CRYOMECH

Medium Pressure Helium Recovery System

INSTALLATION, OPERATION and ROUTINE MAINTENANCE MANUAL

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Section 1

Overview

1 Section 1: Overview

This section provides a general overview of the Cryomech Helium Recovery System, the organizational structure of this manual, and a glossary of defined terms and acronyms.

1.1 Helium Recovery System

1.1.1 General Description

Cryomech's Helium Recovery Systems are designed to collect boiled off helium from a customer's liquid helium cryostat. The boiled off helium is collected in an atmospheric bag. A helium recovery compressor package compresses the atmospheric helium and stores it in pressurized storage cylinders. When the recovered helium is ready to once again be liquefied by a Cryomech Liquid Helium Plant (LHeP), the gaseous helium flows through a Cryomech developed helium purifier. After the gas flows through the purifier, the pure gaseous helium (>99.999%) is then ready to be supplied to the LHeP where it is liquefied and stored in the LHeP dewar.

1.1.2 Features and benefits of Cryomech Helium Recovery Systems

Cryomech's Helium Recovery System has been carefully designed and manufactured to provide high purity helium gas to a helium liquefier.

Primary features

- Easily Installed
- Cryomech Purification Technology
- Automatic impurity detection and control

Primary benefits

- Requires only electrical power to the helium recovery compressor package and LN2 for purifier
- Does not require full time operator
- Easily maintained

1.2 Cryomech Helium Recovery System Manual

This manual introduces the complete Helium Recovery System that consists of an atmospheric (recovery) bag, helium recovery compressor package, pressurized storage cylinders, and helium gas purifier. Please review it carefully before beginning the process of installation and operation.

1.2.1 Organization of the manual

The main body of this manual provides detailed information that is necessary to properly install, operate, and maintain the Cryomech Helium Recovery System. For ease of reference, the information is divided into 8 sections.

It is important to note that numbered lists (labeled 1, 2, etc.) are representative of sequential actions that must be performed in the order listed, whereas bulleted lists indicate that order is not imperative.

This manual also contains essential information for the safe and effective operation of the Cryomech Helium Recovery System. Section 2 explains how to avoid causing unnecessary damage to the system which can void your warranty, and section 3 clearly describes all the safety precautions to adhere to.

Sections 4 through 8 provide complete, step-by-step instructions on handling the *Cryomech* Helium Recovery System, from inspection of the packing crate to routine maintenance. Each safety precaution is also outlined in these sections in each place where observing the caution or warning is necessary.

- **Section 1:** Overview (including definitions and acronyms)
- **Section 2:** Warranty
- **Section 3:** Safety
- **Section 4:** Inspection and unpacking
- **Section 5:** Specifications
- **Section 6:** Installation
- **Section 7:** Operation
- **Section 8:** Routine maintenance
- **Appendix:** Additional information

1.3 Glossary

1.3.1 Definitions

The terms defined below are used with precision in the manual.

The terms are in alphabetical order, and italicized terms within the definitions are terms that are also defined in this section.

Aeroquip® Couplings:

The term "Aeroquip® couplings" is used generically to describe the self-sealing fittings that connect components, e.g. *helium flex lines* are connected to the *helium compressor package* and to the *cold head* via Aeroquip® couplings.

Adsorber:

The adsorber is a vessel that adsorbs certain substances from a gas stream with adsorbent material.

Atmospheric (Recovery) Bag:

The recovery bag is a flexible bag that stores helium gas near atmospheric pressure until the gas can be compressed by the *helium recovery compressor package.*

Category II Installation:

Category II refers to the potential for transient over-voltage conditions in the mains power connection to the equipment. See IEC 664, Sub-clause 5.6 for further details.

Closed Loop System:

This refers to a cryogenic system that has no helium loss because the helium is cycled through a closed loop. The advantage of such a system is that there is no need to add helium.

Cryogenic Temperatures:

Temperatures lower than 120K or -153°C.

Pollution Degree 2:

Pollution degree 2 refers to the extent to which the local environmental conditions could affect the electrical safety of the system. See EN 61010 or UL 61010A for further details.

Pressurized Storage Cylinders:

These cylinders store helium gas that is compressed by the *helium recovery compressor package*.

Purifier:

The purifier decontaminates helium gas from the *pressurized storage cylinders* for liquefaction in the Liquid Helium Plant.

Recovery Compressor Package:

The recovery compressor package is a compressor that compresses helium gas from the *atmospheric bag* to higher pressures for storage in the *pressurized storage cylinders.*

1.3.2 Acronyms

The following acronyms are used in the text and provided here for convenient lookup.

FPT Female Pipe Thread

GPM Gallons per Minute

He Helium

LHe Liquid Helium

LHeP Liquid Helium Plant

LPM Liters per Minute

MPT Male Pipe Thread

PSIG Pounds per Square Inch Gauge

Section 2

Warranty

Section 2: Warranty

2.1 Statement of warranty

The Cryomech Helium Recovery System consists of an atmospheric (recovery) bag, a helium recovery compressor package, a pressurized cylinder manifold, a helium purifier, and various supporting assemblies, some of which are not manufactured by Cryomech Inc. Due to the complexity of these parts, Cryomech supports all other manufacturers' standard warranties. If problems occur with these components after the manufacturer's warranty expires, Cryomech will provide any support necessary to bring the entire recovery system back to optimum working condition. Provided that the customer installs, operates, and maintains this helium recovery system according to the specifications and procedures set forth in this manual, Cryomech, Inc. extends a warranty on:

Output Helium Purity: The gaseous helium exiting the purifier will be ≥ 99.99% pure helium. Please contact Cryomech to discuss recovery practices for optimum operation of the system.

Compressor Package: All parts and workmanship for a period of (1) year after the date of start-up or 18 months after the date of shipment from Cryomech, Inc., whichever comes first. This warranty covers all non-user serviceable components of the helium recovery compressor package. This warranty does not cover user-serviceable parts.

Helium Purifier Assembly: A (1) year warranty period is provided for these components. This includes the helium gas intake assembly, the helium gas safety relief assembly, the impurity sensor, and the dewar. The dewar is warranted to be free from defects in materials and workmanship which result in vacuum failure.

Atmospheric (Recovery) Bag: A (1) year warranty period is provided for this component.

Cryomech will supply maintenance and service support to address any problems that might occur during operation of the Helium Recovery System. If found to be defective and in accordance with the terms of the limited warranty, Cryomech will provide warranty replacement parts at no cost to the customer. However, all shipping and handling charges associated with any warranty repair are the responsibility of the customer.

2.2 Conditions that can void warranty

- **DO NOT** lift the recovery bag with the loop that is attached to the top of the volume. Doing so will damage the storage volume. *This type of damage will void the warranty*. **See Sections 5 and 7.**
- *Operation of the helium recovery system in any situation that does not meet the specifications in this manual will void the warranty.* If you plan to operate the system outside any of the specified conditions, contact Cryomech. **See Sections 5, 6, and 7**.
- *Failure to follow the installation guidelines in this manual could result in voiding the warranty.* **See Section 6**.
- A voltage deviation of **more than 10%** above or below the voltage rating can cause damage to the compressor package, possibly causing failure. *Indications of operation outside that voltage range will void the compressor warranty.*
- Do not allow the lines to come into contact with corrosives or any type of commercial cleaning agent. *Helium leaks caused by exposure to corrosives or commercial cleaning agents will not be covered under warranty.* **See Section 6.**
- Never wet any part of the system. *Water getting into the system will void the warranty.* **See Section 8.**

Section 3

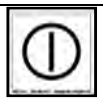
Safety

Section 3: Safety

3.1 Safety and information symbols

3.1.1 Equipment symbols

The safety and information symbol stickers placed on Cryomech Helium Recovery System are defined below.

	Alternating current. The symbol signifies that alternating current is present.
	Internal ground. This symbol represents an internal protective grounding terminal. Such a terminal must be connected to earth ground prior to making any other connections to the equipment.
	Warning Icon. Refer to the documents that accompany the equipment.
	Power switch. This symbol designates an in/out or push/push switch.
	Read the manual or handbook sign. When this symbol is found on a piece of equipment, the user should read the whole manual before starting installation or use. This symbol is found on the compressor package.

3.1.2 Icons in the manual

Definitions of Warning, Caution, and Information icons in the manual

	Warning Icon. A warning message is used when failure to observe instructions or precautions could result in injury or death to humans.
	Electrical Warning Icon. An electrical warning message is used when failure to observe instructions or precautions could result in electrical shock or burns to humans.
	Caution Icon. A caution message is used when failure to observe instructions or precautions could result in significant damage to equipment and/or facilities.
	Information Icon. The accompanying message contains information to aid the operator in obtaining the best performance from the equipment or other important information that does not involve danger to equipment or humans.

3.2 Warnings and cautions

Warnings and cautions for the Cryomech Helium Recovery System are listed here, by subsystem. The same warnings and cautions appear in the appropriate places in the unpacking, installation, operation, and routine maintenance sections of this document.

3.2.1 Section 5. Specifications

Section 5.2 Technical specifications

CAUTION

Operation of the helium recovery system in any situation that does not meet the specifications in this section will void the warranty. **If you plan to operate the system outside any of the specified conditions, contact Cryomech.**

Section 5.3 Description of recovery bag

WARNING

If the atmospheric relief valve opens it may create dangerously low oxygen concentrations in the ambient air. Being odorless, colorless, tasteless, and nonirritating, helium has no warning properties. Humans possess no senses that can detect the presence of helium. **At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.**

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self-contained breathing apparatus or air-line respirator.

Section 5.5 Description of the Helium Purifier Assembly

WARNING

The flow is preset from Cryomech. If adjusted, the calibration of the meter will become inaccurate.

3.2.2 Section 6. Installation

Section 6.1 System installation

CAUTION

Failure to follow these installation guidelines could result in voiding the warranty.

WARNING

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self contained breathing apparatus or air-line respirator.

Section 6.3 Preparation and Installation of the helium recovery compressor package location

WARNING

The helium recovery compressor package must be positioned to provide easy access to all four sides.

WARNING

Be sure to follow all local electrical codes and guidelines.

Section 6.6 Helium Purifier assembly installation

WARNING

If the liquid nitrogen dewar ruptures, the gaseous nitrogen may create dangerously low oxygen concentrations in the ambient air. Being odorless, colorless, tasteless, and nonirritating, nitrogen has no warning properties. Humans possess no senses that can detect the presence of nitrogen. **At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.**

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self-contained breathing apparatus or air-line respirator.

CAUTION

When lowering the LN_2 trap into the dewar, be careful not to damage any of the tubing on the LN_2 trap, because they are shipped with **200 psig (13.78 bar)** of helium.

WARNING

Be sure to follow all local electrical codes and guidelines.

CAUTION

At no time should the Aeroquip® couplings be removed from the LN_2 trap when regenerating the LN_2 trap. Regeneration can be completed without relieving system pressure since the LN_2 trap is equipped with Aeroquip® couplings for sealed removal.

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

Section 6.7 Connections

CAUTION

At no time should the Aeroquip® couplings be removed from purifier when adding or removing the ¼ in. helium flex line. The purifier connections are equipped with Aeroquip® couplings for sealed removal.

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

CAUTION

The line must have an inner diameter which does not restrict the flow of helium gas through it. The inner diameter cannot be any smaller than **1.0 in**. (2.5 cm).

If the line is not connected to the appropriate ¾ in. male Aeroquip® fitting on the cross Aeroquip® connector that is **perpendicular** to the relief valve, then the valve will open prematurely, causing a significant loss of helium from the system.

CAUTION

A medium pressure flex line is supplied to connect the high pressure compressor Aeroquip® to the medium pressure manifold.

3.2.3 Section 7: Operation

Section 7.1 Starting the helium recovery system

CAUTION

A voltage deviation of more than 10% above or below the voltage rating can cause possible failures. ***Indications of voltage operation outside the specified range will void the helium recovery compressor package and/or the purification system warranty.***

CAUTION

A voltage deviation of more than 10% above or below the voltage rating can cause possible failures. *Indications of voltage operation outside that range will void the helium recovery compressor package and/or the purification system warranty*.

Section 7.2 Normal operation

CAUTION

A dewar pressure greater than **15 PSIG** (1.03 bar) indicates a problem with the safety relief valves. The problem must be diagnosed and corrected immediately to prevent damage and ensure safety.

Section 7.4 Inspection

CAUTION

If the liquid nitrogen level gets too low, the LN_2 trap will not work efficiently and will have a much shorter life span.

3.2.4 Section 8: Routine maintenance

Section 8.3 Trap and compressor adsorber regeneration

CAUTION

At no time should the Aeroquip® couplings be removed from the adsorber when regenerating the adsorber. Regeneration can be completed without relieving system pressure since the adsorber is equipped with Aeroquip® couplings for sealed removal.

CAUTION

The heating jacket temperature is set to **225°F** (107°C). The outside of the jacket will be hot; do not touch without personal protective equipment.

Section 8.4 Purifier LN_2 trap removal and regeneration

CAUTION

At no time should the Aeroquip® couplings be removed from the LN_2 trap when regenerating the LN_2 trap. Regeneration can be completed without relieving system pressure, since the LN_2 trap is equipped with Aeroquip® couplings for sealed removal.

CAUTION

When installing the service Aeroquip® to the helium **INLET** or **OUTLET** ports on the LN_2 trap to relieve pressure, it will become extremely cold; do not touch without personal protective equipment.

CAUTION

The LN_2 trap is at liquid nitrogen temperatures. Proper safety, personal protective equipment should be used during this procedure.

CAUTION

When installing the room temperature LN_2 trap, slowly lower it into the dewar to avoid rapid boil off of liquid nitrogen. Proper safety, personal protective equipment should be used during this procedure.

CAUTION

The heating jacket temperature is set to **225°F** (107°C). The outside of the jacket will be hot to the touch.

Section 8.7 Cleaning

CAUTION

Never wet any part of the system. *Water in the system will void the warranty.*

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

Section 4

Inspection and Unpacking

Section 4: Inspection and Unpacking

4.1 Inspection of crates

IMPORTANT

IF THERE IS ANY VISIBLE DAMAGE, DO NOT OPEN OR UNPACK THE PACKING CRATES BEFORE YOU CONTACT CRYOMECH.

Be sure to note on the shipping documents any visible damage to the crate, including tip indicators that have been activated.

4.2 Unpacking

The system is packaged in secure packing crates. The base of each packing crate is a wooden pallet, to which the system is strapped. The walls of the crates are placed around the system and attached to the pallet, and each other, with tension clips (Klimp® fasteners). After adding packing material as needed, the top is clipped onto the packing crate.

4.2.1 Directions for unpacking:

1. After ensuring no visible damage to the packaging, remove the top of the packing crate by unfastening the Klimp® fasteners that join the top to the sides.
2. Check for tip indicators on the inside of the packing crate and notify Cryomech if interior tip indicators have been activated even though tip indicators on the outside were not.
3. Check for any visible signs of damage besides activated tip indicators.
4. Locate and remove items that can easily be lifted out of the crate.
5. Remove the sides of the packing crate by unfastening the Klimp® fasteners that join the sides to the pallet.
6. Remove packing material and any straps that anchor items to the pallet.
7. Ensure that adequate space is prepared for the equipment (see **Section 6** for installation directions).
8. If possible, retain the packing materials and crates for use in the future, to ship the equipment to Cryomech.

4.2.2 Specific directions for moving when unpacking

1. The recovery compressor package needs to be lifted off the pallet base and onto the floor with a fork truck or crane/hoist. The weight of the recovery compressor package is specified in **Section 5**. The recovery compressor package **should not be tipped** at any time.
2. The helium purifier package is equipped with castors and can be rolled by hand after it is removed from the crate.

4.3 Inspection of equipment

4.3.1 Packing list

There is a packing list included with your system. Check that all parts listed on the packing list are included in the crates. Then, check for any signs of damage to the parts.

4.4 Returning a system to Cryomech

1. Contact Cryomech for a return of materials authorization (**RMA)** number and additional detailed instructions on how to properly return system components.
2. Repackage the system:

> **IMPORTANT**
>
> Use the original crates and packaging materials to minimize the likelihood of damage during shipping.

   a. Place the helium recovery compressor package on the pallet on top of sufficient vibration dampening material to prevent the package from touching the pallet.

   b. Strap the helium recovery compressor package to the pallet, making certain that there is sufficient insulating material between the compressor and the straps so the straps will not scrape any paint off the compressor package.

   c. Using protective wrap, secure the atmospheric storage bag and place in container.

   d. Place the helium purifier package on the pallet on top of sufficient vibration dampening material to prevent the wheels from touching the pallet.

   e. Strap the helium purifier package to the pallet. Run the straps through the dewar handles and secure to the pallet.

3. Be sure to include shipping labels on the crates showing which side is up and making clear that the shipment is fragile.
4. Cryomech highly recommends using “tip and tell” indicators. These indicators are helpful in determining whether your package was handled properly or not. Replace used “tip and tell” indicators with new ones (total of three per crate).
5. When the shipment is ready, please contact Cryomech for further instructions on shipping.

Section 5

Specifications

Section 5: Specifications

5.1 Intended use of equipment

The helium recovery system is intended to capture vaporized liquid helium and purify it to be liquefied again.

5.2 Technical specifications

Following are detailed technical specifications for the helium recovery system.

CAUTION

Operation of the helium recovery system in any situation that does not meet the specifications in this section will void the warranty. If you plan to operate the system outside any of the specified conditions, contact Cryomech.

5.2.1 Weights and dimensions

Parameter	Value	
Purification System Weight, Empty	300 lb	136 kg
Purification System Dimensions (L x W x H)	22 x 33 x 52 in	56 x 84 x 132 cm
Dewar Capacity (Purification System)	26.4 gal	100 liters
Helium Recovery Compressor Package Weight	345 lb	157 kg
Helium Recovery Compressor Package Dimensions (L x W x H)	32 x34.5 x28 in	62 x88 x71 cm
Standard Atmospheric (Recovery) Bag ($300\ ft^3$) Weight	96 lb	43.5 kg
Standard Atmospheric (Recovery) Bag Dimensions (L x W x H)	13.5 x 8 x 7 ft **required space*	4.1 x2.4 x2.1 m **required space*

5.2.2 Safety Devices

A number of safety switches and valves are located inside the helium recovery compressor package and on the helium purifier system. They operate automatically, to protect the compressor package and purifier system from developing extreme conditions that can cause damage. Most are transparent to the user and are monitored by the compressor control panel. The safety devices listed below are **not** monitored by the compressor control panel.

Recovery Bag Atmospheric Pressure Relief Valve

The recovery bag atmospheric pressure relief valve is set at **0.15 PSIG (0.01 bar).** At pressures above **0.15 PSIG (0.01 bar),** the relief valve will open automatically and relieve pressure to the atmosphere.

Liquid Nitrogen Dewar Relief Valve

The helium purifier package is equipped with a liquid nitrogen dewar. The dewar atmospheric relief valve is set at **0.5 PSIG (0.03 bar).** At pressures above **0.5 PSIG (0.03 bar),** the valve will open automatically and relieve nitrogen vapor to the atmosphere. Venting is part of normal operation as the liquid nitrogen vaporizes.

