

On-Board[®] IS Cryopump Installation Instructions

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Safety Conventions

Introduction




All CTI-Cryogenics products are safe and dependable when used properly. 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 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 should be noted in the safety notice explanation. Note that this shape may also be used with specific signal words.
	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 *IS* Cryopump Description

Introduction

The On-Board *IS* Cryopump provides fast, clean pumping of all gases in the 10^{-3} to 10^{-9} torr range by condensing gas at low temperatures to achieve low vapor pressures, allowing high pumping speeds and throughputs.

The On-Board *IS* Cryopump is highly-reliable and requires little maintenance. Since the Cryopump exposes no moving parts, operating fluids, or backing pumps to the vacuum, there is no possibility of system or process contamination from the Cryopump.

Installation Instructions

The Installation Instructions for the On-Board *IS* Cryopump provide easily accessible information. All personnel with maintenance responsibilities should become familiar with the contents of these instructions to ensure high performance and safe and reliable operation of the Cryopump.

Microprocessor-Based Control System

The On-Board *IS* Cryopump is equipped with a microprocessor-based control system that allows both monitoring and control of a wide range of important vacuum system functions.

Refer to the *On-Board IS Cryopump System Operation Guide* Helix part number 8040647, that came with the *IS* Controller, for a complete description of the numerous operational functions that are available.

Remote Operation Options

The On-Board *IS* Cryopump can be controlled remotely using an RS-232 protocol. Multiple Cryopumps can be networked using a proprietary BITBUS™ protocol to an *IS* Controller. In this configuration, the networked Cryopumps are managed as a group by the *IS* Controller which coordinates group regeneration cycles and provides a standardized communication link to the process tool host computer. The *IS* Controller allows all Cryopumps to be addressed by the host system through a single RS-232 port. Using this approach, control of the networked Cryopumps can be fully integrated with the process tool control through RS-232 communication.

Figure 1-1 through Figure 1-4 shows the On-Board *IS* cryopumps.

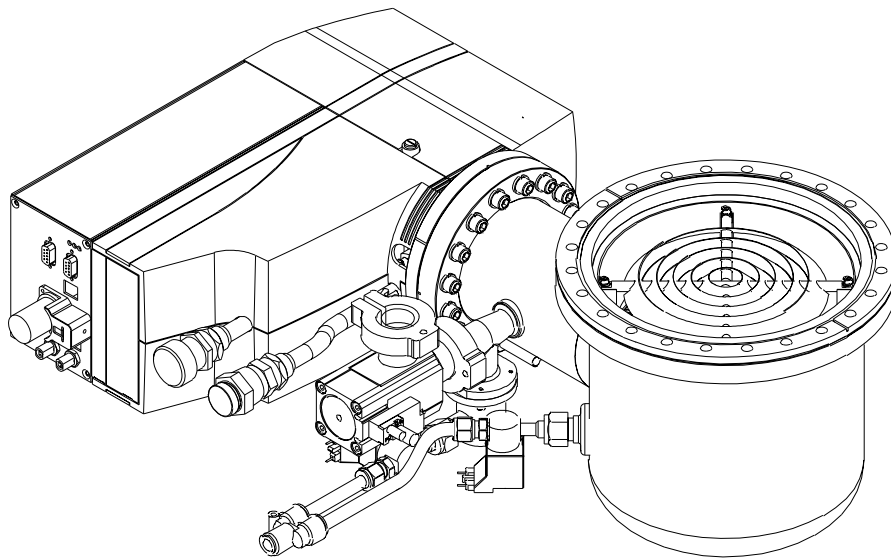


Figure 1-1: On-Board *IS* 8F (Flat) Cryopump

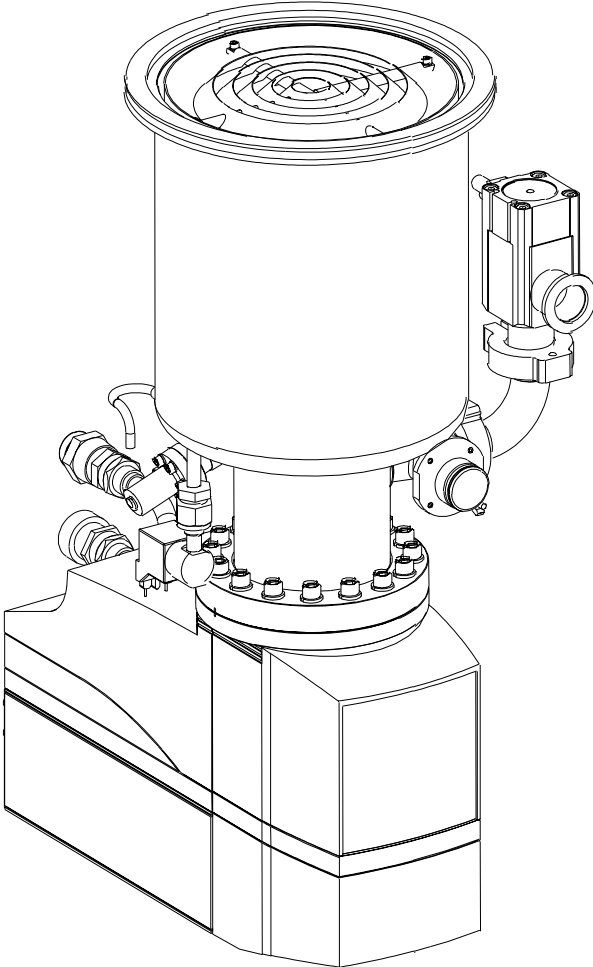


Figure 1-2: On-Board IS 8 (Straight) Cryopump

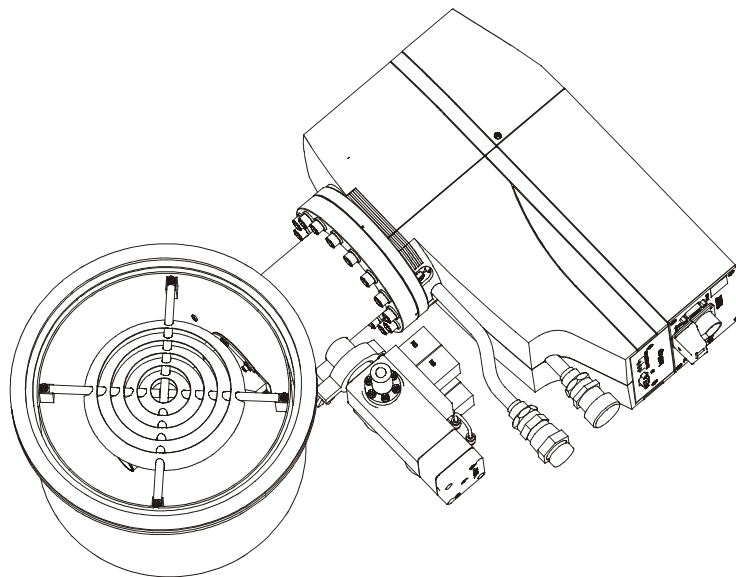


Figure 1-3: On-Board IS 250F and 250FE Cryopump

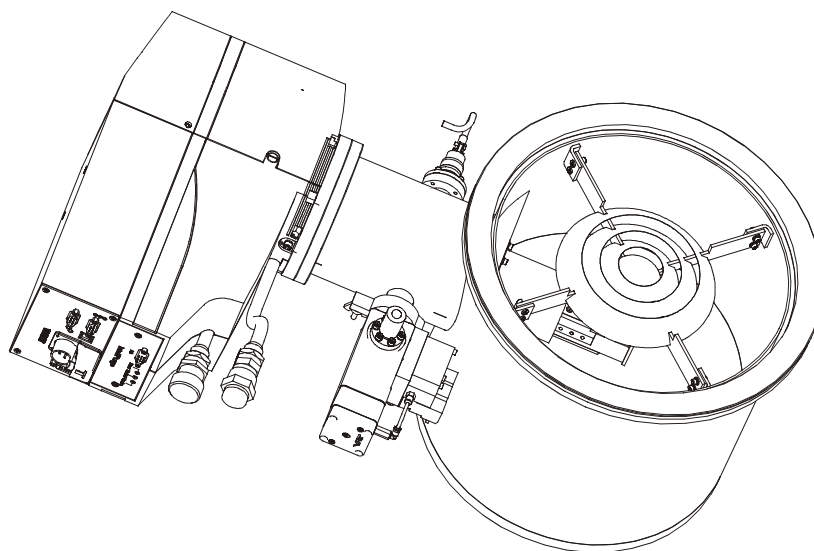


Figure 1-4: On-Board IS 320F and 320FE Cryopump

Performance Specifications

**Table 1-1: On-Board IS 8F Cryopump Specifications
(Helix Part Number 8185038 with Chevron Array)**

Parameter		Specifications
Integrated Hardware		Roughing Valve Purge Valve Cryopump TC Gauge 1st Stage Diode 2nd Stage Diode 1st Stage Heater 2nd Stage Heater RS-232 Interface
Pumping Speeds	Water	4,000 liters/sec
	Nitrogen	1,500 liters/sec
	Hydrogen	2,200 liters/sec
	Argon	1,200 liters/sec
Argon Throughput at 20K*		250 - 700 sccm (torr-liters/sec)
Capacities	Argon	1000 std. liters @ 5×10^{-6} torr 750 std. liters @ 5×10^{-7} torr (recovery in 30 seconds)
	Hydrogen	12 std. liters @ 5×10^{-6} torr
	Nitrogen	550 std. liters (recovery to 5×10^{-7} torr in 30 seconds)
Crossover		150 torr-liters
Full Regeneration - Cold to Cold (with 1 minute extended purge)		≤ 90 minutes (1 pump/1 compressor) ≤ 120 minutes (5 pumps/1 compressor)
Fast Regeneration		≤ 35 minutes (1 pump/1 compressor) ≤ 60 minutes (5 pumps/1 compressor)
Dimensions		Refer to Installation/Interface Drawing
Weight		67 lbs.
*Depends upon system configuration.		

**Table 1-2: On-Board IS 8 Cryopump Specifications
(Helix Part Number 8185039 with Chevron Array)**

Parameter		Specifications
Integrated Hardware		Roughing Valve Purge Valve Cryopump TC Gauge 1st Stage Diode 2nd Stage Diode 1st Stage Heater 2nd Stage Heater RS-232 Interface
Pumping Speeds	Water	4,000 liters/sec
	Nitrogen	1,500 liters/sec
	Hydrogen	2,500 liters/sec
	Argon	1,200 liters/sec
Argon Throughput at 20K*		250 - 700 sccm (torr-liters/sec)
Capacities	Argon	1000 std. liters @ 5×10^{-6} torr > 5000 cycles @ 10 torr-liter (burst recovery to 5×10^{-6} torr)
	Hydrogen	12 std. liters @ 5×10^{-6} torr
Crossover		150 torr-liters
Full Regeneration - Cold to Cold (with 1 minute extended purge)		≤ 90 minutes (1 pump/1 compressor) ≤ 120 minutes (5 pumps/1 compressor)
Fast Regeneration		≤ 35 minutes (1 pump/1 compressor) ≤ 60 minutes (5 pumps/1 compressor)
Dimensions		Refer to Installation/Interface Drawing
Weight		72 lbs.
*Depends upon system configuration.		

**Table 1-3: On-Board IS 250F and 250FE Cryopumps for Implant Specifications
(Helix Part Numbers 8185062G001 and 8185072G001)**

Parameter		Specifications
Integrated Hardware		Roughing Valve Purge Valve Cryopump TC Gauge 1st Stage Diode 2nd Stage Diode 1st Stage Heater 2nd Stage Heater RS-232 Interface
Pumping Speeds	Water	6,500 liters/sec
	Nitrogen	2,200 liters/sec
	Hydrogen	4,500 liters/sec (On-Board IS 250F) 7000 liters/sec (On-Board IS 250FE)
Capacities	Hydrogen	24 std. liters @ 5×10^{-6} torr
Crossover		150 torr-liters
Full Regeneration - Cold to Cold (with 20 minutes extended purge)		≤ 115 minutes (1 pump/1 compressor) ≤ 115 minutes (4 pumps/1 compressor) with TI = 100K
Fast Regeneration		≤ 50 minutes (1 pump/1 compressor) ≤ 50 minutes (4 pumps/1 compressor) with TI = 100K
Dimensions		Refer to Installation/Interface Drawing
Weight		72 lbs.
*Depends upon system configuration.		

