3.3 How to Connect the Cryosurface to the Refrigeration Unit

⚠ Attention

Information in this section is for trained technicians familiar with installing Polycold Fast Cycle Water Vapor Cryopumps. If you are not trained on these procedures, contact the Polycold factory or your nearest service representative. Failure to properly install this product may result in refrigerant leaks or other problems that are not covered by our warranty.

3.3.1 Connect the Refrigerant Line

Tools and materials needed:

- Step ladder
- Torque wrench (optional)

For Parker CPI UltraSeal couplings (standard fitting):

- Silver-plated stainless steel O-rings†
- 1 inch open end wrench
- 15/16 inch open end wrench

For Cajon VCR couplings (optional fitting):

- Silver-plated stainless steel gaskets or unplated nickel gaskets†
- 1-3/16 inch open end wrench
- 1-1/16 inch open end wrench

†Shipped with the unit.

NOTE: *This section assumes the purchase of a refrigerant line from Brooks Polycold Systems Inc. If not, see section 3.6 Refrigerant Line Specification before continuing.*

For PFC/PFC or PFC/P: This section assumes that both refrigerant circuits will be connected at the same time. At times, only one refrigerant circuit may be connected. Thus, when ready to connect the second refrigerant circuit, the refrigerant mixture must be drawn back into the unit. (This is because both refrigerant circuits are connected inside the unit.) See Step 1 and Step 2 in section 8.2 How to Disconnect the Refrigerant Line for instructions.

CAUTION

GENERAL HAZARD
A common source for leaks is improper connection of the couplings. Internal leaks can result in damage to the equipment.
Use a new O-ring or gasket each time the coupling is assembled.
Do not use grease when assembling the couplings. Grease can contaminate the cryopump. It can also mask a leak during the leak-checking procedures. The coupling will leak when the grease gets brittle at cryogenic temperatures.
Do not scratch or dent the sealing surfaces of the couplings.
Always use the O-ring removal tool to remove an O-ring from the Parker CPI UltraSeal couplings. See Step 4 in section 8.2 How to Disconnect the Refrigerant Line for instructions.

3.3.1.1 Inspect the Couplings

Remove any dirt or foreign materials from the sealing surfaces. Make certain there are no scratches (particularly radial scratches) or dents in the sealing surfaces. (See Figure 3-13 and Figure 3-14.) Contact a Polycold sales representative or the Polycold service department if a sealing surface is damaged.

NOTE: *Parker CPI UltraSeal couplings are standard on a 550, 660, 670, or PFC/PFC-1100. Cajon VCR couplings are standard on a PFC-1100.*

WARNING

Use of unauthorized, non-standard couplings will void your warranty. Improper use of, incorrect installation of, over-tightening of, or use of damaged o-rings in couplings will void your warranty. (See CAUTION on page 3-33 for installation guidelines.)

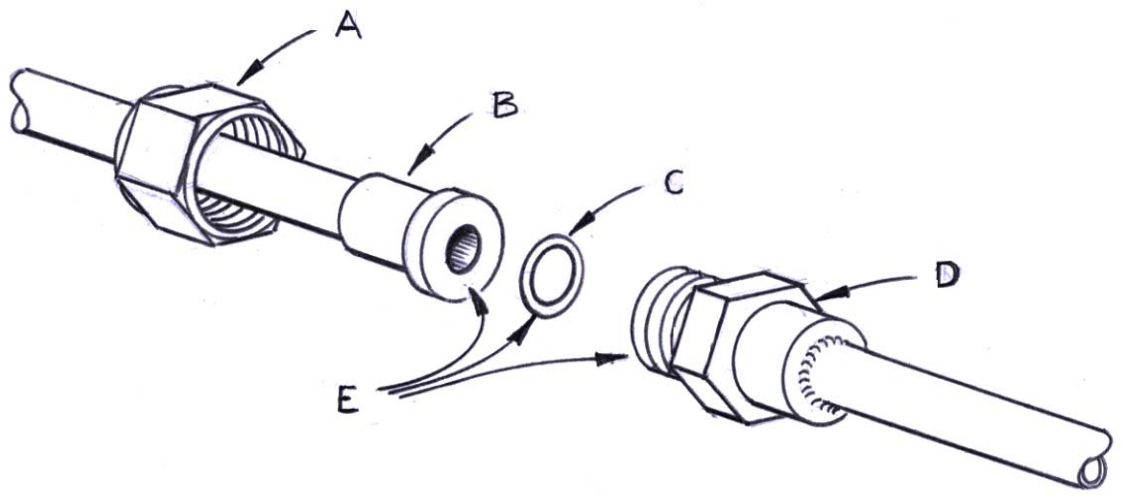

Figure 3-13: Parker CPI UltraSeal coupling (standard fitting)

