HELIX

On-Board® Cryopump Helium Circuit Decontamination Instructions

Purpose

The components and instructions within CTI-CRYOGENICS Kit P/N 8080250K003 will guide you through the process of removing gaseous contamination from an On-Board Cryopump helium circuit by freezing the contaminant in the coldhead of the On-Board Cryopump. A contaminated helium circuit will cause the On-Board Cryopump to operate in a noisy manner, typically referred to as *ratcheting*, which degrades On-Board Cryopump performance.

Separate decontamination of the compressor is only required if the compressor has been opened to atmosphere or the helium pressure in the compressor has dropped to zero.

Kit Contents

Item Number	Description	Quantity
0001	Maintenance Manifold	1
0002	Instruction Sheet	1

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Helium Circuit Contamination

Three methods of decontamination are described in Table 1 and on the following pages. These methods all have isolating gaseous contamination in common by freezing them in one or more cold On-Board Cryopumps. The method to be used will most likely be determined by the amount of time available for the decontamination.

Table 1: Methods of Decontamination

Method	Starting Condition	Estimated Time	Effectiveness of Decontamination
1. Cooldown and sequential decontamination of all On-Board Cryopumps	Requires all On-Board Cryopumps to be cold.	After all On-Board Cryopumps are cold, 45 minutes to decontaminate the first On-Board Cryopump. 30 minutes for each additional On-Board Cryopump.	Maximum
2. Decontamination of only cold On-Board Cryopumps	Only one On-Board Cryopump needs to be cold.	45 minutes to decontaminate the first *cold* On-Board Cryopump 30 minutes for each additional *cold* On-Board Cryopump.	Acceptable
3. Simultaneous Decontamination of all On-Board Cryopumps using helium manifold.	Only one On-Board Cryopump needs to be cold.	45 minutes	Acceptable (may need to be repeated in several months).

NOTE: *If the On-Board Cryopump does not reach its normal operating temperature (below 20K), then that performance degradation may be caused by any of the following:*

a. Helium gas contamination

b. Poor vacuum

c. Thermal load on the On-Board Cryopump arrays

Performing a Fast or Full regeneration cycle will *not* remove gaseous contamination from an On-Board helium circuit. Unless the decontamination procedure is performed, the noisy On-Board Cryopump condition will repeat itself within one - four weeks.

Background

The On-Board Cryopump contains a cryogenic refrigerator assembly called a *coldhead*. There is no way to visually inspect the internal components, so it is best to detect problems by listening for unusual sounds. If the coldhead runs quietly at start up, but begins to make a *ratcheting* noise after the On-Board Cryopump is cooled down, then contaminated helium is the most probable cause.

All gases other than helium can freeze in the coldhead. During manufacturing of On-Board Cryopump systems, gaseous impurities are removed using stringent manufacturing control. The delivered system contains sufficiently low concentrations of gaseous impurities so they are not of concern.

It is possible, over long periods of operation, that additional gaseous contaminants can be released. These gases, along with any air that is added accidentally during installation, will collect in the coldhead as frozen gas. The frozen gas may partially block the regenerator which increases the amount of torque required to drive the displacer mechanism to the point that the motor noise (ie: *ratcheting)* may increase and result in coldhead motor stalling.

These gaseous contaminants can be removed by first freezing them in the coldhead, then disconnecting the helium supply and return lines, warming the coldhead followed by de-pressurizing and pressurizing the helium gas in the coldhead to remove them. The use of this decontamination procedure will return most On-Board Cryopumps to proper operation without the need for removal of the On-Board Cryopump from the tool.

NOTE: *It is strongly recommended that this procedure be performed as soon as possible after the ratcheting noise appears to minimize mechanical loading on the On-Board Cryopump drive mechanism.*

NOTE: *If help is required, call your nearest CTI-CRYOGENICS Customer Support Center for additional technical assistance.*

Equipment/Tools Requirements

The tools and equipment listed in Table 2 must be available to perform this decontamination procedure. If you do not have this equipment, call your local CTI-CRYOGENICS Customer Support Center to order the equipment needed.

