Cryomech Compressor and Haskris Water Chillers

Cryomech Compressor Overview

This guide is intended as an overview of the operation of the SRM compressor and includes instructions for use of the main and backup Haskris Chill Water systems. For in depth operational instructions, see the Cryomech Compressor vendor manual and the Haskris Water Chiller vendor manuals.

The Superconducting Rock Magnetometer (SRM) uses a cyro-compressor to keep a small amount of Helium compressed in order to reach superconducting temperatures. The compressor is water cooled.

The complete Cryomech 2800 He compressor manual can be found here >>> PT405-RM CP2850 Installation_ Operation_ and Maintenance Manual.pdf

Chill Water Sources for the Compressor

The SRM Cryomech 2800 (**Figure 1a**) chilled input line and warm water return line are directly plumbed the water cooled Haskris (**Figure 1b**- the white unit at the forward end of the paleomagnetics lab) through a set of three way valves. This unit is in turn cooled by the ship's chill-water. In the event that the ship's chill water fails or is shut down for maintenance or for repair, a backup water cooling system is in place. The backup system is a Haskris Air Cooled Water Chiller system (**Figure 1c**). This Haskris is also plumbed to the compressor via the set of three way valves. Switching between these systems requires that the user turn the three way valves (explained below in detail).

***Figure 1a**: Cryomech 2800 Series Compressor for SRM. The compressor is located at the aft end of the paleomagnetics lab just behind the load end of the SRM track.*

***Figure 1b**: Main Haskris Water Chiller (water cooled). This unit is located at the forwa paleomagnetics lab and requires ship chill-water.*

Monitoring the System

To monitor the status of the compressor, use the CryoWATCH program (**Figure 2a**) which is available on the SRM computer. The compressor is connected to the SRM PC via an RS232 cable. The application displays the status of the compressor and logs these values to a text file (**Figure 2b**). The communications setup should be the default baud rate of 115200 and a slave address of 16, and the com port may need to be adjusted. **As of Expedition 397P Tie-up in Cape Town (August 2022), the com port is 7.**

When first logging in or restarting the computer, open IMS before opening Cryowatch, otherwise IMS will have trouble with some of its COMs (this problem can be fixed by updating the "CRYOMECH" VISA-Alias in the Cryowatch program).

***Figure 2a**: CryoWATCH Panel Desktop Icon*

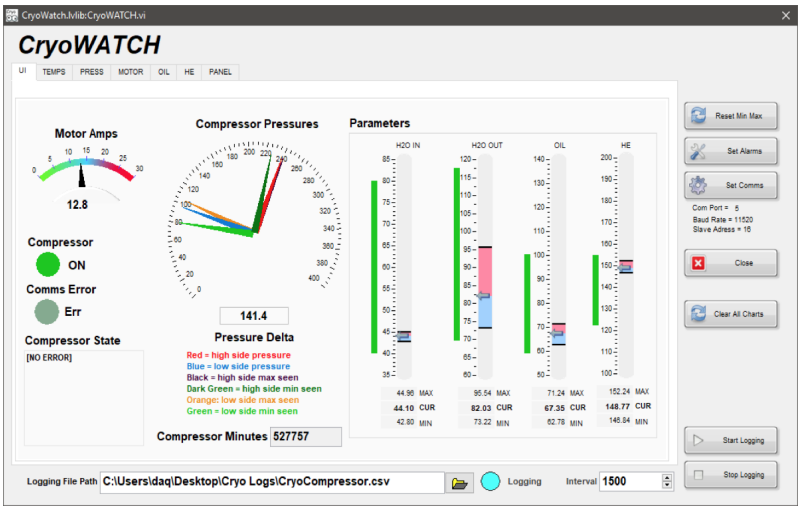

***Figure 2b**: CryoWATCH window. User may monitor water temperatures and oil temperatures after changing the chill water supply.*

