# Operation Manual

# ICP Cryopumps


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Manual No. 144-000100, REV C

GENESIS
Vacuum Technologies

# Certificate of Conformance

Product Name ICP Cryopump

Model Number ______________________________

Serial Number ______________________________

Manufacturer Country of Origin United States

This Mechanical Pump equipment described above complies with all the quality and test requirements specified by Genesis Vacuum Technologies.

______________________________
Quality Manager - Genesis Vacuum Technologies

# Preface

This manual has been prepared to show design, installation, operation, and maintenance of GVT ICP Cryopumps during their life and subsequent disposal. This manual provides a guide for best performance, as well as, safe and continual operation of the ICP Cryopump. Improper handling or operation of the cryopump could affect performance or cause accidents, which may result in an injury to personnel.

The operator is responsible for knowing the hazards and dangers associated with the installation, operation, maintenance, and disposal of cryopumps. The manual includes information and procedures for transport, use, maintenance, and discarding of the cryopumps in accordance with GVT recommendations and applicable local, national, and environmental requirements.

# To Our Customers

Congratulations in selecting Genesis Vacuum Technologies, Inc., (GVT) for your cryopump needs. GVT cryopumps are designed, manufactured and tested to meet our Quality Management System ISO 9001 certified standards for quality and reliability. Read this manual, follow the safety precautions and operate as directed, and the cryopump should provide safe, reliable, and productive performance suited for semiconductor, research and other high vacuum applications.

GVT encourages you to keep this manual. Contact our **Technical Support** at **1-(888) 488-8721** or any of our Service Centers if you require more information or have any questions about the cryopump.

## GENESIS VACUUM TECHNOLOGIES INCORPORATED

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See end of the manual to locate a service facility nearest you or visit us at *www.genvactech.com*.

# Table of Contents

# 1 Safety

General safety guidelines:

- Always comply with all safety labels and hazard icons.
- Never disable any interlock.
- Never take short cuts.
- Only qualified personnel should operate or perform maintenance on this equipment.

## 1.1 User Obligations to Safety

This equipment includes safety features to protect operators and service personnel from harm and to protect the equipment from damage. Follow all safety procedures and maintain all safety features in proper operating condition. You are responsible for all equipment operations according to the recommended procedures, and responsible to maintain safe operating conditions at all times. Genesis Vacuum Technologies, Inc., (GVT) assumes no liability for personal injury or for damage to equipment resulting from the improper operation or service of the equipment.

## 1.2 Safety Labels

Safety labels and hazard icons appear in this manual. The label and icon purpose is to alert personnel of areas requiring specific attention. The list below includes information about the safety labels and hazard icons used in this manual and on the equipment.

### 1.2.1 Danger Label

⚠**DANGER**
The Danger label indicates immediate lethal hazard or severe bodily injury could result when misusing the unit or failure to observe instructions or precautions.

### 1.2.2 Warning Label

⚠**WARNING**
The Warning label indicates potentially lethal hazards or bodily injury that could result when failing to observe instructions or precautions.

### 1.2.3 Caution Label

**CAUTION**

The Caution label indicates where failure to observe instructions or precautions could result in damage to the equipment or facilities.

### 1.2.4 Safety Instructions

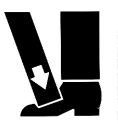
**NOTE**

Notices provide specific instructions about avoiding or preventing a hazardous situation. Notices offer information about safety precautions that an operator may take or special equipment needed to accomplish a task in a reasonably safe method.

## 1.3 Hazard Icons

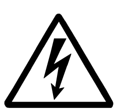
The following hazard icons are examples used throughout this manual.

### 1.3.1 Heavy Object



This icon indicates potential harm from dropping.

### 1.3.2 High Voltage



This icon indicates potential electrical shock.

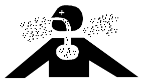
### 1.3.3 Fire Hazard

This icon indicates potential fire hazard.

### 1.3.4 Flammable or Explosive Gases

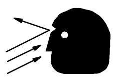
This icon indicates potential harm from explosion.

### 1.3.5 Toxic, Corrosive or Dangerous Gases



This icon indicates potential harm from toxic gases.

### 1.3.6 High Gas Pressure



This icon indicates potential hazard from flying particles, or high-pressure gas.

### 1.3.7 Corrosive Compounds

This icon indicates potential harm from corrosive compounds.

## 1.4 Loading and Unloading

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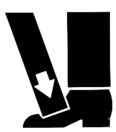
|---|---|
|  Heavy Object | **CAUTION**<br>Wear gloves and safety shoes during transport, loading and unloading the unit. Handle the unit carefully; do not subject the unit to shock or vibration. Never move the unit with cables connected. Set unit on a solid flat surface. |

## 1.5 Electrical Requirements

All electrical connections must be properly grounded in accordance with equipment specifications and in compliance with all applicable codes and ordinances. The equipment must be connected to an electrical supply of the correct voltage. Only fuses and protective devices of the specified ratings and types shall be used.

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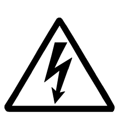
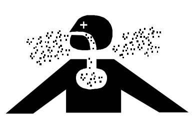
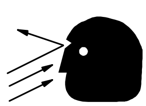
|---|---|
|  Electrical | **DANGER**<br>Hazardous voltage present within this unit can cause severe injury or death. Disconnect the unit from all power sources before making connections between system components or performing troubleshooting and maintenance procedures. Operators and other unauthorized personnel must never open the expander. Only Genesis Service Engineers may conduct internal maintenance of the expander. |

| | |
|---|---|
|  Fire | **WARNING**<br>Application of incorrect supply voltage can create a fire hazard, potential serious shock hazard, and could seriously damage the instrument and any ancillary equipment. Do not connect the instrument to the main power supply until you have verified that the instrument model number represents the proper input voltage for the specific outlet to which the instrument will be connected. |

## 1.6 Dangerous Substances

The ICP Cryopump does not provide protection against toxic, biological or chemical hazardous materials that may be processed in the cryopump. You must provide appropriate safeguards, including protective clothing and emergency exit plans where necessary. You should always consult the cryopump operating instructions before pumping or exhausting any potentially explosive gases or vapors. You are responsible for the proper venting of equipment exhaust systems in compliance with all applicable codes and ordinances.

| | |
|---|---|
|  Dangerous Gases | **WARNING**<br>Upon regeneration the cryopump releases all gases adsorbed by the pumping surfaces. The venting of these gases can be hazardous, toxic, and otherwise injurious to personnel. If the coating, deposition, or implantation process involves the use of toxic, reactive or flammable gases, these gases must be extracted from the cryopump by means of an exhaust system connected to the pressure relief valve on the cryopump. The cryopump must be vented into a self-contained arrangement of collector hood, ducting, and exhaust fan. The cryopump must be vented to the outside, never within the building. |

| | |
|---|---|
|  High-Gas Pressure | **WARNING**<br>Failure of the pressure relief valve can create pressures within the cryopump, which are potentially hazardous to both personnel and equipment. If the pressure relief valve fails to open during the purging of the cryopump, the internal pressure can become high enough to cause damage to system components or personnel. Periodic observation of the pressure relief valve action will ensure proper operation and will avoid potentially hazardous pressures from building up within the cryopump. |

## 1.7 Storage or Disposal

Store the ICP Cryopump under clean dry conditions until required with an acceptable blank off installed on the main flange. When required for use, install the ICP Cryopump as described in section 6 of this manual. Dispose of the ICP Cryopump and any components safely in accordance with all local and national safety and environmental requirements.

## 1.8 General Precautions

The helium used in the refrigerator must always be of high purity (99.995% or better). Failure to use helium of the specified purity will result in contamination of the refrigerator and can cause damage to the cryopump.

The static helium charge pressure in the refrigerator, helium hose/manifold system and compressor must always be within specification (210 ± 5 psi for 2.1 Compressors and 227 ± 5 psi for HC-60 Compressors). Incorrect pressure will result in loss of refrigeration power and/or automatic shutdown.

The cryopump module must never be operated for extended periods of time in high-intensity neutron or gamma-radiation fields, as the radiation will degrade the organic materials inside the refrigerator.

The cryopump module must never be exposed to an environment of high levels of magnetic fields. The electric motor may be demagnetized and fail to operate.

# 2 Scope

This manual includes installation and operation instructions for the Genesis Vacuum Technologies Incorporated Integrated Cryopump (ICP). Please read this manual before you install and operate the ICP Cryopump. Important safety information is highlighted as WARNING and CAUTION instructions. Only qualified personnel with specific training in the safe handling and use of these materials should be allowed to operate and/or perform preventive maintenance on this equipment.

For more in-depth material about the use, function and history of cryopumps, please refer the following books.

Welch, K.M., Capture Pumping Technology, Pergamon Press, 1991.
O'Hanlon, J.F., A User's Guide to Vacuum Technology, John Wiley & Sons, 1989.

## 2.1 Cryopump Description

A cryopump system consists of two main components: the pump module and the compressor module. Each module is connected together by flexible helium hoses that form a closed loop system.

The serial and model number of the cryopump can be found on the neck of the cryopump below the base of the pump body.

Two types of ICP cryopumps are available; The ***Standard*** ICP cryopump features a pump body, refrigerator, relief-valve and a second stage temperature sensor. The ***Quick Regeneration*** ICP cryopump features a *Standard* pump outfitted with dual temperature sensors, integrated heaters, integrated roughing and purge valves, pirani gauge, and a communications interface.

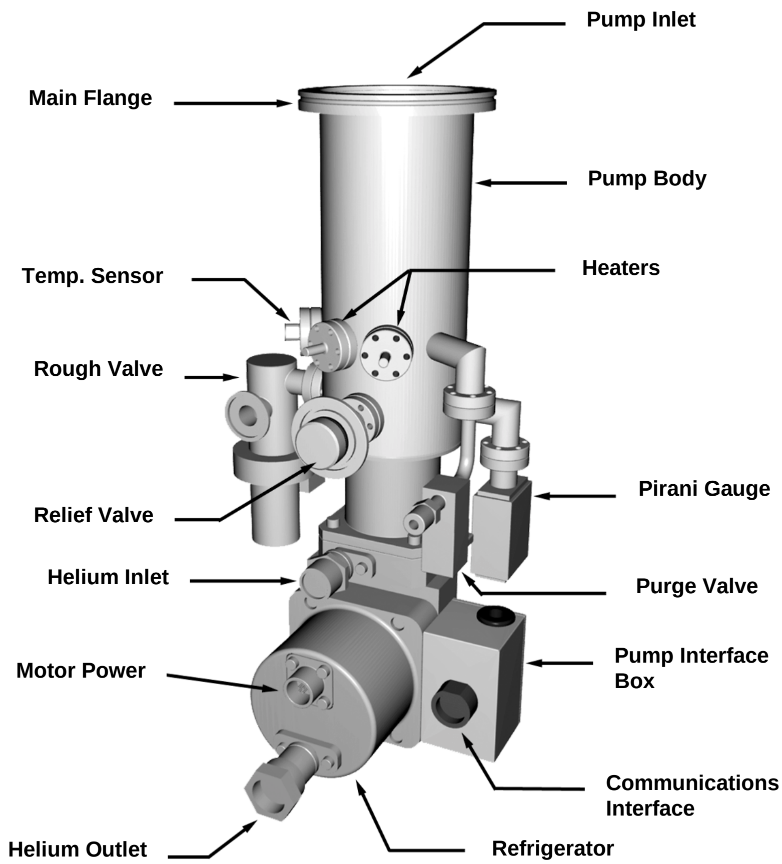


**Figure 1. Typical Cryopump Components**

## 2.2 Cryopump Configurations

The following ICP cryopump configurations are available from Genesis Vacuum Technologies, Inc.:

**Upright** ICP cryopumps consists of a body/flange orientation that is mounted directly in-line with the cryopump centerline.

