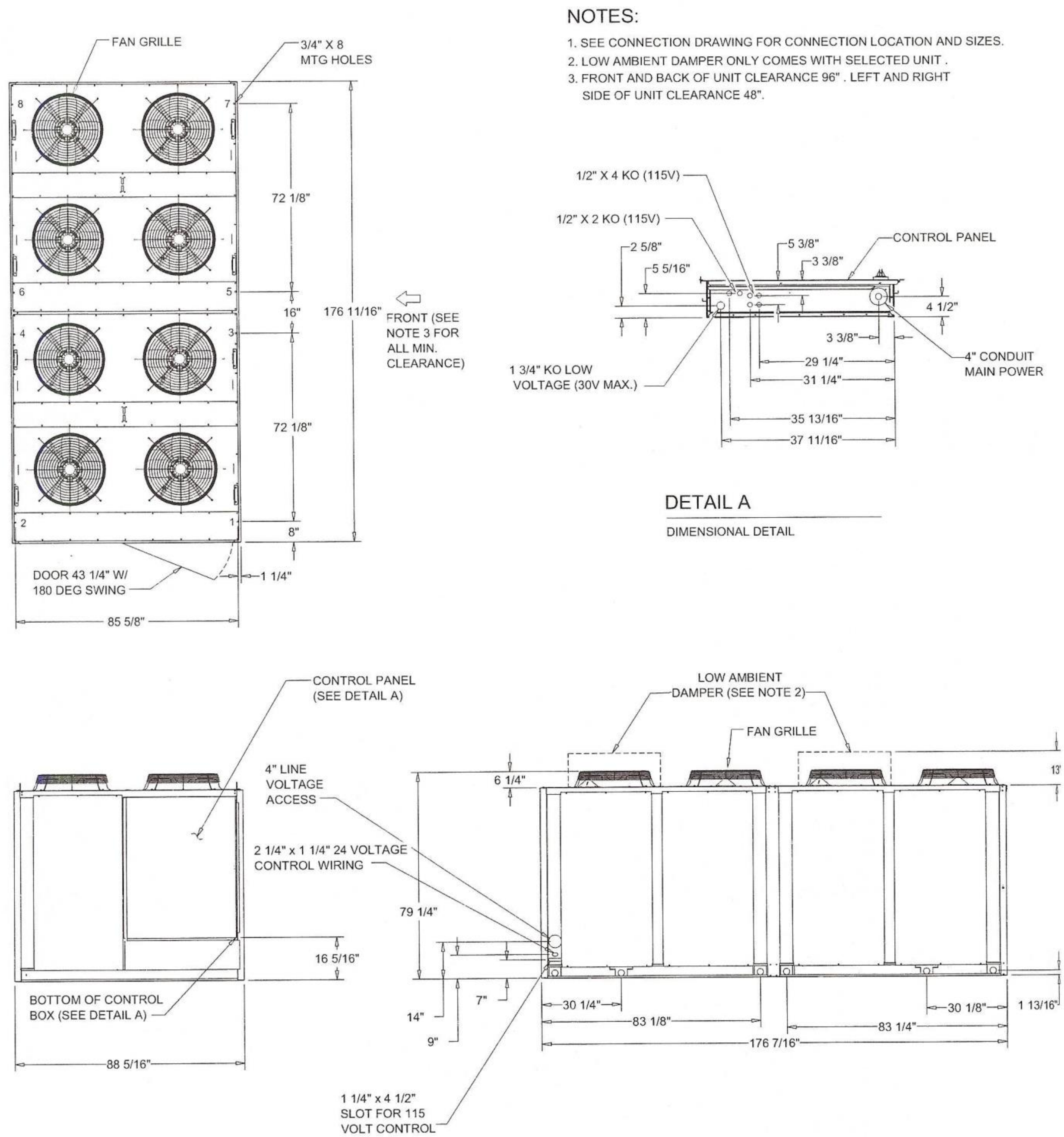
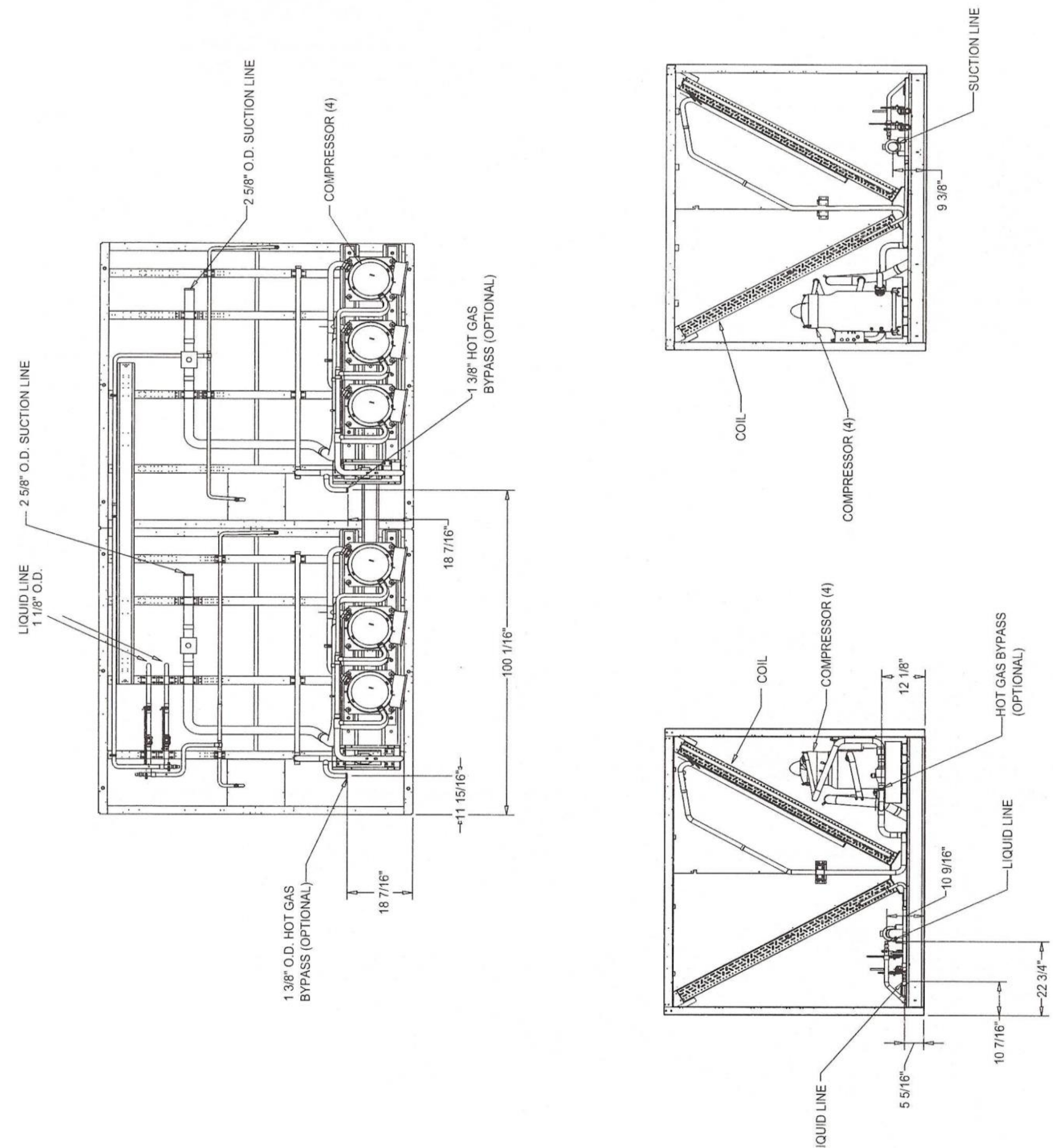


Figure 16. 80-ton air-cooled condensing unit (connections)



Unit Dimensions & Weights

Figure 17. 100- and 120-ton air-cooled condensing unit

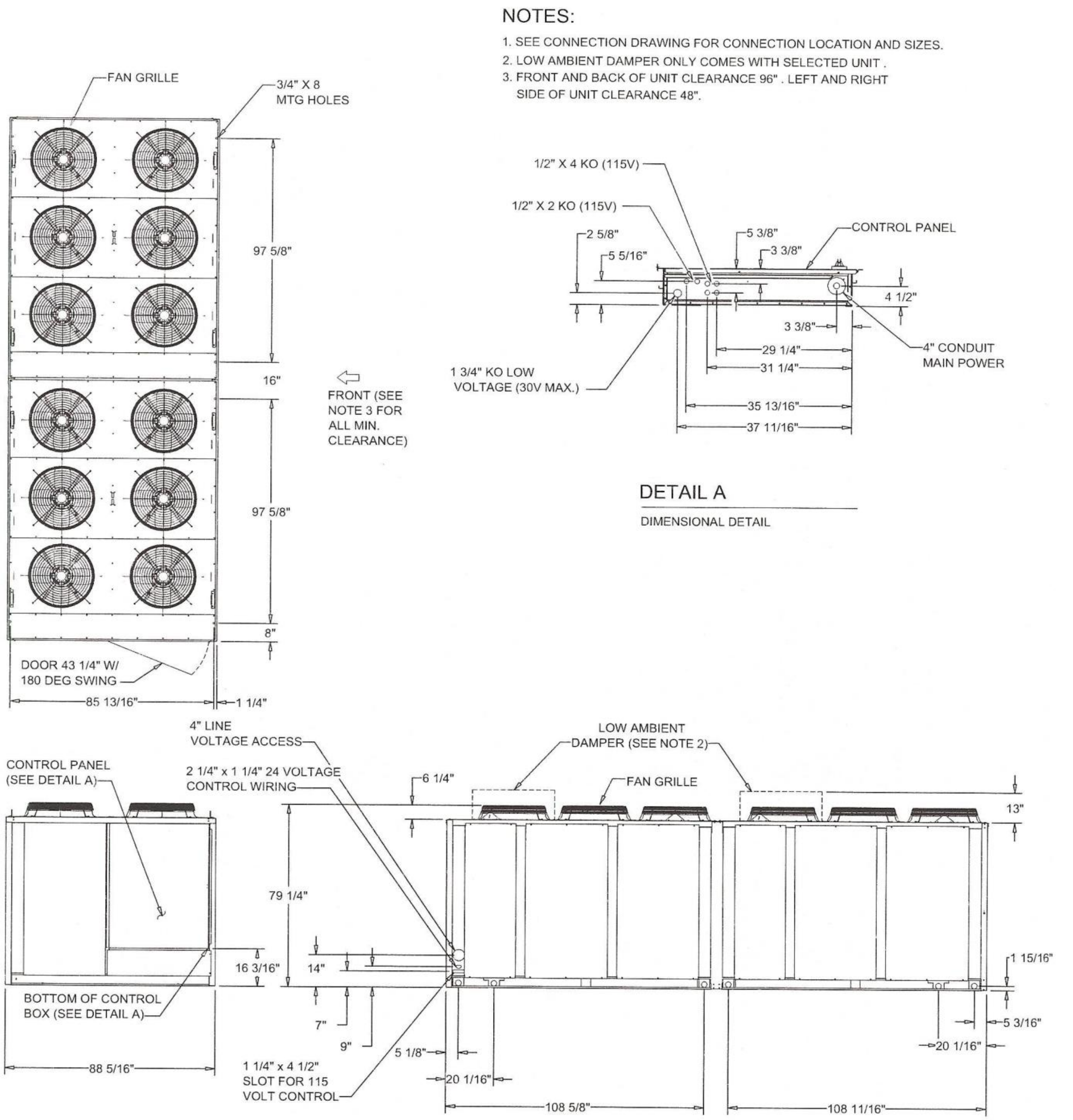


Figure 18. 100- and 120-ton air-cooled condensing unit (connections)

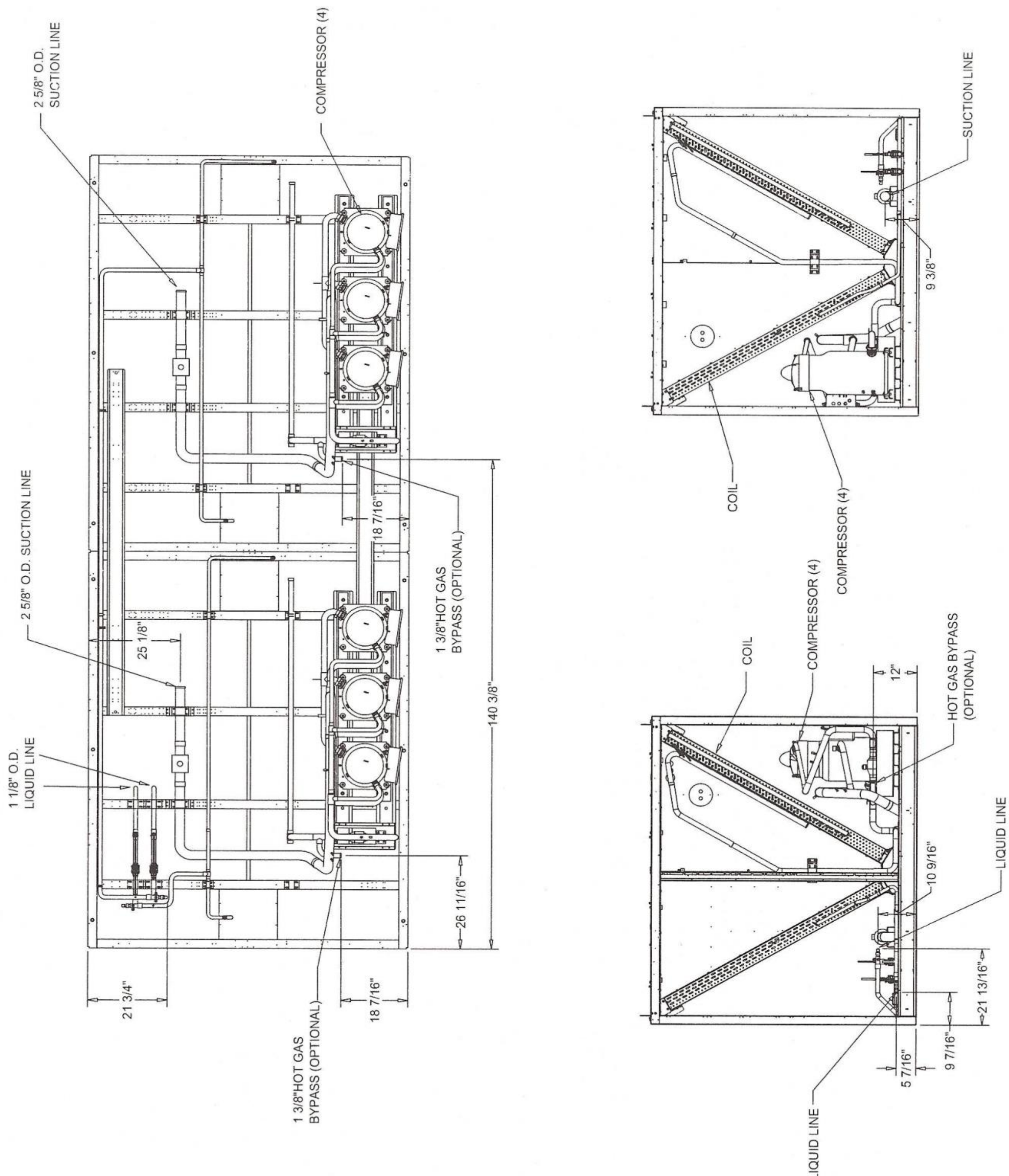
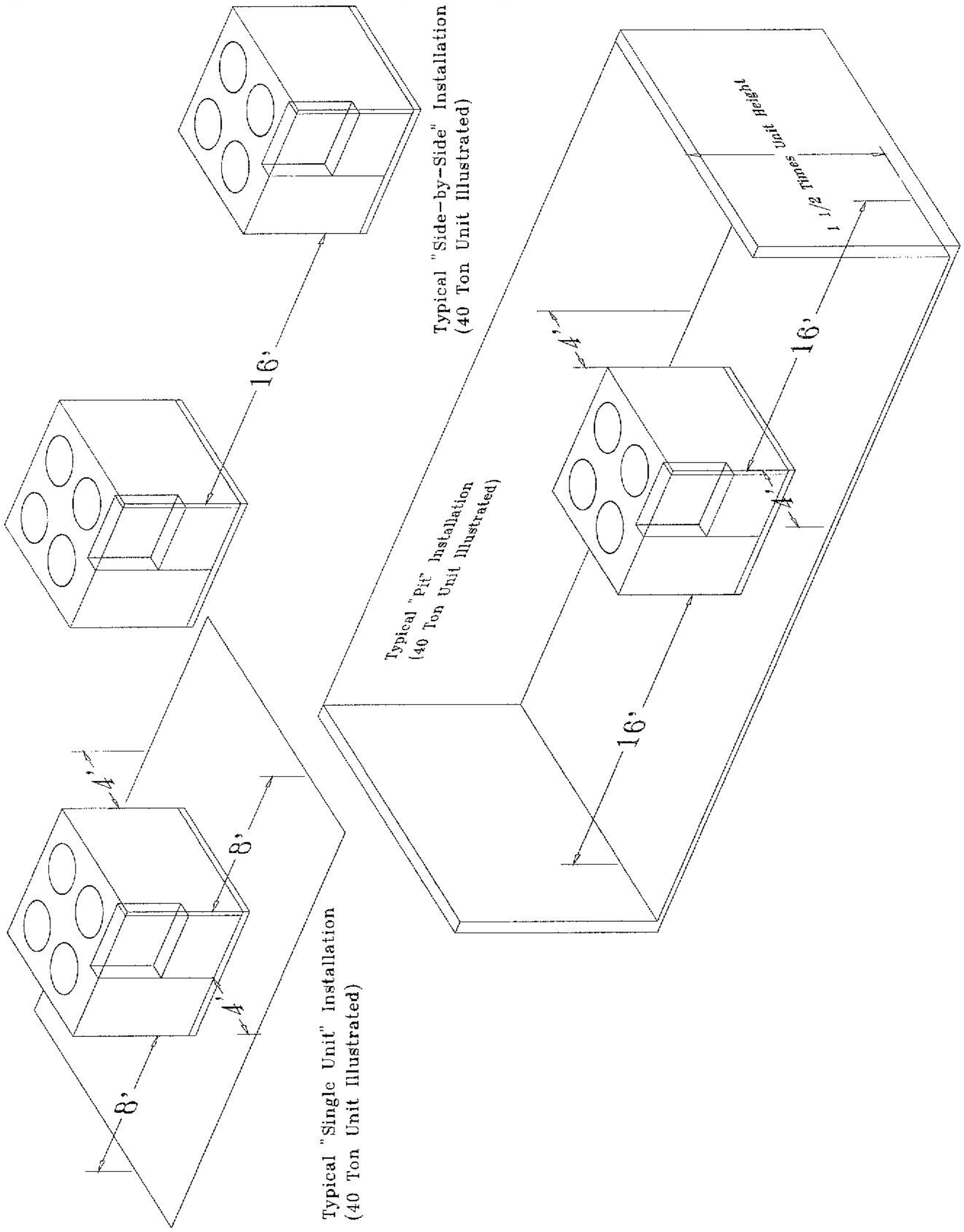


Figure 3-1
Typical Installation Clearances for Single, Multiple or Pit Applications



Leveling the Unit

Before tightening the mounting bolts, level the unit carefully. Use the unit base rail as a reference. Level the unit to within 1/4 inch over its entire length. Use shims if non-adjustable isolators (neoprene) are used.

If adjustable isolators (spring) are used, ensure that the proper isolator housing clearance is maintained while leveling the unit. Isolators are identified by color and/or an isolator part number. Shims under the isolators may be required if the unit can not be leveled using the isolator leveling bolt.

Main Electrical Power Requirements

[ ] Verify the power supply meets the required power requirements of the system.

[ ] Install power wiring in accordance with all applicable codes.

[ ] Install and connect properly sized power supply wiring, with over current protection, to the main power terminal block (1TB1) or to an optional factory mounted nonfused disconnect switch (1S1) in the control panel.

[ ] Install and connect properly sized power supply wiring, with over current protection, to the proper termination point in the air handling unit (If applicable).

[ ] Install and connect properly sized power supply wiring, with over current protection, to the proper termination point for the chilled solution pump (EVP units only).

[ ] Install proper grounding wires to an earth ground.