**Table 1-4: On-Board IS 320F and 320FE Cryopumps for Implant Specifications
(Helix Part Numbers 8185059G001 and 8185049G001)**

Parameter		Specifications		
Integrated Hardware		Roughing Valve		
		Purge Valve		
		Cryopump TC Gauge		
		1st Stage Diode		
		2nd Stage Diode		
		1st Stage Heater		
		2nd Stage Heater		
		RS-232 Interface		
Pumping Speeds		On-Board IS 320F	On-Board IS 320FE	
		Water	11,000 liters/sec	11,000 liters/sec
		Nitrogen	3,300 liters/sec	3,600 liters/sec
		Hydrogen	9,000 liters/sec	12,500 liters/sec
		Argon	2,700 liters/sec	3,000 liters/sec
Capacities:	Hydrogen	30 std. liters @ 5×10^{-6} torr		
Crossover		300 torr-liters		
Full Regeneration - Cold to Cold (with 20 minutes extended purge)		≤ 150 minutes (1 pump/1 compressor) ≤ 150 minutes (3 pumps/1 compressor) with TI = 100K		
Fast Regeneration		≤ 75 minutes (1 pump/1 compressor) ≤ 75 minutes (3 pumps/1 compressor) with TI = 100K		
Dimensions		Refer to Installation/Interface Drawing		
Weight		100 lbs.		
*Depends upon system configuration.				

Theory of Operation

The On-Board *IS* Cryopumps consist of a refrigerator or coldhead, vacuum vessel, electronics, valves, heaters and temperature and pressure sensors for controlling and monitoring the cryopump.

Cryopumps operate on the principle that gas molecules encountering a sufficiently cold surface (array) will be condensed and held at an extremely low vapor pressure, effectively trapping the molecules and preventing them from returning to the vacuum chamber. Gas molecules that travel into a cryopump are condensed or adsorbed on the cryogenically-cooled arrays and thereby are removed or *pumped* from the vacuum chamber.

The On-Board *IS* Cryopump contains two arrays. The first stage array or inlet array normally operates at temperatures between 65 -120K and is primarily used to pump water vapor.

NOTE: First stage temperature can be operated outside the normal operating temperature range. Refer to [Appendix A - Customer Support Information](#) and contact the Customer Support Center for more information.

The second stage array operates at temperatures between 10-20K and is used to pump air gasses such as nitrogen, argon, and oxygen. Activated charcoal is attached to the second stage array, and is used to cryoadsorb hydrogen, helium, and neon. The Cryopump arrays are cooled using a closed cycle, Gifford McMahan refrigeration cycle utilizing compressed gaseous helium as the refrigerant.

Since the Cryopump is a capture pump, it requires a regeneration cycle when it reaches capacity. The On-Board *IS* Cryopump uses an integrated microprocessor, variable speed motor and heaters to provide a fast and thorough regeneration cycle.

The On-Board *IS* Cryopump system consists of the cryopump and a remotely located On-Board *IS* Compressor which provides the compressed helium. The On-Board *IS* Compressor can provide helium for multiple Cryopumps through helium supply and return lines. The *IS* Controller coordinates all Helix Intercomponent Network communications. A typical On-Board *IS* Cryopump system is shown in [Figure 1-5](#).

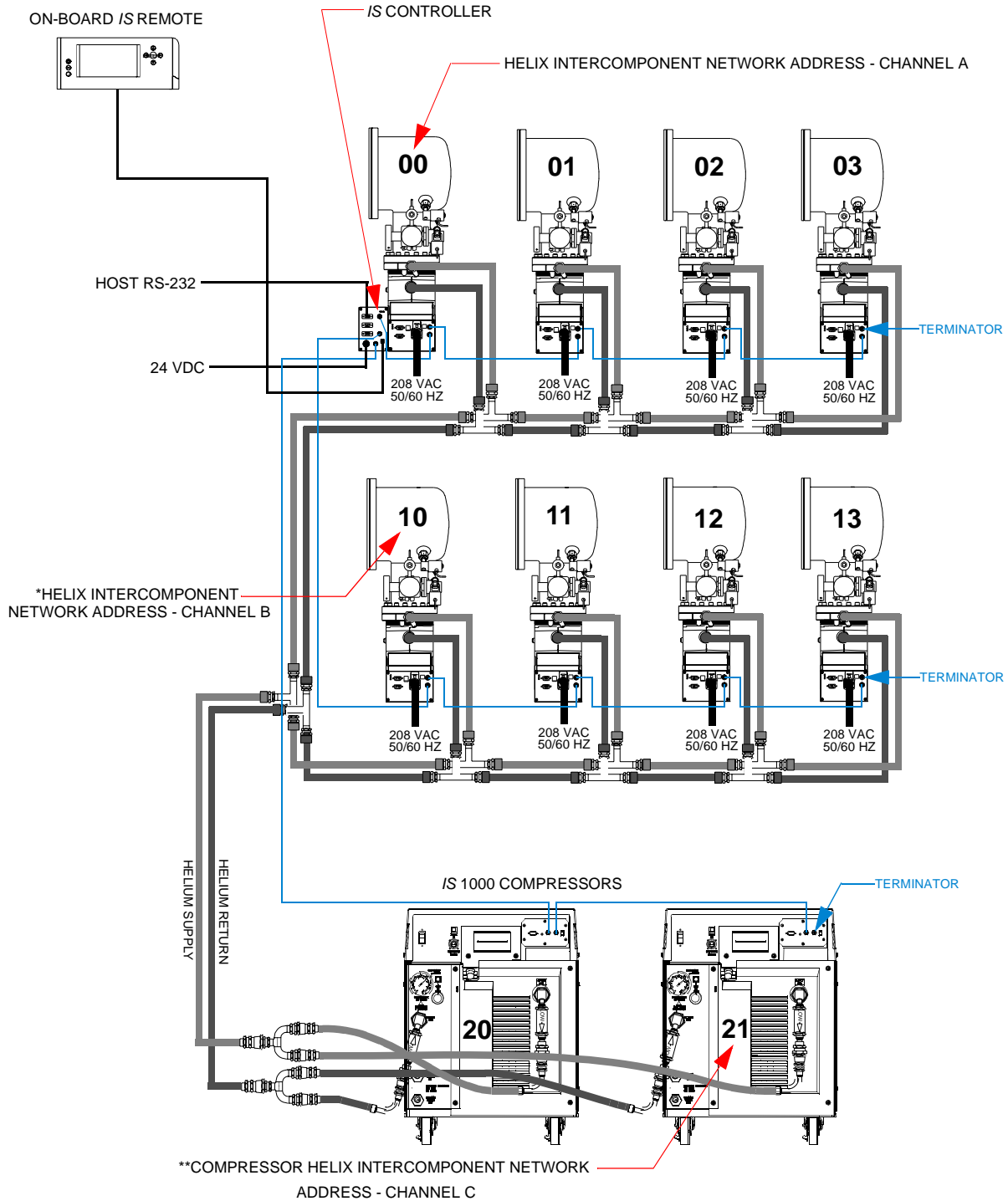


Figure 1-5: Typical On-Board IS Cryopump System

**Note: If the address is set to 0, it appears as 10 on Channel B.*

***Note: If the address is set to 2, it appears as 20 on Channel C.*

Cold Head

The cold head consists of a motor, helium supply and return valves, first and second stage displacer assembly and a cylinder. The cylinder is a welded stainless steel cylinder that is installed in the Cryopump vacuum vessel. The first and second stage arrays are secured to the cylinder inside the Cryopump vacuum vessel.

The displacer assembly is made up of a first and second stage displacer. The displacers are packed with a heat exchange matrix that is used as a thermal reservoir. Each displacer has a seal that causes the helium to flow through the heat exchange matrix inside the displacers rather than between the displacer and the cylinder wall.

Within the coldhead, the motor cycles the displacer assembly up and down the cylinder and actuates the helium supply and return valves. The motor is a direct-drive variable-speed motor, operating between 40-144 rpm.

The following steps and [Figure 1-6](#) describe the Gifford McMahan refrigeration cycle:

1. When the displacer is at the bottom of the cylinder, the helium supply valve opens allowing high pressure helium to fill the cylinder.
2. As the displacer rises, the helium flows through the matrix in the displacers to the bottom of the cylinder.
3. When the displacer reaches the top of the cylinder, the supply valve closes, and the return valve opens allowing the gas to expand and cool.
4. The temperature drop in the expanded helium cools the heat stations, cooling the cryopump arrays.
5. The cooled helium passes out through the return valve, cooling the matrix in the displacers as the displacers move toward the bottom of the cylinder.
6. Steps 1-5 are repeated continuously. With each cycle, the incoming helium is pre-cooled by the matrix as it flows through the displacers, providing an additional increment of refrigeration.

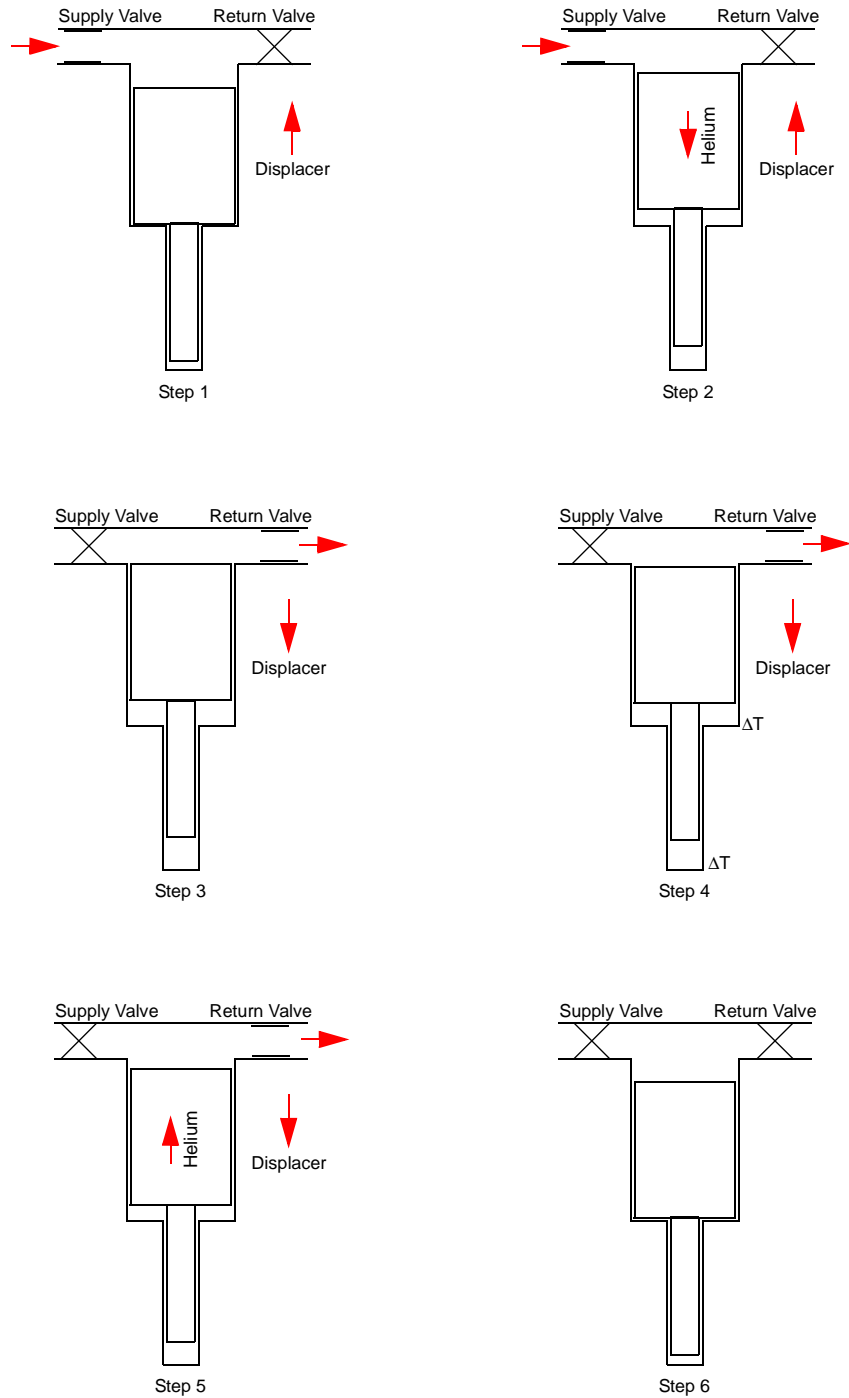


Figure 1-6: Gifford McMahan Refrigeration Cycle

Component Description

The On-Board *IS* Cryopump is driven by a variable speed motor and controlled by an advanced microprocessor On-Board *IS* Module. The On-Board *IS* Module conditions the input power and provides RS-232 and BitBus communication capability. The communication protocol and commands are compatible with all On-Board RS-232 and BitBus network commands.