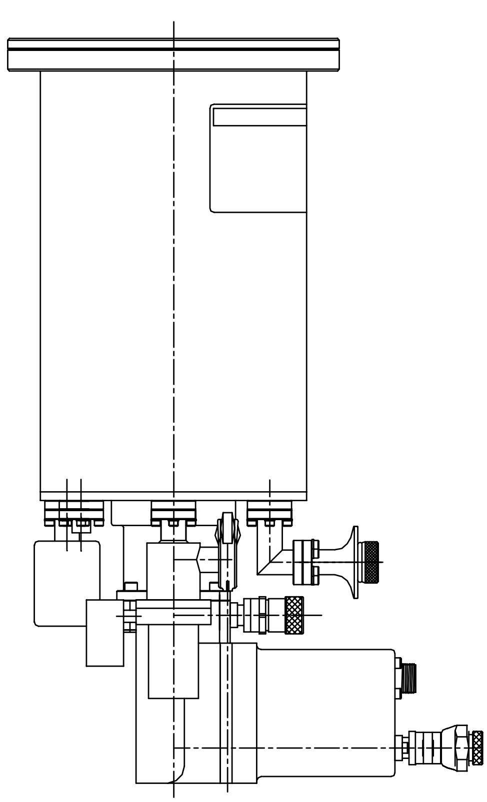


**Figure 2. Typical Upright Cryopump Configuration**

**Low-Profile (LP)** ICP cryopumps consists of a body/flange orientation that is mounted 90 degrees from the centerline of the pump. The refrigerator motor casing has three orientation options, in-line, right and left.

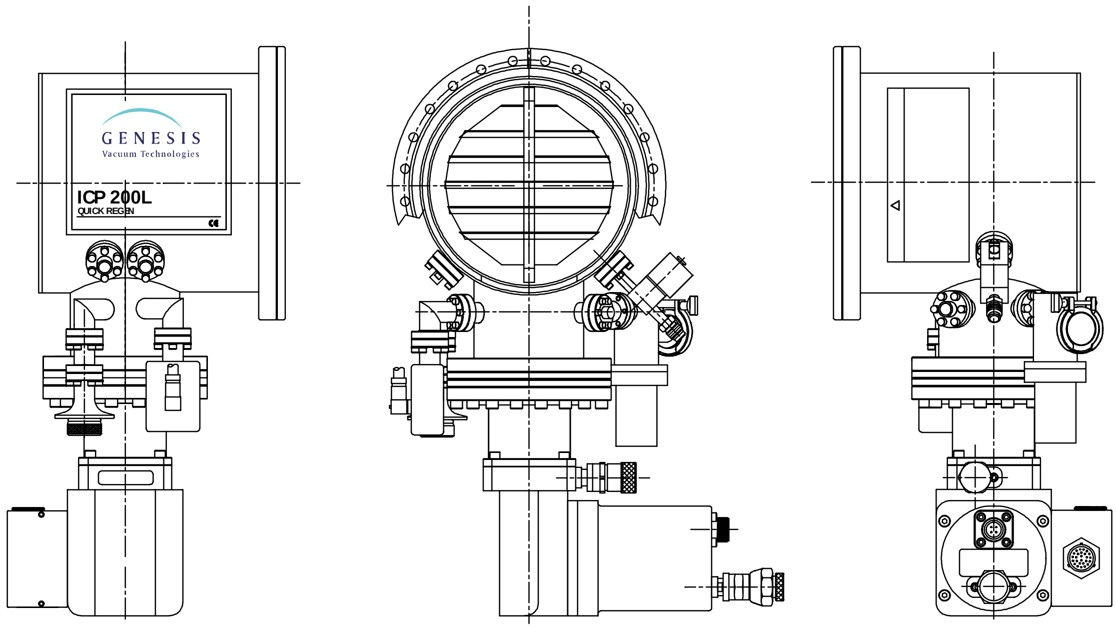



**Figure 3. Typical Low-Profile (Right) Cryopump Configuration**

**High Vacuum (HV)** ICP cryopumps utilize a baffle at the inlet of the pump. HV cryopumps can be configured as an upright or low-profile pump.

**Fixed-Sputter (FS)** ICP cryopumps utilize a throttling plate at the inlet of the pump. FS cryopumps can be configured as an upright or low-profile pump.

**Ultra High Vacuum (UHV)** ICP cryopumps can be configured in any of the above formats with the exception that the main flange must be a metal sealed (CF) flange. UHV pumps meet a minimum of 2 x $10^{-10}$ torr vacuum levels.

## 2.3 Pump Module

The pump module consists of four major components: the refrigerator (expander), the first stage array (includes the baffle or sputtering/orifice plate), the second stage array (charcoal array) and the pump body/main flange.
The expander in the pump module produces refrigeration power to cool the pump arrays to cryogenic temperatures. The first and second stage arrays provide pumping surfaces on which gases from the vacuum chamber are condensed or adsorbed. This type of pump is also known as a capture pump.

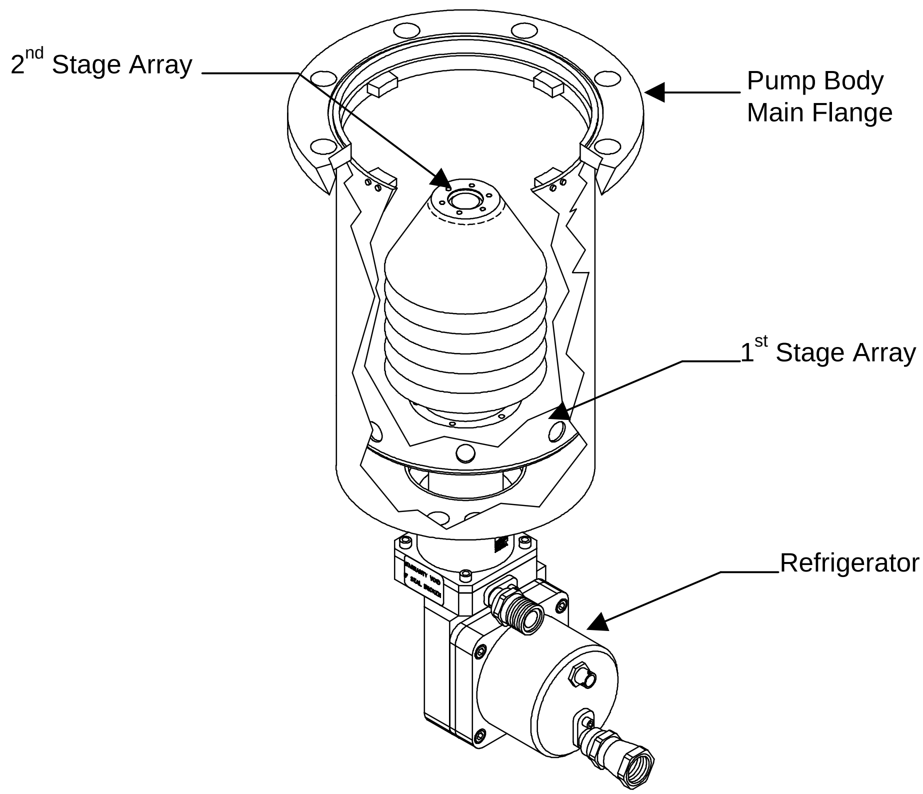



**Figure 4. Typical Pump Module Configuration**

**⚠CAUTION**

**UNDER NO CONDITION SHOULD A CRYOPUMP AT COLD TEMPERATURES BE OPENED TO THE ATMOSPHERE OR DISCONNECTED FROM THE COMPRESSOR. SEVERE DAMAGE TO THE CRYOPUMP WILL RESULT.**

The pump body forms the vacuum tight envelope, which attaches the pump to the vacuum system. The main flange of the pump module is available in standard ANSI, Con-Flat (metal-seal) and ISO flange configurations. It is the end-user's responsibility to provide the necessary hardware to properly install the cryopump onto the system tool.

## 2.4 Refrigerator

The refrigerator operates on the Gifford-McMahon cycle that utilizes high-pressure gas (helium) from the compressor and expands it in two stages to produce cryogenic temperatures at the pump arrays. The actual temperatures produced depend on the thermal and gas loads imposed and the pump configuration that is paired up with a compressor. The normal temperature range for the first stage is 40 to 70 Kelvin and 11 to 20 Kelvin for the second stage. The refrigerator consists of an actuator and a two-stage displacer operated by an electric stepper motor. 99.995% helium is the working gas in the system. The reciprocating motion of the displacer inside the cylinder causes the refrigeration effect thus cooling the first and second stage cold heads.

## 2.5 Cryo-arrays

The cryo-arrays are mechanically attached to the cold head and cooled by the refrigeration power of the expander. The cryo-arrays pump gases in two ways, by cryosorption and by cryocondensation. The first stage pumps most of the easily condensed gas, such as water vapor, and thermally shields the second stage. The second stage pumps all other gases, such as argon, nitrogen, hydrogen, neon and helium.

## 2.6 First Stage Cryo-array

The first stage array consists of an aluminum can with an attached baffle or sputtering plate at the top entrance to the pump. The array is secured to the first stage of the expander by stainless steel screws. Nominally the first stage array operates at a temperature that collects water vapor, but allows gases, such as argon, to pass through the pump opening to the second stage array. If the temperature and pressure were such that argon begins to collect on the first stage, the pump would soon begin to stop pumping and become plugged. This is typically known as argon clamping and is a rare condition with Genesis ICP cryopumps. Raising the temperature of the first stage array to 65 Kelvin eliminates most probable instances of argon clamping. Referring to a vapor pressure chart will be required to determine if a specific temperature and pressure will create an argon-clamping situation within the cryopump.