A. Nut

B. Gland

C. Silver-plated stainless steel O-ring

D. Male coupling

E. Sealing surfaces

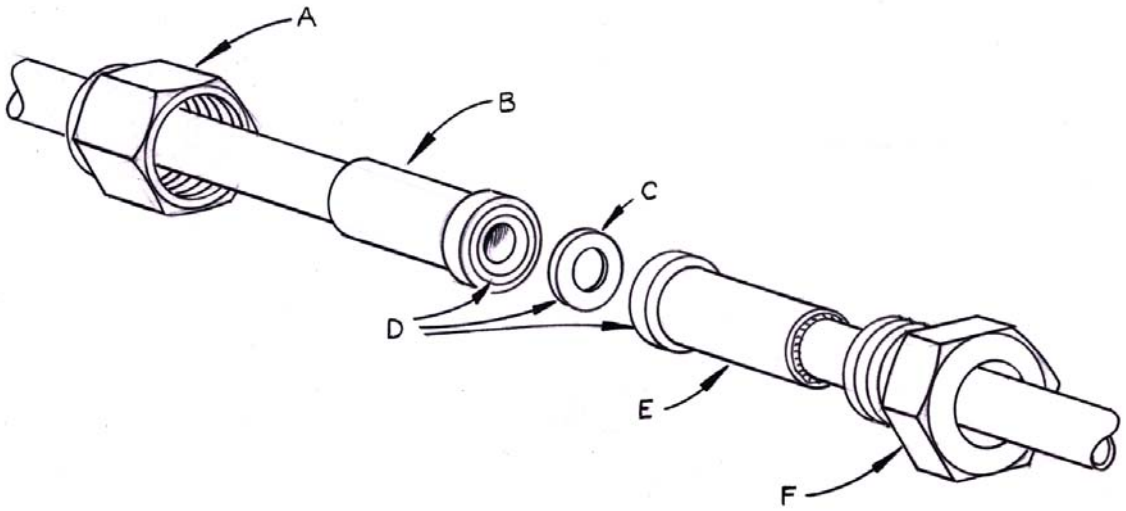

Figure 3-14: Cajon VCR Coupling (optional fitting)

A. Female Nut

B. Gland

C. Silver-plated stainless steel gasket or unplated nickel gasket

D. Sealing surfaces

E. Gland

F. Male nut

3.3.2 Position the Refrigerant Line

⚠ WARNING

Prevent leaks due to line vibration. See 3.3.2.4 Support the Refrigerant Line and Prevent Line Vibrations on page 3-38.

(See Figure 3-15.)

NOTE: *The refrigerant line is made of soft refrigeration copper and has a minimum bend radius of 12 inches (300 mm). It is suitable for being bent once to fit the existing layout.*

1. Bend the refrigerant line so that the couplings are even when they get to the unit (For example, the feed and return lines should have the same bend radius.)

⚠ CAUTION

GENERAL HAZARD
Do not repeatedly bend the refrigerant line. Do not twist the refrigerant line. Do not bend the refrigerant line within 6 inches (150 mm) of the couplings. Improper handling can result in damage to the line or equipment.
Handle the refrigerant line carefully.

2. It may be helpful to connect the refrigerant line to the cryosurface first. If so, tighten the couplings only finger-tight until finishing the positioning of the refrigerant line. (See section 3.2.1.2 Check Unit's Balance Pressure.)

NOTE: *For PFC/PFC or PFC/P: The upper set of couplings is for the first refrigerant circuit. The lower set of couplings is for the second refrigerant circuit.*

3.3.2.1 Attach the Refrigerant Line to the Cryosurface

For Parker CPI UltraSeal couplings (standard fitting): Insert an O-ring into the male coupling's groove. Place the gland against the O-ring and male coupling. Make certain the O-ring does not drop out of the groove. Slide the nut forward and finger-tighten the coupling. While keeping the male coupling stationary with the 15/16-inch wrench, tighten the nut with the 1-inch wrench. Each wrench must have a length of at least 12 inches (300 mm). Tighten until resistance increases sharply and no further tightening occurs. During the tightening procedure, the metal o-ring will be crushed into the o-ring groove. Tighten each coupling to 40-60 foot-pounds (54-80 Nm).

For Cajon VCR couplings (optional fitting): Place a gasket into the female nut. Assemble the components and finger-tighten the coupling. Use both wrenches to tighten each coupling to 40-60 foot-pounds (54-80 Nm).

NOTE: *These fittings are coupled and sealed based on mechanical displacement of the threaded parts, which results in compression at the sealing surface. Torque values are provided for customers requiring a measurable value.*

⚠ WARNING

Use of unauthorized, non-standard couplings will void your warranty. Improper use of, incorrect installation of, over-tightening of, or use of damaged o-rings in couplings will void your warranty. (See CAUTION on page 3-33 for installation guidelines.)