The user may set the Logging File Path and the log period (in seconds) as they see fit. The right hand side of the virtual panel with logging displays the temperatures for the water in, water out, Helium gas, and the oil temperature. The arrow at the boundary between the red and blue bars indicates the current temperature. The upper-most black bar indicates the maximum temperature seen and the lower-most black blue bar marks the minimum temperature seen. This panel also displays the amps that the motor is using and the current high and low pressure of the helium lines. Acceptable temperature and pressure ranges are given in **Table 1**. The additional tabs available allow the user to view graphs of the temperatures, pressures, and other parameters over time. This is useful when adjusting the water flow rate. *Caution: The Panel tab will allow the user to turn the compressor on and off.*

Table 1: Acceptable temperature and pressure ranges for Cryomech 2800 Series Compressor

Control	Minimum	Maximum
He Gas Temperature	-	190F
Oil Temperature	60°F	100°F
He Gas Pressure	35 PSIG	399 PSIG
H_20 In Temperature*	40°F	80°F

*Since the Cryomech water temperature is now set by Haskris units for both the main and backup system, these temperature windows are much tighter and the new limits need to be determined and set in the Cryowatch program.

Alternatively: If CryoWATCH is unavailable, the Cryomech Virtual Panel with Logging panel is available. This can be found on the SRM desktop at C:\Users\daq\Desktop\cryomech\Cryomech\virt_panel. Set the com port number correctly, designate a file path, and the compressor data will be logged.

Trouble Shooting

If you notice the SRM area is unusually quiet and/or an audible beep is coming from the compressor, check the front panel of the compressor (**Figure 3**). It will display the fault that has caused the compressor to shut down. Check the Cryomech Compressor user guide for error messages and how to handle each.

***Figure 3**: SRM Cryomech Compressor. The red box indicates the display which shows the error messages.*

Switching Chill Water Systems

Switching between the main system (ship's chill-water cooled) and backup system is straight forward and should only take a minute. **Figure 4a,b** show the basic plumbing circuit and the correct valve orientations for each system. The backup system should be ready to put in to service at anytime. In order to ensure this, both systems should be cleaned and purged at the end of every expedition as described below.

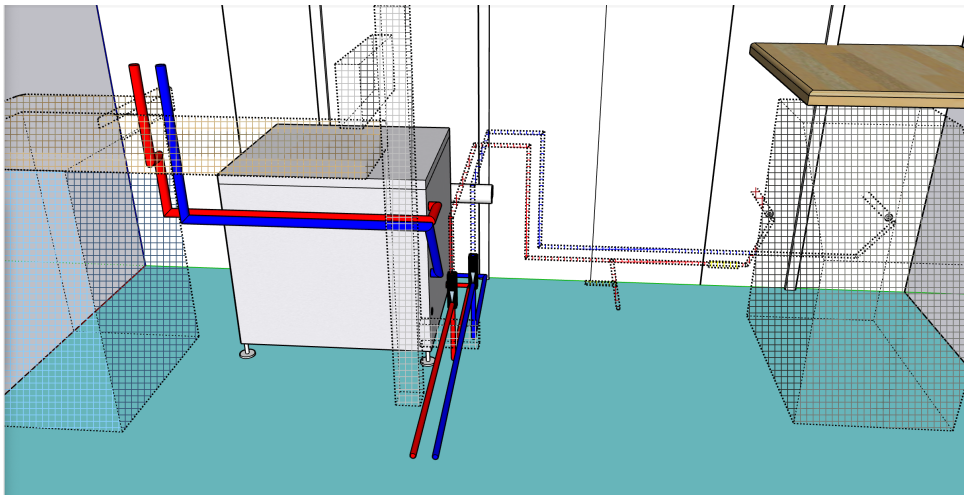

Figure 4a: Diagram of the **main Haskris** and plumbing with its valves set correctly.