Purifier High Pressure Relief Valves

The **INLET, OUTLET,** and **PRESSURE RELIEF** ports on the helium purifier are equipped with a high pressure atmospheric relief valve that is set at **500 PSIG (34.5 bar).** At pressures **above** 500 PSIG (34.5 bar), the valves will open automatically and relieve pressure to the atmosphere.

5.3 Description of recovery bag

The recovery bag (**See Figure 5-1**) is used to collect room temperature, vaporized helium. The bag utilizes high and low level laser position sensors that are supplied with the system. Brief descriptions of the operator interfaces on the recovery bag are given below.

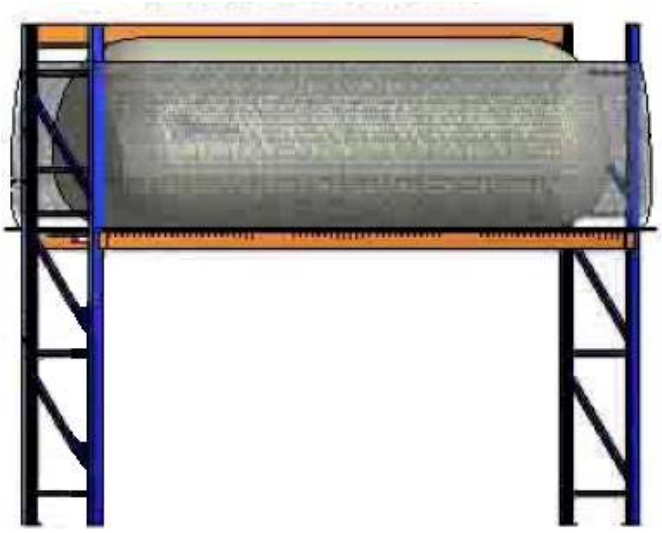


Figure 5-1: Atmospheric (Recovery) bag
*Platform/stand not included

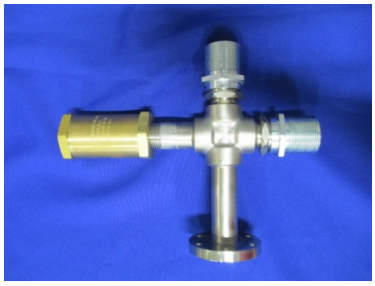


Figure 5-2: Aeroquip Cross Connector

Aeroquip® cross connector
Boil off helium enters the recovery bag through the Aeroquip connector. The compressor package also draws helium gas from this connector. **See Figure 5-2.**

Pressure relief valve
The brass relief valve, located on the Aeroquip cross connector, will open at **0.15 psig (0.01 bar)** to prevent the recovery bag from overinflating.

WARNING

If the atmospheric relief valve opens it may create dangerously low oxygen concentrations in the ambient air. Being odorless, colorless, tasteless, and nonirritating, helium has no warning properties. Humans possess no senses that can detect the presence of helium. **At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.**

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self-contained breathing apparatus or air-line respirator.

Laser level sensors
The laser level sensors control the compressor package by cyclically turning it **ON** and **OFF**. As the recovery bag fills its height increases. When the height is detected by the high position sensor, it will break the laser beam. Then the compressor package will automatically turn on and the recovery bag will begin to deflate. When the recovery bag falls below the low position sensor, the low sensor laser beam will complete and turn off the compressor package, allowing the recovery bag to inflate.

5.4 Description of the medium pressure compressor package

The helium recovery compressor package is used to compress helium gas from the recovery bag and relocate it into the compressed cylinders. The maximum pressure that the helium recovery compressor package can reach is **400 psig (27.6 bar).** The low pressure set point is just below atmospheric pressure. Brief descriptions of the operator interfaces on the front panel of the compressor package are given below.

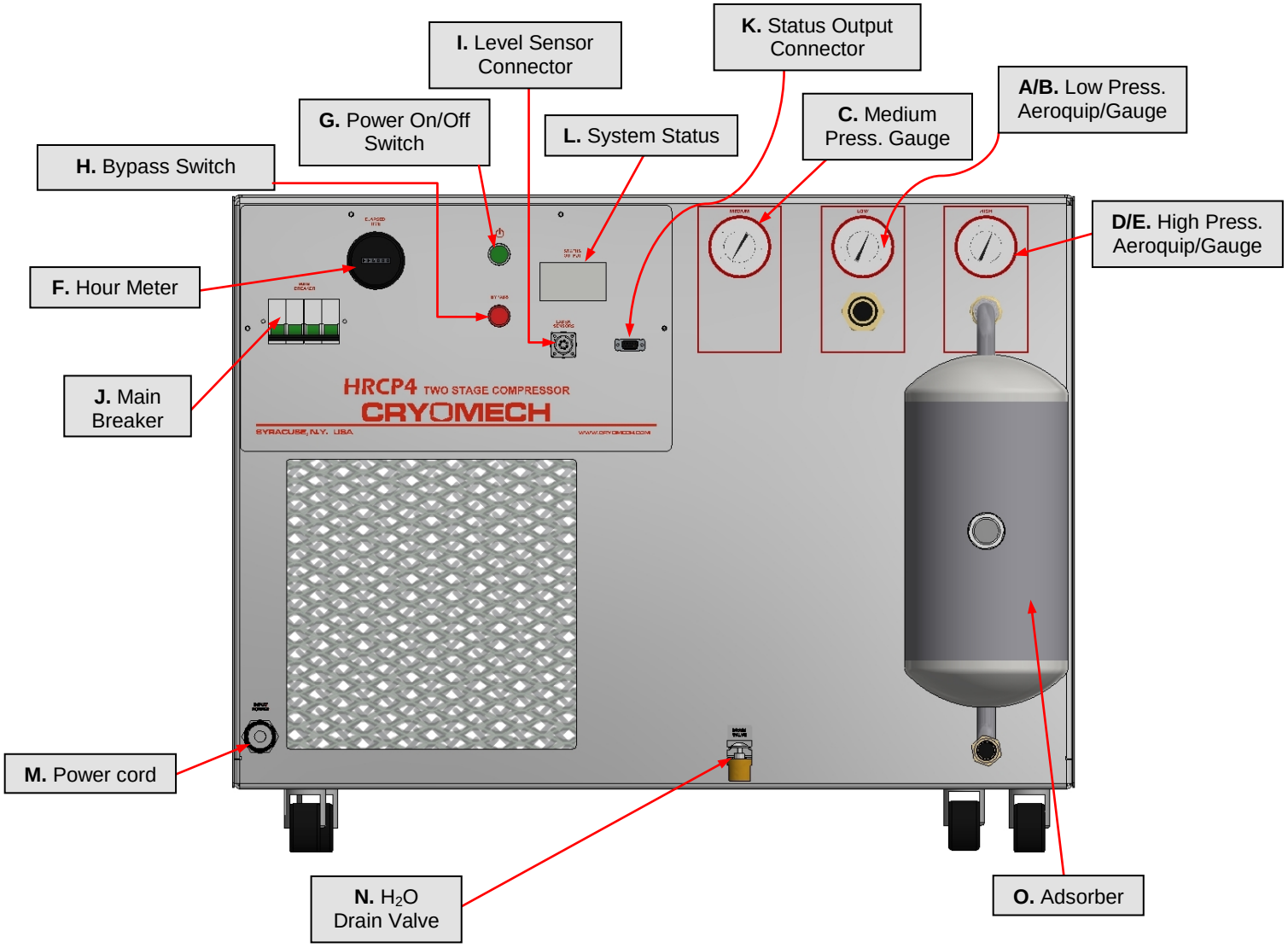


Figure 5-3: Front View of the compressor package

5.4.1 Helium Recovery Compressor Electrical specifications

Parameter	200/230 Volt 60 Hz Model	200 Volt 50 Hz Model	380/415 Volt 50 Hz Model
Nominal voltage	208-230 VAC	200 VAC	380/420 VAC
Operating Voltage range	180-253 VAC	180-220 VAC	342-456 VAC
Frequency	60 Hz	50 Hz	50 Hz
Phase	3	3	3
Mains supply voltage fluctuations	Up to ± 10% of the nominal voltage	Up to ± 10% of the nominal voltage	Up to ± 10% of the nominal voltage
Input Power	5.5 kW	TBD	TBD
Current	TBD	TBD	TBD
Dedicated Circuit Breaker	30 Amps	30 Amps	20 Amps

5.4.2 Front Panel interfaces

This section describes the function of all operator interfaces on the front panel of the helium recovery compressor package, including switches and valves. It also describes the functions of all connectors and gauges on the front panel.

A. Low-Pressure Aeroquip®

The low-pressure helium flex line (not shown) fastens to the low-pressure Aeroquip® that transfers helium gas from the atmospheric storage bag to the compressor package.

B. Low-Pressure Gauge

The low pressure gauge displays the pressure of the helium gas that is being transferred to the compressor package. This should always read **0 PSIG.**

C. Medium-Pressure Gauge

The medium-pressure gauge displays the pressure of gas compressed by the first stage of the 2-stage compressor package. When the compressor package is off, this should always read **0 PSIG.**

D. High-Pressure Aeroquip®

The high-pressure Aeroquip® attaches to the external adsorber female Aeroquip®. The high pressure flex line (not shown) attaches to the male Aeroquip® on the external adsorber, which in turn attaches to the helium storage tanks.

E. High-Pressure Gauge

The high-pressure gauge displays the pressure of compressed helium gas that is transported from the compressor package. When the compressor package is off, this should always read **0 PSIG.**

F. Hour Meter

The hour meter is an elapsed time indicator located on the front panel, near the power switch. The hour meter is used to keep track of time for routine servicing and part replacement, which are determined by the number of hours of active use.

G. Power ON/OFF Button

The push button power switch activates (starts) and deactivates (shuts down) the entire system. When the system is activated, the green button light will be illuminated.

H. Bypass Button

The bypass button runs the compressor regardless of the status of laser level sensor. This can be used to empty the helium recovery bag even when it's not full.

I. Level Sensor Connector

The level sensor cord attaches to the level sensor connector to provide power from the compressor package to the level sensors. The laser level sensors also control when the compressor runs to evacuate the helium recovery bag.

J. Main Circuit Breaker

The front panel-mounted circuit breaker provides over-current protection for the compressor and functions as a main power disconnect.

K. Status Output Connector

The status output connector can be used to remotely monitor and control the compressor system.

L. System Status

The system status screen displays the current status of the compressor and also displays any errors that may have occurred during normal operation.

M. Power Cord

The power cord supplies power to the entire system.

N. H_2O Drain Valve

The H_2O drain valve is used to remove moisture collected from the compressed helium circuit. This valve should be opened/drained weekly to prevent the accumulation of water.

O. Adsorber

The adsorber is used for removing moisture from the impure helium gas stream. This will leave only dry, impure helium gas entering the LN_2 trap. **The adsorber may need to be regenerated every few weeks in the summer and every few months in the winter.** The sight glass on the adsorber has a normally blue bead in the center. When the bead begins to change color from blue to purple, that indicates that the adsorber needs to be regenerated. **See Section 7.**

5.4.3 Pressure manifold description

The pressure manifold is used to connect the medium pressure storage cylinders together. The manifold is designed to withstand pressures of more than **400 psig (27.6 bar)** of helium gas. The manifold has a pressure regulator set to **200 psig (13.8 bar).**

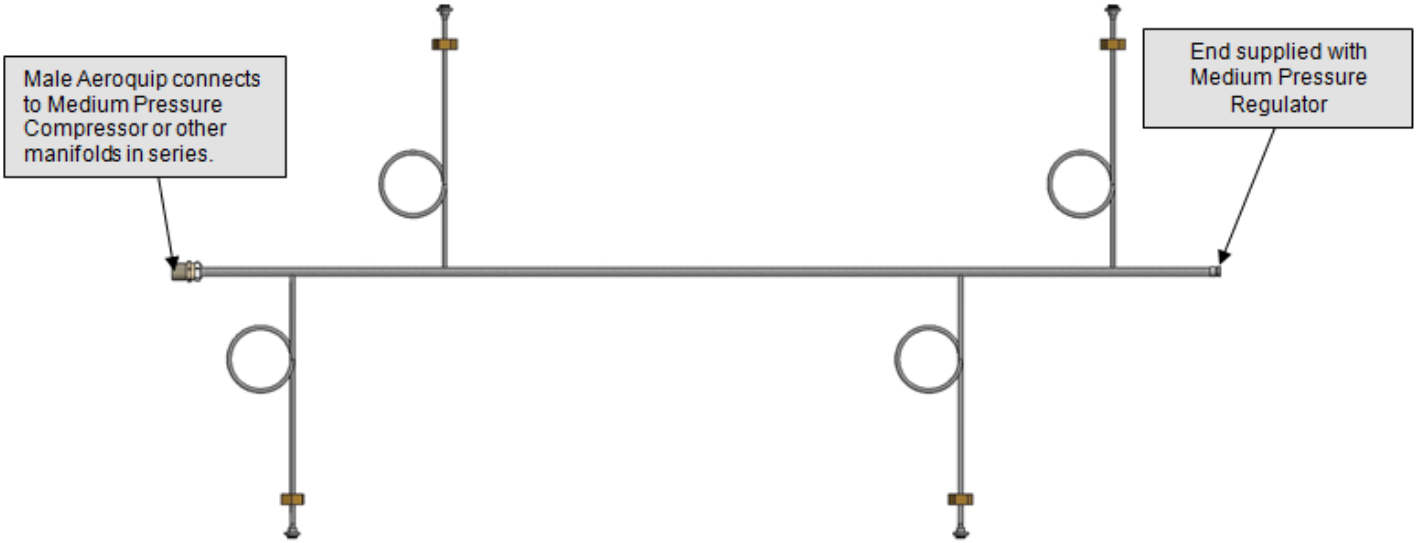
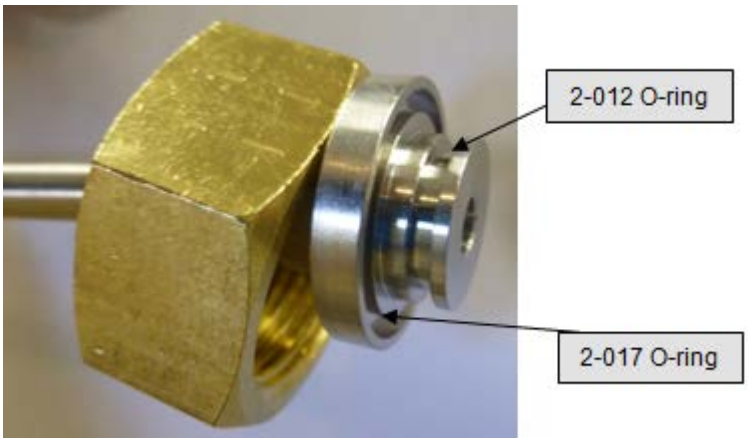


Figure 5-4: Medium Pressure Gas Manifold

¼" Female O-ring fittingsThe ¼" female O-ring fittings are custom-made to ensure a helium tight seal when connecting to their cylinders.



5.5 Description of the helium purifier assembly

Cryomech offers 2 different helium purifier assemblies: a 6" and 8" version. The biggest difference, besides their size, is their adsorption capacity. The 8" purifier has 3 times the adsorption capacity than that of a 6" purifier.

The helium purifier assembly is used to purify the helium gas stored in pressure cylinders. Two liquid nitrogen traps are provided with each system. This allows users to regenerate one trap while the other is in operation. Helium purity coming out of the purifier assembly is **≥99.99%.**

Brief descriptions of the purifier interfaces on the front panel of the controller are given below.

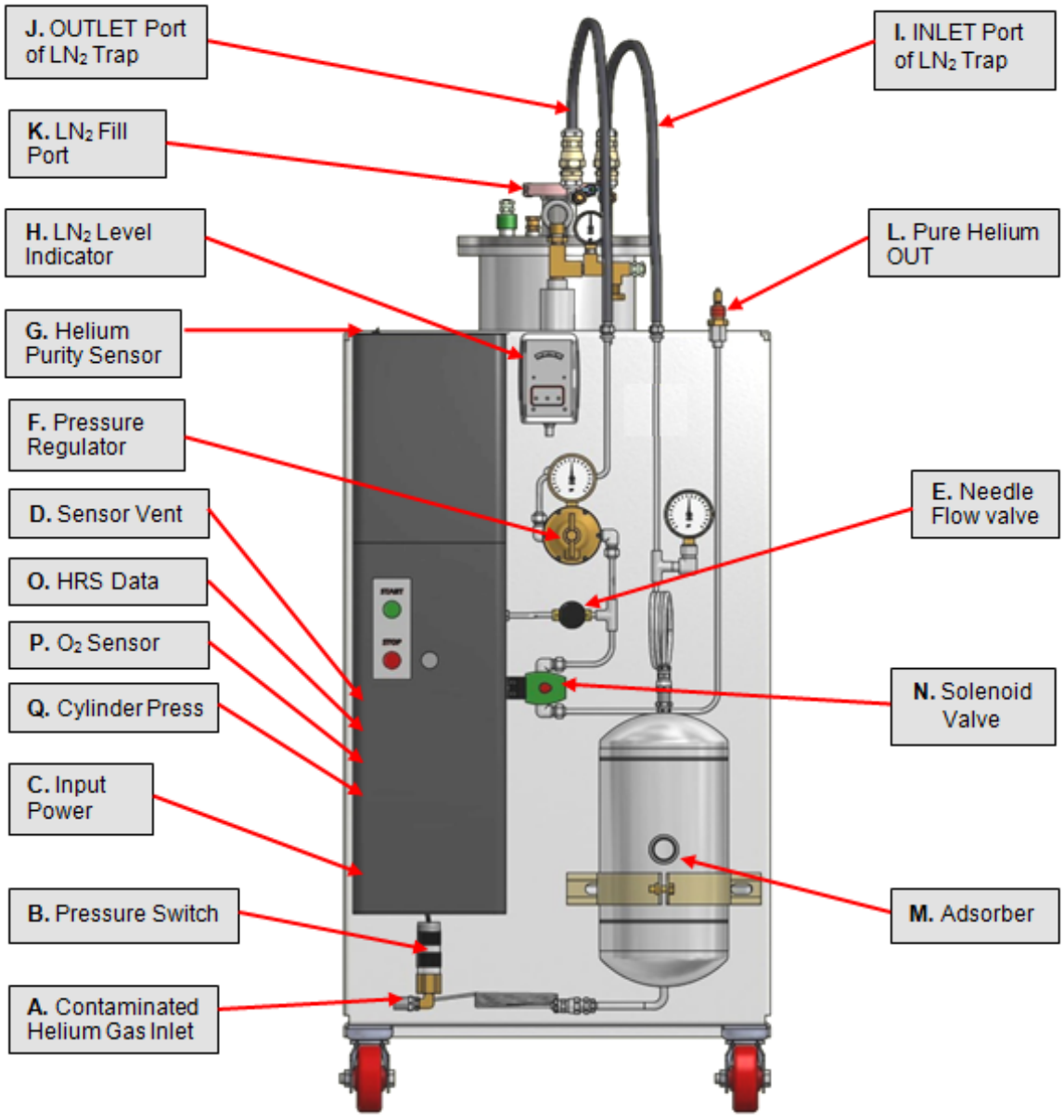


Figure 5-5: Front panel of the helium purifier assembly

A. Contaminated Helium Gas Inlet

The contaminated helium gas inlet is fitted with a ¼" Female Aeroquip. This is where the pressurized helium gas enters the purifier assembly.