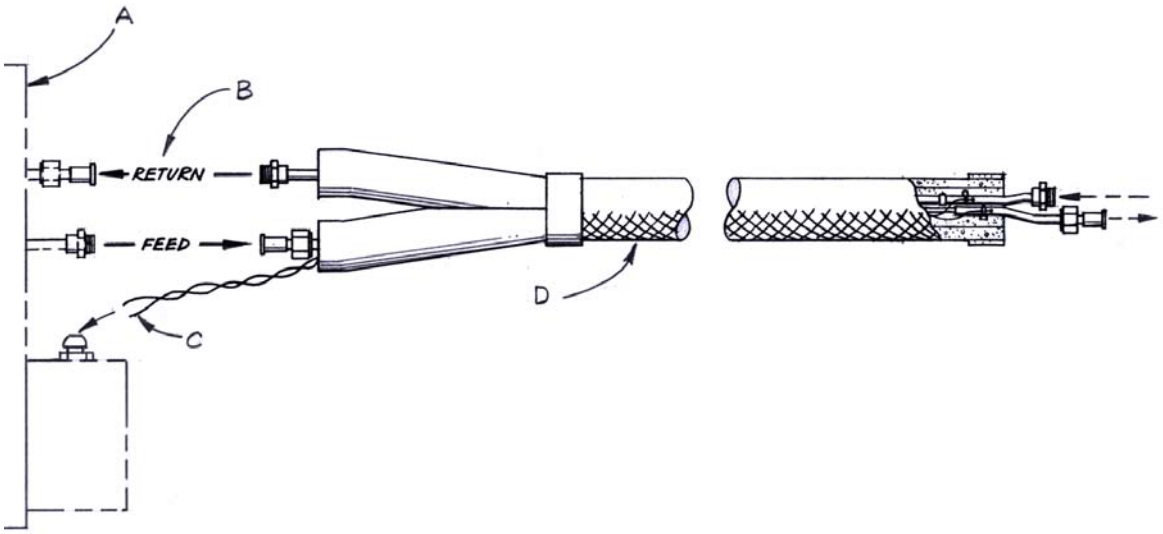

Figure 3-15: Refrigerant line connection

A. Refrigeration unit (top view)

B. Direction of refrigerant flow

C. Thermocouple wires (2)

D. Refrigerant line

3.3.2.2 Verify that the Isolation Valves are Closed, and Remove the Blank-off Fittings

1. Remove the top panel of the unit. The isolation valves are in the box closest to the couplings. Loosen the screws to open the valve box lid. Locate the red hand valves labeled COLD GAS FEED, COMMON RETURN, and HOT GAS

FEED. Turn each hand valve clockwise to make certain it is closed. (See Figure 3-16.)

2. Slowly remove the blank-off fittings from the couplings on the unit. A brief hiss may be heard. However, if refrigerant continues to escape from the unit, quickly reinstall the blank-off fittings and make certain the isolation valves are closed.

3. Keep the blank-off fittings with the unit. They will need to be reinstalled after the refrigerant line is disconnected.

NOTE: *The isolation valves are used to hold the refrigerant mixture in the unit during shipping or whenever the cryosurface or refrigerant line is disconnected. These valves cannot be operated when they are at cryogenic temperatures.*

3.3.2.3 Attach the Refrigerant Line to the Unit

Remove the rubber O-rings from the couplings. Assemble the couplings following the instructions in section 3.2.1.2 Check Unit's Balance Pressure above.

3.3.2.4 Support the Refrigerant Line and Prevent Line Vibrations

Support the refrigerant line at midlength. If a longer refrigerant line is installed, support it every 3 feet (1 m). Make sure the insulation is not crushed with the support. Use supports that are at least 4 inches (100 mm) wide such as tape, hangers, clamps, or cradles.

NOTE: *The brand or type of tape, hangers, clamps, or cradles depends on what is available and acceptable at the installation site. Do not use supports that make direct contact with the exposed tubes or couplings. Do not allow the lines to be vibrated by the application.*

Polycold recommends using a continuous line length from unit to cryocoil feed thru. Brooks Automation does not recommend or warranty use of intermediate fittings. If your line design has an intermediate set of fittings between the unit and chamber feed thru we recommend eliminating this and brazing the tubes together. However, if this cannot be done use only approved fittings. In addition the lines must be supported on each side of the intermediate fitting within 12 inches (300mm) of the fitting.

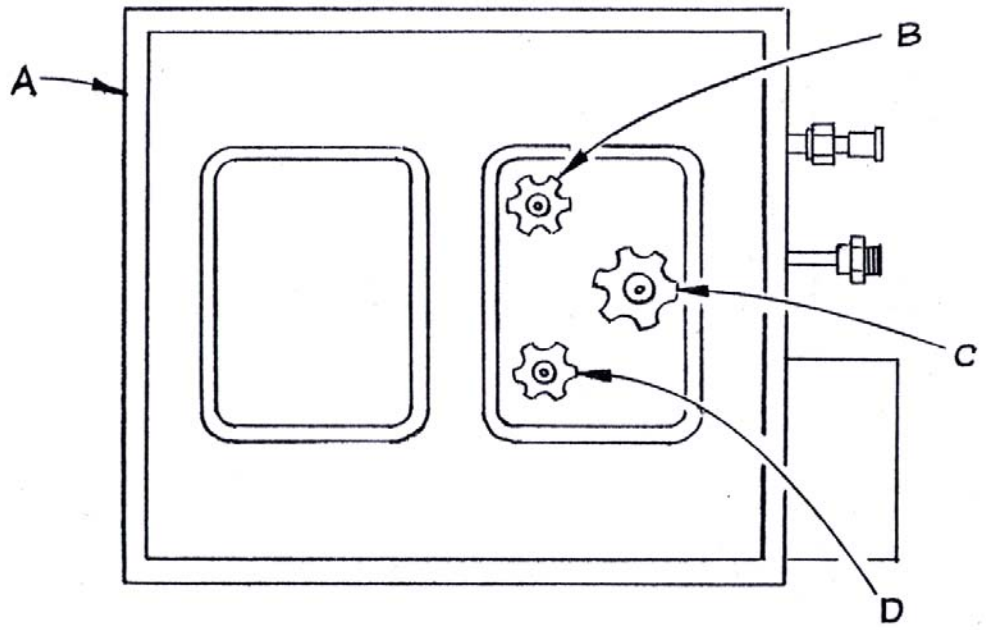

Figure 3-16: Isolation Valves Location

NOTE: *Two valve boxes shown in the previous figure. Some units have a single box.*