In some cases it will be necessary to install a deflector above the cryopump inlet inside the tool to protect the cryopump from excessive heat radiation loads.

## 2.7 Second Stage Cryo-array

The second stage array consists of a copper finned assembly. The top surface of the array is a bright surface that pumps gases such as nitrogen, oxygen and argon. The lower surfaces are coated with activated charcoal onto which hydrogen, helium and neon are pumped.

## 2.8 Pump Body

The pump body consists of a stainless-steel vacuum-tight enclosure with a main flange on the top end and a refrigerator on the bottom end. At a minimum the ICP cryopump is equipped with a safety relief valve, a temperature sensor and several mini-CF (1.33 dia.) ports for attaching roughing and purge line accessories. The end-user is responsible for providing fitting attachments to the cryopump.

## 2.9 Pressure Relief Valve

⚠**WARNING**

**NEVER REMOVE OR DISABLE THE CRYOPUMP PRESSURE RELIEF VALVE. SEVERE INJURY TO THE OPERATOR MAY OCCUR.**

All ICP cryopumps are equipped with a pressure relief valve. Gases pumped by the cryopump are captured and held by the cryo arrays. Typically a cryopump can hold up to 30 liters of hydrogen and 1000 liters of argon. When the pump is regenerated, by warming up to room temperature, the stored gases are released from the cryo arrays. Unless properly released, these gases can cause explosively high-pressure within the cryopump. Refer to the Cryopump Maintenance section (appendix B) for further details regarding the maintenance of the valve.

The pressure relief valve is designed to open at a pressure of 2.7 – 3.0 psi. The pressure relief valve contains a standard NW-40 vacuum connection flange for isolating gas removal from the cryopump.

## 2.10 Temperature Sensors

Cryopump temperature sensors are a self contained Family 10 silicon diodes. *Standard* cryopumps have one sensor attached to the second stage array. *Quick Regeneration* pumps have one sensor attached to the second stage array and one attached to the first stage array. The cryopump temperature for all standard pumps can be read from a Family 10 monitoring device. GVT carries both single and multi-channel Family 10 monitoring devices.

## 2.11 Heaters

ICP *Quick Regeneration* pumps feature heaters for quicker warm-up times during pump regeneration. Heaters are also used to maintain the first or second stage temperatures of the pump to a specified set point.

## 2.12 Blanket Heater

A silicon blanket heater is an optional device that can enhance regeneration of *Standard* pumps. Additionally blanket heaters can be used during a bake out process to remove any trapped gases within the cryopump. Typically this is required to reach UHV pressures. See section 12, Cryopump Bakeout.

## 2.13 Purge Valve

ICP *Quick Regeneration* pumps have an integrated purge valve for regeneration of the cryopump. The valve features a ¼” male VCR fitting to which a dry nitrogen line can be attached. The recommended pressure of the nitrogen line is 25 to 60 psi. The minimum recommended flow rate is 2 scfm.

## 2.14 Roughing Valve

*Quick Regeneration* pumps have an integrated roughing valve for regeneration of the cryopump. The valve is pneumatic actuated and requires an airline pressurized to 60 psi. The air-line actuator requires a 1/8” NPT to ¼” (OD) universal brass compression tube fitting for the air line connection. The roughing valve connects to the roughing system through a standard NW-25 connection.

# 3 High Vacuum Pumps

The term *High Vacuum* (HV) refers to any ICP cryopumps fitted with a baffle on the inlet of the cryopump. The HV pump is considered “valve-less” and as a result offers maximum performance. HV pumps are widely used where high water vapor pumping speed and high hydrogen pumping speed is required. HV pumps also have high impulsive crossover capability and can handle high throughputs.

Due to these characteristics HV pumps have become the preferred pumps in most applications, for instance in thin film evaporation and ion implantation.

Cryopumps are also used in device processing applications such as tube processing stations and component out-gassing stations. In the scientific research community cryopumps are used in beam lines, target chambers for particle accelerators and for general high vacuum applications including space simulation chambers.

## 4 Fixed Sputter Pumps

The term *Fixed Sputtering* (FS) refers to any ICP cryopump fitted with a fixed orifice plate on the inlet of the cryopump.

The pumping speed delivered to the chamber is throttled to a specific speed by the orifice plate. As a standard the ICP 200 series of FS pumps have a 200 liter/second sputtering plate. A 400 liter/second plate is optional. The two different sputtering plates are directly interchangeable. If your process requires a different plate from the one that was shipped with your pump a technician can easily remove and replace the plate. Refer to appendix B for parts and accessories.

The orifice plate is attached to and cooled by the first stage array. While the process gas pumping speed is controlled by the orifice plate, the water vapor pumping speed is kept at the maximum value attainable for a given pump size.

The *Quick Regeneration* cryopumps have the added benefit of being able to use the first stage heater to keep the orifice plate at a specified temperature. This reduces the possibility that argon will freeze on the plate and prevent the pump from working correctly.

Sputtering pumps are able to handle high throughput loads while maintaining low and stable temperatures of the first and second stage arrays. By keeping temperatures low and stable, the water vapor, hydrogen and helium pumping speeds will remain high. Sputtering pumps also accumulate large amounts of process gas. Each ICP 200 FS cryopump comes standard with a 30 liter hydrogen array.

The GENESIS ICP Cryopump can be easily changed from a High Vacuum Pump to a Sputtering Pump in the field. See Figure 5.

## 5 Ultra High Vacuum Pumps

The term *Ultra High Vacuum* (UHV) refers to an ICP cryopump fitted with a Con-Flat (metal sealed) main flange. UHV pumps meet a minimum of 2 x $10^{-10}$ torr vacuum levels. UHV pumps can be configured as a fixed sputtering or high vacuum cryopump and are available in *Standar*d and *Quick Regeneration* configurations.

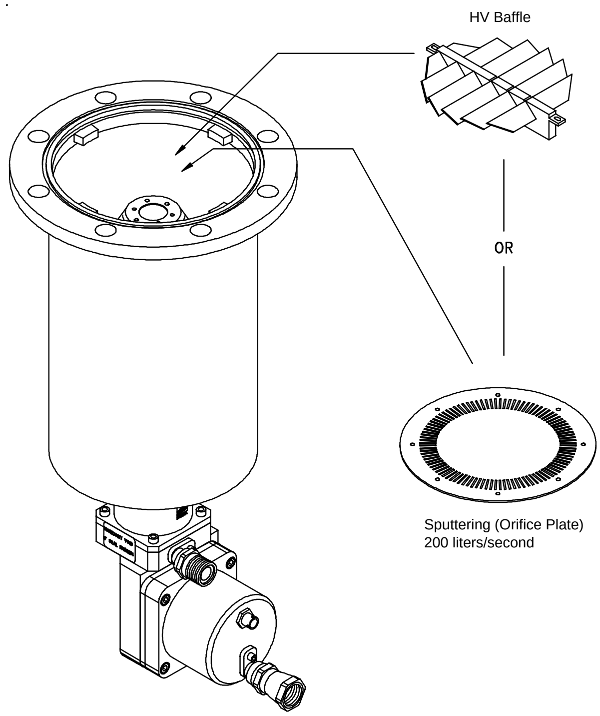



**Figure 5. Changing a High Vacuum pump to a Sputtering Pump.**

# 6 Cryopump Setup

The following section describes the unpacking and setting up of the cryopump for operation.

## 6.1 Unpacking the cryopump

Inspect the shipping box for any damage during transport. If damage exists, take a photograph and report any damage to the shipper at once.

- Check the contents of the shipping box. The box should contain the following items:

  1. Cryopump
  2. Instruction Manual No. 144-000100

- Remove the pump from the shipping box. Carefully remove the plastic wrapping around the pump.

- Inspect the housing flange, pump body and mounted accessories for any damage. Contact Genesis Customer Support if any damage is found.

**⚠ CAUTION**

**DO NOT LIFT PUMP BY ANY OF THE MOUNTED ACCESSORIES AS THESE MAY BE DAMAGED AND CAUSE A VACUUM LEAK WHEN OPERATING THE CRYOPUMP.**

**ALWAYS LIFT THE CRYOPUMP BY THE MAIN BODY AND REFRIGERATOR MOTOR BASE.**

- Keep the main pump opening covered until you are ready to install the pump onto the tool.

- Retain shipping box and other shipping hardware for storage or for return shipment.

- Always use lint-free gloves when handling any internal portions of the cryopump or any gaskets for the main flange. Any oil or dirt from external sources can contaminate the cryopump and cause out-gassing and contamination-related problems.

## 6.2 Pump Installation

⚠**DANGER**

**INSTALLATION OF THE PUMP MUST BE COMPLETE BEFORE ANY ELECTRICAL OR HELIUM CONNECTION TO THE PUMP CAN BE MADE.**

**DO NOT INSTALL AN IONIZATION GAUGE OR ANY OTHER SOURCE OF IGNITION BETWEEN THE CRYOPUMP INLET AND PUMP INLET VALVE. AN EXPLOSION MAY RESULT IF THIS PRECAUTION IS NOT ADHERED TO.**

## 6.3 ANSI Mounting Flange Instructions

- Remove the protective cover and inspect the mounting flange and o-ring groove.
- Clean these surfaces with lint-free paper and propanol alcohol or a suitable solvent.
- Inspect the o-ring for any nicks or cuts. Replace if defective.
- Clean the o-ring with lint-free paper and apply a light coat of vacuum grease (Apiezon L). Wipe off excess with lint-free paper. A properly greased o-ring will have a shiny sheen.
- Insert the o-ring into the o-ring groove uniformly so that it does not bulge or twist at any point.
- Position the pump to align with the mating flange.
- Insert the bolts into holes. Tighten gradually in ¼ to ½ turn increments in an alternating crisscross pattern so that the flanges do not pinch the o-ring or allow it to come out of the o-ring groove. Repeat sequential tightening of the bolts until the flange faces meet and a pronounced resistance to tightening is felt. Refer to the mating flanges manufacturers information for specific torque specifications.
- After installing the cryopump in the vacuum system, close the high vacuum valve and leak check the cryopump to a minimum specification of $2 \times 10^{-8}$ STD. cc/sec helium.
- Proceed to section 7, Connecting Regeneration Hardware.

## 6.4 Metal Sealed Mounting Flange

- Remove the protective cover and inspect the mounting flange and o-ring groove.

- Clean these surfaces with lint-free paper and propanol alcohol or a suitable solvent.