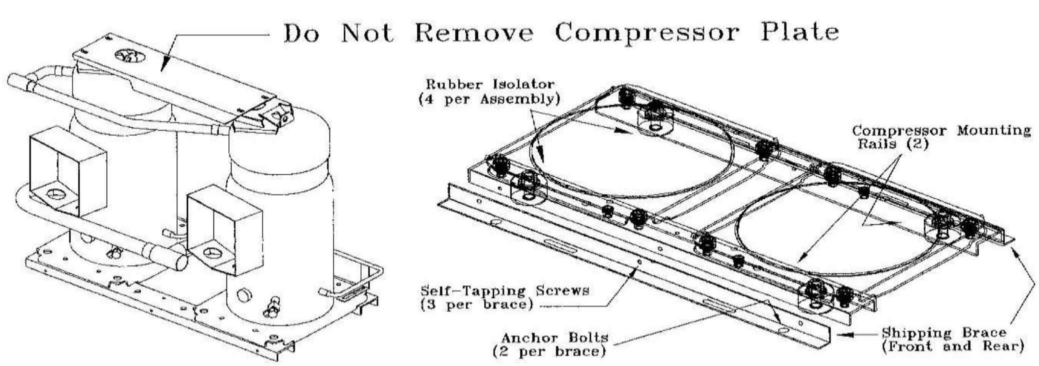
Shipping Fasteners

Compressor Shipping Hardware
Figure 3-6 illustrates the location of each tiedown bolt and rubber isolator bolt for the compressor assembly in each circuit. Refer to the illustration and the following discussion to locate and remove the fasteners.

Two Manifolded Compressors
Each manifolded compressor assembly is rigidly bolted to a mounting rail assembly. The rail assembly sets on four (4) rubber isolators. The assembly is held in place by two shipping braces that secure each compressor assembly rail to the unit's base rail. To remove the shipping hardware, follow the procedures below:

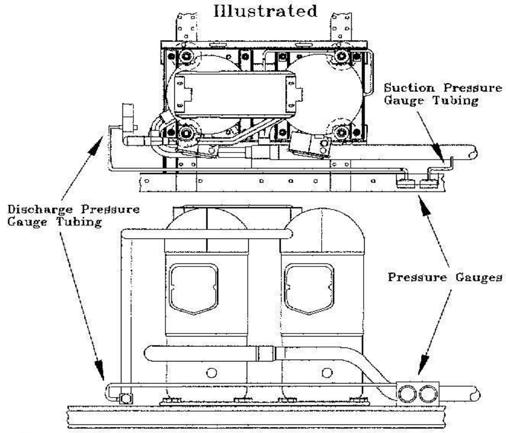
1. Remove the four anchor bolts (2 front and 2 rear), used to secure the shipping brace to the unit's base rail.
2. Remove the three self-tapping screws that secure each shipping brace to the compressor mounting rails.
3. Remove and discard the two 30-1/2" long shipping braces for each assembly.
4. Do not remove the shipping plate located on top of the compressors.
5. Ensure that the compressor rail assembly is free to move on the rubber isolators.

Figure 3-6
Removing Scroll Compressor Shipping Hardware for 20 through 60 Ton Units



Optional Pressure Gauges

When a unit is ordered with optional pressure gauges, ("F" is included in the miscellaneous digit of the model number), a set of gauges and the necessary mounting hardware ship in the location illustrated in the Unit Component "Layout" and "Shipwith" Location. The mounting location and tubing configuration for the optional pressure gauges after field installation is shown below.



Final Refrigerant Pipe Connections

To access the refrigerant pipe connections, remove the louvered side grills. Refer to Figure 3-2.

These condensing units are shipped with a **Nitrogen** holding charge. Install pressure gauges to the appropriate access valve(s) and take a reading. If no pressure is present, refer to the "Leak Testing Procedure" section. If pressure is present, relieve the pressure before attempting to unsweat the "seal" caps. If refrigerant connections are not capped, but are "spun-end" tubes, use a tubing cutter to remove the end from the pipe.

Note: To prevent damage to the system, do not drill a hole in the seal caps or saw the ends off pipe stubs. This may introduce copper chips into the system piping.

Brazing Procedures

Proper brazing techniques are essential when installing refrigerant piping. The following factors should be kept in mind when forming sweat connections.

1. When copper is heated in the presence of air, Copper oxide forms. To prevent copper oxide from forming inside the tubing during brazing, sweep an inert gas, such as dry nitrogen, through the tubing. Nitrogen displaces air in the tubing and prevents oxidation of the interior surfaces. A nitrogen flow of one to three cubic feet per minute is sufficient to displace the air. Use a pressure regulating valve or flow meter to control the flow.

⚠ WARNING:

USE NITROGEN ONLY TO PURGE THE SYSTEM WHILE SWEATING CONNECTIONS.

Failure to follow proper procedures can result in personal injury or death due to a possible formation of an explosive mixture of R-22 and air and/or inhalation of phosgene gas.

2. Ensure that the tubing surfaces to be brazed are clean, and that the ends of the tubes have been carefully reamed to remove any burrs.

3. Make sure the inner and outer tubes of the joint are symmetrical and have a close clearance, providing an easy slip fit. If the joint is too loose, the tensile strength of the connection will be significantly reduced. The overlap distance should be equal to the diameter of the inner tube.

4. Wrap the body of each refrigerant line component with a wet cloth to keep it cool during brazing. Move any tube entrance grommets away for the brazing area.

Note: Use 40 to 45% silver brazing alloy (BAg-7 or BAg-28) on dissimilar metals. Use BCup-6 brazing alloy on copper to copper joints.

5. If flux is used, apply it sparingly to the joint. Excessive flux can enter the system which will contaminate the refrigerant system.

6. Apply heat evenly over the length and circumference of the joint to draw the brazing material into the joint by capillary action. Remove the brazing rod and flame from the joint as soon as a complete fillet is formed to avoid possible restriction in the line.

7. Visually inspect the connection after brazing to locate any pin holes or crevices in the joint. The use of a mirror may be required, depending on the joint location.

Leak Testing Procedure

When Leak-testing a refrigerant system, observe all safety precautions.

Note: Never use oxygen, acetylene or compressed air for leak testing. Always install a pressure regulator, shutoff valves and gauges to control pressure during leak testing.

Trane condensing units are shipped with a **Nitrogen** holding charge. If there is no pressure, the unit must be leak tested to determine the location of leak as follows:

Note: These service procedures require working with refrigerant, Do NOT release refrigerant to the atmosphere! The service technician must comply with all federal, state, and local laws. Refer to general service bulletin MSCU-SB-1 (latest edition).

Use refrigerant gas as a tracer for leak detection and use oil-pumped dry nitrogen to develop the required test pressure. Test the high and low side of the system at pressures dictated by local codes.

1. Close the field supplied liquid line service valve(s) installed near the evaporator and the compressor discharge service valve to isolate the system's high side from the low side. Pressure test the liquid line, discharge line, and condenser coils at pressures dictated by local codes. Do not exceed 10# above the pressure control settings.
2. Connect a refrigerant cylinder to the charging port of the liquid line service valve. Use the refrigerant to raise the high side pressure to 12 to 15 psig.
3. Disconnect the refrigerant cylinder. Connect a dry nitrogen cylinder to the charging port and increase the high side pressure. Do not exceed the condenser maximum working pressure listed on the unit nameplate.
4. Use a halide torch, halogen leak detector or soap bubbles to check for leaks. Check all piping joints, valves, etc...
5. If a leak is located, use proper procedures to remove the refrigerant/nitrogen mixture, break the connection and remake as a new joint. Retest for leaks after making repairs.
6. Repeat the test procedure for the low side of the system, charging through the suction pressure gauge port or through an access provided on the suction line by the installer. Increase the system pressure to 100 psig.
7. If a leak is located, use proper procedures to remove the refrigerant/nitrogen mixture, break the connection and remake as a new joint. Retest for leaks after making repairs.
8. Open the liquid line service valve and the compressor discharge service valve.

Chilled Water Piping

Note: To prevent evaporator damage, do not exceed 150 psig evaporator pressure.

Water Shutoff Valves
Provide shutoff valves in the "Supply" and "Return" pipe near the chiller so the gauge(s), thermostats, sensors, strainer, etc., can be isolated during service.

Pipe Unions
Use pipe unions to simplify disassembly for system service. Use vibration eliminators to prevent transmitting vibrations through the water lines.

Final Water Piping Connections

1. All water piping to the system should be flushed thoroughly before making the final connections.

Note: If an acidic commercial flushing solution is used, construct a temporary bypass around the EVP chiller barrel to prevent damage to the internal components of the evaporator.

2. Connect the water pipe to the EVP chiller.
3. Install the drain plug, (if no drain is used) or ensure the drain shutoff valve is closed.
4. While filling the chiller system with solution, vent the air from the system at the highest points.

Note: To prevent possible damage to the equipment, do not use untreated or improperly treated water in the system.

Field Installed Power Wiring

An overall dimensional layout for the field installed wiring entrance into the unit is illustrated in Figure 3-2. To insure that the unit's supply power wiring is properly sized and installed, follow the guidelines outlined below.

Note: All field installed wiring must conform to NEC guidelines as well as State and Local codes.

Verify that the power supply available is compatible with the unit's nameplate ratings. The available supply power must be within 10% of the rated voltage stamped on the nameplate. Use only copper conductors to connect the 3-phase power supply to the unit.

⚠ CAUTION:

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

Failure to do so may cause damage to the equipment.

⚠ WARNING:

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING. THE LINE SIDE TERMINALS ON THIS SWITCH ARE ENERGIZED WHEN THE SWITCH IS IN THE OFF POSITION

Failure to disconnect power before servicing can cause severe personal injury or death.

Once the door has been opened, it can be closed with the handle in any one of the three positions outlined above, provided it matches the disconnect switch position.

The handle can be locked in the "OFF" position. While holding the handle in the "OFF" position, push the spring loaded thumb key, attached to the handle, into the base slot. Place the lock shackle between the handle and the thumb key. This will prevent it from springing out of position.

Main Unit Power Wiring

Table 3-4 lists the field connection wire ranges for both the main power terminal block 1TB1 and the optional main power disconnect switch 1S1. The unit electrical data is listed in Table 3-5. The electrical service must be protected from over current and short circuit conditions in accordance with NEC requirements. Protection devices must be sized according to the electrical data on the nameplate. Refer to the "Power Wire Sizing & Protection Device Equations", for determining;

a. the appropriate electrical service wire size based on "Minimum Circuit Ampacity" (MCA),

b. the "Maximum Over current Protection" (MOP) device.

c. the "Recommended Dual Element fuse size" (RDE).

1. If the unit is <u>not</u> equipped with an optional factory installed nonfused disconnect switch, a field supplied disconnect switch must be installed at or near the unit in accordance with the National Electrical Code (NEC latest edition). Refer to the "Power Wire Sizing & Protection Device Equations" (DSS calculation), for determining the correct size.
2. Location for the electrical service entrance is illustrated in Figure 3-2. Complete the unit's power wiring connections onto either the main terminal block 1TB1, or the factory mounted nonfused disconnect switch 1S1, inside the unit control panel. Refer to the customer connection diagram that shipped with the unit for specific termination points.
3. Provide proper grounding for the unit in accordance with local and national codes

Table 3-4
Customer Connection Wire Range

CUSTOMER WIRE SELECTION			
POWER WIRE SELECTION TO DISCONNECT SWITCH (1S1)			
UNIT SIZE	UNIT VOLTAGE	DISCONNECT SWITCH SIZE	CONNECTOR WIRE RANGE
20 - 40 TON	380/415/460/575 VOLT	100 AMP	(1) #14 - 1/0
50 TON	575 VOLT	100 AMP	(1) #14 - 1/0
20 - 40 TON	200/230 VOLT	250 AMP	(1) #4 - 350 kcmil
50 - 60 TON	380/415/460 VOLT	250 AMP	(1) #4 - 350 kcmil
60 TON	575 VOLT	250 AMP	(1) #4 - 350 kcmil
50 - 60 TON	200/230 VOLT	400 AMP	(1) #1 - 600 kcmil OR (2) #1 - 250 kcmil
POWER WIRE SELECTION TO MAIN TERMINAL BLOCK (1TB1)			
UNIT SIZE	UNIT VOLTAGE	TERMINAL BLOCK SIZE	CONNECTOR WIRE RANGE
20 - 60 TON	ALL VOLTAGES	335 AMP	(1) #6 - 350 MCM

CONTROL WIRE SELECTION TO CONTROL TERMINAL BLOCKS (7TB5 THRU 7TB8 6TB9)		
WIRE GAUGE	OHMS PER 1000 FEET	MAX WIRE LENGTH
18 AWG	8	500 FT
16 AWG	5	1000 FT
14 AWG	3	2000 FT

Power Wire Sizing and Protection Device Equations

To correctly size the main power wiring for the unit, use the appropriate calculation(s) listed below. Read the load definitions that follow and use Calculation #1 for determining the MCA (Minimum Circuit Ampacity), MOP (Maximum Over current Protection), and RDE (Recommended Dual Element fuse size) for each unit. Use Calculation #2 to determine the DSS (Disconnect Switch Size) for each unit.

Load Definitions: **LOAD 1** = CURRENT OF THE LARGEST MOTOR (COMPRESSOR OR FAN MOTOR)
LOAD 2 = SUM OF THE CURRENTS OF ALL REMAINING MOTORS
LOAD 4 = CONTROL POWER TRANSFORMER
= AND ANY OTHER LOAD RATED AT 1 AMP OR MORE

Calculation #1
(MCA, MOP, and RDE)

MCA = (1.25 x LOAD 1) + LOAD 2 + LOAD 4 **MOP** = (2.25 x LOAD 1) + LOAD 2 + LOAD 4

Select a fuse rating equal to the MOP value. If the MOP value does not equal a standard fuse size as listed in NEC 240 - 6, select the next lower standard fuse rating.

Note: If selected MOP is less than the MCA, then select the lowest standard maximum fuse size which is equal to or larger than the MCA, provided the selected fuse size does not exceed 800 amps.

RDE = (1.5 x LOAD 1) + LOAD 2 + LOAD 4

Select a fuse rating equal to the RDE value. If the RDE value does not equal a standard fuse size as listed in NEC 240 - 6 select the next higher standard fuse rating.

Note: If the selected RDE is greater than the selected MOP value, then select the RDE value to equal the MOP value.

Calculation #2
Disconnect Switch Sizing (DSS)

DSS = 1.15 X (LOAD 1 + LOAD 2 + LOAD 4)

Note: *If selected MOP is less than the MCA, then select the lowest standard maximum fuse size which is equal to or larger than the MCA, provided the selected fuse size does not exceed 800 amps.*

RDE = (1.5 x LOAD 1) + LOAD 2 + LOAD 4

Select a fuse rating equal to the RDE value. If the RDE value does not equal a standard fuse size as listed in NEC 240 - 6 select the next higher standard fuse rating.

Note: *If the selected RDE is greater than the selected MOP value, then select the RDE value to equal the MOP value.*

Calculation #2
Disconnect Switch Sizing (DSS)

DSS = 1.15 X (LOAD 1 + LOAD 2 + LOAD 4)

Table 11. Electrical service sizing data (20-60 ton units)

		Unit Characteristics				Condenser Fan Motor					Compressor Motor				
Model	Electrical Characteristics	Allowable Voltage Range	Min. Circuit Amp	Max. Overcurrent Protection	Rec. Dual Element Fuse Size	KW	NO	HP	FLA	LRA	NO	1A/ 2A RLA	1B/2B RLA	1A/2A LRA	1B/2B LRA
20 Ton	200/60/3XL	180-220	102	125	125	0.9	2	1	4.1	20.7	2	41.4	41.4	267	267
	230/60/3XL	208-254	89	110	100	0.9	2	1	4.1	20.7	2	35.5	35.5	267	267
	460/60/3XL	416-508	46	60	60	0.9	2	1	1.8	9.0	2	18.6	18.6	142	142
	575/60/3XL	520-635	39	50	45	0.9	2	1	1.4	7.2	2	15.8	15.8	103	103
	380/415/50/3XL	342-418 373-456	46	60	50	0.75	2	1	1.7	9.2	2	18.6	18.6	142	142
25 Ton	200/60/3XL	180-220	119	150	150	0.9	3	1	4.1	20.7	2	41.4	52	267	315
	230/60/3XL	208-254	107	150	125	0.9	3	1	4.1	20.7	2	35.5	47	267	315
	460/60/3XL	416-508	52	70	60	0.9	3	1	1.8	9.0	2	18.6	22.2	142	158
	575/60/3XL	520-635	44	60	50	0.9	3	1	1.4	7.2	2	15.8	19.2	103	136
	380/415/50/3XL	342-418 373-456	52	70	60	0.75	3	1	1.7	9.2	2	18.6	22.2	142	158
30 Ton	200/60/3XL	180-220	141	175	175	0.9	3	1	4.1	20.7	2	56.9	56.9	351	351
	230/60/3XL	208-254	123	150	150	0.9	3	1	4.1	20.7	2	48.8	48.8	351	351
	460/60/3XL	416-508	63	80	70	0.9	3	1	1.8	9.0	2	25.5	25.5	197	197
	575/60/3XL	520-635	57	70	70	0.9	3	1	1.4	7.2	2	23.1	23.1	146	146
	380/415/50/3XL	342-418 373-456	63	80	70	0.75	3	1	1.7	9.2	2	25.5	25.5	197	197
40 Ton	200/60/3XL	180-220	193	225	225	0.9	6	1	4.1	20.7	4	41.4	41.4	267	267
	230/60/3XL	208-254	168	200	200	0.9	6	1	4.1	20.7	4	35.5	35.5	267	267
	460/60/3XL	416-508	87	100	100	0.9	6	1	1.8	9.0	4	18.6	18.6	142	142
	575/60/3XL	520-635	73	80	80	0.9	6	1	1.4	7.2	4	15.8	15.8	103	103
	380/415/50/3XL	342-418 373-456	86	100	100	0.75	6	1	1.7	9.2	4	18.6	18.6	142	142
50 Ton	200/60/3XL	180-220	236	250	250	0.9	6	1	4.1	20.7	4	47	52	304	315
	230/60/3XL	208-254	215	250	250	0.9	6	1	4.1	20.7	4	42.3	47	304	315
	460/60/3XL	416-508	102	110	110	0.9	6	1	1.8	9.0	4	20.2	22.2	147	158
	575/60/3XL	520-635	86	100	100	0.9	6	1	1.4	7.2	4	17.1	19.2	122	136
	380/415/50/3XL	342-418 373-456	101	110	110	0.75	6	1	1.7	9.2	4	20.2	22.2	147	158

Table 11. Electrical service sizing data (20-60 ton units)

Model	Electrical Characteristics	Unit Characteristics: Allowable Voltage Range	Min. Circuit Amp	Max. Overcurrent Protection	Rec. Dual Element Fuse Size	Condenser Fan Motor: KW	NO	HP	FLA	LRA	Compressor Motor: NO	1A/ 2A RLA	1B/2B RLA	1A/2A LRA	1B/2B LRA
60 Ton	200/60/3XL	180-220	267	300	300	0.9	6	1	4.1	20.7	4	56.9	56.9	351	351
	230/60/3XL	208-254	232	250	250	0.9	6	1	4.1	20.7	4	48.8	48.8	351	351
	460/60/3XL	416-508	120	125	150	0.9	6	1	1.8	9.0	4	25.5	25.5	197	197
	575/60/3XL	520-635	107	125	125	0.9	6	1	1.4	7.2	4	20.3	20.3	146	146
	380/415/50/3XL	342-418 373-456	119	125	125	0.75	6	1	1.7	9.2	4	25.4	25.4	197	197

Notes:
1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors. LOAD 3= FLA(Full Load Amps) of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Minimum Circuit Ampacity, then select the lowest maximum fuse size which is equal to or larger than the Min Circuit Ampacity, provided the selected fuse size does not exceed 800 amps.