A. Refrigeration unit (top view with panel removed)

B. Cold gas feed isolation valve

C. Common return isolation valve

D. Hot gas feed isolation valve

3.3.3 Check the Refrigerant Line & Cryosurface for Leaks

Tools and materials needed:

- Cylinder of refrigerant gas R-22 or R-134a (mandatory for installations in Europe)
- Cylinder of dry nitrogen gas (dry referring to a very low dew point of –80 C) with a regulator
- Service manifold gauge set with three hoses (manifold)

- Electronic halogen leak detector with a leak sensitivity of at least 0.40 ounces (11 g) per year
- Leak detector soap
- Inspection mirror
- 5/8 inch end wrench
- 15/16 inch end wrench
- 1/4 inch ratchet valve wrench

NOTE: *If these materials are not obtainable, contact the Polycold service department for an alternate method to check for leaks.*

3.3.3.1 Pressurize the Refrigerant Line and Cryosurface

(See Figure 3-17 and Figure 3-18)

1. Make certain the manifold's valves are closed. Connect the manifold's suction (low pressure) hose to the EVACUATION VALVE on the unit. Midseat the EVACUATION VALVE to open it. (Midseat the EVACUATION VALVE by turning the valve stem three complete rotations in the counter-clockwise direction.)

2. Connect the refrigerant cylinder to the manifold's center port. Pressurize the refrigerant line and cryosurface to 10-20 psig (70-140 kPa). Once pressurized, close the valve and disconnect refrigerant cylinder.

3. Connect the nitrogen cylinder to the manifold's center port. Increase the pressure in the refrigerant line and cryosurface to 150 psig (1030 kPa).

⚠ CAUTION

GENERAL HAZARD
Do not pressurize the refrigerant line and cryosurface above 335 psig (2310 kPa). The pressure relief valve may leak if it is activated. Improper pressurization can result in damage to the line or equipment.
Make sure the procedure in this section, section 3.3.3.1 Pressurize the Refrigerant Line and Cryosurface, is followed carefully.

NOTE: *For PFC/PFC or PFC/P:* section 3.3.3.1 Pressurize the Refrigerant Line and Cryosurface *will pressurize both refrigerant circuits.*

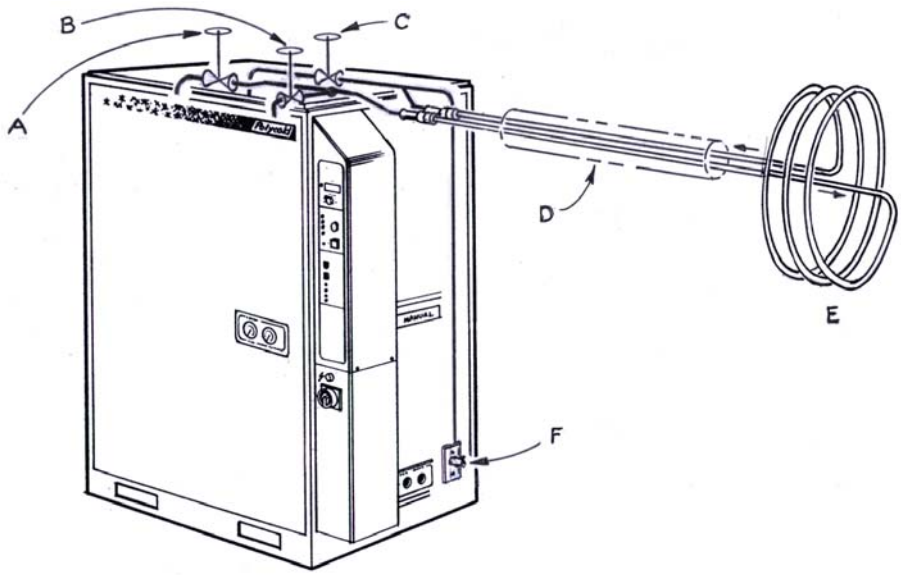

Figure 3-17: Evacuation Valve, Refrigerant Line & Cryosurface Relationship

(Schematic only—actual valve locations not shown)