Table 2: Required Decontamination Equipment

CTI-CRYOGENICS Part Number	Description	Quantity
8080250K003	Maintenance Manifold Kit	1
7021002P001	Charging Hose	1
8043074G060	5 Ft. Flexlines (or longer)	2
-	Ultra Pure Helium (99.999%)	-
571716	1.0 Inch Self Sealing Coupling Wrench	1
571717	1 1/8 Inch Self Sealing Coupling Wrench	1
571718	1 3/16 Inch Self Sealing Coupling Wrench	1
8080015K001	Keypad/display	1
8031403	0-400/0-3000 psig Regulator	1

NOTE: *For best results, CTI-CRYOGENICS suggests the use of a dedicated helium bottle, regulator and charge line which are never separated.*

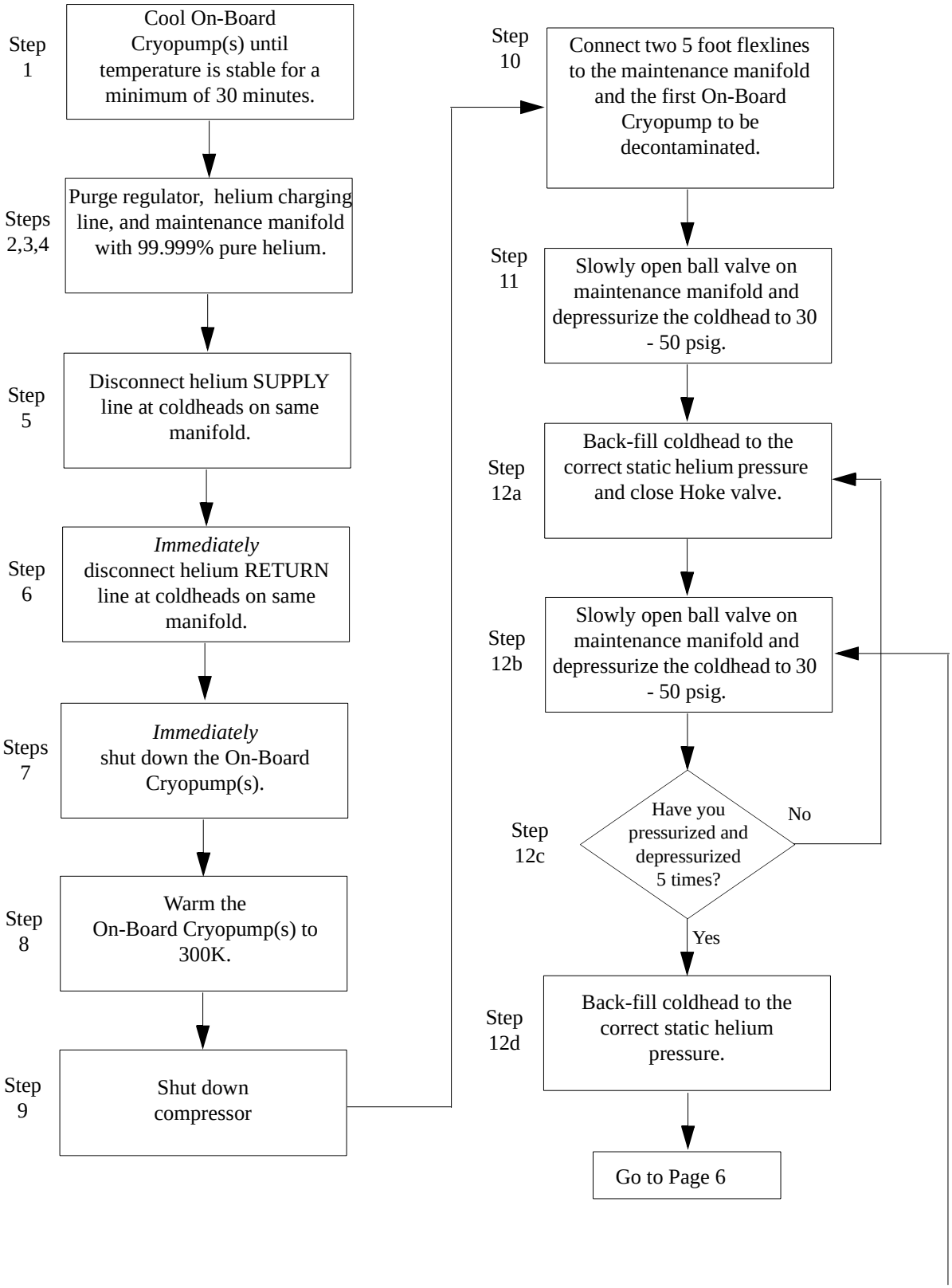

Figure 1: Decontamination Flowchart

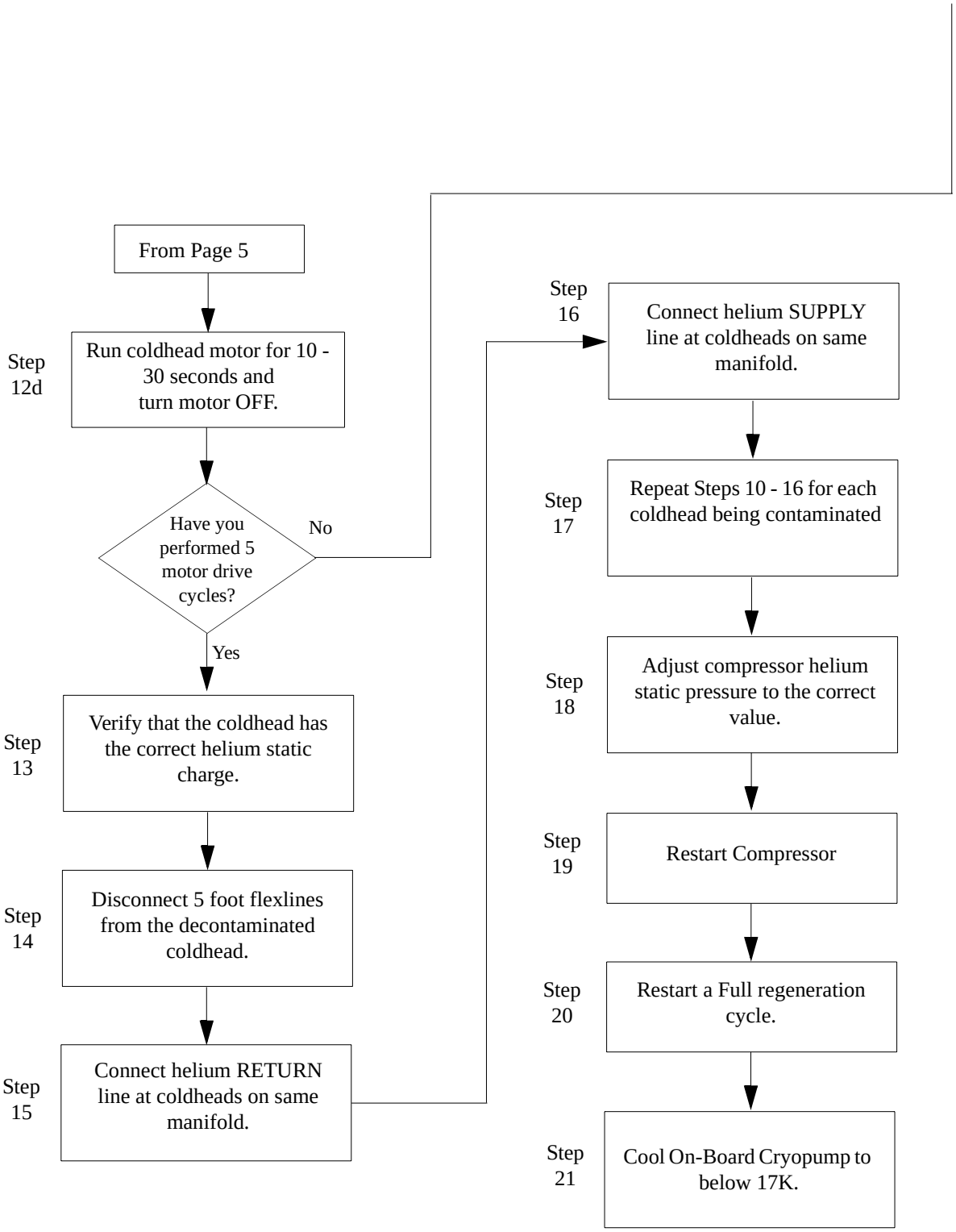

Figure 1: Decontamination Flowchart (continued)

Method 1 - Decontaminate all On-Board Cryopumps

This procedure removes gaseous contamination from the helium circuit by cooling each On-Board Cryopump so the gaseous contamination is frozen in the coldhead. Each On-Board Cryopump is then decontaminated in sequence. This procedure is outlined in Figure 1.