B. Pressure Switch

The pressure switch is used to detect when the pressure in the system is too low (~40 psig). It does this by continuously monitoring the pressure. When it detects that the pressure is too low it stops the gas flow and pauses the system until the pressure rises again up to ~70 psig.

C. Input Power

The input power cord plugs into 110 or 220 volt, single phase power.

D. Sensor Vent

The sensor vent is the exit port from the helium purity meter. Exiting helium gas that has already been analyzed by the purity meter is then returned to the atmospheric (recovery) storage bag.

E. Needle Flow Valve

The needle flow valve control the flow of sample gas through the helium purity meter.

F. Pressure Regulator

The pressure regulator is used to control the pressure out of the purifier. This pressure is optimized for the inlet pressure of the helium impurity meter. The regulator is set to approximately 20 psig (1.4 bar).

WARNING

The pressure regulator is preset from Cryomech. If adjusted, the calibration of the purity sensor will become inaccurate.

G. Helium Purity Sensor

The helium purity sensor is used to detect when the LN_2 traps are required to be regenerated. It does this by continuously monitoring the helium gas leaving the purifier and displaying a measurement of current (ηA) that directly correlates to the purity levels of the helium. The output current increases as the purifier trap becomes saturated. Once the purifier trap is saturated, the reading will peak somewhere between 20-30 ηA (gas purity is less than 99.99% pure). At this point the system will activate the solenoid valve to cut off the helium flow to the helium liquefier. The helium purity sensor also has an audible and visual alarm that is triggered when it is time to regenerate the trap. This type of helium purity sensor is called a helium ionization sensor.

H. LN2 Level Indicator

The LN_2 level indicator monitors the amount of liquid nitrogen in the Dewar. The level indicator is preset to give a visual indication for when the Dewar is full or when it needs to be refilled. **See Section 5.5.1** for a more in-depth description of the Level Indicator.

I. INLET Port to LN2 Trap

The "INLET" port to the LN_2 trap is where the dry contaminated helium gas goes into the purifier.

J. OUTLET Port of LN2 Trap

The "OUTLET" port of the LN_2 trap is where the pure helium gas leaves the purifier.

K. LN_2 Fill Port

The LN_2 fill port is a KF40 flange, used to add LN_2 to the Dewar for the purifier. After the initial fill, the purifier will consume < 40 liquid liters per week of continuous operation.

L. Pure Helium OUT

The pure helium "OUT" port is used for the helium supply to the Cryomech LHeP. A self sealing quick connect coupling is used. A 10' flex line, with self sealing quick connect couplings on each end, is supplied with the system to connect to the LHeP.

M. Adsorber

The adsorber is used for removing any moisture from the impure helium gas stream. This will leave only dry contaminated helium gas entering the LN_2 trap. The adsorber is used for removing moisture from the impure helium gas stream. **The adsorber may need to be regenerated every few weeks in the summer and every few months in the winter.** The sight glass on the adsorber has a normally blue bead in the center. When the bead begins to change color from blue to purple, that indicates that the adsorber needs to be regenerated. The adsorber needs to be regenerated every few months. The sight glass on the adsorber indicates when you need to regenerate the adsorber. See Section 7

N. Solenoid Valve

The solenoid valve is controlled automatically as a function of system operation.

O. HRS Data Port

The HRS data cable will connect to this port from the LHeP.

P. Oxygen Sensor Port

The optional, in-line oxygen sensor cable will connect to this port.

Q. Cylinder Pressure Port

The cylinder pressure transducer cable will connect to this port from the regulator on the pressure manifold.

5.5.1 Description of the Liquid Nitrogen Trap (LN_2 Trap)

The Liquid Nitrogen Trap is what traps most of the impurities that are usually seen in the recovered helium gas. Two traps are provided for each recovery system. A heating blanket assembly is also provided with the recovery system to regenerate the traps when not in use.

A. Helium Pressure Reliefs

The (6") LN2 trap has (3) pressure relief valves installed. They are located on the **IN, OUT,** and **VENT** ports. These atmospheric pressure relief valves are set to 500 psig (34.5 bar). The larger (8") LN2 trap will have (5) pressure relief valves.

B. Liquid Nitrogen Dewar Pressure Relief

The Dewar pressure relief is used for relieving the pressure built up from the boil off liquid nitrogen inside the Dewar. It is set for 0.5 psig (0.03 bar)

C. IN Port to LN2 Trap

The **IN** port to the LN_2 trap is the dry contaminated helium gas going into the trap.

D. OUT Port of LN2 Trap

The **OUT** port of the LN_2 trap is where the pure helium gas leaves the trap.

E. LN_2 Fill Port

The LN_2 fill port is a KF40 flange that is used to add LN_2 to the Dewar for the purifier. After the initial fill, the purifier will consume < 40 liquid liters per week during continuous operation.

Brief descriptions of the interfaces are given below, in Figure 5-6.

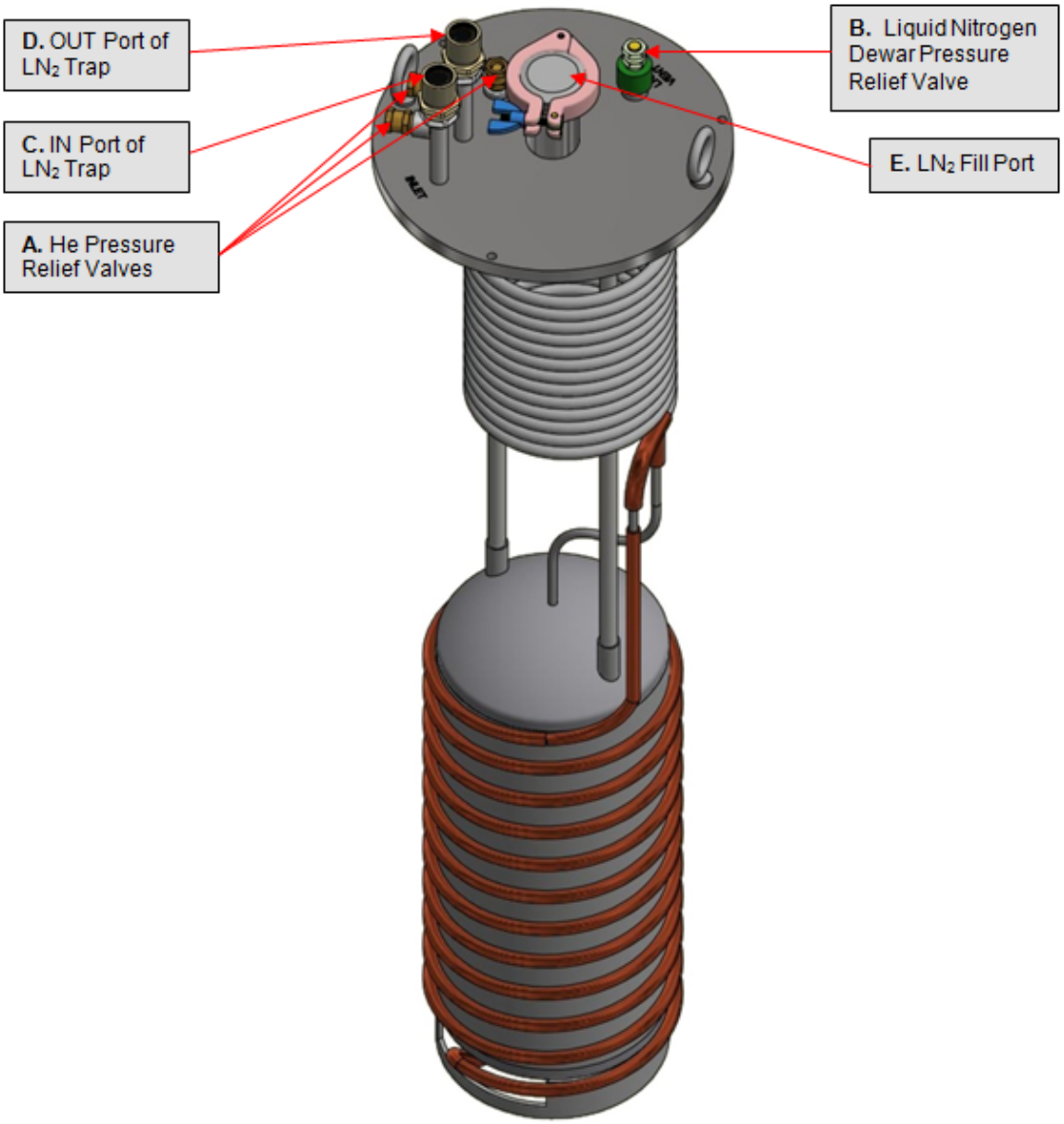


Figure 5-6: Liquid Nitrogen Trap Assembly

5.5.2 Description of the Level Indicator/Switch

The Level Indicator/Switch acts as capacitor, whose capacitance changes with the average dielectric constant of the material surrounding it. The level indicator measures this capacitance to determine the level, based on the calibration settings. The capacitance of the sensor is a function of the ratio of the dielectric constant of the liquid to the dielectric constant of the vapor. Therefore, in order to measure liquid level, the main assumption is that the dielectric constant of the liquid is different than the dielectric constant of the vapor.

See Section 8.7 for recalibration instructions if required.

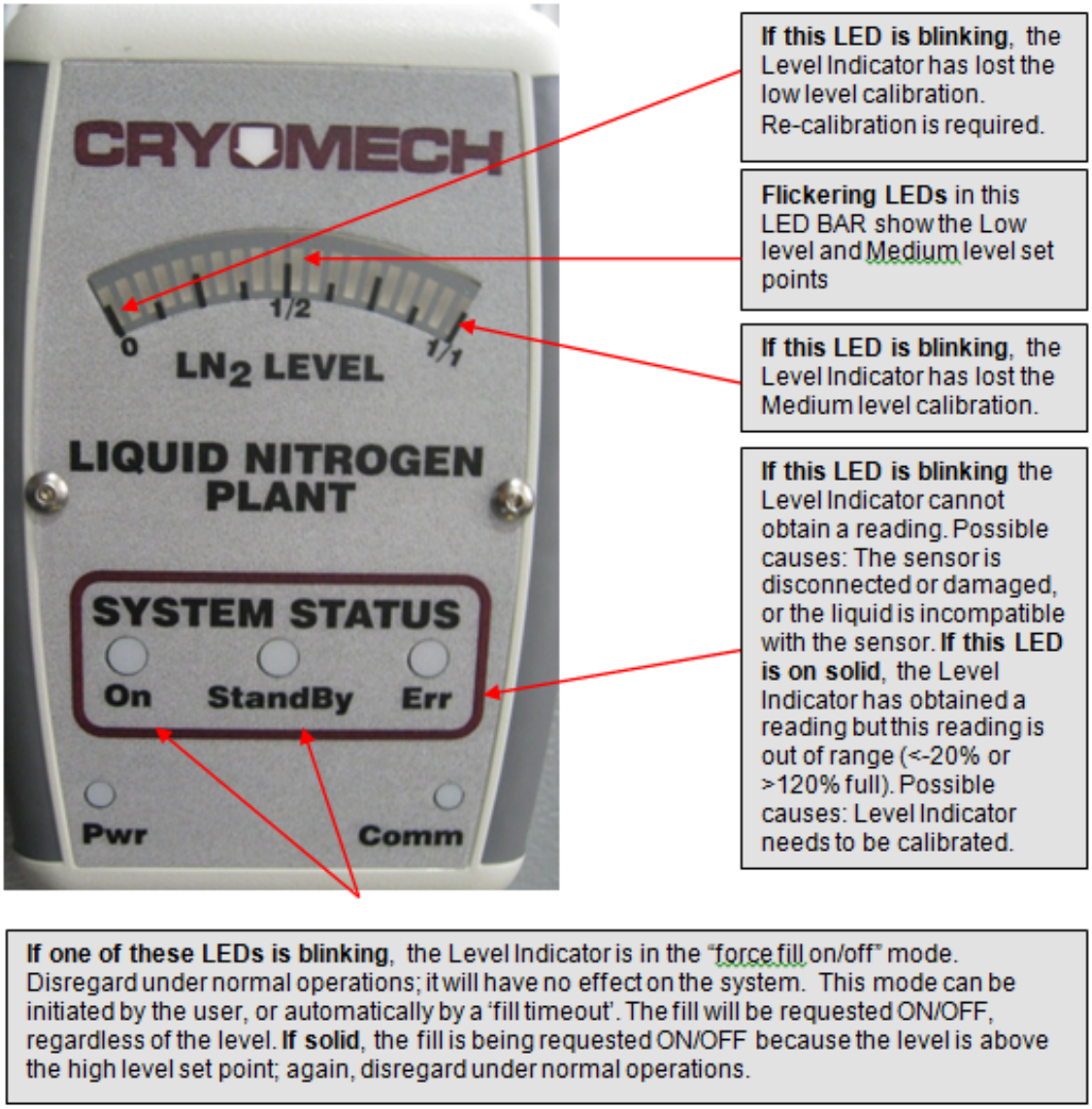


Figure 5-7: LN2 level indicator

Section 6

Installation

Section 6: Installation

6.1 System installation

The entire section on the installation of the helium recovery system should be reviewed before installing the system.

CAUTION

Failure to follow these installation guidelines could result in voiding the warranty.

If the system is installed in an enclosed, confined space, an oxygen monitor/alarm should be installed to warn about the possibility of a deficient oxygen level. Helium is an asphyxiant in high concentrations. If a leak develops in any of the helium gas supply lines, a dangerously low oxygen concentration is possible in the ambient air.

If the liquid nitrogen dewar ruptures or develops a leak, the liquid nitrogen will quickly vaporize and may create dangerously low oxygen concentrations in the ambient air.

Being odorless, colorless, tasteless, and nonirritating, helium and nitrogen have no warning properties. Humans possess no senses that can detect the presence of helium or nitrogen. **At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.**

WARNING

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self contained breathing apparatus or air-line respirator.

6.2 Connection of the medium pressure manifold to the medium pressure storage cylinder bank

INFORMATION

A medium pressure flex line is supplied to connect the high-pressure Aeroquip® from the helium recovery compressor to the medium pressure manifold.

1. The standard system is supplied with four medium pressure cylinders.
    - Note: Cylinders are charged with **10 PSIG.**
    - The cylinder measures 58 inches in height.
2. The optimal location of the helium storage cylinders is beside the compressor package and below the recovery bag because they connect to both.
    - Follow pressurized gas cylinder safety precautions associated with your occupational hazard training.
3. The medium pressure manifold is supplied with fittings attached. **See Figure 6-1.**

- Orient the manifold so that the ½ in. Aeroquip® end is closest to compressor.
- Ensure that the O-rings are present and properly set in the O-ring grooves.
- Replace missing or damaged O-rings.

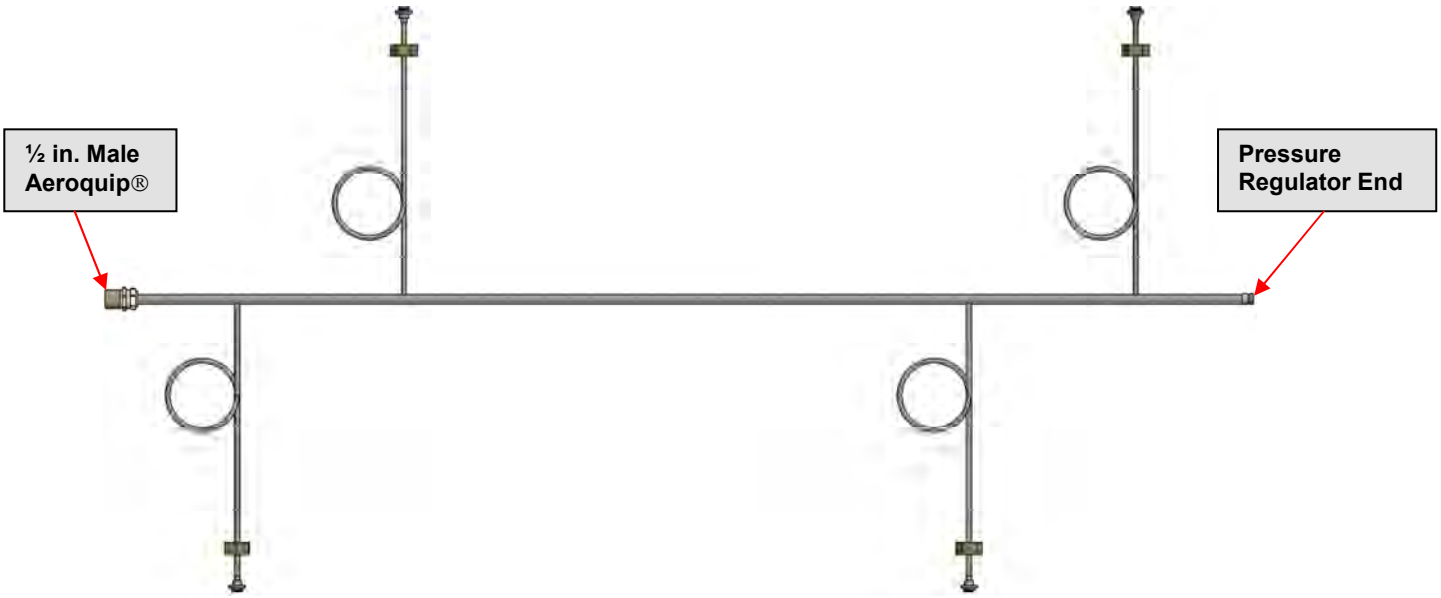


Figure 6-1: Medium Pressure Manifold

4. Insert the stainless steel fitting into one of the two valves on a supplied tank.
    - Push the brass nut forward, toward the fitting, and tighten.
5. Repeat **step 4** with the remaining tanks **before** step 6.
6. Check for O-ring on the end of manifold where regulator attaches. **See Figure 6-1.**
7. Attach the pressure regulator. **See Figure 6-2.**
    - Use a wrench to attach the female O-ring fitting on pressure regulator to male O-ring fitting on medium pressure manifold.

