Quantum Technology

Internal Cold Head
Hot Swap Procedure

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1 Overview

The document describes a cold head hot swap procedure. A "hot swap" is defined as the replacement of a cold head interior assembly (displacer, piston, and motor) while leaving the shell containing the first and second stage attached to the system, thus leaving the seal to the cold box intact. In the specific hot swap that was used to create this procedure, the displacer was damaged such that attempting to run the displacer motor would blow a fuse in the compressor, and thus this procedure will include inspection and repair of damaged electronics.

2 Safety

2.1 General Notes

Quantum Technology Corp. systems are designed according to the national safety standards. The installation, operation and service are to be performed in accordance with the technical manual. Contact Quantum Technology with any questions.

2.2 Warnings Related to Cryogenics

Avoid Injury Extreme cold may cause frostbite. Do not touch any parts with frost while handling system components. Do not splash cryogenic liquids on any areas of clothing or exposed skin; otherwise, skin tissue will get damaged. Always wear eye protection and gloves.

Avoid Asphyxiation Oxygen deficiency hazard exists around this equipment. A safety analysis of the room it will be located in is required to determine the appropriate safety measures prior to installing this equipment. Keep the environment properly ventilated to avoid build up of low oxygen gases.

2.3 General Warnings

Avoid Electric Shock All electrical supply equipment must meet applicable codes and be installed by qualified personnel.

Avoid Injury Never use compressed gas in the system without a proper regulator. Overpressure can cause serious injury if the system equipment

ruptures. Never surpass the maximum allowable working pressure of the system. Use pressure rated components for all connections. Depressurize the system before performing maintenance. Secure all high-pressure flexible lines. Always wear eye protection when handling pressurized gas lines and other pressurized equipment. Never heat up the pressurized gas line or other pressurized components.

2.4 Cautions

Preserve Your Warranty Modification to equipment without the consent of the manufacturer will void the warranty.

Prevent Equipment Damage Damage to gas lines can result from crimping by repeated bending and repositioning.

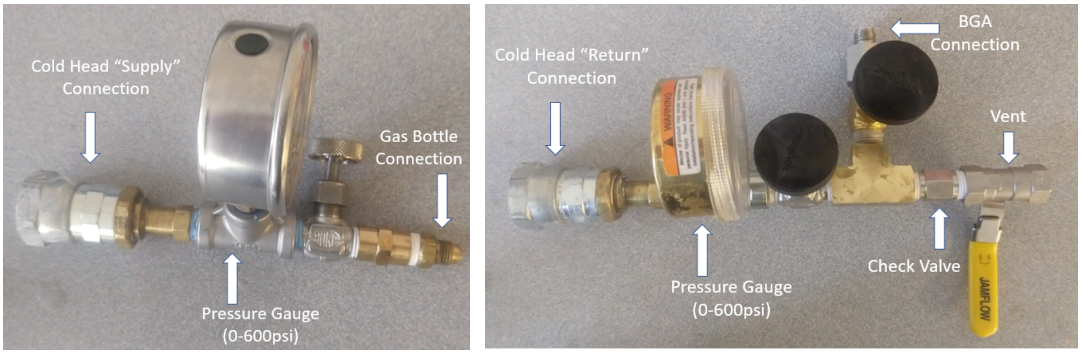
Avoid Gas Leaks

3 Required Tools and Parts

This procedure requires a complete closed loop cold head system, including a cold head, cold head compressor with cooling water, interconnecting lines between cold head and compressor. Other tools and fittings required are listed below

- Aeroquip assemblies with needle valves, pressure gauges (0-600psi), a tee with 1/8" connection for BGA (on return assembly), and a check valve (on return assembly). Pictured in Figure 1
- Portable BGA purity meter with 1/8" rotometer inlet connection. Pictured in Figure 2
- 1/8" tubing with connections to BGA rotometer inlet and Aeroquip return assembly
- Replacement cold head, assembled in shell
- Flat cold head wrenches
- UHP helium bottle with 0-600psi regulator and tube attachment Aeroquip supply assembly
- Torque wrench capable of 19 N*m with M8 hex adapter

- M8 hex wrench
- Crescent wrenches
- Replacement fuses if damaged (1A 240V, **Part number**)
- Screwdrivers



(a) (b)

Figure 1: Aeroquip assemblies used during the cold head hot swap procedure. (a) is the supply side assembly and (b) is the return side assembly.