- Inspect the knife edges and copper gasket for any nicks, dings or scratches. Replace gasket if defective. If the knife-edge of the cryopumps main flange is damaged contact Genesis Vacuum Technologies Customer Support.

- Copper gaskets can only be used once. Discard any previously used copper gaskets.

- Position the pump to align with the mating flange.

- Insert the bolts into holes. Tighten gradually in ¼ to ½ turn increments in an alternating crisscross pattern. Repeat sequential tightening of the bolts until the flange faces meet and a pronounced resistance to tightening is felt. Refer to the mating flanges manufacturers information for specific torque specifications.

- After installing the cryopump in the vacuum system, close the high vacuum valve and leak check the cryopump to a minimum specification of $2 \times 10^{-8}$ STD. cc/sec helium.

- Proceed to section 7, Connecting Regeneration Hardware.

## 6.5 ISO Mounting Flange

- Remove the protective cover and inspect the mounting flange and o-ring groove.

- Clean these surfaces with lint-free paper and propanol alcohol or a suitable solvent.

- Clean the centering-ring assembly with lint-free paper and apply a light coat of vacuum grease (Apiezon L) to the o-ring. Wipe off excess with lint-free paper. A properly greased o-ring will have a shiny sheen.

- Position the centering-ring assembly between the mating flanges and align.

- Place claw clamps evenly around flanges and tighten sequentially until the flange faces meet and a pronounced resistance to tightening is felt. Refer to the mating flanges manufacturers information for specific torque specifications.

- After installing the cryopump in the vacuum system, close the high vacuum valve and leak check the cryopump to a minimum specification of $2 \times 10^{-8}$ STD. cc/sec helium.

Proceed to section 7, Connecting Regeneration Hardware.

# 7 Connecting Regeneration Hardware

This section details how the Genesis Vacuum Technologies ICP Cryopump is connected to a system tool. Refer to figure 6 for a diagram showing a typical cryopump setup.

## 7.1 Standard Pumps

All *Standard* Genesis ICP cryopumps are equipped with 1.33 mini-CF ports for roughing and purge port connections. It is the responsibility of the cryopump end user to make these connections. End users can either request technical drawings from Genesis Vacuum Technologies, Inc. or review the pump data sheet included with your cryopump.

## 7.2 Quick Regeneration Pumps

All *Quick Regeneration* ICP cryopumps are equipped with an NW 25 roughing port and a ¼” Male VCR purge port adapter. Refer to figure 6 for locations.

- Connect the vacuum roughing hose with the provided NW-25 center o-ring assembly and NW-25 clamp.
- Remove the protective cap on the purge valve and inspect the VCR port seal surface for any nicks or scratches.
- Connect the purge port hose with a female to male ¼” VCR flexible metal hose. VCR gaskets are not included with the cryopump.
- Refer to the GENESIS G2ICC manual for all electrical connection details. GENESIS Manual No. 144-000200.

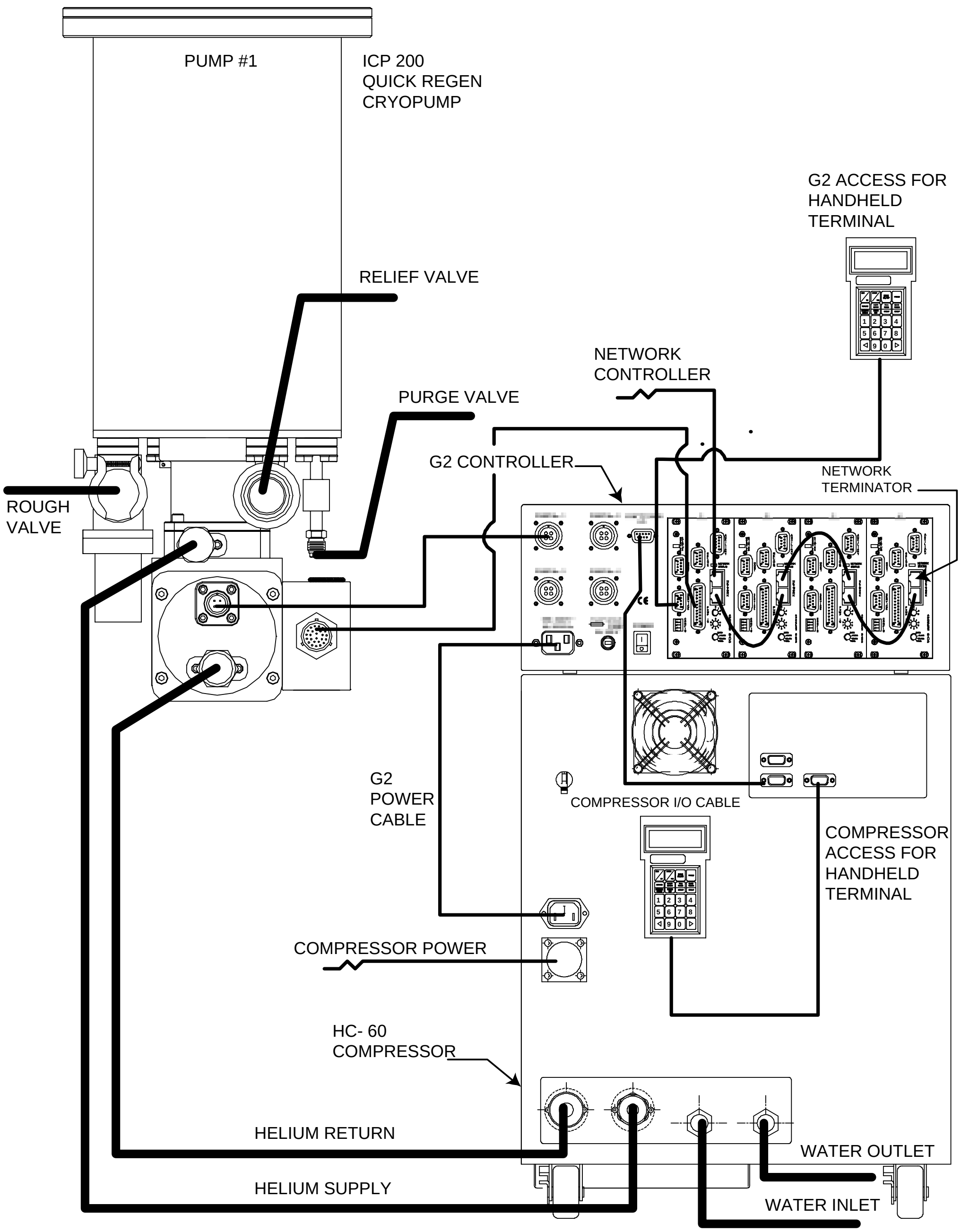



**Figure 6. System Setup Diagram for Quick Regeneration Pumps**

# 8 Connecting Helium Hoses with Self-Sealing Couplings

Genesis Vacuum Technologies utilizes flexible helium hoses that are fitted with a male self-sealing coupling at one end and a female self-sealing coupling at the other end. A wrong connection can not be made when you are connecting an Genesis cryopump to an Genesis compressor.

## 8.1 Connection Procedure

Before beginning to connect the helium hoses, it is important to layout the hoses in accordance with the tool plan. This will ensure that you have all the right hoses in the right places.

- Remove the coupling dust caps and plugs from the pumps, hoses and compressors.

- Inspect and clean the sealing surfaces as required. To clean sealing surfaces, wipe with lint-free paper and then lightly grease the sealing surfaces with a vacuum grease (Krytox 240 AC). Remove excess grease with lint-free paper.

- Make sure that the two mating connectors are properly aligned. Apply a light film of vacuum grease (Krytox 240 AC) on the male coupling threads. It is important NOT to use any other type of grease as this could contaminate the helium in the system.

- Rotate the female coupling onto the male coupling. Do not allow the body of the female coupling, where the backing wrench is placed, to turn. Do not allow the hoses to rotate while making the connection. When making the connection, the coupling nut must be turned to the end of its travel. Once resistance is met, additional torque is not needed for proper sealing.

- If a hissing noise if heard during the tightening, continue turning the female coupling until the seal is complete. Do not stop turning or the system may bleed down in helium pressure.

- If a back wrench is not used, it is possible to loosen the coupling and damage may occur to the o-ring inside the coupling. If this occurs it is recommended to get a replacement hose.

- Save the dust caps from the couplings for later use if and when the pump is disconnected from the compressor.

- Once the system is connected with all the helium hoses, check the static charge pressure from the compressor unit. The static charge is the system pressure while the compressor unit is turned off. The static charge must meet the requirement for the compressor unit. If this pressure is lower or higher you may need to add or bleed the system helium. Always use 99.995% certified helium.

**⚠CAUTION**

**NEVER ALLOW THE COMPRESSOR/CRYOPUMP SYSTEM TO GO BELOW 50 PSI HELIUM PRESSURE. IF THIS SHOULD OCCUR CONTACT GENESIS SERVICE.**

# 9 Operating the Cryopump

This section describes how to operate the GENESIS ICP cryopump successfully. It covers roughing the pump, chilling down, estimating crossover pressure, estimating the length of time between regenerations and regenerating the pump.

Generally these instructions are for *Standard* ICP cryopumps. *Quick Regeneration* ICP cryopumps will automatically perform the roughing and pressure rise tests.

## 9.1 Roughing the Cryopump

**⚠CAUTION**

**NEVER CONTINUOUSLY ROUGH ON A CRYOPUMP THAT IS CHILLING DOWN. BACKSTREAMING FROM THE ROUGHING PUMP TO THE CRYOPUMP WILL RESULT AND MAY DAMAGE THE CRYOPUMP.**

The rough pump creates an insulating vacuum in the cryopump prior to cool-down. For a cryopump to operate correctly the pressure inside the pump must not be too high. Heat will be conducted from the pump walls through the gas to the cryo-arrays. If the cryopump is operated while the outgassing rate is too high, the pressure inside the pump will rise to levels that break the insulating vacuum before the cryo-arrays have cooled to operating temperature. The cryopump must be roughed to a minimum pressure of 100 millitorr before starting. However some processes will require that the pump be roughed to a minimum of 5 millitorr, such as a process that requires hydrogen gas. It is critical to remove most of the water vapor from the pump if hydrogen gas is to be pumped during a process.

On initial installation of the cryopump, moisture may have accumulated during shipping and installation. If this is the case roughing may continue for at least 30 minutes after the cryopump has reached 100 millitorr. Alternatively if the pressure in the pump does not rise above 100 millitorr after roughing, the pump can be started.