WARNING

High helium gas pressure may be present within high vacuum pump systems and can cause severe injury from propelled particles or parts.

1. All On-Board Cryopumps on the same manifold should have been running with second stage below 25K for at least 30 minutes. If not, then cool the remaining On-Board Cryopumps down and run for 30 minutes minimum after reaching 25K to trap contaminants in the coldhead. Continue with Step 2 even if any pump does not cool below 25K (its performance may already be affected by contamination). Close the high vacuum valves to isolate the On-Board Cryopumps from the vacuum chamber.

After Step 1 has been completed, all of the coldheads have been cooled and the contaminant gases frozen in the coldhead.

2. Attach a regulator (0-400/0-3000 psig) and charging line to a helium bottle (99.999% pure). DO NOT OPEN THE BOTTLE VALVE AT THIS TIME.
3. Purge the regulator and charging line as described in Steps a through d below. Use only 99.999% helium gas.
    a. Open the regulator a small amount by turning the adjusting knob clockwise until it contacts the diaphragm, turn the adjusting knob so that the regulator is barely open.
    b. Slowly open the bottle valve, and purge the regulator and line for 10 to 15 seconds. Keep the helium flowing to prevent re-contamination.
    c. Loosely connect the charge line to the closed Hoke valve on the maintenance manifold. Refer to Figure 3.
    d. Continue to purge the charge line for 30 seconds, and tighten the charge line flare fitting onto the Hoke valve while the helium is flowing.
4. Open the ball valve using the extended handle. Open the Hoke valve. Purge the manifold for 30 seconds, close the ball valve, then close the Hoke valve.

Steps 2 - 4 are required to ensure that the regulator, charging line and the maintenance manifold 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 the use of a dedicated helium bottle, regulator and charge line which are never separated.

Once Step 4 has been completed, all of the coldheads have been cooled and the gaseous contaminant frozen in the coldhead. The maintenance manifold has also been connected to the helium bottle and filled with clean helium.

NOTE: *The helium SUPPLY line should be disconnected first to prevent the crosshead relief valve from opening.*

5. While each On-Board Cryopump is still operating, disconnect the helium SUPPLY line at all of the coldheads on the same manifold. The On-Board Cryopump helium supply line is shown in Figure 2.

CAUTION

Be sure to use two wrenches to ensure that the self sealing coupling adapter does not back out during disassembly. Disconnect the helium supply line. Refer to Figure 4.

6. Immediately after Step 5, and while each On-Board Cryopump is still operating, disconnect the helium RETURN line at all of the coldheads on the same manifold. The On-Board Cryopump helium return line is shown in Figure 2.

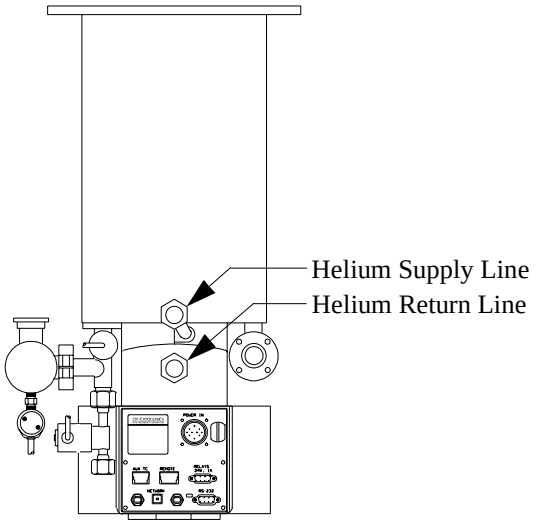

Figure 2: On-Board Cryopump Helium Supply and Return Lines

7. Immediately after Step 7, shut down all of the On-Board Cryopumps as described in the appropriate **On-Board Module Programming and Operation Instructions** manual.

8. Warm the On-Board Cryopumps to 300K as follows:
    a. Regenerate each On-Board Cryopump to be decontaminated by pressing the **REGEN** button, followed by **1** then **2** on the Network Terminal keypad.
    b. When the pumps reach 300K, discontinue the regeneration cycle by pressing **REGEN** and **0**. Repeat this process on each pump.

