STANDARD LABORATORY INTERFACE COMPONENTS

MODELS WMX
DMX
FMX

TECHNICAL MANUAL

Advanced Research Systems, Inc.

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6/01

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SAFETY

GENERAL

THE INTERFACE COMPONENTS ARE DESIGNED TO PROVIDE SAFE OPERATION WHEN THE INSTALLATION, OPERATION AND SERVICING ARE PERFORMED IN ACCORDANCE WITH THE INSTRUCTIONS IN THIS TECHNICAL MANUAL. CONSULT THE ADVANCED RESEARCH SYSTEMS, INC. IF A QUESTION SHOULD ARISE THAT IS NOT ANSWERED IN THIS MANUAL.

SPECIAL NOTICES

THREE TYPES OF SPECIAL NOTICES – WARNINGS, CAUTIONS, AND NOTES – ARE USED IN THIS TECHNICAL MANUAL. THEY APPEAR AS FOLLOWS AND SERVE THE PURPOSES STATED.

WARNING

WARNINGS CALL ATTENTION TO ACTIONS OR CONDITIONS WHICH CAN RESULT IN INJURY OR DEATH TO PERSONNEL.

CAUTION

CAUTIONS CALL ATTENTION TO ACTIONS OR CONDITIONS WHICH CAN RESULT IN DAMAGE TO THE EQUIPMENT OR IN ABNORMAL PERFORMANCE.

NOTE

Notes give important, additional information, explanations or recommendations related to the procedure or discussion presented.

WARNINGS and CAUTIONS, like other safely instructions, appear in the text where they are especially applicable. Because of their importance, they are summarized in this safety section, the first section to be read.

WARNINGS

EXTREME COLD CAN CAUSE INJURY FROM FROSTBITE. ALLOW THE REFRIGERATOR TO WARM TO ROOM TEMPERATURE BEFORE REMOVING THE VACUUM SHROUD. BE CAREFUL NOT TO TOUCH ANY FROSTED PARTS.

DURING VACUUM LEAK CHECKING, DO NOT PRESSURIZE THE VACUUM SHROUD. INTERNAL PRESSURE CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

LIMIT THE QUANTITY OF GAS INJECTED TO THE SAMPLE TO KEEP THE INTERNAL PRESSURE OF THE SHROUD NEGATIVE WHEN THE SYSTEM WARMS TO ROOM TEMPERATURE.

AVOID ICING INSIDE THE VACUUM SHROUD. PROMPTLY REPAIR VACUUM LEAKS. WHEN FROZEN GASES WARM TO ROOM TEMPERATURE, THE PRESSURE INCREASE WITHIN THE SHROUD CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

CAUTIONS

EVACUATE THE VACUUM SHROUD TO AT LEAST 0.05 TORR BEFORE STARTING THE REFRIGERATION SYSTEM, TO AVOID EXCESSIVE CONVECTIVE HEAT TRANSFER, WHICH PREVENTS COOLDOWN.

FAILURE TO ISOLATE THE SHROUD FROM THE VACUUM SYSTEM WILL ALLOW VACUUM PUMP OIL TO MIGRATE TO THE INTERFACE.

NEVER BREAK THE VACUUM WITH THE VACUUM PUMP CONNECTED. VACUUM PUMP OIL WILL BE BLOWN INTO THE VACUUM SHROUD.

MODIFICATION TO EQUIPMENT WITHOUT THE CONSENT OF THE MANUFACTURER IS PROHIBITED AND WILL VOID THE WARRANTY.

INTRODUCTION

A typical complete laboratory system may be either closed cycle or open cycle. A closed cycle system consists of a compressor(s), interconnecting gas hoses, a refrigerator and its interface components. In a open cycle system, the refrigerator is cooled by liquid nitrogen or liquid helium, transferred from a Dewar flask, In either type of system, optional instrumentation can also be furnished.

A variety of standard interface components, sample holders, radiation (radiant heat) shields and vacuum shrouds is available to suit the customer's needs. Specific data, details and dimensions for standard interface components are contained in separate data sheets furnished with the components.

This technical manual contains information for installation, operation, maintenance, troubleshooting, service and warranty for standard interface components used with laboratory refrigeration systems. The WMX, DMX, and FMX families of interface components are defined as follows:

> WMX interfaces are used in 4K open cycle systems with a LT-3 liquid Heli-tran® refrigerator*.
>
> DMX interfaces are used in closed cycle refrigeration systems with a model DE-202 expander.
>
> FMX interfaces are used in closed cycle refrigeration systems with a model DE-204 expander.

Standard interface components are available for the following laboratory functions: Spectroscopy, X-ray diffraction, narrow gap magnet studies and EPR. Component model numbers are listed in the following table:

*Heli-tran® is a registered trade name of IGC-APD Cryogenics, Inc.