Table 12. Electrical service sizing data (80-120 ton units)

Model	Electrical Characteristics	Unit Characteristics: Allowable Voltage Range	Min. Circuit Amp	Max. Overcurrent Protection	Rec. Dual Element Fuse Size	Condenser Fan Motor: KW	NO	HP	FLA	LRA	Compressor Motor: NO	1A/ 2A RLA	1B/ 2B RLA	1C/ 2C RLA	1A/ 2A LRA	1B/ 2B LRA	1C/ 2C LRA
80 Ton	200/60/3XL	200/60/3XL	411	450	450	0.9	8	1	4.1	20.7	6	60.5	60.5	60.5	320	320	320
	230/60/3XL	230/60/3XL	358	400	400	0.9	8	1	4.1	20.7	6	52	52	52	320	320	320
	460/60/3XL	460/60/3XL	174	175	175	0.9	8	1	1.8	9	6	25.4	25.4	25.4	160	160	160
	575/60/3XL	575/60/3XL	139	150	150	0.9	8	1	1.4	7.2	6	20.3	20.3	20.3	135	135	135
100 Ton	200/60/3XL	200/60/3XL	480	500	500	0.9	12	1	4.1	20.7	6	60.5	60.5	83.9	320	320	485
	230/60/3XL	230/60/3XL	425	450	450	0.9	12	1	4.1	20.7	6	52	52	74.5	320	320	485
	460/60/3XL	460/60/3XL	207	225	225	0.9	12	1	1.8	9	6	25.4	25.4	37.2	160	160	215
	575/60/3XL	575/60/3XL	166	175	175	0.9	12	1	1.4	7.2	6	20.3	20.3	29.8	135	135	175
120 Ton	200/60/3XL	200/60/3XL	574	600	600	0.9	12	1	4.1	20.7	6	83.9	83.9	83.9	485	485	485
	230/60/3XL	230/60/3XL	515	600	600	0.9	12	1	4.1	20.7	6	74.5	74.5	74.5	485	485	485
	460/60/3XL	460/60/3XL	255	300	300	0.9	12	1	1.8	9	6	37.2	37.2	37.2	215	215	215
	575/60/3XL	575/60/3XL	204	225	225	0.9	12	1	1.4	7.2	6	29.8	29.8	29.8	175	175	175

Notes:
1. LOAD 1= Current of the largest motor (Compressor or Fan Motor); LOAD 2=Sum of the currents of all remaining motors. LOAD 3= FLA(Full Load Amps) of the electric heater; LOAD 4= Any other load rated at 1 amp or more.
2. For Electric Heat MCA, MOP, RDE values, calculate for both cooling and heating modes.
3. If selected Max Over Cur is less than the Minimum Circuit Ampacity, then select the lowest maximum fuse size which is equal to or larger than the Min Circuit Ampacity, provided the selected fuse size does not exceed 800 amps.

Use the checklist provided below in conjunction with the "General Unit Requirement" checklist" to ensure that the unit is properly installed and ready for operation. Be sure to complete all of the procedures described in this section before starting the unit for the first time.

[ ] Turn the field supplied disconnect switch, located upstream of the unit, to the "Off" position.

WARNING:
HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

Failure to disconnect power before servicing can cause severe personal injury or death.

[ ] Turn the "System" selection switch (at the Remote Panel) to the "Off" position and the "Fan" selection switch (if applicable) to the "Auto" or "Off" position.

[ ] Check all electrical connections for tightness and "point of termination" accuracy.

[ ] Verify that the condenser airflow will be unobstructed.

[ ] Check the condenser fan blades. Ensure they rotate freely within the fan orifices and are securely fastened to the fan motor shaft.

[ ] Disable the compressor (s) by unpluging the reset relay for each circuit. Refer to the unit-wiring diagram that sipped with the unit.

[ ] Verify that all compressor service valves, discharge service valves, and liquid line service valves is back seated on each circuit.

CAUTION:
COMPRESSOR SERVICE VALVES!

COMPRESSOR SERVICE VALVES MUST BE FULLY OPENED BEFORE START-UP (SUCTION, DISCHARGE, LIQUID LINE, AND OIL LINE).

Failure to fully open valves prior to start-up may cause compressor failure due to lack of refrigerant and/or oil flow.

[ ] Remove the protective plastic coverings that shipped over the compressors.

[ ] Check the compressor oil levels. The oil level in each manifold set of compressor sight glasses should be equally 1/2 to 3/4 full when they are "Off".

[ ] Pack Stock Units;
Two low pressure switches are installed at the factory. However, only one is wired into the control circuit. This is to facilitate either an EVP chiller application or an air over evaporator application. Before starting the system, verify that the correct pressure switch for the application is connected to the control circuit. Refer to Table 5-2 for the pressure control settings and the unit wiring diagram, that shipped with the unit, for the appropriate connections.

[ ] Check the condenser coils. They should be clean and the fins should be straight. Straighten any bent coil fins with an appropriate sized fin comb.

[ ] Inspect the interior of the unit for tools and debris.

EVP Chiller Applications
[ ] Fill the chilled water system.

[ ] Vent the chilled water system at the highest points in the system.

[ ] Once the system has been filled, inspect the entire chilled water piping system for leaks. Make any necessary repairs before proceeding.

Note: To avoid possible equipment damage, do not use untreated or improperly treated system water.

[ ] Inspect the interior of the unit for tools and debris in preparation for starting the unit and complete the remainder of the "Pre-start" procedures before starting the unit.

System Evacuation Procedures (For Service)

Each refrigeration circuit for split system applications must be evacuated before the unit can be started. Use a rotary type vacuum pump capable of pulling a vacuum of 100 microns or less. Verify that the unit disconnect switch and the system control circuit switches are "OFF".

The oil in the vacuum pump should be changed each time the pump is used with a high quality vacuum pump oil. Before using any oil, check the oil container for discoloration which usually indicates moisture in the oil and/or water droplets. Moisture in the oil adds to what the pump has to remove from the system, making the pump inefficient.

When connecting the vacuum pump to a refrigeration system, it is important to manifold the vacuum pump to both the high and low side of the system (liquid line access valve and suction line access valve). Follow the pump manufacturer's directions for the proper methods of using the vacuum pump.

The lines used to connect the pump to the system should be copper and of the largest diameter that can practically be used. Using larger line sizes with minimum flow resistance can significantly reduce evacuation time. Rubber or synthetic hoses are not recommended for system evacuation because they have moisture absorbing characteristics which result in excessive rates of evaporation, causing pressure rise during the standing vacuum test. This makes it impossible to determine if the system has a leak, excessive residual moisture, or a continual or high rate of pressure increase due to the hoses.

An electronic micron vacuum gauge should be installed in the common line ahead of the vacuum pump shutoff valve, as shown in Figure 4-1. Close Valves B and C, and open Valve A.

Start the vacuum pump, after several minutes, the gauge reading will indicate the maximum vacuum the pump is capable of pulling. Rotary pumps should produce vacuums of 100 microns or less.

Note: Do not, under any circumstances, use a megohm meter or apply power to the windings of a compressor while it is under a vacuum. Electrical shorting between motor windings and/or housing can occur while in a vacuum, causing motor burnout.

Open Valves B and C. Evacuate the system to a pressure of 300 microns or less. As the vacuum is being pulled on the system, there could be a time when it would appear that no further vacuum is being obtained, yet, the pressure is high. It is recommended that during the evacuation process, the vacuum be "Broken", to facilitate the evacuation process.

To break the vacuum;
Shutoff valves A, B, & C and connect a refrigerant cylinder to the charging port on the manifold. Purge the air from the hose. Raise the standing vacuum pressure in the system to "zero" (0 psig) gauge pressure. Repeat this process two or three times during evacuation.

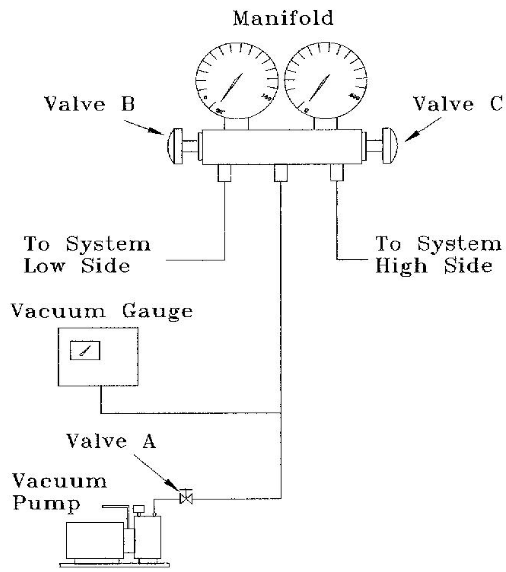
Note: It is unlawful to release refrigerant into the atmosphere. When service procedures require working with refrigerants, the service technician must comply with all Federal, State, and local laws. Refer to the General Service Bulletin MSCU-SB-1 (latest edition).

Standing Vacuum Test
Once 300 microns or less is obtained, close Valve A and leave valves B and C open. This will allow the vacuum gauge to read the actual system pressure. Let the system equalize for approximately 15 minutes. This is referred to as a "standing vacuum test" where, time versus pressure rise. The maximum allowable rise over a 15 minute period is 200 microns. If the pressure rise is greater than 200 microns but levels off to a constant value, excessive moisture is present. If the pressure steadily continues to rise, a leak is indicated. Figure 4-2 illustrates three possible results of the "standing vacuum test".

If a leak is encounter, repair the system and repeat the evacuation process until the recommended vacuum is obtained.

Once the system has been evacuated, break the vacuum with refrigerant, and complete the remaining "Pre-Start Procedures" before starting the unit.

Figure 4-1
Typical Vacuum Pump Hookup



Voltage Imbalance

Excessive three phase voltage imbalance between phases will cause motors to overheat and eventually fail. The maximum allowable voltage imbalance is 2%. Measure and record the voltage between phases 1, 2, and 3 and calculate the amount of imbalance as follows:

$$\% \text{ Voltage Imbalance} = 100 \times \frac{AV - VD}{AV} \text{ where;}$$

$$\text{AV (Average Voltage)} = \frac{\text{Volt 1} + \text{Volt 2} + \text{Volt 3}}{3}$$

V1, V2, V3 = Line Voltage Readings
VD = Line Voltage reading that deviates the farthest from the average voltage.

> **Example:** If the voltage readings of the supply power measured 221, 230, and 227, the average volts would be:
>
> $$\frac{221 + 230 + 227}{3} = 226 \text{ Avg.}$$

VD (reading farthest from average) = 221

The percentage of Imbalance equals:

$$100 \times \frac{226 - 221}{226} = 2.2\%$$

The 2.2% imbalance in this example exceeds the maximum allowable imbalance of 2.0%. This much imbalance between phases can equal as much as a 20% current imbalance with a resulting increase in motor winding temperatures that will decrease motor life. If the voltage imbalance is over 2%, notify the proper agencies to correct the voltage problem before operating this equipment.

Electrical Phasing

Proper electrical phasing can be quickly determined and corrected before starting the unit by using an instrument such as an Associated Research Model 45 Phase Sequence Indicator and following the steps below:

[ ] Turn the field supplied disconnect switch that provides power to terminal block 1TB1 to the "Off" position.

[ ] Connect the phase sequence indicator leads to the terminal block or to the "Line" side of the optional factory mounted disconnect switch as follows;

Black (phase A)	to	L1
Red (phase B)	to	L2
Yellow (phase C)	to	L3

[ ] Close the main power disconnect switch or circuit protector switch that provides the supply power to the condensing unit.

⚠ WARNING:

HAZARDOUS VOLTAGE!

HIGH VOLTAGE IS PRESENT AT TERMINAL BLOCK 1TB1 OR UNIT DISCONNECT SWITCH 1S1.

To prevent injury or death form electrocution, it is the responsibility of the technician to recognize this hazard and use extreme care when performing service procedures with the electrical power energized.

[ ] Observe the ABC and CBA phase indicator lights on the face of the sequencer. The ABC indicator light will glow if the phase is ABC. If the CBA indicator light glows, open the disconnect switch or circuit protection switch and reverse any two power wires.

[ ] Restore the main electrical power and recheck the phasing. If the phasing is correct.

[ ] Open the main power disconnect switch or circuit protection switch and remove the phase sequence indicator.

Sequence of Operation

Thermostatic Expansion Valve
The reliability and performance of the refrigeration system is heavily dependent upon proper expansion valve adjustment. Therefore, the importance of maintaining the proper superheat cannot be over emphasized. Accurate measurements of superheat will provide the following information.

1. How well the expansion valve is controlling the refrigerant flow.
2. The efficiency of the evaporator coil.
3. The amount of protection the compressor is receiving against flooding or overheating.

The recommended range for superheat is 10 to 16 degrees at the evaporator. Systems operating with less than 10 degrees of superheat:

a. Could cause serious compressor damage due to refrigerant floodback.

b. Removes working surface from the evaporator normally used for heat transfer.

Systems operating with superheat in excess of 16 degrees:

a. Could cause excessive compressor cycling on internal winding thermostat which leads to compressor motor failure.

b. Lowers the efficiency of the evaporator by reducing the heat transfer capability.

The outdoor ambient temperature must be between 65°F and 105°F and the relative humidity of the air entering the evaporator must be above 40 percent. When the temperatures are outside of these ranges, measuring the operating pressures can be meaningless.

Sequence of Operation

Condenser Fans
Condenser fan cycling is accomplished through interlocking the fan contactors with liquid line pressure switches (4S11 and 4S12). When the low ambient damper option is applied, ambient thermostats (1S36 & 1S37) are used to provide additional fan cycling control on "No System Control", Constant Volume, and Variable Air Volume applications. Figure 5-3 illustrates the condenser fan locations with their respective fan and relay designator.

When a cooling command has been initiated (circuit #1, first step), condenser fans 2B1, 2B2, and 2B3 are held "Off" by the liquid line pressure switch (4S11) and normally open interlock contacts 1K5 & 1K6. Once the pressure switch has closed (275 psig), condenser fan relay 1K5 is energized starting fan 2B1. The normally open interlock contacts 1K5 closes, energizing fan contactor 1K6, starting fan 2B2. When the normally open interlock contacts 1K6 close, they seal 1K6 contactor in the "On" position until the cooling demand has been satisfied. Condenser fan 2B3 on 25, 30, 50 & 60 Ton units is not allowed to start until compressor relay 1K13 has energized and the low ambient thermostat (1S36, if applicable) has closed.

If a second step cooling command is initiated, (circuit #2), condenser fans 2B4, 2B5, and 2B6 are held "Off" by the liquid line pressure switch (4S12) and normally open interlock contacts 1K8 & 1K9. Once the pressure switch has closed (275 psig), condenser fan relay 1K8 is energized starting fan 2B4. The normally open interlock contacts 1K8 closes, energizing fan contactor 1K9, starting fan 2B5. When the normally open interlock contacts 1K9 close, they seal 1K9 contactor in the "On" position until the cooling demand has been satisfied. Condenser fan 2B6 on 50 and 60 Ton units is not allowed to start until compressor relay 1K14 has energized and the low ambient thermostat (1S37, if applicable) has closed.

Sequence of Operation

Low Ambient Dampers
Low Ambient Dampers are available as a factory installed option or can be field-installed. Dampers are used to extend the operation of these units from the standard operational temperatures to a minimum of 0°F without hot gas bypass or 10°F with hot gas bypass. (These values apply when wind speed across the condenser coil is less than 5 m.p.h.). If typical wind speeds are higher than 5 m.p.h., a wind screen around the unit may be required. By restricting the airflow across the condenser coils, saturated condensing temperatures can be maintained as the ambient temperatures change.

The low ambient damper actuator controls damper modulation for each refrigerant circuit in response to saturated condensing temperature.

Compressor Crankcase Heaters
Each compressor is equipped with a crankcase heater and is controlled by a 600 volt auxiliary switch on the compressor contactor. The proper operation of the crankcase heater is important to maintain an elevated compressor oil temperature during the "Off" cycle to reduce oil foaming during compressor starts.

When the compressor starts, the sudden reduction in crankcase pressure causes the liquid refrigerant to boil rapidly causing the oil to foam. This condition could damage compressor bearings due to reduced lubrication and could cause compressor mechanical failures.

When power has been "Off" for an extended period, allow the crankcase heater to operate a minimum of 8 hours before starting the unit.

Sequence of Operation

Pump Down
Each circuit will go into a pump down cycle when the last compressor on that circuit is turned "Off". During pump down, the solenoid valves are closed, the reset circuit is bypassed and the compressor will continue to run until the 30 psig pressure switch opens.

Low Ambient Thermostats
In addition to the low ambient dampers on 25, 30, 50 & 60 Ton units, a low ambient thermostat is installed to further restrict the airflow across the condenser by cycling the 2B3 condenser fan on 25 & 30 Ton units plus 2B6 on 50 & 60 Ton units. The thermostat opens when the ambient temperature reaches 30°F and closes at approximately 33°F.

Compressor Start-Up
(All Systems)

1. Before closing the field provided or optional factory mounted disconnect switch at the unit, ensure that the compressor discharge service valve and the liquid line service valve for each circuit is back seated.

⚠CAUTION:
COMPRESSOR SERVICE VALVES!

COMPRESSOR SERVICE VALVES MUST BE FULLY OPENED BEFORE START-UP (SUCTION, DISCHARGE, LIQUID LINE, AND OIL LINE).

Failure to fully open valves prior to start-up may cause compressor failure due to lack of refrigerant and/or oil flow.

---

2. If the system has been previously charged before starting, disable the compressor(s) by unplugging the reset relay for each circuit. Refer to the unit-wiring diagram that sipped with the unit. Turn the main power disconnect to the "On" position and allow the crankcase heater to operate a minimum of 8 hours before continuing.

Note: Compressor Damage could occur if the crankcase heater is not allowed to operate the minimum 8 hours before starting the compressor(s).

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3. Attach a set of service gauges onto the suction and discharge gauge ports for each circuit.

System Start-Up (Continued)

4. Charge liquid refrigerant into the liquid line of each refrigerant circuit with the required amount of R-22. Refrigerant should be charged into the system by weight. Use an accurate scale or a charging cylinder to monitor the amount of refrigerant entering the system. Refer to Table 5-3 for the required amount of refrigerant for the condensing unit.

   If the pressure within the system equalizes with the pressure in the charging cylinder before charging is completed, complete the process by charging into the suction (low) side of the system after the system has been started.

   Table 5-4 gives the minimum starting temperatures for both "Standard" & "Low" Ambient units.

   Do not attempt to charge the system with the low ambient dampers and/or hot gas bypass operating (if applicable). Disable the low ambient dampers in the "Open" position (refer to the "Low Ambient Damper Adjustment" section) and de-energize the hot gas bypass solenoid valves before proceeding.

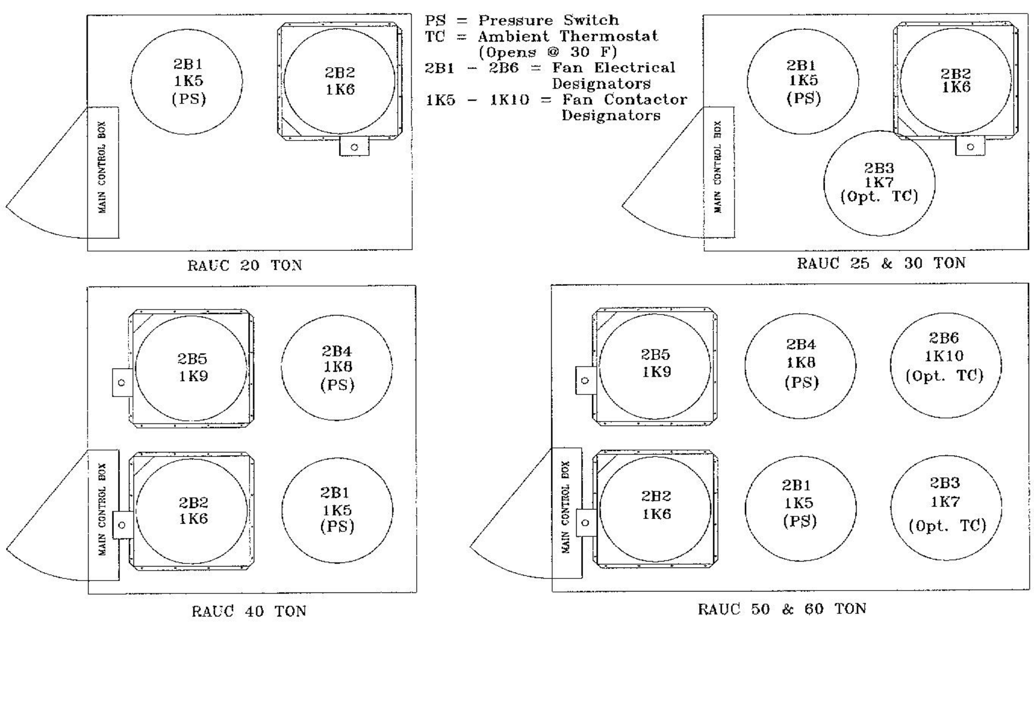
5. On units with dual circuits, start only one circuit at a time. To disable the compressors, unplug the appropriate lockout relay inside the unit control panel. Refer to Table 5-5 for the compressor sequencing and Figure 5-4 for their location.

6. Close the "High Side" valve on the manifold gauge set.

7. Set the "System" selection switch to the "Cool" position

8. Turn the main power disconnect switch or circuit protector switch, to the unit, "On".

Figure 5-3
Condenser Fan Locations



⚠ WARNING:
HAZARDOUS VOLTAGE
ROTATING PARTS!

UNIT STARTS AUTOMATICALLY

Make sure all personnel are standing clear of the unit before proceeding. The system components will start when the power is applied.

9. Turn the 115-volt control circuit switch 1S2 to the "On" position.

   a. Once each compressor or compressor pair has started, verify that the rotation is correct. If a scroll compressor is rotating backwards, it will not pump and a loud rattling sound can be observed.

   b. Check the condenser fans for proper rotation. The direction of rotation is clockwise when viewed from the top of the unit.