Inlet Port

The Inlet Port is the opening of the vacuum vessel through which process gases enter the cryopump. The Inlet Port is connected to the vacuum chamber via the gate valve.

Vacuum Vessel

The Vacuum Vessel contains the first and second stage condensing arrays which are cooled to condense process gases.

First Stage Array

The First Stage Array is the first condensing array that a process gas molecule encounters within the Cryopump. Gases such as water vapor and hydrocarbons are condensed onto the first stage array which operates at 65 to 120K. The On-Board *IS* Cryopump utilizes either a chevron array or a sputter plate for the first stage array. The chevron array maximizes the Cryopump pumping speed for all gasses. The sputter plate maximizes the water pumping speed while maintaining reduced process gas pumping speeds.

Second Stage Array

The Second Stage Array condenses gases such as N₂, O₂, Ar, CO₂, and CO and operates at temperatures from 10 to 20K. Activated charcoal is attached to the second stage array which cryoadsorbs H₂, He, and Ne.

Refrigerator

The refrigerator consists of a two-stage cylinder (part of the vacuum vessel) and a coldhead assembly, that together produce closed-cycle refrigeration at temperatures that range from 65 to 120K for the first stage and 10 to 20K for the second stage, depending on operating conditions.

First and Second Stage Heaters

The first and second stage heaters are mounted to the cold head cylinder, are used to warm the Cryopump during a regeneration cycle, and help maintain array temperature settings.

Thermocouple (TC) Gauge

The TC Gauge measures cryopump pressure during a regeneration cycle and sends pressure information to the On-Board *IS* Module.

Diode Connector

The Diode Connector is connected to the diodes that are mounted on the first and second stage arrays of the Cryopump. The diodes measure the first and second stage array temperatures. Array temperature information is sent to the On-Board *IS* Module.

On-Board *IS* Cryopump Valve Operation

The following describes the operation of the valves in the 8 and 8F On-Board *IS* cryopumps.

Purge Valve

The purge valve controls the flow of nitrogen to the Cryopump vessel. During a regeneration cycle, the purge valve opens and allows nitrogen to flow through the vessel to dilute and remove the cryopumped gases.

Roughing Valve

The Roughing Valve connects to a system rough pump or dry pump. The rough valve is used during the Cryopump regeneration cycle to rough the Cryopump to rough vacuum (approximately 50-100 microns) before the Cryopump begins to cool down.

Exhaust Purge Valve

PVD: The Exhaust Purge Valve purges room temperature nitrogen across the O-ring of the Cryopump relief valve to prevent the O-ring from getting too cold during regeneration. The exhaust purge valve actuates whenever the Cryopump rough valve is actuated.

Implant: The Exhaust Purge Valve suppresses oxygen in the exhaust line during regeneration. It is independently controlled.

Vacuum Vessel Pressure Relief Exhaust Valve

The Vacuum Vessel Pressure Relief Exhaust Valve is a spring loaded valve which releases process gases during a regeneration cycle. The relief valve opens at approximately 2-3 psig.

On-Board *IS* Cryopump Multi-Function Valve Operation

The multi-function valve combines the functions of the rough valve, pump purge valve, exhaust purge valve, and relief valve. The basic functions as described previously also apply, except that all valves on the Multi-Function valve are piloted, and therefore require high pressure air for operation. On the 250mm and 320mm On-Board *IS* Cryopumps with the IntelliPurge system, the Exhaust Purge and Pump Purge valves are normally open valves, requiring air to close, and air and Nitrogen to open. See the description of the IntelliPurge system in the [Connecting IntelliPurge](#) section for details.

Helium Supply Fitting

The Helium Supply Fitting provides a connection for high pressure compressed helium from the *IS* 1000 Compressor to the Cryopump.

Helium Return Fitting

The Helium Return Fitting provides a connection to return low pressure helium which has been cycled through the Cryopump to the On-Board *IS* Compressor.

On-Board IS 8F Cryopump Component Description and Facility Requirements

Component Name	Facility Requirement or Specification	
1 TC Gauge	N/A	
2 Vacuum Vessel Mounting Flange	Contact Helix for the Installation/Interface drawing.	
3 Cold Throttle Plate (covers First Stage Array)	N/A	
4 Roughing Valve Pilot	Supply port 1/8" one-touch tube connection 60 psig minimum	Exhaust port 1/4" one-touch tube connection 80 psig maximum
5 Roughing Valve	N/NW-25 ISO KF flange 10 cfm	
6 Pump Purge Valve and Exhaust Purge Valve Nitrogen Connection	3/8" one-touch tube connection Minimum 4scfm	60 psig minimum 80 psig maximum
7 Helium Return Fitting	See Figure 2-9 .	
8 Module Power Connector	208 VAC (range: 180 - 253 VAC) 5 amps 50/60 Hz	Single phase Also see Figure 1-12 .
9 Communication Module	N/A, see Figure 2-9 .	
10 Diode Connector	N/A	
11 Address Switches	See Figure 1-12 .	
12 Status LEDs	See Figure 1-12 .	
13 Host (RS-232) Connector	See Figure 1-12 .	
14 Service (RS-232) Connector	See Figure 1-12 .	
15 Pump Purge Valve	See component number 6 on this page.	
16 Pressure Relief Valve Adapter	1/2" Female NPT (for Pressure Relief Valve, internal component)	
17 Exhaust Purge Valve	See component number 6 on this page.	
18 Helium Supply Fitting	See Figure 2-9 .	
19 On-Board IS Remote Connector	See Figure 1-12 .	
20 Helix Intercomponent Network Connectors	See Figure 1-12 .	

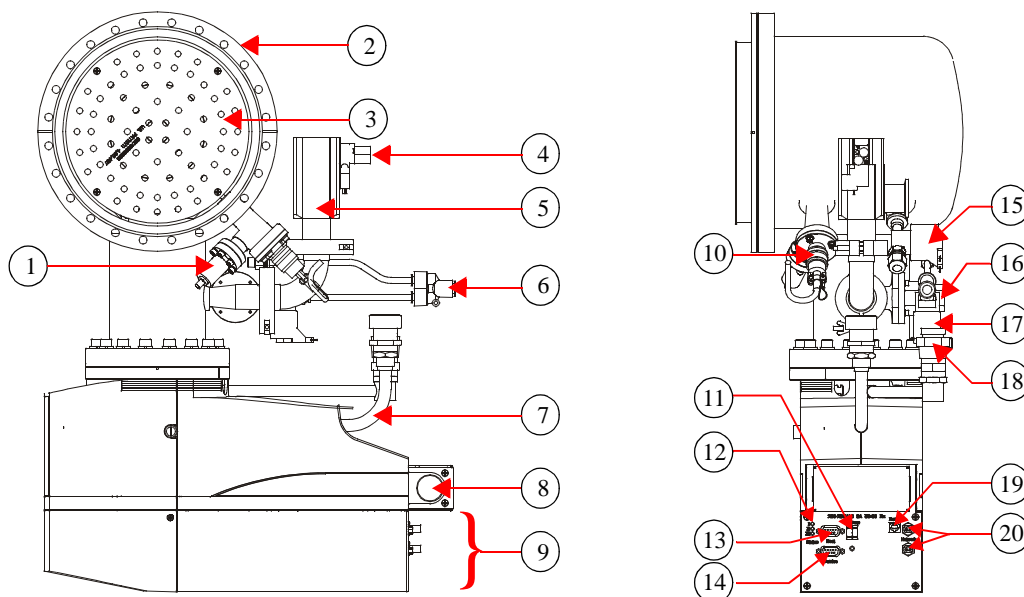


Figure 1-7: On-Board IS 8F Cryopump Component Identification

On-Board IS 8F Cryopump, with the Multi-Function Valve, Component Description and Facility Requirements

Component Name	Facility Requirement or Specification		
1 *TC Gauge	N/A		
2 Address Switches	See Figure 1-12 .		
3 Status LEDs	See Figure 1-12 .		
4 Host (RS-232) Connector	See Figure 1-12 .		
5 Service (RS-232) Connector	See Figure 1-12 .		
6 *Multi-Function Valve Pilot	1/4" one-touch tube connection	60 psig minimum	80 psig maximum
7 Diode Connector	N/A		
8 On-Board IS Remote Connector	See Figure 1-12 .		
9 Helix Intercomponent Network Connectors	See Figure 1-12 .		
10 Module Power Connector/Module Interlock	208 VAC (range: 180 - 253 VAC) 5 amps	50/60 Hz Single phase	Also see Figure 1-12 .
11 Vacuum Vessel Mounting Flange	Contact Helix for the Installation/Interface drawing.		
12 First Stage Array (Visible on the Front)	N/A		
13 Multi-Function Valve	N/A		
14 *Pump Purge Valve and Exhaust Purge Valve Nitrogen Connection	Minimum 4scfm 1/8" Female NPT	PVD: 60 - 80 psig	Implant: 25 - 30 psig
15 *Pressure Relief Valve Adapter	1/2" Female NPT (for Pressure Relief Valve, internal component)		
16 *Roughing Valve	N/NW-25 ISO KF flange	10 cfm	
*Pump Purge Valve (Not Shown)	See component number 14 on this page.		
*Exhaust Purge Valve (Not Shown)	See component number 14 on this page.		
17 Helium Supply Fitting	See Figure 2-9 .		
18 Helium Return Fitting	See Figure 2-9 .		
19 Communication Module	N/A, see Figure 2-9 .		

*Part of Multi-Function Valve

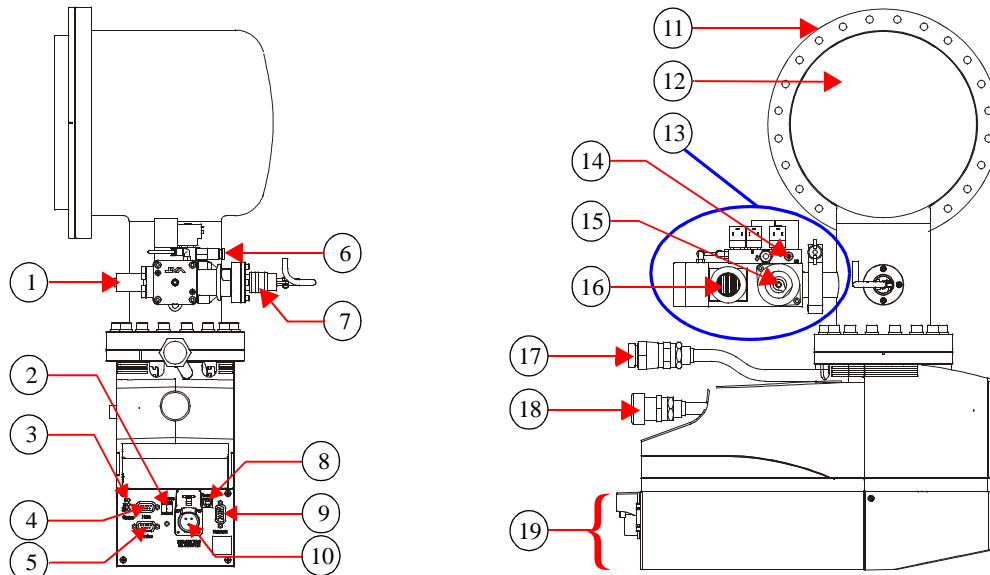


Figure 1-8: On-Board IS 8F Cryopump, with the Multi-Function Valve, Component Identification

On-Board IS 8 Cryopump Component Description and Facility Requirements

Component Name		Facility Requirement or Specification	
1	Pressure Relief Valve Adapter	1/2" Female NPT (for Pressure Relief Valve, internal component)	
2	Vacuum Vessel Mounting Flange	Contact Helix for the Installation/Interface drawing.	
3	Vacuum Vessel	N/A	
4	Diode Connector	N/A	
5	TC Gauge	N/A	
6	Helium Supply Fitting	See Figure 2-9.	
7	Helium Return Fitting	See Figure 2-9.	
8	Communication Module	N/A, see Figure 2-9.	
9	Pump Purge Valve	1/8" NPT Female Minimum 2 scfm	60 psig minimum 80 psig maximum
10	On-Board IS Remote Connector	See Figure 1-12.	
11	Helix Intercomponent Network Connectors	See Figure 1-12.	
12	Module Power Connector/Module Interlock	208 VAC (range: 180 - 253 VAC) 5 amps	50/60 Hz Single phase Also see Figure 1-12.
13	Roughing Valve	N/NW-25 ISO KF flange	10 cfm
14	Roughing Valve Pilot	Supply port 1/8" one-touch tube connection	PVD: 60 - 80 psig Implant, with Multi-Funtion Valve: 25 - 30 psig
15	Address Switches	See Figure 1-12.	
16	Status LEDs	See Figure 1-12.	
17	Host (RS-232) Connector	See Figure 1-12.	
18	Service (RS-232) Connector	See Figure 1-12.	

