CRYO Industries of America, Inc.

OPERATING INSTRUCTIONS

SUPERCONDUCTING MAGNET SYSTEM

1. INTRODUCTION

The CRYO Superconducting Magnet/Cryostat System is one of the most versatile tools available to the scientist today. Before operating the system, please read this manual thoroughly. In addition, **read the separate magnet and accessories manuals.**

Many options are available to increase the versatility of the basic system. Since all these options are not always incorporated into the typical unit, this manual treats the operation of the basic system. Optional items will be described in their own (enclosed) sections or manuals.

FOLLOW STANDARD AND PROPER CRYOGENIC PROCEDURES. If you have any questions, we, at CRYO Industries, are only a phone call away and would be happy to answer any questions - (603) 893-2060, FAX (603) 893-5278.

2. UNPACKING AND SET-UP

Unscrew the panel labeled
"OPEN THIS SIDE".
from the shipping crate. Remove the dewar from the crate.

The magnet is installed inside of the dewar. For shipping safety purposes, packing material has been installed around the magnet inside of the helium reservoir. The magnet support with

variable temperature insert **MUST** be removed (lifted out of the dewar) before using. **PACKING** OR SHIPPING MATERIAL HAS BEEN INSTALLED AROUND THE MAGNET. THIS SHIPPING MATERIAL MUST BE REMOVED BEFORE USING THE SYSTEM.

The magnet support assembly is attached to the top of the dewar with (8) bolts. Remove these (8) eight bolts.

TWO 1/4-20 threads have been provided for use in lifting the magnet and variable temperature insert (if equipped) out of the dewar. Lift by raising straight up.

3. EVACUATE INSERT

Most dewars and inserts are shipped with the vacuum space evacuated. This is a result of the final testing at the factory, and it helps ensure a clean vacuum space. As a precaution against a deterioration of the vacuum which arises sometimes during transit or a prolonged storage period, the insert should be re-evacuated prior to use. This is best done with a good pumping station (e.g. cold - trapped rotary/diffusion or turbo molecular pumping system) capable of bringing the ultimate pressure down to approximately 10-5 Torr. For reference, an engineering drawing showing the details of your system is enclosed.

A recommended practice is to pump the variable temperature insert insulating vacuums with a high vacuum type pumping system, prior to EACH use .

If a high vacuum system is not available, the insert can be evacuated with a two stage rotary pump. It is recommended that you use a liquid nitrogen cold trap or sieve with your mechanical pump.

Initial or regular pumping of the dewar vacuum is not required. A vacuum maintenance system has been installed in the dewar which will help maintain the insulating vacuum in the dewar for a long time. However,

pumping with a high vacuum system can help maintain the highest vacuum. A recommended practice is to periodically pump the dewar insulating vacuum with a high vacuum type pumping system, usually turbo or diffusion based. Use only a high vacuum type system for the dewar - a mechanical (roughing) pump is not recommended. A valve has been installed on the outer dewar body for periodic evacuation of the dewar insulating vacuum. Pump the dewar vacuum space when observing a possible degradation of the vacuum - usually represented by a higher consumption of liquid helium or condensibles (water) forming on the outer dewar body.

☞ The variable temperature insert has a standard insulating vacuum that should be pumped before EACH new use of the system.

☞ The dewar has a vacuum maintenance system installed and therefore only needs infrequent periodic evacuation.

Every vacuum jacket is protected against over-pressure with a relief valve which will vent excess pressures. The dewar relief is a non adjustable burst disk type. The insert and sample spaces are protected with auto resetting spring loaded reliefs. Some of these spring loaded reliefs are adjustable; these reliefs have been pre-set at the factory. DO NOT ADJUST. NEVER SET TO A HIGHER PRESSURE.

The evacuation valves supplied for the dewar and insert vacuums are the highly reliable bellows sealed type. After evacuating, valves should be firmly closed, but care should be exercised to avoid damaging the seat with too much pressure.

Never pump the vacuum jacket of the dewar while liquid helium is in the dewar; liquid helium will usually cryopump to a lower pressure (10-6 Torr

or less) than some of the pumping stations.

CAUTION: If insulating spaces are vented for some reason, such venting should be done very slowly to avoid sudden pressure changes and to avoid possible collapsing of components in these vacuum spaces.

4. PRE-COOL CRYOSTAT

Purge the helium can with helium gas. During the purge and while helium gas is flowing, temporarily plug the vent so that the helium gas (purges) flows through the high current leads. After purging, close the high current lead valve. Make sure any pressure reliefs installed in vent lines are in the proper direction for the venting flow.

Fill the liquid helium reservoir with liquid nitrogen. When the dewar is warm, it is much more efficient to force the liquid nitrogen to exit near the bottom of the reservoir by passing it through a tube that can insert into the dewar.

Allow time for the liquid nitrogen to cool the system. Overnight is usually a convenient length of time to precool.

Helpful notes: (I). It is not a requirement to pre-cool the liquid helium reservoir with liquid nitrogen; however, pre- cooling will substantially reduce the consumption of liquid helium used during transfer. (ii). For precool, a 3/8 inch thin wall stainless steel tube is ideal for insertion into the dewar. (iii). An economical heat gun, sold in most department stores, is ideal for removing extra frost formations.