If an oil-sealed mechanical pump is used for roughing, precautions must be taken to ensure that oil does not migrate (backstream) from the mechanical pump into the cryopump. If oil backstreams into the cryopump, it will plug the activated charcoal and damage the pumps adsorption ability. Backstreaming can be easily prevented by installing a molecular sieve trap or liquid-nitrogen trap between the mechanical pump and the cryopump. The isolation valve for the cryopump must be between the cryopump and the molecular sieve/roughing pump. These precautions are required for both *Standard* and *Quick Regeneration* cryopumps.

A sieve trap is a canister filled with molecular sieve material, i.e. small porous granules with a very large effective surface area. The material filters out the backstreaming oil vapors. When saturated with oil, it becomes ineffective as a filter. The oil must be removed through regeneration or replacement of the sieve material. Follow the manufacture’s instructions for regenerating the molecular sieve or trap. This must be done or else the trap will become ineffective.

### 9.2 Pressure Rise

An initial pressure rise check (Rate-of-Rise) is recommended for all *Standard* ICP pumps after installation. *Quick Regeneration* ICP pumps will automatically perform a pressure rise check during every regeneration.

After roughing of the cryopump for an initial 30 to 60 minutes. The pressure rise in the pump can be checked by closing the roughing valve and monitoring the pressure. If the pressure does not rise above 100 millitorr within a 15 minute period, further steps are not needed and the cryopump can be started. If the pressure rises above 100 millitorr within 15 minutes, reopen the roughing valve to reduce the pressure below 25 millitorr, then close the roughing valve. If the pressure rises again, there may be a vacuum leak in the system or pump.

## 10 Cryopump Cool Down

Once the cryopump is roughed down and the roughing valve is closed, turn on the cryopump by switching on the main power switch on the compressor module. Refer to the compressor manual for details pertaining to your particular compressor.

If the pump has a main (gate) high-vacuum isolation valve connecting it to the system, close this valve during cool down to prevent gases from the system from condensing on the cooling surfaces of the cryopump.

After approximately 60 to 120 minutes, depending on pump size, the cryopump will have cooled down and the pressure inside the pump should drop below 1 millitorr.

The cryopump temperatures can be read from the remote temperature monitor, G2ICC Controller or host computer. Typically after cool down the second stage reads 12 Kelvin and the first stage reads 40 Kelvin.

## 11 Crossover Pressure

Once the cryopump has cooled to operating temperatures, as indicated on the monitoring system, the cryopump has attained its full pumping speed and is ready to be vented into the system.

Cryopumps have the ability to accommodate very high impulsive throughputs to an order of magnitude above their steady-state throughput capability. This provides shorter roughing times, allowing the mechanical pump to be valved off at high pressure. Valving off the roughing pump when the pressure is still in the viscous flow region also reduces the probability of oil backstreaming into the chamber.

As an example; the maximum impulsive throughput capability of the ICP 200 cryopump is 300 torr-liters. This means the cryopump can take a gas burst of 300 torr-liters and still recover.

$$\text{Maximum Crossover Pressure (Torr)} = \frac{\text{Impulsive Throughput (Torr Liters)}}{\text{Chamber Volume (Liters)}}$$

If there is an impulsive gas load over the cryopumps capability, the cryopump may not be able to recover. As a result the cryo-arrays will warm to a point where the previously condensed gases will be released. The pressure inside the cryopump will rise to a point where the gas in it will conduct heat from the room temperature pump wall to the cryo-arrays. Under these conditions the cryopump will not return to proper operating temperatures until a regeneration cycle is implemented.

## 12 Cryopump Bake out

All *Standard* and *Quick Regeneration* ICP cryopumps are manufactured with UHV compatible materials which have a low outgassing rate. To reach system pressures below 1 x $10^{-9}$ Torr a system and cryopump bake out is required. Baking out the system while the cryopump is in operation will raise the radiation load on the pump, causing second stage temperatures to rise. Bake out temperatures must be regulated in order to keep the second stage temperatures below 35 Kelvin. This is necessary to maintain a light gas load on the cryopump. Bake out should be performed immediately after regeneration.

If ultra high vacuum pressures are required below 1 x $10^{-9}$ Torr, it may be necessary to bake out the cryopump body. This can be done with a heating tape or heater band wrapped around the pump body while the cryopump is being roughed down. It may require up to 8 hours of baking to sufficiently remove all trapped gases from the pump body wall. The first and second stage should be kept below 325 Kelvin during this bake out procedure.

An adequately baked cryopump will not rise in pressure by more than 5 millitorr during a rate of rise test. If this is not achieved continue baking the cryopump.

## 13 Regeneration

Cryopumps are capture pumps which store all pumped gases, unlike diffusion or turbo molecular pumps which exhaust the gases through a roughing pump. Therefore cryopumps have a gas capacity limit. Once this limit is reached the cryopump requires regeneration.

Regeneration is the process whereby captured gases are expelled from the cryopumps first and second stage arrays. Regeneration must be done typically when a process performance requirement is not achieved. Such as base pressure or pumping speed.

Most end users perform regeneration at scheduled intervals rather than waiting for a pressure rise to occur. A suitable time interval between regenerations is usually determined on the basis of user experience. See section 13.3, When to Regenerate.

### 13.1 Full Regeneration

Full regeneration removes all gases from the first and second stage arrays. During this three step process the pump is regenerated by; (1) Warm-up and purge, (2) Roughing and Rate of Rise test and (3) Chill down.

### 13.1.1 Standard ICP Cryopumps

The following steps outline the full regeneration process for the Genesis *Standard* ICP cryopump.

#### 13.1.1.1 Warm-up and purge

The high vacuum gate valve should first be closed before performing the warm-up and purge. The cryopump is turned off and the purge valve is opened to allow dry nitrogen gas into the cryopump. A gas heater can be used to speed up the warm-up process. The heated gas should never exceed 100 degrees C. Turn off the gas flow after the second stage has reached 300 Kelvin.

Stored gasses within the cryopump will be released through the pressure relief valve. A minimum of 2 scfm nitrogen gas flow is required to ensure that the second stage array will not become contaminated by water vapor that has condensed on the first stage baffle. This is done by directing the gas flow past the second stage towards the first stage baffle. Gas flow should continue until the second stage array reaches room temperature (295 to 300 Kelvin).

For unusual conditions where the end-user has pumped a large amount of water vapor, an extended purge of up to 60 minutes may be required to rough down the pump in a timely manner.

#### 13.1.1.2 Roughing and Rate-of-Rise

After the warm-up is complete, the pump is evacuated with a roughing pump to remove the remaining gases and to prepare the pump for chill-down. For most applications, a 15 to 30 minute roughing period will be adequate to bring the pump down to 50 millitorr. Refer to section 9.1 for details about the roughing process.

At the end of roughing, a rate-of-rise test should be performed to ensure that all gases, usually water vapor, have been removed and that no leaks are present. A good rule of thumb is that the rate-of-rise should be no more than 10 millitorr per minute.

#### 13.1.1.3 Chill Down

Following an acceptable rate-of-rise test, the cryopump can now be chilled down and placed back into operation. Depending upon the type of roughing pump, placement, and pipe diameter and length from the roughing pump to the cryopump, a full regeneration will be completed in 2 to 3 hours from cold to cold temperatures.

### 13.1.2 Quick Regeneration ICP Cryopumps

The following steps outline the full regeneration process for the Genesis *Quick Regeneration* ICP cryopump. The full regeneration process *for Quick Regeneration* pumps is automated through the use of the G2ICC. Regen commands and parameters can be set with a host computer. The following is based on using the handheld service terminal. Refer to the GENESIS G2ICC manual for all additional regeneration information. (Manual No. 144-000200).

#### 13.1.2.1 Start-up

Pressing the "FULL REGEN" button of the service terminal initiates cryopump Full Regeneration. As the module receives the full regeneration signal, the Service Terminal normal page switches to the full regen page showing the readings of sensors, or internal clocks or counters of the events. The operator may abort at any time during the sequence by pressing "FULL REGEN" button again.

#### 13.1.2.2 Regen Start Delay

When the Regen Start Delay event is active, regeneration will not start until the set time for delay has elapsed.

#### 13.1.2.3 Warm-Up

With the Hi-Vacuum valve closed, the cryopump begins to warm-up. The pump motor stops and the cryo-array heaters turn on, effectively disassociating the gases from the arrays and the relief valve opens to exhaust the gases. This feature only works if Hi-Vac Enabled has been selected in the Gen 2 setup.

#### 13.1.2.4 Extended Purge

When this event is active, the pump purge will continue for a predetermined period of time after both arrays have reached the temperature set points. The operator must set the extended purge time prior to warm up completion.

#### 13.1.2.5 Roughing/Rate of Rise

At the end of the purge period or extended purge, the purge valve closes and rough valve opens. The Rate of Rise (ROR) test starts after the base pressure set point has been reached. When the base pressure is reached, the rough valve closes. During the ROR test the pressure is monitored. If the pressure exceeds the set point (10 millitorr/min) then the rough valve re-opens. The ROR test is repeated up to 20 times (factory default) until the cryopump is completely roughed. If after 20 tests (factory default) the pressure still exceeds the set point, then the ROR test failed and the Service Terminal will indicate this. In this case, see the Diagnostics and Troubleshooting section of the Gen 2 controller manual to rectify the fault and press "CLEAR ERROR" when complete.

#### 13.1.2.6 Chill down

The last step of the regeneration sequence includes the cryopump chill down. Chill down starts after a successful ROR test. Under the chill down event, both the compressor and pump start. When the second stage cryo-array reaches a temperature below the factory default setting, regeneration is considered complete.

## 13.2 Quick Regeneration

The operator conducts quick regeneration of the cryopump when it is necessary to remove condensed gases such as nitrogen, hydrogen, helium and argon on the second stage array only. The first stage array is warmed up to 140 Kelvin during the gas purge stage. Quick regeneration does not remove all gases or water vapors from first stage cryoarray. However, the operator should still include the same sequence of events as described under the Full Regeneration mode, the only difference being the time to complete a regeneration cycle will be shorter.

## 13.3 When to Regenerate

To determine the best time to regenerate a cryopumped system, determine the length of time it takes for pump-down times or operating pressure to become unsatisfactory. Develop a regeneration schedule based on 60% of that time. This will help to ensure that a consistent process can be maintained. To make an estimate for the (maximum) time between regeneration cycles for a specific gas such as hydrogen or argon, two factors must be known; the capacity of the pump for that gas and gas flow rate or partial pressure of the gas. Once known divide the capacity by the throughput (partial pressure times pumping speed). The result will be the approximated time it takes to reach capacity.

$$\text{Time to Capacity (hours)} = \frac{\text{Capacity (torr - liters)}}{\text{Partial Pressure (torr)} \times \text{Pumping Speed (liters/sec)} \times 3600\ \text{(sec/hr)}}$$

Capacity and pumping speed are given in the Pump Product Data Sheets, Appendix A or can be obtained at www.genvactech.com.

