3.5 Cryosurface & Cryogenic Feed-through Specification

⚠ CAUTION

GENERAL HAZARD
The tubing, cryosurfaces, and feed-through 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, cryosurfaces, and feed-through are free of oil and moisture before connecting it to the refrigeration unit.

3.5.1 If the Cryosurface is a Coil

NOTE: *This section assumes that a refrigerant circuit will be used to capture water vapor in a vacuum chamber.*

3.5.1.1 Choose a Good Location

The cryocoil must be located so that:

- Evaporant (deposition source material) is not deposited on its surface.
- It has the best possible (unimpeded) view of the surfaces most likely to emit water vapor.
- It is facing away (or can be shielded) from sources of heat greater than 50°C.
- It is not subject to damage from moving objects.
- It can be supported without significant thermal conductance from the vacuum chamber.

If vacuum isolated feed-through is used, it must be located so that water will not collect in it when the cryocoil is defrosted. Subsequent freezing of this water may damage the cryocoil and / or cause vacuum or refrigerant leaks.

Table 3-9: Cryocoil Size Specification

Refrigeration Unit	Total Surface Area ft² (m²)	Tube Diameter in (mm)	Tube Length ft (m)
PFC-550-LT	2.7 (0.25)	3 / 8 (10)	27 (8.0)
PFC-550-HC	5.4 (0.50)	1 / 2 (12)	41 (13)
PFC-551-HC (CE)	5.4 (0.50)	1 / 2 (12)	41 (13)
PFC-552-HC (CE)	5.4 (0.50)	1 / 2 (12)	41.1 (13.3
PFC-660-HC	7.5 (0.70)	5 / 8 (16)	46 (14)
PFC-661-HC (CE)	7.5 (0.70)	5 / 8 (16)	46 (14)
PFC-662-HC (CE)	7.5 (0.70)	5 / 8 (16)	46 (14)
PFC-670-HC	7.5 (0.70)	5 / 8 (16)	46 (14)
PFC-672-HC (CE)	7.5 (0.70)	5 / 8 (16)	46 (14)
PFC-1100-LT	5.4 (0.50)	1 / 2 (12)	41 (13)
PFC-1100-HC	21.6 (2.0)	5 / 8 (16)	132 (40)
PFC-1101-LT (CE)	5.4 (0.50)	1 / 2 (12)	41 (13)
PFC-1101-HC (CE)	21.6 (2.0)	5 / 8 (16)	132 (40)
PFC-1102-HC (CE)	21.6 (2.0)	5 / 8 (16)	132 (40)

NOTE:

For PFC/PFC: The total surface area must be divided between the two cryocoils.
Larger cryocoils may give faster pumping speeds, and can be used in some applications. However, if the heat load is too great, the cryopump will become less efficient and may be shut off by a protective device.

3.5.1.2 Design the Cryocoil and Feed-through to the Following Requirements:

	**⚠ CAUTION** GENERAL HAZARD The cryocoil and feed-through must be designed to sustain a working pressure of 450 psig (3100 kPa). The cryocoil and feed-through are part of the refrigerant circuit of the cryopump. Failure to comply with the former specifications can result in damage to the equipment. Do not use reservoir-type or large volume cryocoils. Do not use large diameter tubing.

1. The cryocoil must be a single continuous circuit (tube).
   - Do not put branches in the circuit. It causes uneven distribution of the refrigerant mixture that degrades the performance of the cryopump.
   - Do not add fins or panels to the circuit. The increased mass takes longer to cool and defrost the cryocoil and raises the cryocoil temperature.
2. The cryocoil must be either stainless steel or refrigeration grade copper tubing.
   - Stainless steel tubing is more durable and less chemically reactive. Minimum wall thickness is 0.020 inches (0.5 mm).
   - Refrigeration grade copper tubing is easier to work with. Minimum wall thickness is 0.030 inches (0.76 mm).
3. The cryocoil must have the proper surface area based on the diameter and length of the tubing. See Table 3-9.
4. The cryogenic feed-through must be thermally isolated; a vacuum isolated feed-through is preferred.
5. If customer is providing feed-through, mating couplings are shipped with the unit. The couplings must be offset 3 inches (76 mm) to be connected to the refrigerant line. (See Figure 3-1.)

