



On-Board[®] Waterpump
Installation and
Maintenance Instructions

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For Technical Support:

Location	GUTS® Contact Number
North America	+1-800-FOR-GUTS (1-800-367-4887) +1-978-262-2900
Europe	+49-1804-CALL-GUTS (+49-1804-2255-4887)
Japan	+81-45-477-5980
China	+86-21-5131-7066
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Safety Conventions

Introduction




Follow all safety precautions during installation, normal operation, and when servicing CTI-Cryogenics products.

This chapter explains the safety conventions used throughout this manual. CTI-Cryogenics uses a specific format for cautions and warnings, which includes standard signal words and safety shapes.

See also the *Customer Support* appendix or call your local Customer Support Center for assistance.




Signal Word Descriptions

All cautions and warnings contain signal words, which call attention to safety messages and designate the degree of hazard seriousness. The following table shows the signal words and their meanings that may be used in this document.

Term	Example	Definition
CAUTION		A signal word accompanied by a safety shape that indicates a potentially hazardous situation or unsafe practice. If not avoided, the action may result in minor or moderate personal injury or equipment damage . A CAUTION is highlighted in yellow.
CAUTION		A signal word that indicates a situation or unsafe practice, which if not avoided may result in equipment damage . A CAUTION is highlighted in yellow.
WARNING		A signal word accompanied by a safety shape that indicates indicates a potentially hazardous situation. If not avoided, the action may result in serious injury or death . A WARNING is highlighted in orange.

Safety Shape Descriptions

All cautions and warnings contain safety shapes, which have specific safety meanings. The following table shows some of the safety shapes used in this document and their meanings.

Example	Term	Shape Definition
	General Warning	Indicates a general hazard. Details about this hazard appear in the safety notice explanation.
	High Voltage	Indicates a high voltage hazard.
	Hot Surface	Indicates a surface is hot enough to cause discomfort or a burn.

References

For more information about safety standards, see the following documents:

- ISO 7010: 2003(E), Graphic symbols - Safety colours and safety signs - Safety signs used in workplaces and public areas
- ISO 3864-1: 2002(E), Graphic symbols - Safety colours and safety signs - Part 1: Design principles for safety signs in workplaces and public areas

Section 1 - On-Board Waterpump

Introduction

Installation and Maintenance Instructions for On-Board Waterpumps provide easily accessible information. All personnel with installation and maintenance responsibilities should become familiar with the contents of this manual to ensure safe, reliable On-Board Waterpump performance. Information on On-Board Waterpump module programming and operation can be found in the appropriate **On-Board W Module Programming and Operation Instructions** manual (that comes with your On-Board Waterpump).

General

On-Board Waterpumps remove water vapor quickly and efficiently from your vacuum system. An On-Board Waterpump condenses and captures water vapor at cryogenic temperatures thereby providing extremely low vapor pressures to provide maximum water vapor pumping speed. On-Board Waterpumps are highly reliable and rugged units that require a minimum of servicing. The possibility of system or process contamination from the waterpump itself is eliminated since the waterpump exposes no moving parts or operating fluids to the vacuum system. On-Board Waterpumps are available in a variety of configurations that permit varied installations. These include: Inline versions installed directly to or with other high vacuum pumps and In Situ versions designed to integrate a water pumping cryopanel directly into the process chamber, wafer handler, or load lock. Examples of each pump type are shown in [Figure 1-3](#), [Figure 1-4](#), and [Figure 1-5](#).

Microprocessor-Based Control System

On-Board Waterpumps are equipped with a state-of-the-art microprocessor based control system that can monitor and control a wide range of important vacuum system functions. Operations are performed on the keypad/display panel that is mounted on the waterpump. Operation of the related hardware (i.e., valves, heaters, etc.) is controlled automatically from the commands entered at the keypad/display.

On-Board W Module Rear Panel Description

The On-Board W Module rear panel contains several components. Refer to [Figure 1-1](#) for the location and description of these components.

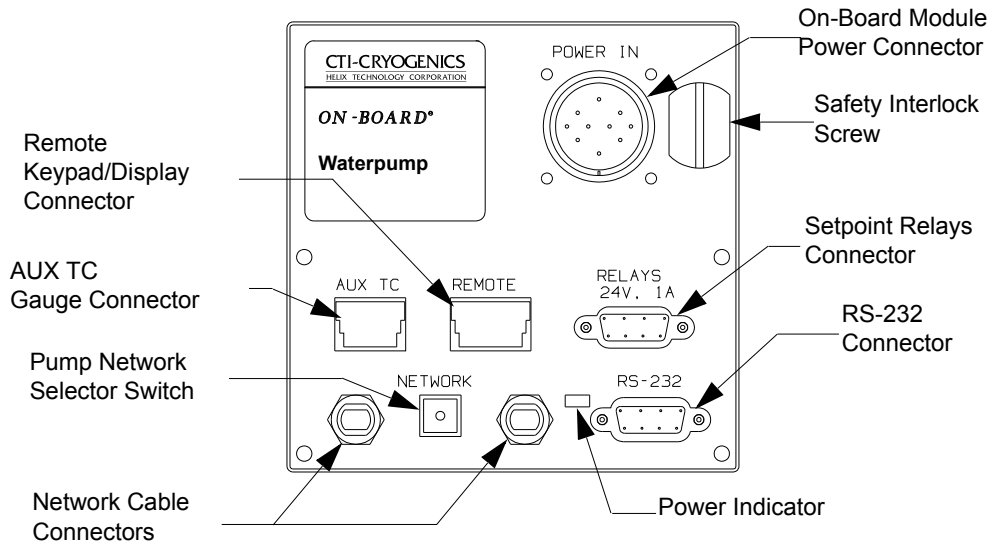


Figure 1-1: On-Board W Module Rear Panel

Remote Operation Options

On-Board Waterpumps can be controlled remotely using either a BITBUS™ or RS-232 protocol. The most common implementation, used in multiple On-Board Waterpump process tools, is to network the On-Board Waterpumps using the BITBUS™ protocol.

In this configuration, the networked On-Board Waterpumps are managed as a group by the On-Board Network Terminal, which coordinates group regeneration cycles and provides a standardized communication link to the process tool host controller. Using this approach, control of the networked On-Board Waterpumps is fully integrated with process tool control.

A remote keypad/display is available which provides the same functions as the basic On-Board keypad/display.

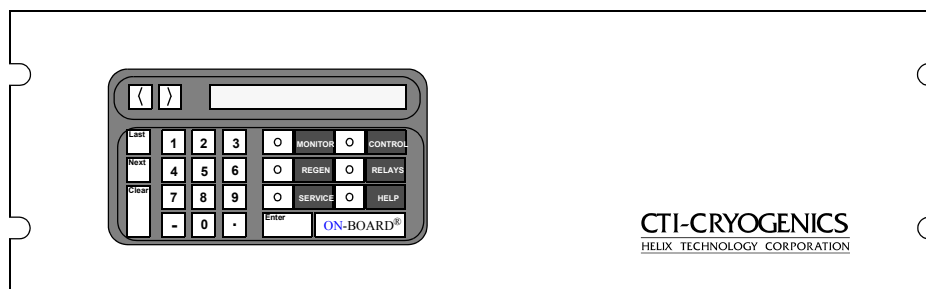


Figure 1-2: Remote Keypad/Display

Theory of Operation

Each On-Board Waterpump consists of, as a minimum, a coldhead and a cryogenic array. Water vapor is removed from your vacuum chamber, thereby creating a vacuum when it is condensed on the cryogenically-cooled array.

Cold Head

The coldhead (also referred to as a refrigerator) consists of a single-stage coldhead cylinder (part of the vacuum vessel) and drive unit displacer assembly, that together produce closed-cycle refrigeration at a nominal temperature of 107K. Within the drive unit displacer assembly, the drive unit actuates the displacer-regenerator assembly located in the coldhead cylinder and thereby controls the flow of helium into the coldhead. Within the drive unit are located the crankcase and drive motor, which is a direct-drive constant-speed motor, operating at 72 rpm on 60 Hz power and 60 rpm on 50 Hz power.

During operation, high pressure helium from the compressor enters the coldhead at the helium supply connector, and flows through the displacer-regenerator assembly, crankcase, and motor housing before exiting through the helium gas return connector and returning to the compressor.

Helium expansion in the displacer-regenerator assembly provides cooling to the waterpump array.

Vacuum Vessel and Arrays

The 107K array condenses water vapor. The temperature of the coldhead station is measured by a temperature sensor and transmitted to the On-Board Module for display.

Compressor Gas and Oil Flows

Helium returning from the On-Board Waterpump coldhead enters the compressor, and a small quantity of oil is injected into the gas stream, thereby overcoming helium's low specific heat and inability to carry heat produced during compression. Helium is then compressed and passed through a heat exchanger for removal of compression-generated heat. The helium continues its flow through an oil-mist separator and a charcoal filter adsorber (cartridge), within the compressor, where oil and contaminants are removed. A differential pressure relief valve in the compressor limits the operating pressure differential between the helium supply and return lines, thereby allowing compressor operation without coldhead operation. When coldhead operation reaches a steady-state condition, further pressure regulation is unnecessary.

On-Board In Situ Waterpump

Hardware Configuration

The On-Board In Situ Waterpump, shown in [Figure 1-3](#), is shipped with the following standard components:

- Keypad/Display (mounted on waterpump or remotely located)
- Diode (not shown)
- On-Board Module
- Setpoint Relays Connector
- RS-232 Interface Connector
- Network Connector
- Installation Hardware

NOTE: Custom cryopanel panels can be designed to fit customer requirements.

Water Pumping Specifications

On-Board In Situ Waterpumps can achieve a water pumping speed of 96 liters per second for each inch of exposed cryopanel front surface area.