A. Cold gas feed isolation valve (closed)

B. Hot gas feed isolation valve (closed)

C. Common return isolation valve (closed)

D. Refrigerant line

E. Cryosurface

F. Evacuation valve

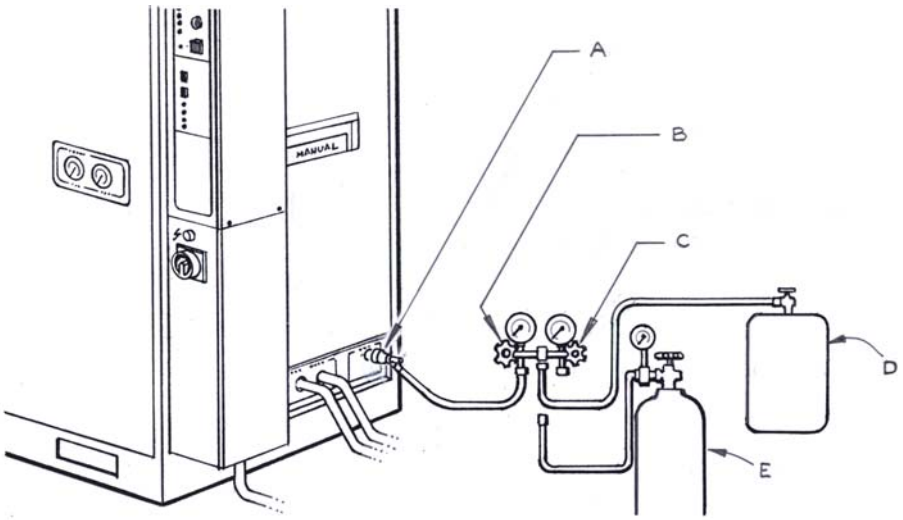

Figure 3-18: Refrigerant Line & Cryosurface—Leak-check Charging Set-up

A. Evacuation valve; pressure relief outlet (not shown)

B. Manifold suction valve

C. Manifold discharge valve (closed)

D. Cylinder of R-22 or R-134a

E. Cylinder of dry nitrogen gas

3.3.3.2 Check for Refrigerant Leaks

1. With the halogen leak detector, carefully check each connection that was made. This includes the Parker CPI UltraSeal or Cajon VCR couplings, the EVACUATION VALVE, and any brazed joint that may have been made. The Parker and Cajon couplings have two small access holes on each nut to help find leaks. With a finger cover one hole and put the sensor at the other hole. (See Figure 3-19.)

2. If no leaks are found, check the pressure on the manifold to verify that it is still at 150 psig (1030 kPa). If the pressure has not changed, go on to section 3.3.4 Evacuate the Refrigerant Line and Cryosurface.

NOTE: *If there is a large leak and the source cannot be gotten close to without activating the leak detector, open the manifold's suction valve until the pressure drops to about 50 psig (345 kPa). This should allow detection of the source of the leak.*

3.3.3.3 Pinpoint and Repair Any Leaks

WARNING

Never add refrigerant to a unit with a leak. Always pinpoint and repair any leaks prior to adding refrigerant or re-charging.

If a leak is found with the halogen leak detector, pinpoint its location with leak detector soap. A bubble that forms in about 2 minutes represents a leak equivalent to 1.5 ounces (43 grams) per year.

NOTE: ***Note:*** *Avoid making bubbles when applying the leak detector soap.*

If a leak is found on the Parker CPI UltraSeal or Cajon VCR couplings

- With a finger cover the lower access hole and apply leak detector soap to the higher access hole. Observe the higher access hole for at least 2 minutes. If a bubble forms, verify that the coupling is tightened to within specification.
- If the coupling still leaks, it must be reassembled. Open the manifold's suction valve to release the gas in the refrigerant line and cryosurface. Then disassemble the coupling following the instructions in Step 4 in section 8.2 How to Disconnect the Refrigerant Line. Make certain the coupling's sealing surfaces are not scratched or damaged. Re-assemble the coupling following the instructions in section 3.3.1 Connect the Refrigerant Line.

If a leak is found on a brazed joint

- Apply leak detector soap to the joint. Use an inspection mirror to view all sides of the joint. Observe the joint for at least 2 minutes. If the joint has a leak, it must be repaired. Open the manifold's suction valve to release the gas in the refrigerant line and cryosurface. Repair the leak following the instructions in section 3.7 Brazing Specification.

If a leak is found on the EVACUATION VALVE

- Apply leak detector soap to the packing. Observe the packing for at least 2 minutes. Tighten the valve packing if it is the source of the leak. If the packing is not the source of the leak, the valve must be replaced.

3.3.3.4 Confirm that the Refrigerant Line and Cryosurface are Leak-free

Use the halogen leak detector to check any repair that was made. (See section 3.3.3.1 Pressurize the Refrigerant Line and Cryosurface and section 3.3.3.2 Check for Refrigerant Leaks.) Repeat this procedure until all leaks have been repaired.