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.)

6. It is preferable to weld or braze all connections inside the vacuum chamber. If this is not practical, use one of the couplings listed below. These couplings have been tested and found to be satisfactory. Other types of couplings may leak.
   - Parker CPI Ultra Seal couplings with silver-plated stainless steel O-rings.
   - Cajon VCR couplings with silver-plated stainless steel gaskets or unplated nickel gaskets.

7. The supports for the cryocoil must allow for thermal contraction and expansion as the coil is cooled and defrosted. Also the supports must not add a significant heat load to the cryopump. Suitable supports can be made of thin stainless steel rods or tubing. Some plastics may be suitable for certain applications.

3.5.1.3 Carefully Build the CryoCoil (and Feed-through)

Use a tubing bender or mandrel so that the tubing is smooth and wrinkle-free. Follow the instructions in section 3.7 Brazing Specification. Make certain the tubing is clean and free of corrosion, flux, and particle residue (inside and out).

3.5.1.4 Pressure-test the CryoCoil to 615 psig 4240 kPa (gauge) (i.e., 6.895 X psig)

This test must be done before you connect the cryocoil 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 430 psig.*

3.5.1.5 Check the Cryocoil for Leaks

Use a helium mass spectrometer if one is available.

⚠ 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.

3.5.2 If the Cryosurface is a Baffle

NOTE: *This section assumes the use of a refrigerant circuit to control back streaming. Back streaming will contaminate the system because it is the process of hot vapor migrating and condensing on cold surfaces. When the vacuum pump is used, the pump oil heats up and travels opposite of the pumping direction and condenses the system resulting in system contamination.*

3.5.2.1 Choose a Good Location

- The cryobaffle must be shielded from sources of heat greater than 50°C.
- The cryobaffle must not come in direct contact with the vacuum chamber.

3.5.2.2 Design the Cryobaffle (and Feed-through) to the Following Requirements

⚠ CAUTION

GENERAL HAZARD
The cryocoil, cryobaffle and feed-through must be designed to sustain a working pressure of 450 psig (3100 kPa). The cryocoil, cryobaffle and feed-through are part of the refrigerant circuit of the cryopump. Failure to comply with the former specifications can result in damage to the equipment.
Do not use reservoir-type or large volume cryobaffles. Do not use large diameter tubing.

1. The cryobaffle should have a single continuous circuit (tube). Braze the fins of a baffle to this tube.
   - Contact a local Polycold sales representative or Brooks Polycold Systems Inc. for instructions on sizing the cryobaffle and other information.

- Do not put branches in the circuit. It causes uneven distribution of the refrigerant mixture that degrades the performance of the cryopump.

2. The cryobaffle should be made with refrigeration grade copper tubing and with OFHC (oxygen free, high capacity) copper fins.
   - The refrigeration grade copper tubing must have a minimum wall thickness of 0.030 inches (0.76 mm).
   - The cryobaffle may be nickel-plated.

3. The cryogenic feed-through must be thermally isolated; a vacuum isolated feed-through is preferred.

NOTE: *Some multi-coolant baffles do not have appropriate feed-throughs and should not be used. If the feed-through is not sufficiently insulated:*

- The additional heat load at the feed-through can significantly degrade the performance of the cryopump.
- The elastomeric seal (O-ring) may become too cold and cause a vacuum leak.
- Ice may form on the outside surfaces of the vacuum chamber.

NOTE: *If customer is providing feed-through, mating couplings are shipped with the unit. The couplings must be offset 3 inches (76 mm) to be connected to the refrigerant line. (See* Figure 3-1.*)*

3.5.2.3 Carefully Build the Cryobaffle (and Feed-through)

- Use a tubing bender or mandrel so that the tubing is smooth and wrinkle-free.
- Follow the instructions in section 3.7 Brazing Specification.
- Make certain the tubing is clean and free of corrosion, flux, and particle residue inside and out.

3.5.2.4 Pressure-test the Cryobaffle to 615 psig 4240 kPa (gauge) (i.e., 6.895 X psig)

This test must be done before connecting the cryobaffle 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 430 psig*

3.5.2.5 Check the Cryobaffle for Leaks

Use a helium mass spectrometer if one is available

⚠ 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.