## Service Facility Addresses

| ADDRESS | TELEPHONE | FAX |
|---|---|---|
| Genesis Vacuum Technologies<br>1101 National Drive, Suite A<br>Sacramento, CA 95834 | (916) 928-6007 | (916) 928-6146 |

# Appendix A

## Cryopump General Specifications

## ICP 100

| Model | | ICP 100 | ICP 100 Q |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 600 | |
| | Hydrogen | 750 | |
| | Argon | 500 | |
| | Water | 1100 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 5.0 | |
| Pumping Capacity (Std. Liters) | Argon | 90 | |
| | Hydrogen | 2 | |
| Crossover | Torr L | 55 | |
| Standard Cooldown time | min | 50 | |
| Standard Regeneration Time | Full Regeneration | 70 | |
| | Quick Regeneration | NA | 35 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 10 | |

## ICP 150

| Model | | ICP 150 | ICP 150 Q |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 660 | |
| | Hydrogen | 1300 | |
| | Argon | 550 | |
| | Water | 2200 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 6.0 | |
| Pumping Capacity (Std. Liters) | Argon | 860 | |
| | Hydrogen | 10 | |
| Crossover | Torr L | 150 | |
| Standard Cooldown time | min | 80 | |
| Standard Regeneration Time | Full Regeneration | 100 | |
| | Quick Regeneration | NA | 45 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 11 | |

## ICP 200 Upright

| Model | | ICP 200 | ICP 200 Q |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 1500 | |
| | Hydrogen | 2200 | |
| | Argon | 1200 | |
| | Water | 4000 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 10.0 | |
| Pumping Capacity (Std. Liters) | Argon | 1100 | |
| | Hydrogen | 30 | |
| Crossover | Torr L | 300 | |
| Standard Cooldown time | min | 85 | |
| Standard Regeneration Time | Full Regeneration | 115 | |
| | Quick Regeneration | NA | 45 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 22 | |

## ICP 200 Low-profile

| Model | | ICP 200L | ICP 200 LQ |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 1500 | |
| | Hydrogen | 2500 | |
| | Argon | 1200 | |
| | Water | 4000 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 10.0 | |
| Pumping Capacity (Std. Liters) | Argon | 1500 | |
| | Hydrogen | 10 | |
| Crossover | Torr L | 300 | |
| Standard Cooldown time | min | 60 | |
| Standard Regeneration Time | Full Regeneration | 90 | |
| | Quick Regeneration | NA | 45 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 21 | |

## ICP 250 Low-profile

| Model | | ICP 250 L | ICP 250 LQ |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 2500 | |
| | Hydrogen | 5200 | |
| | Argon | 2000 | |
| | Water | 6500 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 10.0 | |
| Pumping Capacity (Std. Liters) | Argon | 2000 | |
| | Hydrogen | 30 | |
| Crossover | Torr L | 300 | |
| Standard Cooldown time | min | 120 | |
| Standard Regeneration Time | Full Regeneration | 150 | |
| | Quick Regeneration | NA | 60 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 26 | |

## ICP 300 Upright

| Model | | ICP 300 | ICP 300 Q |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 3000 | |
| | Hydrogen | 4900 | |
| | Argon | 2500 | |
| | Water | 10000 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 10.0 | |
| Pumping Capacity (Std. Liters) | Argon | 2100 | |
| | Hydrogen | 30 | |
| Crossover | Torr L | 300 | |
| Standard Cooldown time | min | 120 | |
| Standard Regeneration Time | Full Regeneration | 160 | |
| | Quick Regeneration | NA | 60 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 34 | |

## ICP 300 Low-profile

| Model | | ICP 300 L | ICP 300 LQ |
|---|---|---|---|
| Pumping Speed (Liter/sec) | Nitrogen | 3000 | |
| | Hydrogen | 4900 | |
| | Argon | 2500 | |
| | Water | 10000 | |
| Reachable Pressure | Torr | $10^{-9}$ | |
| Maximum Flow Rate Argon | Torr L/s | 10.0 | |
| Pumping Capacity (Std. Liters) | Argon | 2100 | |
| | Hydrogen | 30 | |
| Crossover | Torr L | 300 | |
| Standard Cooldown time | min | 120 | |
| Standard Regeneration Time | Full Regeneration | 160 | |
| | Quick Regeneration | NA | 60 |
| Flange Options | | ANSI ASA, ANSI ASA Rotatable, ISO Clamp, ISO Bolted, Conflat, Conflat Rotatable, JIS | |
| Weight | Kg | 33 | |

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# Appendix B

## Cryopump Maintenance

## Cryopump Maintenance

The cryopump unit under normal circumstances will not require maintenance. However there are a few items that must be maintained in-order to ensure consistent and proper operation of the cryopump and vacuum system.

## Pressure Relief Valve

The pressure relief valve will require periodic cleaning of the o-ring seal. This is easily done with a lint free cloth lightly soaked with isopropyl alcohol. The pump needs to be warmed up and at atmospheric pressure to proceed with cleaning of the o-ring. Additionally it is best to only clean the o-ring when the relief valve is dry to the touch.

- Pull back the poppet of the relief valve and insert the lint free cloth that is soaked with isopropyl alcohol. Re-seat the poppet back onto the o-ring with the cloth in between the poppet and the o-ring.

- Turn the poppet and cloth a few times to remove the grime from the o-ring.

- Repeat one or two times to ensure that the o-ring and poppet are clean.

- Vacuum grease is not required for this type of seal. If used, particles may stick to the o-ring and a leak may result.

- A damaged o-ring can easily be replaced by removing the old o-ring over the poppet. Care must be take to ensure that the seal surface is not damaged while removing the o-ring. Never use a metal object to remove the o-ring, only use a plastic object. Clean the sealing surface of the valve and then place the new o-ring on the valve by fitting it over the poppet and seating it on the valve. Refer to the Parts and Accessories section for the o-ring specification.

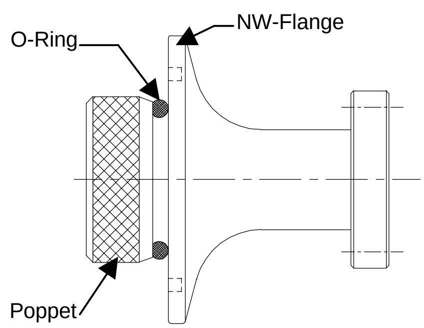

**Figure 7. Cryopump Pressure Relief Valve**

## Parts and Accessories

Before ordering parts and accessories, check with a Genesis Service Center or a Genesis Sales Representative to confirm the correct part number and availability for your specific cryopump.

### Sputtering Plates

Accessories for the Genesis ICP FS Cryopumps:

200 liter/second orifice plate, Genesis part number: 0760-497300
400 liter/second orifice plate, Genesis part number: 0760-413600

### Pressure Relief Valve

Replacement parts for the Genesis Pressure Relief Valve:

Pressure Relief Valve, Genesis part number: 0760-602600.
O-Ring (Parker #2-213), Viton Material. Genesis part number: 140-000400.

### Second Stage Arrays

Replacement parts for the Genesis Second Stage Array:
(Capacity is noted in standard liters of Hydrogen)

**ICP 100:** 2$^{nd}$ Stage Array (2L), Genesis part number: 111-000100.

**ICP 150:** 2$^{nd}$ Stage Array (6L), Genesis part number: 0760-606000.

**ICP 200L Low-Profile:** 2$^{nd}$ Stage Array (10L), Genesis part number: 111-001600.

**ICP 200 Upright:** 2$^{nd}$ Stage Array, Genesis part number: (30L) 111-000300.

**ICP 250L Low-Profile:** 2$^{nd}$ Stage Array, Genesis part number: (30L) 0760-575700

**ICP 300 Upright:** 2$^{nd}$ Stage Array, Genesis part number: (30L) 111-000300.

**ICP 300L Low-Profile:** 2$^{nd}$ Stage Array, Genesis part number: (30L) 0760-575700

## Pump and Purge Procedure

### 1 Scope

This procedure provides the instructions to pump and purge a cryopump, helium hoses, and compressor.

### 2 Reference Documents

0760-2123 Manifold, Expander-Helium Gas

### 3 Tools and Equipment

| | |
|---|---|
| 0917-000200 | Pump and Purge Manifold Kit |
| 0760-282200 | Compressor Tool Kit |

### 4 Disposable Equipment

Helium, High Purity, 99.995%

### 5 Manifold Pump and Purge

**WARNING**

**Operator shall wear safety glasses to prevent serious injury in case of malfunction during testing**

**WARNING**

**Manifolds should be inspected for oil or any other contamination prior to use. Do not use manifolds that are contaminated.**

**Note: If the Vent and Charge Adapter Manifolds (P/N 0917-0002) are already charged from previous use and there is no uncertainty regarding the purity of helium within the manifolds, skip following steps and go to Section 6.**

**Note: Helium must be no less than 99.995% (Grade 5) pure with a dew point not less that -80° F.**

5.1. Connect the Vent Manifold (adapter with male aeroquip) to the Charge Manifold (adapter with female aeroquip) as shown in Figure 8. Verify that both manifold valves are closed.

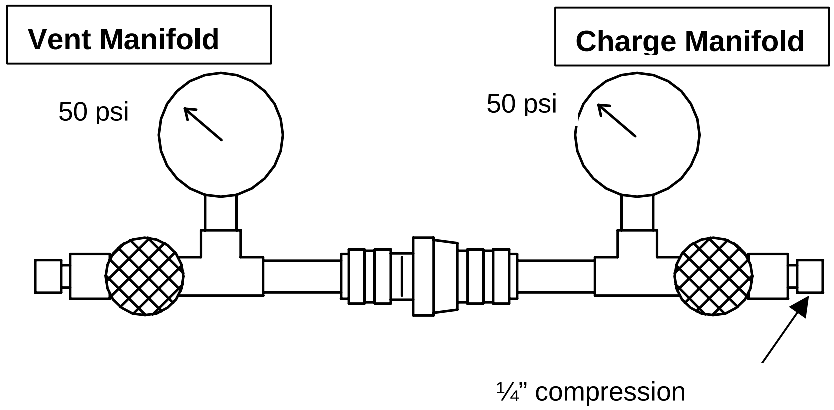


**Figure 8: Vent and Charge Manifolds**

5.2. Connect hose with a ¼" female compression fitting to a Grade 5 helium source. Adjust helium source pressure regulator to 100 psig.

