

CH360 Cryogenic CCD Camera Head

This camera head is designed for use in imaging applications where unusually low light levels demand long exposures.

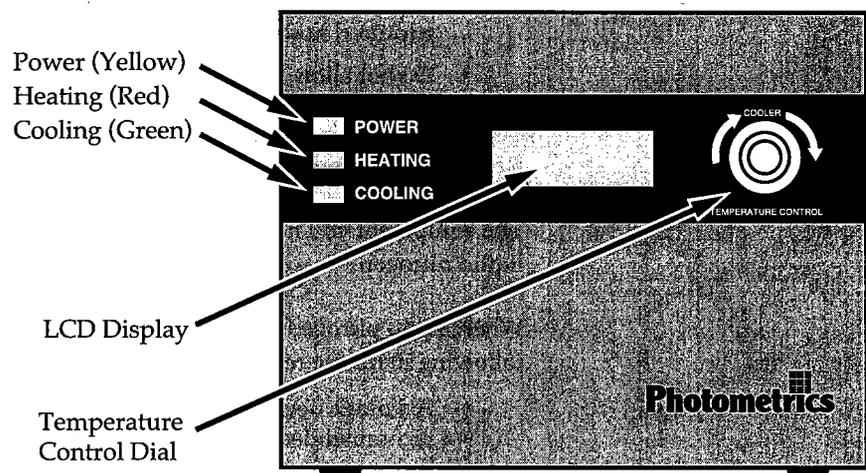
The cryogenic dewar reduces dark current to negligible levels with liquid nitrogen cooling. The liquid nitrogen is contained in a dewar flask.

A sliding cold finger connects the aluminum lining of the dewar to a CCD heat sink. The heat conductivity of the cold finger balances the CCD's radiation loss to permit the CCD to reach a minimum temperature of approximately -120°C (not as cold for larger CCDs).

Temperature Control

The CEU supplied with a cryogenically cooled camera head (or as an option with a thermoelectrically cooled camera head) has a temperature control dial on the front panel that allows you to cool the CCD to the desired temperature. The temperature is shown on the LCD display. When the CEU is on, the temperature of the CCD stabilizes at the point set on the dial. When the CEU is off, the CCD is cooled to its lowest uncontrolled temperature.

CEU Front Panel
(for Cryogenically Cooled Camera Heads)



The CCD in a cryogenically cooled camera head should be operated at the highest (that is, the least negative) temperature that yields acceptable dark current. Because dark current levels vary widely with the type of CCD used, it is not possible to give an optimal temperature. A starting temperature of -100°C is appropriate for most applications.

Temperatures above -90°C are not recommended because dewar hold time is greatly reduced. At temperatures below -130°C , long-wavelength quantum efficiency and performance deteriorate rapidly.

Filling the CH360 Dewar The dewar need not be filled for initial setup and checkout (such as when taking a test exposure using CAMTEST™). It will not hurt the camera head to run warm. Once the system checks out, you should fill the dewar according to the precautions and procedures detailed in this section. Only one person is needed to fill the dewar.

Note: For optimum dark current performance, fill the dewar and then connect the camera head to the CEU and put in a bias loop until ready for use.

Precautions

Liquid nitrogen is safe if you use it carefully. It can be extremely hazardous if you do not use correct procedures and fail to take certain simple precautions:

- Always wear gloves and protective clothing, including goggles or a full face shield. The temperature of liquid nitrogen is -196°C , and it can cause severe frostbite if brought in contact with the skin. The eyes are especially vulnerable; liquid nitrogen splashed into the eyes results in permanent cornea damage.
- Stand away from the fill tube vent when filling the dewar. The vent emits cold gases.
- Always ensure that hoses carrying liquid nitrogen are securely clamped. Avoid excessive feed pressures, which could lead to a ruptured hose or a failed hose connection.
- Do not allow bystanders into the area while transferring liquid nitrogen.

Required Equipment

The equipment you need to fill the dewar depends on the available source of liquid nitrogen.

When liquid nitrogen is stored in a dewar *with a pressurized valving system*, the following items are required:

- A storage dewar filled with liquid nitrogen. A 25-liter dewar is recommended.
- Gloves and goggles or full face shield for personal safety.
- Cryogenic tubing to transfer liquid nitrogen from the storage dewar to the camera head dewar. The tubing must fit tightly over the storage dewar outlet and the fill port of the camera head dewar fill tube. (The fill port has an outer diameter of 0.5 inches.) A length of less than four feet is recommended.