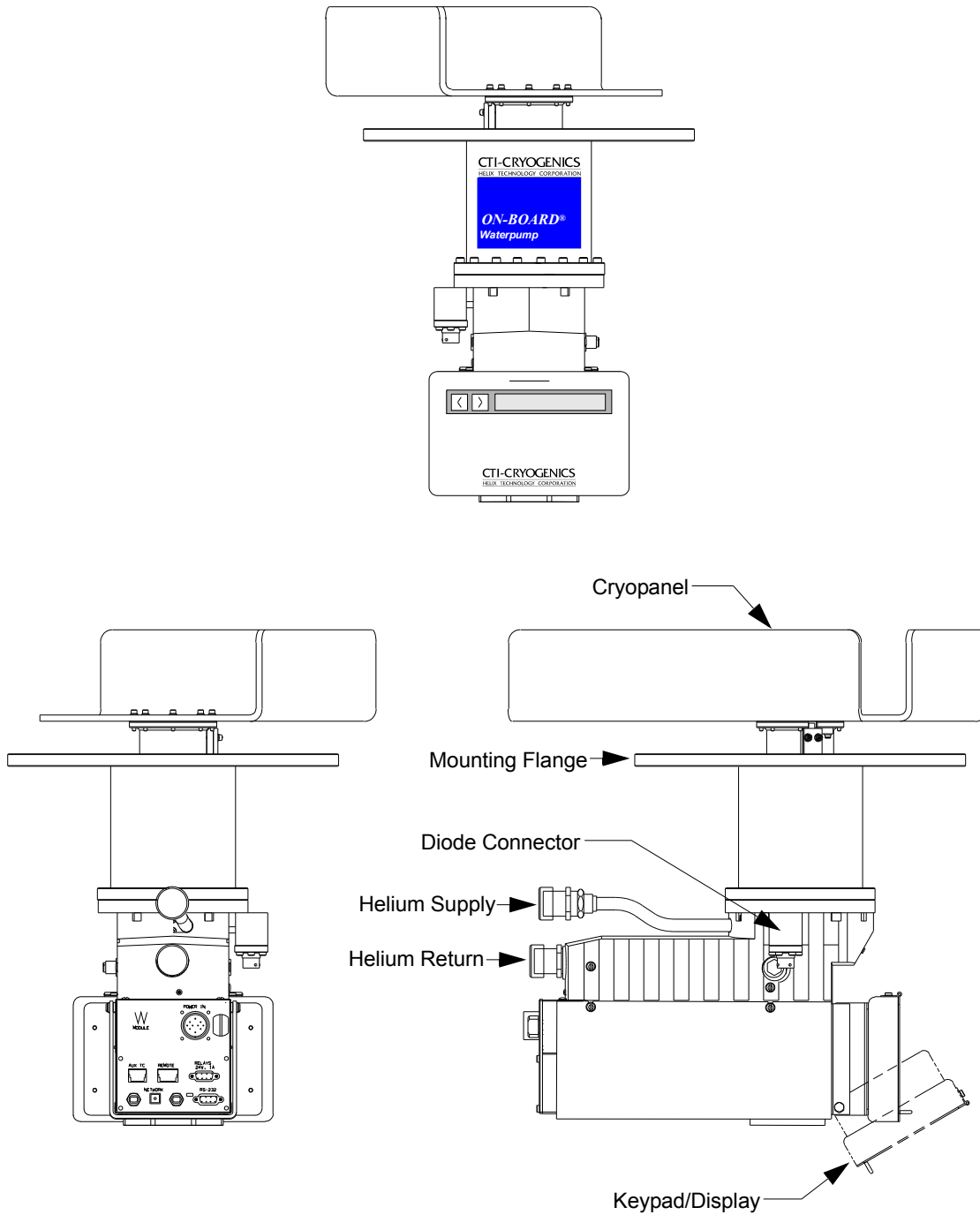


Figure 1-3: On-Board In Situ Waterpump

On-Board Inline Waterpump

Hardware Configuration

The On-Board Inline Waterpump is shown in [Figure 1-4](#) and contains the following standard components:

- Keypad/Display (mounted on waterpump or remotely located)
- Diode (not shown)
- Thermocouple (TC) Gauge
- On-Board Module
- Setpoint Relays Connector
- RS-232 Interface Connector
- Network Connector
- Relief Valve
- Installation Hardware

Specifications

Refer to [Table 1-1](#) for On-Board Inline Waterpump specifications.

Table 1-1: Typical On-Board Inline Waterpump Specifications

Inlet Flange Size (in/mm)	Water Pumping Speed (liters/second)	Nitrogen Conductance (liters/second)	Weight (lb./kg)
4/100	1100	450	50/22.7
6/160	2500	1000	50/22.7
8/200	4000	1800	55/24.9
10/250	7000	2800	70/31.8
16/400	16,000	7,200	90/40.8

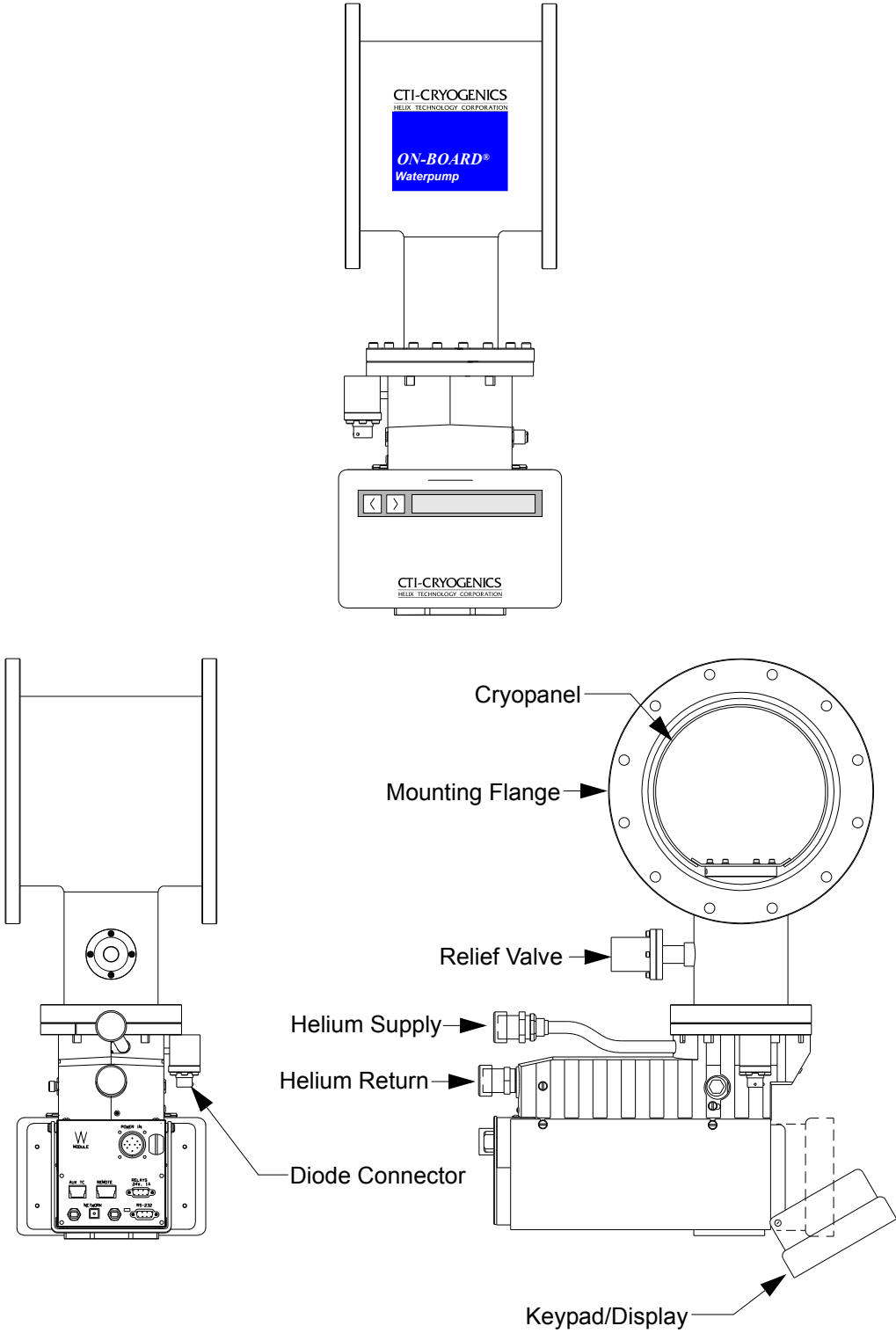


Figure 1-4: On-Board In-Line Waterpump

On-Board LowProfile Waterpump

Hardware Configuration

The On-Board LowProfile Waterpump is shown in [Figure 1-5](#) and contains the following standard components:

- Keypad/Display (mounted on waterpump or remotely located)
- Diode (not shown)
- On-Board Module
- Setpoint Relays Connector
- RS-232 Interface Connector
- Network Connector
- Relief Valve
- Installation Hardware

Table 1-2: Typical On-Board LowProfile Waterpump Specifications

Inlet Flange Size (in/mm)	Water Pumping Speed (liters/second)	Nitrogen Conductance (liters/second)	Weight (lb./kg)
4/100	800	500	50
6/160	1900	1150	55
8/200	3800	2300	60

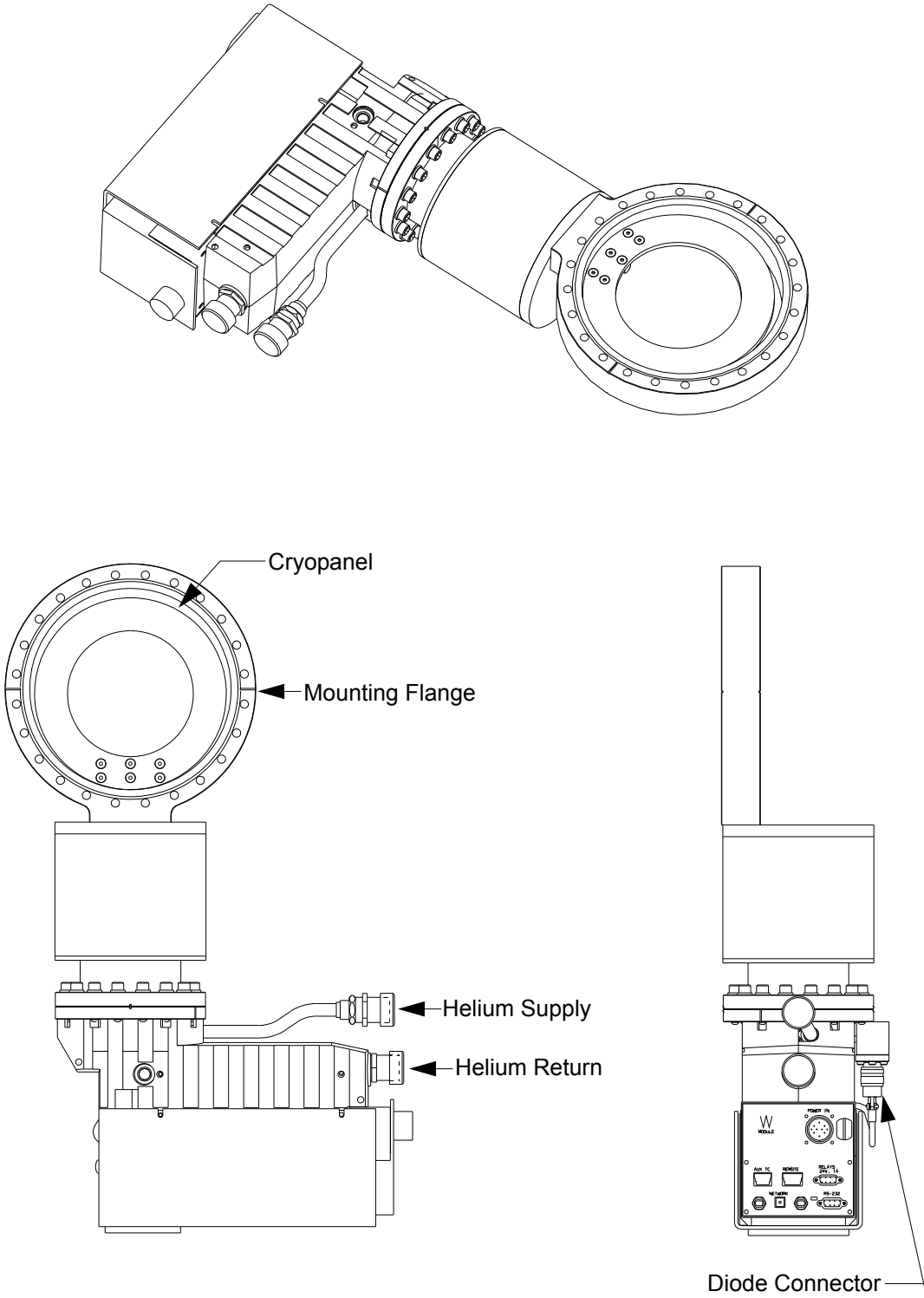


Figure 1-5: On-Board LowProfile Waterpump

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Section 2 - Keypad/Display Mounting Positions

Introduction

Depending upon the orientation in which the On-Board Waterpump is installed, the keypad/display can be mounted in one of four positions A, B, C, or D.

Mounting Keypad/Display in Position A

Typically, the On-Board Waterpump is shipped with the keypad/display mounted in position A, shown in [Figure 2-1](#).