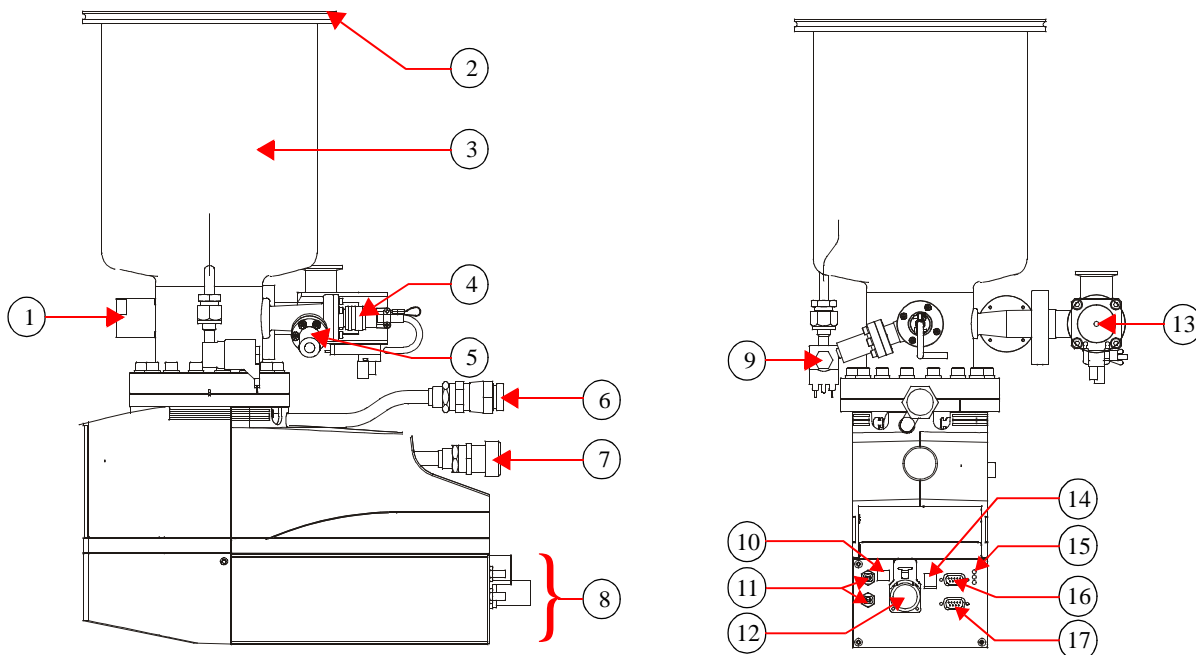


Figure 1-9: On-Board IS Straight 8 Cryopump Component Identification

On-Board IS 250F and 250FE Cryopump Component Description and Facility Requirements

Component Name	Facility Requirement or Specification	
1 *TC Gauge	N/A	
2 IntelliPurge LEDs	N/A	
3 On-Board IS Remote Connector	See Figure 1-12 .	
4 Helix Intercomponent Network Connectors	See Figure 1-12 .	
5 Module Power Connector/Module Interlock	208 VAC (range: 180 - 253 VAC) 5 amps	50/60 Hz Single phase Also see Figure 1-12 .
6 Diode Connector	N/A	
7 *Multi-Function Valve Pilot	1/4" one-touch tube connection	60 psig minimum 80 psig maximum
8 IntelligPurge I/O Connection	High-density DB-15. See Table 2-1 for pin descriptions.	
9 Address Switches	See Figure 1-12 .	
10 Status LEDs	See Figure 1-12 .	
11 Host (RS-232) Connector	See Figure 1-12 .	
12 Service (RS-232) Connector	See Figure 1-12 .	
13 Vacuum Vessel Mounting Flange	Contact Helix for the Installation/Interface drawing.	
14 First Stage Array (Visible on the Front)	N/A	
15 Multi-Function Valve	N/A	
16 *Pressure Relief Valve Adapter	1/2" Female NPT (for Pressure Relief Valve, internal component)	
17 *Roughing Valve	N/NW-25 ISO KF flange	17 - 20 cfm
18 *Pump Purge Valve and Exhaust Purge Valve Nitrogen Connection	Minimum 4.25scfm 1/8" Female NPT	25 psig minimum 30 psig maximum
*Pump Purge Valve (Not Shown)	See component number 6 on this page.	
*Exhaust Purge Valve (Not Shown)	See component number 6 on this page.	
19 Helium Supply Fitting	See Figure 2-9 .	
20 Helium Return Fitting	See Figure 2-9 .	
21 Communication Module	N/A, see Figure 2-9 .	

*Part of Multi-Function Valve

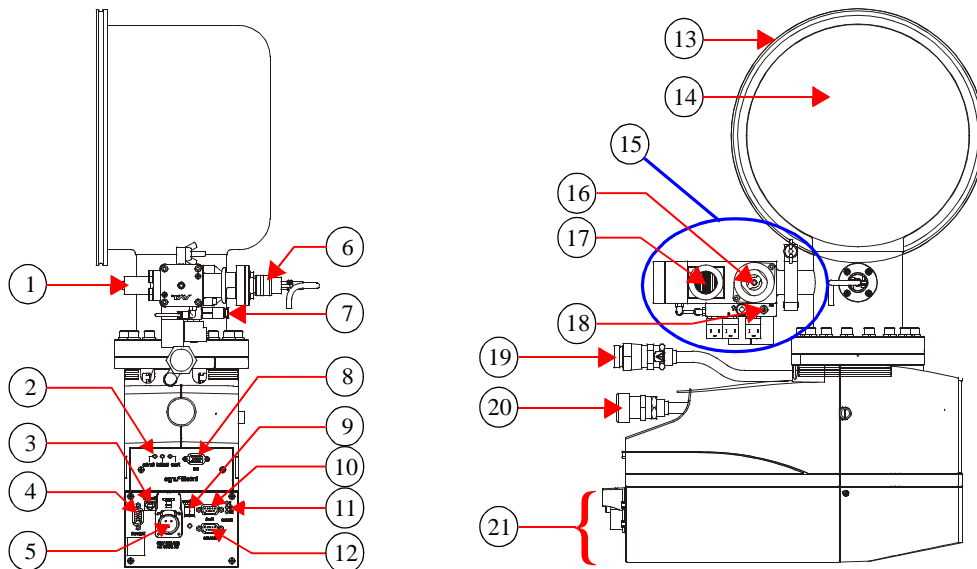


Figure 1-10: On-Board IS 250F and 250FE Component Identification

On-Board IS 320F and 320FE Cryopump Component Description and Facility Requirements

Component Name	Facility Requirement or Specification	
1 *TC Gauge	N/A	
2 IntelliPurge I/O Connection	N/A	
3 Address Switches	See Figure 1-12 .	
4 Host (RS-232) Connector	See Figure 1-12 .	
5 Status LEDs	See Figure 1-12 .	
6 Service (RS-232) Connector	See Figure 1-12 .	
7 *Multi-Function Valve Pilot	1/4" one-touch tube connection	60 psig minimum 80 psig maximum
8 IntelliPurge LEDs	High-density DB-15. See Table 2-1 for pin descriptions.	
9 On-Board IS Remote Connector	See Figure 1-12 .	
10 Helix Intercomponent Network Connectors	See Figure 1-12 .	
11 Module Power Connector/Module Interlock	208 VAC (range: 180 - 253 VAC) 5 amps	50/60 Hz Single phase Also see Figure 1-12 .
12 Vacuum Vessel Mounting Flange	Contact Helix for the Installation/Interface drawing.	
13 First Stage Array (Visible on the Front)	N/A	
14 Multi-Function Valve	N/A	
15 *Pump Purge Valve and Exhaust Purge Valve Nitrogen Connection	Minimum 4.25 scfm 1/8" Female NPT	25 psig minimum 30 psig maximum
16 *Pressure Relief Valve Adapter	1/2" Female NPT (for Pressure Relief Valve, internal component)	
17 *Roughing Valve	N/NW-25 ISO KF flange	17 - 20 cfm
*Pump Purge Valve (Not Shown)	See component number 6 on this page.	
*Exhaust Purge Valve (Not Shown)	See component number 6 on this page.	
18 Helium Supply Fitting	See Figure 2-9 .	
19 Helium Return Fitting	See Figure 2-9 .	
20 Communication Module	N/A, see Figure 2-9 .	
21 Diode Connector	N/A	

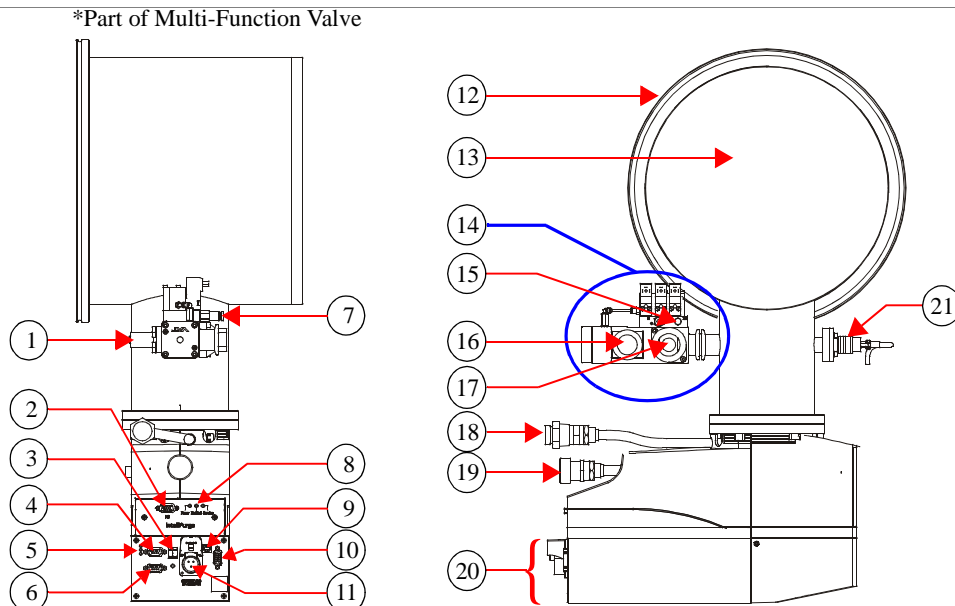


Figure 1-11: On-Board IS 320F and 320FE Component Identification

On-Board *IS* Module

The On-Board *IS* Module controls the operation of the On-Board *IS* Cryopumps. In addition, the On-Board *IS* Module conditions the input power and provides host computer RS-232 and Network communication ports. [Figure 1-12](#) shows the current On-Board *IS* module components, and [Figure 1-13](#) shows the obsolete module components.

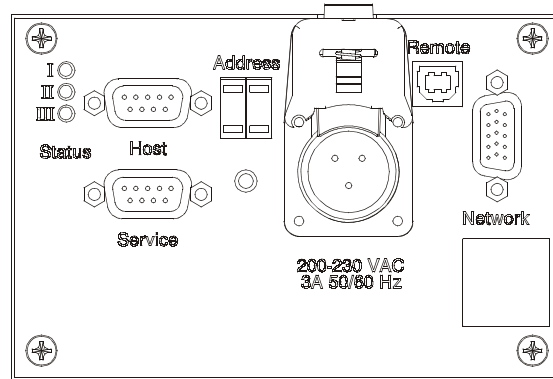


Figure 1-12: On-Board *IS* Current Module Components

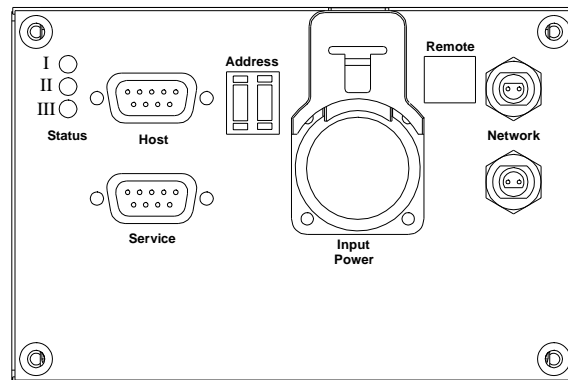


Figure 1-13: On-Board *IS* Obsolete Module Components

Status LEDs

The Status LEDs (I, II and III) give On-Board IS Cryopump, regeneration cycle and network communications status. [Table 1-5](#) describes the LEDs on the Communication Module. [Table 1-6](#) describes the IntelliPurge LEDs.