APPLICATION	REFRIGERATORS LT-3-110	DE-202	DE-204
	Interface Model Numbers		
Spectroscopy (UV, visible, IR, Raman)	WMX-1E	DMX-1E	FMX-1E
Spectroscopy (Matrix isolation)	WMX-1A/E	DMX-1A/E	
X-Ray diffraction (General)	WMX-2	DMX-2	
X-Ray diffraction (Dynamo)	WMX-2B	DMX-2B	
X-Ray diffraction (Goniometer)		DMX-2D	
Diamond Anvil Cell			FMX-4
Narrow gap magnet studies (41.3 mm)	WMX-12	DMX-12	FMX-12
Narrow gap magnet studies (35 mm)	WMX-12B	DMX-12B	
EPR	WMX-15	DMX-15	
Spectroscopy (Large sample)	WMX-16E	DMX-16E	FXM-16E
Spectroscopy (Large sample, matrix isolation)	WMX-16EA	DMX-16AE	

DESCRIPTION

Assembly

Figure 1 shows a simplified typical interface assembled to a refrigerator as it would be during operation. The vacuum shroud and the radiation shield need to be removed to exchange samples.

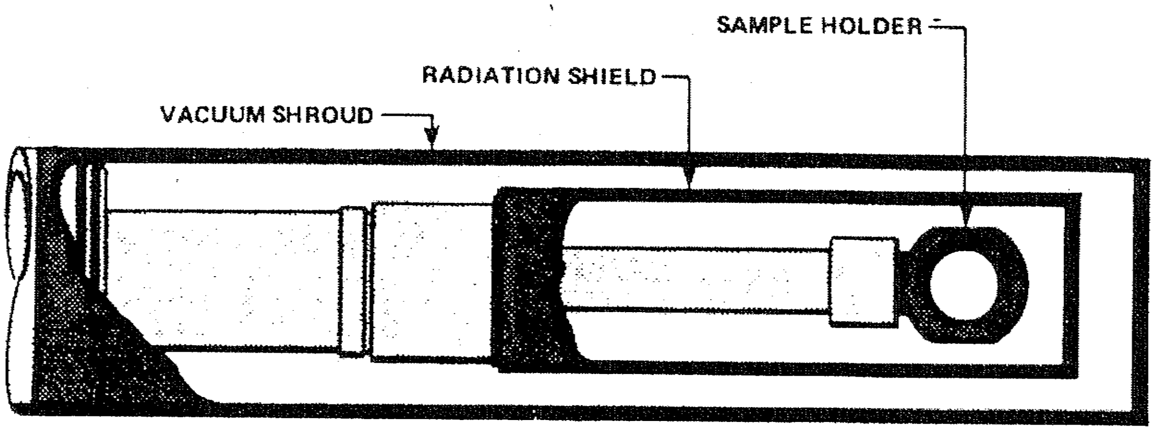

Figure 1 Typical Interface

The interface serves four basic functions: to hold the sample to be examined, to shield the sample area from radiant heat so that the low temperature required can be attained, to form a vacuum envelope which allows low temperatures to be reached and to provide an environment suitable for sample examination. These functions are performed by the sample holder, radiation shield and vacuum shroud. The vacuum required is created inside the shroud and shield by the customer's pumping system connected to the port on the refrigerator skirt.

Windows in the shroud and openings in the shield provide access to and visibility of the sample by the operator or optional instruments, or both.

Shroud Windows

Shroud windows may be either fixed or removable. A fixed window is epoxy bonded in place on the vacuum shroud. The adhesive bond must be vacuum tight. See Figure 2.

"Stress free" removable windows are used on most shrouds. As shown in Figure 3, the window is held in place by the port cover and seals against the shroud with an O-ring. The window is not bonded to the port cover. Port covers are held in place with cap screws.

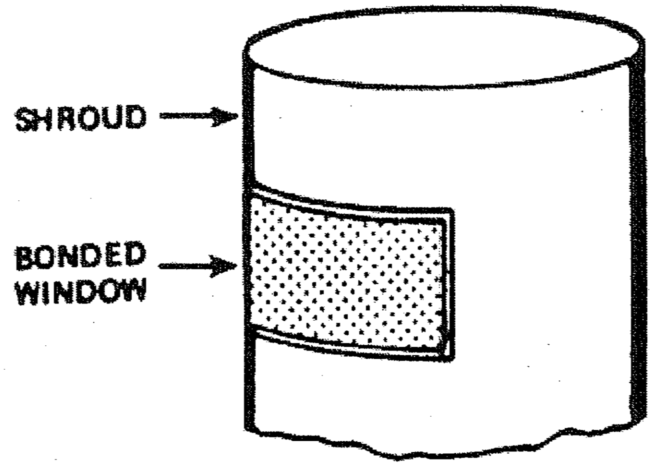

Figure 2 Vacuum Shroud with Fixed Window

It is only necessary to hand-tighten the retaining screws as the vacuum will pull the window against the o-ring. If vacuum cannot be established, then lightly tighten the retaining screws.

NOTE:
Too much torque on the retaining screws could cause the window to crack.