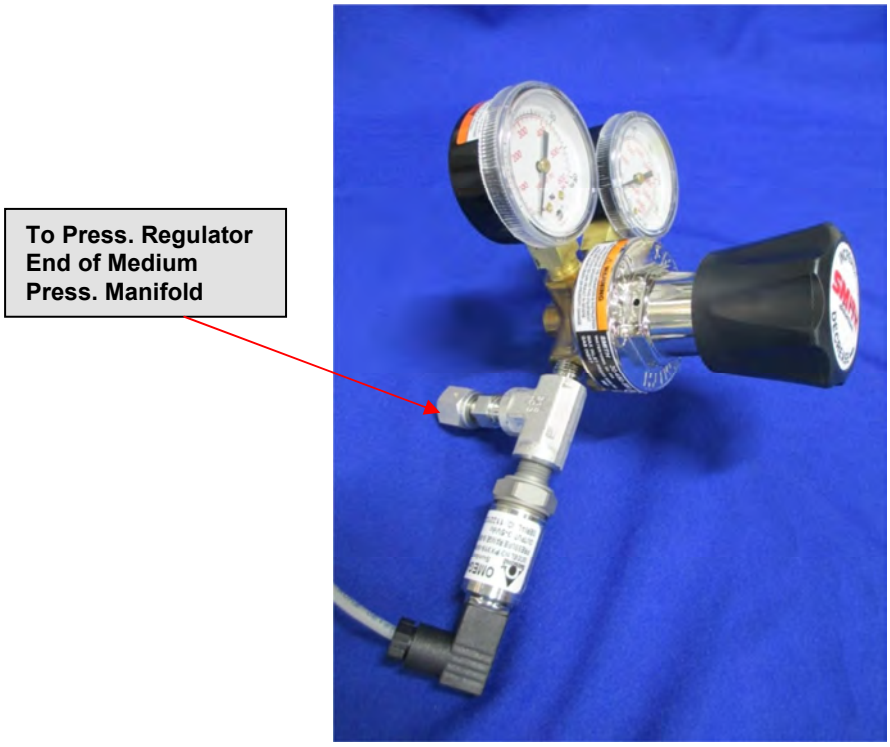


Figure 6-2: Pressure regulator with O-ring fitting and transducer

6.3 Preparation and installation of the helium recovery compressor package location

1. Confirm that the physical space containing the helium recovery compressor package has an ambient temperature in the range of **45 to 100°F (7 to 38°C).**
2. Place the compressor package in a level position. For the helium recovery compressor package to operate under optimal conditions, it must be oriented **within 5°** of being level.

> **WARNING**
>
> The helium recovery compressor package must be positioned to provide easy access to all four sides.

3. The optimal location of the helium recovery compressor package is beneath the recovery bag.
4. Position the helium recovery compressor package so there is sufficient space around it for scheduled maintenance. **See Section 8.**

6.3.1 Compressor package wiring and startup

> **WARNING**
>
> Be sure to follow all local electrical codes and guidelines.

1. Verify that the compressor nameplate voltage and frequency matches the utility power.
2. The system **MUST** be connected to a dedicated circuit breaker.
   - The breaker must be mounted near the helium recovery compressor package, within easy reach of the operator.
   - The breaker also must be marked as the disconnecting device for the system.
   - Specifications for circuit breakers vary according to the system's operating voltage. See the electrical specification tables in **Section 5** for more information.
3. Verify that the dedicated circuit breaker is turned **OFF**.
4. The helium recovery compressor package comes with a main power cord attached.
   - Ensure the length of the cord is sufficient to safely connect to the power source.
   - Adjust the location of the helium recovery compressor package if the cord does not reach the power source.
5. Connect the ground wire.
   - The ground (earth) wire in the power cord is either green or green/yellow striped.
   - Connect this wire to the ground (earth) connector in the breaker panel.
   - Securely tighten the wire into the connector.
   - It is important not to disable this wire.
6. Connect the remaining hot wires in the power cord to the corresponding lugs on the dedicated breaker in the breaker panel.
   - Securely tighten the wires into the connectors.
   - ***Note:*** *For 3-phase compressor packages, the order of wires is not important at this time—correct order will be determined in the following step.*
7. Energize the circuit breakers.
8. Push the green power **ON** button to start the helium recovery compressor.
   - The button should illuminate*.

***If it does not illuminate**, perform the following steps to correct a reversed compressor package:

a. Switch **OFF** the breaker on the front panel of the compressor package.

b. Turn **OFF** the power at the dedicated circuit breaker, to prevent electrical shock.

c. Examine the power cord and wire colors at the panel circuit breaker.

d. Exchange the position of any two of the phase wires.

e. Energize both breakers and press the green power **ON** button. *The compressor package should now operate properly.*

6.4 Installation of the atmospheric (recovery) bag assembly

1. The recovery bag must remain safely **away from all puncture hazards**.
   - Pay close attention to the materials selection process of designing the racking system. For example, a tarp may be necessary to cover a plywood platform, to avoid a puncture hazard presented by wooden splintering of the material.
   - Cryomech, Inc. is not responsible for repair of any damage to the recovery bag as a result of the racking system/platform designed and built by the customer.
   - An enclosure with additional vertical support is recommended around the recovery bag; incorporate netting, additional bars, or solid walls.
2. Environmental ambient temperature range is **45 to 100°F (7 to 38°C).**
3. Build a racking system to house the recovery bag assembly with minimum space dimensions: L x W x H: **13.5 x 8.0 x 7.0 ft** (4.1 x 2.4 x 2.1 m) assuming standard bag.
   - This will accommodate the 18 in. gap, required between the lower laser positioning sensor and the recovery bag, assuming standard bag dimensions.
   - Refer to **Section 6.5,** before designing the racking system support beams.
4. Position the recovery bag assembly so there is sufficient space for installation.

6.4.1 Installation of the atmospheric (recovery) bag to the assembly

Once the racking system has been assembled, the recovery bag can be mounted on it.

Follow the steps, below, to install the recovery bag:

1. Lift the packaged, recovery bag onto the platform of the racking system.
2. Unpack the recovery bag so that it lays flat on the platform.
   - Orient the bag with the connection port on the desired end.
3. Inspect the cross Aeroquip® connector. **See Figure 6-3.**
   - O-ring is present and properly seated into the flange groove.
   - The **0.15 PSIG (0.01 bar)** atmospheric relief valve and two Aeroquips® are present and properly connected.

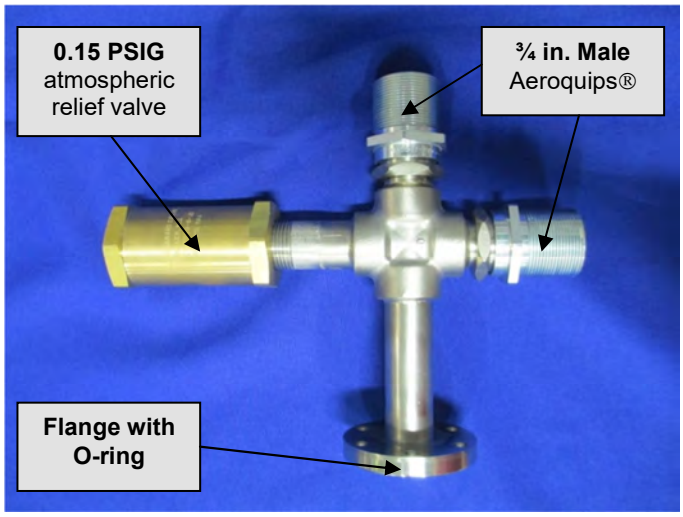


Figure 6-3: Cross Aeroquip® connector

4. Install the cross Aeroquip® connector onto the bag connection port. **See Figure 6-10.**
   - Locate and fasten with the six ¼-20 x 1 in. screws (provided).
5. It is recommended that a vent tube be connected to the pressure relief valve to safely vent helium to the outside air. This may not be necessary if the room containing the recovery bag is sufficiently ventilated and oxygen sensors are present. To install the tubing:
   - Acquire an adapter for connection of tubing to the ¾ in. FPT end of the **0.15 PSIG** (0.01 bar) pressure relief valve.
   - Tubing should be flexible, to allow movement with respect to bag deflation.
   - Tubing should be routed to the outside air, to safely vent helium from the recovery bag.
6. Ensure the recovery bag is completely flat and in its final position.
7. Secure the recovery bag to the platform with screws through the flaps reinforced with grommets, as shown in **Figure 6-4**.
   - This is not necessary if the platform, itself, is secure to hold the bag.

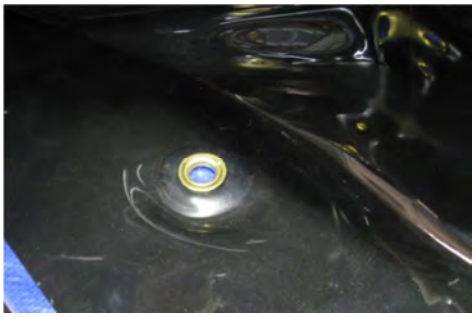


Figure 6-4: Storage bag grommet

6.5 Installation of the laser positioning level sensors

The system is shipped with two laser positioning sensors. The high sensor functions to switch the helium recovery compressor package on; the low sensor turns it off.

The sensors should be mounted on the racking system support beams. The recommended position for the high sensor is **54 in (1.4 m)** above the platform, and the position for the low sensor is **16 in (0.4m)** above the platform. *The lower laser positioning sensor should be installed 18" away from the recovery bag, to prevent the possibility of a false trip, stopping the compressor cycle early.* This can occur if the laser sensor is too close, which causes reflection of the laser off of the recovery bag.

INFORMATION

For ease of installation, this step should be done after the helium recovery compressor package has been installed.

1. Switch circuit breaker power **OFF** to helium recovery compressor package.
2. Connect the two ends (marked HIGH and LOW) of the laser sensor cable to the **HIGH** and **LOW** laser position sensors, respectively.

3. Loosely install the laser sensors onto the support beams, closest to where the helium recovery compressor package will be located.

4. Cut two pieces of the provided reflective tape approximately **2 in (4.5 cm)** long.

5. Apply one piece of the reflective tape on each support beam directly across from the laser position sensors.

6. Switch circuit breaker power **ON** to the helium recovery compressor package.

7. Starting with the high level sensor, position the laser beam so the bright red dot is centered on the reflective tape.

8. The laser has been positioned correctly when the red **LED** on top of the laser position sensor is **OFF**.

9. Tighten the laser mounting hardware to maintain its position.

10. Repeat **steps 8 – 10** for the low level laser position sensor.

    - **NOTE:** During normal operation, the low level laser position sensor is **OFF** when the compressor is **OFF,** and it will turn **ON** when the compressor starts a pump-down cycle. The high level laser position sensor is **ON** continuously.

6.6 Installation of the helium purifier assembly

1. Confirm that the physical space containing the helium purifier assembly has an ambient temperature range of **45 to 100°F (7 to 38°C)**.
2. Confirm the physical space containing the helium purifier assembly can fit the assembly-specific minimum space dimensions:

   6" Purifier Assembly (L x W x H): **33 x 22 x 52 in** (84 x 56 x 132 cm)

   8" Purifier Assembyl (L x W x H): **34 x 26 x 61 in** (86 x 66 x 155 cm)
3. A chain hoist capable of lifting at least **100 lbs** will be required for installing the trap into the liquid nitrogen dewar.

WARNING

If the liquid nitrogen dewar ruptures, the gaseous nitrogen may create dangerously low oxygen concentrations in the ambient air. Being odorless, colorless, tasteless, and nonirritating, nitrogen has no warning properties. Humans possess no senses that can detect the presence of nitrogen. **At low oxygen concentrations, unconsciousness and death may occur in seconds and without warning.**

Personnel, including rescue workers, should not enter areas where the oxygen concentration is **below 19.5%** unless provided with a self-contained breathing apparatus or air-line respirator.

4. The LN_2 traps and the purifier assembly are shipped separately. Both traps are pre-charged with **200 PSIG** (13.8 bar) of **99.999%** pure helium.
5. Remove packaging cover from purifier by loosening thumbscrews.

- Retain thumbscrews. **See step 9, below.**

6. Carefully lift the LN_2 trap using a chain hoist; wheel the purifier assembly underneath.
7. Carefully and slowly lower the LN_2 trap into the dewar on the purifier assembly.
8. Position the LN_2 trap as displayed, so the inlet and outlet flex lines can be easily installed and removed when appropriate. **See Figure 6-5.**

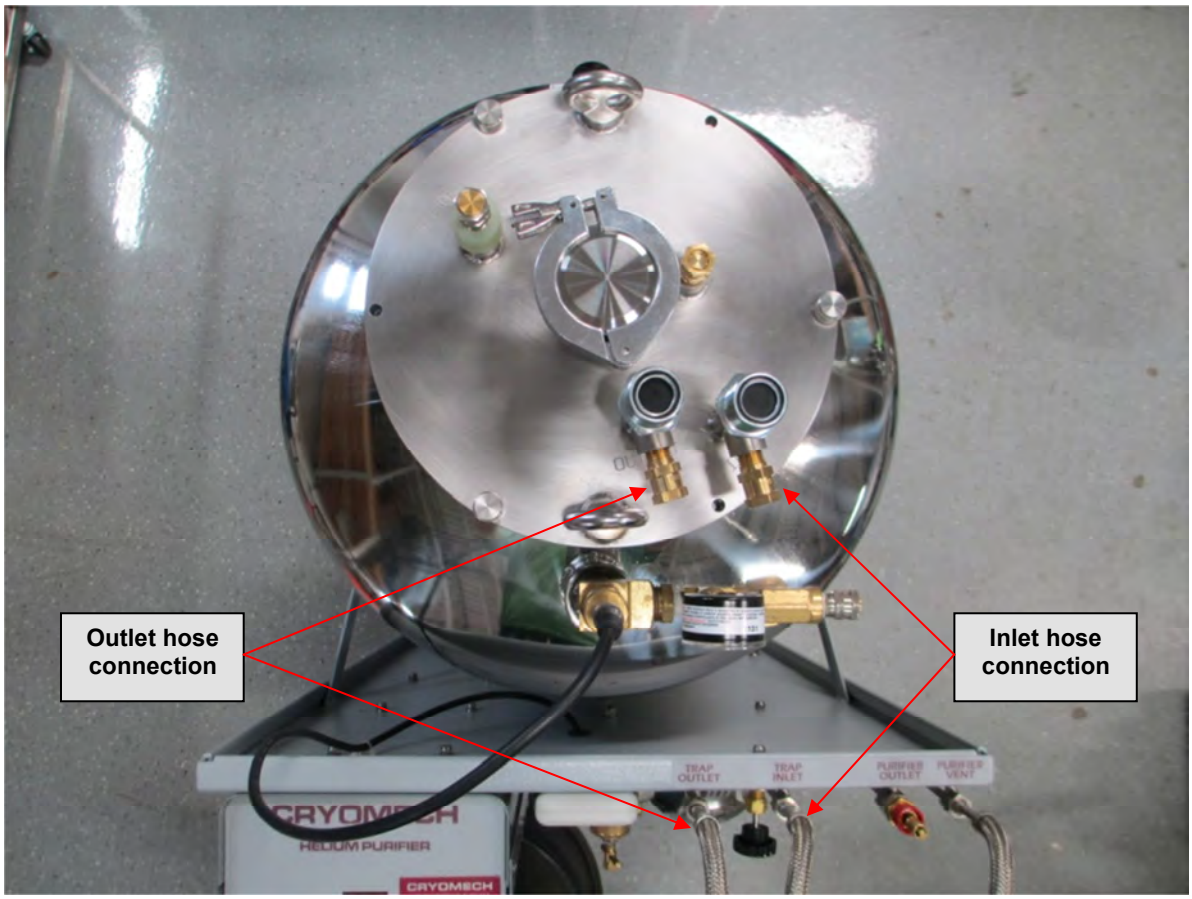


Figure 6-5: Orientation of LN2 trap

9. Install and hand-tighten the supplied (¼-20 x 1 in) thumbscrews to secure the LN_2 trap to the dewar flange.

CAUTION

When lowering the LN_2 trap into the dewar, be careful not to damage any of the tubing on the LN_2 trap, because they are shipped with **200 psig (13.78 bar)** of helium.

10. Position the helium purifier assembly so there is sufficient space around it for attaching the helium flex lines. Consideration should also be given to the space required for the user to work around it during installation and use.
11. Remove all dust caps and plugs from the helium flex lines.
    - Save for future use.

12. Make certain that the flat gaskets are present, and properly seated, in the male Aeroquip® fittings of the purifier assembly. **See Figure 6-6.**

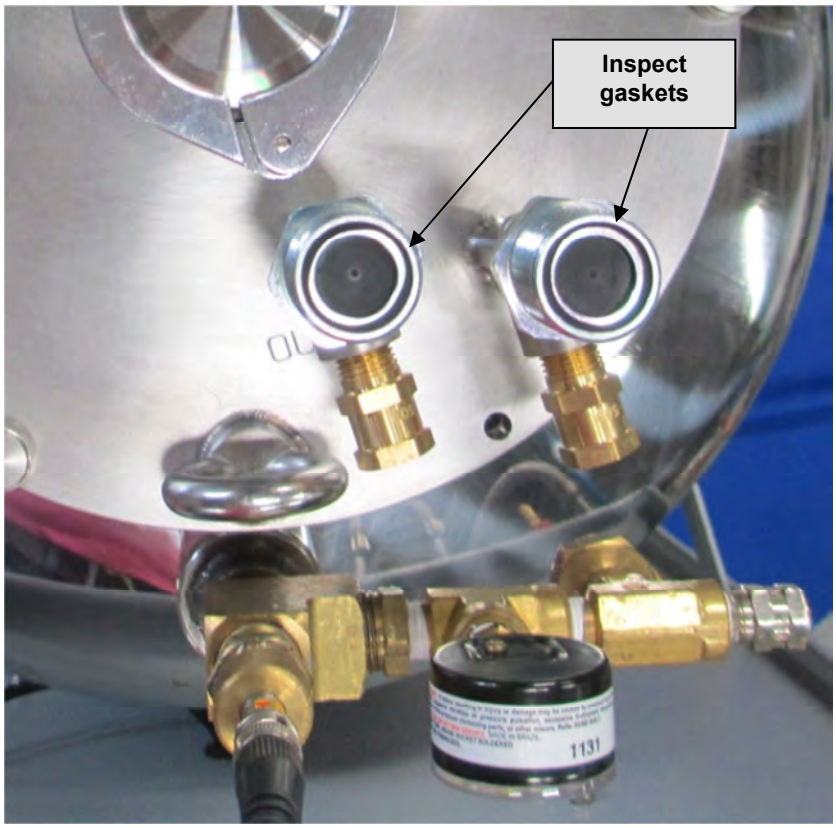


Figure 6-6: ½ in. Aeroquip® gasket inspection; top view of LN_2 trap

13. Remove any visible particles from the ends of all Aeroquip® couplings with a dry, clean, lint-free cloth.

IMPORTANT

Before connecting flex lines, ensure the Aeroquip® couplings on the ends of the lines match those of the components intended for connection.

When connecting or disconnecting the flex lines, Cryomech, Inc. recommends using Teflon spray lubricant on the threads.

A can of lubricant is included with each system.

Please read the usage instructions, which are packaged with the lubricant and included in **Appendix B** of this manual, **before** using the lubricant.

14. Connect the “trap outlet” and “trap inlet” flex lines to the “outlet” and “inlet” trap Aeroquips®, respectively.
    - Use the wrenches supplied in the tool kit: **1 1/8 in** and **1 3/16 in**, open ended.
    - When attaching the Aeroquip® to the mating connector, make sure the threads are in alignment before tightening the connector. **See Figure 6-7.**

CAUTION

At no time should the Aeroquip® couplings be removed from the LN_2 trap when regenerating the LN_2 trap. Regeneration can be completed without relieving system pressure since the LN_2 trap is equipped with Aeroquip® couplings for sealed removal.