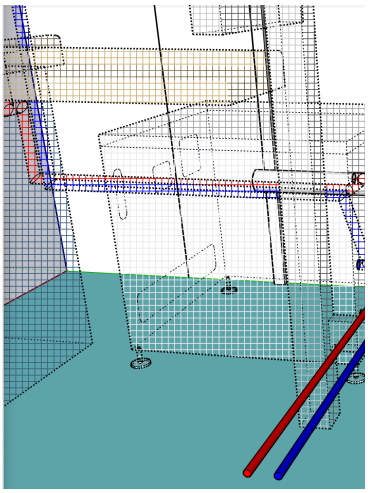

Figure 4b: Diagram of the **backup Haskr**

The ship's chill water may be shut down for routine maintenance or repair. In this situation, the crew should notify the technical staff prior to the shutdown. This will allow a technician to switch to the backup Haskris system ***before*** the chill water is shut down, preventing the compressor from shutting down and allowing the SRM system to continue working uninterrupted.

If the ship's chill water system shuts down unexpectedly, the cooling water delivered to the Haskris will begin to warm up. Cryowatch's alarms trigger when the "water in" exceeds 70°F, though no audible warning is set up. (Since main and backup systems deliver nearly constant water temperature, can we set up and audible alarm? Either on the computer? Or the an oil temperature alert on the Cryomech and not just the shut down alert at 120°F.) The Haskris will continue to pump until its water reaches 125°F, but the Cryomech will shut down before that when the oil temperature reaches 120° F. This takes around 10 minute and as long as the temperature as it is noticed is plenty of time to switch to the back up system. Once this happens then compressor will not start again until the oil is below 100°F and the field will need to be re-trapped.

Switching to the Backup Haskris

This protocol assumes that the backup Haskris is clean, full of ship tap water, and plugged in. It also assumes that the **Purge Valve** is **closed** and the **Backup Shutoff Valve** is **open** (**Figure 5** - details in Purging the Systems below) and Cryowatch is running and logging.

1. Turn **on** the **backup** Haskris with its main power switch on the front panel. It takes a few sections to initialize. If the pump doesn't start after initialization then toggle the power switch to help prime the pump.
2. Turn both black selector valve **down** 180°(located at forward end of the paleomagnetics lab). The white arrow should now point to the two lines labeled "**Backup to/from Cryomech**". The pressure change will likely make a clunk noise which is normal (**Figure 5**).
3. Turn **off** the **main** Haskris with the power switch on its front panel as soon as possible.
4. Check the temperature setting on the front panel of the backup Haskris. The green display is the set temp and the red display is the actual temp. The set set should be 65°F.
5. Press the bottom left button once and verify that the A1SP temp is set to 125°F. The arrows adjust this and press the button left two more times to return to the main menu.
6. Double check that the water level in the backup is near the lid level. Top off with clean ship tap water if necessary (NOT DI water).
7. Monitor with Cryowatch to ensure that the water and oil temperatures stabilize indicating that the backup system is functioning. (Even when doing a planned switch, the temperature will likely rise some.)
8. If the backup Haskris is needed to operate for more than a few minutes it needs to be moved away from the wall as it generates a lot of heat. Undo the tie-down and carefully roll out from under the table about 1 m aft minding 2 flexible hose connections and power connections. There is a tie-down anchor for this location as well.