After Step 9 has been completed, all of the coldheads have been cooled and the contaminant gases frozen in the coldhead. Helium gas lines have been disconnected at the coldheads, and the coldheads warmed up to 300K. The next step is to remove the contaminant from each coldhead in sequence.

9. Shut down the compressor.
10. Connect the two helium flexlines to the maintenance manifold and the coldhead of the first On-Board Cryopump to be de-contaminated.

CAUTION

Be sure to use two wrenches to ensure that the self sealing coupling adapter does not back out during disassembly. Disconnect the helium supply line. Refer to Figure 4.

11. De-pressurize the coldhead to between 30 and 50 psig (200 and 330 kPa) by slowly opening the ball valve and allowing the helium to bleed out slowly.

CAUTION

Reducing the coldhead pressure below 30 psig (200 kPa) may introduce more contaminants into the helium circuit.

12. Perform the following steps in sequence:

NOTE: *Refer to appropriate Compressor Installation, Operation, and Maintenance Instructions for the correct static helium charge pressure.*

    a. Back-fill the coldhead with helium to the correct static charge pressure by adjusting the regulator to the required pressure, and opening the Hoke valve on the manifold. Close the Hoke valve when the pressure is correct.
    b. De-pressurize the coldhead to between 30 and 50 psig (200 and 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 coldhead may be further contaminated.
    c. Perform the flushing Steps 12a and 12b four more times.

d. Again back-fill the coldhead to the correct static charge pressure and run the coldhead drive motor for 10 to 30 seconds by using the remote keypad. Ensure the network cable is removed and press **CONTROL** and **1** to turn the motor on. Press **0** to turn the motor off.

e. Repeat Steps b - d four times. There are a total of 5 drive motor runs with five flushes each for a total of 25 flushes.

NOTE: *Refer to appropriate Compressor Installation, Operation, and Maintenance Instructions for the correct static helium charge pressure.*

13. Verify that the coldhead has the correct helium static charge pressure.
14. Disconnect the 5 foot flexlines from the decontaminated coldhead supply and return connectors.
15. Reconnect the system helium RETURN line to the return connector on the coldhead as shown in Figure 2.
16. Reconnect the system helium SUPPLY line to the supply connector on the coldhead as shown in Figure 2.

Once Step 16 has been completed, the decontamination of the first On-Board Cryopump is completed and charged to the correct pressure with clean helium. The remaining coldheads need to be decontaminated.

17. Repeat Steps 10 - 16 for each coldhead being decontaminated.
18. Once Step 17 has been completed, the On-Board Cryopumps are ready to be cooled down. Adjust the compressor pressure to the correct charge pressure.

NOTE: *Refer to the appropriate Compressor Installation, Operation, and Maintenance Instructions for the correct static helium charge pressure value and adjustment procedure.*

NOTE: *The charging adapter can be inserted into any helium line at the tool to simplify the final adjustment of system pressure. It should be removed after final pressure adjustment.*

19. Restart the compressor.
20. Start a Full Regeneration cycle on all the On-Board Cryopumps to prepare the vacuum side of the On-Board Cryopump.
21. Allow the On-Board Cryopumps cryopumps to cool to below 17K.

If *ratcheting* in the On-Board Cryopump reappears, call your nearest CTI-CRYOGENICS Customer Support Center for additional technical assistance.

Decontamination Alternatives

Method #1 Decontaminate All Cryopumps

The preceding procedure is the most effective method to remove gaseous contaminants from the helium circuit. All On-Board Cryopumps were first cooled down and the contaminant frozen. Each On-Board Cryopump was decontaminated in sequence.

All On-Board Cryopumps that are cold must be decontaminated. If they are cold and not decontaminated, then gases frozen in these On-Board Cryopumps will re-contaminate the helium gas when they are warmed up.

Method # 2 Decontamination of Only Cold Cryopumps

If time is critical, then an alternate method of decontamination, using Method 1 as a basis may be used. This procedure will also remove gaseous contaminant in the system.

If certain On-Board Cryopumps are warm in Step 1 then they can remain at room temperature (i.e. over 290K). With the compressor on and cold On-Board Cryopumps left on, run these "warm" On-Board Cryopumps for 5 minutes. Running these "warm" On-Board Cryopumps for a short time will move any concentrated contaminant out of these coldheads into the compressor. The contaminants will then be carried to the cold On-Board Cryopumps where they will be frozen.

