Cryomech Compressor and Haskris Water Chiller

Introduction

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

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

The ship's chill water is plumbed directly to the SRM Cryomech 2800 series compressor through a heat exchanger coil (**Figures 1 and 2a, b**). This system is comprised of a chilled input line and warm water return line. The heat exchanger coil is used to warm the ship's chill water before it reaches the compressor. These lines are plumbed through a set of three way valves at the forward end of the paleomagnetics lab.

Figure 1 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.

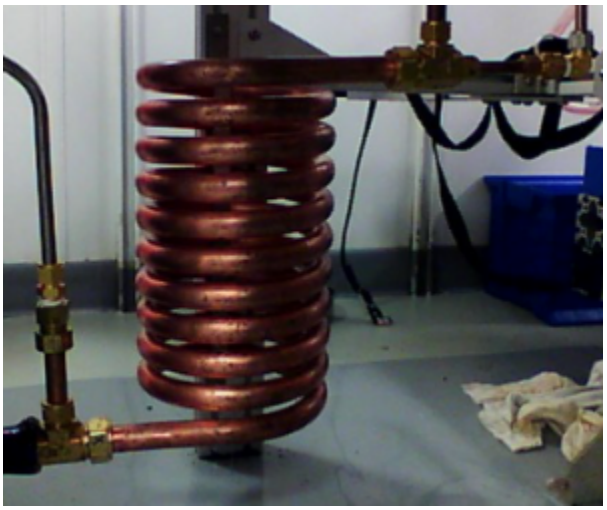

Figure 2a: Heat Exchanger coil placed in line with the ship's chill water supply. The warm water returning from the compressor warms the cold water flowing to the compressor.

Fig 2b: A bypass valve for the tube-in-tube heat exchanger coil was installed on Exp. 379T (July 2019). This valve allows you to cut the heat exchanger out of the cooling loop and run directly on ship's chill water entirely. Opening or closing this valve gives you approximately 10F of oil temperature change. The pictured valve position indicates the heat exchanger is included in the cooling loop.

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 3**). The 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 3: Haskris Water Chiller. This unit is located at the forward end of the paleomagnetics lab. The unit is air cooled and will generate heat in the lab space.

Monitoring the System

To monitor the status of the compressor, use the CryoWATCH program (**Figure 4**) 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 5**). The communications setup should be the default baud rate of 115200 and a slave address of 16. The com port may need to be adjusted. The current configuration requires com port number 5. Monitoring Compressor status:

Figure 4: CryoWATCH Panel Desktop Icon

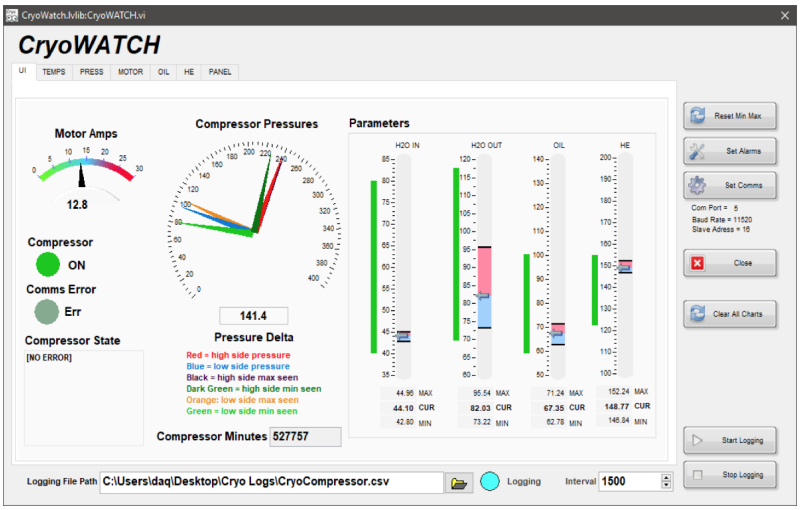

Figure A5: CryoWATCH window. User may monitor water temperatures and oil temperatures after changing the chill water supply.

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

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

*The ship's chill water temperature can vary. There is no method for controlling this temperature in the lab. Temperatures below 40 F have been noted and no issues were encountered. For colder water temperatures, reduce the water flow. For warmer water temperatures increase the flow rate.

Adjusting the Water Flow Rate

Because of the low temperature of the incoming chill water, it is important to set the flow rate using a metering valve found at the forward end of the paleomagnetics lab (**Figure 6**). **You should set the flow rate as high as possible while keeping the compressor's oil temperature above 60 F** (t emperatures in the 80s or 90s are better)**.** Make small adjustments when turning the valve as reducing the flow too far will cause the compressor to shut down and give a "low flow" error. If this happens, open the valve again to the previous position and press the ON button on the compressor to restart the system. Monitor the oil tab after adjusting the metering value to ensure the temperature stays within the appropriate range.

Alternative: 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 to 5, designate a file path, and the compressor data will be logged.

Figure 6: Metering valve for the ship's chill water. The red tape is used as a

reference when adjusting the valve. All adjustments should be small and incremental.

The pressure of the ships chill water is maintained around 50PSI when leaving the pump in the engine room. Pressure is much less by the time it reaches the paleomag lab. Adequate pressure and flow rate must be maintained to ensure proper exchange of heat within the compressor, or the outflow water and oil temperatures will spike, causing shut down of the compressor. Approximate pressure of ship chill water entering the compressor can be read off the chill water pressure gauges in the mechanical room adjacent to the paleomag lab. These gauges should read >25PSI at least, with pressure around 28PSI providing adequate flow to the compressor for necessary heat exchange. If pressure of the ships chill water drops too much, the Haskris system should be engaged to ensure proper compressor functionality. The Haskris contains its own pump and refrigeration, allowing for more control over the water entering the compressor system.