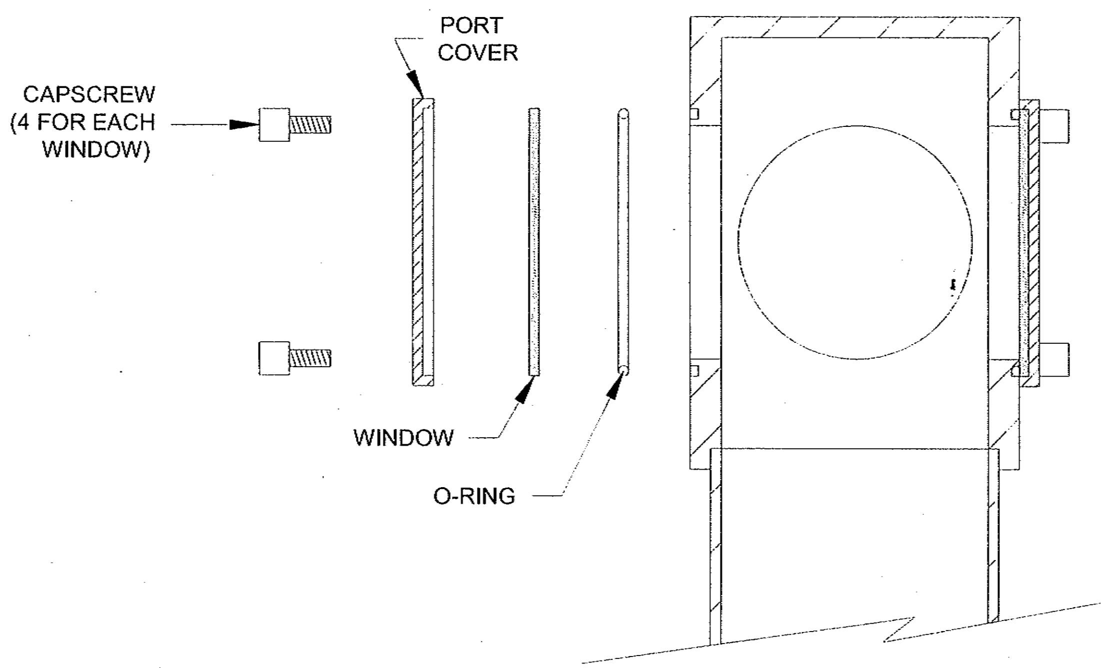

Figure 3 Vacuum Shroud with Removable Window

INSTALLATION

Use the procedure which follows to assemble the interface components to the cold head. A separate procedure gives instructions for making connections to gas injection ports on interfaces so equipped.

Assembling the Interface

Proceed as follows to assemble an interface to a refrigerator.

1. Verify that the refrigerator is at room temperature.
2. Verify that electrical power to the refrigerator is off.
3. Unscrew the adapter from the radiation shield.
4. Examine the refrigerator's first stage heat station and the adapter. Both must be clean and free of any surface conditions that could prevent full contact. See Figure 4.
5. Use the indium sheet in the Installation Kit to make a 5-hole, 2-slot gasket to fit between the first stage heat station and the adapter.
6. Position the gasket on the heat station.
7. With its threaded sleeve toward the refrigerator's second stage heat station, place the adapter around the second stage and seat its flange against the gasket on the first stage. See Figure 4.
8. Align the ducts and the screw holes in the adapter with those in the first stage heat station and the gasket. See Figure 5.

Note:
Be sure that all instrumentation leads pass through the duct and slots.

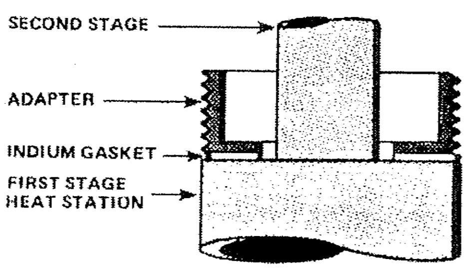

Figure 4 Install the Shroud Adapter

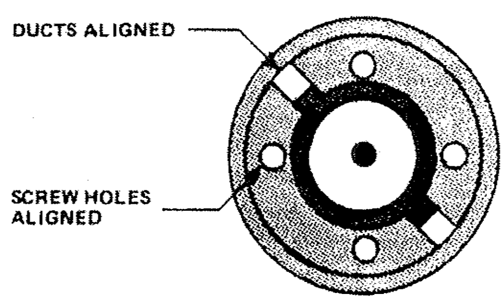

Figure 5 Alignment of Indium Gasket and Adapter

9. Fasten the adapter to the first stage with the screws supplied.

10. Examine the end of the second stage heat station and the mating sample holder surface. Both must be clean and free of any surface conditions that could prevent full contact with each other.

Note:
If protective coatings cover any sample holder surfaces, peel them off before proceeding with step 11.

11. Cut an indium gasket to fit the end of the second stage heat station. Put a hole in the gasket center for the mounting stud on the sample holder. Put the gasket on the bottom of the sample holder. See Figure 6.

12. Screw the sample holder into the end of the second stage heat station. Tighten it finger tight. See Figure 7.

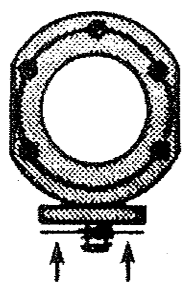

Figure 6 Install Indium Gasket On Sample Holder

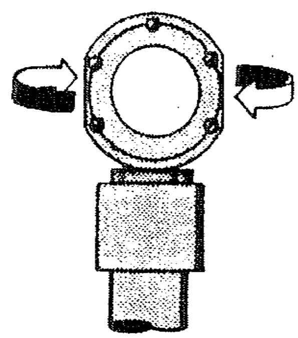

Figure 7 Install Sample Holder

Note:
The procedure for changing samples follows in the Operation section of this technical manual.