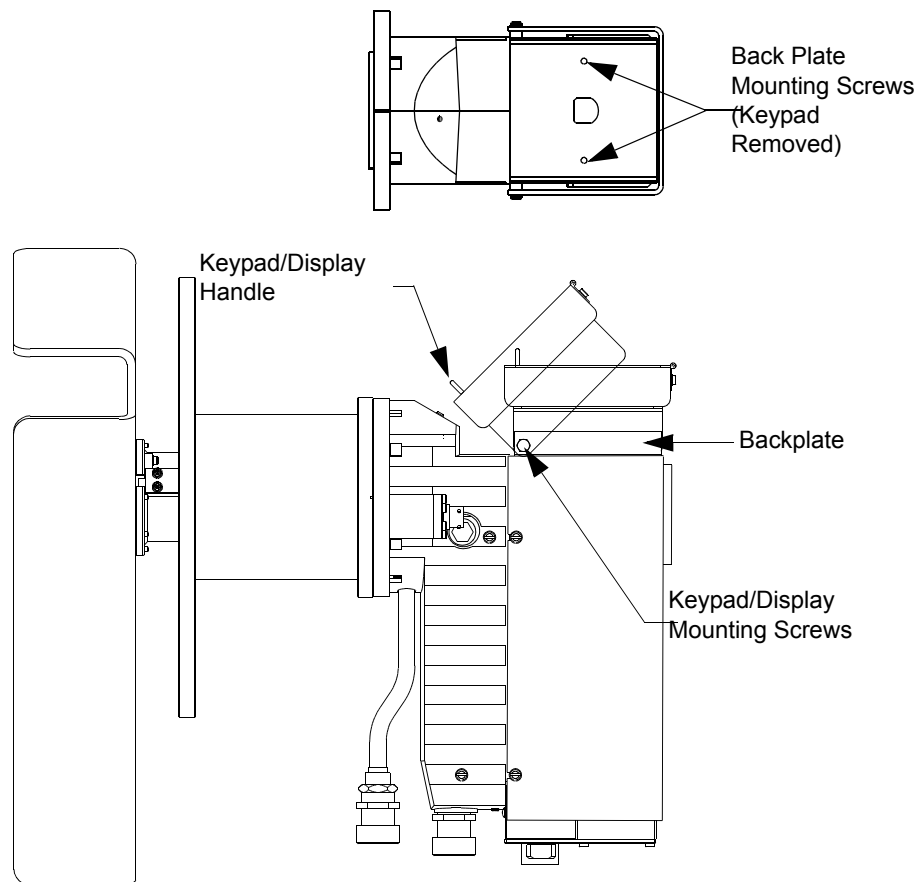


Figure 2-1: Keypad/Display Mounting Position A

Mounting Keypad/Display in Position B

Refer to [Figure 2-2](#) and the following procedure to change keypad/display to position B.

1. Remove the 2 screws, washers, and nuts holding the keypad/display to the back plate.
2. Remove the 2 screws and washers holding the back plate.
3. Rotate the back plate, being careful not to strain the cable, so the keypad/display mounting screw holes are oriented as shown in [Figure 2-2](#).
4. Mount the back plate using the 2 screws and washers removed during step 2.
5. Remount the keypad/display using the 2 screws, washers, and nuts removed in step 1 as shown in [Figure 2-2](#).

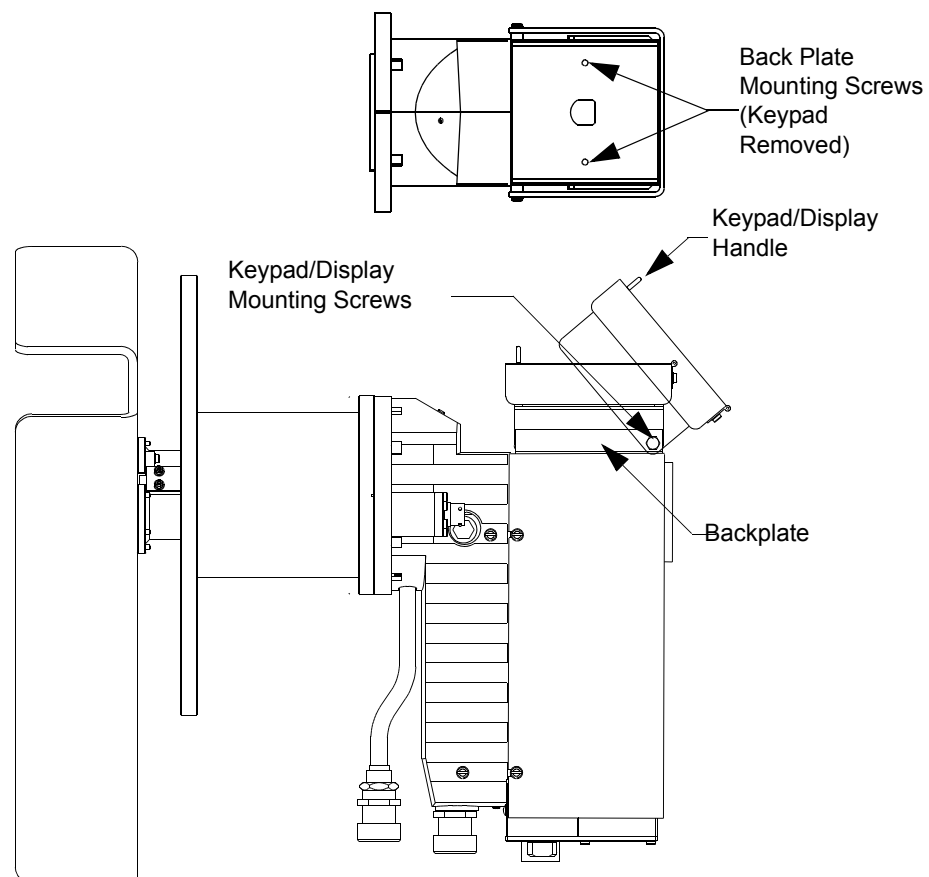


Figure 2-2: Keypad/Display Mounting Position B

Mounting Keypad/Display in Position C

Refer to [Figure 2-2](#) and the following procedure to change keypad/display to position C.

1. Remove the 2 screws, washers, and nuts holding the keypad/display to the back plate.
2. Turn the keypad/display over.
3. Remount the keypad/display using the 2 screws, washers, and nuts removed in step 1 as shown in [Figure 2-3](#).

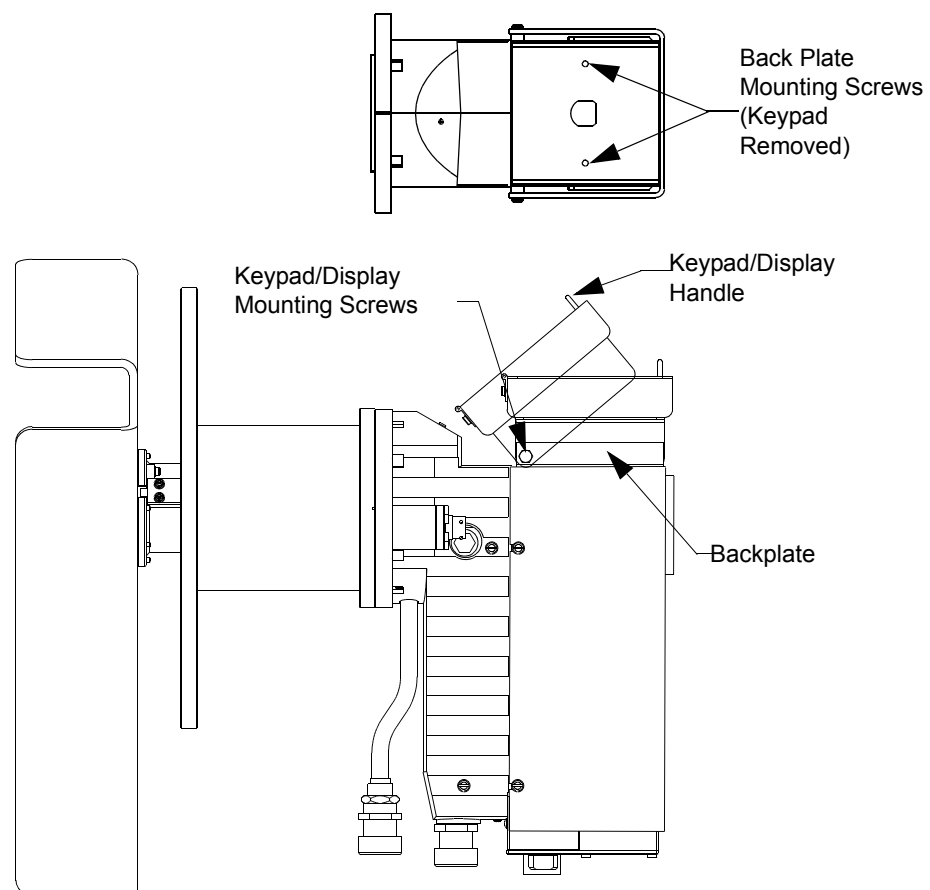


Figure 2-3: Keypad/Display Mounting Position C

Mounting Keypad/Display in Position D

Refer to [Figure 2-4](#) and the following procedure to change keypad/display to position D.

1. Remove the 2 screws, washers, and nuts holding the keypad/display to the back plate.
2. Remove the 2 screws and washers holding the back plate.
3. Rotate the back plate, being careful not to strain the cable, so the keypad/display mounting screw holes are oriented as shown in [Figure 2-4](#).
4. Remount the back plate using the 2 screws and washers removed during step 2.
5. Remount the keypad/display using the 2 screws, washers, and nuts removed in step 1 as shown in [Figure 2-4](#).

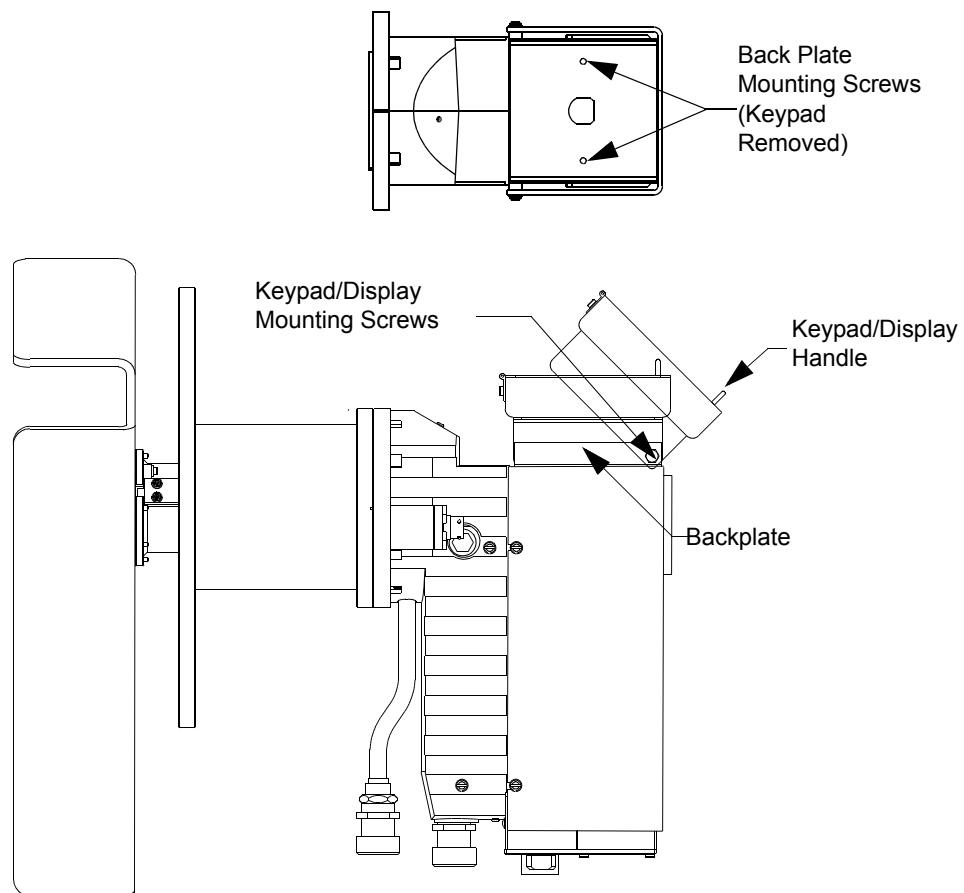


Figure 2-4: Keypad/Display Mounting Position D

Section 3 - On-Board In Situ Waterpump Installation

Application

An On-Board In Situ Waterpump can be equipped with a *cold link* for small diameter (4.0 inches or less) vacuum port applications. The cold link is inserted through the small vacuum port as shown in [Figure 3-2](#).

