Guide to Cleaning the Water-Cooling System for our Ultracold Apparatus

Russell Kamback

August 29, 2024

Apparatus Information:

The water-cooling apparatus for the magnetic coils consists of assorted sizes of copper tubing ranging from about 1 cm diameter to 2 mm diameter inside the coils. Connections are made of 3/8” Swagelok NPT fittings. The estimated temperature of the water is between 15 and 25 degrees Celsius, and the estimated pressure differential is about 20 psi (80 psi supply and 60 psi return). The estimated flow rate is between 1 and 1.5 gallons per minute.

Materials Used:

- 1:1 solution of Rydlyme descaling agent mixed with water
- Pump (Model 350, 115 Volts AC, 24 Watts)
- Bucket for holding the pump and Rydlyme solution
- Garden hose connecting tap water to pipes

Descaling Procedure:

We disconnected the Swagelok fittings on the supply and return valves so that we can access the inside of the cooling pipes. The entire process consisted of alternating between running in tap water from the sink, running in compressed air, and pumping Rydlyme descaler through the system.

First, we made a 1:1 solution of water and Rydlyme. We filled the blue bucket with enough solution to completely submerge the pump. We then connected the pipe to one end of a brass T, with the other end connected to the input end of our loop via plastic tubing with 3/8” Swagelok fittings attached on either side.

Fig 1. Bucket containing 1:1 solution of Rydlyme and water. The output tube is displayed facing into the bucket as part of the closed-loop descaling system.

The output end of our loop empties back into the same bucket. Clip the plastic output tube to the side of the blue bucket so that it does not move around and spray water anywhere in the lab. Once this is set up, we plug the pump into the wall to run it. Do **NOT** plug the pump in before submerging it completely, for dry running the pump may damage it. We let this run for the day, then shut it off to let the chemical sit in the pipes overnight. It took about two weeks of doing this every afternoon for the plastic portions of the water-cooling pipes to become clear.

Every day, it is good to use a pH indicator on the Rydlyme and water solution. The pH will be somewhere between 0 and 1 if the solution is still active. If the pH reads above 4, the solution is spent and should be replaced.

After the first day of running Rydlyme through the loop, we flushed it out with tap water by attaching one end of a garden hose to the sink, running it across the room, and

attaching the other end to the input of our loop. We had the output end going into an empty garbage bin. Since this is not a closed-loop operation, the tap water would need to be shut off and the garbage bin emptied every two minutes or so. Every few cycles of tap water, we switch the direction of flow by switching the input and output tubes in the hopes that the change will help break up any particulate stuck in the pipes.

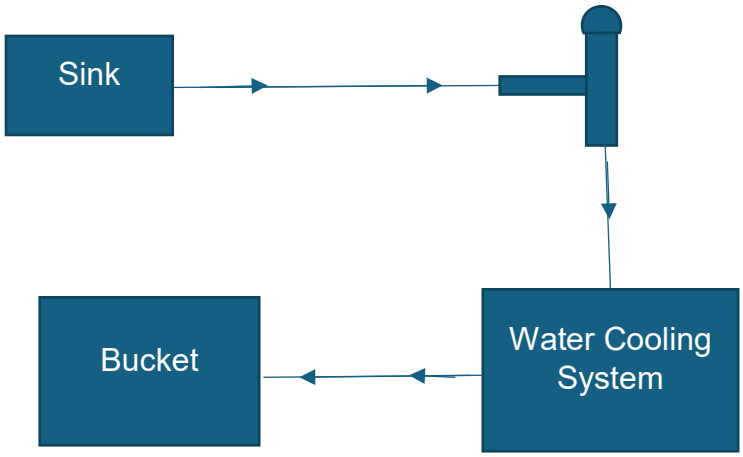

Fig 2. Diagram of the setup for flushing tap water through the system. On the top right, there is a brass T with one end capped, allowing the garden hose to connect to the input of the pipes.

After running a few cycles of tap water, we switch to compressed air by attaching the air line to the input of our loop. Again, the output points into the empty bin. The air pressure should be set to between 15 and 20 psi. Initially, any water in the pipes will shoot out. We wait until all the water is out before ending this cycle. This can run for much longer since there is no water involved. Usually, we let the air run for about 10 -15 minutes before switching back to water.

We implement this alternation of tap water and compressed air a few times until minimal dirty water exits the output tube and until the plastic tubes near the coils are mostly clear. This may take a few days. At the end of each day, we reattach the Rydlyme pump and run it for about a half hour before turning it off and letting the chemical sit in the pipes overnight.

Below are some pictures of the plastic tubes mentioned above:

Fig 3. Images (1), (2), and (3) from left to right

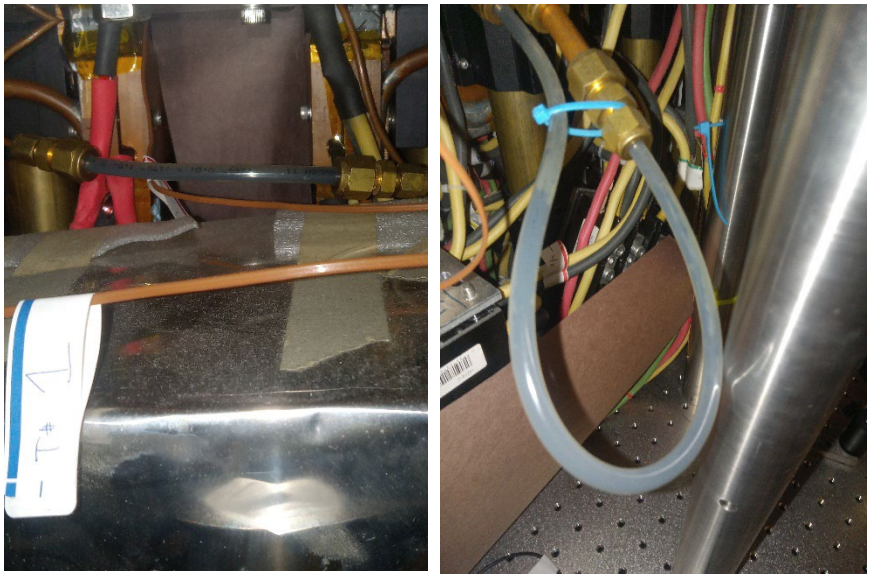

Fig 4. Images (4) and (5) from left to right

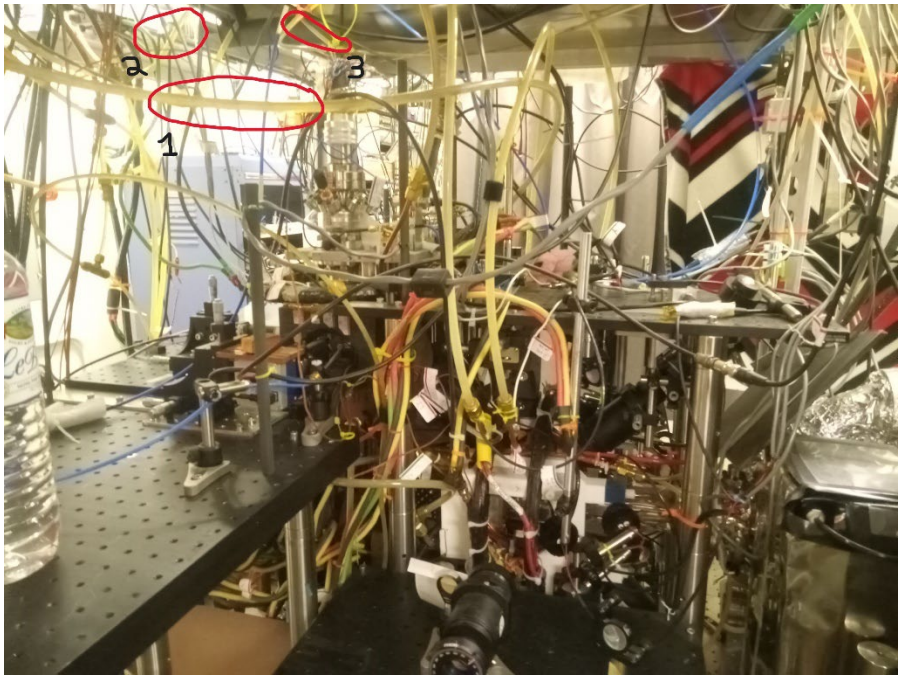

Fig 5. Broad display of apparatus with labelling. The numbers correspond to the locations of the images numbered in Fig 3.

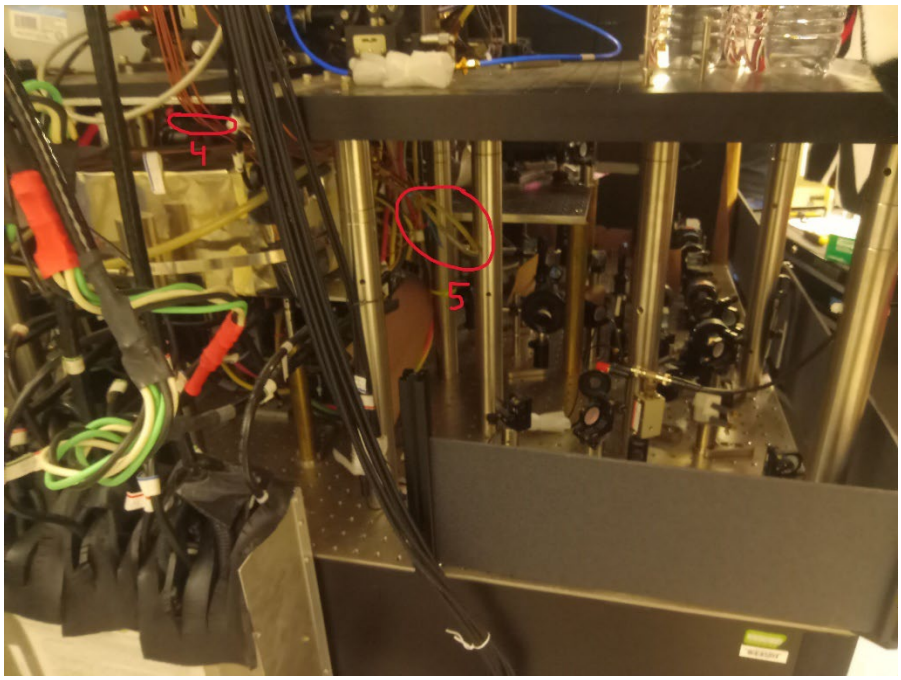

Fig 6. Broad display of apparatus with labelling. The numbers correspond to the locations of the images numbered in Fig 4.