In this method, the following Steps replace the corresponding Steps in Method 1:

Step 1 - Method #2

Any On-Board Cryopumps on the same manifold which are running should have been running below 25K for at least 30 minutes. Any pumps warmer than 290K should be kept warm. Continue with Step 2 even if any pump does not cool below 25K (its performance may already be affected by contamination) . Close the high vacuum valves to isolate the On-Board Cryopumps from the vacuum chamber.

Step 17 - Method #2

Repeat Steps 10 - 16 for each On-Board Cryopump which is not above 290K.

Method # 3 Grouped Decontamination using Manifold

The time required to decontaminate each On-Board Cryopump in Method #1 after it is cooled and warmed up is about 30 minutes. If time is not available to decontaminate each On-Board Cryopump in sequence, then the alternate is to decontaminate all On-Board Cryopumps together, i.e.: *Grouped Decontamination*. At least one of the On-Board Cryopumps must be cold. The decontamination is performed from the compressor side of the common supply and return manifolds.

In this method the following Steps replace the previous Steps:

Step 5 - Method #3

While each On-Board Cryopump is still operating, disconnect the helium SUPPLY line at the compressor side of the common supply manifold at the tool.

Step 6 - Method #3

While each On-Board Cryopump is still operating, disconnect the helium RETURN line at the compressor side of the common supply manifold at the tool.

Step 10 - Method #3

Verify that the compressor is off. Connect the two 5 foot helium flexlines to the maintenance manifold and the compressor side of the common supply and return manifold.

CAUTION

Be sure to use two wrenches to ensure that the self sealing coupling adapter does not back out during disassembly. Disconnect the helium supply line. Refer to Figure 4.

Steps 11 - 16 - Method #3

All connections are to the manifold, not the individual coldheads. All coldhead drive motors are to be run for 10 to 30 seconds using the remote keypads per Step 12d. At the end of Step 16, all of the On-Board Cryopumps are decontaminated.