   All Motors are Rotating Backwards;

   1. Turn the field supplied disconnect switch or circuit protector switch that provides power to the condensing unit to the "Off" position. Lock the disconnect switch in the open position while working at the unit.

   2. Interchange any two of the field connected main power wires at the unit terminal block 1TB1 or the optional factory mounted non-fused disconnect switch (1S1) in the unit control panel.

Note: Interchanging "Load" side power wires at the contactors will only affect the individual fan rotation. Ensure that the voltage phase sequence at the main terminal block 1TB1 is ABC as outlined in the "Electrical Phasing" section.

   Some Motors are Rotating Backwards;

   1. Turn the field supplied disconnect switch or circuit protector switch that provides power to the condensing unit to the "Off" position. Lock the disconnect switch in the open position while working at the unit.

   2. If the electrical phasing is correct, interchange any two of the motor leads at the contactor for each motor that is rotating backwards. Before condemning a compressor, interchange any two leads (at the compressor Terminal block) to check the internal phasing. Refer to the illustration in Figure 5-5 for the compressor terminal/phase identification. If the compressor runs backward for an extended period (15 to 30 minutes), the motor winding can overheat and cause the motor winding thermostat to open.

10. With the compressors operating, slowly open the "Low Side" valve on the manifold gauge set. The remainder of the refrigerant will be drawn into the system.

Note: To prevent compressor damage due to no refrigerant flow, do not utilize the compressors to pump the system down below 7 PSIG under any circumstances.

11. After the compressors and condenser fans for the operating circuit have been operating for approximately 30 minutes, observe the operating pressures. Use the appropriate pressure curve in Table 5-6 to determine the proper operating pressures. If the operating pressures indicate a refrigerant shortage, measure the system superheat and system subcooling.

Note: Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all Federal, State and local laws. Refer to general service bulletin MSCU-SB-1 (latest edition).

Subcooling
The outdoor ambient temperature must be between 65°F and 105°F and the relative humidity of the air entering the evaporator must be above 40 percent. When the temperatures are outside of these ranges, measuring the operating pressures can be meaningless.

With the unit operating at "Full Circuit Capacity", acceptable subcooling ranges between 14°F to 22°F.

Measuring Subcooling

a. At the liquid line service valve, measure the liquid line pressure. Using a Refrigerant 22 pressure/temperature chart, convert the pressure reading into the corresponding saturated temperature.

b. Measure the actual liquid line temperature as close to the liquid line service valve as possible. To ensure an accurate reading, clean the line thoroughly where the temperature sensor will be attached. After securing the sensor to the line, insulate the sensor and line to isolate it from the ambient air.

Note: Glass thermometers do not have sufficient contact area to give an accurate reading.

c. Determine the system subcooling by subtracting the actual liquid line temperature (measured in b) from the saturated liquid temperature (converted in a).

Measuring Superheat

a. Measure the suction pressure at the outlet of the evaporator as close to the expansion valve bulb location as possible.

b. Measured the suction line temperature as close to the expansion valve bulb, as possible.

c. Using a Refrigerant/Temperature chart, convert the pressure reading to a corresponding saturated vapor temperature.

Note: On many Trane fan/coil units, an access valve is provided close to the expansion valve bulb location. This valve must be added on climate changers and other evaporators.

d. Subtract the saturated vapor temperature (converted in c), from the actual suction line temperature (measured in b). The difference between the two temperatures is known as "superheat".

12. Verify that the oil level in each compressor is correct. The oil level may be down to the bottom of the sight glass but should never be above the sight glass.

13. Once the checks and adjustments for the operating circuit has been completed, check and record the:

ambient temperature;
compressor oil level (each circuit);
compressor suction and discharge pressures (each circuit);
superheat and subcooling (each circuit);

Record this data on an "operator's maintenance log" shown in Table 5-8. Repeat these procedures for the second refrigeration circuit, if applicable.

14. Turn the 115-volt control circuit switch 1S2 to the "OFF" position and open the field provided or optional factory mounted disconnect switch.

15. After shutting the system off, check the compressor oil appearance. Discoloration of the oil indicates that an abnormal condition has occurred. If the oil is dark and smells burnt, it has overheated because of: compressor is operating at extremely high condensing temperatures; high superheat; a compressor mechanical failure; or, occurrence of a motor burnout.

If the oil is black and contains metal flakes, a mechanical failure has occurred. This symptom is often accompanied by a high compressor amperage draw.

If a motor burnout is suspected, use an acid test kit to check the condition of the oil. Test results will indicate an acid level exceeding 0.05 mg KOH/g if a burnout occurred.

Compressor Oil

The scroll compressor uses **Trane OIL-42 without substitution**. The appropriate oil charge for a 9 and 10 Ton scroll compressor is 8.5 pints. For a 14 and 15 Ton scroll compressor, use 13.8 pints.

Compressor Crankcase Heaters

9 and 10 ton scroll compressors have a 100-watt heater installed. 14 and 15 ton scroll compressors have two 80-watt heaters installed per compressor.

Table 5-2
Pressure Control Switch Settings

Pressure Switch	Make	Break
Hi Pressure	350 psi	405 psi
Lo Pressure		
EVPB	60 psi	45 psi
All others	40 psi	30 psi
Condenser Fan Cycling Switch	275 psi	155 psi
(EVP Only w/HGB - wo/HGB) Std.		
Low Ambient Thermostat	33 F	30 F
Compressor Winding T-Stat	181 F	221 F

Note: Pack Stock units will have both low pressure switches shipped and the user should use the above valves that apply.

Table 5-3
Recommended Refrigerant Capacities

Approximate Total System Refrigerant Charge (Lbs. Per Circuit)	
30 Ton	30
40 Ton	33
50 Ton	38
60 Ton	44

Table 5-4
Minimum Starting Ambient Temperature

Unit Size	Minimum Starting Ambient (1) Standard Units No HGBP
40-60	40°

Note :
1. Minimum starting ambients in degrees F and is based on the unit operating at minimum step of unloading and 5 mph wind across condenser.

Table 5-5
Compressor Sequence

Unit Size	Control Step	Circuit 1		Circuit 2
20	1	A	50%	
	2	A,B	100%	
25	1	B	40%	
	2	A,B	100%	
30	1	A	50%	
	2	A,B	100%	
40	1	A	50%	
	2	A	50%	C (50%)
	3	A	50%	C.D (100%)
	4	A,B	100%	C.D (100%)
50	1	A	61%	
	2	A	61%	C (61%)
	3	A	61%	C.D (100%)
	4	A,B	100%	C.D (100%)
60	1	A	50%	
	2	A	50%	C (50%)
	3	A	50%	C.D (100%)
	4	A,B	100%	C.D (100%)

Note: A, B, C and D indicate which compressor in the unit is operating. (%) indicates the amount of the circuit in operation during a given step. Refer to the compressor location illustration for the unit.

Figure 5-5
Typical Compressor Terminal Block

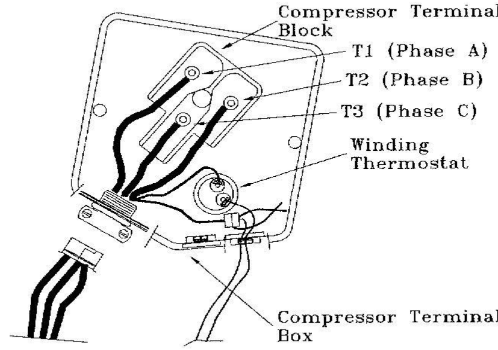


Figure 5-4
Typical Compressor Locations

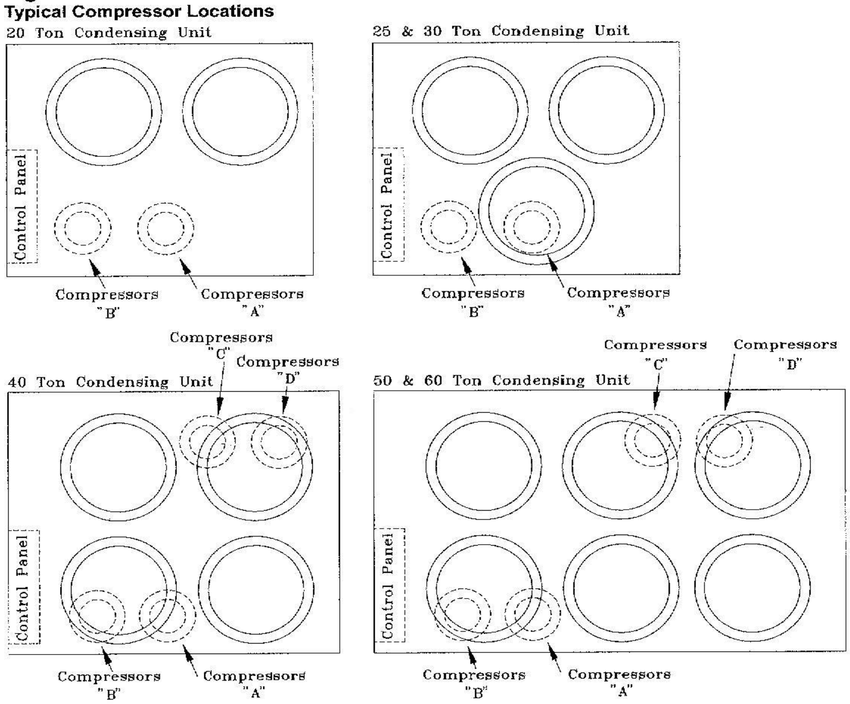


Table 19. Thermal expansion valve manufacturer settings

Sporlan

Standard off the shelf nominal valve settings (90 PSIG air test setting)

Valve	Superheat, °F	CW turns available	CCW turns available	Superheat change per turn	Field adjust for 18°F (DX evap coil)	Field adjust for 15°F (EVP only)
ERZE-1-GA	12	4.5	4.5	2.4°F	2.5 CW	—
ERZE-1-1/2-GA						
ERZE-2-GA						
ERZE-3-GA						
ERZE-4-GA						
ERZE-5-GA						
ERZE-6-GA						
ERZE-8-GA						
ERZE-12.5-GA						
ERZE-15-GA						
OZE-20-GA				3.4°F	.25 CW	.25 CW
OZE-25-GA						
OZE-35-GA						
OZE-50-GA		7.5		1.8°F	3.25 CW	1.75 CW
OZE-60-GA						

Emerson

Standard off the shelf nominal valve settings

Valve	Nom Tons	Superheat, °F	CW turns available	CCW turns available	Superheat change per turn	Field adjust for 18°F (DX evap coil)	Field adjust for 15°F (EVP only)
C	1-1/2 to 7	13	6	6	4	1.25 CW	
TF	12 to 20		5	5	2	2.5 CW	1.0 CW

Danfoss

Standard off the shelf nominal valve settings

Valve	Body size	SHT, °F	CW turns available	CCW turns available	Superheat change per turn	Field adjust for 18°F (DX evap coil)	Field adjust for 15°F (EVP only)
TGEL 3.5 TR	TGE 10	14.4	4	3	4.5°F	.75 CW	—
TGEL 4.5 TR							
TGEL 6.5 TR							
TGEL 9 TR							
TGEL 13 TR							
TGEL 15 TR	TGE 20		7		3	1.25 CW	.25 CW
TGEL 19 TR							
TGEL 23 TR							
TGEL 31 TR	TGE 40			4			
TGEL 35 TR							
TGEL 46 TR							

Pressure Curves

To Check Operating Pressures

1. Start the unit and allow the pressures to stabilize.
2. Measure the outdoor air dry bulb temperature (F) entering the condenser coil.
3. Measure the discharge and suction pressure (psig) next to the compressor.
4. Plot the outdoor dry bulb temperature and the operating suction pressure (psig) onto the chart.
5. At the point of intersection, read to the left for the discharge pressure. The measured discharge pressure should be within +/- 10 psig of the graph.