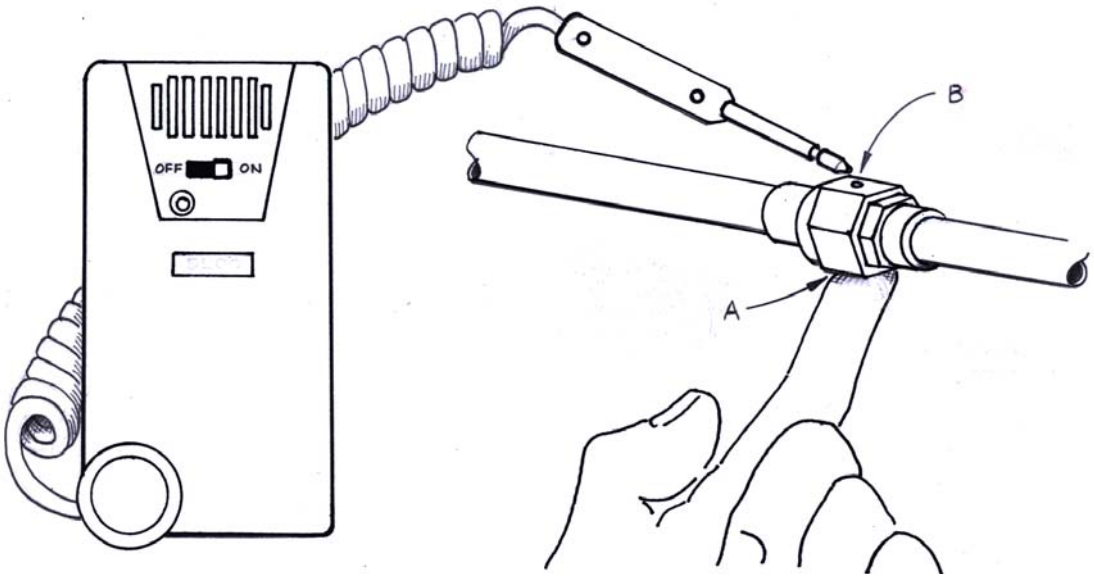

Figure 3-19: Couplings—Leak-checking Method

A. Cover one hole with finger

B. Put sensor at other hole

3.3.4 Evacuate the Refrigerant Line and Cryosurface

Tools and materials needed:

- Vacuum pump with a 1/4-inch SAE male flare connection that is capable of pumping down to at least 0.05 torr (6.5 Pa)
- Thermistor or thermocouple type vacuum gauge
- Cylinder of dry nitrogen gas with a regulator
- Service manifold gauge set with hoses (manifold)
- 1/4 inch ratchet valve wrench
- 5/8 inch end wrench
- 15/16 inch end wrench

WARNING

GENERAL HAZARD
Failure to have a qualified refrigeration technician do all refrigeration work could result in death or serious injury.
Do not attempt evacuation. Contact a qualified refrigeration technician.

3.3.4.1 Evacuate the Refrigerant Line and Cryosurface

1. Evacuate the refrigerant line and cryosurface to 0.1 torr (13 Pa). (See Figure 3-20.)

2. Allow the vacuum pump to continue pumping for 30 minutes.

3. Close the manifold's suction valve and turn off the vacuum pump.

NOTE: *The vacuum pump should evacuate the refrigerant line & cryosurface to 0.1 torr (13 Pa) within 30 minutes. If not, there may be a leak.*

3.3.4.2 Evacuate the Refrigerant Line and Cryosurface a Second Time

1. Connect the nitrogen cylinder to the manifold's center hose. (See Figure 3-20.) Pressurize the refrigerant line and cryosurface to 10-20 psig (70-140 kPa).

2. Evacuate the refrigerant line and cryosurface to 0.1 torr (13 Pa). Allow the vacuum pump to continue pumping for 30 minutes. Close the unit's EVACUATION VALVE while the vacuum pump is still pumping. Turn off the vacuum pump. Slowly remove the hose from the EVACUATION VALVE.