Table 1-5: Status LED Description

LED	Purpose	LED States		
		OFF	Amber	Green
I	Cryopump Status	Motor OFF	1st and/or 2nd stage temperature control is OFF	Motor ON and 1st and 2nd stage temperature control ON.
II	Regen Status	Normal Operation	Fast Regeneration Cycle in progress	Full regeneration cycle in progress.
III	Network Communication Status	No network communication	Heater Fault Interrupt	Blinking LED - normal network communication.

*Second stage temperature control is only available on On-Board IS Cryopumps for Implant.

Table 1-6: IntelliPurge Status LED Description

	Normal Operation	During Power Fail	Fault
Power LED	Green when unit is powered	Off	Green or Off
Enabled LED	Fully green when unit is fully charged	Fading green as unit discharges	Green or OFF
Service LED	Off	Off	Steady red when there is a fault in the redundant circuit. Flashing red when there is a significant component failure. UPS circuit may not work.

Control Module Components

The following sections describe the control module components on the On-Board IS cryopumps.

Host

The Host connector allows the On-Board *IS* Cryopump to communicate with a host computer using the CTI-Cryogenics command set. Refer to [Table 1-7](#) for additional information on the communication protocol.

NOTE: Refer to [Appendix A - Customer Support Information](#) and call the Customer Support Center to request a copy of the **On-Board IS Cryopump System Command Set Manual** part number 8040677 if you are controlling the On-Board *IS* Cryopump system through a process tool host computer.

Table 1-7: RS-232 Communication Information

Parameter	Value
Baud Rate	9.6 kbps
Data Bits	7
Parity	Even
Number of Stop Bits	1

NOTE: The RS-232 Communication Cable must be fully shielded through to the outer shell. Use cable Helix part number 8132157 or equivalent.

Service

The Service connector allows CTI-Cryogenics service personnel to connect diagnostic equipment to On-Board *IS* Cryopump.

Address Selector Switch

The Address Selector Switch establishes the network address (0 - 9) of the On-Board *IS* Cryopump on the Helix Intercomponent Network. Use channel B to get pumps 10 - 19.

Input Power

The Input Power connector allows 208 VAC to be connected directly to the On-Board *IS* Cryopump. Refer to [Table 2-1](#) for input power specifications.

Remote

The Remote connector allows a remote keypad/display to be connected to the On-Board *IS* Cryopump.

Network

The network connectors allow the On-Board *IS* Cryopump to be connected to the Helix Intercomponent Network.

Newer modules use HD15 connector for the Network connector. Adapter part number 8186509G001 is available to connect the HD15 style module to an existing two pin network cable.

Section 2 - Installation

Introduction

This installation information is for both experienced and inexperienced On-Board *IS* Cryopump system technicians.

The flowchart in [Figure 2-1](#) shows the On-Board *IS* Cryopump installation process, which is explained in this chapter.

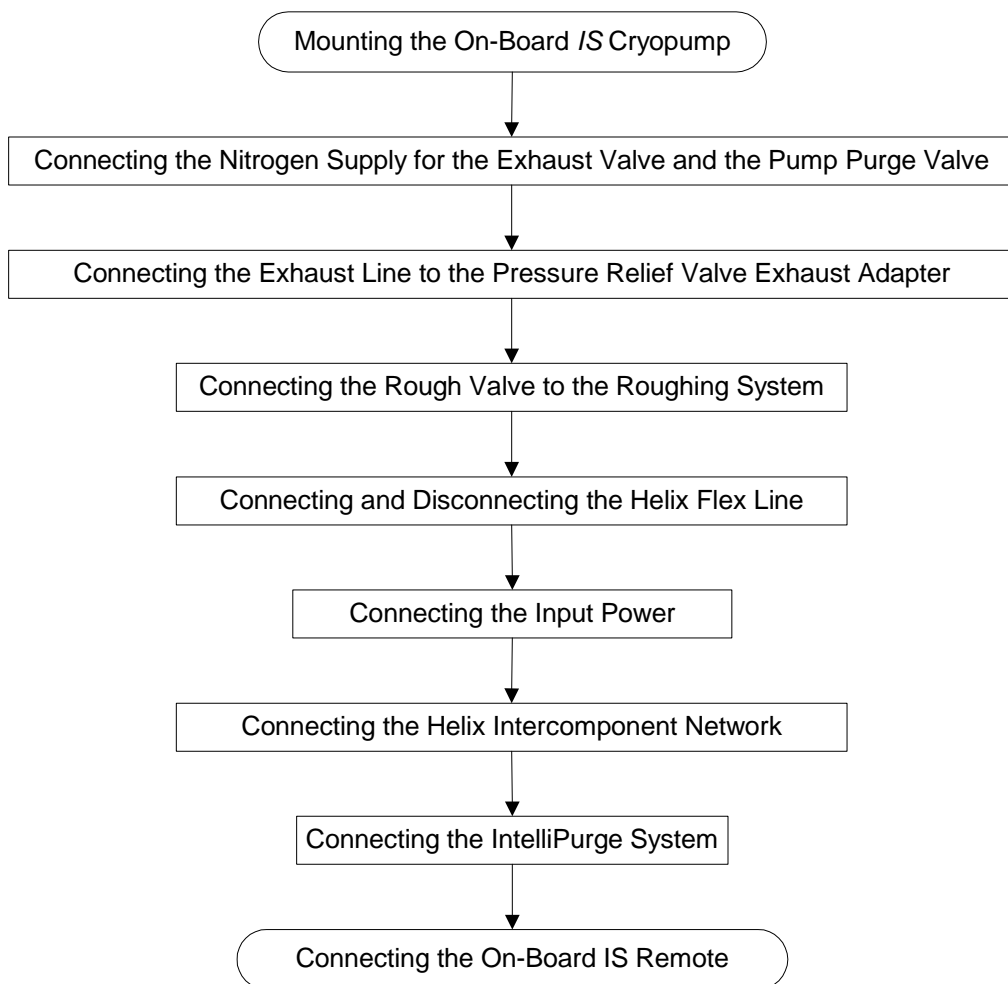


Figure 2-1: On-Board *IS* Cryopump Installation Process

See also [Figure 2-16](#) for an example of a typical cryopump system.


Mounting the On-Board IS Cryopump

The On-Board IS Cryopump may be installed on the vacuum system Hi-Vac valve flange in any orientation without affecting its performance.

NOTE: Before mounting the On-Board IS Cryopump to the vacuum system, a high-vacuum isolation valve (Hi-Vac valve) should be installed between the On-Board IS Cryopump and the vacuum chamber to isolate the On-Board IS Cryopump from the chamber during rough pumping, cooldown, and regeneration.

Install the On-Board IS Cryopump on the vacuum system flange as shown in [Figure 2-2](#) and as follows:

1. Remove the protective cover from the vacuum vessel mounting flange of the On-Board IS Cryopump.
2. Clean all sealing surfaces and install the metal seal gasket, centering ring (not shown), or O-ring.
3. Mount the On-Board IS Cryopump on the Hi-Vac valve or vacuum chamber mounting flange.
4. Install all claw clamps (not shown) or mounting bolts and lock washers.
5. Tighten the mounting bolts to mounting flange specifications.

	<p style="text-align: center;">CAUTION</p> <p style="text-align: center;">Heavy Object</p> <p>To avoid injury when installing or removing cryopumps, use a lifting aid and proper lifting techniques.</p>
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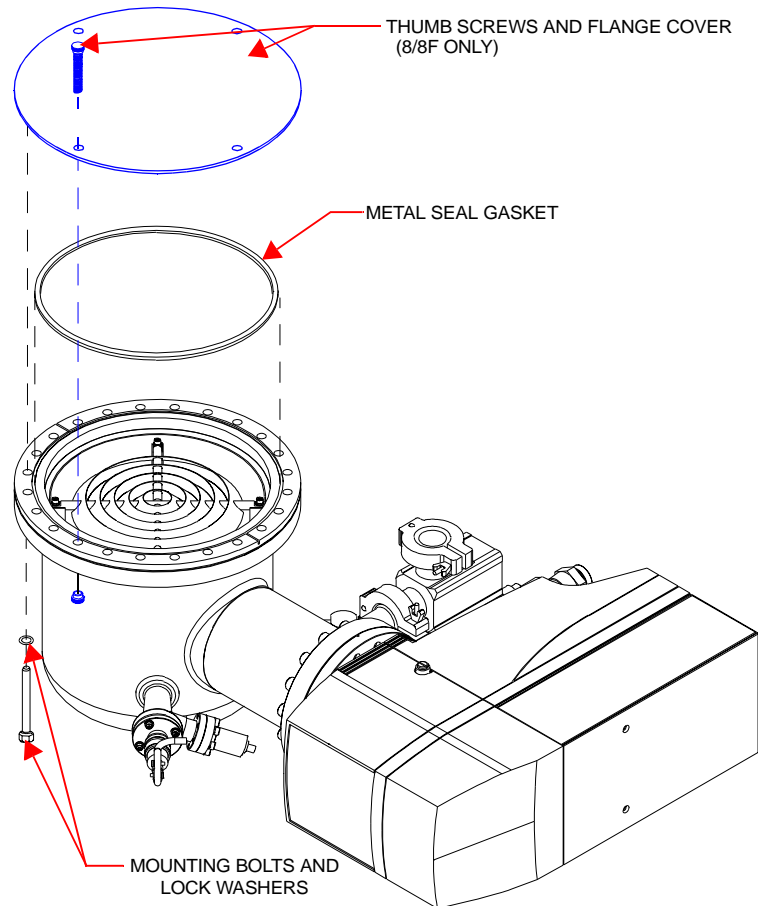


Figure 2-2: On-Board *IS* Cryopump and Metal Seal Gasket Installation (8F Cryopump)

Connecting the Nitrogen Supply for the Exhaust Valve and the Pump Purge Valve

Cryopumps create a vacuum by condensing and capturing gases, but the cryopumps have a finite capacity. Periodically they must be defrosted (regenerated) to restore full performance. A pressure relief valve on the cryopump vents the gases that are released during regeneration.

1. Connect tubing to the nitrogen purge connection as shown in [Figure 2-3](#).

See [page 1-16](#) through [page 1-20](#) for component descriptions and facility requirements for each cryopump.

2. Adjust the nitrogen supply pressure regulator according to the specifications on [page 1-16](#) through [page 1-20](#).

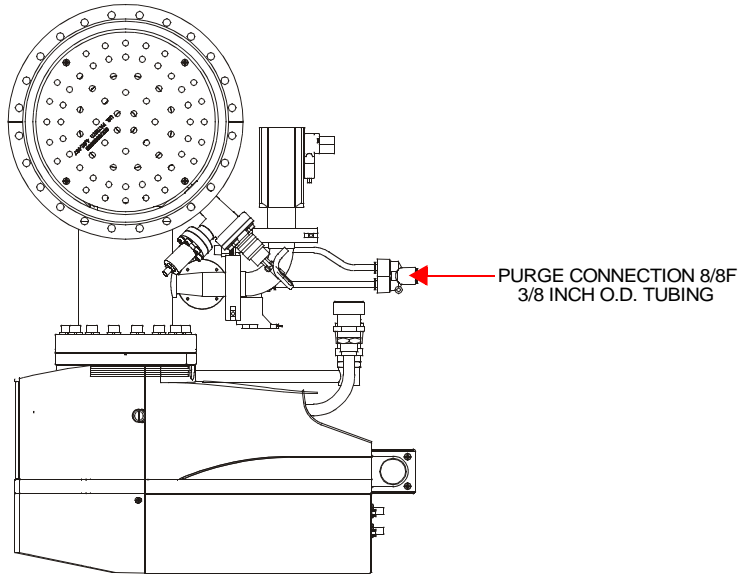


Figure 2-3: Nitrogen Connection

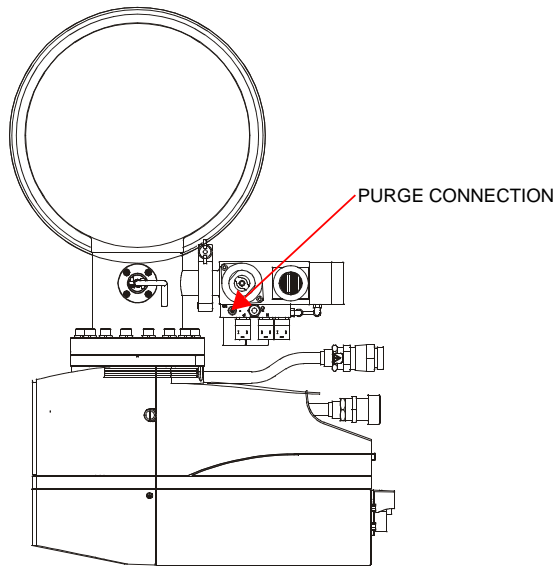


Figure 2-4: Nitrogen Connection Through the Multi-Function Valve

Connecting the Pressure Relief Valve and Exhaust System

	<p style="text-align: center;">⚠ WARNING</p> <p style="text-align: center;">Toxic, Corrosive, or Flammable Gas</p> <p>To prevent personal injury, over pressurization, and equipment damage, connect an exhaust system vent line to the On-Board <i>IS</i> Cryopump pressure relief valve before pumping toxic, corrosive, or flammable gases.</p>
--	--

An exhaust gas adapter is available from Helix. See [Figure 2-5](#).