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

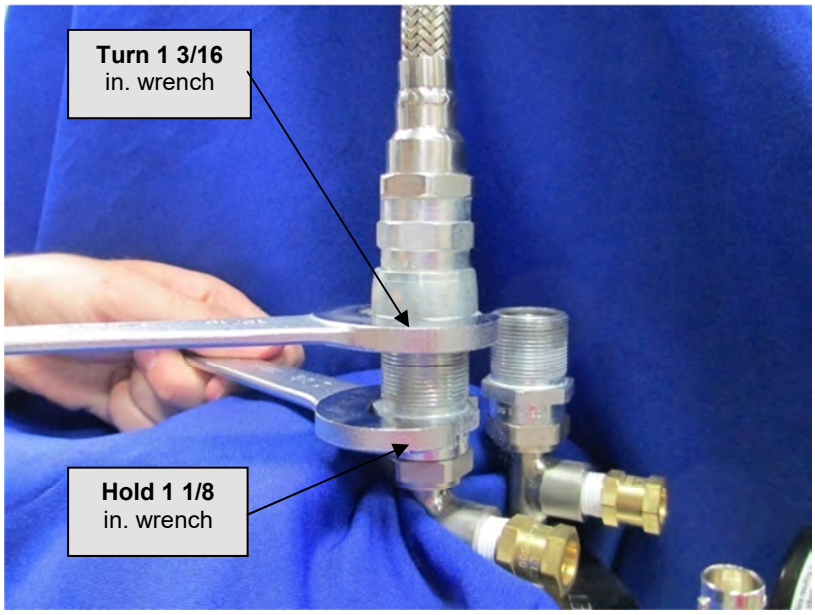


Figure 6-7: Connecting the flex lines to the LN_2 trap

15. Ensure that the pressure gauge after the adsorber on the helium purification assembly still reads approximately **200 psig** (13.8 bar).
16. Connect one end of the power cord to the helium purifier and the other end to the power source.

WARNING

Be sure to follow all local electrical codes and guidelines.

17. Fill the dewar with liquid nitrogen until the liquid level meter indicates a full level.
    - This will require approximately:

      For 6" Purifiers, 70 liquid liters.

      For 8" Purifiers, 140 liquid liters.
    - **Notice:** A significant pressure drop in the helium purifier occurs as LN_2 is cooling the helium gas.

6.7 Connections

6.7.1 Leak check medium pressure manifold and cylinder connections

1. The medium pressure manifold is equipped with a pressure regulator to reduce the pressure from **400 PSIG** (27.6 bar) to **200 PSIG** (13.8 bar).
2. Adjust the regulator to **200 PSIG** (13.8 bar).
   - Completely tighten dial by turning clockwise. Then, loosen **1 3/4 turns** to set the regulator to approximately 200 PSIG.
   - System must be charged with sufficient pressure before verifying **200 PSIG**.
   - System must have at least **40 PSIG** for purifier to run.
   - Cylinders are shipped charged with **10 PSIG**
3. Open only **one** medium pressure helium cylinder.
4. Inspect the medium pressure lines and fittings for leaks. If a leak detector with a sniffer probe is not available, perform the following leak check procedure:
   - Spray soapy water or Windex on connections
   - Visually inspect the connections for bubbles, indicating a leak.
   - Fix leaks found by replacing O-rings, properly tightening Aeroquip® connectors, sealing connections to the cylinders, eliminating debris, adding Teflon tape, etc.
   - Ensure there are **no leaks** present **before step 5**.
5. Fasten one end of the 10 ft (length), ¼ in. ID (inner diameter) flex line with ¼ in. female Aeroquips® to the pressure regulator.
6. Inspect and verify the presence of the gasket seated in the ¼ in. male Aeroquip® on the purifier inlet. **See Figure 6-8**.

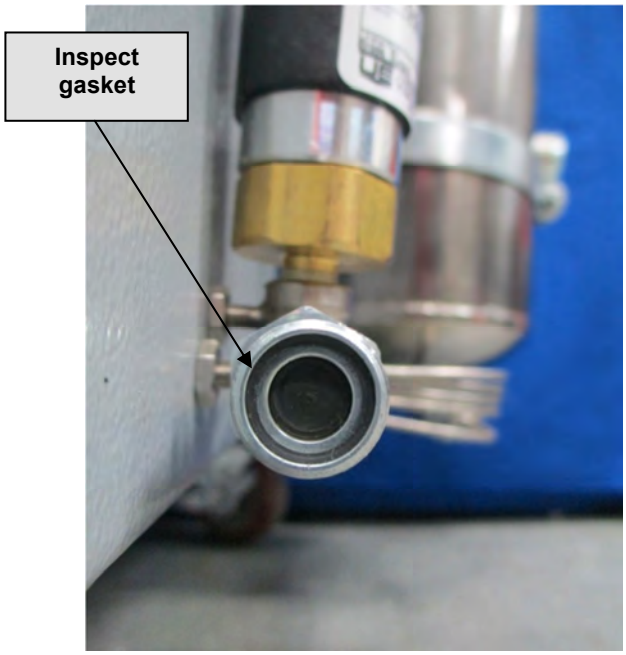


Figure 6-8: Inspect the gasket on the ¼ in. male Aeroquip®

7. Connect the other end of the flex line to the ¼ in. male Aeroquip® inlet on bottom left corner of the purifier. **See Figure 6-9.**

CAUTION

At no time should the Aeroquip® couplings be removed from purifier when adding or removing the ¼ in. helium flex line. The purifier connections are equipped with Aeroquip® couplings for sealed removal.

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

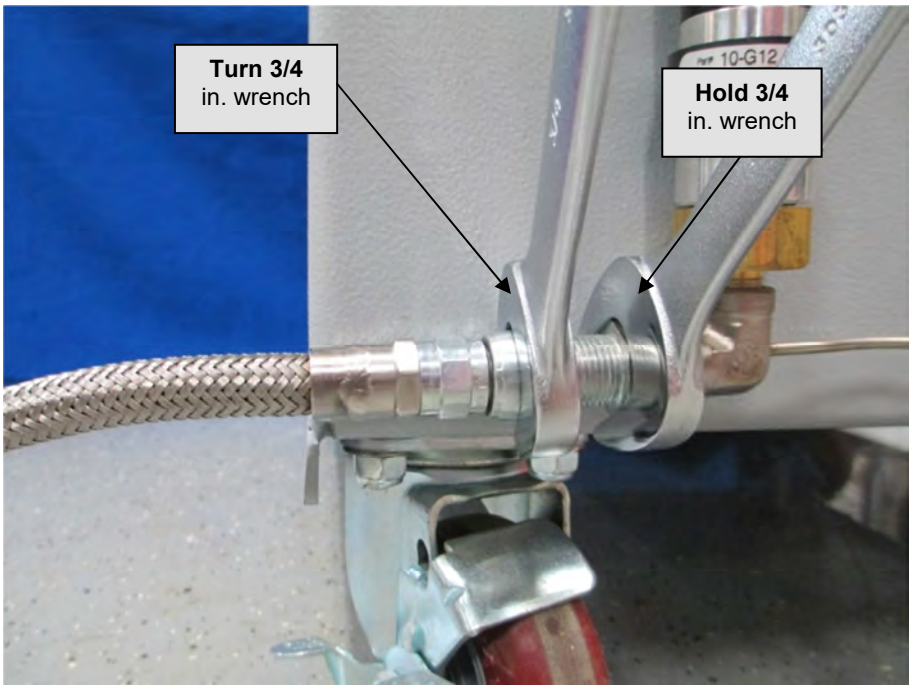


Figure 6-9: Connect ¼ in. helium flex line to purifier

8. Open the remaining medium pressure helium cylinder valves.

6.7.2 Connection of the flex line from the purifier outlet to the LHeP

1. Locate the flex line labeled ***Purifier Outlet to LHeP,*** with female quick connect fittings on each end.
2. Connect one end of the flex line to the helium purifier assembly outlet.
3. Connect the other end to the LHeP gas inlet.

6.7.3 Connection of the line between the atmospheric (recovery) bag and the helium recovery compressor package

CAUTION

The line must have an inner diameter which does not restrict the flow of helium gas through it. The inner diameter cannot be any smaller than **1.0 in**. (2.5 cm).

If the line is not connected to the appropriate ¾ in. male Aeroquip® fitting on the cross Aeroquip® connector that is **perpendicular** to the relief valve, then the valve will open prematurely, causing a significant loss of helium from the system.

1. Ensure the cross Aeroquip® connector is attached to the recovery bag, as specified in **Section 6.4.1**.
2. Locate the 10 ft long, 1 in. ID, flexible line, labeled ***recovery bag to helium compressor***, with ¾ in female Aeroquip® fittings on both ends.
3. Connect one end of the flex line to the ¾ in. male Aeroquip® fitting on the cross Aeroquip® connector that is **perpendicular** to the relief valve. **See Figure 6-10**.

Figure 6-10: *Recovery bag to helium compressor* flex line connection

4. Connect the other end of the flex line to the ¾ in. male Aeroquip® fitting located on the front face of the helium recovery compressor package, beneath the low pressure gauge. **See Figure 5.3.**

6.7.4 Connection of the line from the helium compressor outlet to the medium pressure manifold

CAUTION

A medium pressure flex line is supplied to connect the high pressure compressor Aeroquip® to the medium pressure manifold.

1. Locate the flex line labeled ***helium compressor to pressure cylinders manifold***.
2. Fasten one end of the flex line to the ½ in. male Aeroquip® located on the bottom of the adsorber, attached to the helium recovery compressor. **See Figure 5-3.**
3. Fasten the other end to the ½ in. male Aeroquip® on the medium pressure cylinders manifold, opposite the regulator end. **See Figure 6-1.**

6.7.5 Connection of the low pressure manifold

1. Locate ¾ in MPT to O-ring fitting adapter.
   - Inspect adapter for O-ring. **See Figure 6-11.**

Figure 6-11: Adapter with O-ring

2. Wrap pipe thread on adapter with Teflon (PTFE) tape. **See Figure 6-12.**
   - Wrap in the opposite direction that the fittings will be threaded.

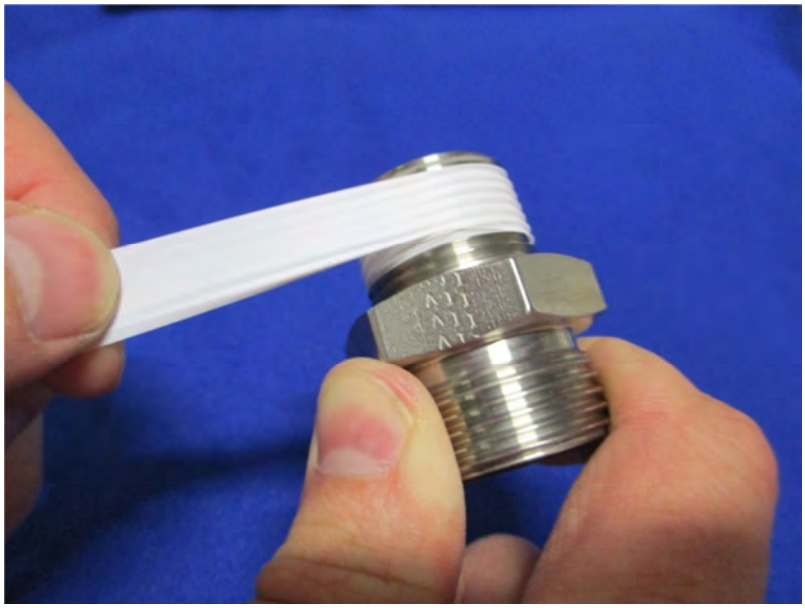


Figure 6-12: Seal threads with Teflon tape.

3. Install the adapter to the end of recovery piping, fitted with ¾ in. FPT.
4. Install low pressure manifold to O-ring fitting on end of adapter on recovery piping. **See Figure 6-13.**

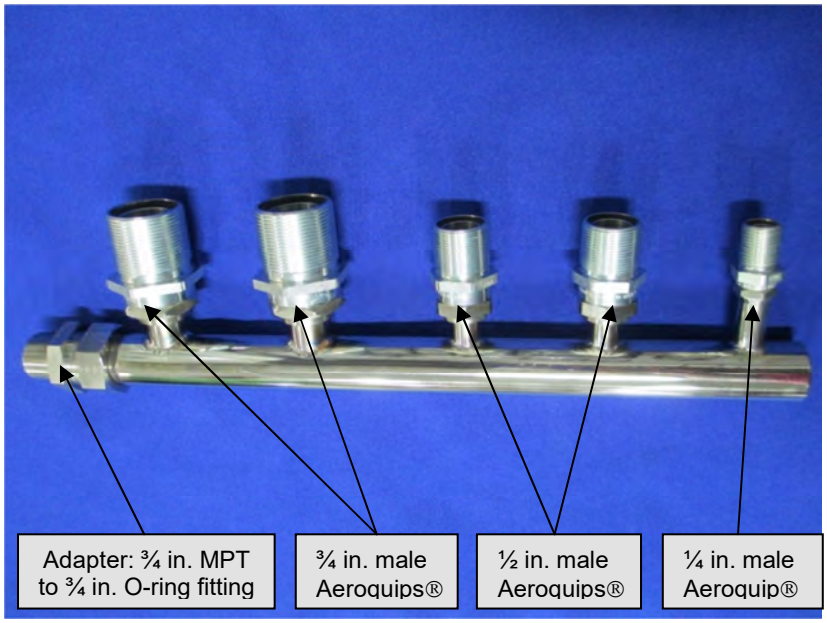


Figure 6-13: Low pressure manifold

5. Leak check recovery piping.
   - Charge the recovery piping with helium gas. Do not exceed the pressure specifications of the material and fittings used in the recovery piping.
   - Leak check all fittings on the recovery piping with a sniffer leak detector, if available.

- If not available, a solution of soapy water can be used on the fittings to check for leaks. Apply the solution to the fittings. Any leaks will show up as bubbles in the solution.

6. Locate the flex line labeled ***low pressure manifold to recovery bag***.
7. Fasten one end of the flex line to the ¾ in. male Aeroquip® on the cross Aeroquip® connector, attached to the recovery bag.
8. Fasten the other end to the ¾ in. male Aeroquip® on the low pressure manifold.
9. Locate the flex line labeled ***vapor collection line from dewar to low pressure manifold***.
10. Fasten one end to the ½ in. FPT fitting on the 10 PSIG in-line relief valve, located on the LHeP dewar.
    - Prepare ½ in. MPT fitting on end of flex line with Teflon tape. **See Figure 6-12.**
11. Fasten the other end of the flex line to the ½ in. male Aeroquip® on the low pressure manifold.
12. Locate the flex line, labeled ***vapor collection line to transfer dewar vent***.
13. Fasten one end of the flex line to the ½ in. male Aeroquip® on the low pressure manifold.
14. Install male quick connect on in-line relief valve, located on the transfer dewar.
15. Fasten the female quick connect end of the flex line to the male quick connect fitting, located on the transfer dewar.
16. Locate the **sensor vent tube** (¼ in. **HDPE** tubing) from the shipping crate.
17. Push one end into the helium "sensor vent" port on the left side of the purifier.
    - Give a slight tug backwards to ensure that the tube is fully installed.
18. Route the other end of the **sensor vent tube** back to the low pressure manifold.
    - The sensor vent connector is equipped with a ¼ in. female Aeroquip®.
    - Attach the sensor vent connector to the ¼ in. male Aeroquip® on the low pressure manifold *or the purifier will not work*.
19. Ensure both needle flow valves on the purifier are completely open.
    - This allows helium gas to flow through the purity meter, to purge the sensor.
    - One black knob is located above inlet pressure gauge and the other is labeled *purity sensor flow control.* Ensure both are open.
    - Refer to **Figure 5-5 (E),** in **Section 5** of this manual.

6.7.6 Data connections

The following connections are located on the left side of the purifier's front panel, beneath the sensor vent port. **See Figure 5-5 (O—Q), in Section 5** of this manual.

1. Connect the cable from the pressure transducer to the port labeled ***CYLINDER PRESS***.
2. Connect the HRS data cable from LHeP to the port labeled ***HRS DATA.***
3. Optional – If an in-line oxygen sensor is used, connect the oxygen sensor cable to the port labeled ***OXYGEN SENSOR.***

Section 7

Operation

Section 7: Operation

7.1 Starting the helium recovery system

With the installation complete, make the following checks before starting the helium recovery system. Automatic operation of the helium recovery system is controlled by a few different control systems. The laser level positioning sensors monitor the height of the atmospheric (recovery) bag turning the helium recovery compressor package ON and OFF. The helium purity sensor on the helium purification system monitors the purity of the helium gas leaving the purification system.

Carefully follow the steps outlined in this section to ensure proper starting and operation of the helium recovery system.

7.1.1 Checks before operating

1. Input power meets the specifications found on corresponding identification labels.

> **CAUTION**
>
> A voltage deviation of more than 10% above or below the voltage rating can cause possible failures. ***Indications of voltage operation outside the specified range will void the helium recovery compressor package and/or the purification system warranty.***

2. The laser positioning level sensor cord is connected to the helium recovery compressor package.
3. The green light on the high position laser is illuminated, ensuring that it has been calibrated correctly.
4. The low position laser light will **not** illuminate if the compressor is **OFF**.
5. An adequate amount of liquid nitrogen is in the purifier dewar.
6. Aeroquip® couplings on helium flex lines are properly connected.
7. The ambient temperature range and other air space requirements meet the helium recovery compressor specifications in **Section 5**.
8. The helium purity sensor vent has a return line connected to the low pressure manifold.
9. The dot displayed in the adsorber sight glass is **blue**, and the silica gel beads surrounding it in the sight glass are also **blue.**

NOTE: *When saturated with water the dot in middle of sight glass turns pink* ***(Section 7.4.1)****, indicating the adsorber needs to be regenerated. Ignoring this routine maintenance will cause an impedance to flow and require significantly more frequent* LN_2 *trap regeneration.* **See section 8.3.**

7.1.2 Startup procedure (compressor)

1. Power **ON** the helium recovery compressor.
2. The compressor is now ready for operation.
   - The compressor is designed to be run automatically without an operator continuously monitoring operation.
   - The compressor can be stopped and restarted manually, by pushing the Compressor **OFF** and **ON** buttons.

7.1.3 Startup procedure (purifier)

1. Open the needle valve to allow the helium gas to flow through the purity meter.
   - **Note:** If purity sensor flow control valve was previously closed, allow the purifier to purge the sensor for 2-3 minutes **before** proceeding to step 2.
2. Power **ON** the helium purification system.
   - Press the green start button on the purification assembly front panel. **See Figure 7-1a.**
   - Helium gas will begin to flow through the purifier.
3. Attach purge adapter (**Figure 7-1c)** to the purifier outlet port (**Figure 7-1b)** for 15-30 seconds.
4. Remove the adapter.
5. The display on the top of the purifier will list numbers when the purifier is on. If this number does not fall **below 20, with a solid green LED light next to it**, within 2 minutes the purifier will shut **OFF**. Refer to **Section 7.5.1** for troubleshooting.