13. Wipe a light coat of vacuum grease on the male threads of the radiation shield adapter to prevent thread galling.

14. Screw the radiation shield onto its adapter. Align the shield openings with the sample holder. The radiation shield threads do not need to bottom on the adapter. See Figure 8.

15. Verify that there are O-rings in the grooves of the refrigerator skirt, that they are clean and not twisted or nicked, and that they are lightly coated with vacuum grease.

16. Press the vacuum shroud onto the skirt of the refrigerator. Align the shroud windows with the opening(s) in the radiation shield. See Figure 9.

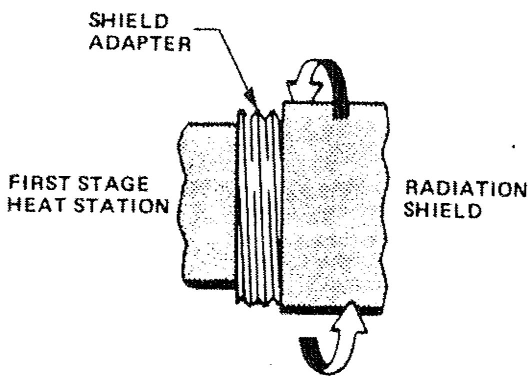

Figure 8 Install Radiation Shield

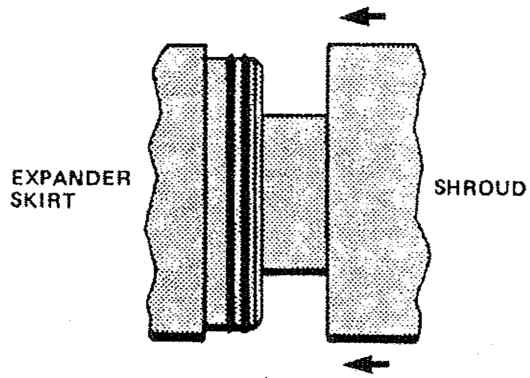

Figure 9 Install Vacuum Shroud

Note:
The vacuum shroud is not fastened to the refrigerator or held with external hardware. It is held in place only by atmospheric pressure after the internal vacuum is pulled.

17. Position and mount the refrigerator to limit the travel of the shroud in the event of an internal pressure buildup. Direct it away from personnel.

    DE-202/DE-204 mounting – Use the four bolt holes on the corners of the warm flange.

    Heli-tran mounting – Clamp per instructions in the Heli-tran manual.

Gas Injection Fittings

Some vacuum shrouds are equipped with gas injection fittings. As shipped, the fittings are plugged. If gas injection will be used, the plugs need to be removed and replaced with gas injection needles before evacuating the shroud.

1. Loosen the fitting nut. Pull the plug from the fitting. See Figure 10.

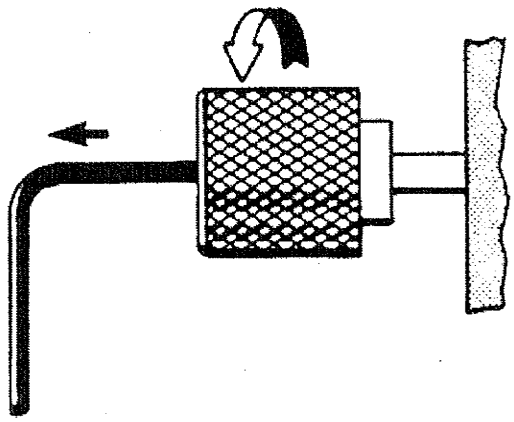

Figure 10 Remove Plug from Gas Injection Fitting

2. Examine the injection needle to be inserted into the fitting. The end must be smooth and clean so that the O-ring seal inside the fitting will not be damaged, which would prevent proper sealing.

3. Push the injection needle through the fitting and into the shroud cavity. Do not contact the radiation shield or the sample holder. See Figure 11.

4. Secure the fitting nut finger tight. See Figure 12.

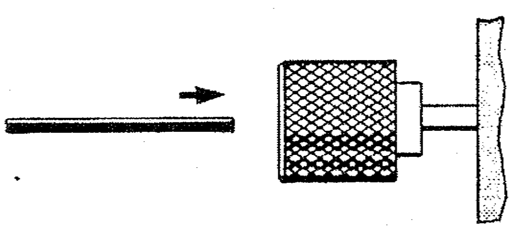

Figure 11 Insert Gas Injection Needle

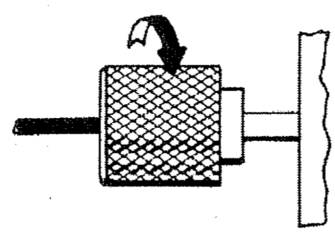

Figure 12 Tighten Gas Injection Fitting Nut

OPERATION

Evacuate Vacuum Shroud

1. Attach a vacuum valve to the NW fitting on the refrigerator. Connect the valve to a vacuum pump capable of pumping to less than 0.05 torr ultimate pressure.

