

3.6 Refrigerant Line Specification

Tools and materials needed:

- closed-cell pipe insulation rated for cryogenic temperatures
- type T (copper-constantan) thermocouple wire
- wire stripper, a thermal wire stripper is preferred
- soft drawn refrigeration grade copper tubing with a minimum wall thickness of 0.030 inches (0.76 mm)

For 550, 551, 552, 660, 661, 662, 670, 672, and PFC/PFC-1100, 1101, and 1102

feed line: 5/16 inch (8 mm) OD tube brazed to a short 1/2 inch (12 mm) OD tube

return line: 1/2 inch (12 mm) OD tube

For PFC-1100, 1101, and 1102

feed line: 3/8 inch (10 mm) OD tube brazed to a short 5/8 inch (16 mm) OD tube

return line: 5/8 inch (16 mm) OD tube

Parker CPI UltraSeal or Cajon VCR couplings (Mating couplings are provided to connect the refrigerant line to the unit).

For 550, 551, 552, 660, 661, 662, 670, 672, and PFC/PFC-1100, 1101, and 1102

1/2-inch Parker CPI UltraSeal couplings with silver-plated stainless steel O-rings

For PFC-1100, 1101, and 1102

5/8-inch Cajon VCR couplings with silver-plated stainless steel gaskets or unplated nickel gaskets


For brazing:

See [section 3.7 Brazing Specification](#).

For soldering:


- sand paper
- propane torch
- 60/40 tin-lead rosin core solder
- rosin flux

3.6.1 How to Build the Feed and Return Lines

	⚠ CAUTION
	GENERAL HAZARD The refrigerant line must be designed to sustain a working pressure of 450 psig (3100 kPa). The refrigerant line is part of the refrigerant circuit of the cryopump. Improper design and / or handling can result in damage to the line or equipment. Design and handle the refrigerant line carefully.

NOTE: *Position the unit as close as possible to the cryosurface. The longer the refrigerant line, the warmer the refrigerant gets before it reaches the cryosurface.*

NOTE: *Braze the refrigerant line to the cryosurface unless the cryosurface will be removable. If so, use Parker CPI UltraSeal or Cajon VCR couplings. These couplings have been tested and found to be satisfactory. Other types of couplings may leak.*


	⚠ 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.)

3.6.1.1 Carefully Build the Feed and Return Lines

- Follow the instructions in [section 3.7 Brazing Specification](#).
- Make certain the tubes are clean and free of corrosion, flux, and particle residue inside and out.


3.6.1.2 Attach Thermocouples to the Feed and Return Lines near the Feed-through Port

Remove 1/2 inch (13 mm) of insulation from one end of the 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.

- Twist the two wires together. Apply flux and pre-tin the twisted wires. Remove the flux residue with a wet rag while it is still hot.
- Use sand paper to remove oxidation from the copper tube. Apply flux to the tube. Position the thermocouple wire so that the first twist of wire (nearest the insulation) is against the tube. Solder the wire twist to the copper tube. Remove the flux residue with a wet rag while the joint is still hot.

NOTE: *Make certain the wire twist closest to the insulation is in contact with the copper tube. It is the first twist of wire closest to the insulation that senses and determines the temperature reading.*

	⚠ CAUTION
	GENERAL HAZARD Do <u>not</u> overheat the flux. Do <u>not</u> melt or cut the plastic insulation on the thermocouple wire. It may create false readings and can result in damage to the equipment. Be careful when attaching thermocouples to the feed and return lines.

- Wrap the thermocouple wire tightly around the tube 3-4 times. Allow enough thermocouple wire to run along the refrigerant line to the unit, plus an additional 4 feet (1.2 m) to reach the terminal blocks inside the low voltage box.

3.6.1.3 Pressure Test the Refrigerant Line to 615 psig (4237 kPa)

This test must be done before connecting the cryosurface to the refrigeration unit. The pressure relief valve for the refrigerant line and cryosurface may leak if it is pressurized above 335 psig (2310 kPa).


NOTE: *615 psig = 1.43 x 450 psig*

3.6.1.4 Check the Feed and Return Lines for Leaks

Use a helium mass spectrometer if one is available.

3.6.1.5 Insulate the Feed and Return Lines

Provide at least 1-1/4 inches (32 mm) wall thickness of insulation around the feed and return lines. The insulation must be airtight or the refrigerant line will cryopump water. If the system is not completely sealed and airtight, water vapor from the air will accumulate on some of the surfaces.

	⚠ CAUTION
	GENERAL HAZARD The tubing must be free of oil and moisture before connecting it to the refrigeration unit. Failure to comply with the former specification can result in damage to the equipment. Make sure the tubing is free of oil and moisture before connecting it to the refrigeration unit.