5. `BLOW OUT' THE LIQUID HELIUM RESERVOIR

Remove the liquid nitrogen from the liquid helium reservoir. Insert a tube through the access or fill port TO THE BOTTOM OF THE helium reservoir. Seal the tube so that a small pressure can

be applied above the liquid in the reservoir. Pressurize the reservoir with helium gas. The liquid nitrogen will be `blown out' of the tube. Try to assure that all the liquid nitrogen is removed. In other words, REMOVE ALL LIQUID NITROGEN FROM THE HELIUM RESERVOIR PRIOR TO TRANSFERRING HELIUM.

Leave the reservoir back filled with helium gas. Install the helium reservoir pressure safety relief onto the pumping arm. All other helium ports should be stoppered closed. Helpful note: The end of you supplied `blow out' tube(s) has a small angle machined; this will prevent the common error of having a square end against the bottom of the reservoir preventing the removal of liquid nitrogen.

6. TRANSFER LIQUID HELIUM

Transfer liquid helium into the helium reservoir; fill to the desired volume of liquid helium desired. For initial fill, most efficient transfer will occur if the transfer line reaches the bottom of the reservoir. For refill, the transfer line should be inserted just above the liquid helium level.

Helpful note: The NW port with the main relief is a good vent path for the exiting gas during liquid helium transfer. Remove the quick connect flange during transfer to vent. Re-install the relief immediately after transfer.

7. INSTALL PRESSURE REGULATOR

After the completion of the liquid helium transfer, in removed, re-install the vent pressure relief/regulator. All other helium ports should be stoppered closed. All helium gas venting should go through the high current lead positive pressure relief. (Sometime it is more efficient to divert some of the vent gas to intercept heat loads; for example, down the neck. If there is more than one vent

port is used, all vent ports should be combined and vented through ONE relief.)

OPERATE ONLY WITH THE SAFETY PRESSURE RELIEFS IN PLACE; DO NOT REPLACE WITH BLANK CAPS.

The positive pressure relief on the high current leads is set to a lower pressure then the main reservoir safety pressure relief. So, during normal operation, the system will vent solely through the high current leads. The larger relief installed on the main reservoir is for safety and does not vent through normal operation. If neede, the Main reservoir relief is adjustable by tightening the nut located in the bottom of the relief. The setting has been preset at the factory and should not need adjustment.

CAUTION: Tightening the adjusting screws inward will increase the pressure setting. **WARNING:** Turning the screws in too far will disable the relief.

8. VARIABLE TEMPERATURE

Refer to the variable temperature insert cryostat information located elsewhere in this manual.

9. MAGNET OPERATION BELOW 4.2 K

If the system is equipped with a lambda plate, see the section titled “Lambda Plate Operation”.

To pump the helium bateh: Remove the pressure above the liquid helium bath.

WARNING - BE CAREFUL, REMOVAL OF THE POSITIVE PRESSURE ABOVE THE LIQUID HELIUM WILL RESULT IN A QUICK EVOLUTION OF COLD GAS. <u>AVOID CONTACT!!!</u>

Attach a mechanical pump to the NW port on to which the pressure regulator was attached and pump on the liquid helium. The roughing pump will reduce the boiling point of the liquid, bringing the system to the lowest possible temperature.

Notes: (I). Due to vapor droplets, density changes, internal liquid cooling requirements, etc., it is normal to consume approximately 50% of the liquid helium volume before reaching terminal temperature.

(ii). If possible, do not use the same pump on the helium reservoir as is used on the insulating vacuum of the dewar. Large amounts of helium may temporarily contaminate the roughing pump causing helium to backstream into the insulating vacuum space of the dewar.

(iii). NEVER pump on the helium can without the dewar insulating vacuum intact for it will collapse under reverse pressure.

10. SUPERCONDUCTING MAGNET OPERATION

Before any attempt is made to charge the magnet, remove (or tie down) any objects (tools, screws, etc.) that could be magnetized and attracted to the magnet when the field is turned on.

Make absolutely sure that the liquid helium level is above the superconducting coil before the field is turned on, and throughout the whole time that current is passing through the coil. Failure to do so may result in a magnet quench (sudden loss of field associated with the coil going "normal") that could damage the coil. Make sure that the pressure relief is installed on the pumping arm.

Never disconnect the power supply leads when using the magnet.

Make certain that the helium reservoir is venting through the vapor cooled high current magnet leads. This flow should be periodically checked throughout the experiment to ensure proper cooling of these leads.

Consult the separate power system manual for the proper procedure to charge the magnet.

While operating in the persistent mode, DO NOT DISCONNECT THE POWER SUPPLY FROM THE CIRCUIT. Make sure to always note and to remember the exact current at which the magnet was put into persistent mode.

MAINTAIN THE LIQUID HELIUM LEVEL ABOVE THE TOP OF THE MAGNET.

11. SHUT DOWN

(I). Follow the procedures in the power supply manual to reduce the magnetic field to ZERO.

(ii). Turn off all power to the vaporizer or any sample mount(s).

(iii). Close the helium throttle valve.