2. At 0.05 torr, start the refrigerator.

3. At 150 K on the refrigerator 2nd stage, valve off the refrigerator from the vacuum pump.

CAUTION
FAILURE TO ISOLATE THE SHROUD FROM THE VACUUM SYSTEM WILL ALLOW VACUUM PUMP OIL TO MIGRATE TO THE INTERFACE.

CAUTION
NEVER BREAK THE VACUUM WITH THE VACUUM PUMP CONNECTED. VACUUM PUMP OIL WILL BE DRAWN INTO THE VACUUM SHROUD.

Changing Samples and Startup

WARNING
EXTREME COLD CAN CAUSE INJURY FROM FROSTBITE. ALLOW THE REFRIGERATOR TO WARM TO ROOM TEMPERATURE BEFORE REMOVING THE VACUUM SHROUD. BE CAREFUL NOT TO TOUCH ANY FROSTED PARTS.

1. For a closed cycle system, turn off electrical power to the compressor(s). This turns off power to the refrigerator.

   For an open cycle system, stop the flow of liquid nitrogen or liquid helium to the refrigerator.

2. Allow the refrigerator to warm to room temperature.

Note:
A slow warm up before relieving the vacuum in the shroud avoids thermal stresses and the condensation of water on cold surfaces.

3. Relieve the vacuum in the vacuum shroud. Allow the pressure to rise to atmospheric.

CAUTION

NEVER BREAK THE VACUUM WITH THE VACUUM PUMP CONNECTED. VACUUM PUMP OIL WILL BE DRAWN INTO THE VACUUM SHROUD.

4. Remove the vacuum shroud from the skirt of the refrigerator. The shroud is held only by the friction of the double O-ring seal. See Figure 13.

5. Unscrew the radiation shield from its adapter on the first stage heat station. See Figure 14.

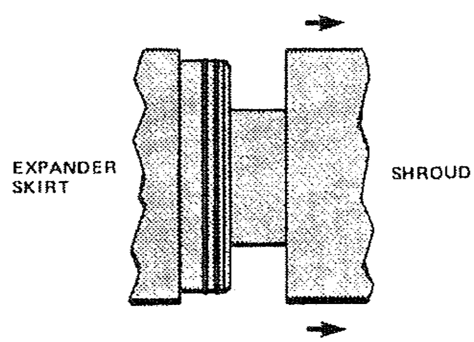

Figure 13 Remove Vacuum Shroud

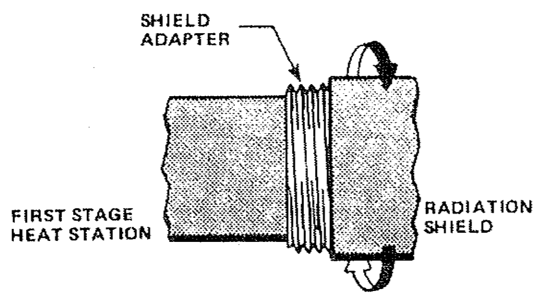

Figure 14 Remove Radiation Shield

6. Examine all components for cleanliness. See the section Handling Interface Components.

7. Mount the sample. If the holder must be removed for sample mounting, unscrew it from the second stage heat station. See the section Sample Mounting.

8. Wipe a light coat of vacuum grease on the male threads of the radiation shield adapter.

9. Screw the radiation shield onto it adapter. Align the shield openings with the sample holder. The radiation shield threads do not need to bottom on the adapter. See Figure 8.

10. Press the vacuum shroud onto the skirt of the refrigerator. Align the shroud windows with the opening(s) in the radiation shield. See Figure 9.

11. If al· other system components are ready for operatior·, begin to pump the insulating vacuum.

12. When the vacuum reaches 0.05 torr, start the refrigeration system.

    For a closed cycle system, start the compressor(s). The valve motor in the refrigerator should also start.

    For an open cycle system, start the flow of liquid nitrogen or liquid helium to the refrigerator.

CAUTION

EVACUATE THE VACUUM SHROUD TO AT LEAST 0.05 TORR BEFORE STARTING THE REFRIGERATION SYSTEM, TO AVOID EXCESSIVE CONVECTIVE HEAT TRANSFER, WHICH PREVENTS COOLDOWN.

13. When the refrigerator temperature reaches 150K, close the isolating vacuum valve.

CAUTION

FAILURE TO ISOLATE THE SHROUD FROM THE VACUUM SYSTEM WILL ALLOW VACUUM PUMP OIL TO MIGRATE TO THE INTERFACE.

WARNING

AVOID ICING INSIDE THE VACUUM SHROUD. PROMPTLY REPAIR VACUUM LEAKS. WHEN FROZEN GASES WARM TO ROOM TEMPERATURE, THE PRESSURE INCREASES WITHIN THE SHROUD CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

Shutdown

WARNING

EXTREME COLD CAN CAUSE INJURY FROM FROSTBITE. ALLOW THE REFRIGERATOR TO WARM TO ROOM TEMPERATURE BEFORE REMOVING THE VACUUM SHROUD. BE CAREFUL NOT TO TOUCH ANY FROSTED PARTS.

1. For a closed cycle system, turn off electrical power to the compressor(s). This turns off power to the refrigerator.

   For an open cycle system, stop the flow of liquid nitrogen or liquid helium to the refrigerator.