On-Board In Situ Waterpump Installation (without Cold Link)

CAUTION

Make sure the diode is not damaged during installation of the On-Board In Situ Waterpump.

1. Clean all sealing surfaces of the waterpump and vacuum system mounting flange.
2. Install the O-ring or metal seal gasket on the vacuum chamber mounting flange.
3. Install the On-Board In Situ Waterpump on the vacuum chamber mounting flange and secure it into place using mounting clamps as shown in [Figure 3-1](#).
4. Install the indium gasket on the end of the heat station.
5. Install the two alignment pins into the top and bottom center holes of the heat station as shown in [Figure 3-1](#).
6. Install the cryopanel on the alignment pins and secure the cryopanel to the heat station using mounting screws, lock washers, and flat washers as shown in [Figure 3-1](#).
7. Remove the alignment pins.
8. Install the two remaining mounting screws, lock washers, and flat washers.
9. Torque the mounting screws to 20 in.-lbs. and hold for 5 seconds to allow the indium to flow then re-torque the screws.
10. Proceed with **Helium Supply and Return Line Installation**.

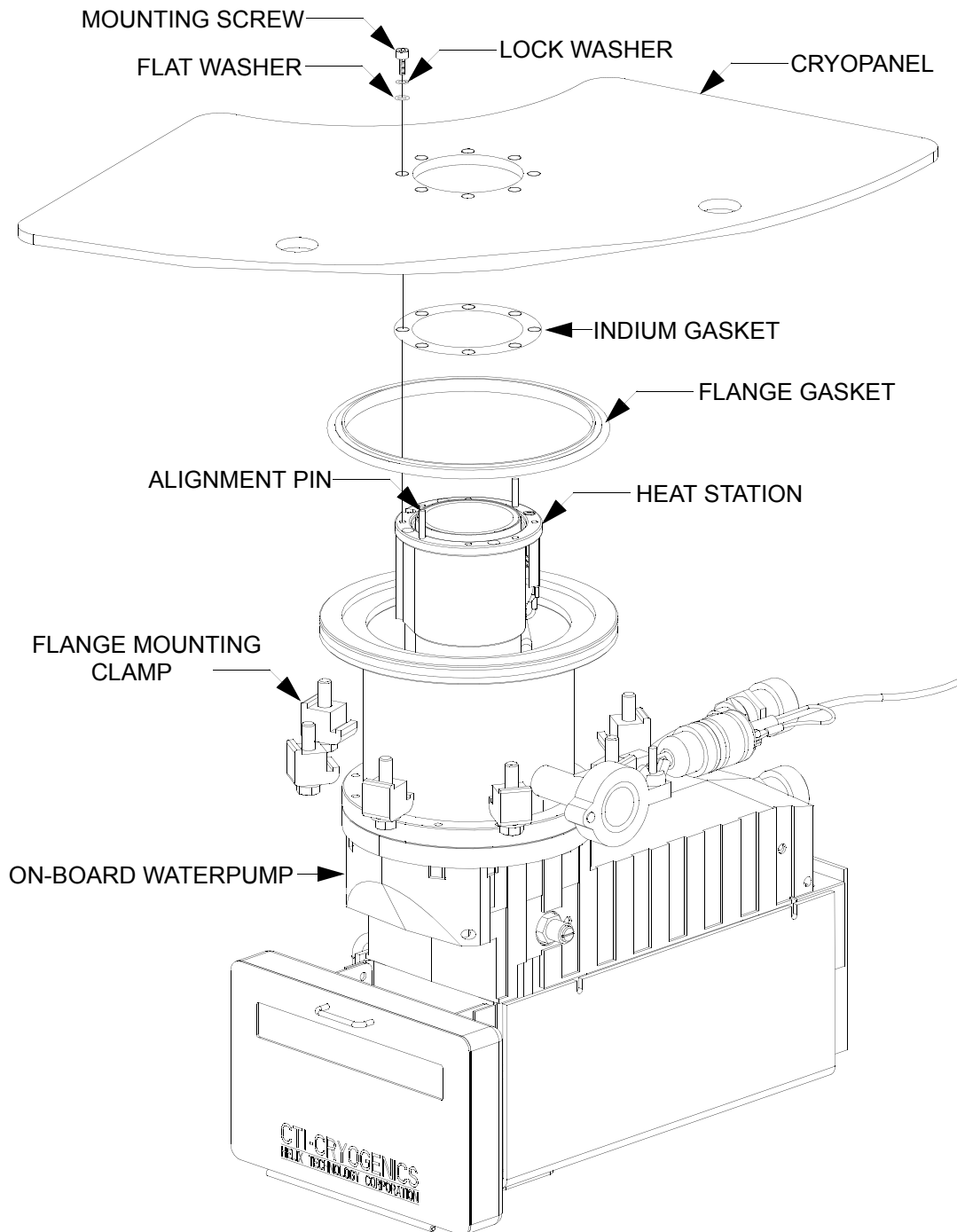


Figure 3-1: Typical On-Board In Situ Waterpump Install. (ISO Flange without Cold Link

On-Board In Situ Waterpump Installation (with Cold Link)

1. Clean all sealing surfaces of the waterpump and vacuum system mounting flange.
2. Install the O-ring or metal seal gasket on the vacuum chamber mounting flange.
3. Install the On-Board In Situ Waterpump on the vacuum chamber mounting flange and secure it into place using mounting clamps as shown in [Figure 3-2](#).
4. Install an indium gasket on top of the cold link as shown in [Figure 3-2](#).
5. Install the cryopanel and secure it into place with the mounting screws, lock washers, and flat washers as shown in [Figure 3-2](#).
6. Torque the mounting screws to 20 in.-lbs. and hold for 5 seconds to allow the indium to flow then re-torque the screws.
7. Proceed with **Helium Supply and Return Line Installation**.

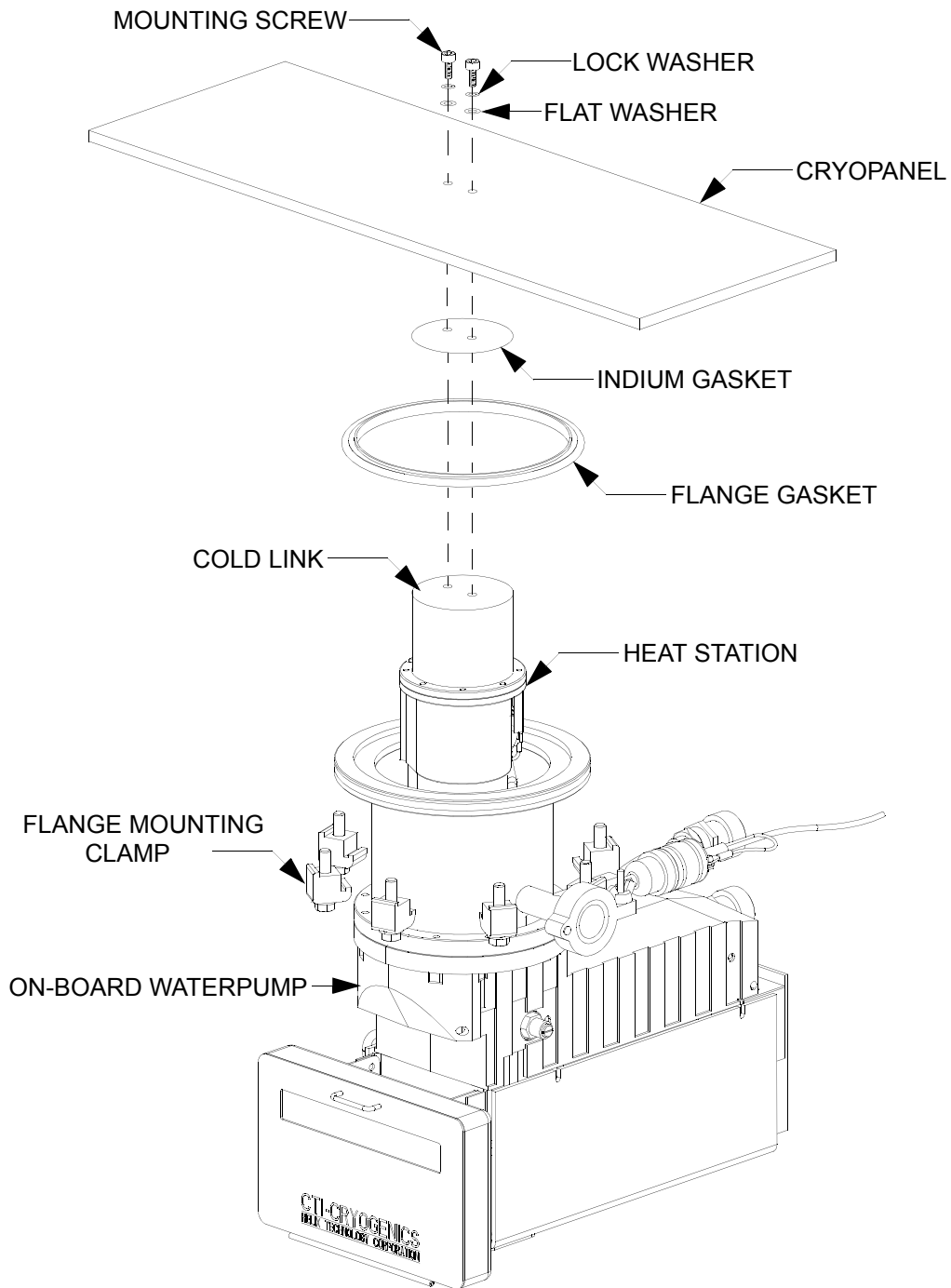


Figure 3-2: Typical On-Board In Situ Waterpump Installation (ISO Flange with Cold Link)

Helium Supply and Return Line Installation

Refer to the following procedure to connect the helium supply and return lines between the On-Board In Situ Waterpump and the compressor.

1. Attach the supply and return line identification decals (supplied) to their respective line ends.
2. Remove all dust plugs and caps from the supply and return lines, compressor, and waterpump. Check all fittings. Ensure the flat gas-gaskets are present in the connectors.
3. Connect the helium return line from the GAS RETURN connector on the rear of the compressor to the GAS RETURN connector on the waterpump as shown in [Figure 3-2](#).
4. Connect the helium supply line from the SUPPLY connector on the compressor to the gas SUPPLY connector on the waterpump as shown in [Figure 3-3](#).
5. Proceed with **Power Cable Connections**.