Figure 61. 20 ton pressure curve

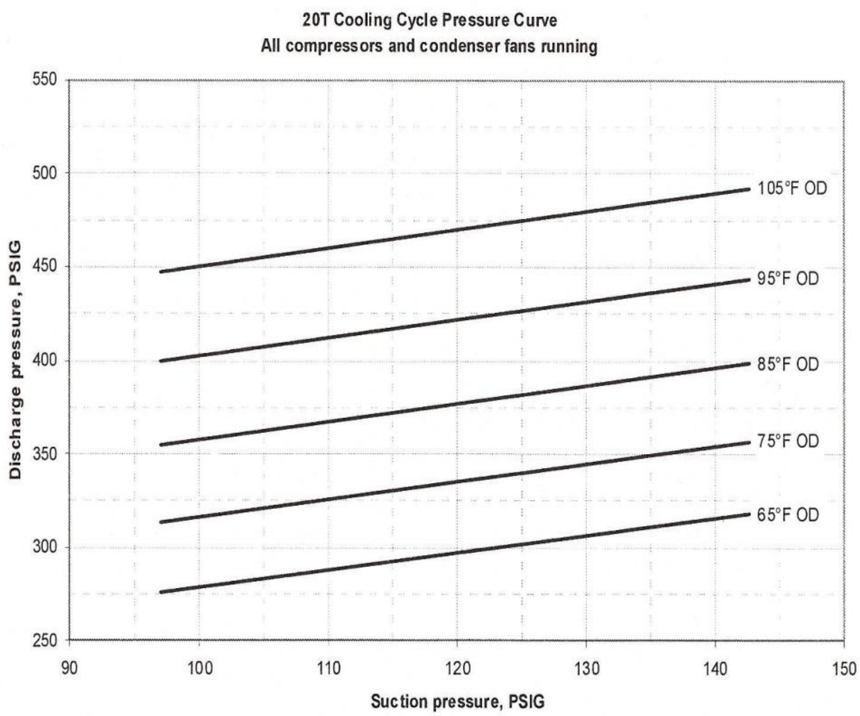


Figure 62. 25 ton pressure curve

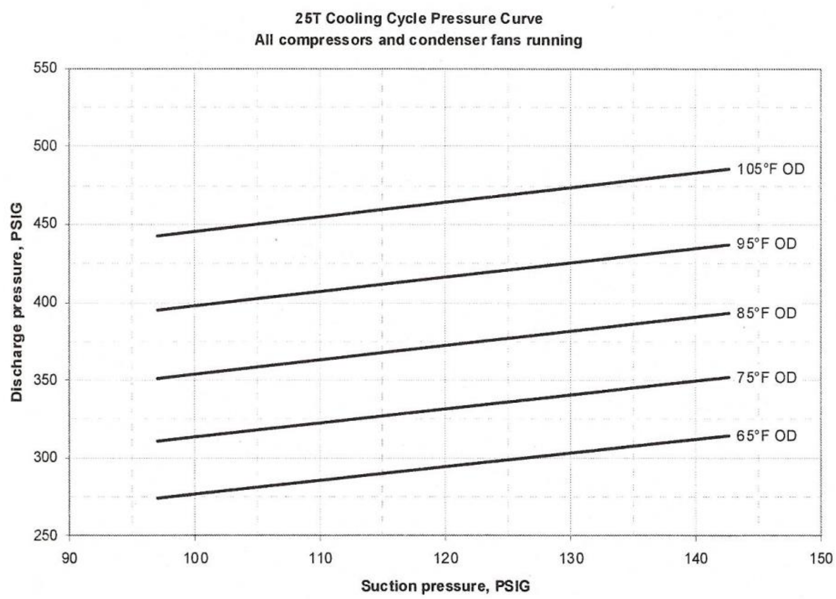


Figure 63. 30 ton pressure curve

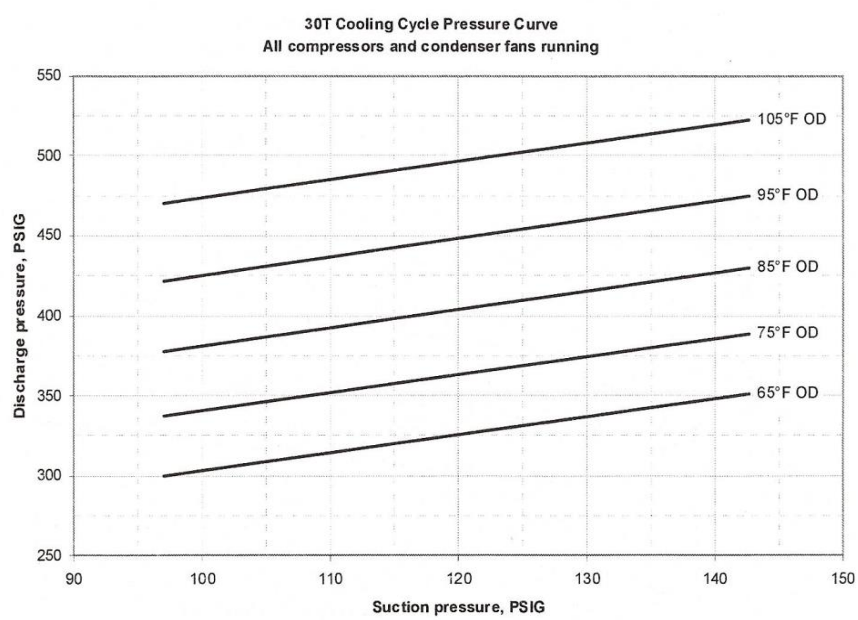


Figure 64. 40 ton pressure curve

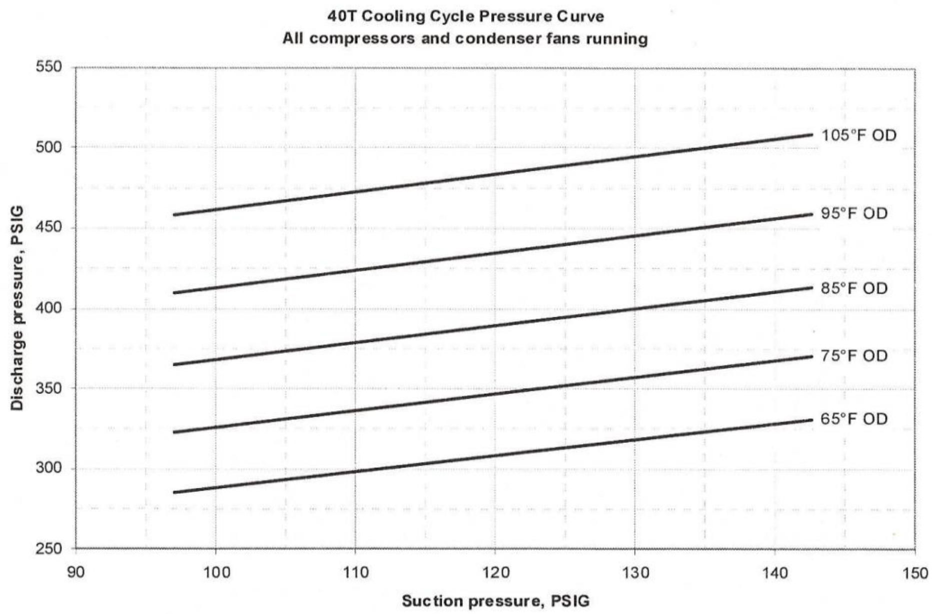


Figure 65. 50 ton pressure curve

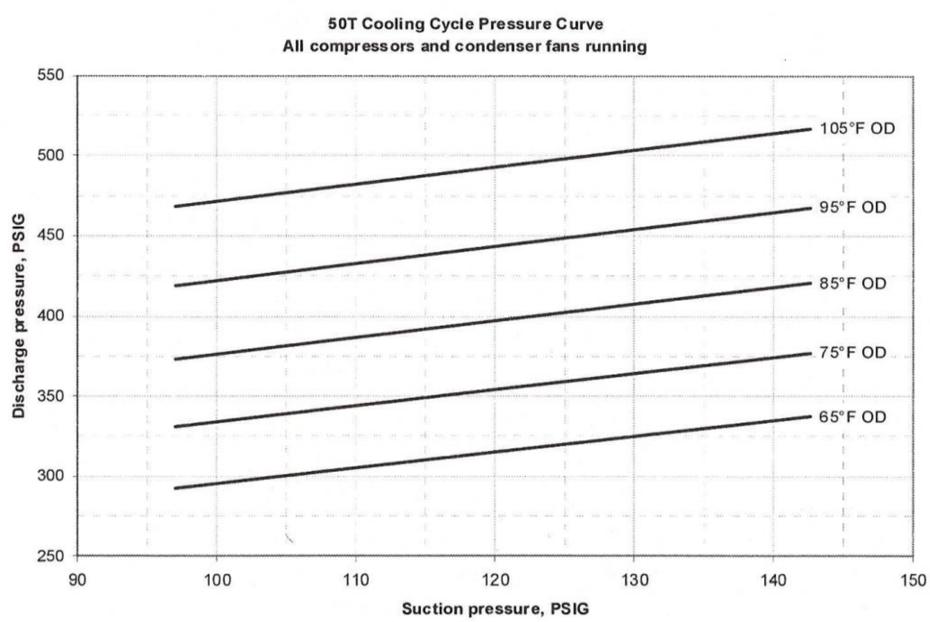


Figure 66. 60 ton pressure curve

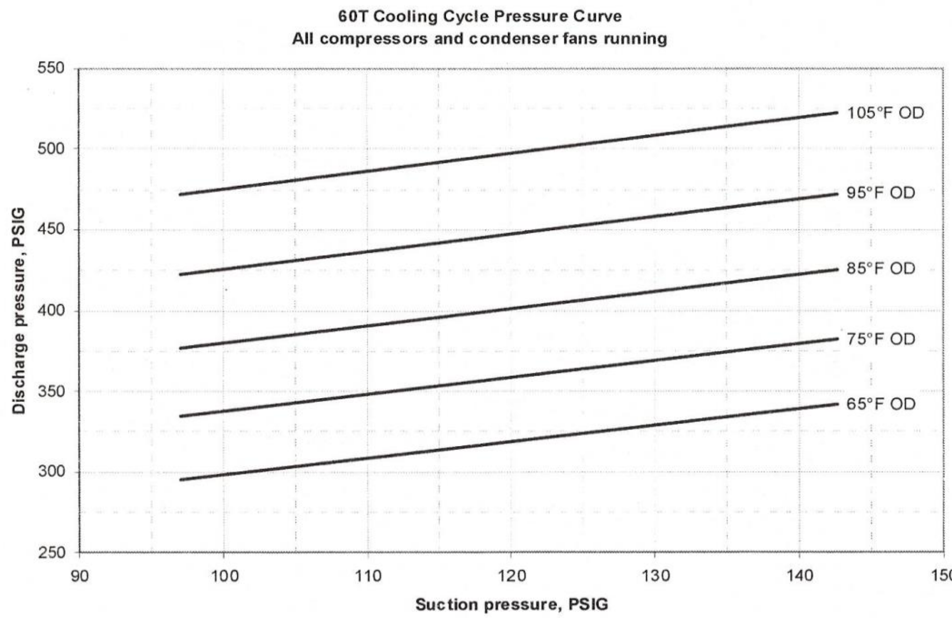


Figure 67. 80 ton pressure curve

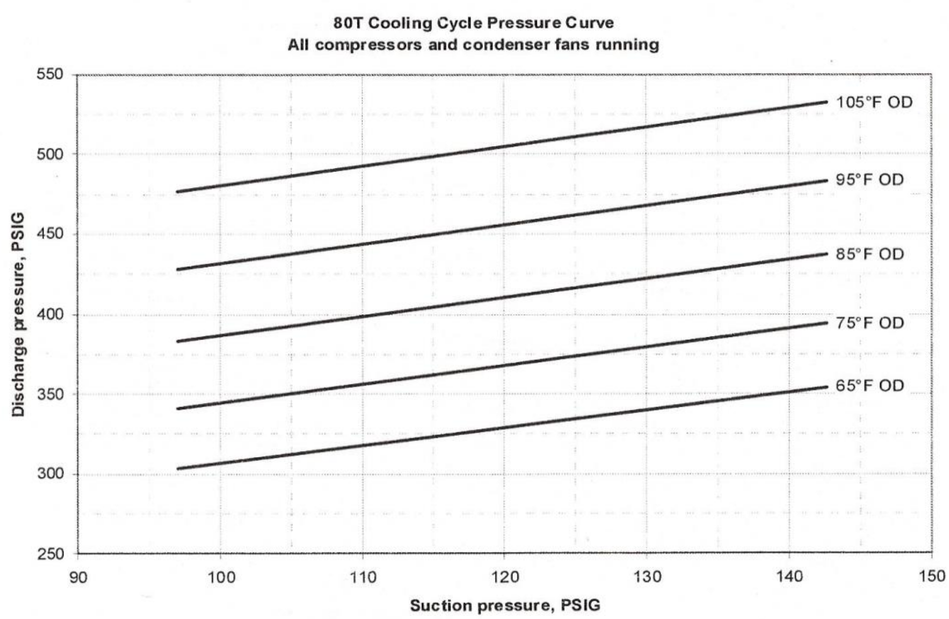


Figure 68. 100 ton pressure curve

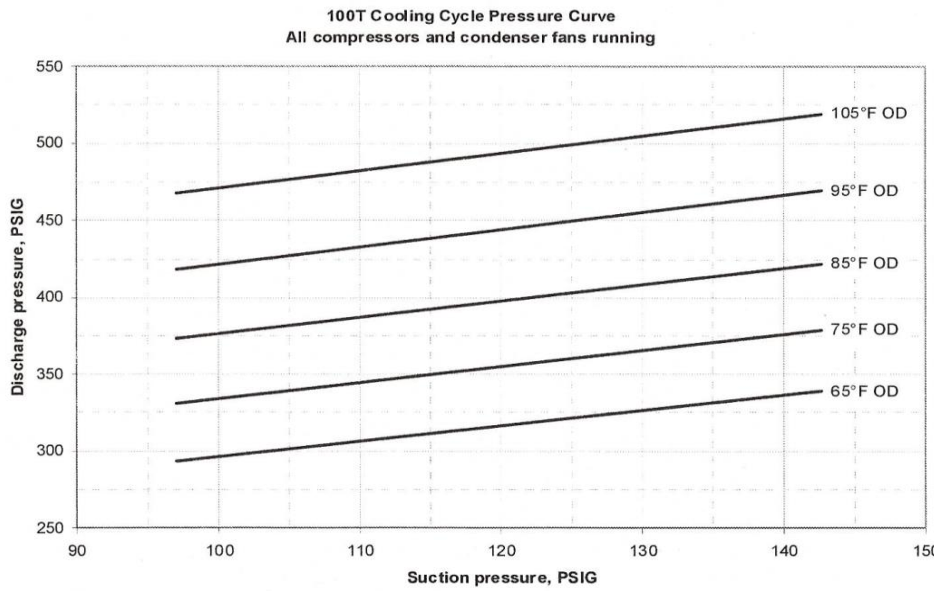
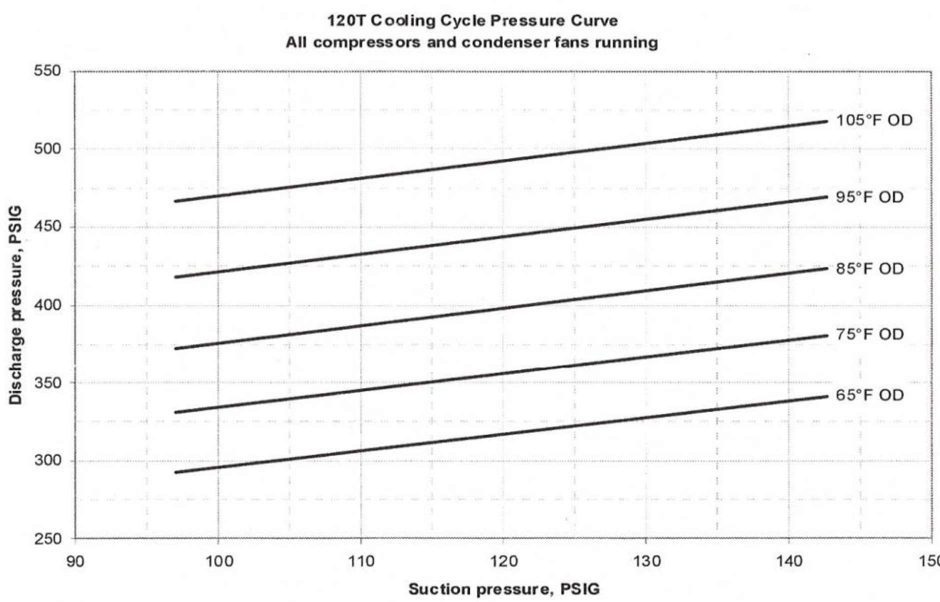


Figure 69. 120 ton pressure curve



Compressor Operational Sounds

Because of the scroll compressor design, it emits a higher frequency tone (sound) than a reciprocating compressor. It is designed to accommodate liquids, both oil and refrigerant, without causing compressor damage. The following discussion describes some of the operational sounds that differentiate it from those typically associated with a reciprocating compressor. These sounds do not affect the operation or reliability of the compressor.

At Shutdown:
When a Scroll compressor shuts down, the gas within the scroll expands and causes momentary reverse rotation until the discharge check valve closes. This results in a "flutter" type sound.

At Low Ambient Start-Up
When the compressor starts up under low ambient conditions, the initial flow rate of the compressor is low due to the low condensing pressure. This causes a low differential across the thermal expansion valve that limits its capacity. Under these conditions, it is not unusual to hear the compressor rattle until the suction pressure climbs and the flow rate increases.

Scroll Compressor Replacement

Table 6-1 lists the specific compressor electrical data and the circuit breaker operating ranges.

The compressor manifold system was purposely designed to provide proper oil return to each compressors. The refrigerant manifolded system must not be modified in any way.

Note: Altering the manifold piping may cause oil return problems and compressor failure.

Should a compressor replacement become necessary and a suction line filter drier is to be installed, install it a minimum of 18 inches upstream of the oil separator tee. Refer to the illustration in Figure 6-1.

Anytime a compressor is replaced, the oil for each compressor within the manifolded set must be replaced.

The scroll compressor uses **Trane OIL-42 without substitution**. The appropriate oil charge for a 9 and 10 Ton scroll compressor is 8.5 pints. For a 14 and 15 Ton scroll compressor, use 13.8 pints.

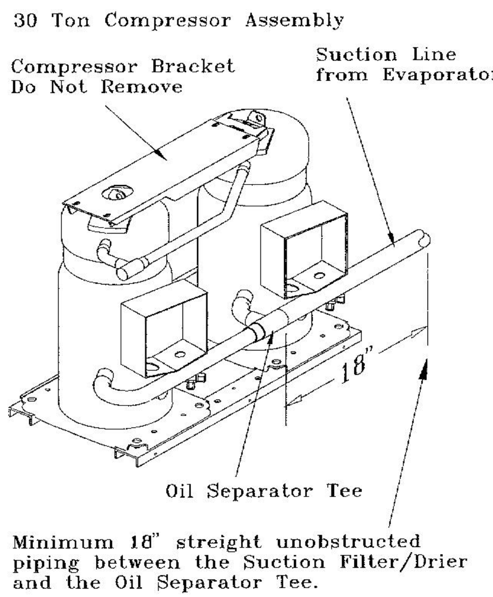
Note: Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all Federal, State and local laws. Refer to general service bulletin MSCU-SB-1 (latest edition).

Note: Refrigerant oil is detrimental to some roofing materials. Care must be taken to protect the roof from oil leaks or spills.

Table 6-1
Compressor Circuit Breaker Data

Voltage	Comp Tons	RLA	LRA	Must Hold	Must Trip
200	9	41.4	269.0	50.4	58.0
230	9	41.4	251.0	50.4	58.0
460	9	18.1	117.0	22.0	25.3
575	9	14.4	94.0	17.5	20.2
380/415	9	17.2	110.0	20.9	24.1
200	14	60.5	404.0	73.7	84.7
230	14	60.5	376.0	73.7	84.7
460	14	26.3	178.0	32.0	36.8
575	14	21.0	143.0	25.6	29.4
380/415	14	26.2	174.0	31.9	36.7

Figure 6-1
Suction Line Filter/Drier Installation



Fuse Replacement Data

Table 6-2 lists the replacement fuses for the control circuit, compressors, and condenser fans.

Table 6-2
Fuse Replacement Data

FUSE REPLACEMENT SELECTION				
FUSE DESCRIPTION	UNIT SIZE	UNIT VOLTAGE	FUSE TYPE	FUSE SIZE
CONDENSER FAN FUSE (1F1-1F3 ON 20 - 30 TON) (1F1-1F6 ON 20 - 60 TON)	ALL	200/230 VOLT	CLASS K5	25 AMP
		460/575 VOLT 380/415 VOLT		15 AMP
CONTROL CKT FUSE (1F7)	20-30 TON	ALL	BUSSMANN S - 3.20	3.20 AMP
	40-60 TON	ALL	BUSSMANN S - 6.25	6.25 AMP
COMPR PROTECTOR FUSE (1F8 ON 20 - 60 TON) (1F9 ON 40 - 60 TON)	ALL	ALL	BUSSMANN MTH - 6	6 AMP

Coil Cleaning

Regular coil maintenance, including annual cleaning, enhances the unit's operating efficiency by minimizing:

compressor head pressure and amperage draw;
evaporator water carryover;
fan brake horsepower, due to increase static pressure losses;
airflow reduction.

At least once each year, or more often if the unit is located in a "dirty" environment, clean the evaporator and condenser coils using the instructions outlined below. Be sure to follow these instructions as closely as possible to avoid damaging the coils.

To clean refrigerant coils, use a soft brush and a sprayer (either a garden pump-up type or a high-pressure sprayer). A high-quality detergent is also required; suggested brands include "SPREX A.C.", "OAKITE 161", "OAKITE 166" and "COILOX". If the detergent selected is strongly alkaline (ph value exceeds 8.5), add an inhibitor.

1. Remove enough panels from the unit to gain access to the coil.
2. Protect all electrical devices such as motors and controllers from any over spray.
3. Straighten any bent coil fins with a fin comb.
4. Mix the detergent with water according to the manufacturer's instructions. If desired, heat the solution to 150°F maximum to improve its cleansing capability.

⚠CAUTION:

CONTAINS REFRIGERANT!

SYSTEM CONTAINS OIL AND REFRIGERANT

Do not heat the detergent-and-water solution above 150° F. Hot liquids sprayed on the exterior of the coil will raise the coil's internal pressure and may cause it to burst.

Failure to follow proper procedures can result in personal illness or injury or severe equipment damage.

Note: Refrigerant oil is detrimental to some roofing materials. Care must be taken to protect the roof from oil leaks or spills.

5. Pour the cleaning solution into the sprayer. If a high-pressure sprayer is used:

   a. do not allow sprayer pressure to exceed 600 psi.

   b. the minimum nozzle spray angle is 15 degrees.

   c. maintain a minimum clearance of 6" between the sprayer nozzle and the coil.

   d. spray the solution perpendicular (at 90 degrees) to the coil face.

6. Spray the leaving-airflow side of the coil first; then spray the opposite side of the coil. Allow the cleaning solution to stand on the coil for five minutes.
7. Rinse both sides of the coil with cool, clean water.
8. Inspect both sides of the coil; if it still appears to be dirty, repeat Steps 6 and 7.
9. Reinstall all of the components and panels removed in Step 1 and any protective covers installed in step 2.
10. Restore the unit to it's operational status and check system operation.

System operation

[ ] Close the main power disconnect switch for the condensing unit and all system support equipment. Turn all system control circuit switches to the "On" position.

⚠WARNING:

HAZARDOUS VOLTAGE
ROTATING PARTS!

UNIT STARTS AUTOMATICALLY

Make sure all personnel are standing clear of the unit before proceeding. The system components will start when the power is applied.

[ ] With the unit running, check and record the:

ambient temperature;
compressor oil level (each circuit);
compressor suction and discharge pressures (each circuit);
superheat and Subcooling (each circuit);

Record this data on an "operator's maintenance log" simular to the one illustrated in the "Final Setup" section of this manual. If the operating pressures indicate a refrigerant shortage, measure the system Superheat and system Subcooling. For guidelines, refer to the "System Start-Up" section.

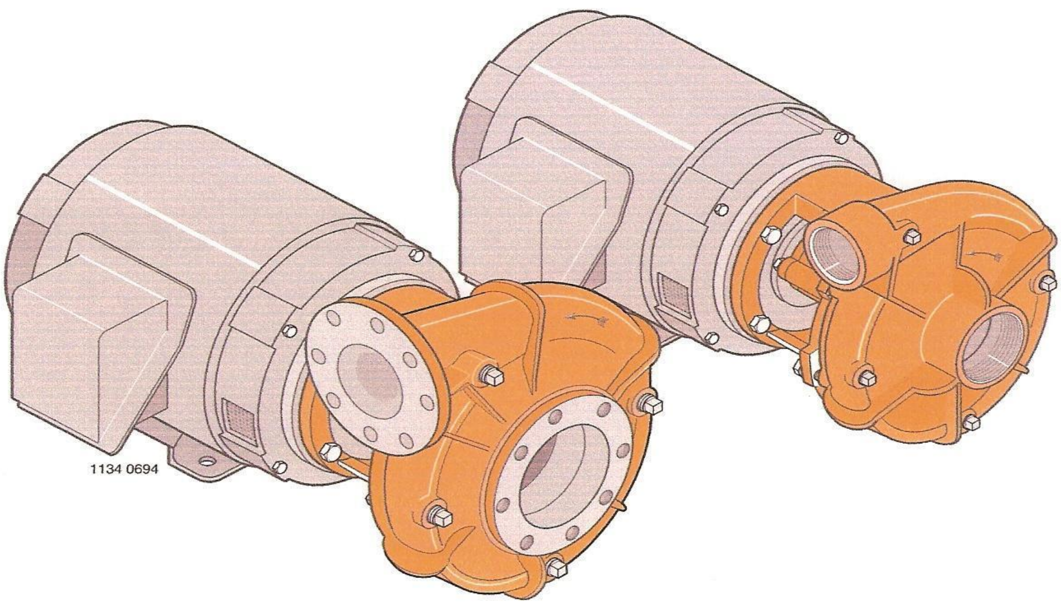
Note: Do Not release refrigerant to the atmosphere! If adding or removing refrigerant is required, the service technician must comply with all federal, state and local laws. Refer to general service bulletin MSCU-SB-1 (latest edition).

BERKELEY®

OWNERS MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST

Close Coupled Motor Driven Centrifugal Pump



IMPORTANT

For best possible performance and continuous, satisfactory operation, read these instructions before installing your new pump.
Should service be required, this manual can be a valuable guide.
It should be kept near the installation for ready reference.
Record nameplate data from pump on blank nameplate inside this manual for future reference.

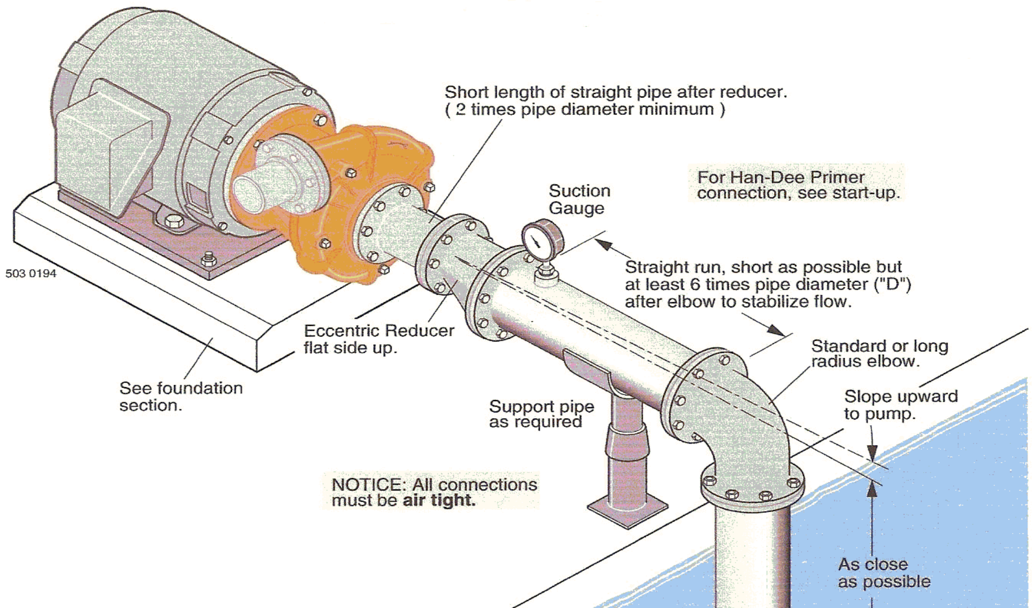
Berkeley Pumps / 293 Wright Street / Delavan, WI 53115

F00634 (Rev. 10/27/06)

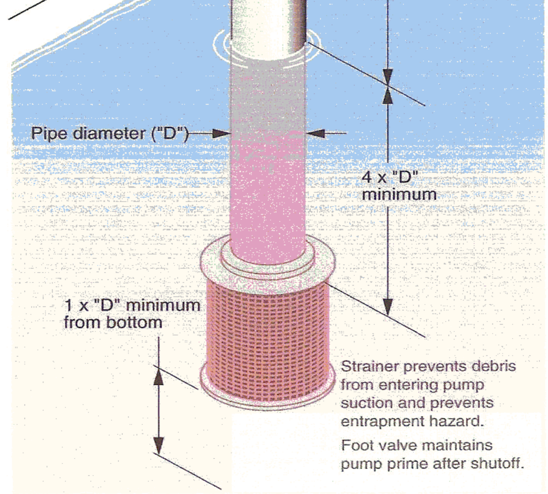
Installation

Centrifugal Pump Suction Connection

Suction Lift



- Use pipe, tubing, or reinforced hose to make suction connection. Hose must have sufficient strength to resist collapse under the pressure differential that occurs while pump is running.
- Suction pipe size should be at least one commercial pipe size larger than opening of pump inlet. Flow velocity should not exceed 8 ft./sec.
- Suction screen must screen out solids that could clog pump impeller.
- Suction screen area must be at least four times suction pipe area.
- Net Positive Suction Head Available (NPSHA) must exceed Net Positive Suction Head Required (NPSHR) by the pump or reduced performance and severe pump damage may result.
- All suction piping must have continuous rise to the pump suction inlet. A 1/4 inch per foot minimum slope is recommended.