2. Allow the refrigerator to warm to room temperature.

Note:
A slow warm-up before relieving the vacuum in shroud avoids thermal stresses and the condensation of water on cold surfaces.

3. Relieve the vacuum in the vacuum shroud. Allow the pressure to rise to atmospheric.

CAUTION
NEVER BREAK THE VACUUM WITH THE VACUUM PUMP CONNECTED. VACUUM PUMP OIL WILL BE DRAWN INTO THE VACUUM SHROUD.

Handling Interface Components

To avoid degraded performance, handle interface components carefully. Keep them clean and dry. All surfaces exposed to vacuum conditions, including the inside of the skirt, the shroud, the sample holder, the refrigerator cylinder and all items attached to it, must be clean and dry. Water, grease and oil are the most common foreign materials which can make vacuum pumping difficult and lengthy. Even after freezing, they continue to degrade refrigerator performance and contaminate the sample environment.

The shield's reflective surfaces are essential to attaining low temperatures. Dirt on or deterioration of these surfaces will degrade performance.

Rough handling can distort the shroud or its windows, causing leaks. Dents can contribute to thermal short circuits by making component-to-component contact more likely to occur.

Windows which are dirty, scratched, deformed, or which contain fingerprints will attenuate or divert the instrumentation beam or field, resulting in inaccurate or invalid indications.

Refer to the instructions supplied with each window for its handling and cleaning information.

Sample Mounting

The technique of mounting a sample is determined on-site by the requirements of the experiment, and many ways have been devised. The most common is to hold the sample to the holder with a paste-like compound. A supply of a mounting compound is shipped with the interface. Use the smallest quantity which will hold the sample in place.

In some applications, a mechanical device is designed by the customer on-site to hold the sample to the holder. In others, the sample is sandwiched between two quartz windows which assemble to the sample holder. See Figure 15.

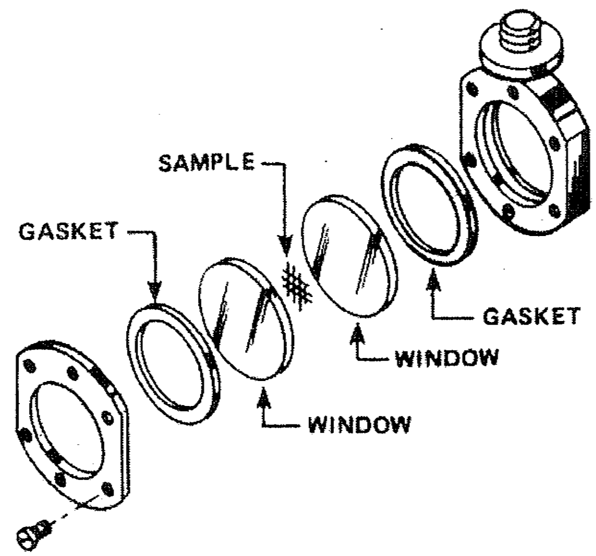

Figure 15 Assembly of Sample Holder

The refrigerator and interface may be oriented so that the sample is held in place by gravity.

Gas Injection

When gas injection is used, the position of the injection needles with respect to the sample must be checked each time they are used to avoid depositing gas on surfaces other than the sample and to be sure the needles do not contact any components.

WARNING

LIMIT THE QUANTITY OF GAS INJECTED TO THE SAMPLE TO KEEP THE INTERNAL PRESSURE OF THE SHROUD NEGATIVE WHEN THE SYSTEM WARMS TO ROOM TEMPERATURE.

Either the needles or the plugs must be in the gas injection fittings when the shroud is in use. The fittings are not self-sealing.

Shroud Rotation

The shroud can be rotated by hand at any time, including when it contains a vacuum. When rotating the shroud, keep it seated against the refrigerator skirt.

MAINTENANCE

Other than keeping components clean and polished to facilitate vacuum pumping and attaining low temperatures, the interface requires no maintenance unless it is damaged or develops a leak.

CAUTION
MODIFICATION TO EQUIPMENT WITHOUT THE CONSENT OF THE MANUFACTURER IS PROHIBITED AND WILL VOID THE WARRANTY.

Leak Checking and Leak Repair

Leak checking applies only to the shroud because it forms the vacuum envelope. Leak checking is performed with the shroud mounted to the refrigerator. Soap solution testing cannot be used. Use a mass spectrometer helium leak detector. Follow the manufacturer's instructions.

While pumping a vacuum inside the shroud, use a spray probe emitting a low pressure helium jet to search the outside of the shroud for leaks that allow helium to enter the envelope. A leak will be detected by the presence of the helium in the leak detector.

WARNING
DURING VACUUM LEAK CHECKING, DO NOT PRESSURIZE THE VACUUM SHROUD. INTERNAL PRESSURE CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

The most likely points of leakage are at windows, gas injection fittings and the shroud-to-refrigerator seal. If the leak is at a removable window or at a gas injection fitting, tighten the screws or fitting and recheck the leak before replacing parts. Otherwise, use whichever of the following procedures is needed. In all procedures, the refrigeration system must be shut down, the refrigerator warmed to room temperature and the vacuum fully relieved.