Power Cable Connections



WARNING

Set the power switch on the compressor front panel to the OFF (0) position before making any electrical connections to the On-Board In Situ Waterpump. Do not connect the compressor to its power source until all connections have been made to the waterpump system components.

1. Connect the power cable from the cold head connector on the compressor to the On-Board In Situ Waterpump power connector.
2. Proceed with **Setpoint Relays Connections** (if required).

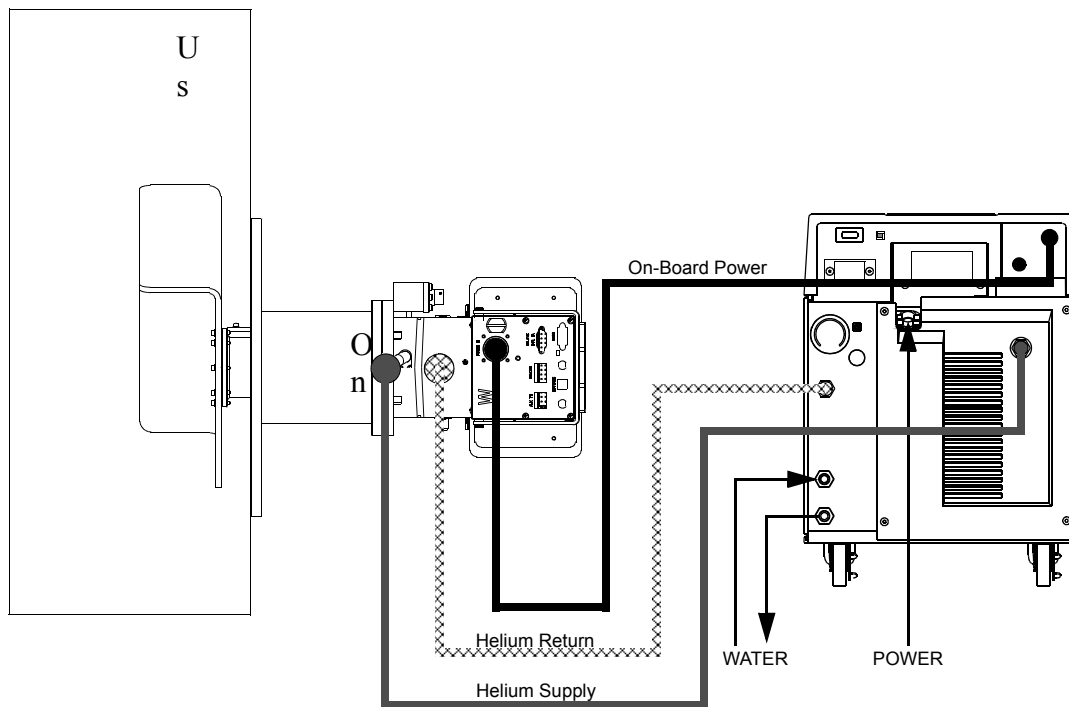


Figure 3-3: Typical On-Board In Situ Waterpump Installation

Setpoint Relays Connection

The setpoint relays are two mechanical relays incorporated into the On-Board In Situ Waterpump. The relays are rated at 1 amp at 24V AC/DC and contain both normally-open and normally-closed contacts.

Connections are made through the 9-pin D connector labeled *Relays* on the connector plate of the In Situ Waterpump. Refer to [Figure 3-4](#) for connector location and pin identification.

When the setpoint relays are used, connection to the relays (R1 and R2) is made via the setpoint relay connector located at the rear of the On-Board Module. Refer to [Figure 3-4](#) and the following procedure if the waterpump requires the use of the setpoint relays.

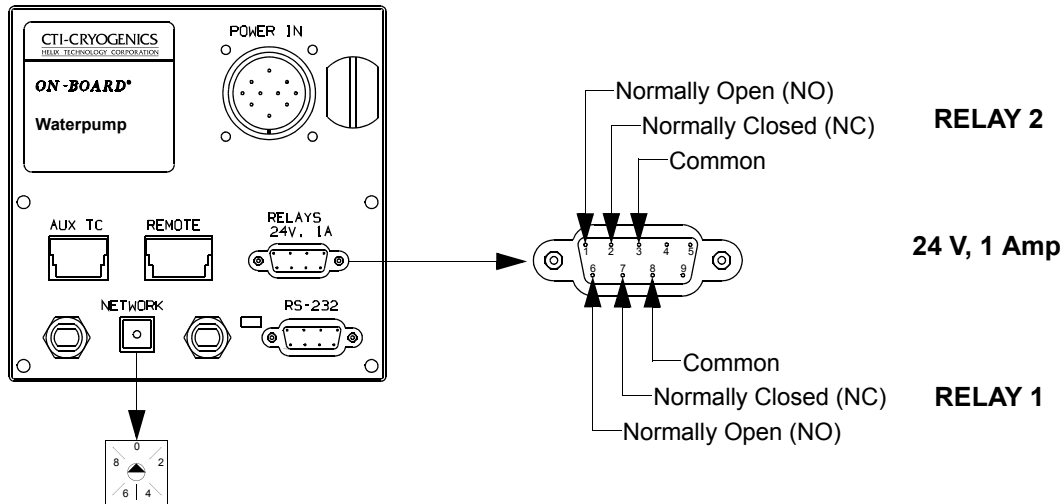


Figure 3-4: Setpoint Relay Connector Location and Pin Identification

1. Determine whether the On-Board equipment requires setpoint relay contacts to be either in a normally open or normally closed position for the application.
2. Referring to [Figure 3-4](#) for pin identification, prepare a 9-pin DSub mating connector, meeting MIL DTL 24308/1-1 and equipment requirements.
3. Upon completion, connect the setpoint relay receptacle to its connector located on the On-Board Module.
4. Program the relays as described in the appropriate **On-Board W Module Programming and Operation Instructions** manual that came with the On-Board Waterpump.

Check Helium Pressure

Verify proper helium static pressure as described in the Installation Section of the appropriate compressor manual.

Programming and Operation

Refer to the **On-Board W Module Programming and Operation** manual the came with your On-Board In Situ Waterpump to program and operate the On-Board In Situ Waterpump.

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Section 4 - On-Board Inline Waterpump Installation

Application

On-Board Inline Waterpumps are designed to operate in a vacuum environment of 1 micron or less.

***NOTE:** Refrigerator overload and waterpump housing sweating may result if the On-Board Inline Waterpump is installed in a vacuum environment greater than 1 micron.*

Preparation

1. Remove the protective covers from the main flanges of the On-Board Inline Waterpump.
2. Clean all sealing surfaces of the waterpump and vacuum system mounting flange.
3. Install the O-ring or metal seal gasket on the vacuum chamber mounting flange.

Installation

1. Install the On-Board Inline Waterpump in series with the vacuum system mounting flange and existing vacuum pump using the customer supplied mounting bolts as shown in [Figure 4-1](#).
2. Proceed with **Helium Supply and Return Line Installation**.

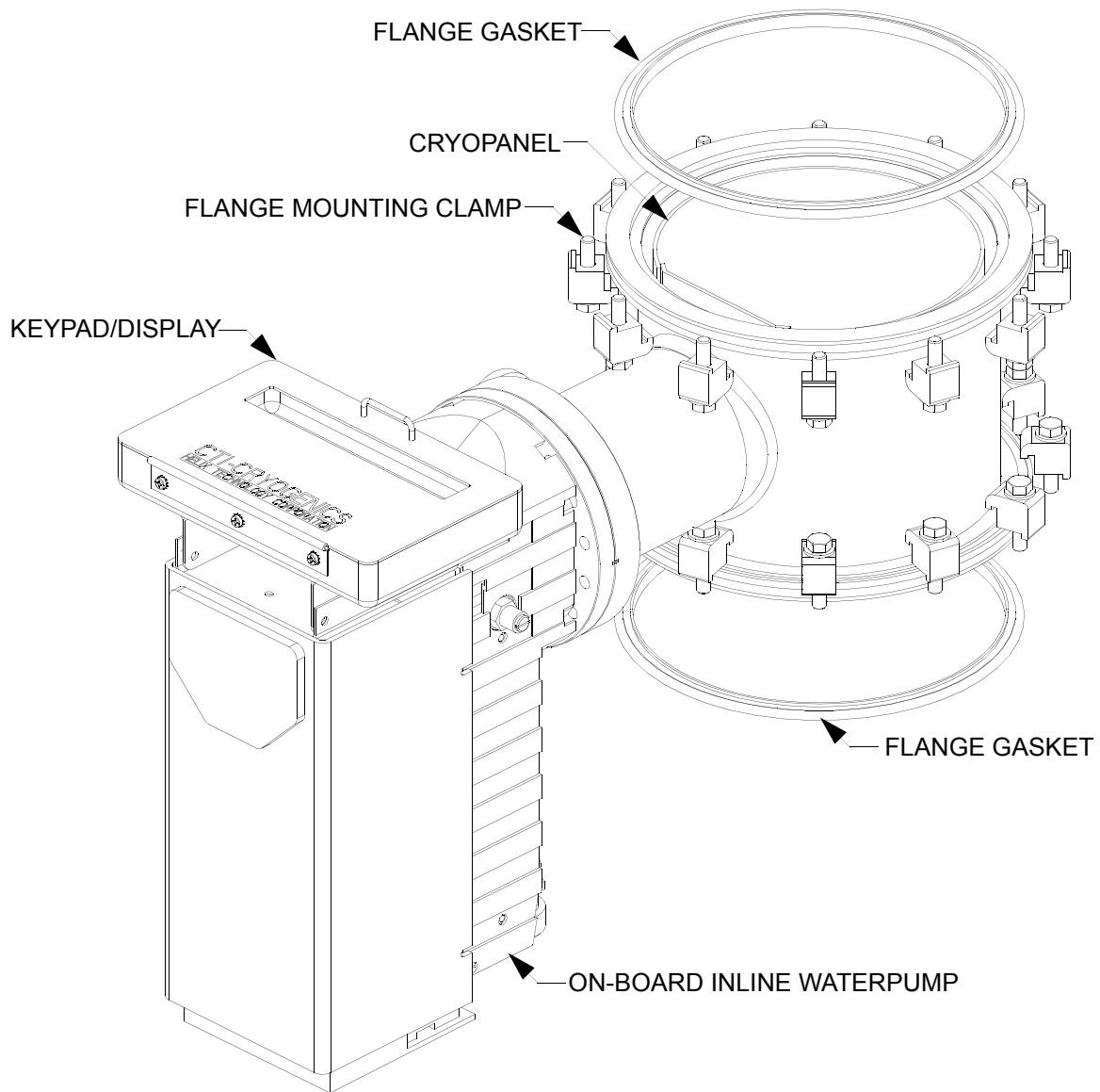


Figure 4-1: Typical On-Board Inline Waterpump Installation

Helium Supply and Return Line Installation

Refer to the following procedure and [Figure 4-2](#) to connect the helium supply and return lines between the On-Board Inline Waterpump and the compressor.

1. Attach the supply and return line identification decals (supplied) to their respective line ends.
2. Remove all dust plugs and caps from the supply and return lines, compressor, and waterpump. Check all fittings. Ensure the flat gaskets are present in the connectors.
3. Connect the helium return line from the GAS RETURN connector on the rear of the compressor to the GAS RETURN connector on the waterpump.
4. Connect the helium supply line from the SUPPLY connector on the compressor to the gas SUPPLY connector on the waterpump.
5. Proceed with **Power Cable Connections**.