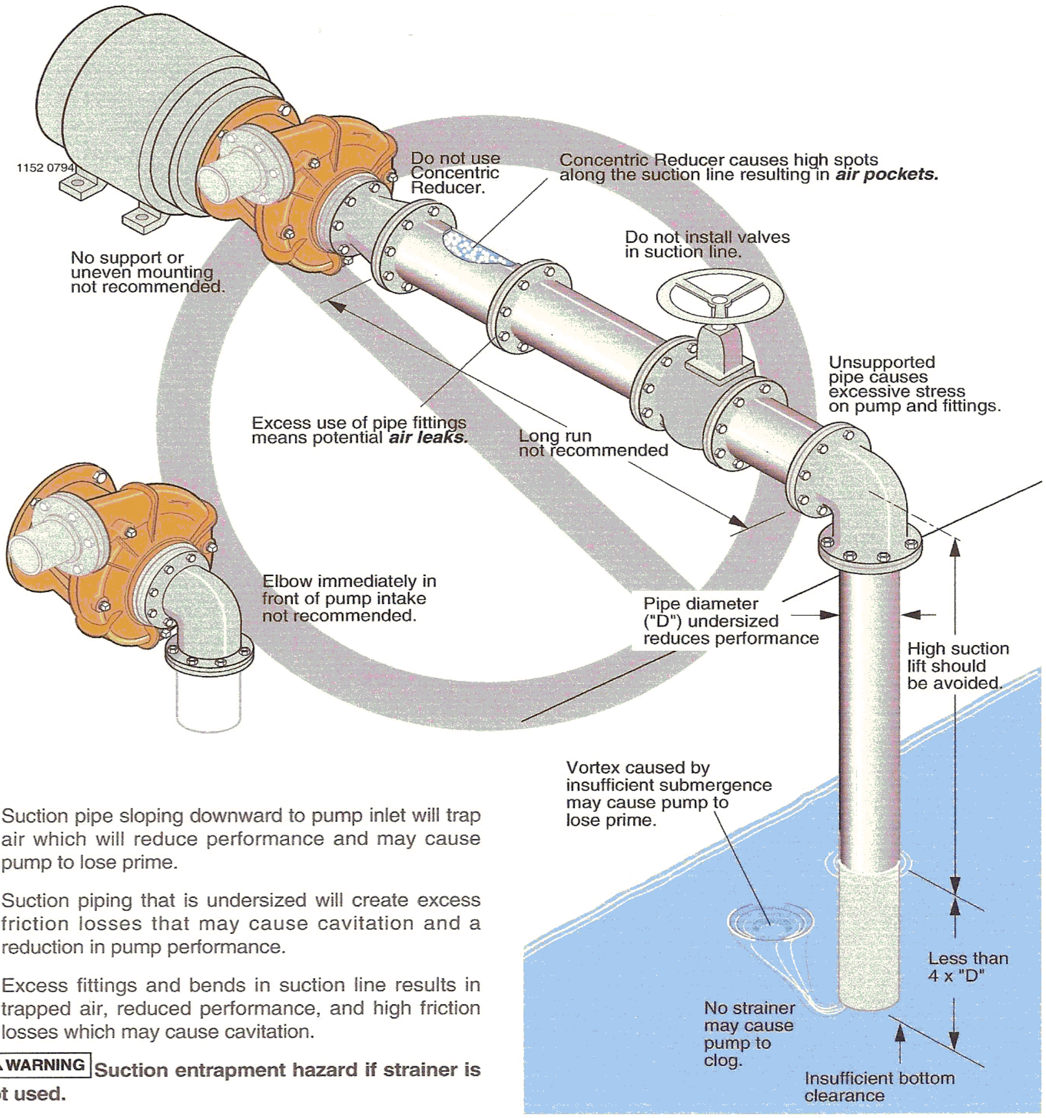


Recommended

Installation

Centrifugal Pump Suction Connection

Suction Lift



- Suction pipe sloping downward to pump inlet will trap air which will reduce performance and may cause pump to lose prime.
- Suction piping that is undersized will create excess friction losses that may cause cavitation and a reduction in pump performance.
- Excess fittings and bends in suction line results in trapped air, reduced performance, and high friction losses which may cause cavitation.

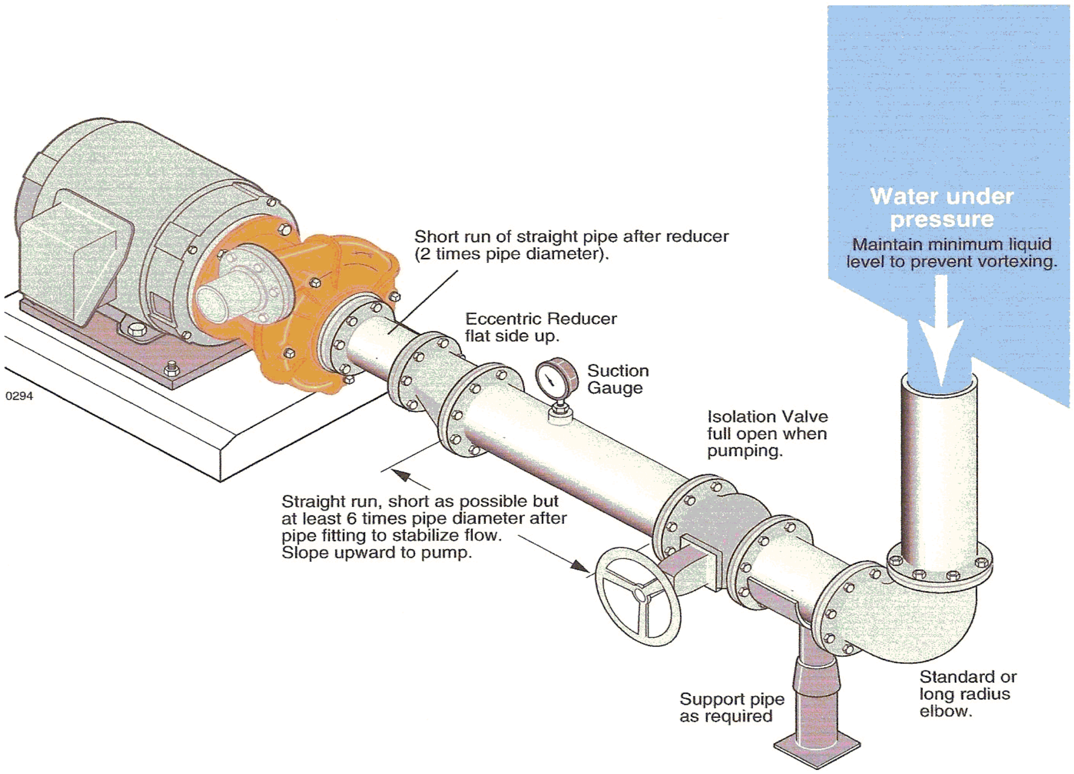
⚠WARNING Suction entrapment hazard if strainer is not used.

Not Recommended

Installation

Centrifugal Pump Suction Connection

When Flooded Suction Exists



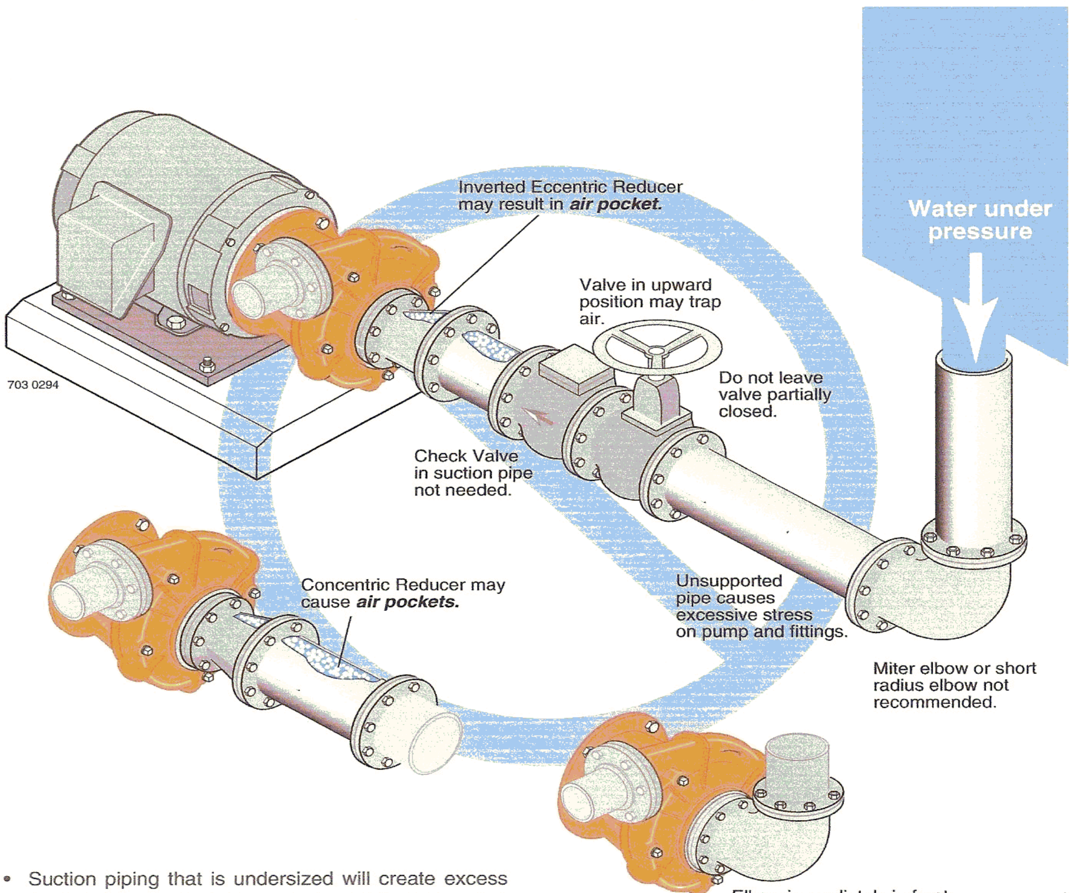
- Use pipe, tubing, or reinforced hose to make suction connection. Hose must have sufficient strength to resist collapse under the atmospheric pressure differential that may occur while pump is running.
- It is important, even with a flooded suction condition, that proper pipe fittings are used so water is delivered to impeller eye with a smooth flow and consistent velocity.
- Suction pipe size should be at least one commercial pipe size larger than opening of pipe inlet. Flow velocity should not exceed 8 ft./sec.
- An isolation valve is used in a pressurized suction pipe to permit servicing pump.
- Piping run and connection fittings should be properly aligned and independently supported to reduce strain on pump case.
- If solids are present, a strainer should be used to protect the pump.

Recommended

Installation

Centrifugal Pump Suction Connection

When Flooded Suction Exists

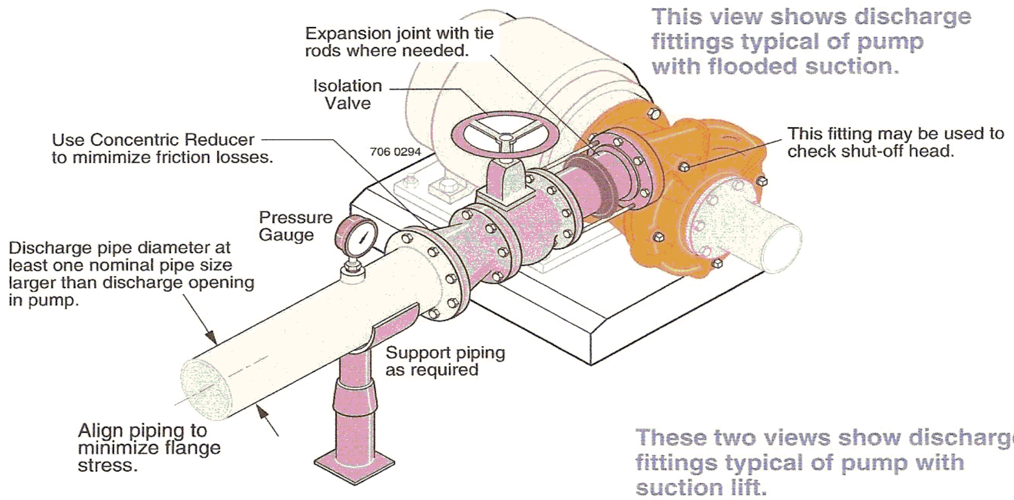


- Suction piping that is undersized will create excess friction losses that may cause cavitation and a reduction in pump performance.
- Excess fittings and bends in suction line results in trapped air, reduced performance, and high friction losses which may cause cavitation.
- If check valve is required for back flow prevention, locate on the discharge side of pump.

Not Recommended

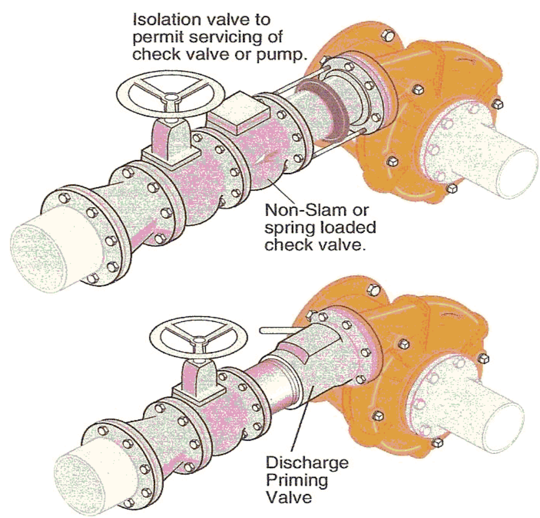
Installation

Discharge Connection



This view shows discharge fittings typical of pump with flooded suction.

These two views show discharge fittings typical of pump with suction lift.

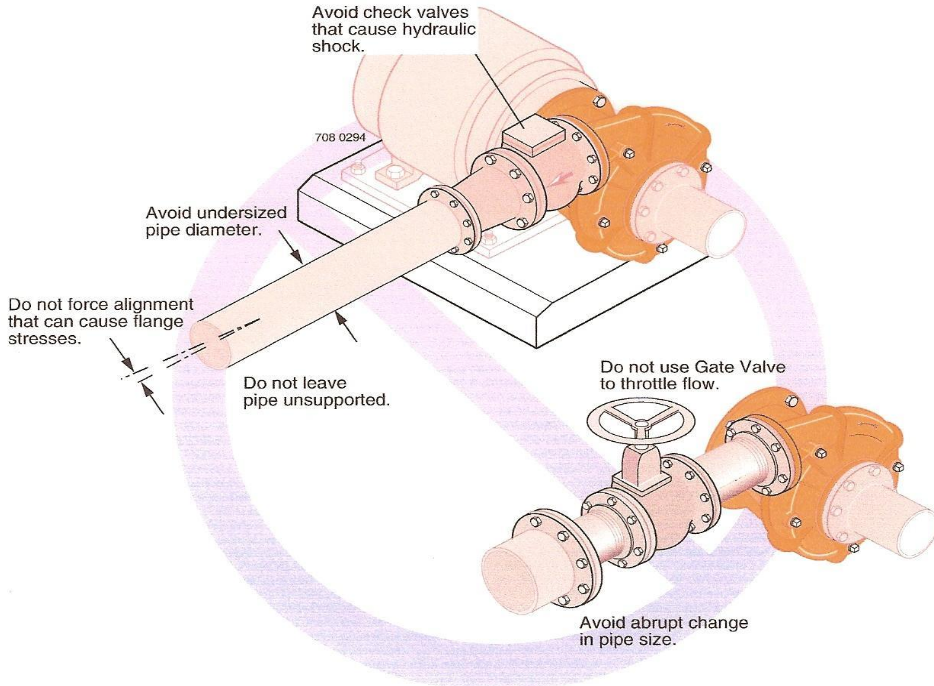


- Use pipe, tubing or reinforced hose to make discharge connection. Material selected must have sufficient strength for operating pressures.
- Discharge pipe should be sized so that flow velocity is below 8 feet per second.
- Use **ONLY** non-slamming check valves to prevent hydraulic shock (water hammer).
- Use gate, ball, or butterfly valve for isolation. Valve should be full open during operation.
- Maintain proper pipe size throughout discharge system, using as few elbows and tees as possible to keep friction loss to a minimum.
- Install pressure gauge after reducer as shown to check operating pressure or shut-off head.

Recommended

Installation

Discharge Connection



- Avoid excess friction loss caused by numerous fittings, insufficient pipe diameter, and sharp turns in pipe run.
- Swing type check valves can permit build-up of reverse velocity before closing causing hydraulic shock or "water hammer."

⦸ Not Recommended ⦸

Start-up

General Information

CHECK ROTATION:

Before pump is put into operation, rotational direction must be checked to assure proper performance of pump. Refer to illustration on Page 16.

⚠ WARNING **Hazardous voltage. Can shock, burn, or cause death.** Disconnect power to pump before servicing.

Do not attempt any wiring changes without first disconnecting power to pump.

PRIMING:

Pump priming is the displacement of air with water in the pump and suction piping. Pump **MUST BE** completely filled with water when operating.

Refer to Page 17 for instruction on the following conditions:

1. Suction lift with priming pump (water source below pump).
2. Suction lift with foot valve (water source below pump).
3. Flooded suction (water source above pump, or incoming water pressure is greater than atmospheric pressure).

SPECIAL CASE - HYDRAULIC BALANCED PUMPS: Hydraulic balanced pumps operate with a very low positive pressure across the stuffing box, permitting a much looser fit of the packing rings around the shaft sleeve to control the loss of water from the pump through the stuffing box. Because of the looser fit of the packing rings, air can be more easily drawn into the pump through the stuffing box when priming the pump with an air evacuation type primer.

A grease fitting, communicating through the side of the stuffing box to a lantern ring in the packing set, is provided to grease-seal the stuffing box to prevent air leakage during priming.

If pump cannot be primed due to air leakage through stuffing box, **DO NOT** tighten packing. Instead, pump grease into lantern ring until back pressure occurs forcing grease into the lantern ring, grease-sealing the stuffing box. After priming, when unit is put into operation, the grease will be flushed out through the packing by the water flowing outward through the stuffing box. Proceed with normal adjustment of the packing as described on Page 18. Note that the grease seal only is used for control of air leaking during priming, and that only the packing gland is used to control flow of water through the stuffing box during normal operation.

When necessary to replenish the grease supply use an NLGI no. 4 Water Pump Grease.

STARTING:

⚠ WARNING **Never run pump dry**. Running pump without water will overheat pump and damage internal parts. Always make sure pump is primed prior to start-up.

NOTICE: Refer to maintenance section if pump has packing for adjustment prior to start-up.

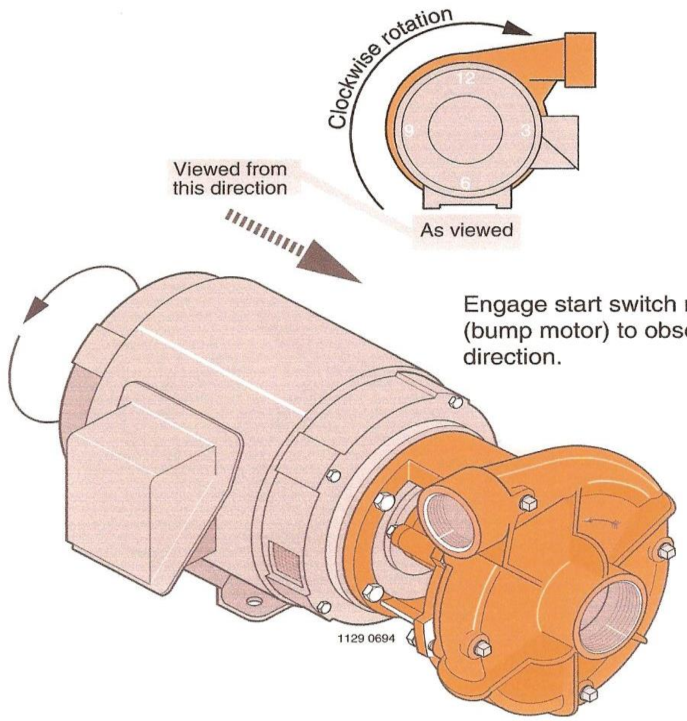
Prime pump by one of the above procedures. Turn on power to pump. Slowly open discharge valve until desired flow rate is achieved. Place the “Hand-Off-Auto” selector switch in the “Auto” position. The pump will be started automatically when the pilot device signals the motor starter.