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 7**). 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 7: Cryomech Compressor for SRM. Red box indicates display which will indicate a low flow error if cooling water is not circulating to the compressor.

Compressor Shutdown and displays 'Low Flow' fault message: Check the orientation of the three way valves at the forward end of the paleomagnetics lab to ensure they are all the way open. Monitor the H20 In temperature on the CryoWATCH Panel. If water is flowing, open the metering valve to allow for more flow to the compressor and turn the compressor on using the green ON switch. Continue monitoring the water and oil temperatures.

The chill water is still flowing, but is no longer refrigerated: Monitor the oil temperature using the CryoWATCH Software and increase the flow rate with the metering valve as necessary. **Remember, even chill water at 80 F can keep the compressor running.**

Ship's chill water is off: The Haskris will need to be turned on to supply chill water to the compressor. *The compressor will not shut down if you momentarily interrupt flow, only if the temperature of compressor's oil rises too high or if the flow is shut off completely.*

Switching Chill Water Systems

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 compressor will shut off, beep audibly, and signal a "low flow" error on the front console of the compressor. **You have approximately 10 minutes from the time the compressor shuts off to the time when the SRM warms above 7 K and loses the trapped field.**

From **ship's chill water** to **Haskris water chiller** supply:

1) Open the Haskris water tank cover to monitor the water level. (**Figure A8**).

The Haskris is filled with tap water or ship's chill water. If you open the tank and the surface of the water is growing biologic experiments, it is best to empty the tank with a wet vacuum and refill the Haskris water tank before starting the system. If the ship's chill water is still on, the tank can be filled by opening the outlet 3 way valve and allowing the water returning from the compressor to flow into the Haskris for a short period of time. If the ship's chill water is off, fill the Haskris tank with clean, drinkable water (Not Deionized water!) via a bucket. **ROUTINE MAINTENANCE -> At the end of every expedition, remove the water, clean and replace with drinkable water.**

Figure 8: Haskris Water Chiller with water tank open. Water surface should be clean. Do not pump dirty water through the Haskris.

The blue box indicates the power switch for the Haskris. The orange box indicates the water temperature set temperature and actual temperature as well as the Haskris controls.

2) Turn on the Haskris power using the switch on the front of the Haskris (**Figure 8**). Wait 10 seconds. The Haskris is a closed loop system and can be started before the water supply is diverted as long as there is water in the Haskris tank. If the water level drops significantly, add more water to the tank before opening the valves.

3) Use the up and down arrows to set the desired water temperature for the water leaving the Haskris (**Figure 8**). The water temperature should be set at 65 degrees F or above. Remember, the goal is to keep the compressor oil temperature as close to 90 degrees F as possible.

4) Locate the black 3 way valves at the forward end of the paleomagnetics lab (**Figure 9**). When the ship's chill water is used to supply cold water to the SRM compressor, the valves should point toward the chill water lines (white arrows pointed toward the right when facing aft) (**Figure 10**).

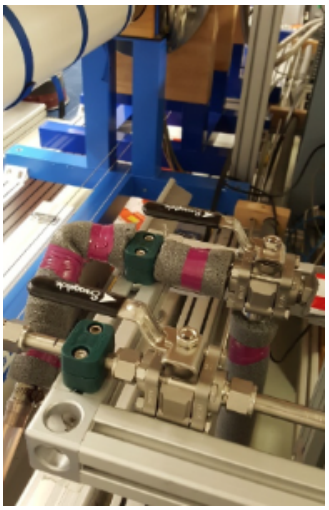

Figure 9: Three Way Valve controls for the compressor cooling water. By rotating these valves the user may switch from ship's chill water to the Haskris Water Chiller or vice versa. Arrows on hoses indicate direction of water flow.

Figure 10: Valve positions when using ship's chill water for cooling the SRM compressor.

5) Turn both valves 180 degrees. This can be done simultaneously or one at a time. **This step should be done quickly to avoid completely draining the Haskris water tank or overfilling the tank. Make sure the valves are turned the full 180 degrees.**

When the Haskris water chiller is used to supply cold water to the SRM compressor, the valves should point toward the Haskris water lines (to the left when looking aft) (**Figure 11**).

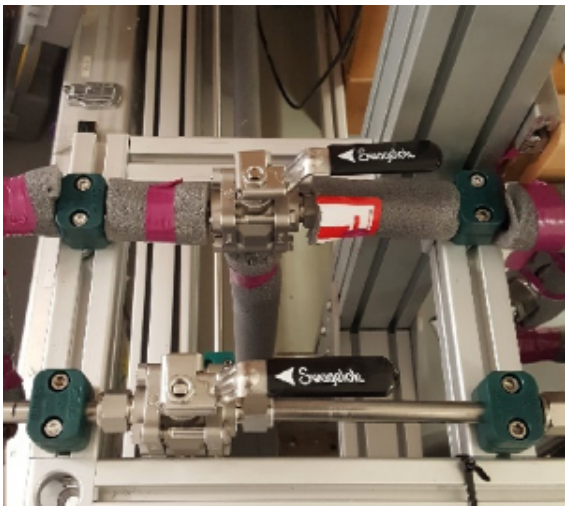

Figure 11: Valve handles after being turned to Haskris mode. Note that the white arrows point toward the Haskris Water Chiller hoses.

6) Once the valves are turned, monitor the compressor vitals using the CryoWATCH software on the SRM computer. Monitor the water temperatures and oil temperatures on the right hand side of the screen.

To switch back to ship's chill water from the Haskris, turn the valves back to the original position (**Figure 10**). Turn off the Haskris and monitor the oil temperature in the CryoWATCH software.