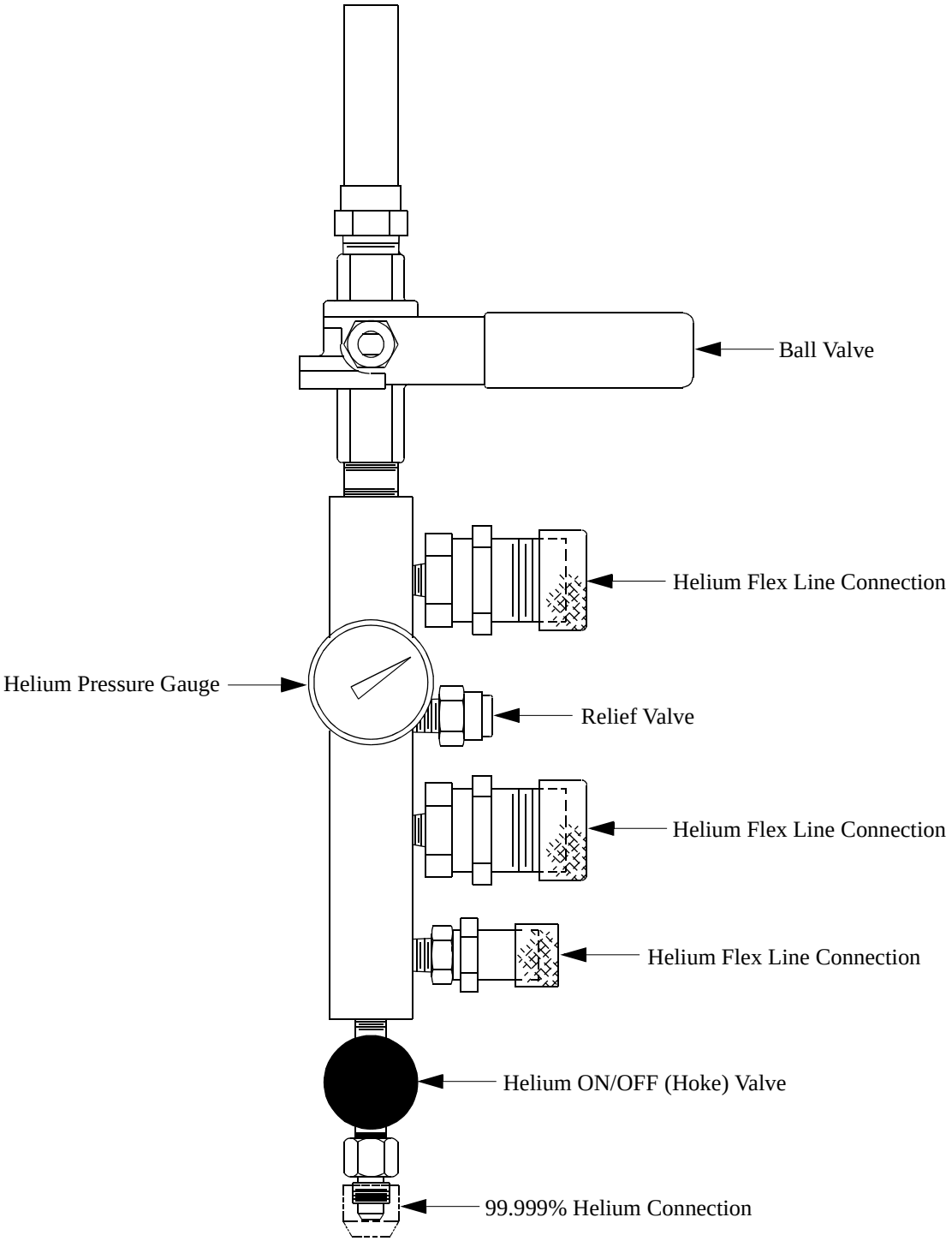

Figure 3: Maintenance Manifold Part Number 8032051G001

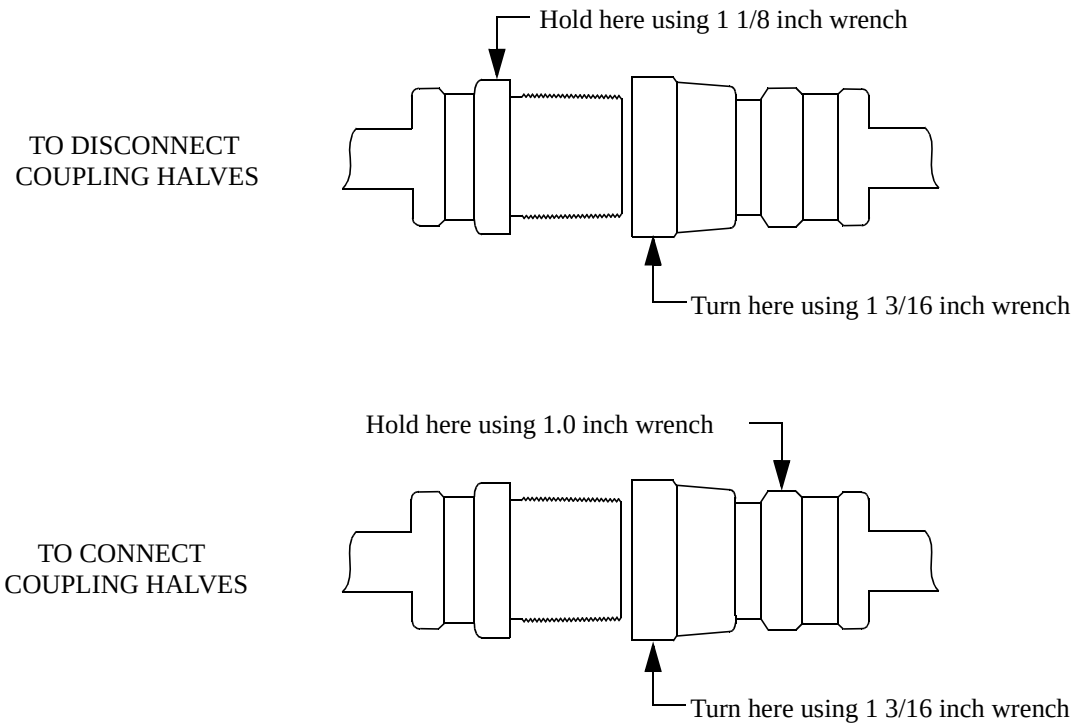

Figure 4: Proper Helium Line Coupling Disconnection/Connection