3. Reinstall the protective cap and the flare nut with bonnet onto the EVACUATION VALVE. (See Figure 3-21).

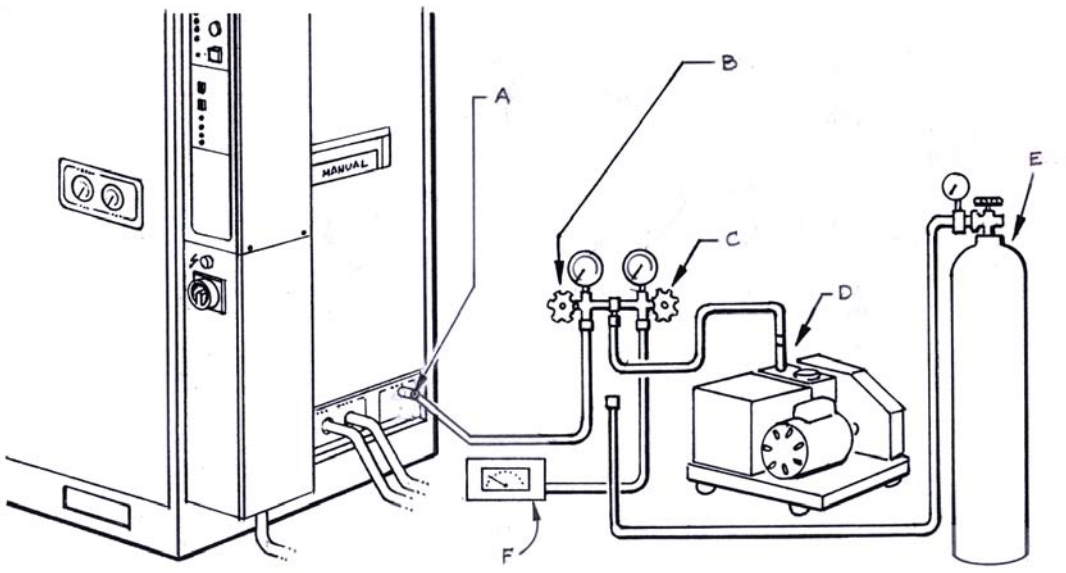

Figure 3-20: Refrigerant Line & Cryosurface—Evacuation Set-up

A. Evacuation valve

B. Manifold suction valve

C. Manifold discharge valve

D. Vacuum pump

E. Cylinder of dry nitrogen gas

F. Vacuum gauge

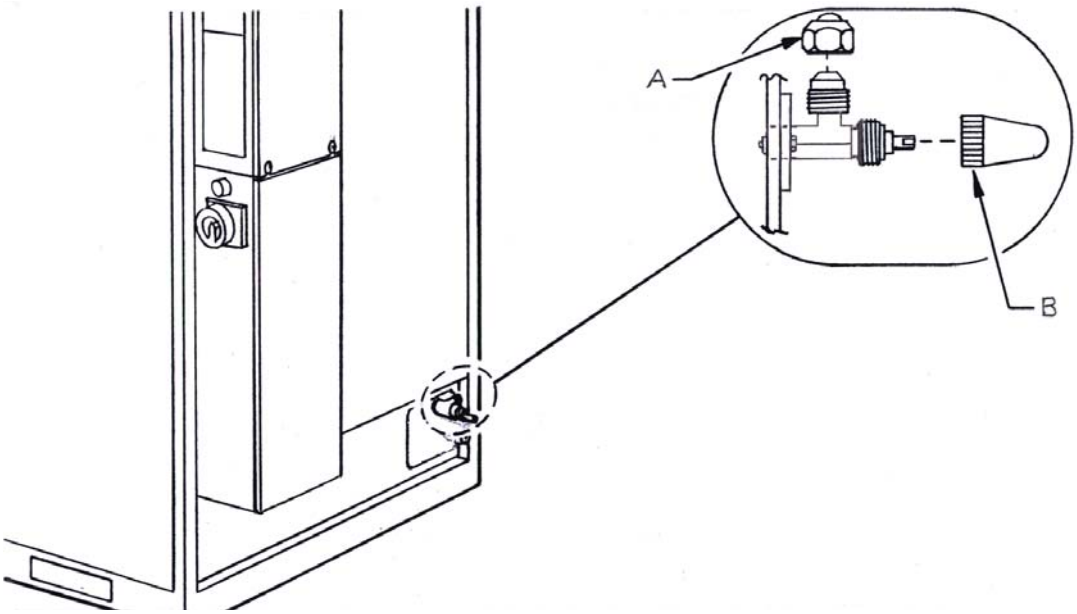

Figure 3-21: Evacuation Valve Closure

A. Bonnet with flare nut

B. Cap

3.3.5 Connect the COIL IN & COIL OUT Thermocouples

Tools and materials needed:

- Phillips screwdriver
- small straight blade screwdriver
- wire stripper, a thermal wire stripper is preferred

For PFC / PFC or PFC / P:

- four small labels or tape
- Armaflex tape, about 1x2 inches (25x50 mm)

If someone other than Polycold made the refrigerant line on this system, make sure that the thermocouples were properly installed. Please refer to section 3.6 Refrigerant Line Specification.

⚠ WARNING

ELECTRICAL HAZARD
Contact could cause electric shock and result in death or serious injury.
Make certain the ON / OFF switch and the power disconnect switch are in the OFF position.

3.3.5.1 Remove the Low Voltage Box Panel

Loosen the two lower screws on the side of the low voltage box. Slide the panel straight up to remove it. (See Figure 3-22.)

3.3.5.2 Put the COIL IN and COIL OUT Thermocouples in the Low Voltage Box

1. Locate the thermocouple wires labeled COIL IN and COIL OUT on the refrigerant line. Locate the EXTERNAL TC fitting on the back of the low voltage box.

2. Unscrew the cap and remove the rubber seal from the EXTERNAL TC fitting.

3. Slide the cap over the thermocouple wires.

4. Slip the thermocouple wires into the slit in the rubber seal. Insert the rubber seal into the fitting and screw on the cap.

NOTE: *For PFC/PFC or PFC/P*

- Fold a small piece of tape around each thermocouple wire next to its label.
- Label the tape “#1” on the COIL IN and COIL OUT thermocouple wires coming from the first refrigerant circuit.

5. Label the tape “#2” on the COIL IN and COIL OUT thermocouple wires coming from the second refrigerant circuit.

6. Instead of using the rubber seal, wrap the Armaflex tape around the thermocouple wires so that the wires fit tightly in the EXTERNAL TC fitting.