STOPPING:

Pump will stop automatically when the pilot device de-energizes the motor starter. Turn the “Hand-Off-Auto” selector switch to “Off” position if you want to stop the pump while it is running.

Start-up

Determine Pump Rotation



Engage start switch momentarily (bump motor) to observe rotational direction.

Direction of Pump Rotation is determined by viewing liquid end of pump from the **back** or **shaft side**, and ***not*** from looking into the impeller eye or front of volute case. A rotation direction arrow is cast into the pump body and shows correct rotation.

- Electric Motors:

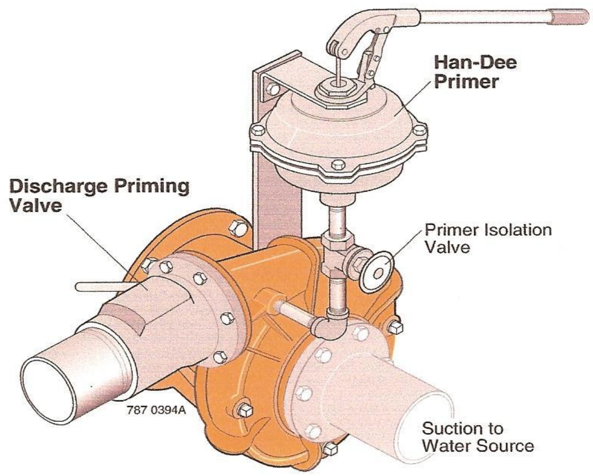
  Single Phase: Refer to wiring information on the motor plate to obtain proper rotation.

  Three Phase: If pump runs backwards, reverse any two leads coming off incoming power (L1, L2, L3) until proper rotation is obtained. Reverse L1 and L2, or L2 and L3, or L1 and L3.

- Pump running backward - Centrifugal pumps will still pump liquids, however, GPM and head (discharge pressure) will be a fraction of the published performance.

Start-up

Pump Priming



Installations With Flooded Suction.

- Open air vent (or pipe plug) in the highest tapped opening in pump case.
- Open inlet isolation valve, allowing water to fill the pump completely and force all air out through vent.
- Rotate shaft slowly allowing any air trapped in impeller to escape.
- Close vent opening when water without air emerges.

Installations With Suction Lift and Foot Valve.

- Close air tight valve on discharge.
- Remove pipe plug from highest opening on pump case.
- Completely fill pump and suction piping with water.
- Rotate shaft slowly allowing any air trapped in impeller to escape.
- When all air has been forced out of pump, replace pipe plug. Use pipe joint compound on plug threads and tighten as necessary to prevent leakage.

Installations With Suction Lift and Priming Pump.

- Close air tight valve.
- Han-Dee Primer operation:
  1. Open Han-Dee Primer isolation valve.
  2. Work handle of Han-Dee primer up and down to evacuate air from the suction line. (Refer to primer owner's manual for proper procedure).
  3. When water flows freely from primer, close Han-Dee Primer isolation valve. (Pump case should now be filled with water).
- Immediately start pump.
- Slowly open butterfly valve (if used) until desired flow is achieved. (Discharge Priming Valve will open automatically).

Maintenance
General Information

LUBRICATION:

LIQUID END of pump requires **no** lubrication. Wear rings, packing rings, and models using a mechanical shaft seal, are lubricated by the liquid being pumped. Do not run dry!

NOTE: Grease fitting in packing area is for priming only. See *PRIMING* in start-up section for instruction.

MOTOR bearings are lubricated at the factory. Re-lubrication at intervals consistent with the amount of use will provide maximum bearing life. Refer to motor Instruction Manual for proper motor lubrication and maintenance instructions.

PERFORMANCE CHECK:

Periodically check the output of the pump. If performance is noticeably reduced, refer to Troubleshooting Chart.

OBSERVATIONAL MAINTENANCE:

When the pump and system operation have been stabilized, verify that pump unit is operating properly. Observe the following:

VIBRATION: All rotating machines can be expected to produce some vibration, however, excessive vibration can reduce the life of the unit. If the vibration seems excessive, discontinue operation, determine cause of the excessive vibration, and correct.

NOISE: When the unit is operating under load, listen closely for unusual sounds that might indicate that the unit is in distress. Determine the cause and correct.

OPERATING TEMPERATURE: During operation, heat is dissipated from the pump and the driver. After a short period of time, the surface of the pump bracket will be quite warm (as high as 150°F), which is normal. If the surface temperature of the pump bracket or driver is excessive, discontinue operation, determine cause of the excessive temperature rise, and correct. Bearings will run hotter for a brief run-in period after packing which is normal. However, worn bearings will cause excessive temperatures and need to be replaced. The pump unit is cooled by the water flowing through it, and will normally be at the temperature of the water being pumped.

STUFFING BOX: After a short period of operation, verify that the stuffing box area and gland are not hot. If heating is detected, loosen the gland nuts evenly until water is just running out of stuffing box in a *DROPLET* form. Water must not be streaming or spraying out. Verify cool operation periodically. Adjust gland nuts *EVENLY* as necessary for lubrication and cooling of the packing. If packing has been tightened to the limit of the packing gland travel, additional packing is necessary.

PACKING: *Starting new pump.*

Before starting pump for the first time, loosen gland nuts and retighten finger tight. Proceed with pump start-up procedure. Allow packing to leak liberally for a few moments. Then tighten gland nuts one complete turn each until leakage is reduced to 40 to 60 drops per minute.

REPACKING:

Refer to Page 19.

MECHANICAL SEAL:

Adjustment or maintenance is normally not required. The seal is enclosed within the pump and is self adjusting. Seal is cooled and lubricated by the liquid being pumped. Refer to Pages 20 and 21 for removal and replacement. Do not run dry!

PUMP PROTECTION-COLD WEATHER/WET WEATHER INSTALLATIONS:

SYSTEM DRAINS: Provide drain valves to empty system, including pump case, to prevent freezing damage.

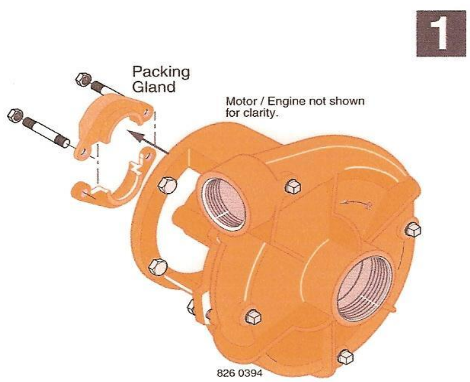
SHELTER: If possible, provide shelter for unit to protect from weather. Allow adequate space around pump unit for service. When effectively sheltered, a small amount of heat will keep temperature above freezing. Provide adequate ventilation for unit when running. For severe weather problems, where other shelter is not practical, a totally enclosed fan-cooled enclosure can be considered for electric motors.

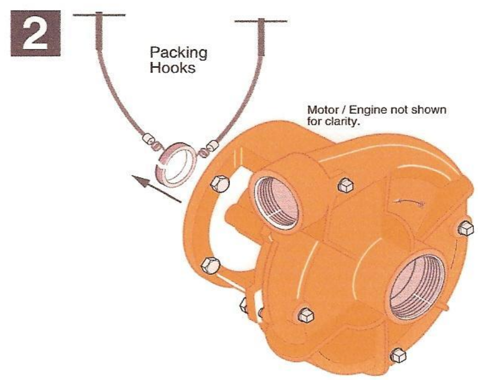
CONDENSATION: When the temperature of metal parts is below dew point and the surrounding air is moist, water will condense on the metal surfaces and can cause corrosion damage. In severe situations, a space heater can be considered to warm the unit.

Maintenance

Packing Ring Replacement

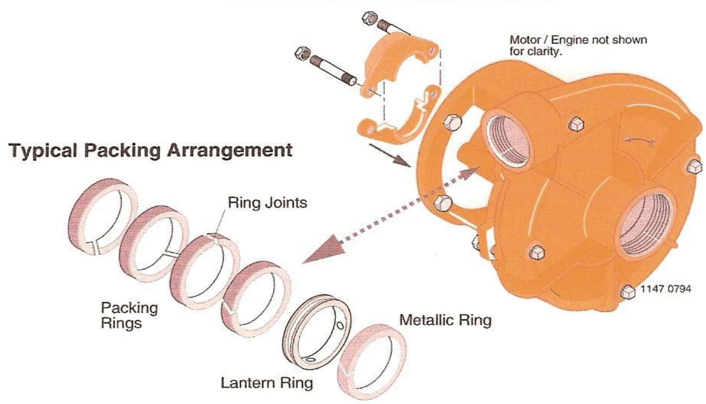
Removal





- Unfasten hardware holding Packing Gland in place and slide back on shaft to expose packing rings. A split Packing Gland is shown.
- Remove packing rings from Stuffing box using two commercially available Packing Hooks as shown.
- Slide Lantern Ring (if used) back to expose any remaining rings, including metallic. Remove them in the same manner.

Installing New Rings



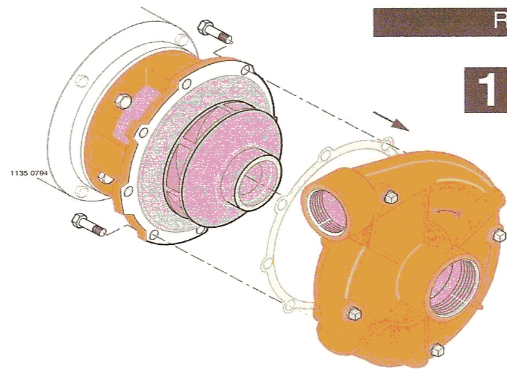
- Clean shaft sleeve and Packing Gland.
- Inspect shaft sleeve for wear, replace if needed.
- Install new packing rings in stuffing box by placing over shaft sleeve and pushing them in as far as they will go.
- Rotate ring joint 90 degrees when installing each ring as shown.
- Slide packing gland into position, then gently and evenly tighten nuts to force rings into place and seat (do not overtighten). Loosen nuts again to hand tight.
- Start primed pump and allow packing to leak liberally.
- Tighten gland nuts one complete turn each until leakage is reduced to 40 to 60 drops per minute.

Maintenance

Mechanical Shaft Seal

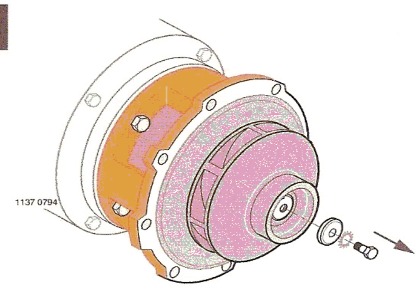
Removal

1



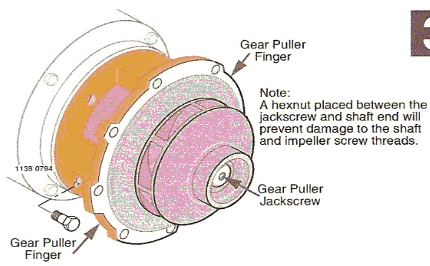
- Unfasten hardware holding volute to bracket.
  NOTE: For model B4EY, consult factory for special instructions.
- Remove volute to expose impeller.

2



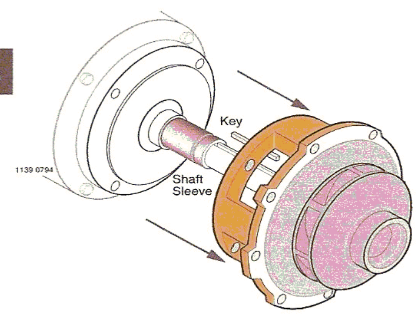
- Peel off old gasket or O-Ring and discard.
- Hold impeller stationary and remove impeller screw and associated hardware.

3



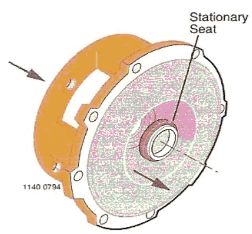
- Remove capscrews holding bracket to motor.
- Install a standard gear puller to shaft end and motor bracket placing puller fingers in the area shown.

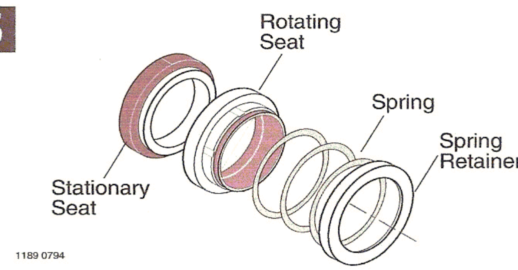
4



- Rotate gear puller jackscrew until impeller clears shaft. Mechanical shaft seal will come off with motor bracket.
- If a seal retaining ring is part of the assembly, it will need to be replaced.

5





- Push stationary seal out of seal cavity from the back of bracket.
- Clean seal cavity in bracket thoroughly.

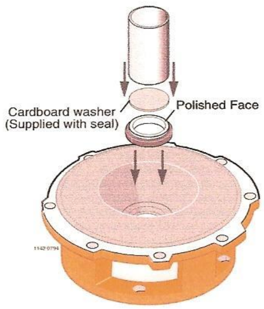
Procedure and parts will vary slightly depending on pump style.

Maintenance

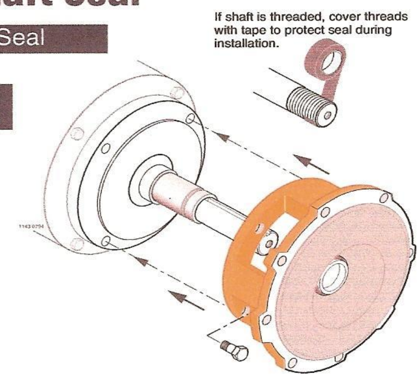
Mechanical Shaft Seal

Installing New Seal

1 **2**

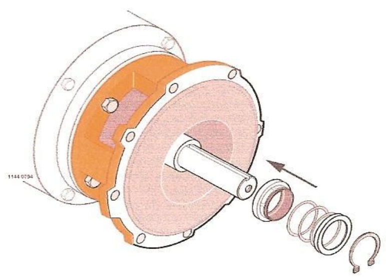


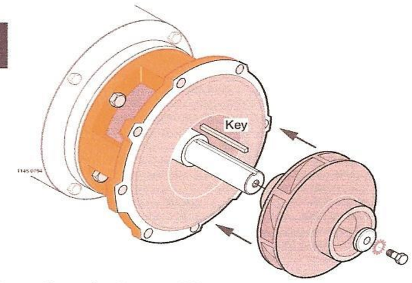
Do not scratch or chip polished ceramic face. Also . . .do not touch polished surface



- Place bracket on a smooth, flat surface, pump side up.
- Apply a small amount of mineral oil to O-Ring on stationary seal and press into seal cavity. Cover ceramic face with cardboard washer and press straight in using a piece of pipe or tubing.
- Reinstall bracket on motor using extreme care not to scratch or chip ceramic face of seal with shaft.

3 **4**

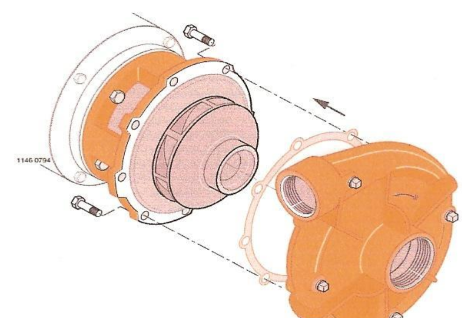




- Apply a small amount of mineral oil to inside diameter of rubber ring in rotating seat and outside of shaft sleeve. Slide rotating seat onto shaft, polished face first, until it is tight against ceramic face.
- Compress seal spring and install retaining ring in shaft sleeve groove (if used).
- Place impeller key in motor shaft keyway. Slide impeller on to shaft as far as possible.
- Clean threads thoroughly.
- Apply non-permanent thread adhesive to impeller capscrew and shaft threads.
- Install impeller washer, shakeproof lockwasher, and capscrew.

5

- Install gasket and volute on bracket. Use a new gasket or O-Ring when reassembling to prevent leakage (a coat of grease on gasket will aid in future disassembly and maintenance).
- Apply anti-seizing compound to capscrews and tighten securely.



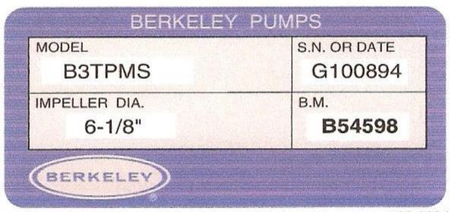
Procedure and parts will vary slightly depending on pump style.

General Information

ORDERING REPLACEMENT PARTS:

Locate the Berkeley nameplate on the pump; plate is normally on the motor bracket. Information found on this plate is shown below. To be sure of receiving correct parts, provide all nameplate data when ordering. The **BM (Bill of Material)** number is most important. Write your nameplate information on the blank nameplate below for future reference as nameplates can become worn or lost.

SAMPLE ONLY



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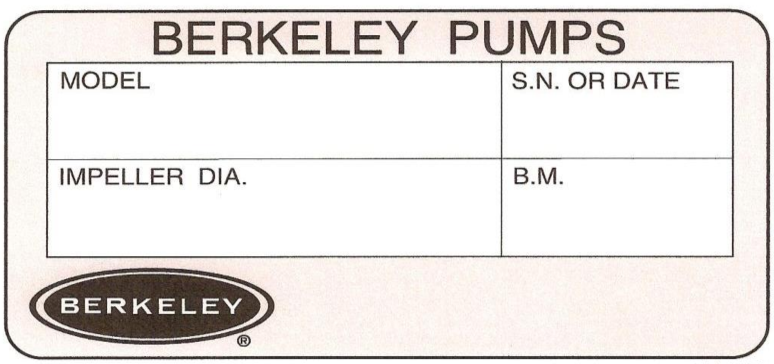
Illustrations on the following page show typical components used in the assembly of motor drive centrifugal pumps. Both mechanical seal and packing styles are shown. Refer to these drawings when ordering any replacement parts.



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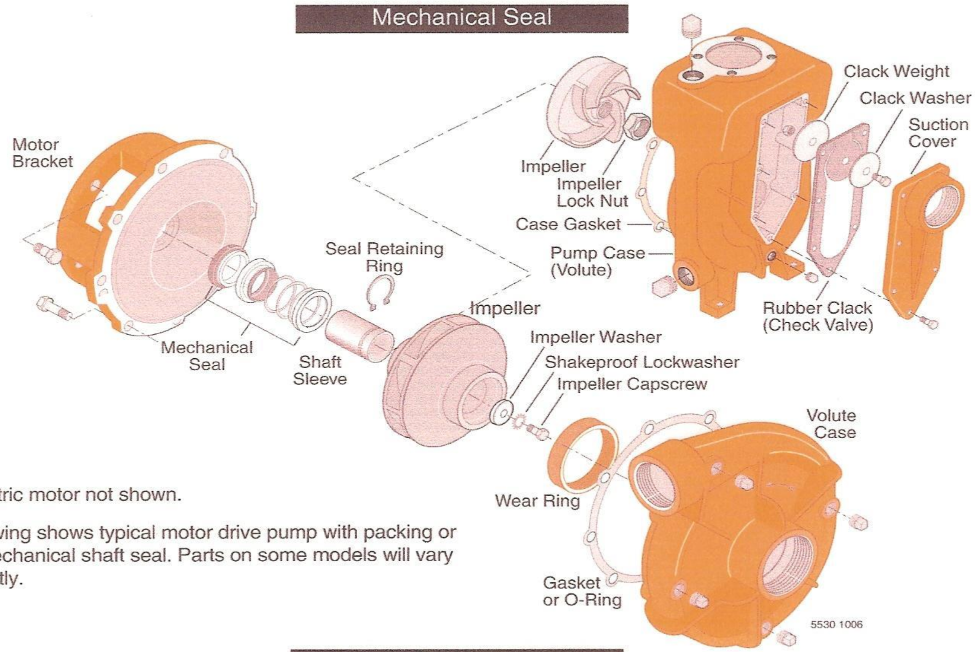
Record your nameplate data here.