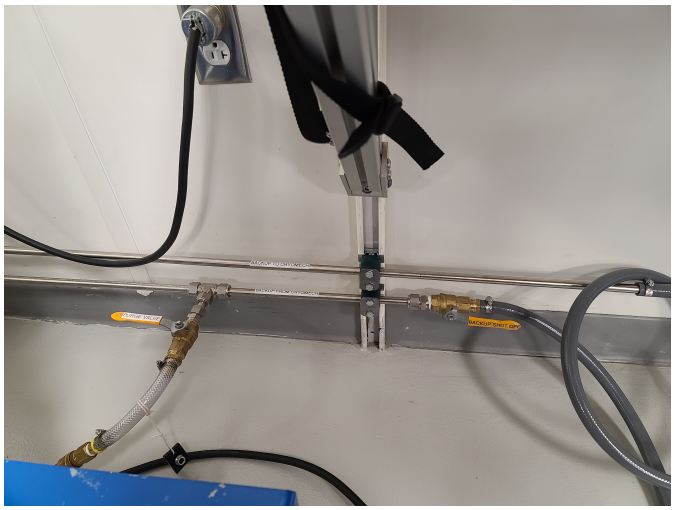

Figure 5: Purge Valve is closed and the Backup Shutoff Valve is open.

Figure 6: The two selector valves shown in the Backup position.

Switching to the Main Haskris

This protocol assumes that the main Haskris is clean, full of ship tap water, and plugged in and the ship's chill-water is function and both valves are open (**Figure 7**). It also assumes that the **Purge Valve** is **closed** and the **Backup Shutoff Valve** is **open** (**Figure 5** - details in Purging the Systems below) and Cryowatch is running and logging.

1. Turn **on** the **main** Haskris with its main power switch on the front panel. If the pump doesn't start within a few seconds toggle the power switch to help prime the pump.
2. Turn both black selector valve **up** 180° (located at forward end of the paleomagnetics lab). The white arrow should now point to the two lines labeled "**Main to/from Cryomech**". The pressure change will likely make a clunk noise which is normal (**Figure 8**).
3. Turn **off** the **backup** Haskris with the power switch on its front panel as soon as possible.
4. Check the temperature setting on the front panel of the main Haskris. The green display is the set temp and the red display is the actual temp. The set set should be 65°F.
5. Press the bottom left button once and verify that the A1SP temp is set to 125°F. The arrows adjust this and press the button left two more times to return to the main menu.
6. Double check that the water level in the main unit is near the fittings in the reservoir. Top off with clean ship tap water if necessary (NOT DI water).
7. Monitor with Cryowatch to ensure that the water and oil temperatures stabilize indicating that the backup system is functioning. (Even when doing a planned switch, the temperature will likely rise some.)
8. Once satisfied that the main is functioning properly, then the backup needs to be moved fore about 1 m and stowed under the table minding 2 flexible hose connections and power connections - it is very easy to run over them. Secure the unit with its tie-down and anchor.

Figure 7: Ship's chill-water valves shown **open**.

Figure 8: The two selector valves shown in the **main** position.

Purging the Systems

Purging the systems not only helps to keep the reservoirs and lines clean, but also tests the backup system ensuring that it is ready to put into service on a moments notice. It should be done at the end of every expedition in the same way that the reservoirs were a regular EOX maintenance task.

While the process is not difficult, it is best to prep for the job and maybe even do a mental run through if is the the first time.

Preparation:

- Open Cryowatch and make sure it is logging.
- Turn the backup system on to verify that it is functioning and then turn off.
- The **main** Haskris system should be in use.
- The **backup** Hasrkis should be away from the wall for access to the **purge valve** and the **backup shutoff valve**.
- **Open** the **purge valve** and **close** the **backup shutoff valve** (**Figure 9**). The purge valve allows the system to drain for purging, and the backup shutoff prevents the main system from filling and overflowing the backup system.
- Both systems' fill reservoirs should be open are ready for filling.
- A 5 gallon bucket of clean tap water (NOT DI) should be ready by the system being purged.
- The purge line should be clipped into an empty 5 gallon bucket near the system being purged.
- Purging is best done in the order presented below to ensure the backup is ready to go when needed. A second person is helpful, though not necessary since the two systems access points are in different spots.