Repairing leaks at brazed or welded joints requires special skills. Contact Advanced Research Systems, Inc. if any such leaks are detected.

Shroud-to-Refrigerator Leak Repair

1. Remove the shroud from the skirt of the refrigerator.

2. Examine the shroud's interior mating surface for foreign matter, burrs or scratches which could degrade sealing. See Figure 16.

3. Remove the refrigerator skirt O-rings and discard them.

4. Examine the skirt's mating surface and grooves for foreign matter, burrs or scratches that could degrade sealing. See Fig. 18.

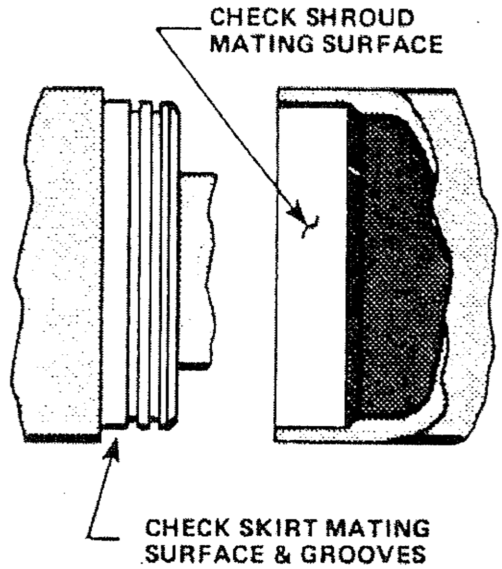

Figure 16 Examine Vacuum Shroud's Mating Surfaces

5. Wipe any preservatives or dirt from new O-rings. Coat them lightly with vacuum grease and install them in the grooves. Be sure they are not twisted.

6. Press the shroud onto the skirt.

Gas Injection Fitting Leak Repair

1. Loosen the nut, then withdraw the injection needle from the fitting. See Figure 17.

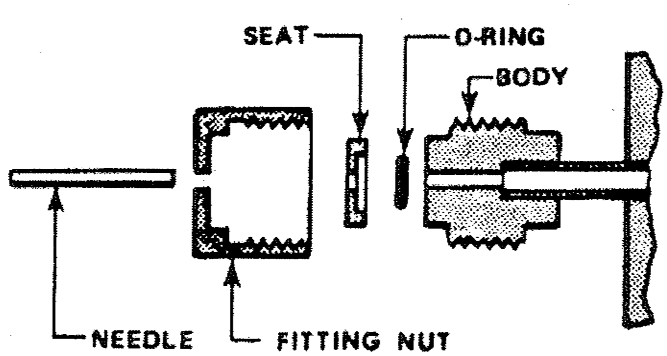

Figure 17 Disassemble Gas Injection Fitting

2. Unscrew and remove the fitting nut. The seat and O-ring will be loose. Retain the seat. Discard the O-ring.

3. Examine the needle, the seat, and all mating surfaces on the fitting parts. Look for and remove foreign matter, burrs and scratches which could prevent proper sealing.

4. Lightly coat a new O-ring with vacuum grease. Place it in the recess in the seat. See Figure 18.

5. Thread the nut, the seat, and the O-ring onto the injection needle. See Figure 19.

6. Insert the needle into the body. Engage and tighten the nut finger tight.

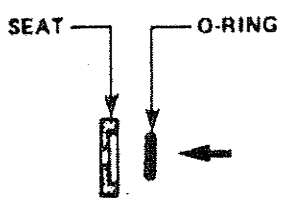

Figure 18 Insert O-ring Into Seat

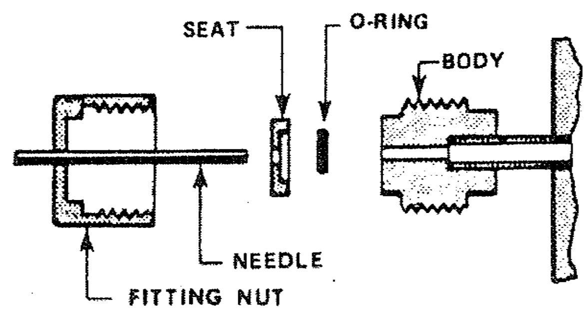

Figure 19 Assemble Gas Injection Fitting

Removable Window Leak Repair

If there is a leak between a bonded window and its shroud or port cover, use the Fixed Window Leak Repair procedure to correct that problem. For all other leak problems with removable windows, proceed as follows.

1. Remove the mounting screws and separate the components. See Figure 20.

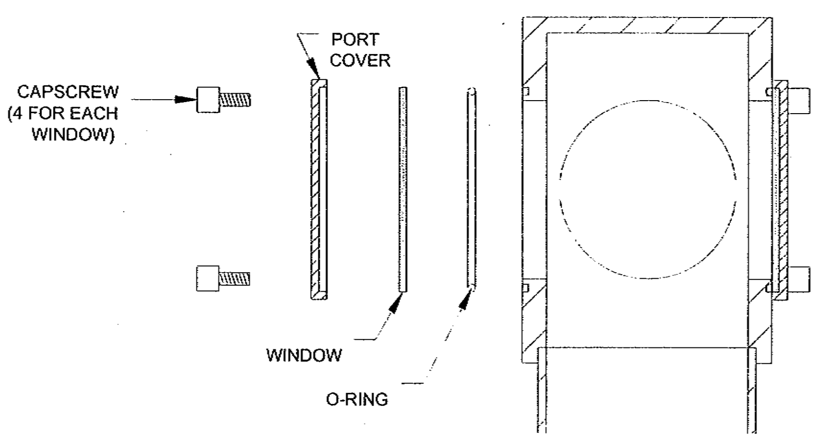

Figure 20 Repair Removable Window

2. Discard the O-rings.

3. Examine the O-ring grooves, the face of the shroud around the port, the port cover, and the window surfaces. Look for and remove foreign matter, burrs or scratches which could prevent proper sealing.