	<p style="text-align: center;">⚠ WARNING</p> <p style="text-align: center;">Exhaust Gas System Requirements</p> <p>To avoid over pressurization and equipment damage, ensure the exhaust gas system vent line has a minimum inside diameter of 1/2 inch.</p> <p>During regeneration, the exhaust system must be able to maintain a peak gas flow of 8 SCFM per cryopump.</p>
--	--

For example: if 4 cryopumps are regenerated together, then the peak gas flow requirement is 32 SCFM.

1. Install a customer supplied 1/2 inch x 14 NPTF Tube Adapter in the exhaust gas adapter as shown in [Figure 2-5](#).
2. Connect a customer supplied 1/2 inch exhaust system vent line to the Tube Adapter fitting as shown in [Figure 2-5](#).

	<p style="text-align: center;">⚠ WARNING</p> <p style="text-align: center;">Pressure Relief Valve Operation</p> <p>To avoid over pressurization, equipment damage, and improper pressure relief valve operation, ensure the 1.30-inch diameter x 1.38-inch long volume around the pressure relief valve remains unobstructed.</p>
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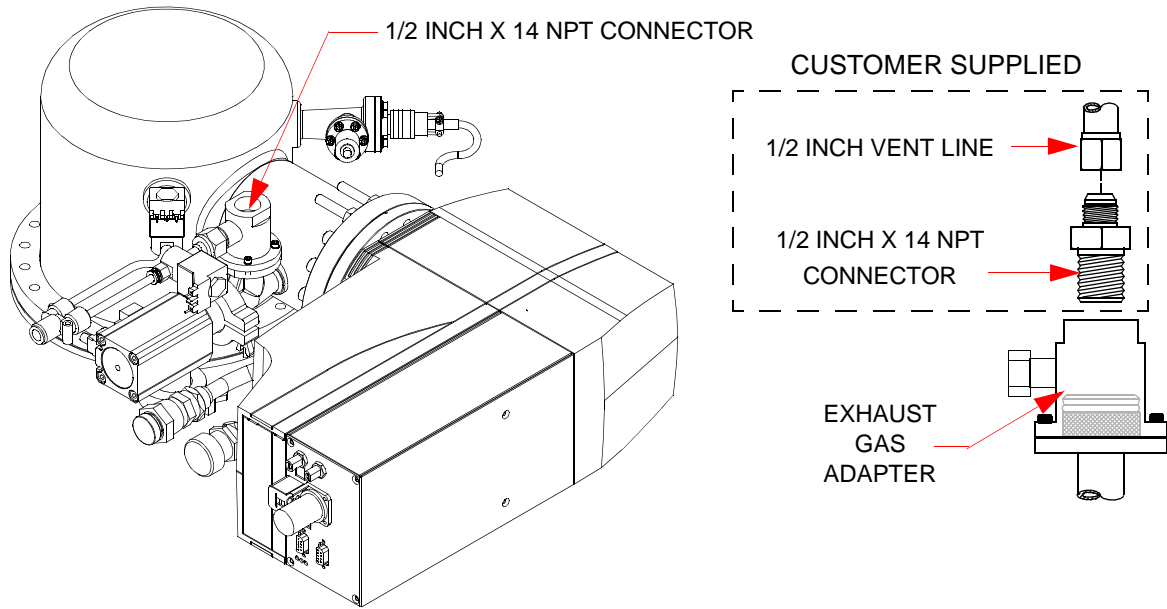


Figure 2-5: Pressure Relief Valve Exhaust Connection

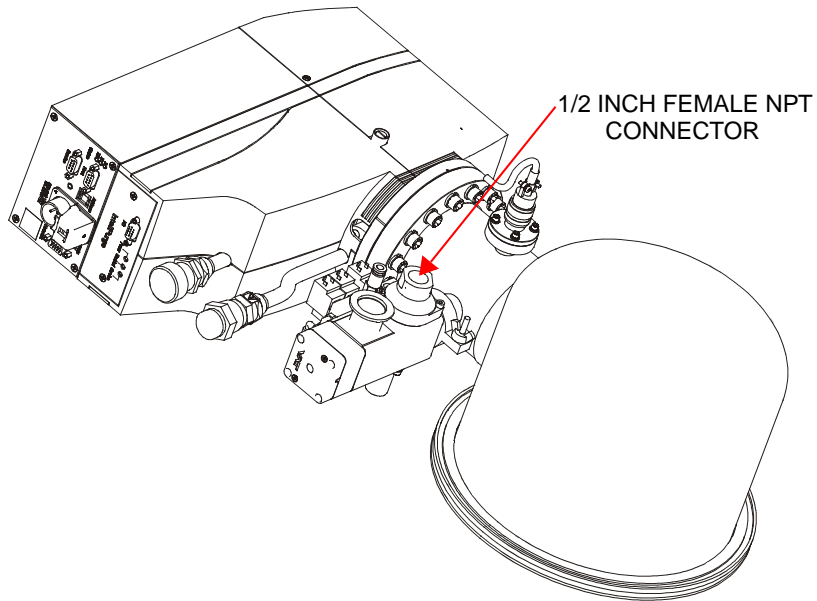


Figure 2-6: Pressure Relief Valve Exhaust Connection Through the Multi-Function Valve

Connecting the Roughing System

NOTE: The roughing system must provide 10 cfm (8, 8F) or 17 to 20 cfm (250, 320) to successfully utilize FastRegen capability. Measure in atmospheres at each On-Board IS Cryopump.

Connect your On-Board IS Cryopump to a roughing pump system using a roughing line with the largest inside diameter possible to minimize the roughing time required during start-up procedures prior to normal operation. The roughing pump should have a blank-off pressure of less than 20 microns.

NOTE: Refer to [Figure 2-7](#) for all Roughing System Connections.

1. Remove the clamp and blank-off from the On-Board IS Cryopump Roughing System Connection.
2. Connect the roughing system line to the On-Board IS Cryopump roughing valve using the clamp provided. Tighten the clamp.
3. Attach the high pressure air or nitrogen to the Roughing Valve Pilot or Multi-Function Valve Pilot connection point.

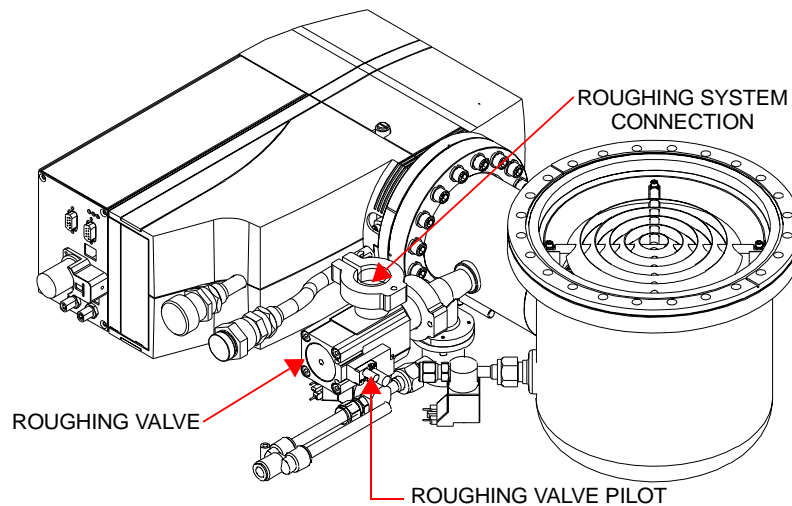


Figure 2-7: Roughing System Connections

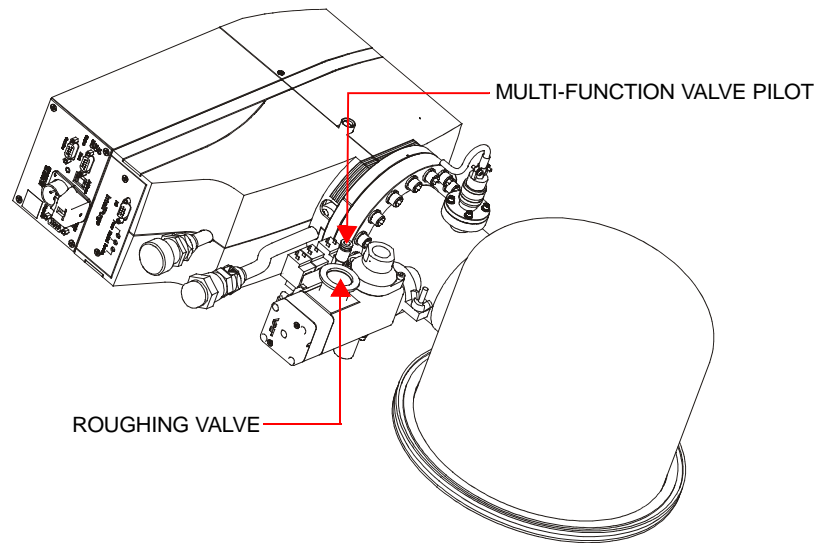


Figure 2-8: Roughing System Connections Through the Multi-Function Valve

Connecting and Disconnecting the Helium Flex Line

	<p>CAUTION</p> <p>Equipment Damage</p> <p>Make sure the helium flex lines are connected and disconnected from the IS 1000 Compressor appropriately, and as shown in Figure 2-9. Failure to follow this procedure could damage connector O-ring seals or cause a helium circuit leak.</p>
--	--

	<p>CAUTION</p> <p>Compressor Damage</p> <p>To avoid damaging the compressor, do not connect multiple compressors to a single helium manifold that feeds a common supply and return header.</p> <p>If it becomes necessary to make this connection, contact CTI-Cryogenics for specific instructions.</p>
--	--

NOTE: The number of On-Board IS Cryopumps connected to an IS 1000 Compressor varies based upon the On-Board IS Cryopump models used. Contact your local Helix Customer Support Center if you need more information on specific compressor/pump applications.

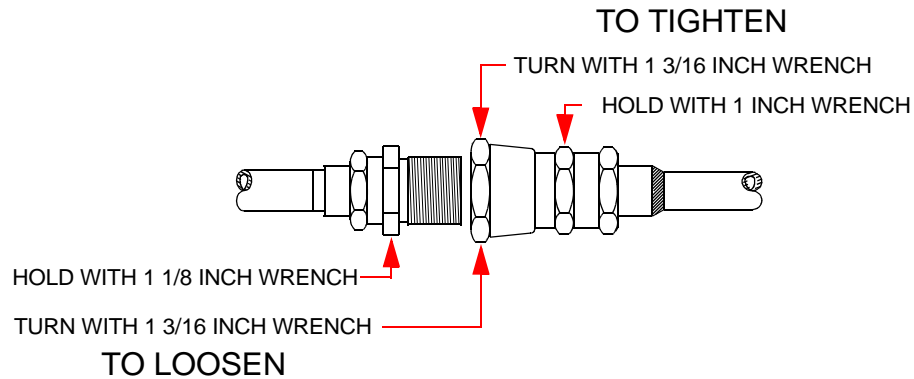


Figure 2-9: Connecting and Disconnecting Helium Flex Line Self Sealing Couplings

Connecting the Helium Flex Line

NOTE: Refer to [Figure 2-9](#) and [Figure 2-10](#) during this procedure.