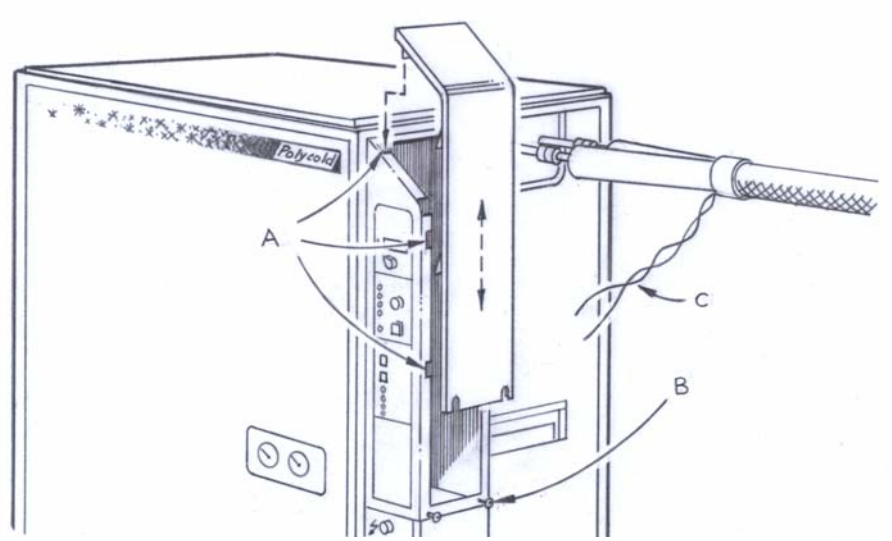

Figure 3-22: Low Voltage Box Panel Removal

A. Notches

B. Loosen screws

C. Thermocouple wires

3.3.5.3 Connect the Thermocouple Wires to the Terminal Boards

NOTE: *The terminal blocks are located on a printed circuit board directly below the temperature meter.*

1. Strip about 1/4 inch (6 mm) of insulation from the end of each thermocouple wire.

	⚠ CAUTION
	GENERAL HAZARD Make sure not to nick the conductor. The wire may break with future vibration and can result in damage to the equipment. Do not nick the conductor.

2. Attach the thermocouple wires to their designated locations. The blue-insulated copper wire must be attached to the positive (+) terminal. The red-insulated constantan wire must be attached to the negative (–) terminal. (See Figure 3-23.)

- Position #3: COIL IN
- Position #4: COIL OUT

For PFC/PFC or PFC/P:

- Position #3: #1 COIL IN
- Position #4: #1 COIL OUT
- Position #5: #2 COIL IN
- Position #6: #2 COIL OUT

3.3.5.4 Reinstall the Low Voltage Box Panel

1. Slide the panel straight down onto the low voltage box so that the two side tabs go into their notches.

2. Push the top of the panel towards the unit and at the same time push down so that the top tab goes into its notch.

3. Tighten the two screws.

NOTE: *The temperature from a single thermocouple in **Figure 3-20** can be displayed at a remote location through the remote connector. To accomplish this see section 3.8.2 Additional Instructions for Remote Temperature Indication.*

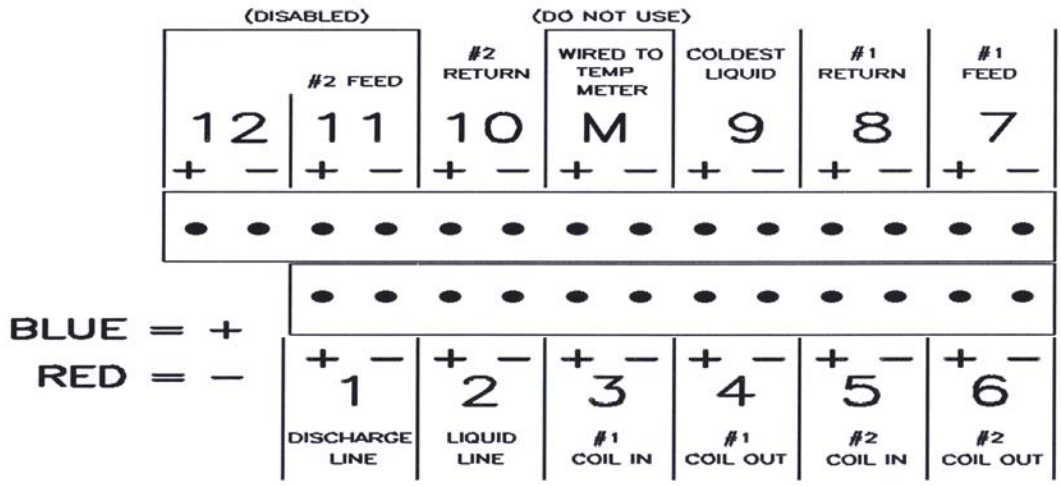

Figure 3-23: Thermocouple (TC) positions identification

1. TC #1 = DISCHARGE LINE
2. TC #2 = LIQUID LINE
3. TC #3 = #1 COIL IN
4. TC #4 = #1 COIL OUT
5. TC #5 = #2 COIL IN
6. TC #6 = #2 COIL OUT
7. TC #7 = #1 FEED
8. TC #8 = #1 RETURN
9. TC #9 = COLDEST LIQUID

M. Wired to temperature meter—do not use.

10. TC #10 = #2 RETURN
11. #2 FEED—disabled
12. Disabled