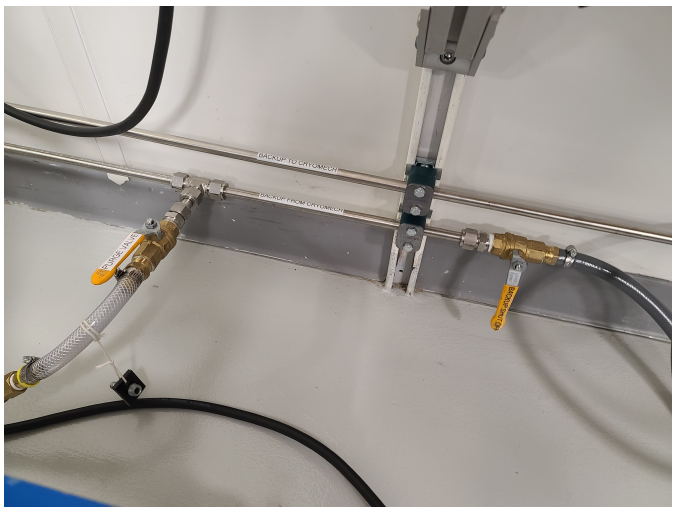

Figure 9: The **purge valve open** and the **backup shutoff valve closed**.

Purging the Main System

1. With everything prepped and ready, switch the "from cryomech" line to the backup system by turning its black selector valve down 180° (**Figure 10**). Warm water leaving the Cryomech should begin to flow out of the purge line.
2. Once the main's reservoir is empty, the pump will start coughing.
3. Refill the reservoir. If the pump stalls, toggle power switch until resumes it pumping again.
4. Allow the refilled reservoir to purge again and run completely dry.
5. The next steps should be done as quickly as possible to switch to the backup system.
    a. Turn off the main Haskris
    b. Close the purge valve.
    c. Open the backup shutoff valve.
    d. Turn on the back up Haskris
    e. switch the "to cryomech" line to the backup system by turning its black selector valve down 180°. Both selector valves should be down and the Cryomech should be switched to the backup system.
6. Monitor with Cryowatch to observe the temperatures and as long as the oil stays below 120°F, the SRM temperature should stay well below the superconducting threshold.
7. Once the temperatures begin to recover, physically clean the reservoir. Also remove, clean (or replace), and reinstall the filter.
8. Refill the reservoir with ship tap water.
9. Once the temperatures are fully recovered begin the next section.

Figure 10: The "from cryomech" line switched to the backup system by turning its black selector valve down 180°.

Purging the Backup System

1. Ensure that the backup system is running.
2. With everything prepped and ready (now at the backup Haskris), leave the backup shut off valve open, but also open the purge valve. Warm water leaving the Cryomech should begin to flow out of the purge line.
3. As the reservoirs empties, you may have to defeat the backups float switch by holding it up.
4. Once the backup's reservoir is empty, the pump will start coughing.
5. Refill the reservoir. If the pump stalls, toggle power switch until it resumes pumping again.
6. Allow the refilled reservoir to purge again and run completely dry.
7. The next steps should be done as quickly as possible to switch to the main system.
    a. Turn off the back up Haskris.
    b. Close the purge valve.
    c. Turn on the main Haskris.
    d. Switch both the "to/from cryomech" lines to the main system by turning the black selector valves up 180°. Both selector valves should be up and the Cryomech should be switched to the main system.
8. Monitor with Cryowatch to observe the temperatures and as long as the oil stays below 120°F, the SRM temperature should stay well below the superconducting threshold.
9. Once the temperatures begin to recover, physically clean the reservoir. Also remove, clean (or replace), and reinstall the filter.
10. Refill the reservoir with ship tap water.
11. Move the backup Haskris back under the table.
12. Once the temperatures are fully recovered, temporarily turn back on the backup Hasrkis, switch both selector valves to the backup position, wait a few seconds, then swtich the valve back to the main, turn off the backup Haskris, and refill if need. This step ensures that the backup pump is primed and completely ready to operate.
13. Replace all lids and covers.
14. The water remaining in the purge line can be drained at the quick couple fitting into the low pan (which lives in the underbelly of the cooling system). This helps to prevent bio experiments in the purge line.

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