4. Check the port cover for flatness. If it is distorted, flatten it or replace it.

5. Wipe the new O-rings to remove any preservatives. Lightly coat them with vacuum grease and place them in their grooves.

6. Clean all other parts just before reassembly. Reassemble the parts to the vacuum shroud.

Fixed Window Leak Repair

Fixed windows are held in place with and sealed by an adhesive.

To repair a window leak, apply an epoxy adhesive to the crack between the window and the shroud. See Figure 21

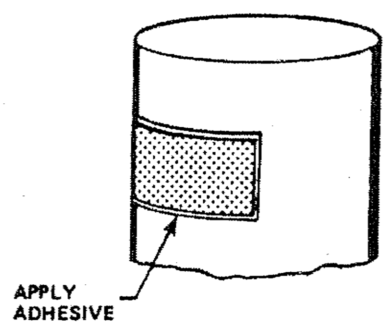

Figure 21 Repair Fixed Window

Allow time for the adhesive to cure before subjecting the shroud to a vacuum.

Indium Gaskets

Indium gaskets are used for their excellent heat transfer property. They are placed between the second stage heat station and the sample holder, between the first stage heat station and the radiation shield adapter and between the parts of some sample holders. Do no substitute gaskets of a different material.

Examine these gaskets every time the parts between which they fit are separated. Replace a gasket when it is worn, damaged or irreparably deformed.

TROUBLESHOOTING

The troubleshooting guide which follows lists possible interface problems, offers causes to consider, and suggests logical solutions. When the solution involves more than a few simple obvious steps, refer to the details in the paragraphs following this guide or in the Maintenance section.

WARNING

AVOID ICING INSIDE THE VACUUM SHROUD. PROMPTLY REPAIR VACUUM LEAKS. WHEN FROZEN GASES WARM TO ROOM TEMPERATURE, THE PRESSURE INCREASE WITHIN THE SHROUD CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

WARNING

DURING VACUUM LEAK CHECKING, DO NOT PRESSURIZE THE VACUUM SHROUD. INTERNAL PRESSURE CAN LAUNCH THE SHROUD WITH SUFFICIENT FORCE TO CAUSE PERSONAL INJURY AND EQUIPMENT DAMAGE.

Troubleshooting Guide

Problem	Possible Cause	Corrective Action
Frosting at the heat station.	Leakage at the vacuum shroud.	Repair leaks. See the section Leak Checking and Leak Repair.
	Relieving insulating vacuum too soon.	Allow refrigerator to reach room temperature before relieving the vacuum.
	Starting refrigeration too soon.	Allow vacuum to reach 0.05 torr before starting the refrigeration system.

CAUTION

EVACUATE THE VACUUM SHROUD TO AT LEAST 0.05 TORR BEFORE STARTING THE REFRIGERATION SYSTEM, TO AVOID SWEATING WHICH PREVENTS COOLDOWN.

Problem	Possible Cause	Corrective Action
Inability to attain an adequate insulating vacuum.	Leakage at the vacuum shroud.	Repair leaks. See the section Leak Checking and Leak Repair.
	Contaminants enclosed within the vacuum envelope.	Return to ambient conditions. Clean and dry all surfaces inside the vacuum envelope.
	Excessive outgassing by the sample.	See the Outgassing paragraph which follows this guide.
Inability to reach low Temperatures.	Leakage at the vacuum shroud.	Repair leaks. See the section Leak Checking and Leak Repair.
	Contaminants enclosed within the vacuum envelope.	Return to ambient conditions. Clean and dry all surfaces inside the vacuum envelope.
	Thermal short circuit.	See the Thermal Short Circuits paragraph which follows this guide.
	Sample too large.	Reduce the amount of sample. See Excessive Sample paragraph which follows this guide.

Thermal Short Circuits

A thermal short circuit occurs when contact between interface components or between interface components and items they enclose creates an abnormal heat path that hinders or prevents the desired refrigeration effects. Such contact can occur through misalignment of interface components, dents in the shield or shroud, loose instrumentation leads or sensors or the improper inclusion of foreign materials within the insulating vacuum space.

Outgassing

Some sample materials release so much gas that pumping an adequate vacuum takes too much time or can't be done at all. The usual solution is to coat the inside of the radiation shield with a getter material such as charcoal, which will adsorb the gas. Discuss such problems with Advanced Research Systems, Inc.

Excessive Sample

The amount of sample used can be so large that too much time is needed to cool it to the temperature desired. Use the least amount of sample material that allows acceptable results.

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