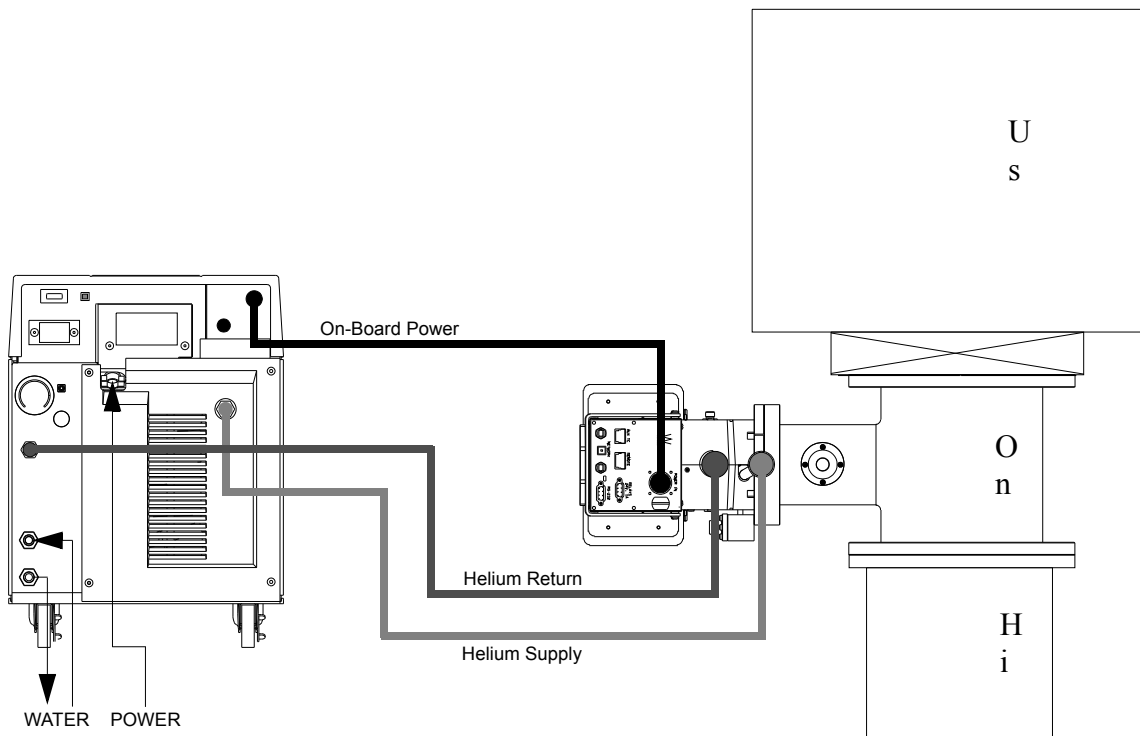



Figure 4-2: Typical On-Board Inline Waterpump Connections

Power Cable Connections



WARNING

Set the power switch on the compressor front panel to the OFF (0) position before making any electrical connections to the On-Board Inline Waterpump. Do not connect the compressor to its power source until all connections have been made to the waterpump system components.

1. Connect the power cable from the cold head connector on the compressor to the On-Board Inline Waterpump power connector as shown in [Figure 4-2](#).
2. Proceed with **Setpoint Relays Connection** (if required).

Setpoint Relays Connection

The setpoint relays are two mechanical relays incorporated into the On-Board Inline Waterpump. The relays are rated at 1 amp at 24V AC/DC and contain both normally-open and normally-closed contacts. Connections are made through the 9-pin D connector labeled *Relays* on the connector plate of the Inline Waterpump. Refer to [Figure 4-3](#) for connector location and pin identification.

When the setpoint relays are used, connection to the relays (R1 and R2) is made via the setpoint relay connector located at the rear of the On-Board module. Refer to [Figure 4-3](#) and the following procedure if the waterpump requires the use of the setpoint relays.

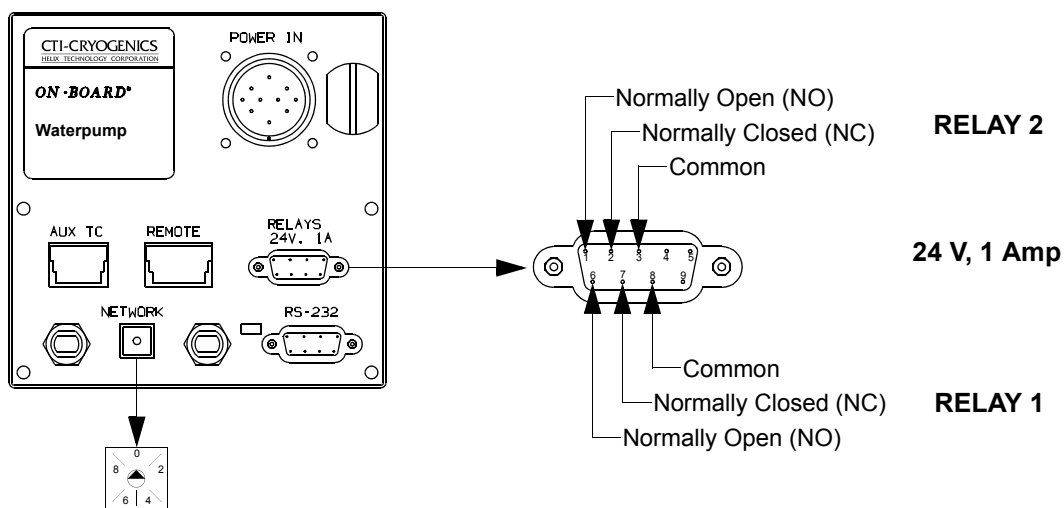


Figure 4-3: Setpoint Relay Connector Location and Pin Identification

1. Determine whether the On-Board equipment requires setpoint relay contacts to be either in a normally open or normally closed position for the application.
2. Referring to [Figure 4-3](#) for pin identification, prepare a 9-pin DSub mating connector, meeting MIL DTL 24308/1-1 and equipment requirements.
3. Upon completion, connect the setpoint relay receptacle to its connector located on the On-Board Module.
4. Program the relays as described in the appropriate **On-Board W Module Programming and Operation Instructions** manual that came with the On-Board Waterpump.
5. Proceed with **Vent Pipe Connection**.

Vent Pipe Connection



WARNING

Avent pipe must be connected to the On-Board Inline Waterpump relief valve and directed to a safe location if toxic, corrosive, or flammable gases are being pumped.

The On-Board Inline Waterpump pressure relief valve can be vented directly into the room or can be connected to an exhaust system. When connecting a vent pipe to the waterpump, a 1.30 inch diameter x 1.38 inch long volume around the relief valve must remain open for proper relief valve operation. Vent pipe adapters are available from CTI-CRYOGENICS (CTI-CRYOGENICS P/N 8080250K008). Refer to **Appendix A** for the location of CTI-CRYOGENICS' world wide customer support centers.

Check Helium Pressure

Verify proper helium static pressure as described in the appropriate CTI-CRYOGENICS Compressor manual.

Programming and Operation

Refer to the **On-Board W Module Programming and Operation** manual the came with your On-Board Waterpump to program and operate the On-Board Inline Waterpump.

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Section 5 - On-Board LowProfile Waterpump Installation

Application

On-Board LowProfile Waterpumps are designed to operate in front of a turbopump in a high vacuum environment with low water quantities. The On-Board LowProfile Waterpump is designed for applications which have moderate heat loads and require additional water speed to increase chamber recovery time.

NOTE: Refrigerator overload and waterpump housing sweating may result if the On-Board LowProfile Waterpump is installed in a vacuum environment greater than 1 micron.

On-Board LowProfile Waterpump Installation (Metal Seal Vacuum Flange)

Refer to this procedure and [Figure 5-1](#) for installing the On-Board LowProfile Waterpump between a customer supplied turbo pump and process chamber on a metal seal mounting flange.

CAUTION

Do not damage the sealing surfaces of the On-Board LowProfile Waterpump, customer supplied turbo pump, and vacuum system during this procedure.

1. Determine if the fore/roughing pump connection on the turbo pump is in the correct position for your installation. Rotate the turbo pump into the correct position as required.
2. Remove the protective covers from the On-Board LowProfile Waterpump flange.
3. Clean the On-Board LowProfile Waterpump, customer supplied turbopump, and vacuum system sealing surfaces.
4. Install three installation studs into three holes on the vacuum chamber mounting flange.
5. Place the metal seal gasket on the top flange of the On-Board LowProfile Waterpump.
6. Lift the On-Board LowProfile Waterpump and metal seal gasket and insert the alignment studs through the holes in the waterpump flange.

7. Install the metal seal gasket on the top flange of the customer supplied turbo pump.
8. Lift the customer supplied turbo pump and metal seal gasket and insert the alignment studs through holes in the waterpump flange.
9. Insert the remaining mounting studs in the mounting holes.
10. Install washers and nuts on all mounting studs.
11. Push up on the customer supplied turbo pump and hand tighten all the nuts on the mounting studs.
12. Using a circular torque pattern, tighten the mounting nuts according to the customer supplied turbo pump torque values.
13. Connect the Fore/Roughing Pump Valve to the customer supplied turbo pump as required.
14. Proceed with **Helium Line Connections**.

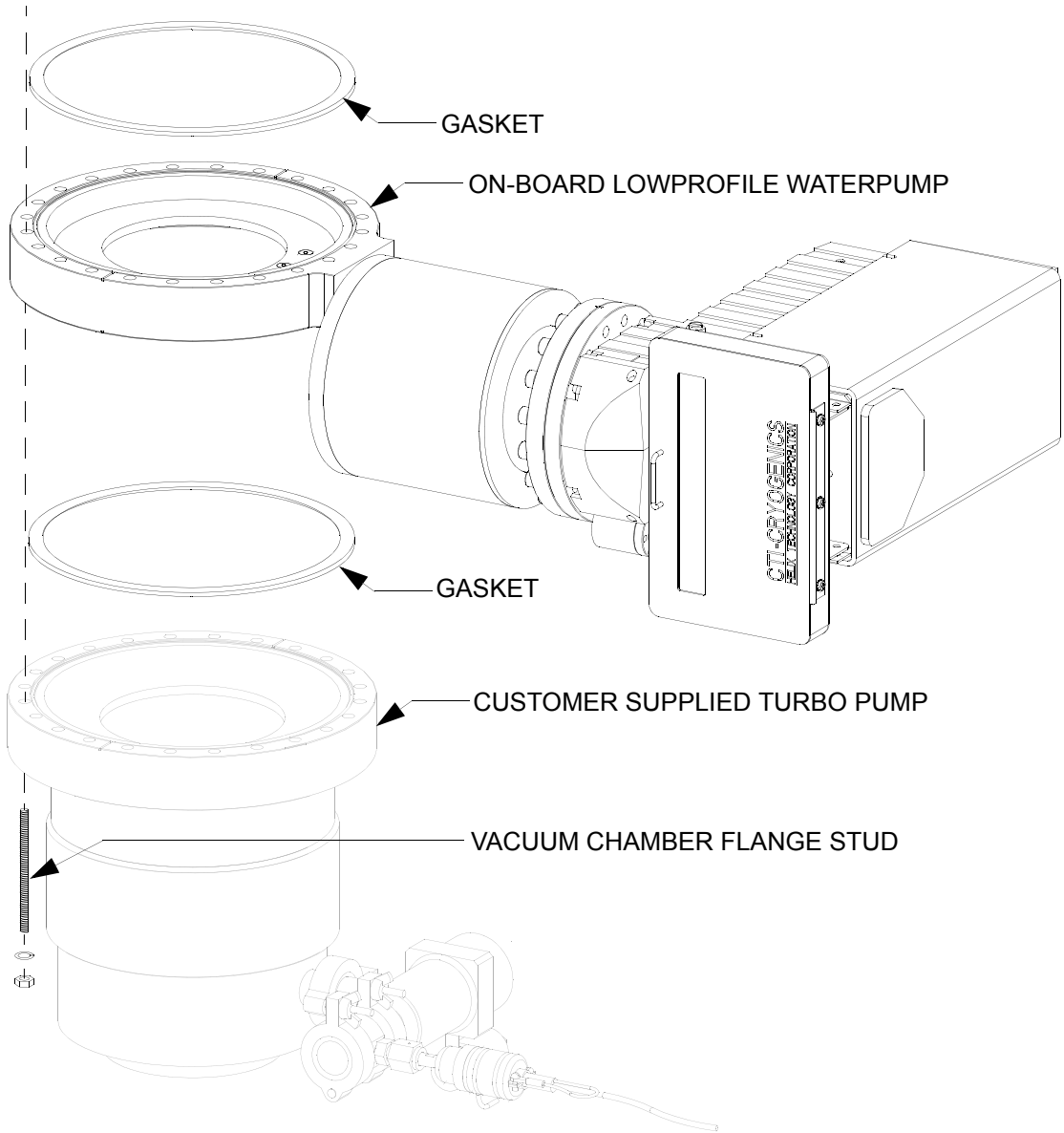


Figure 5-1: On-Board LowProfile Waterpump Installation (Metal Seal Flange)

On-Board LowProfile Waterpump Installation (ISO Mounting Flange)

Refer to this procedure and [Figure 5-2](#) for installing the On-Board LowProfile Waterpump between a customer supplied turbo pump and process chamber on a metal seal mounting flange.