5.3. Connect helium source hose to the Charge Manifold ¼" compression fitting per Figure 9. DO NOT OPEN VALVE ON CHARGE MANIFOLD AT THIS TIME.

5.4. Open the valve on the helium source and loosen the compression fitting on the helium hose. Allow helium to flow out of the hose fitting for a minimum of 1 minute while maintaining a 100 psig regulated pressure. This step will ensure that the helium source hose is purged of air prior to the pump and purge operation.

5.5. Reduce (but do not shut off) the helium flow and tighten the helium source hose compression fitting. Once the connection is tight, close the valve on the helium source to shut off flow.

5.6. Open the valve on the Charge Manifold and then open the valve on the helium source. When the helium pressure in both manifolds reaches 100 psig close the Charge Manifold valve.

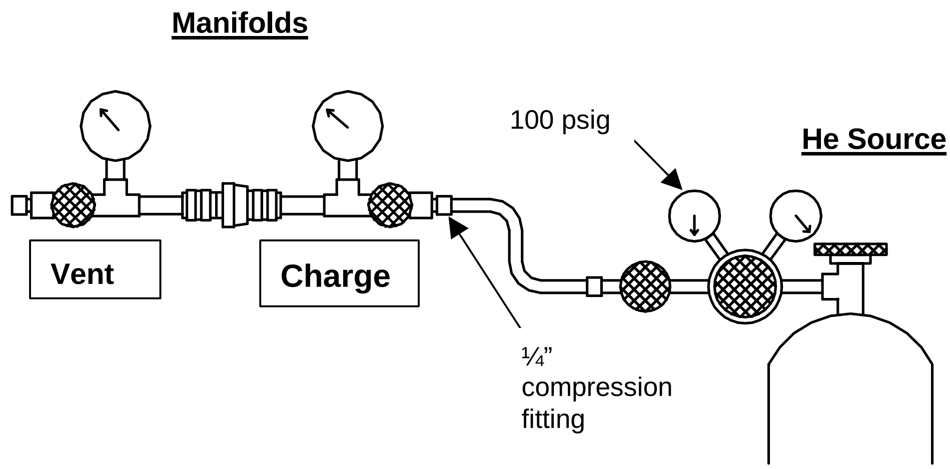


**Figure 9: Manifold Purge**

5.7. Slowly open the Vent Manifold valve and allow the manifold pressure to bleed down to 50 psig. Close the Vent Manifold valve and allow the manifold pressure to return to 100 psig.

5.8. Repeat 5.7 a total of 10 times. This process will purge both manifolds of any contaminating gases.

5.9. After the final purge cycle, close the Charge Manifold valve once the manifold pressure has returned to 100 psig. Disconnect Vent Manifold from the Charge Manifold.

**Note: Do not disconnect Charge Manifold from the helium source hose if proceeding to Section 6. Once the helium source hose is disconnected, the hose must be purged per 5.4 before reconnecting to either manifold.**

## 6 Cryopump and Hose Set Pump and Purge

**Note: High-pressure exhaust gas must be vented and directed away from personnel.**

6.1. Determine the configuration of the cryopumps, hose sets, and compressor and proceed as follows:

a. <u>One pump per compressor configuration</u>: Proceed to 6.2.
b. <u>Two-pump per compressor configuration</u>: For the first cryopump, disconnect the helium supply and return hoses at the manifold (Point

1A or 1B) as shown in Figure 10. For the second cryopump, disconnect the supply and return hoses at the compressor (Point 2) as shown in Figure 10. Proceed with 6.2-6.13 for each cryopump.

c. <u>Three-pump per compressor configuration</u>: Disconnect the helium supply and return hoses on the first cryopump at Point 1A, the second cryopump at Point 1B, and the third cryopump at Point 2 as shown in Figure 10. Proceed with 6.2-6.13 for each cryopump.

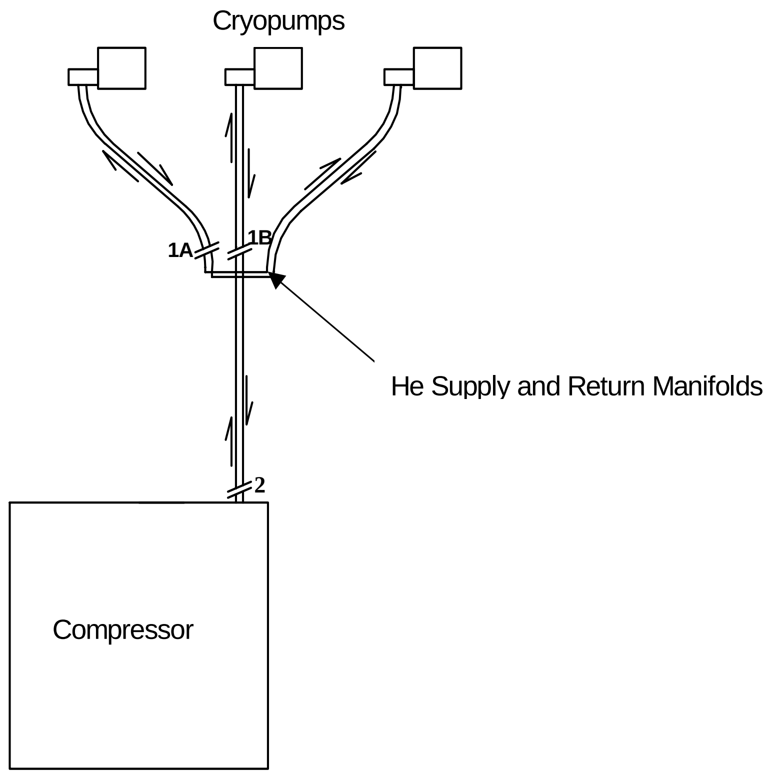


**Figure 10: Pump and Purge Locations for Two- and Three-Cryopump Configurations.**

6.2. Connect the Vent Manifold (adapter with male aeroquip) to the Helium Return Hose (A) as shown in Figure 11.

6.3. Connect the Charge Manifold (adapter with female aeroquip) to the Helium Supply Hose (B) as shown in Figure 11. (Note that the Charge Manifold should already be connected to a helium source per Section 5). Verify that the helium source is regulated to 250 psig.

6.4. Verify that the Cryopump expander power cable is connected to the cryopump where shown in Figure 11.

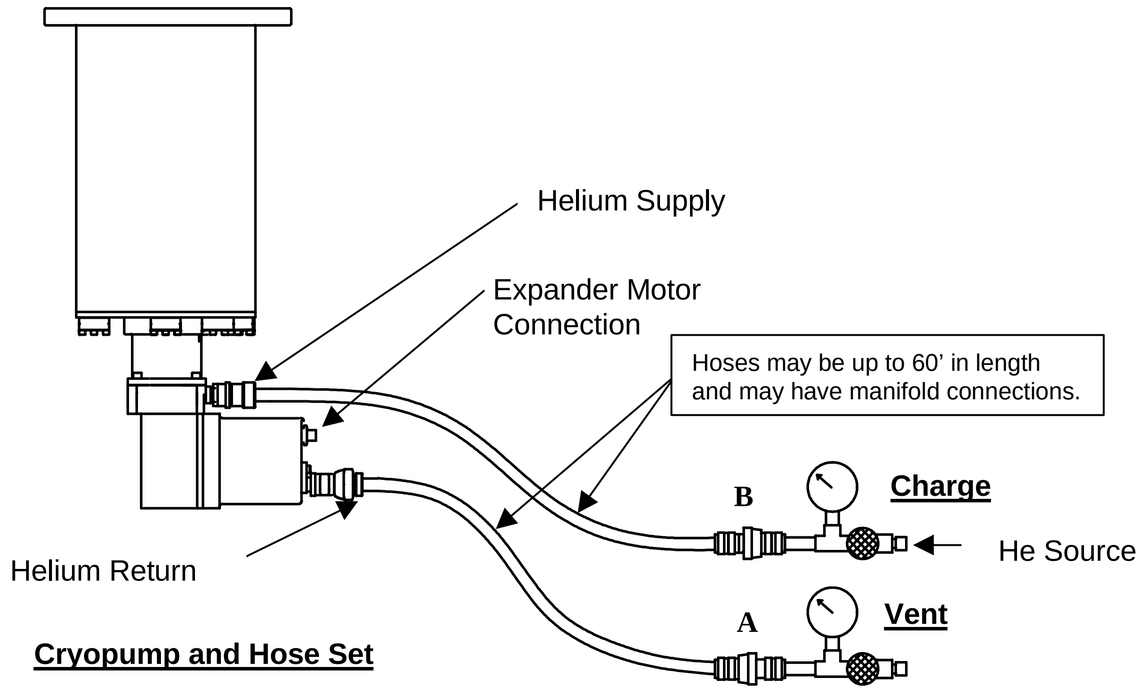


**Figure 11: Cryopump and Hose Pump and Purge**

6.5. Open the Charge Manifold valve approximately three full turns.

6.6. Open the Vent Manifold valve approximately one full turn. Do not allow the pressure to drop below 50 psi.

6.7. Immediately turn on the cryopump expander motor. *Note: The expander motor can be turned on via the Gen II Controller, the $C^3$ Controller, or directly from the compressor (when in manual mode) depending upon the configuration of the system. See the appropriate operators manual to determine how to complete this step.*

6.8. Allow the Helium gas to flow for 30 seconds, then close the vent valve.

6.9. Monitor the Vent Manifold gauge. When the gauge stabilizes at a helium source pressure of 250 psig., close the Charge Manifold valve.

6.10. Slowly open the Vent Manifold valve to vent the gas charge. Close the valve when the Vent Manifold pressure gauge reaches 50 psig.

6.11. Re-open the Charge Manifold valve and repeat 6.9 to 6.10 for a total of twenty-five cycles.

6.12. Finish by charging the expander to 250 psig.

6.13. Turn off the expander motor.

6.14. With both manifold valves closed and the system recharged, remove the Vent Manifold from the Helium Return Hose.

**Note: Do not disconnect the Charge Manifold from the helium source hose if proceeding to Section 7. Once the helium source hose is disconnected, the hose must be purged per 5.4 of Section 5 before reconnecting to either manifold.**

6.15. Remove the Charge Manifold from the Helium Supply Hose.

## 7 Compressor Pump and Purge

**Note: High pressure exhaust gas must be vented and directed away from personnel.**

7.1. Connect the Vent Manifold (adapter with male aeroquip) to the Helium Supply Port (A) on the compressor as shown in Figure 12.

7.2. With the Charge Manifold closed and connected to the helium source (per Section 5), increase the helium line pressure to 250 psig.