Figure 7-1a: Front Panel of Helium Purification System

Figure 7-1b: Purifier Outlet Port

Figure 7-1c: Purge adapter

6. The system is now ready for operation.
    - The purifier is designed to be run without an operator continuously monitoring the process.
    - An operator is only required to intermittently monitor the purity sensor and liquid nitrogen levels of the helium purifier. These can be monitored from the LHeP touch screen or through the LHeP remote viewing software. Consult LHeP manual for instructions on using LHeP software.
7. The purifier has two alarms. They can be reset by pressing the red **STOP** button.
    - If the red **STOP** light is on continuously and the purifier emits a continuous tone:
        - The helium purity sensor is measuring a small level of contamination in the helium gas coming from the outlet of the LN_2 trap. If this occurs at any time other than starting with a fresh trap, the trap is saturated and can no longer adsorb any contamination.
        - Replace the contaminated LN_2 trap with a regenerated one. Refer to **Section 8.3** for trap regeneration procedures. Replacing and regenerating traps is part of normal system operation, and its frequency depends on contamination levels and system usage.
    - If the red **STOP** light is flashing and the purifier emits an intermittent beep:
        - The purifier inlet pressure has dropped **below 40 PSIG**.
        - The purifier will automatically restart when the inlet pressure rises **above 80 PSIG.**
        - If the purifier is turned off by pressing the red **STOP** button it will not automatically restart and requires a manual restart, by pressing the green **START** button when the pressure is above **70 PSIG**.

7.2 Normal operation

7.2.1 Compressor pressure

On start up:

- The high pressure gauge will start at nearly zero and increase rapidly, to a preset internal compressor pressure, independent of the helium storage cylinder pressure. As the helium storage cylinders are filled, the high pressure gauge may begin to increase when the cylinder pressure exceeds the preset value.
- The medium pressure gauge will start at nearly zero and increase slowly, to around **70 PSIG** (4.8 bar), and can vary, depending on conditions.
- The low pressure gauge will always be around **0 PSIG** (0 bar) because the low pressure side of the compressor is connected to the atmospheric helium storage bag.

7.2.2 Normal Sounds

When operating properly, the only sound should be from the helium recovery compressor package. If the helium recovery compressor package is in standby mode, no sound should be produced from the helium recovery system. The helium recovery compressor package is in standby mode when the green power **ON** pushbutton is illuminated but the recovery bag hasn't reached the full position and the helium recovery compressor package is not running.

7.2.3 Normal Operation of the helium purification system

During normal operation, the helium purification system will consume less than 40 liters of LN_2 per week. The liquid level monitor displays the amount of liquid nitrogen in the dewar. This is for determining when more liquid is required, and when it is at its optimal height. Refer to **Section 5** for the functions of the liquid nitrogen level monitor.

If good practices are used while recovering helium gas, and the user-installed recovery piping is leak tight, contamination levels will remain low in the helium gas. Low levels of contamination will allow continuous use of the LN_2 trap for approximately 20 days (or longer). Initially, a higher level of contamination may be found in the helium gas, and the LN_2 traps will require more frequent regeneration.

A low pressure switch continuously monitors gaseous pressure. When the pressure drops **below 40 PSIG**, the pressure switch will shut **OFF** flow into the purification system. A slow, audible alarm will emit intermittent beeps to alert that pressure is too low for the system to operate efficiently. Once the pressure rises **above 80 PSIG**, the audible alarm will stop and gas flow will resume.

Low pressure gas flows through the purifier outlet only when the green **START** light is on. When the purity is detected below the pre-set value, a solenoid valve will shut **OFF** the flow. This prevents contaminated helium gas, which will contaminate the LHeP's condensing surfaces, from traveling through the purification system. A visual and audible helium purity alarm will alert with a solid, continuous buzzing tone when it is time for the LN_2 trap to be regenerated. When a regenerated LN_2 trap is installed into the purification system, push the green button. The purification system will operate normally again.

There is a sight glass mounted in the middle of the adsorber, displaying **blue** silica beads surrounding a **blue** center dot. If the center dot turns **pink**, then the adsorber needs to be regenerated. Do **not** allow the silica beads to turn **pink** with a **pink** center dot; an indication that the adsorber is fully saturated and contamination is capable of entering and obstructing the purifier. **See Section 7.4.1.**

Refer to **Figure 7-2**, below, for an illustration of helium flow through the purifier.

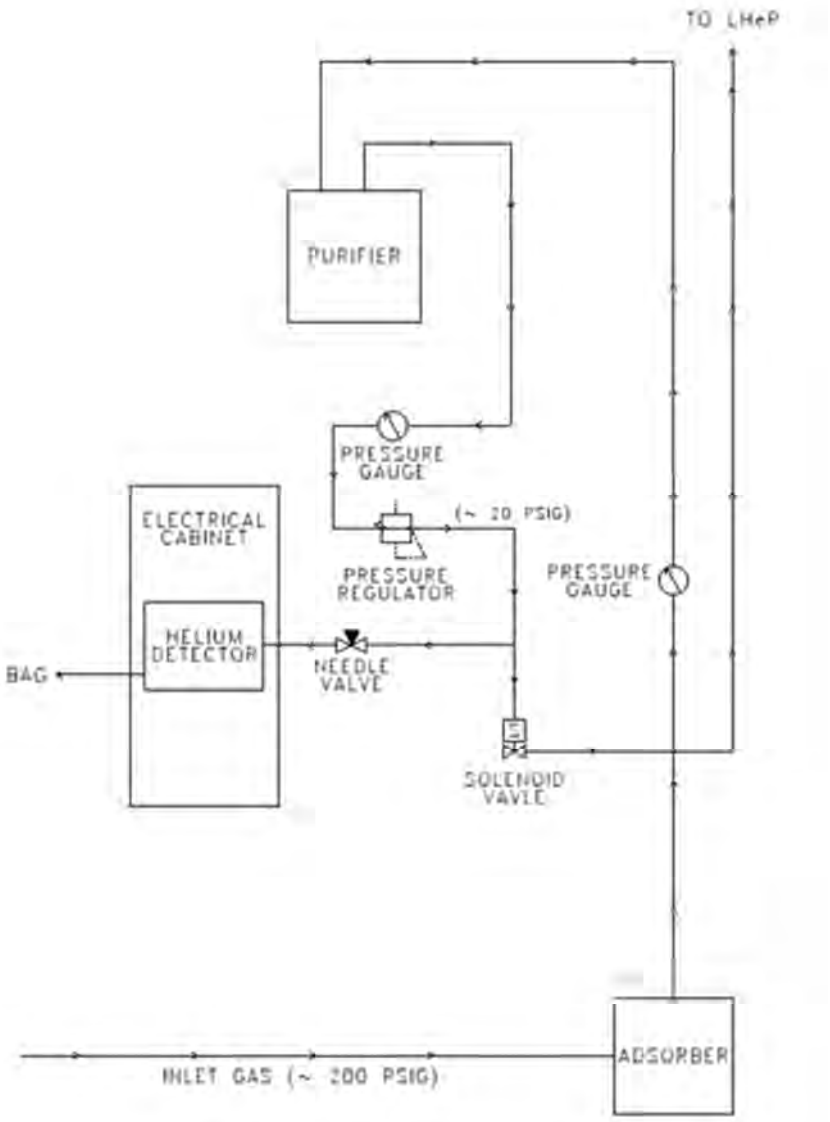


Figure 7-2: Helium purification flow diagram

7.2.4 Liquid nitrogen Dewar pressure

During normal operation, the LN_2 dewar pressure will be approximately **0.5 PSIG** (0.03 bar). The LN_2 dewar has a safety burst disc, set to **15 PSIG** (1.03 bar).

If the dewar pressure gauge shows a pressure greater than **15 PSIG** (1.03 bar), the problem must be diagnosed and corrected immediately. The KF flange on the top of the purifier can carefully be loosened to relieve the pressure.

CAUTION

A dewar pressure greater than **15 PSIG** (1.03 bar) indicates a problem with the safety relief valves. The problem must be diagnosed and corrected immediately to prevent damage and ensure safety.

7.2.5 Helium recovery compressor package

The helium recovery compressor package collects helium vapor from the recovery bag and compresses it for storage at a higher pressure and smaller volume. This is accomplished in two compression stages: an intermediate pressure and a final pressure, in which it is transferred to the storage cylinders.

The compressor package is designed for automatic operation. A laser position sensor system monitors the height of the recovery bag and can start or stop the compressor. When the recovery bag is inflated to the high level, the laser position sensor will automatically start the compressor and begin a pump down cycle. When the recovery bag has been pumped down to the low level, a second laser position sensor will stop the compressor, and put it in a standby mode; ready to start again.

A safety system protects the compressor package from damage due to high pressure, low pressure, compressor overload, and high temperatures.

7.3 Shutdown procedure

7.3.1 Helium recovery compressor package

Press the green button on the front panel of the compressor package so that it is not illuminated. This will turn off the compressor system.

7.3.2 Helium purification system

Press the red **OFF** button on the front panel of the helium purification system. This will shut off the flow solenoid and purity sensor.

7.4 Inspection

The helium recovery system has been designed to give continuous, trouble-free service. There are, however, some periodic inspections that will help detect and prevent system failure. Observe the following list carefully.

INFORMATION

It is helpful to monitor the helium recovery system in order to detect changes in performance early. These changes can signify degradation in performance that could result from the beginning of a problem that requires attention.

7.4.1 External adsorbers

The system has two external adsorbers: on the purifier and on the recovery compressor package. The external adsorbers should be inspected **daily**. Silica beads inside the adsorber give an indication of the amount of moisture inside the adsorber. The adsorber needs to be regenerated **(Section 8.3) before** the surrounding beads turn pink.

The sight glass, mounted in the middle of the adsorber, displays **blue** silica beads surrounding a **blue** center dot when completely dry **(Figure 7-3a)**. If the center dot **turns pink**, then the adsorber needs to be regenerated **(Figure 7-3b)**. Do **not** allow the silica beads to turn **pink** with a **pink** center dot; an indication that the adsorber is fully saturated and moisture is capable of entering and obstructing the purifier **(Figure 7-3c).**

Figure 7-3a: Blue beads signify a dry condition.

Figure 7-3b: Pink dot signifies a saturated adsorber. **Regenerate adsorber.**

Figure 7-3c: Pink dot and pink beads signify an oversaturated adsorber. **Regenerate adsorber.**

7.4.2 Pressures

Recovery system gauges should be monitored daily, because changes in pressure readings can be used for diagnosing problems. It is important to know whether the changes are sudden or gradual and how the changes are, relative to each other.

Cryomech recommends maintaining a regular record of the pressure readings at intervals unique to your specific needs. Please contact Cryomech, Inc. for further advice.

7.4.3 Helium purification assembly

The helium purification assembly has parameters that should be monitored regularly.

The liquid nitrogen level should be monitored **daily**. This is to ensure that the liquid level does not reach an unacceptable low level. Once users become more familiar with their system, this inspection can become less frequent.

CAUTION

If the liquid nitrogen level gets too low, the LN_2 trap will not work efficiently and will have a much shorter life span.

The helium purity meter should be inspected **daily**. It is important to know when the LN_2 trap needs to be regenerated. When the helium purity meter detects an unacceptable level of contamination, a solenoid valve will close. This will cause the flow of helium gas to stop flowing through the purifier. An audible alarm can be heard when it is time to regenerate the LN_2 traps.

7.5 Troubleshooting

7.5.1 Helium purifier will not start

PROBLEM	The steady alarm and red light on the purifier is activated.
POSSIBLE CAUSE	a. LN_2 trap is saturated with contamination b. Purifier LN_2 level is too low c. Needle valve is closed d. Sensor vent line is not connected e. There is too much impurity in the purity sensor f. Impurities in the purifier piping g. Liquid nitrogen trap not sufficiently regenerated.
SOLUTION	a. If the purifier was running with the same trap for at least a few hours before the alarm, it is likely that the LN_2 trap needs to be regenerated. Replace the LN_2 trap as per **Section 8.4.** b. Fill the purifier LN_2 dewar until the level meter displays a level reading. Fill to the full level if enough LN_2 is available. c. Fully open the needle valve on the front of the purifier. d. Connect the sensor vent line ¼" female Aeroquip® to the low pressure manifold. e. Turn off the purifier with the red **STOP** button. Let the helium gas flow through the purity sensor for 15 minutes and try starting the purifier. If the helium purity sensor still reads impure gas, proceed to f. f. Disconnect the quick connect fitting from the purifier outlet. Press the **START** button and attach the Purge Adapter (**see Figure 7-2c** for 15 seconds. Remove the purge Adapter. If the purifier still goes to an alarm after 2 minutes, repeat e. g. Remove the liquid nitrogen trap from the purification system and regenerate it to the vacuum levels and for the duration specified in **Section 8** and charge trap with at least 99.999% helium gas. h. Excess contamination may be present in recovered helium gas, which may indicate improper recovery procedures or a helium leak in recovery piping or recovery system. Leak check the entire system.

7.5.2 Helium recovery compressor will not start

PROBLEM	Helium recovery compressor will not start.
POSSIBLE CAUSE	a. No power supplied to the helium recovery compressor. b. Circuit breaker is **OFF**. c. Recovery bag is not at the high position. d. The high pressure cylinders are full. e. The atmospheric helium storage bag is completely empty. f. No power supplied to the helium recovery compressor.

SOLUTION	a. Check the power supply to the helium recovery compressor and verify that it meets the requirements outlined in **Section 5**. b. Make sure circuit breaker is on. c. If the recovery bag is not inflated to the high position with helium, the level position sensor will not turn on the helium recovery compressor. The user can press the BYPASS button to override the laser position sensors. d. Excess helium can be liquefied by the LHeP. e. If the low laser position sensor is misaligned the compressor may continue to run until the atmospheric storage bag is completely empty. A low pressure switch will protect the compressor from damage. Perform the laser position sensor alignment procedure from **Section 6.6.** f. Verify the ambient temperature is within the specifications in **Section 5.** Verify the cooling fan is running and the airflow is not obstructed.

7.5.3 Helium recovery compressor powers off

PROBLEM	System has prematurely shut itself down.
POSSIBLE CAUSE	a. Lower laser sensor not aligned correctly or too close to bag. b. Circuit breaker tripped. c. Interruption of the power supply to the compressor package. d. Flex line to compressor inlet not completely tightened.
SOLUTION	a. Mount sensor per **Section 6, paragraph 6.5**. b. Reset the circuit breaker on the front panel of the compressor package. **See Section 5**. c. Check the power supply to the system and verify that it meets the requirements outlined in **Section 5**. d. Tighten flex line Aeroquips® completely and ensure that the lower level sensor is aligned correctly per **Section 6, paragraph 6.5.** e. Tighten flex line Aeroquips® completely.

7.5.4 "Err" light on liquid nitrogen level monitor display is illuminated

PROBLEM	The RED "Err" light on the display is illuminated.
POSSIBLE CAUSE	a. Sensor is disconnected. b. The level indicator is reading a liquid level out of range. (<-20% or >120% full)
SOLUTION	a. Make certain the level monitor cable is properly connected to the level monitor and the dewar. b. The dewar could be either overfilled with liquid nitrogen or empty. The level monitor may need to be re-calibrated. **See Section 8**

7.6 Contact Cryomech with Questions

It is hoped that the Operations Section of this manual has helped you to obtain satisfactory results in the use of your Helium Recovery System. While the information offered should facilitate set up and operation, you may have a special situation that requires further considerations. If after reading the Operations Section, you still have questions, contact Cryomech for further information.

7.6.1 Contact Information

Cryomech, Inc.
113 Falso Drive
Syracuse, NY 13211

Phone: (315) 455-2555
Fax: (315) 455-2544

Email: support@cryomech.com

Website: www.cryomech.com

Section 8

Routine Maintenance

Section 8: Routine Maintenance

8.1 Introduction

This section contains basic, essential maintenance information. For more detailed information, please contact Cryomech.

8.2 Maintenance schedule

Maintenance	Frequency	Comment
Adsorber regeneration (Compressor)	As required	See Section 8.3
Adsorber regeneration (purifier)	As required	See Section 8.3
LN_2 trap regeneration	As required	See Section 8.4
LN_2 Dewar fill procedure	As required	See Section 8.5
Drain Water Valve	Weekly	See Section 8.6

8.3 Purifier/compressor adsorber and trap regeneration

Required tools*:

Quantity	Description	Comment
2	3/4” Open end wrench	For Aeroquip® coupling
2	1 3/16” Open end wrench	For Aeroquip® coupling
2	Adjustable wrench	For the cylinder clamp
1	Charging/vacuum manifold	For evacuating LN_2 trap
2	Charging/vacuum lines	For evacuating LN_2 trap
1	Vacuum pump	For evacuating LN_2 trap
1	Heater jacket assembly	For baking the adsorber

** Refer to **Figure 8-1** and **Figure 8-2** for typical vacuum/charging station assembly.*

CAUTION

At no time should the Aeroquip® couplings be removed from the adsorber when regenerating the adsorber. Regeneration can be completed without relieving system pressure since the adsorber is equipped with Aeroquip® couplings for sealed removal.

8.3.1 Vacuum/Charging Station

Construct a vacuum/charging station similar to **Figure 8-1**, by following these guidelines*:

A. The vacuum pump can reach approximately **25 microns**, or better, pressure.
   - Must be a dry pump, for example a dry scroll pump.
   - Due to the significant amount of water in the adsorber, a dry scroll pump is recommended for this application.