CAUTION

Do not damage the sealing surfaces of the On-Board TurboPlus System and vacuum system during this procedure.

1. Determine if the fore/roughing pump connection on the turbo pump is in the correct position for your installation. Rotate the turbo pump into the correct position as required.
2. Remove the protective covers from the On-Board LowProfile Waterpump flange.
3. Clean the On-Board LowProfile Waterpump, turbopump and vacuum system sealing surfaces.
4. Install the On-Board LowProfile Waterpump alignment studs into 3 holes in the vacuum system mounting flange.
5. Install the gasket on the top flange of the On-Board LowProfile Waterpump as shown in [Figure 5-2](#).
6. Lift the On-Board LowProfile Waterpump and gasket and insert the alignment studs through the holes in the waterpump flange.
7. Insert the mounting screws and washers in the mounting holes.
8. Remove the alignment studs and insert the remaining mounting screws.
9. Using a circular torque pattern, tighten the mounting screws to 195 inch-pounds (22 Nm).
10. Install the gasket on top of the customer supplied turbo pump flange as shown in [Figure 5-2](#).
11. Lift the customer supplied turbo pump and gasket into place and install the bolt and clamp assemblies.
12. Using a circular torque pattern, tighten the mounting screws according to the customer supplied turbo pump torque values.
13. Connect the Fore/Roughing Pump Valve to the customer supplied turbo pump as required.
14. Proceed with **Helium Line Connections**.

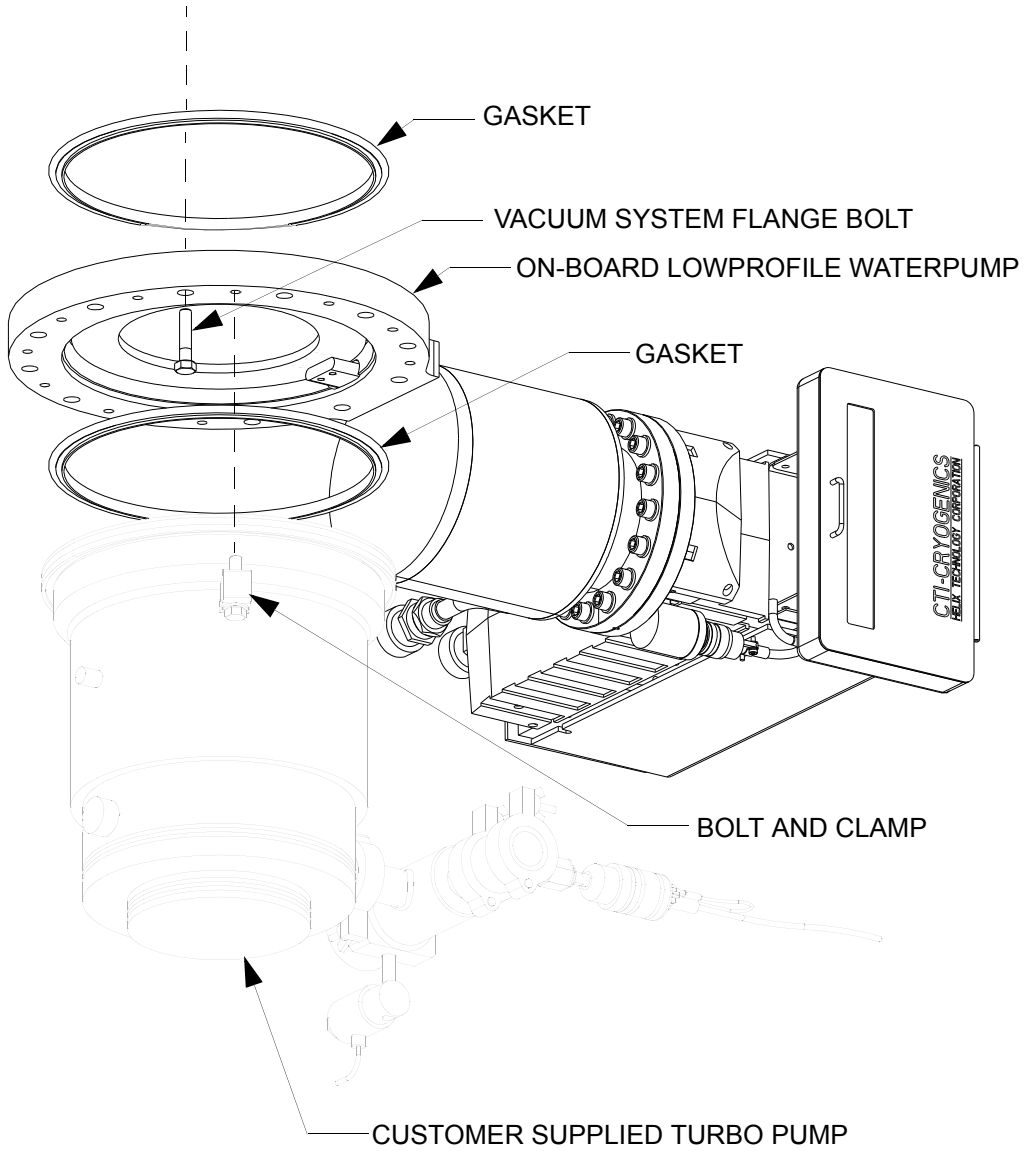


Figure 5-2: On-Board LowProfile Waterpump Installation (ISO Flange)

Helium Line Connections

Refer to the following procedure and [Figure 5-3](#) to connect the helium supply and return lines between the On-Board LowProfile Waterpump and the compressor.

1. Attach the supply and return line identification decals (supplied) to their respective line ends.
2. Remove all dust plugs and caps from the supply and return lines, compressor, and waterpump. Check all fittings. Ensure the flat gaskets are present in the connectors.
3. Connect the helium return line from the GAS RETURN connector on the rear of the compressor to the GAS RETURN connector on the waterpump.
4. Connect the helium supply line from the SUPPLY connector on the compressor to the gas SUPPLY connector on the waterpump.
5. Proceed with **Power Cable Connections**.

Power Cable Connections



WARNING

Set the power switch on the compressor controller front panel to the OFF (0) position before making any electrical connections to the On-Board LowProfile Waterpump. Do not connect the compressor controller to its power source until all connections have been made to the waterpump system components.

1. Connect the power cable from the cold head connector on the compressor to the On-Board Waterpump power connector as shown in [Figure 5-3](#).
2. Proceed with **Setpoint Relays Connection** (if required).

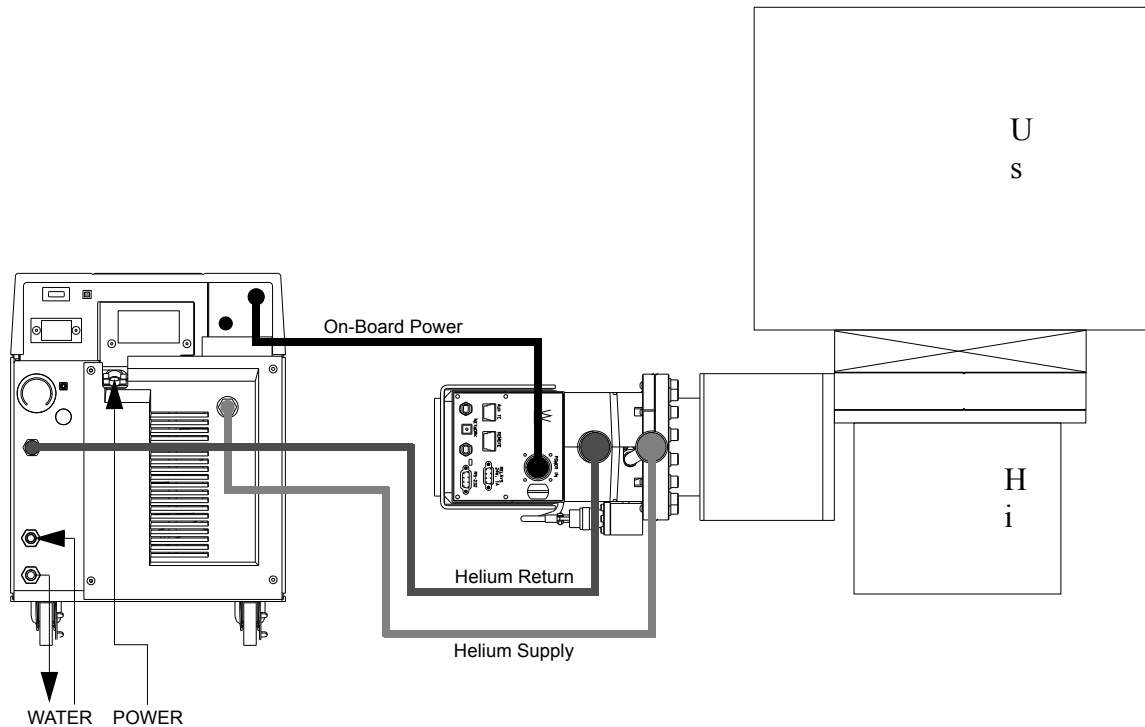


Figure 5-3: Typical On-Board LowProfile Waterpump Installation

Setpoint Relays Connection

The setpoint relays are two mechanical relays incorporated into the On-Board LowProfile Waterpump. The relays are rated at 1 amp at 24V AC/DC and contain both normally-open and normally-closed contacts. Connections are made through the 9-pin D connector labeled *Relays* on the connector plate of the On-Board LowProfile Waterpump. Refer to [Figure 5-4](#) for connector location and pin identification.

When the setpoint relays are used, connection to the relays (R1 and R2) is made via the setpoint relay connector located at the rear of the On-Board Module. Refer to [Figure 5-4](#) and the following procedure if the On-Board LowProfile Waterpump requires the use of the setpoint relays.