1. Remove all dust plugs and caps from the Gas Supply and Return lines, and the IS 1000 Compressor and cryopump Supply and Return connectors. Check for the presence of a flat gasket in the male connector, and no gasket in the female connector.
2. Connect the Gas Return line to the GAS RETURN connector on the rear of the IS 1000 Compressor and then to the GAS RETURN connector on the On-Board IS Cryopump or helium manifold. Using two wrenches as shown in [Figure 2-9](#), tighten the connector.
3. Connect the Gas Supply line to the GAS SUPPLY connector on the rear of the IS 1000 Compressor and then to the GAS SUPPLY connector on the On-Board IS Cryopump or helium manifold. Using two wrenches as shown in [Figure 2-9](#), tighten the connector.
4. Attach the Supply and Return line identification labels to each end of the appropriate lines.
5. Refer to *On-Board IS 1000 Compressor Quick Installation Guide*, Helix part number 8040645 to verify proper system ("OFF" Condition) helium charge pressure.

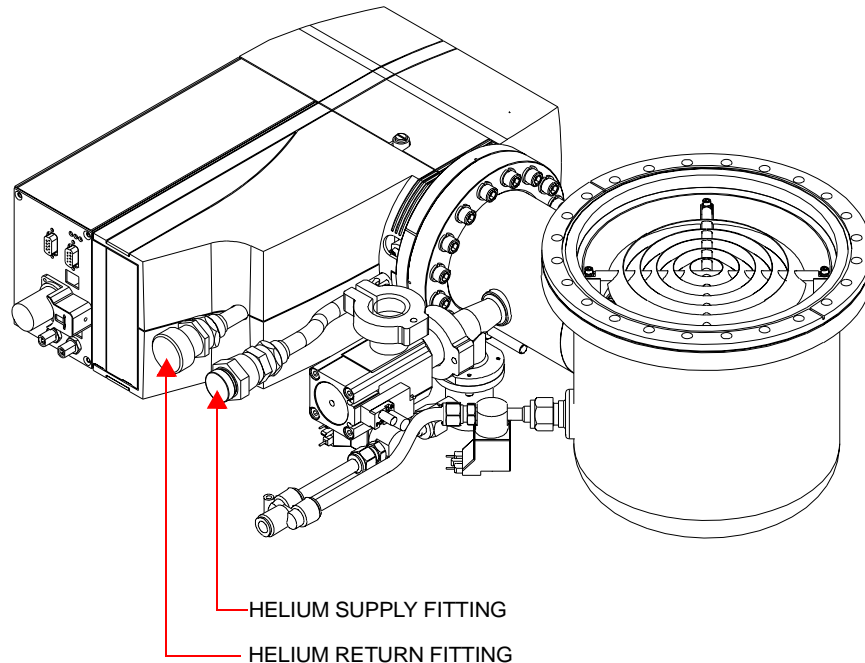



Figure 2-10: Helium Supply and Return Fitting Connections

Disconnecting the Helium Flex Line

NOTE: Refer to [Figure 2-9](#) and [Figure 2-10](#) during this procedure.

1. Using two wrenches as shown in [Figure 2-9](#), disconnect the two self sealing coupling connectors quickly to minimize helium leakage.
2. Connect the helium-return line from the gas-return connector on the rear of the compressor to the gas-return connector on the On-Board IS Cryopump.
3. Connect the helium supply line from the supply connector on the cartridge to the gas-supply connector on the On-Board IS Cryopump.
4. Attach the supply and return line identification decals (CTI-Cryogenics supplied) to their respective connectors.

Connecting the Input Power Through the Module Power Connector

	<p style="text-align: center;">⚠ WARNING</p> <p style="text-align: center;">High Voltage</p> <p>High voltage electric shock could cause severe injury or loss of life.</p> <p><i>After you finish making all the appropriate connections on the module, ensure the On-Board IS Cryopump Power Cable is connected to a 208 VAC, Single-Phase 5 Amp source. Follow all appropriate electrical code requirements to avoid high voltage electric shock.</i></p>
---	---

Refer to [Figure 2-11](#) and [Figure 2-12](#) as necessary throughout the following instructions.

1. Remove the four cover screws.
2. Slide the cover off the Module Power Connector.
3. Remove either one of the two punch-outs.
4. Feed the three wire ends of the input power cable through the punch-out hole so that the wire ends are near the connection points.
5. Attach the two wires (J1-A-Hot and J1-B-Hot) and one ground wire (J1-C-Ground) to the appropriate connection points.
6. Slide the cover on.
7. Replace the cover screws and tighten them.
8. Plug the other end of the cable into the power source.

NOTE: *The power source end of the cable may be different from the example in [Figure 2-12](#).*

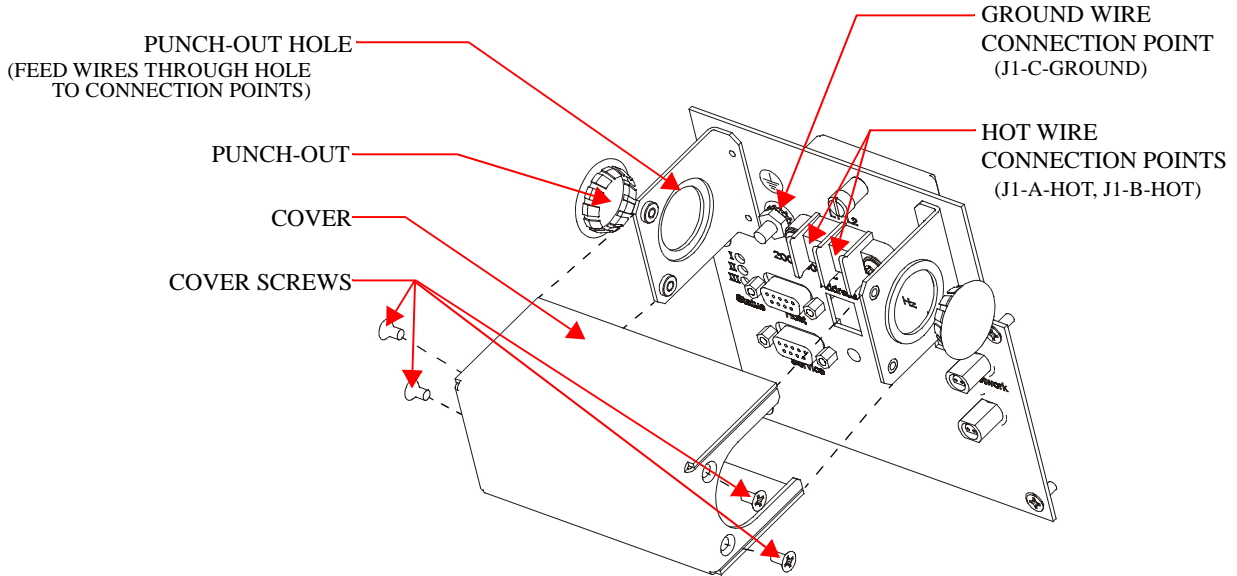


Figure 2-11: Input Power Cable Connection Points for the Module Power Connector

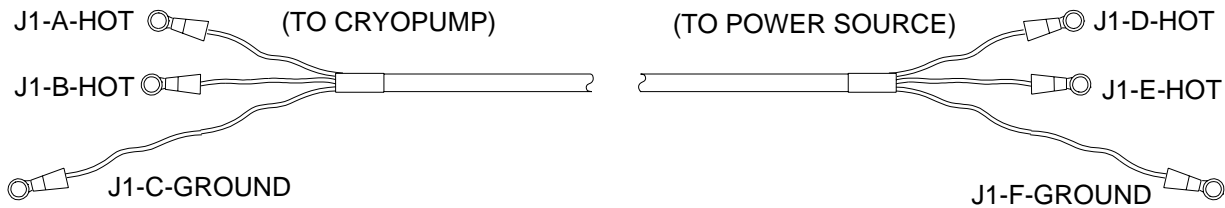




Figure 2-12: Input Power Cable

Connecting the Input Power Through the Communication Module

	<p style="text-align: center;">High Voltage</p> <p>High voltage electric shock could cause severe injury or loss of life.</p> <p>To avoid high voltage electric shock, ensure the On-Board IS Cryopump Power Cable is connected to a 208 VAC, Single-Phase 5 Amp source, and that you follow all appropriate electrical code requirements.</p>

 	<p style="text-align: center;">⚠ CAUTION</p> <p style="text-align: center;">Crush Hazard and Equipment Damage</p> <p>To avoid dropping the On-Board <i>IS</i> Module, do not move the power cable clamp until you are ready to connect the power cord to the On-Board <i>IS</i> Cryopump. The power cable clamp assists in securing the On-Board <i>IS</i> Module to the pump.</p>
--	--

1. Insert a flat blade screwdriver into the power cable clamp slot on the On-Board *IS* Cryopump Module as shown in [Figure 2-13](#).
2. Move the screwdriver away from the power cable connector cap in [Figure 2-13](#).

The screwdriver is held in place in the power cable clamp slot.

The power cable clamp releases the power cable connector cap and the locking tab appears.

3. Remove the power connector cap.
4. Connect the input power cable to the input power cable connector on the module, and then rotate the connector collar until tight.
5. Remove the screwdriver to lower the power cable clamp. This secures the input power cable with the power cable clamp.
6. Connect the opposite end of the input power cable to a local 208 VAC, Single-Phase 5 Amp source as shown in [Figure 2-14](#).

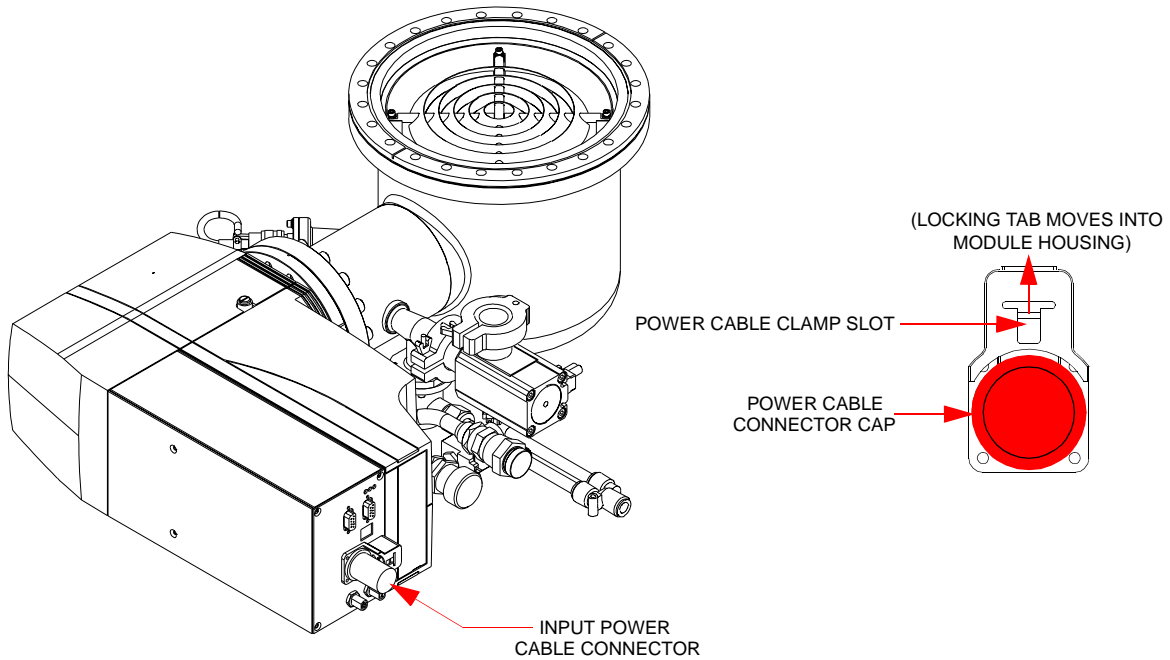


Figure 2-13: Input Power Cable Connection Point for the Module Power Connector

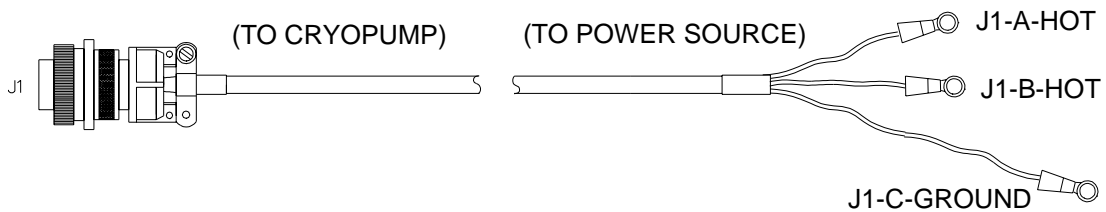


Figure 2-14: Input Power Cable

Connecting the Helix Intercomponent Network

NOTE: Refer to the *On-Board IS Controller Quick Installation Guide (8040657)* for information on connecting On-Board IS Cryopumps to the Helix Intercomponent Network.