B. The **vacuum gauge** can read **25 microns**, or less.

C. The compressed helium cylinder contains **99.999% pure helium**, or greater.

D. A **high pressure regulator** is securely attached to the helium tank, leak tight.

E. The **vacuum manifold** is connected to the pump, leak tight.

F. The **charging flex lines** are connected to the manifold fittings, leak tight.

G. The **helium flex line** is connected to the manifold and regulator, leak tight.

H. The **service Aeroquips®** are functional; inspect gaskets, remove debris, etc.

* ***A.—D****. are user-acquired materials;* ***E.—H****. are provided by Cryomech.*

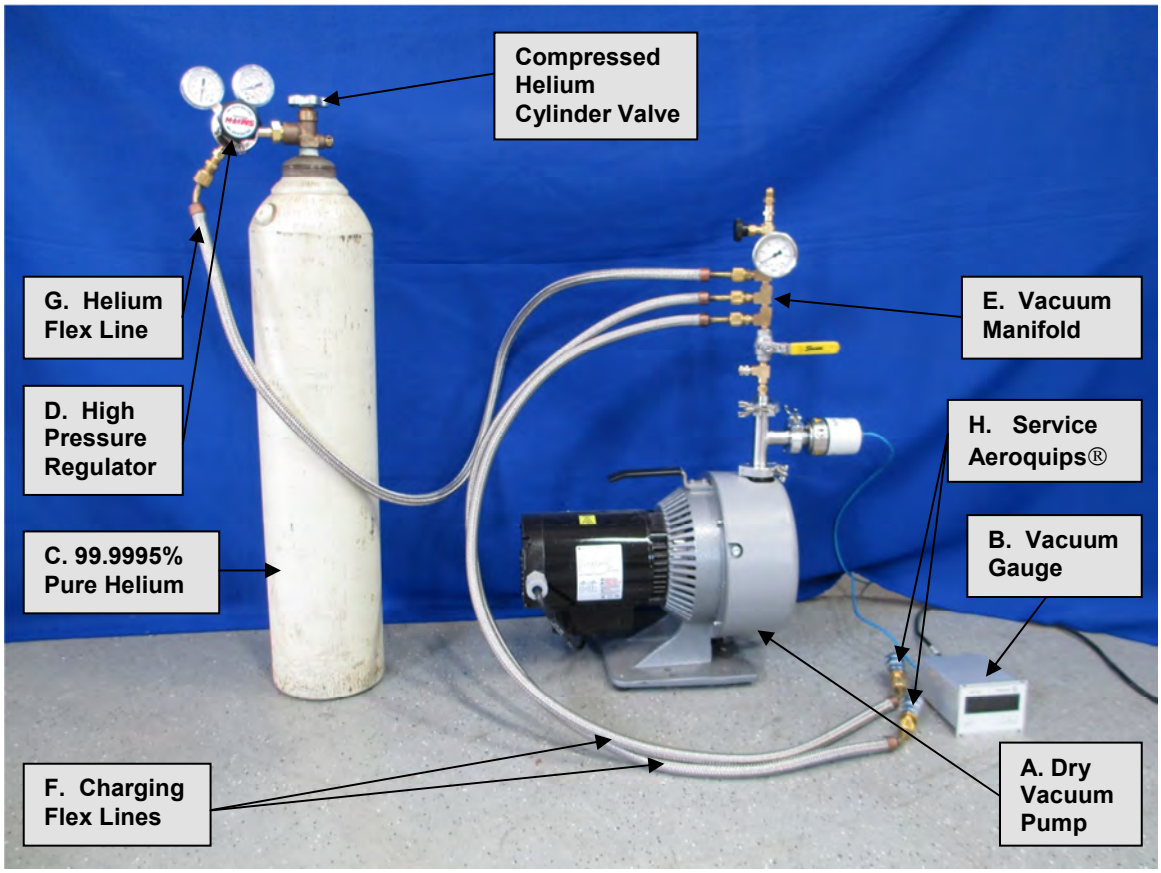


Figure 8-1: Typical Vacuum/charging system

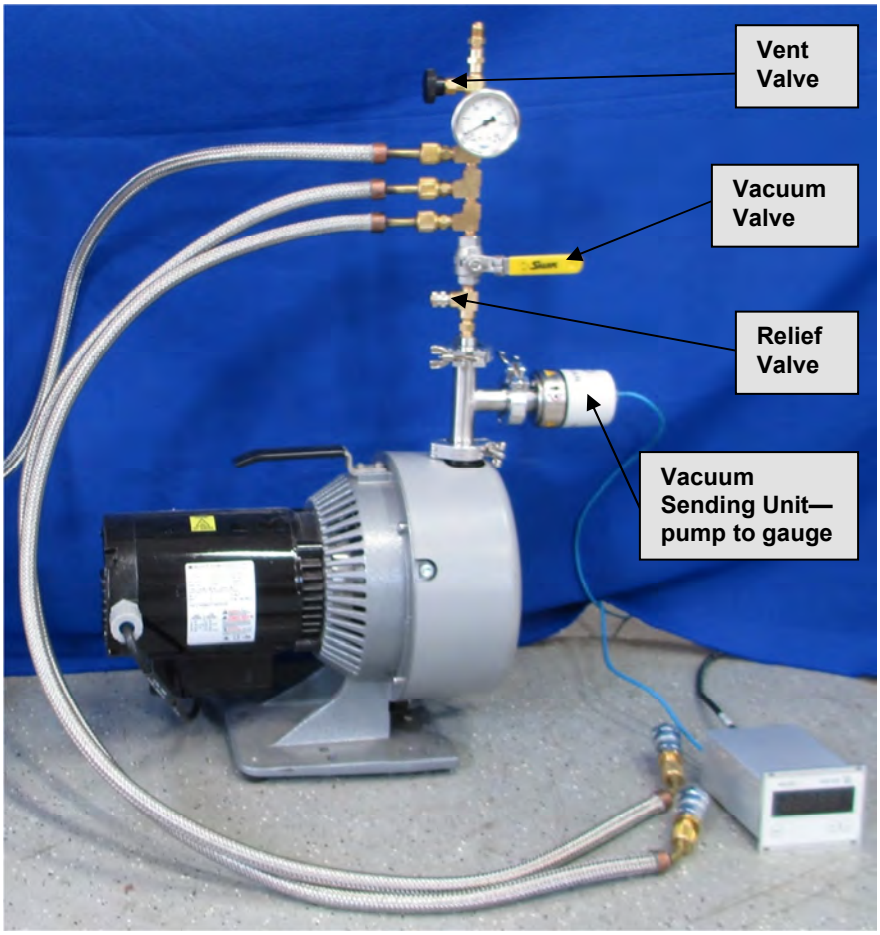


Figure 8-2: Close up of vacuum/charging manifold and dry pump

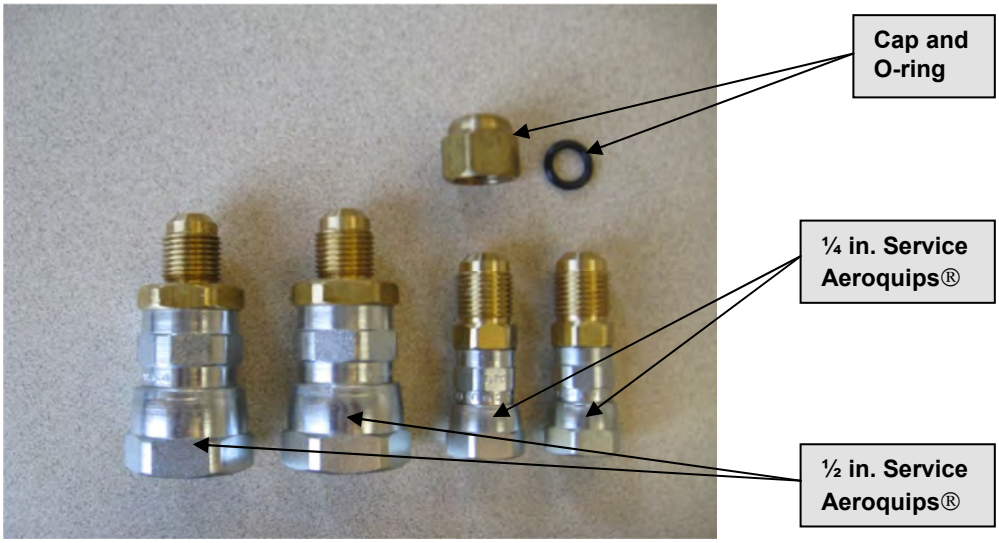


Figure 8-3: Service Aeroquips®

8.3.2 Removing the purifier adsorber

1. Ensure that the dot in the center of the sight glass is pink.
   - If the dot is blue, the adsorber does not need to be regenerated.
   - If the silica gel is blue, but the dot is pink, the adsorber needs to be regenerated.

Figure 8-4a: Blue beads signify a dry condition.

Figure 8-4b: Pink dot signifies a saturated adsorber. **Regenerate adsorber.**

Figure 8-4c: Pink dot and pink beads signify an oversaturated adsorber. **Regenerate adsorber.**

2. Disconnect the **helium flex line** from the purifier inlet. **See Figure 8-5.**

CAUTION

At no time should the Aeroquip® couplings be removed from purifier when adding or removing the ¼ in. helium flex line and adsorber. The purifier connections are equipped with Aeroquip® couplings for sealed removal.

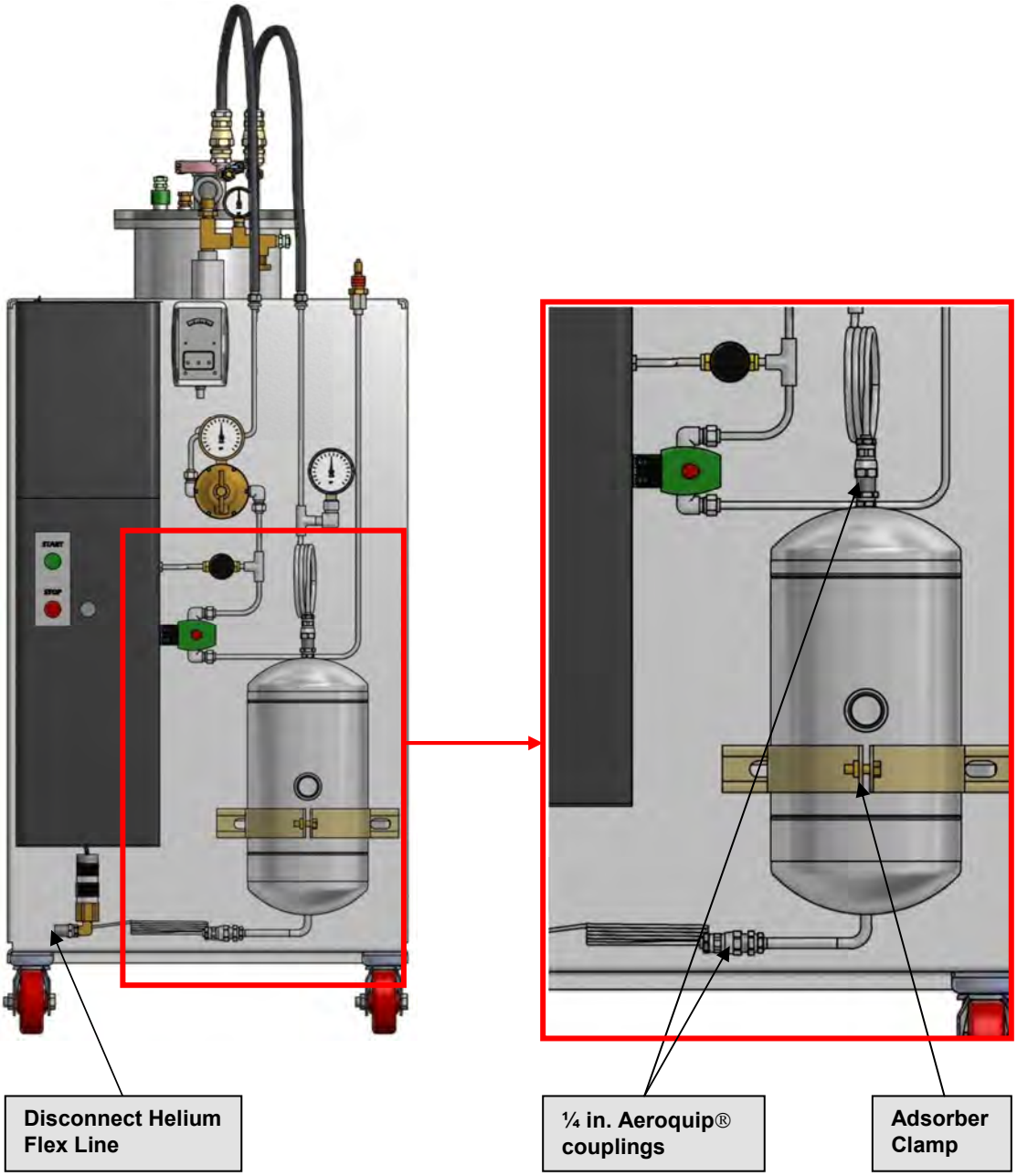


Figure 8-5: Disconnection of the purifier adsorber

3. Disconnect the **¼ in. Aeroquip® couplings** on the adsorber**. See Figure 8-5**.
   - Use two ¾ in wrenches: Hold the male Aeroquip®, turn the female Aeroquip®.
4. Remove the **adsorber clamp** using the adjustable wrenches. **See Figure 8-5.**
   - Hold the adsorber by hand; loosen the nut to remove the clamp.
5. Remove the adsorber.
6. Proceed to **Section 8.3.4.**

8.3.3 Removing the helium recovery compressor adsorber

1. Ensure that the dot in the center of the sight glass is pink.
   - If the dot is blue, the adsorber does not need to be regenerated.
   - If the silica gel is blue, but the dot is pink, the adsorber needs to be regenerated.

Figure 8-6a: Blue beads signify a dry condition.

Figure 8-6b: Pink dot signifies a saturated adsorber. **Regenerate adsorber.**

Figure 8-6c: Pink dot and pink beads signify an oversaturated adsorber. **Regenerate adsorber.**

2. Disconnect the adsorber Aeroquip® couplings using the **1 3/16 in** and **1 1/8 in** open end wrench, at the two locations shown in **Figure 8-7**.

- Use two wrenches: Hold the male Aeroquip®, turn the female Aeroquip®.

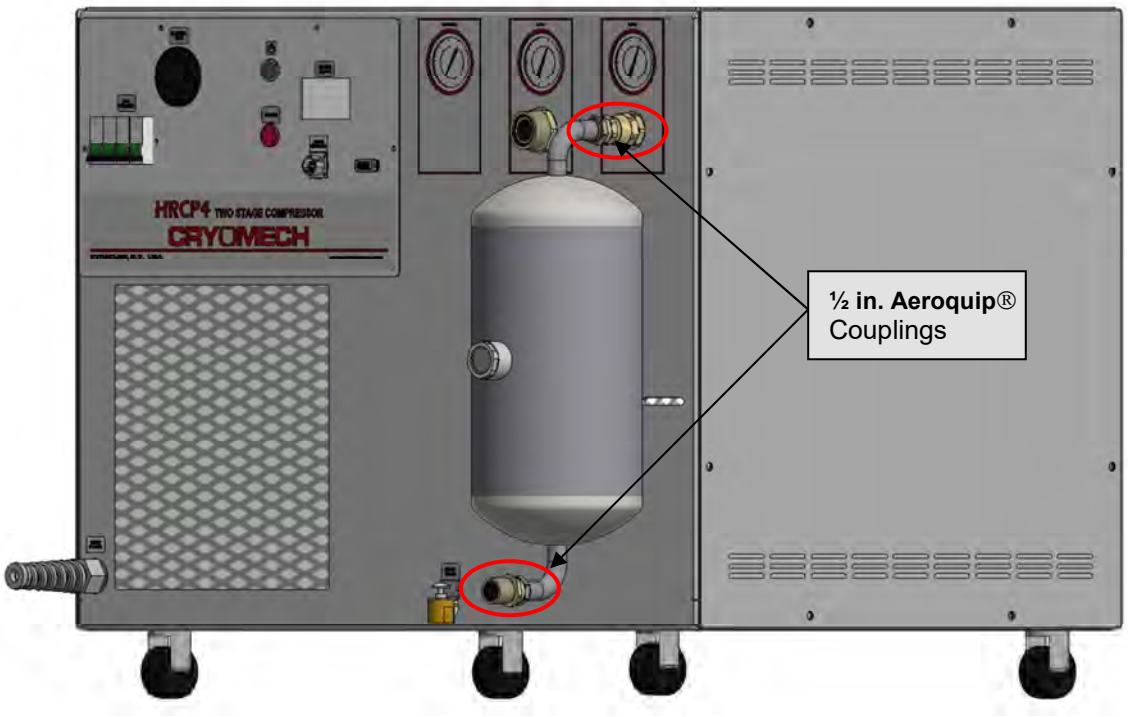


Figure 8-7: Disconnection of the compressor adsorber (Isometric view)

8.3.4 Regenerating purifier or helium recovery compressor adsorber

1. Close the **compressed helium cylinder valve**. **See Figure 8-1.**
2. Close the **vacuum valve** on the vacuum/charging station. **See Figure 8-2.**

3. Connect the proper size service Aeroquips® to the end of the flex lines on the vacuum/charging station.
4. Connect the service Aeroquips® to the adsorber
5. Vent the helium charge to atmosphere with the helium vent valve. **See Figure 8-2.**
6. Close the helium vent valve.
7. Open the vacuum valve. **See Figure 8-2.**
8. Wrap the **heating jacket**, provided with the recovery system, tightly around the adsorber after it has been removed from the purifier assembly front panel.
   - The Aeroquip® connectors on both ends of the adsorber should be outside of the heating jacket. **See Figure 8-8.**

Figure 8-8: Heating jacket, containing adsorber

9. Plug the heating jacket power cord into an electrical socket.
   - The heating jacket will automatically turn on, maintain a temperature of **225°F** (107°C), and begin to bake the adsorber.

CAUTION

The heating jacket temperature is set to **225°F** (107°C). The outside of the jacket will be hot; do not touch without personal protective equipment.

   - Power on the vacuum pump and evacuate the adsorber for **at least 24 hours**,
     - The vacuum pump valve should be open.
     - Allow vacuum to reach its lowest pump value; if it does not reach 25 microns or less, the pump may be bad or there may be a leak.
     - The dot in the center of the sight glass will turn blue. **See Figure 8-6a.**
10. Unplug the heater jacket.
11. Close the vacuum pump valve on the charging manifold.
12. Pressurize the compressor and/or purifier adsorber to **200 PSIG** of **99.999%** or greater purity helium from the cylinder. **See Figure 8-1.**

- Allow the adsorber to cool down to room temperature.

13. Remove the heating jacket from the adsorber and reinstall.

8.4 Purifier LN_2 trap removal and regeneration

Required tools:

Quantity	Description	Comment
1	Vacuum/charging system	For regeneration/charging
2	3/4" Open end wrench	For Aeroquip® coupling
1	1-3/16" Open end wrench	For Aeroquip® coupling
1	1-1/8" Open end wrench	For Aeroquip® coupling
2	1/2" Female service Aeroquip®	For relieving pressure and evacuating LN_2 trap
1	Heater jacket assembly	For baking the LN_2 trap
1	Chain hoist	For removing the LN_2 trap from the dewar

CAUTION

At no time should the Aeroquip® couplings be removed from the LN_2 trap when regenerating the LN_2 trap. Regeneration can be completed without relieving system pressure, since the LN_2 trap is equipped with Aeroquip® couplings for sealed removal.

If moving the purifier is necessary to access a chain hoist capable of lifting 100lbs:

a. Press the red **STOP** button and disconnect the power cord from the purifier.

b. Close **purity sensor flow control** valve.

c. Disconnect helium sensor vent line Aeroquip® from low pressure manifold. **See Figure 6-15 in Section 6** of this manual.

d. Disconnect the purifier helium inlet Aeroquip® line. **See Figure 5-5 (A & L) in Section 5** of this manual.
   - Use two ¾ in. wrenches: Hold the male Aeroquip®, turn the female Aeroquip®.

e. Disconnect the purifier helium outlet quick connect line. **See Figure 5-5 (L) in Section 5** of this manual.

f. Disconnect the power plug from the purifier.

g. The purifier may now be freely moved.

h. Follow these steps, in reverse order, to reconnect the purifier.

1. Disconnect the **INLET** and **OUTLET** lines to the LN_2 trap using the **1-3/16 in.** and **1-1/8 in.** open end wrenches. **See Figure 6-9 in Section 6** of this manual.

   - Use two wrenches: Hold the male Aeroquip® and turn the female Aeroquip®.

2. Connect a ½ in. service Aeroquip® (**Figure 8-3**) to **either** the helium **INLET** or **OUTLET** ½ in. male Aeroquip® connections on the LN_2 trap**. See Figure 6-8 in Section 6** of this manual.

> **CAUTION**
>
> When installing the service Aeroquip® to the helium **INLET** or **OUTLET** ports on the LN_2 trap to relieve pressure, it will become extremely cold; do not touch without personal protective equipment.

   - Relieve **most** of the helium pressure to the atmosphere.
3. Allow the service Aeroquip® to reach room temperature.
4. Remove the service Aeroquip®.
5. Remove the KF40 flange from the fill port of the trap.
6. Remove the thumbscrews on the room temperature flange of the LN_2 trap.
7. Carefully remove the contaminated LN_2 trap from the dewar, using a chain hoist.
8. Place it on the trap stand provided with the helium recovery system.

> **CAUTION**
>
> The LN_2 trap is at liquid nitrogen temperatures. Proper safety, personal protective equipment, should be used during this procedure.