4 Check and Replace Broken Fuses

When swapping out a working cold head in the course of routine maintenance, this step can be skipped.

1. Unplug all cable connections on the back of the compressor. The helium and water lines can remain attached.
2. Remove the 18 Phillips head bolts on the top and left/right sides of the compressor housing, then remove the cover.
3. Remove the black cover shown in Figure 6 and use a screwdriver to remove the four pin connections.
4. locate and unplug the remaining cables from the control box, making careful note of where each cable connects.
5. Remove the larger screws on the front of the control box, and remove the box from the compressor housing. Place on a benchtop.

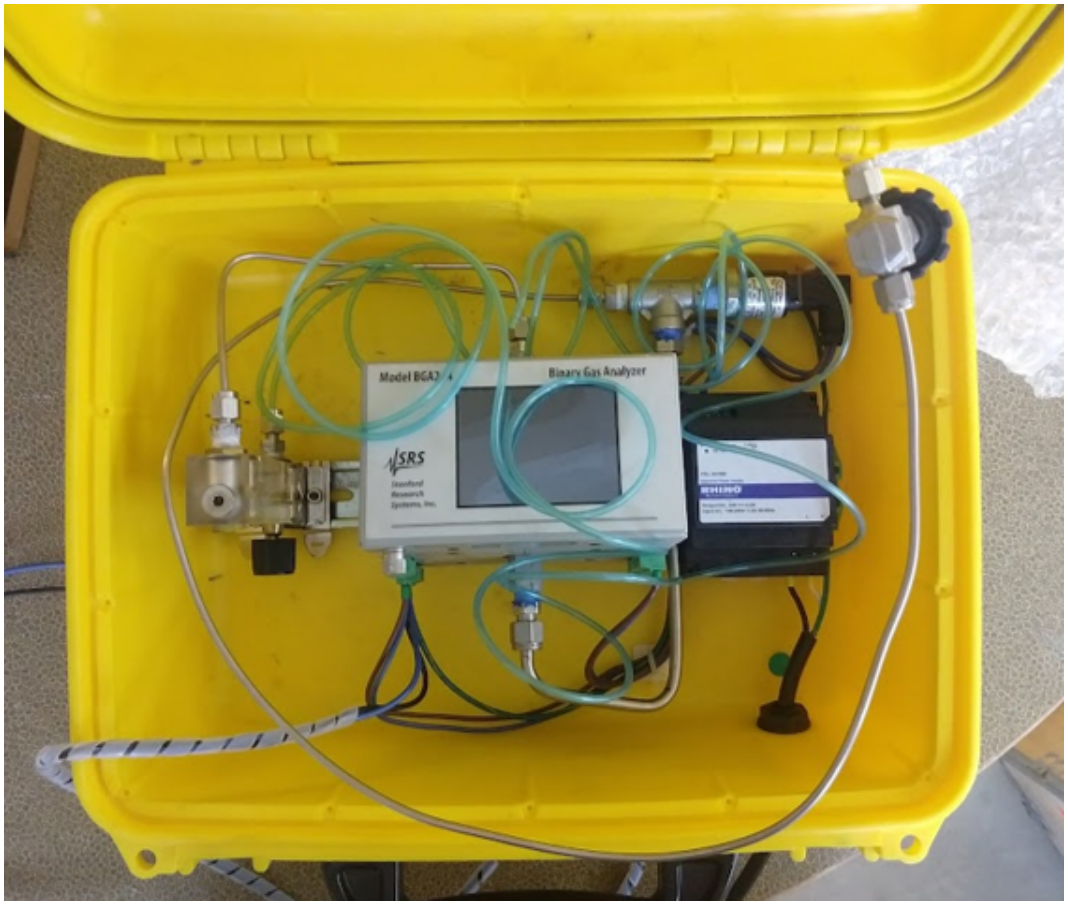


Figure 2: BGA purity meter with 1/8 tube input (attached to the bottom of the rotometer on the left

6. Remove the four screws on the side panel shown in Figure 3.
7. Remove side panel and carefully unplug the 5 pin terminal blocks (13 pins total) as shown in Figure 4 and Figure 5. The cable ribbon is often glued, and will likely need to stay attached.
8. Replace fuses. The fuse location is shown in Figure 5. Inspect for broken fuses and replace.

