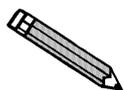


CryoCooler Model 029

The CryoCooler is an optional unit for operations with the AutoChem at subambient temperatures. With it a sample can be cooled and held for an extended time at any temperature between +20 and -100 °C. Temperatures are guaranteed to be held within ± 5 °C between +20 and -80 °C, and within ± 10 °C between -80 and -100 °C. This holding temperature can be shifted at any time either up or down within the overall range. After being at a fixed temperature, the sample temperature can be ramped down or up to ambient at rates anywhere between 1 and 50 °C/min but, with optimum control at rates being between 10 and 25 °C/min. At ambient temperature, the furnace controller takes over and proceeds with ramped heating without CryoCooler involvement.

The CryoCooler unit consists of a cryogenic pump mechanism, a storage dewar for liquid nitrogen (LN₂) and a transfer line that attaches to the AutoChem furnace. Stable subambient temperatures are achieved by causing small, frequently repeated injections of LN₂ to fill the furnace cavity within which is located the sample (Actually, the stream that reaches the sample compartment is not liquid but cold vapor.). Upward ramped temperatures are obtained by simultaneously diminishing the frequency of LN₂ inputs and increasing the energy input to the furnace.

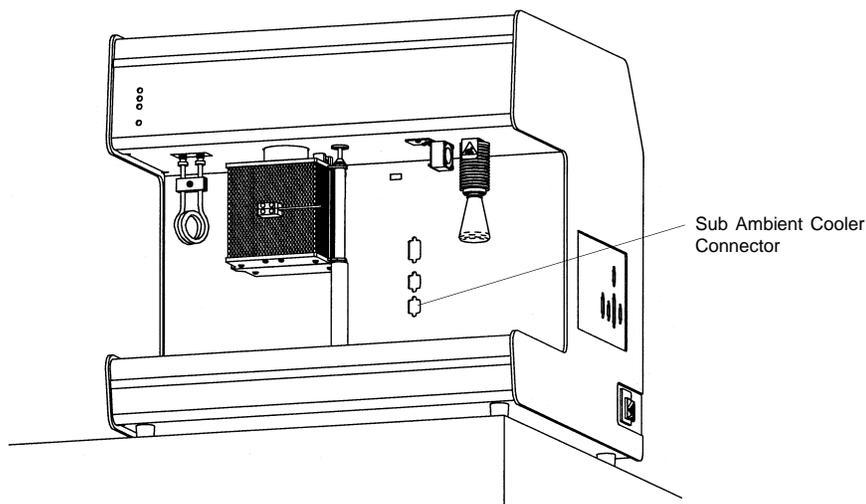
Water within the CryoCooler mechanism inevitably causes it to malfunction. Its accumulation must be avoided. Water collects in the transfer section when it is withdrawn while cold from the LN₂ dewar and allowed to warm to ambient temperature. Moisture from the atmosphere condenses within the mechanism. When the transfer section is subsequently re-immersed in LN₂, this water freezes and prevents the motor from turning on, or blocks the transfer line. Below is described how this is prevented and what to do when it occurs.



Be sure the mechanism is clean and dry before inserting it into the LN₂. If the transfer system has accumulated water or water vapor inside, it will freeze when inserted and prevent operation.

Installation

1. Attach one end of the cable (provided with the CryoCooler) to the connector labeled **SubAmbient Cooler** on the front panel of the analyzer. Attach the other end of the cable to the CryoCooler.



2. To verify the CryoCooler is operating properly before inserting it into LN₂, enable manual control, right-click on the CryoCooler icon, and set the speed to 100%. The green light on the housing should come on and the rotor at the end opposite the housing should be visibly turning. Turn the CryoCooler off using manual control, but leave the cable connected.
3. Insert the transfer mechanism into its dewar filled approximately two-thirds full of LN₂. Boiling will result as the mechanism contacts the LN₂ so insert it slowly over a period of several minutes. This permits most of the resulting vapor to escape before the mechanism is finally centered on the dewar opening.



Insert the transfer mechanism into the LN₂ slowly. Inserting the mechanism too quickly will cause boil-off of the LN₂ and possible splashing onto the hands.

4. Place the dewar on the floor near the front of the analyzer or beside the analyzer on its workbench.
5. Attach the transfer line of the CryoCooler to the furnace inlet tube.
6. Secure the transfer line by tightening the thumbwheel on the transfer line terminal.

7. Allow five minutes for thermal expansion and contraction effects to dissipate, then start the AutoChem analysis.

If the CryoCooler fails to respond, it may be due to components having not yet thermally adjusted to their new temperature surroundings or to ice formation from previously condensed moisture. Wait a few minutes and try again. Failure this time is almost certainly due to ice formation.

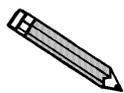
Routine Maintenance

The buildup of ice and frost particles is unavoidable in any device which uses liquid nitrogen in a laboratory environment. The CryoCooler has been carefully designed to minimize problems from ice. Ice problems can be avoided almost entirely if, on a weekly basis, the dewar is emptied of liquid nitrogen and its interior carefully and thoroughly dried. Repeated filling and evaporation can lead to an accumulation of ice crystals within the dewar itself.

Recovering from an Iced Condition

If ice buildup should occur, a thermal overload switch activates and cuts power to the pump motor. The green light will also be off in this condition. Perform the following steps to remove ice buildup.

1. Remove the transfer mechanism from its dewar.
2. Unplug the transfer mechanism from the instrument to allow a few minutes for the thermal protector to reset itself.
3. Blow dry air or nitrogen into the transfer line and out of the pump, holding the mechanism nearly vertical. Also blow into the pump inlet and into one of the holes of the member connecting the housing and the pump just above its connection point to the pump. It is advisable to heat the pump mechanism with a laboratory heat gun until it is too warm to hold. When doing so, be careful not to heat the plastic transfer line directly; it will melt if overheated.
4. Slowly insert the mechanism back into the dewar and proceed with the sample analysis.



The CryoCooler reservoir retains LN₂ for several days when not used. If its use is temporarily suspended, leave it plugged into the instrument but disconnected from the furnace inlet. An internal heater produces a slight outflow of gaseous nitrogen sufficient to prevent the counterdiffusion of moisture-laden ambient air and consequent deposition of ice in the transfer line.

Replenishing the Dewar

Replenishing the dewar without removing the pump and then having to dry it can be accomplished in either of two ways:

- Lift the housing a few inches above the neck of the dewar, allowing it to rest on the rim of the neck. The nozzle of the Model 021 LN₂ transfer system (refer to Chapter 10 of the AutoChem operator's manual for ordering information) can then be inserted and the dewar refilled.
- Withdraw the transfer mechanism from the nearly empty dewar and immediately insert it into another full dewar, allowing introduction of insignificant ice.