Understanding the operation of LN2 delivery system on Rheometrics RSA2/RMS800/RDS2/RDA2/ARES

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The following is a guide to understanding the operation of the LN2 delivery system on the above mentioned Rheometrics instruments. It is intended only as a guide by means of the author's own personal experience at attempting repairs. The reader is encouraged to seek additional advice if any of this is unclear. Above all, safety is most important when working on electrical-mechanical devices. You should use proper care when working on such a devise. *Make sure all power is disconnected and proper safety attire is used, such as protective gloves and eyewear. Above all, common sense must prevail and if the reader should have difficulty they should stop and get assistance.*

The LN2 delivery system used on the Rheometrics instruments has been in use for more than 20 years. Surprisingly it has not changed very much over those years even though the packaging has. One fundamental change occurred around 1990 when the solenoid arrangement was changed from 2 solenoids to 3. This occurred on the RSA2 and RDA2 and was later retrofitted to the RMS and RDS, it has not changed through to the present day ARES which still uses the exactly the same system. There are of course small adaptations from instrument to instrument to allow for different electrical connections and delivery systems to the heater assembly.

Basic considerations

It should be noted that the LN2 dewar system is only used with Forced Convection Oven assembly {FCO}. Also often the first place to look when there is a problem with the LN2 is to check to see if the External supply of LN2 is operating properly. That is the pressure should be between 22 and 30 psi. Too low a pressure and the LN2 dewar will not fill properly and too much pressure and the dewar may be damaged. We once discovered that students at a University had hooked up a high pressure External supply and applied over a 100-psi to the dewar!

Once the correct external supply has been hooked up check the in-line filter just before the inlet solenoid. This can be removed and the sintered filter assembly can be replaced or cleaned and reused. Check to see if there is any blockage in the line. We once had a customer that experienced a blockage in the filter because the external supply tank had been left exposed to the outside elements for some time and a wasp's nest appeared in the outlet valve. When the supply was finally hooked up the nest was flushed into the filter in the dewar.. It is a wonder no one was stung!

Description of the mechanics

Once these factors have been examined next it is helpful to understand the basic operation of the dewar, that's what we call the small chamber in back that handles the LN2 from the external source. Basically the dewar is a small stainless steel vessel that has a double wall and is evacuated to give it excellent insulation properties. On top of this vessel sits the Aluminum manifold. The manifold contains the necessary valves, level sensor and immersion heater. It is insulated with foam and given a hard coating to protect it. Between the Aluminum manifold and the stainless steel vessel is a cryogenic "O" ring that sits in a groove in the stainless steel vessel and seals against the Aluminum manifold. Over time this "O" ring will deteriorate and

cause leakage. The basic operation of the solenoid valves in a 3-valve system operates in the following manner. The command for low temperature is made, the operator depresses the LN2/GAS button on the system controller {on all systems except ARES} this opens the inlet and dump solenoid {the dump solenoid is distinguishable by the cylindrical muffler that is attached at the exit}. The LN2 flows from the big external tank down the stainless steel hose, past the sintered filter and in through the inlet valve in the manifold of the dewar. The LN2 flows past a needle valve also in the manifold and down into the dewar. The cold LN2 will gasify upon striking the warm dewar and this gas escapes out the dump valve through the muffler. The third solenoid valve which leads to the oven remains closed until the dewar is full and the "LN2 Ready" light is illuminated. There is a level sensor that protrudes down from the manifold. The level sensor is basically two thermisters mounted on a long slender circuit board. When the level of the LN2 in the dewar is high enough one of these thermisters is covered. The cold LN2 changes the resistance of the circuit that the thermister is connected to. The change in resistance causes the "LN2 Ready" light to come on, the third solenoid is now opened to the oven, this third valve is called the exit valve, the dump solenoid closes and the immersion heater is activated so that power is pulsed to it. The LN2 travels out the exit valve through the heater gun and into the oven, where the PRT and thermocouple monitor the temperature. As the temperature drops the heater gun will be activated to stabilize the temperature in the oven allowing it to reach the commanded temperature with a degree of accuracy. The level of the LN2 in the dewar is controlled with a float valve and the needle valve previously mentioned. As the LN2 in the dewar is used up the float value will drop and release the needle valve causing more LN2 to enter the dewar, a simple but effective way to control the LN2 level.

Trouble shooting

There are a number of things you can do in the event of a problem with your LN2 delivery system. First, most problems originate from the LN2 delivery system, Check the external delivery tank for sufficient pressure, it should be around 22 psi. Check for any blockage, this could be in the hose or in the filter or even at the inlet valve itself. Regular maintenance should include cleaning or replacing the LN2 filter. If the problem is with the level sensor, try checking the two circuits at the connector. If you remove the level sensor make sure you relieve the pressure in the system first or you could get a shower of LN2. Remember to use proper protective gear when dealing with LN2. If you have any doubt get help.

A common problem is that the small dewar will not fill, that is "LN2 Ready" light will not come on. This could be for any of the reasons mentioned above as well as problems in the Oven control board 703-00246, certain chips on the control board activate the solenoids, if any of these are damaged the solenoids will not turn on. Check the voltage to the solenoid. The immersion heater is another source of problems. This is where heat is generated to help gasify the LN2. Power is pulsed to this device from a triac, if the heater is open it will not operate, you may wish to check the triac for proper operation as well. Another source of problems is with the cryogenic "O" ring. This will break down over the years and cause a leak. It can only be replaced by tearing down the dewar assembly.

All these suggestions are only a guide, remember to use protective gear such as eyewear and gloves. Get help if there is any doubt about any of this. Never expose yourself to high voltage, always unplug the device you are working on and get help from your maintenance or technical staff, these people can be a valuable asset when working on electrical-mechanical devises. Remember to look for the simple things first, use a good dose or common sense and if in doubt, ask!

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