Figure 3: Side panel. Remove 4 screws to reach fuses

5 Before Swapping the Cold Head

Before swapping the cold head, both cold heads must be prepped.

1. Ensure that the cold head is off and has been warmed to room temperature.
2. Unplug the power cord from the cold head motor
3. Disconnect the supply and return hoses from the cold head using the thin cold head wrenches, making sure to hold the cold head attachment in place so that it cannot turn.
4. Attach the supply and return assemblies (Figure 1) to their respective connections, making sure that all valves are closed.
5. Release any excess helium in the cold head through the Aeroquip assemblies.
6. Transfer the supply and return assemblies to the replacement cold head, and repeat steps 4 and 5. Leaving the fittings on the new cold head when finished.

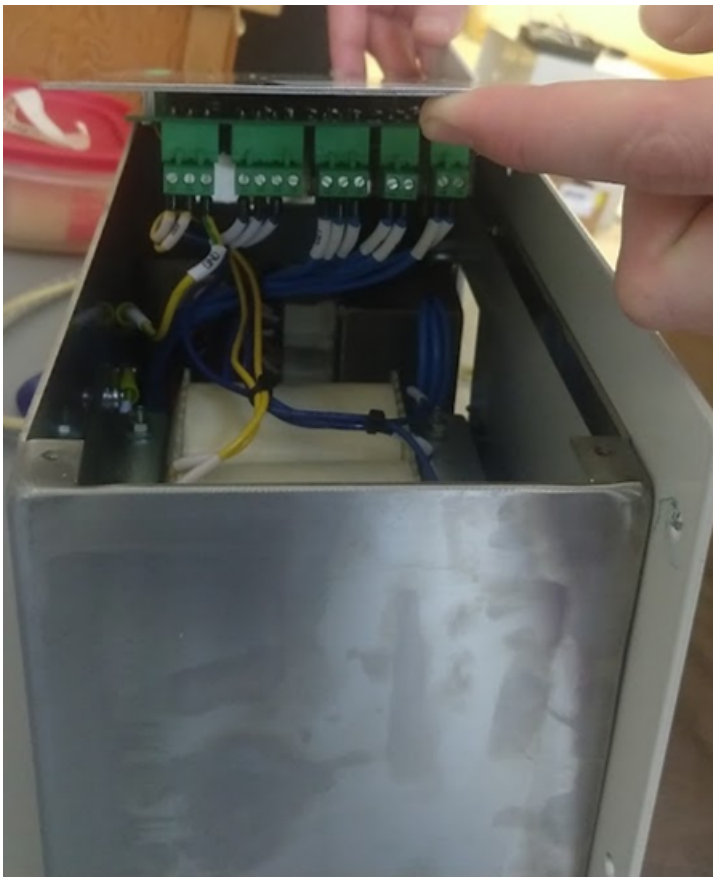


Figure 4: The pin terminals that need to be unplugged

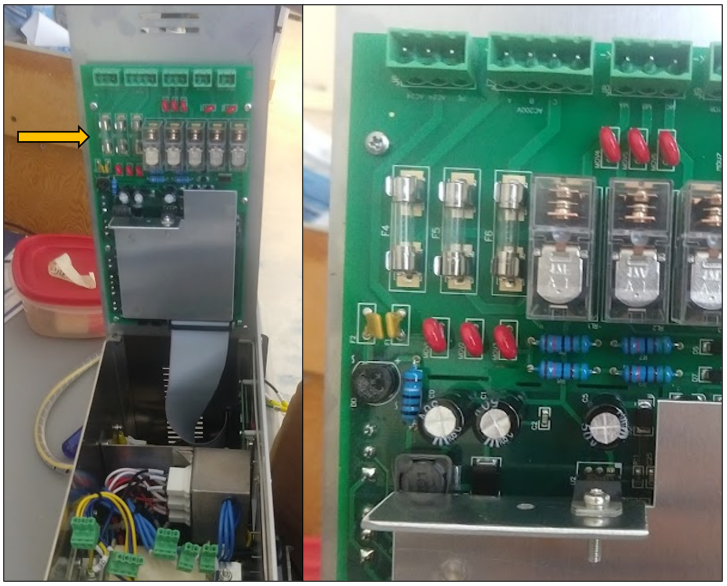


Figure 5: Location of the fuses on the removed panel

Figure 6: Remove black cover and 4 screw terminals

6 Swapping out the Cold Head

1. Remove the four M8 Bolts on each of the cold heads.
2. Starting with the currently installed cold head, lift from the motor to remove the displacer and motor assembly from the cylinder (Figure 7, gently placing the assembly on the table and wiping down with a dust-free cloth. Inspect for any damage and document.
3. Inspect the o-ring on the remaining shell. This o-ring can be reused or swapped with the new one in the next step.
4. Clean out to the bottom of the now exposed cylinder using a clean cloth and isopropyl alcohol (Figure 8)
5. Lift the displacer assembly out of the replacement cold head, and seat into the the cylinder
6. tighten down the four M8 bolts in a star pattern with a torque wrench to 19 N*m

(a) (b)

Figure 7: Lifting the displacer out of the cylinder

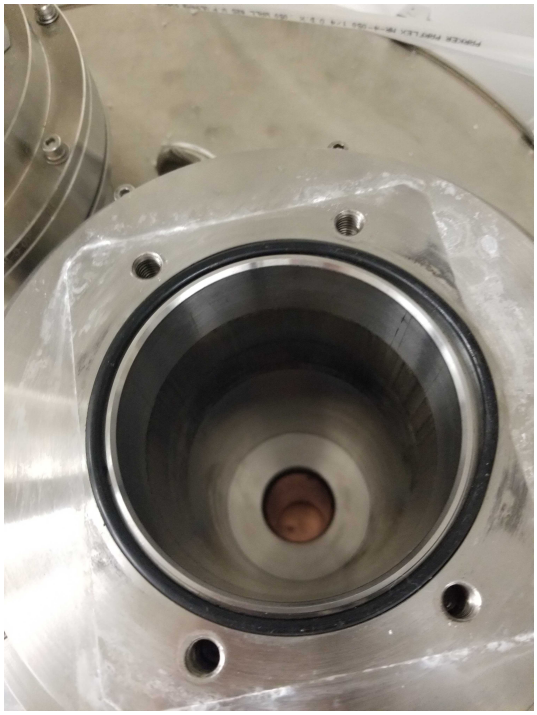