7.3. Connect the Charge Manifold to the Helium Return Port (B) as shown in Figure 12.

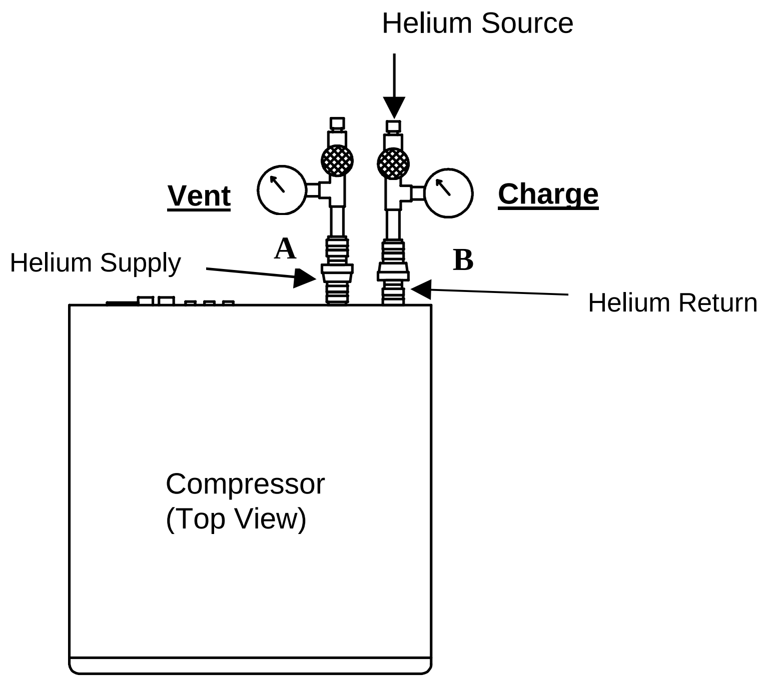


**Figure 12: Compressor Pump and Purge**

7.4. Open the Charge Manifold valve while inspecting the pressure gauge located on the Vent Manifold. When the Vent Manifold gauge stabilizes at the helium source pressure (~250 psig), close the Charge Manifold valve.

7.5. Slowly open the Vent Manifold valve to vent the gas charge. Close the valve when the Vent Manifold pressure gauge reaches 50 psig.

7.6. Repeat 7.4 and 7.5 for a total of twenty-five cycles.

7.7. Very slowly open the Charge Manifold valve. When the pressure gauge(s) on the compressor reaches a pressure of 210 psi, quickly close the Charge Manifold valve. Verify that the pressure gauge on the compressor stabilizes at 210 psi. **Note: If the compressor is an HC60, the charge pressure should be 227 psi instead of 210 psi.**

7.8. With both manifold valves closed and the compressor recharged, remove the Vent Manifold from the Helium Supply Port.

7.9. Remove the Charge Manifold from the Helium Return Port.

7.10. Connect the Helium Supply Hose and the Helium Return Hose back to the compressor.

7.11. Remove the Charge Manifold from the helium source, making sure that the manifold remains pressurized.

**7.12. AFTER ALL OF THE HELIUM HOSES, MANIFOLDS, PUMPS AND COMPRESSOR CONNECTIONS ARE COMPLETED. CHECK THE SYSTEM PRESSURE FROM THE GAUGE ON THE COMPRESSOR. A 2.1 OR 4.8 COMPRESSOR SYSTEM SHOULD BE CHARGED TO 210 PSI. A HC-60 COMPRESSOR SYSTEM SHOULD BE CHARGED TO 227 PSI (1.57 MPa).**

7.13. System pump and purge is complete.

## Cryopump Troubleshooting Guide

| Symptom | Possible Cause | Corrective Action |
|---|---|---|
| Long roughing time or roughing error from G2 Controller. | • Low air pressure to roughing valve.<br>• Roughing pump is insufficient or roughing lines do not allow enough throughput.<br>• Cryopump may have a high volume of water vapor.<br>• Roughing base pressure on controller may be set too low for application.<br>• Relief valve may require maintenance.<br>• Roughing valve malfunction | • Air supply should be set at 60 psi.<br>• Improve roughing system.<br>• Extend purge time or use a purge heater.<br>• See Gen 2 controller manual.<br>• See Section B2, Cryopump Maintenance<br>• Contact your GENESIS service representative. |
| Long purge time. | • Low nitrogen source pressure.<br>• G2 Controller has been set with an extended purge time. | • Nitrogen supply should be set to25 to 60 psi.<br>• See Gen 2 controller manual. |
| Cryopump does not turn on or G2 reports a compressor error. | • Compressor is in the wrong mode (remote/local).<br>• Compressor power is off.<br>• A compressor error has not been cleared. | • See compressor manual and check all compressor and Gen 2 cable connections.<br>• Turn compressor on.<br>• See compressor manual. |
| Cryopump shows ice or condensation on the pump body during operation. | • The system or cryopump may have a vacuum leak. | • Leak check system and pump. |
| Cryopump does not reach base temperature or base pressure. | • Compressor static charge pressure is below specification.<br>• Oil back streaming from a roughing pump may have contaminated the pump.<br>• The system or cryopump may have a vacuum leak. | • See compressor manual and check all aeroquip fittings for proper tightening.<br>• Contact your GENESIS service representative.<br>• Leak check system. |

| Symptom | Possible Cause | Corrective Action |
|---|---|---|
| The cryopump runs for a short period of time before the compressor and cryopump shutdown. | • Compressor static charge pressure is above or below specification.<br>• The compressor cooling water supply may not be adequate.<br>• Compressor error.<br>• Pressure after roughing may be too high. | • See Compressor manual.<br>• Improve cooling water supply to compressor.<br>• Check compressor for error code, see compressor manual.<br>• See controller manual. |
| Cryopump does not maintain base temperature. | • Regenerate cryopump.<br>• High thermal load on cryopump.<br>• High gas impulse.<br>• Cryopump may require scheduled service. | • See section 13 Regeneration.<br>• Reduce thermal load, see cryopump specification sheet.<br>• Reduce gas impulses, see cryopump specification sheet.<br>• If the cryopump has operated for more than 20,000 hours scheduled service may be required. |
| Cryopump temperature fluctuates or cryopump is abnormally noisy. | • Possible helium contamination in system helium lines, compressor and pumps. | • Perform a pump and purge. See appendix B. |
| Cryopump shuts down for no apparent reason. | • Compressor error.<br>• Controller reporting error.<br>• Pump failure. | • See compressor manual.<br>• See controller manual.<br>• Contact your GENESIS service representative. |
| Pump does not reach 300K during regeneration. | • Pump is a standard pump and will only warm up to 290K.<br>• Purge gas heater failure.<br>• Quick Regeneration pump heater failure.<br>• Warm up temp. setting is not set correctly. | • Install a purge gas heater.<br>• Contact your GENESIS service representative for any component failures.<br>• See controller manual. |
| Erratic temperature display of first and second stage. | • Temperature sensor malfunction. | • Contact your GENESIS service representative. |

**Environmental Health and Safety Clearance Form**

The following form must accompany all Product returns to Genesis Technologies Service Centers.

Your GENESIS service representative can assist you with filling out the required information on the form for your particular product. All returns must be assigned an RMA number from a service representative before Genesis Technologies will accept the shipment of the product.

GENESIS
Vacuum Technologies

# ENVIRONMENTAL HEALTH & SAFETY CLEARANCE FORM

GENESIS VACUUM TECHNOLOGIES
1101 NATIONAL DRIVE, SACRAMENTO, CA 95834 U.S.A
PHONE: (916) 928-6007
FAX : (916) 928-6146

**P.O. #:**

**RMA #:**

CALL SERVICE CENTER FOR RMA #

PLEASE FAX OR MAIL A COMPLETED COPY OF THIS FORM TO GENESIS SERVICE CENTER PRIOR TO SHIPPING EQUIPMENT

## 1.0 PRODUCT AND CUSTOMER IDENTIFICATION DATA

SITE NAME:

ADDRESS: ______________________

______________________

PHONE/FAX: ______________________

IS THIS EQUIPMENT USED OR CONTAMINATED?

IF YES, CHECK HERE ☐ GO TO SECTION 2.0

IF NO, CHECK HERE ☐ GO TO SECTION 3.0

MODEL NO.: ______________________

SERIAL NO.: ______________________

PART NO.: ______________________

PROCESS TYPE: ______________________

TOOL TYPE: ______________________

TOOL I.D.: ______________________

LENGTH OF SERVICE: ______________________

## 2.0 IDENTIFICATION AND LISTING OF ALL CONTAMINANTS (GASES, LIQUIDS, SOLIDS)

2.1 WAS THE EQUIPMENT USED WITH ANY OF THE FOLLOWING PROCESS MATERIALS?

2.1.1 RADIOACTIVE HAZARD S? YES ☐ NO ☐ **IF YES, DO NOT DISPATCH. CONTACT SERVICE CENTER**

2.1.2 BIOLOGICAL HAZARDS? YES ☐ NO ☐ **IF YES, DO NOT DISPATCH. CONTACT SERVICE CENTER**

2.1.3 TOXIC HYDRIDE MAT 'LS? YES ☐ NO ☐ (E.G., ARSINE, PHOSPHINE)

2.1.4 OTHER HAZARDOUS MAT 'LS? YES ☐ NO ☐ (E.G., PROCESS GASES, BY -PRODUCTS, SOLIDS)

IF YES TO ANY QUESTIONS LISTED IN SECTION 2.1, GO TO SECTION 2. 2; IF NO, GO TO SECTION 3.0

2.2 PLEASE LIST ALL SUBSTANCES OR BY -PRODUCTS **WHICH MAY HAVE** COME INTO CONTACT WITH THE EQUIPMENT:

| CHEMICAL NAME | CHEMICAL SYMBOL | SPECIAL INSTRUCTIONS |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

ATTACHED ADDITIONAL FORMS AND/OR ADDITIONAL DOCUMENTATION? YES ☐ NO ☐

## 3.0 REASON FOR RETURN OR SERVICING OF EQUIPMENT

3.1 BRIEFLY DESCRIBE ANY EQUIPMENT ANOMALIES: ______________________

______________________

______________________

3.2 IS THIS A WARRANTY OR SERVICE CONTRACT JOB? YES ☐ NO ☐ IF YES, ORDER OR CONTRACT #: ____________

## 4.0 DECLARATION: I CERTIFY TO THE BEST OF MY KNOWLEDGE THAT THE INFORMATION ON THIS FORM IS COR RECT.

NAME: ______________________

SIGNATURE: ______________________

JOB TITLE: ______________________

COMPANY: ______________________

PHONE/FAX #: ______________________

SIGNATURE DATE: ______________________

EST. SHIPPING DATE: ______________________

EST. DELIVERY DATE: ______________________