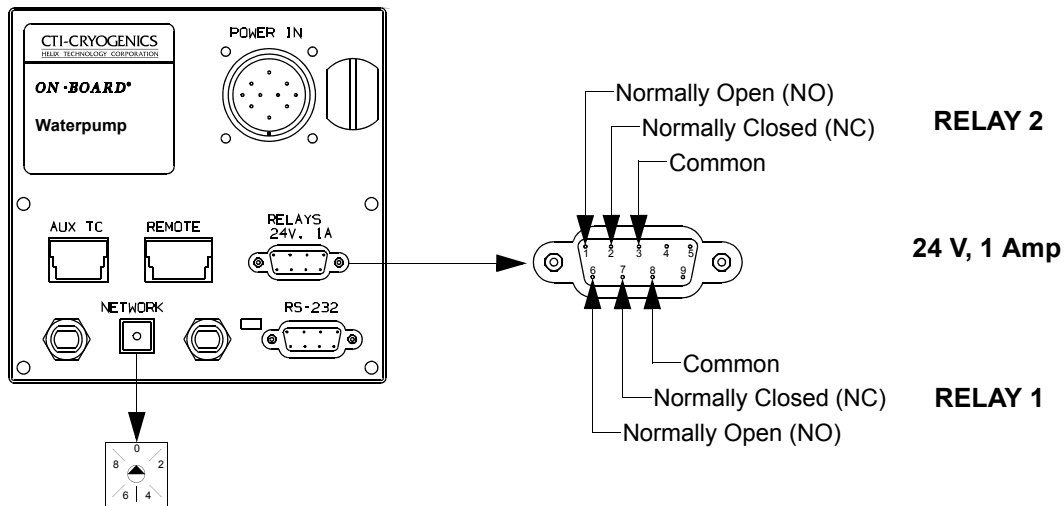


Figure 5-4: Setpoint Relay Connector Location and Pin Identification

1. Determine whether the On-Board equipment requires setpoint relay contacts to be either in a normally open or normally closed position for the application.
2. Referring to [Figure 5-4](#) for pin identification, prepare a 9-pin DSub mating connector, meeting MIL DTL 24308/1-1 and equipment requirements.
3. Upon completion, connect the setpoint relay receptacle to its connector located on the On-Board Module.
4. Program the relays as described in the appropriate **On-Board W Module Programming and Operation Instructions** manual that came with the On-Board LowProfile Waterpump.

Check Helium Pressure

Verify proper helium static pressure as described in the appropriate CTI-CRYOGENICS Compressor manual.

Programming and Operation

Refer to the **On-Board W Module Programming and Operation** manual the came with your On-Board LowProfile Waterpump to program and operate the waterpump.

Section 6 - Troubleshooting

Troubleshooting Techniques

The primary indication of trouble in a vacuum pumping system is a rise in base pressure of the vacuum chamber. A high base pressure is usually caused by an air-to-vacuum leak in the system.

A rise in water partial pressure may be caused by a leak in the vacuum system or by a fault in the waterpump (regeneration may be necessary). Typically, the waterpump is working properly if the refrigerator temperature is 107K.

Isolate the high-vacuum pump by closing the Hi-Vac valve (if applicable) and leak check the vacuum chamber if a leak is suspected in the vacuum system. A leak may be present below the Hi-Vac valve if no leaks are found. Leak checking below the Hi-Vac valve should be performed with the high-vacuum pump shut off. If no leak is found, refer to the waterpump troubleshooting procedures summarized in [Table 1](#).

The problems presented in [Table 1](#) are followed by possible causes and corrective actions. The causes and corresponding actions are listed in their order of probability of occurrence.

Technical Inquiries

Refer to **Appendix A** of this manual for the location of CTI-CRYOGENICS' world wide customer support centers.

Table 6-1: Troubleshooting Procedures

Problem	Possible Cause	Corrective Action
<p>Poor base pressure of vacuum system, and waterpump temperature of 107K.</p>	<p>Air-to-vacuum leak in vacuum system or in waterpump.</p> <p>Loose array preventing good thermal contact between cold station and refrigerator.</p> <p>Problem with main vacuum source.</p>	<p>Check waterpump relief valve for proper sealing.</p> <p>Check waterpump for leaks.</p> <p>Check vacuum chamber and Hi-Vac valve for leaks.</p> <p>Warm waterpump to ambient temperature and torque the array screws to 20 in.-lbs.</p> <p>Perform DEFROST cycle.</p> <p>Check main vacuum source for proper operation.</p>
<p>Poor base pressure of vacuum system and a waterpump temperature above 107K.</p>	<p>Decrease in waterpump refrigerator performance.</p> <p>Excessive thermal load on the waterpump.</p> <p>Full panel.</p> <p>Problem with main vacuum source.</p>	<p>Add helium if the return pressure gauge reads below normal operating range of 60-85 psig (415-590 kPa).</p> <p>Reduce thermal radiation load by shielding the waterpump or by lowering the temperature of the radiating surface.</p> <p>Perform DEFROST cycle.</p> <p>Check main vacuum source for proper operation.</p>

Table 6-1: Troubleshooting Procedures (Continued)

Problem	Possible Cause	Corrective Action
<p>Waterpump fails to cool down to the required operating temperature or takes too long to reach that temperature.</p>	<p>Low helium supply.</p>	<p>Refer to compressor manual.</p>
	<p>Supply and Return line connectors are loose.</p>	<p>Tighten connectors using two wrenches.</p>
	<p>Compressor problems.</p>	<p>Refer to compressor manual.</p>
	<p>High base pressure due to leak in vacuum system or waterpump.</p>	<p>Check waterpump relief valve for proper seating.</p>
		<p>Check waterpump for leaks.</p>
	<p>Poor base pressure due to poor operating main vacuum source</p>	<p>Check vacuum system for leaks.</p>
<p>Check waterpump relief valve for proper seating.</p>		
<p>Check waterpump for leaks.</p>		
<p>Incomplete regeneration may not have fully removed water from the waterpump vacuum vessel.</p>	<p>Check vacuum system for leaks.</p> <p>Regenerate the waterpump as described in On-Board W Module Programming and Operation manual.</p>	

Table 6-1: Troubleshooting Procedures (Continued)

Problem	Possible Cause	Corrective Action
No Display	No power to On-Board Waterpump.	<p>Make sure power switch on the compressor is turned on.</p> <p>Check electrical connections.</p> <p>Check fuses and circuit breakers.</p> <p>Turn power Off, then On to reboot module.</p> <p>Refer to Appendix A and call Customer Service.</p>
Display does not update and/or keys do not function.	<p>Electronics has locked up.</p> <p>Keypad requires reinitialization.</p>	<p>Turn power Off, then On to reboot module.</p> <p>Refer to Appendix A and call Customer Service.</p> <p>Refer to Appendix A and call Customer Service.</p>
Rough valve clicks but does not open or close.	Too little or lack of air pressure to drive rough valve.	Increase air pressure to 60-80 psig.

Section 7 - Maintenance

Cryopanel Maintenance Kit

An On-Board Waterpump Cryopanel Maintenance Kit is available from CTI-CRYOGENICS. The kit provides new indium gaskets, screws, nuts, washers, etc. which are used to remove and reinstall the cryopanel during maintenance intervals.

Refer to **Appendix A** and call the local CTI-CRYOGENICS Customer Support Center for more information.

Helium Circuit Decontamination

Contamination of the helium-gas circuit is indicated by sluggish or intermittent operation (ratcheting) of the cold head drive mechanism. With severe contamination, the cold head drive may seize and fail to operate. One of the major sources of contamination is using helium gas of less than the required purity. When performing the decontamination process, use only 99.999% pure-helium gas, and make sure the regulator and charging line is properly connected and purged.

The Decontamination Procedure will remove contaminants from the cold head and/or compressor, thereby restoring system performance. The cold trapping of contaminants inside the cold head during this procedure will also decontaminate the compressor if the contamination of the system is not severe. Separate decontamination of the compressor is required whenever the compressor has been opened to atmosphere, or the helium pressure has dropped to zero. Refer to the appropriate compressor manual for compressor decontamination information.

Decontamination Procedure

1. Cool down the waterpump and operate it for one to three hours.

***NOTE:** If the system will not cool down, proceed to step 2. Operating the waterpump isolates the contaminants by freezing them in the coldhead. The contaminants in the helium gas circuit of the waterpump become frozen inside the cold head. The longer the waterpump is operated beyond the one hour period, the greater is the amount of contamination that becomes isolated inside the cold head.*

2. Shut down the waterpump.
3. Immediately disconnect the helium supply and return lines from the gas supply and gas return connectors at the rear of the compressor. Leave them attached to the cold head.

4. Attach the maintenance manifold (available from CTI-CRYOGENICS) to the disconnected ends of the return and supply lines.
5. Reduce the pressure in the cold head to a level of 30 psig by using the maintenance manifold. Reducing the pressure in the cold head to below 30 psig (200 kPa) may introduce more contaminants into the helium circuit.
6. If you have the automatic REGEN On-Board option, start a regeneration and then discontinue it when the waterpump reaches 300K. If you only have the manual regeneration option, turn the waterpump off and open the purge valve until the first-stage temperature reaches 290K.

NOTE: Step 7 ensures that both the regulator and the charging line will be purged of air and that the air trapped in the regulator will not diffuse back into the helium bottle. For best results, CTI-CRYOGENICS suggests a dedicated helium bottle, regulator, and line, which are never separated, for adding helium.

7. Attach the regulator (0-3000/0-400 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME. Purge the regulator and charging line as introduced in steps a through d below. Do not use helium gas that is less than 99.999% pure.



WARNING

Never open a helium gas bottle valve unless the manifold charging valve is closed.

- a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm; then, turn approximately 1/8 to 1/4 turn more, so that the regulator is barely open.
 - b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Turn the regulator knob counterclockwise until the helium stops flowing.
 - c. Loosely connect the charge line to the 1/8-inch valve on the maintenance manifold.
 - d. Purge the charge line again, as in step a, for 30 seconds, and tighten the charge line flare fitting onto the valve while the helium is flowing.
8. Perform in sequence:

- a. Backfill the cold head with helium to a static charge pressure of 245-250 psig (1690-1725 kPa) by adjusting the regulator to the required pressure, and opening the valve on the manifold. Close the valve when the pressure is correct.
 - b. Depressurize the cold head to 30 - 50 psig (200 - 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly. Do not reduce the pressure to less than 30 psig or the cold head may be further contaminated.
 - c. Perform the flushing steps a and b four more times.
 - d. Pressurize the cold head to compressor static charge pressure and run the cold head drive motor for 10 to 30 seconds by actuating the compressor ON/OFF switch to on.
 - e. Perform steps b through d four more times for a total of 25 flushes and five drive-motor runs.
9. Verify that the cold head is pressurized to the static charge pressure for the helium compressor.
 10. Disconnect the maintenance manifold from the helium return and supply lines.
 11. Reconnect the helium return and supply lines to the return and supply connectors at the rear of the compressor. The On-Board waterpump is now ready for operation.

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Appendix A - Customer Support Information

Customer Support Center Locations

To locate a Customer Support Center near you, please visit our website www.helixtechnology.com on the world wide web and select *CONTACT* on the home page.

Guaranteed Up-Time Support (GUTS)

For 24 hour, 7 day per week Guaranteed Up-Time Support (GUTS) dial:

800-367-4887 - Inside the United States of America

508-337-5599 - Outside the United States of America

Product Information

Please have the following information available when calling so that we may assist you:

- Product Part Number
- Product Serial Number
- Product Application
- Specific Problem Area
- Hours of Operation
- Equipment Type
- Vacuum System Brand/Model/Date of Manufacture

E-mail

For your convenience, you may also e-mail us at:

techsupport@helixtechnology.com

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