Pump Nomenclature

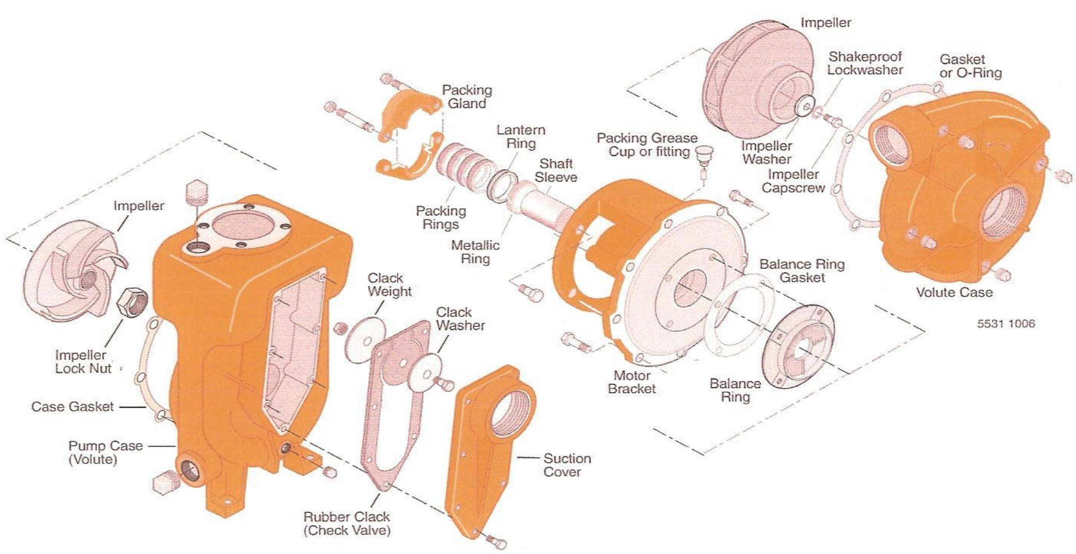
Electric Motor Drive

Mechanical Seal



- Electric motor not shown.
- Drawing shows typical motor drive pump with packing or a mechanical shaft seal. Parts on some models will vary slightly.

Packing



Maintenance

Troubleshooting

SYMPTOM	PROBABLE CAUSE																	
	GROUP I ELECTRICAL									GROUP II MECHANICAL					GROUP III SYSTEM			
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	A	B	C
Pump runs, but no water delivered										X		X				X	X	
Not enough water delivered			X	X					X	X	X		X			X	X	
Not enough pressure			X	X					X	X	X		X			X	X	
Excessive vibration									X	X	X			X			X	X
Abnormal noise										X	X	X		X	X		X	X
Pump stops	X	X	X	X	X	X	X	X										
Overheating		X	X	X					X		X		X	X	X			X

CAUSE	CORRECTIVE ACTION
I. ELECTRICAL	
A. No voltage in power system	Check phase-to-phase on line side of starter contactor. Check circuit breaker or fuses.
B. No voltage on one phase (Three Phase Units)	Check phase voltage on line side of starter contactor. Isolate open circuit (circuit breaker, fuse, broken connections, etc.)
C. Low voltage at motor	Running voltage across each leg of motor must be ±10% of nominal voltage shown on nameplate.
D. Motor leads improperly grouped for voltage	Refer to lead grouping diagram on motor nameplate.
E. Control failure	Check control device, starter contactor, H-O-A selector switch, etc., for malfunction.
F. Thermal overload switch open	Check phase-to-phase on line side of starter contactor.
G. Installation failure	Check motor or windings to ground with megohmmeter.
H. Open windings	Check leg-to-leg with ohmmeter.
I. Frequency variation	Check frequency of power system. Must be less than 5% variation from motor nameplate rating.
II. MECHANICAL	
A. Flow through pump completely or partially obstructed	Locate and remove obstruction. Refer to Repair Instructions for disassembly.
B. Wrong direction of rotation	Reverse rotation of three phase motor by interchanging any two leads. See manufacturer's Instructions for reversing single phase motor.
C. Pump not primed	Reprime. Inspect suction system for air leaks.
D. Internal leakage	Check impeller for wear of controlled clearances (See Repair Instructions).
E. Loose parts	Inspect. Repair.
F. Stuffing box not properly adjusted	Adjust gland.
III. SYSTEM	
A. Pressure required by system at design flow rate exceeds pressure rating of pump	Compare pump pressure and flow rate against pump characteristic curve. Check for closed or partially closed valve in discharge piping system. Reduce system pressure requirement. Increase pressure capability of pump.
B. Obstruction in suction piping	Locate and remove obstruction.
C. Pressure rating of pump exceeds pressure requirement of system at design flow rate	Compare pump pressure and flow rate against pump characteristic curve. Inspect discharge piping system for breaks, leaks, open by-pass valves, etc. If necessary, reduce flow rate by partially closing discharge valve.

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CENTRIFUGAL PUMPS

INSTALLATION

PACKAGE CONTENTS
1. Each pump is carefully tested and packaged at the factory.
2. The catalog lists all parts included with package. A packing list packed with pump, also lists contents.
3. Be sure all parts have been furnished and that nothing has been damaged in shipment.
4. OPEN PACKAGES AND MAKE THIS CHECK BEFORE GOING ON JOB.

PIPING - Pipes must line up and not be forced into position by unions. **Piping should be independently supported near the pump so that no strain will be placed on the pump casing.** Where any noise is objectionable, pump should be insulated from the piping with rubber connections. Always keep pipe size as large as possible and use a minimum of fittings to reduce friction losses.

SUCTION PIPING - Suction pipe should be direct and as short as possible. It should be at least one size larger than suction inlet tapping and should have a minimum of elbows and fittings. The piping should be laid out so that it slopes upward to pump without dips or high points so that air pockets are eliminated. The highest point in the suction piping should be the pump inlet except where liquid flows to the pump inlet under pressure. A foot valve must be used to keep pump primed. Where liquid flows to the pump, it may be desirable to use a check valve in the suction line or discharge line to keep pump primed.

To prevent air from being drawn into suction pipe due to a suction whirlpool, the foot valve should be submerged at least three feet below the low water level. The suction pipe must be tight and free of air leaks or pump will not operate properly.

DISCHARGE PIPING - Discharge piping should never be smaller than pump tapping and should preferably be one size larger. A gate valve should always be installed in discharge line to serve as a shut-off for throttling if capacity is not correct. To protect the pump and foot valve from water hammer and to prevent backflow, a check valve should be installed in the discharge line between the pump and gate valve.

ELECTRICAL CONNECTIONS - Be sure motor wiring is connected for voltage being used. Unit should be connected to a separate circuit, direct from main switch. A fused disconnect switch or circuit breaker must be used in this circuit. Wire of sufficient size should be used to keep voltage drop to a maximum of 5%. All motors, unless provided with built-in overload protection, must be protected with an overload switch, either manual or magnetic. Three phase motors require overload protection. Single phase motors equipped with built-in overload protection. **Never install a pump without proper overload protection.** A flexible metallic conduit should be used to protect the motor leads.

PRIMING - The pump must be primed before starting. The pump casing and suction piping must be filled with water before starting motor. Remove vent plug in top of casing while pouring in priming water. A hand pump or ejector can be used for priming when desired. When water is poured into pump to prime, use care to remove all air before starting motor.

If pump does not start immediately, stop and re-prime.

STARTING - It is good practice to close the discharge valve when starting the pump as it puts less starting load on the motor. When the pump is up to operating speed, open the discharge valve to obtain desired capacity or pressure. Do not allow the pump to run for long periods with the discharge valve tightly closed. If the pump runs for an extended period of time without liquid being discharged, the liquid in the pump case can get extremely hot.

ROTATION - The pump must run in direction of arrow on pump case. All single phase motors are single rotation and leave factory with proper rotation. Three phase motors may run either direction. If rotation is wrong when first starting motor, interchange any two line leads to change rotation.

STOPPING - Before stopping pump, close the discharge valve. This will prevent water hammer and is especially important on high head pumps.

FREEZING - Care should be taken to prevent the pump from freezing during cold weather. It may be necessary, when there is any possibility of this, to drain the pump casing when not in operation. Drain by removing the pipe plug in the bottom of the casing.

ROTARY SEAL - Centrifugal pumps are fitted only with rotary seal. This seal is recommended for water free from abrasives. If liquid contains abrasives, the Centrifugal pump should not be used.

BEARINGS - Lubricate motor bearings in accordance with motor manufacturer's instructions.

Single seal ball bearings are used on 125B, 150B, 200B bearing bracket units. Proper amount of grease has been provided in the bracket cavity between the bearings. This should be sufficient grease for 4000 hour operation. After this usage the old grease should be cleaned out and new grease added. Use only best grade ball bearing greases.

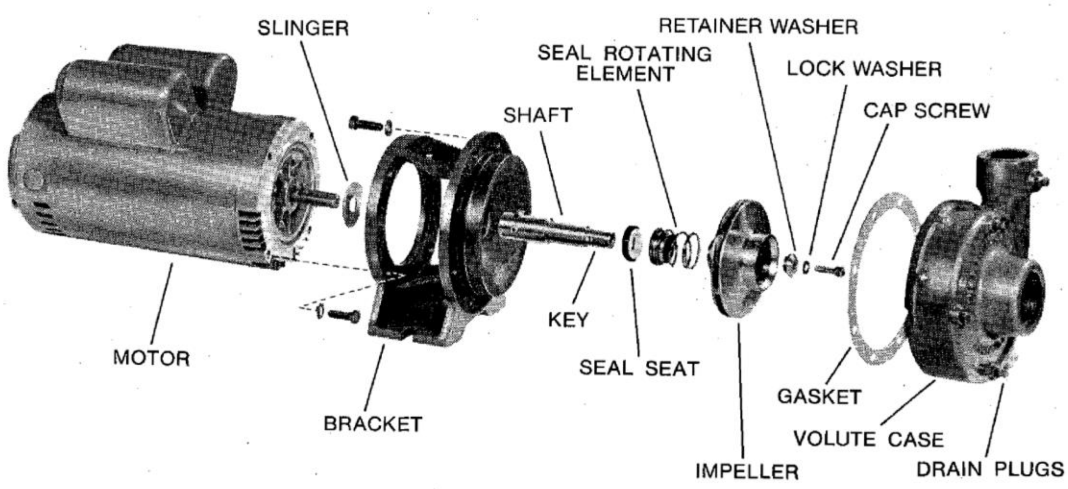
BELT DRIVES - On V-belt drives, if possible, the tight side of the belt should be at the bottom. Adjust belt tension just tight enough to prevent slippage; excess tension unnecessarily loads the bearings. Normally the belt speed should not exceed 5000 feet per minute and the pulley ratio should not exceed 5 to 1. The distance between the shaft centers should be at least twice the diameter of the larger pulley.

SERVICE

TROUBLE SHOOTING GUIDE

A No water delivered
B Not enough water delivered
C Not enough pressure
D Pump runs for short while; then loses prime

	POSSIBLE CAUSE OF PROBLEM	D	C	B	A
1.	Pump not properly primed; repeat priming operation				X
2.	Discharge head too high. Check total head with gauge at pump inlet and discharge. (With no water, the gauge at discharge would show shut-off pressure.)			X	X
3.	Excessive volume being discharged. Throttle discharge valve.		X		
4.	Speed too low. Check pump drive belts for slippage. If hot, tighten belts. Check motor voltage and speed.		X	X	
5.	Rotation wrong. Change shaft rotation.		X	X	X
6.	Suction lift too high. Check with vacuum gauge. This should not exceed 15 feet.	X		X	X
7.	Air leak in suction line. Check line under pressure to find leak.	X	X	X	X
8.	Air pocket in suction line. Check line for proper slope.	X			X
9.	Insufficient submergence of suction pipe. Foot valve should be three feet below lowest water level.	X		X	
10.	Sediment chamber clogged. Remove and clean thoroughly. Make sure gsket is in good condition and sealing surfaces clean before reassembly of sediment chamber cap.		X		
11.	Impeller or suction line plugged.		X	X	X
12.	Impeller and volute case badly worn. Disassemble pump; if clearance on diameter is over .030", replace worn impeller and worn volute case.		X	X	
13.	Suction strainer plugged. Clean strainer.	X			
14.	Impeller diameter too small for condition required.		X	X	
15.	Seal leaking - seal is worn or seal face cocked. Replace with new seal and carefully follow directions.				



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DISASSEMBLY INSTRUCTIONS

All pumping parts can be removed from case without disturbing the piping.

POWER SUPPLY - Open the power supply switch contacts and remove fuses. Disconnect the electrical wiring from the motor.

VOLUTE CASE

(a) Drain pump case by removing drain plugs.
(b) Remove the bolts securing volute case to pump bracket.
(c) To pry components apart, use two screwdrivers - opposite each other - in openings provided between the bracket and case. (Fig. 1)

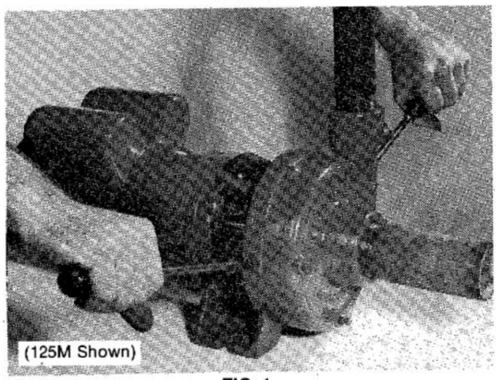


FIG. 1

IMPELLER

(a) Remove impeller by holding stub shaft with water pump pliers and unscrewing capscrew. (Fig. 2)

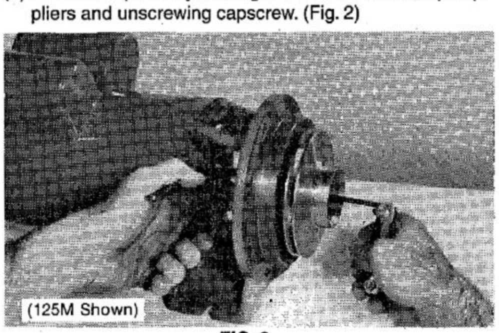


FIG. 2

SEAL

(a) The seal used on 125M, 125B, 150M, 200M, is 7/8".
(b) Always replace both rotating assembly and stationary ceramic seat. DO NOT USE OLD STATIONARY SEAT WITH NEW ROTATING SEAL ASSEMBLY.
(c) Using two screwdrivers, pry out rotating assembly of shaft seal. (Fig. 3)
(d) Old ceramic ring can be removed from housing by cracking with a chisel or screwdriver without removing the pump shaft.
(e) A new shaft seal should always be used when rebuilding a pump. All pump parts should be cleaned thoroughly before being reassembled.

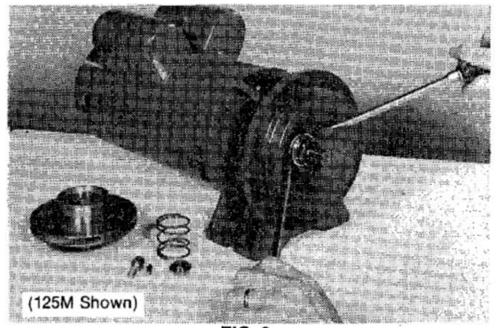


FIG. 3

MOTOR

(a) Remove four bolts holding bracket to motor and remove motor. (Fig. 4)
(b) Remove set screw in stub shaft coupling to disconnect motor pump shaft.

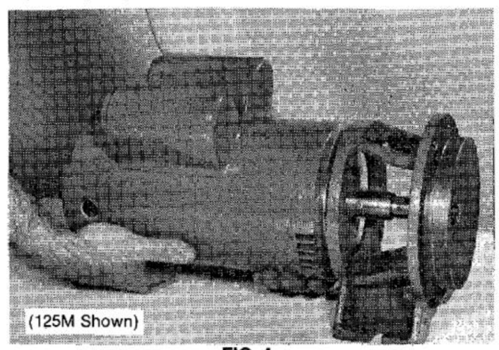


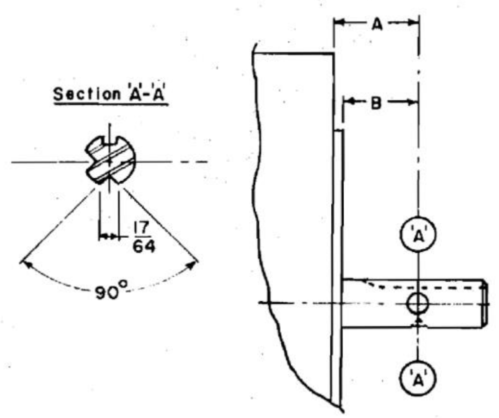
FIG. 4

		IMPELLER	
	H.P.	NUMBER	O.D.
125m	2	11725B2	5 3/8
	3	11725B3	5 13/15
150M	2	12935B2	4 5/8
	3	12935B1	5 1/8
	5	12935B3	5 15/16
200M	3	12936B2	4 7/16
	5	12936B1	5 1/8
	7 1/2	12936B3	5 3/4
125B		11725B3	5 13/16
150B		12935B3	5 15/16
200B		12936B3	5 3/4

FIG. 5

ASSEMBLY INSTRUCTIONS

SPOTTING MOTOR SHAFT - Locate "Spotting Position" from motor mounting face to center of spot. A drilling guide and locating fixture is recommended for uniform and accurate spotting. Make two spots with a drill point, at 90 degrees apart - must be on motor shaft keyway. (Fig. 6)



CATALOG NO.	A	B
125M	1.125 ± .005	---
150M2 & 3	1.125 ± .005	---
150M5	---	1.562 ± .005
200M3	1.125 ± .005	---
200M5 & 7½	---	1.562 ± .005

FIG. 6

MOTOR

(a) Place rubber deflector over motor shaft, slide shaft extension into positon and tighten set screws.

(b) Assemble motor and shaft onto bracket, using (4) $^3/_8$-16 UNC Hex Head Cap Screws, $1^1/_8$" long on all except the 150M5, 200M3, 200M5 & $7^1/_2$. On these units use (4) $^1/_2$-13UNC Hex Head Cap Screws, $1^1/_4$" long.

SEAL INSTALLATION

(a) Insert seal seat in position by using finger pressure to press firmly and squarely until it bottoms. The use of light oil (SAE10) on the rubber element will facilitate assembly. Care must be taken to keep oil, grease and dirt off face areas of seal. Be sure the seal faces are not damaged during assembly (cracked, scratched or chipped) or the seal will leak during operation.

(b) Check dimension from face of ceramic seat to shaft shoulder. This distance should be as noted in Figure 7 within a tolerance of ± 1/64.

(c) Install rotating element of seal on shaft (Fig. 8), be sure the lapped sealing surface is toward seal seat, and assemble impeller. Check diameter of impeller against motor horsepower rating to insure proper performance (Fig. 5).

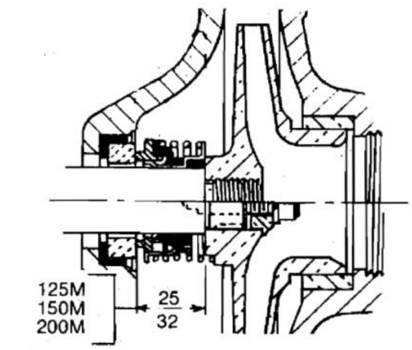


FIG. 7

IMPELLER

(a) Secure impeller using Key (3/16 square x 21/32" log), impeller retainer washer, 5/16 stainless steel helical spring lockwasher and 5/16-18UNC socket head cap screw, 1" long (stainless steel). It is also recommended that a locking type sealant be applied to both cap screw thread prior to assembly.

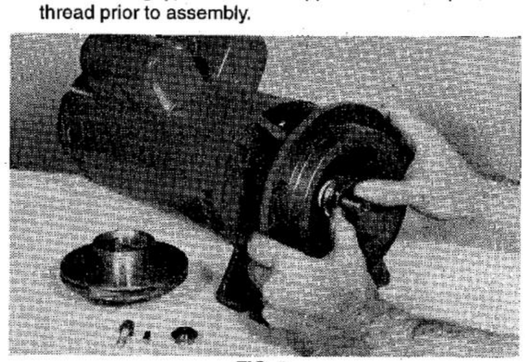


FIG. 8

VOLUTE CASE

(a) Worn volute case will cause excessive leakage with a new impeller, thereby reducing the amount of service obtained from a new impeller.

(b) Assemble gasket and volute case with $^3/_8$-16UNC Hex Head Cap Screws $1^1/_8$" long.

Rotate pump shaft with fingers, being sure that there is no tight spot or binding of assembly. A uniform drag of the seal faces will be present.

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