9. Allow the contaminated LN_2 trap to reach room temperature, and the condensation on the surface to dry completely.
10. Vent the remaining helium pressure in the warmed LN_2 trap to the atmosphere.
    - Note: A significant amount of pressure will build as the trap warms up.
11. Close the compressed helium cylinder valve on the vacuum/charging station. **See Figure 8-1.**
12. Close the vacuum valve on the vacuum/charging station. **See Figure 8-2.**
13. Connect the two ½ in. service Aeroquips® to the ends of the charging flex lines. **See Figure 8-1.**
14. Connect the charging flex lines to both the **INLET** and **OUTLET** ports of the LN_2 trap.
15. Open the helium vent valve to vent any residual helium charge to the atmosphere. **See Figure 8-2.**
16. Close the helium vent valve. **See Figure 8-2.**
17. Open the vacuum pump valve. **See Figure 8-2.**
18. Tightly wrap the heating jacket around bottom of the LN_2 trap.
21. Plug in the heating jacket.
    - The heating jacket will automatically turn on, maintain a temperature of **225°F** (107°C), and begin to bake the LN_2 trap.

CAUTION

The heating jacket temperature is set to **225°F** (107°C). The outside of the jacket will be hot; do not touch without personal protective equipment.

22. Power on the vacuum pump and evacuate the LN_2 trap for **at least 24 hours**,
    - The vacuum pump valve should be open.
    - Allow vacuum to reach its lowest pump value (25 microns or less).
23. Close the vacuum pump valve.
24. Unplug the heater jacket.
25. Pressurize the LN_2 trap with **200 PSIG** of **99.999%** or greater purity helium from the attached helium cylinder. **See Figure 8-1.**
26. Allow the LN_2 trap to cool to room temperature.
27. Remove the LN_2 trap from the heating jacket.
28. The LN_2 trap can be stored, ready for use when the other LN_2 trap, currently in use, has become contaminated.

Purifier LN_2 trap replacement

1. Carefully lift the regenerated LN_2 trap, using a chain hoist.
2. Lower the regenerated LN_2 trap into the dewar.

CAUTION

When installing a room temperature LN_2 trap, lower it slowly into the dewar to avoid rapid boil off of liquid nitrogen. Proper safety, personal protective equipment, should be used during this procedure.

3. Connect the flexible helium **INLET** and **OUTLET** lines to the respective LN_2 trap using the 1-3/16" and 1-1/8" open end wrenches. **See Figure 6-9 in Section 6** of this manual.
    - Use two wrenches: Hold the male Aeroquip® and turn the female Aeroquip®.
4. Tighten thumbscrews into the top of the LN_2 trap to fasten to the dewar flange.
5. Replace the KF40 flange.

8.5 Dewar fill-procedure

The dewar must maintain a certain level of liquid nitrogen for the purifier to work properly.

1. The liquid nitrogen must be replenished **before** the liquid level gauge reads approximately empty. **See Figure 8-9.**

Figure 8-9: Liquid nitrogen level gauge

2. Carefully unscrew and loosen the wing-nut on the KF40 clamp.
3. Remove the KF40 blank and centering ring. **See Figure 8-10.**
4. Place the liquid nitrogen extraction line into the KF40 fill port.
5. Fill with liquid nitrogen until the liquid level gauge reads full (1/1). **See Figure 8-9.**
   - The LN_2 level monitor will not register an accurate reading until it is nearly full.
6. Remove the extraction line
7. Replace the centering ring, KF40 blank, and clamp. **See Figure 8-10.**
8. If overfilled, the purifier can still be run. Filling to this level is not recommended because the excess liquid nitrogen above the full line will boil off more rapidly.

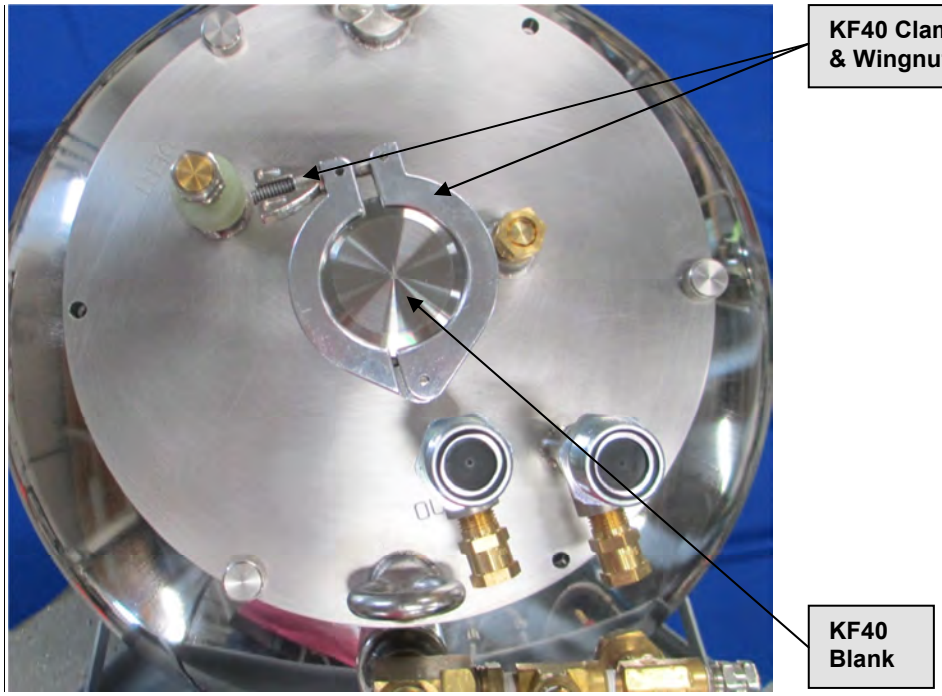


Figure 8-10: dewar fill port

8.6 H_2O Drain Valve

The moisture from the compressed helium circuit is removed by pressing the push-button H_2O drain valve. Hold the push button down until the water flow stops. This should be done on a weekly basis. **See Figure 8-11.**

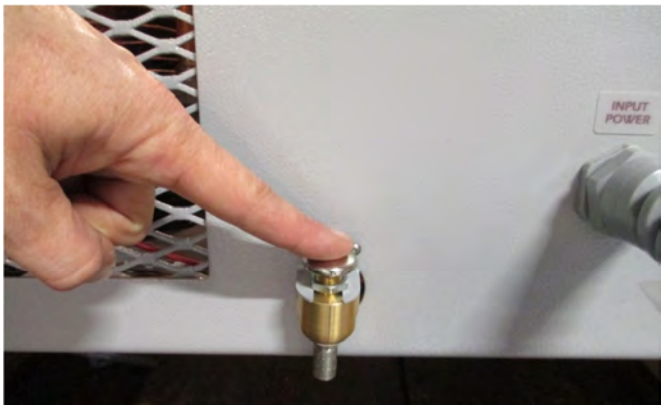
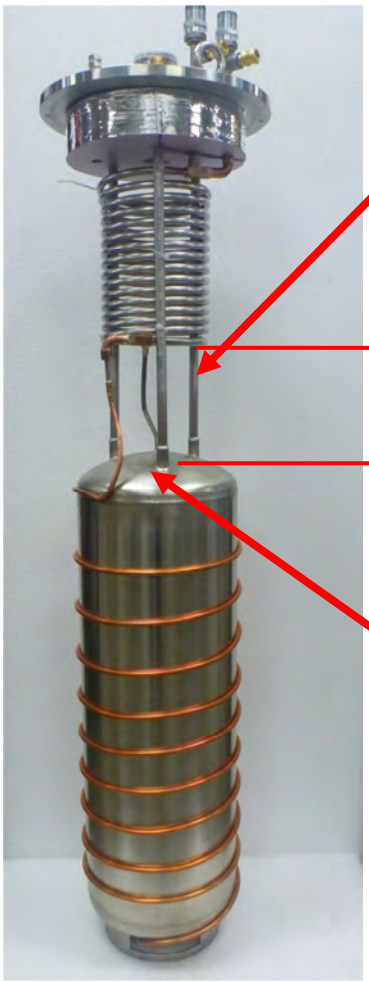


Figure 8-11: H_2O Drain Valve

8.7 Level Gauge Calibration

8.7.1 Recognizing High and Low levels



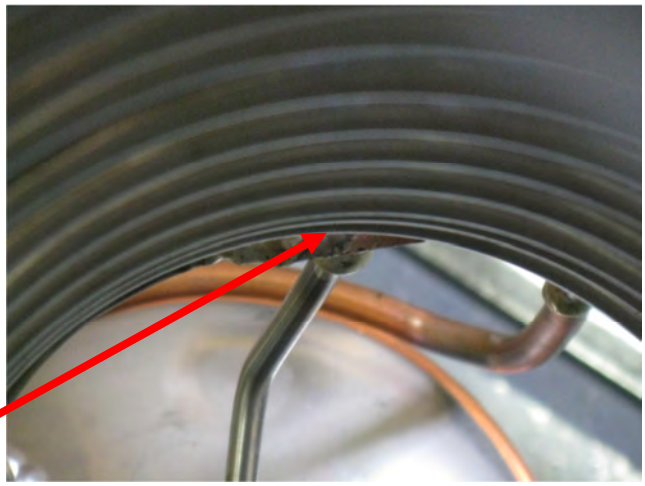


Figure 8-11: High & Low Levels

Magnified view looking down through the fill port

1. View the liquid nitrogen level with a flashlight through the fill port (KF40) on top of the trap flange. The low level calibration requires the liquid to just barely cover the top of the trap (**See Figure 8-11**). If necessary, wait until the level drops by natural boil off. When the low level is correct, perform the low level calibration.

Note: Some purifiers may have a cutout on the panel allowing for easy access to the set point switches. If your purifier has a cutout, skip step 1a and 1b.

8.7.2 Setting the Low level limit:

1. Loosen the liquid nitrogen level gauge from the purifier panel by removing the two nuts, lock washers and flat washers and loosening the knurled screws from the d-sub connector and pulling it away from the panel **(See Figure 8-13)**. Make sure you do not disconnect the d-sub at this point, the sensor connector and power cord should remain connected. Do not remove the long screws from the level gauge.
2. On the back of the gauge there are four access holes for internal switches across the top **(See Figure 8-12)**. When viewed from the back they are numbered 1 – 4 from left to right. Gently pull the gauge slightly away from the panel.
3. Using a small Allen wrench or bent paper clip, press switch #1 for one second. While the switch is pressed, the green level indication LEDs will all flash once to show the low level calibration has been accepted.

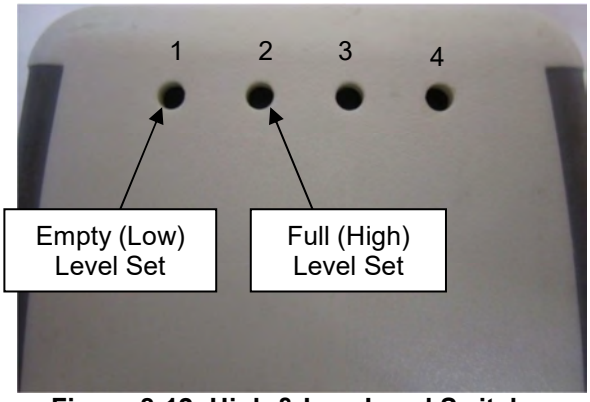


Figure 8-12: High & Low Level Switches

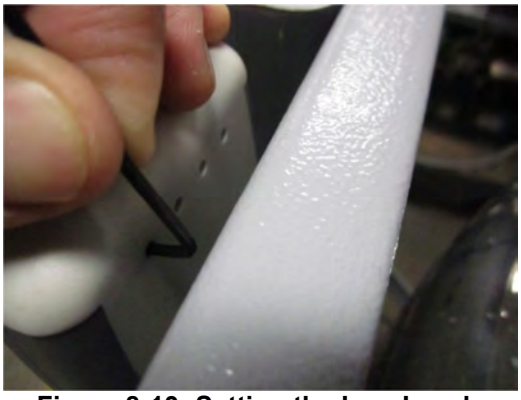


Figure 8-13: Setting the Low Level

8.7.3 Setting the high level limit:

1. Add liquid nitrogen to the dewar through the fill port until the liquid level just touches the bottom of the counterflow heat exchanger. Stop to check the level frequently to avoid over filling the dewar.

2. The lowest point of the counterflow heat exchanger is the tee shown in **Figure 8-11**. The liquid level needs to be up to the underside of the tee. When the high level is correct, perform the high level calibration by pressing switch #2 for one second **(See figure 8-12)**. While the switch is pressed, the green level indication LEDs will all flash once to show the high level calibration has been accepted. The liquid level gauge should now show full and the red “Err” LED should not be lit.

3. If applicable, refasten the level gauge to the front panel of the purifier.

4. The level gauge and probe are now be calibrated.

8.8 The level gauge and probe are now be calibrated.

8.9 Cleaning

8.9.1 Compressor package and helium purification system

The compressor package and helium purification system require no internal cleaning. If necessary, wipe the outside of each if it becomes dusty or dirty.

CAUTION

Never wet any part of the system. *Water getting into the system will void the warranty.*

8.9.2 Aeroquip® couplings

WARNING

Never remove an Aeroquip® coupling from any part of the recovery system without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

If operated in a clean environment, the only parts of the helium recovery system that are likely to require cleaning are the Aeroquip® couplings. The mating surfaces of the Aeroquip® couplings can get particles on them when the helium flex lines are detached.

If an Aeroquip® coupling needs cleaning:

- Wipe the mating surfaces of the coupling with a dry, lint-free cloth.
- After wiping, blow off the coupling with clean, dry compressed air.
- Solvents should never be used.

8.10 Manufacturer-only parts

The following parts are available only from Cryomech:

Helium flex lines

The helium flex lines must be handled with care. If they become damaged and need to be replaced, new ones must be obtained from Cryomech.

Main power cord

If the power cord becomes damaged, a replacement should be obtained from Cryomech.

Atmospheric recovery storage bag level sensor cables

If the level cables become damaged, a replacement should be obtained from Cryomech.

Liquid level monitor cable

If the liquid level monitor cable becomes damaged, a replacement must be obtained from Cryomech.

Appendix B

Spray Lubricant Instructions

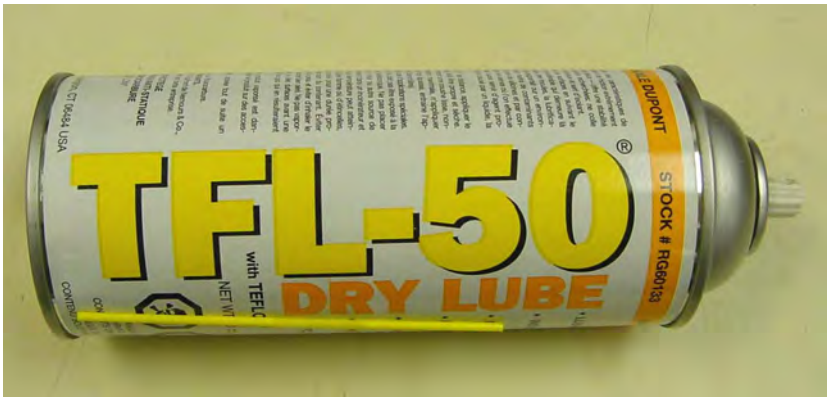
Appendix B: Spray lubricant instructions

CAUTION

Failure to follow these instructions will cause performance degradation and will void the warranty on your system. Cryomech is not able to supply TFL-50® in shipments. Purchasing information is included on the last page of this document.

The purpose of this work instruction is to document the proper use of TFL-50® Dry Lube on Cryomech systems with Aeroquip® connectors.

Related documents and work instructions: TFL-50® MSDS



Connection, Installation

1. Connection, Installation
   1.1. Prepare the mating Aeroquips® for connection
      1.1.1. Clean the female and male Aeroquips using a lint free cloth or Q-tip.
      1.1.2. Make certain the flat gasket is properly seated in the male Aeroquip®.

Figure 1
Cleaning the **female** Aeroquip®

Figure 2
Cleaning the **male** Aeroquip®

1.2. Thread the female Aeroquip® onto the male by hand, until tight.

Figure 3
Female to male connection, hand tightened

CAUTION

Never apply lubricant to the open ends of the Aeroquips®. Doing so will contaminate the system and void the warranty. Apply lubricant to the Aeroquips® only after they are hand tightened together.

2. Before using this product carefully read and follow the instructions on the can. Only a small amount of TFL-50® should be used. A typical amount is shown below. The spray nozzle should only be depressed for 1 second or less. If a white film appears on the surface, too much lubricant has been applied.

Figure 4

2.1. Apply a small amount of TFL-50® to the swivel portion of the female Aeroquip®.

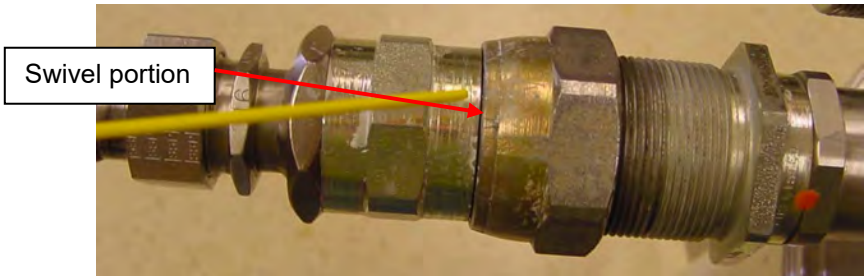


Figure 5

2.2. Apply a small amount of TFL-50® to the threaded portion of the male Aeroquip®.

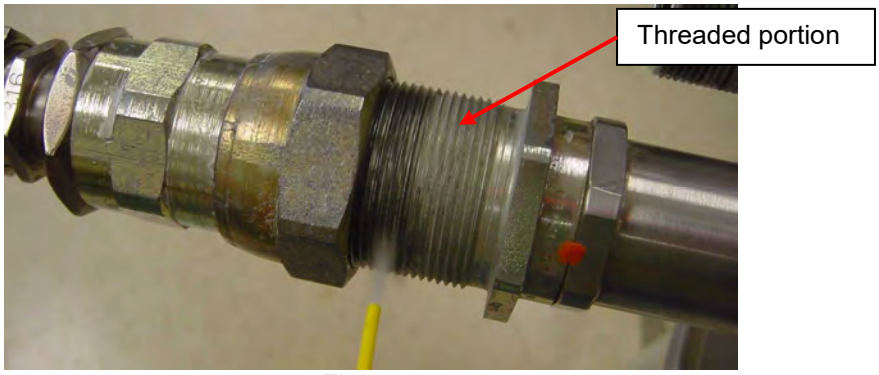


Figure 6

2.3. Use wrenches to tighten the Aeroquips® completely (see manual for instructions).

3. Disassembly

3.1. Apply a small amount of TFL-50® to the swivel portion of the female Aeroquip® as shown in Figure 5.

3.2. Use wrenches to loosen and remove the Aeroquips® (see manual for instructions).

4. Purchasing information

US customers can purchase TFL-50® Dry Lube directly from the manufacturer:

Web: http://tfl50.com/TFL50-USA/index.php?route=product/category&path=59

Phone number: (800) 643-6735

International customers must purchase the TFL-50® Dry Lube directly and arrange shipment:

http://tfl50.com/TFL50-USA/index.php?route=information/information&information_id=8