Figure 8: The cold head cylinder before cleaning

7 Purging and Filling the Cold Head

In order to purge the cold head and fill with helium to 99.999% purity, the cold head must be purged with a helium bottle using the cold head separate driving mode. This mode allows the cold head motor to drive the displacer without connecting or running the compressor. The user can open and close a valve on the return line to simulate a running cold head, allowing helium to purge all spaces.

1. With all valves on the Aeroquip assemblies closed, attach the helium bottle and regulator to the supply side. Open the supply side needle valve and open the tank, setting the regulator to 240psi.
2. Reattach the cold head motor cable from the compressor.
3. open the need valve on the return Aeroquip assembly, and crack the vent valve to verify that helium can flow through the cold head. Close the vent valve, leaving the needle valve open.
4. Unplug the data cable connecting the compressor to the PLC. This can cause separate driving mode to fail.
5. Prepare for cold head separate driving mode. To activate this mode, turn on the compressor and toggle through the "Display" setting until "Cold Head Run, YES-ON, NO-OFF". Before pressing the "ON" button, prepare to cycle the vent valve on the return Aeroquip assembly.
6. Press the "ON" button. When the motor begins to cycle, begin to open and close the return side vent valve in beat with the motor, ensuring that helium is flowing from the bottle with each puff. Cycle for 2-4 minutes.
7. Quickly stop separate driving mode by pressing the "OFF" button. Very carefully crack the needle valve leading to the BGA until flow is visible on the rotometer.
8. Allow BGA 5-10 minutes to stabilize and record the purity.
9. If purity is lower than 99.999%, repeat steps 5-8 until 99.999% purity is achieved.
10. Reattach hoses and PLC data cable. The cold head can now be run normally.