Connecting IntelliPurge

	<p>CAUTION</p> <p>Equipment Damage</p> <p>To avoid equipment damage, connect IntelliPurge only if the implant tool is configured to use IntelliPurge.</p> <p>Contact the implant tool manufacturer to check the applicable settings.</p>
--	--

Refer to [Figure 2-15](#) as necessary for the following steps.

1. Connect the IntelliPurge I/O cable to the IntelliPurge Panel High Density DB15 Connector (not shown).
2. Connect the position sensors and control solenoid for the high-vacuum isolation valve to the IntelliPurge I/O cable.

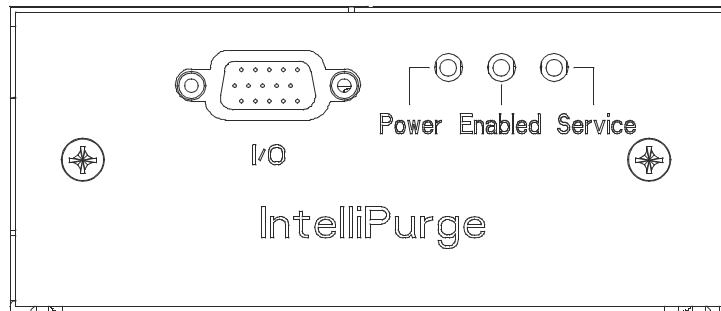


Figure 2-15: IntelliPurge Panel

Table 2-1: IntelliPurge Pin Descriptions

Pin	Description
1	Override Input (12V to 30V DC Override Enable Voltage)
2	Override Voltage Return
3	2nd Stage Warm Up Alarm Relay Normally Open Contact
4	2nd Stage Warm Up Alarm Relay Common Contact
5	2nd Stage Warm Up Alarm Relay Normally Closed Contact
6	24 VDC Return
7	24 VDC Output
8	24 VDC Return
9	Gate Valve Control Relay Normally Open Contact

Table 2-1: IntelliPurge Pin Descriptions

Pin	Description
10	Gate Valve Control Relay Common Contact
11	Gate Valve Control Relay Normally Closed Contact
12	Gate Valve Open Sense Return
13	Gate Valve Open Sense Output
14	Gate Valve Closed Sense Return
15	Gate Valve Closed Sense Output

On-Board *IS* Remote Connections

If desired, an On-Board *IS* Remote can be connected to the On-Board *IS* Cryopump for direct communication with the Cryopump. Refer to the ***On-Board *IS* Remote Quick Installation Guide*** Helix part number 8040664 for information on how to install On-Board *IS* Remote.

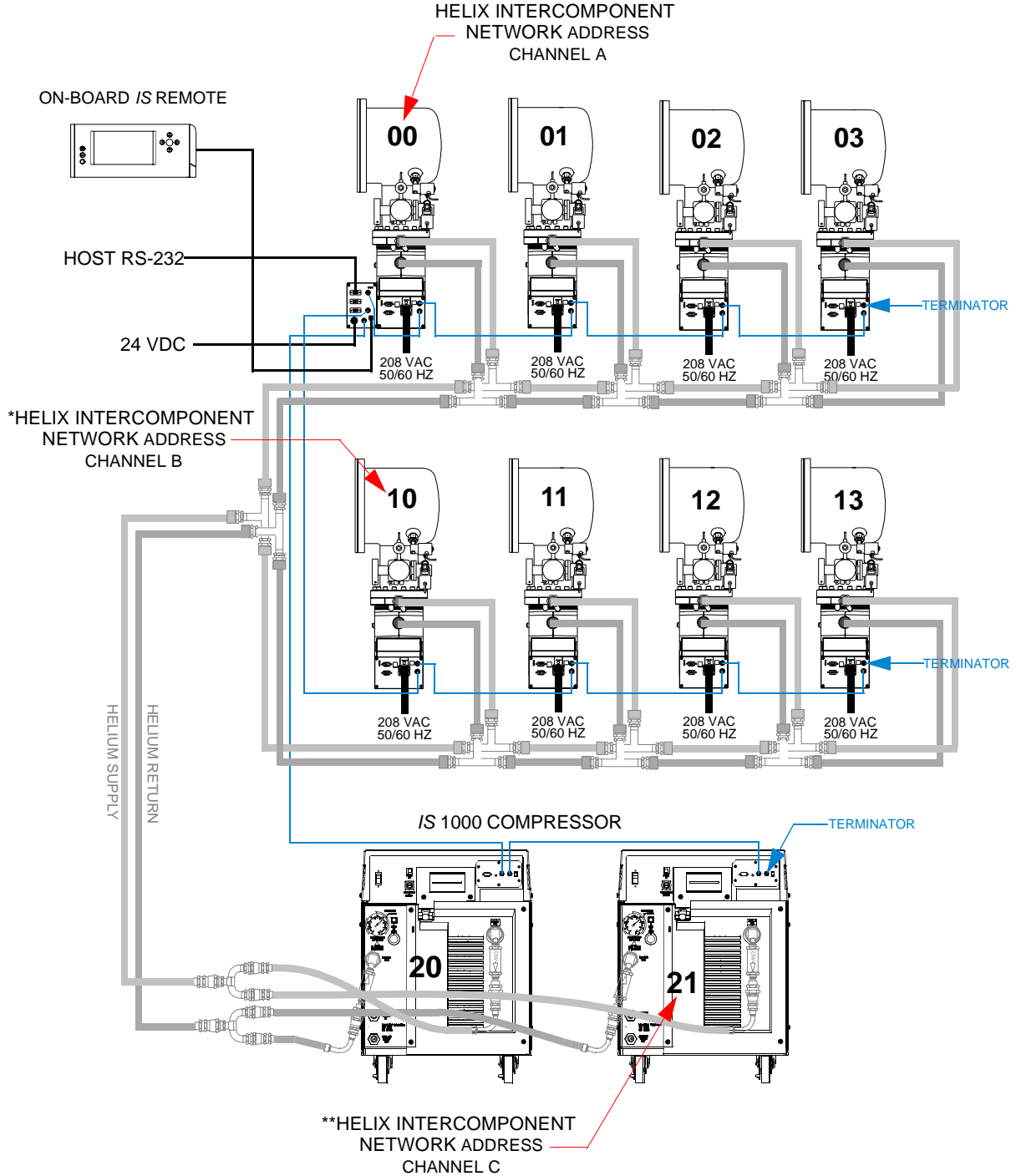


Figure 2-16: Typical On-Board IS Cryopump System

**Note: If the address is set to 0, it appears as 10 on Channel B.*

***Note: If the address is set to 2, it appears as 20 on Channel C.*

Section 3 - Troubleshooting

Keeping a Normal Operation Log

Maintaining a log of certain parameters during normal operation can be a valuable tool in troubleshooting vacuum problems. The log may contain many parameters. However, the following minimum parameters should be included:

- chamber base pressure
- chamber pumpdown time
- chamber rate of rise

In addition, a baseline chamber RGA scan is useful for system troubleshooting

Assessing Basic Trouble

The primary indication of trouble in a vacuum pumping system is a rise in base pressure of the vacuum chamber. A rise in the base pressure may be caused by the following:

- a leak in the vacuum system
- the cryopump reaching capacity
- the cryopump running too warm

Typically a high base pressure is caused by an air-to-vacuum leak in the system.

If a leak in the vacuum system is suspected, do the following:

1. Isolate the On-Board *IS* Cryopump by closing the Hi-Vac valve and leak check the vacuum chamber.
2. Leak check all potential sources of leaks such as:
 - through process gas valves
 - chamber rough valves
 - chamber cooling lines

If no leaks are found, a leak may be present on the cryopump side of the Hi-Vac valve.

Leak checking on the cryopump side of the Hi-Vac valve should be performed with the On-Board IS Cryopump shut off and at room temperature.

Leak checking while the On-Board IS Cryopump is cold may mask leaks that are present (due to the ability of the cryopump to pump helium). If no leak is found, refer to the cryopump troubleshooting procedures summarized in [Table 3-1](#).

Understanding Specific Causes and Corrective Actions

The problems presented in [Table 3-1](#) are followed by possible causes and corrective actions. The causes and corresponding actions are listed in their order of probability of occurrence.

Table 3-1: On-Board IS Cryopump Troubleshooting Basic Causes and Actions

Problem	Possible Cause	Corrective Action
High vacuum system base pressure, and a cryopump temperature <i>below</i> 20K.	1. Air-to-vacuum leak in vacuum system or in cryopump.	1. Check vacuum chamber and Hi-Vac valve for leaks. Check cryopump side of high vac valve for leaks.
	2. High partial pressure of noncondensables (helium, hydrogen, or neon) within the cryopump because the Second Stage array has reached full capacity.	2. Regenerate the cryopump as described in the <i>On-Board IS Cryopump System Operation Guide</i> Helix part number 8040647.

Table 3-1: On-Board IS Cryopump Troubleshooting Basic Causes and Actions

Problem	Possible Cause	Corrective Action
High base pressure of vacuum system, and a cryopump temperature above 20K.	1.Low helium pressure.	1.Check compressor Helium pressure. If the helium return pressure gauge reads below the normal operating pressure, add gas as described in the <i>On-Board IS 1000 Compressor</i> Installation, Operation, and Maintenance Instructions Helix part number 8040597.
	2.High partial pressure of non-condensables (helium, hydrogen, or neon) within the cryopump because the Second Stage array has reached full capacity.	2.Regenerate the cryopump as described in the appropriate <i>On-Board IS Cryopump System Operation Guide</i> Helix part number 8040647.
	3.Excessive thermal load on frontal array.	3.Look for new sources of thermal loads on the cryopump.
	4.Helium gas line contamination.	4.See part number (document) 8040720 for more information about helium circuit decontamination.

Table 3-1: On-Board IS Cryopump Troubleshooting Basic Causes and Actions

Problem	Possible Cause	Corrective Action
Cryopump fails to cool down to the required operating temperature or takes too long to reach that temperature (20K).	1.Low helium pressure.	1.Add gas as described in the <i>On-Board IS 1000 Compressor Installation, Operation and Maintenance Instructions</i> Helix part number 8040597.
	2.Loose or disconnected helium self sealing couplings.	2.Fully connect all helium self sealing couplings.
	3.Compressor problems.	3.Refer to the <i>On-Board IS 1000 Compressor Installation, Operation and Maintenance Instructions</i> Helix part number 8040597.
	4.Leak in vacuum system or cryopump.	4.Check vacuum chamber and Hi-Vac valve for leaks. Check cryopump side of Hi-Vac valve for leaks.
	5.Helium gas line contamination.	5.See part number (document) 8040720 for more information about helium circuit decontamination.
Status LED III is not illuminated.	Network cable is disconnected from the On-Board IS Module.	Reconnect network cable to the On-Board IS Module.
Status LED III is Amber.	On-Board IS Cryopump Heater Failure	Refer to Appendix A - Customer Support Information for customer support information and contact Helix Technology Corporation for assistance.
Rough valve clicks but does not open and close.	Too little or no air pressure to drive valve.	Increase air pressure to 60 to 80 psig.
Purge valve clicks but does not open.	Too little or no air or nitrogen pressure to drive valve.	Increase air pressure to 60 to 80 psig. Increase nitrogen pressure to the correct pressure, 25 - 35 psig or 60 - 80 psig.

Table 3-1: On-Board IS Cryopump Troubleshooting Basic Causes and Actions

Problem	Possible Cause	Corrective Action
Gate Valve does not operate.	1.Cryopump is not below 22K or is in regeneration.	1.Safety interlock.
	2.Gate Valve cabling is not connected	2.Connect cabling and clear gate valve error (gate valve will close and needs to be sensed closed).
	3.Gate valve sensing is in error	3.Clear gate valve error. If the error does not clear, check voltages at the gate valve position indicators and at the cryopump. The gate valve error will need to be cleared anytime the gate valve cable is disconnected.

Technical Inquiries

***NOTE:** Refer to [Appendix A - Customer Support Information](#) for customer support information and assistance.*

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:

1 800-367-4887 - Inside the United States of America

+1 508-337-5599 - 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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