Note: Cryogenic tubing and all necessary adapters can be obtained from where you purchase liquid nitrogen. *Do not use polyvinyl chloride or soft plastic tubing; these materials can shatter and cause personal injury.*

When liquid nitrogen is stored in a dewar *without a pressurized valving system*, the following items are required:

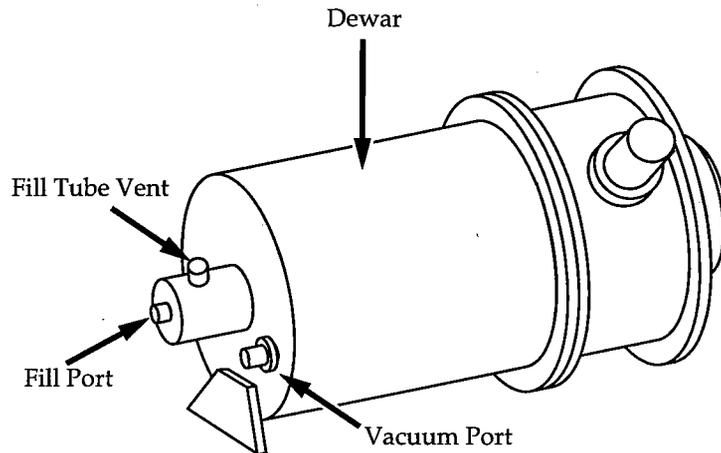
- Two to three liters of liquid nitrogen.
- An open dewar flask or stainless steel thermos.
- Gloves and goggles or full face shield for personal safety.
- Polyethylene funnel with a 0.5-inch diameter tube end.

Filling Procedure (for dewar with pressurized valving system)

Warning: Do not allow liquid nitrogen to spill on the dewar vacuum port or run down the side of the dewar. This can cause the o-ring vacuum seals to fail, venting the dewar to atmosphere.

1. Fit one end of the cryogenic hose to the fill port of the camera head dewar.

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2. Fit the free end of the cryogenic hose tightly over the outlet of your storage dewar.
3. Open the pressurized valve on the storage dewar to fill the camera head dewar.

At first, all of the transferred liquid nitrogen turns to gas and is expelled out the fill tube vent. (Liquid nitrogen coming in contact with the warm flask acts much like water poured into a hot pan on a stove.) When the dewar cools to the temperature of the liquid nitrogen, the actual transfer of liquid nitrogen begins.

There is often a momentary increase in the venting gas when the dewar reaches the temperature of the liquid nitrogen. This is normal and is not dangerous.

The dewar is full when liquid nitrogen begins to back out of the fill tube vent.

4. Close the pressurized valve on the storage dewar.
5. For maximum hold time, top off the dewar with liquid nitrogen after the boiling has diminished to a low level (30 to 120 minutes later).
6. Remove the cryogenic hose from the fill port of the camera head dewar.
7. Wait between 40 and 60 minutes for complete stabilization of the CCD temperature. The dewar is ready for use.

Filling Procedure (for dewar without pressurized valving system)

Warning: Do not allow liquid nitrogen to spill on the dewar vacuum port or run down the side of the dewar. This can cause the o-ring vacuum seals to fail, venting the dewar to atmosphere.

1. Fill an open dewar flask or stainless steel thermos with liquid nitrogen.
2. Invert the CH360 dewar so the fill port is facing up (the dewar is on its side in the figure on page 23). [For the CH370 or CH372, unscrew and remove the fill port plug.]
3. Insert the funnel into the fill port.
4. Fill with liquid nitrogen from the open dewar flask or stainless steel thermos. The dewar is full when liquid nitrogen is released from the fill tube vent. [For the CH370 or CH372, the liquid nitrogen may spill out the top.]
5. Remove the funnel. [For the CH370 or CH372, reinsert the fill port plug.]
6. For maximum hold time, top off the dewar with liquid nitrogen after the boiling has diminished to a low level (30 to 120 minutes later).
7. Wait between 40 and 60 minutes for complete stabilization of the CCD temperature. The dewar is ready for use.

If the temperature of the dewar does not drop after the dewar is filled (the green light on the CEU remains lit after 60 minutes), evacuate the dewar according to the following instructions.

Evacuating the CH360 Dewar

The entire dewar is under vacuum, except for the liquid nitrogen vessel. It has undergone several pumping cycles before delivery and should not require attention for several months after it is put into service. Corrective action must be taken when the vacuum is degraded.

The best indicator of the dewar vacuum condition is cryogen hold time, the length of time liquid nitrogen remains in the dewar after filling. When the dewar is filled to capacity and cooled with liquid nitrogen, the cryogen hold time for the CH360 should be ten hours or more at the maximum cooling setting. You should pump the dewar if the cryogen hold time drops by 20%. Frost accumulation on the outside surface of the dewar body is an indication of complete vacuum failure.

To pump the dewar, use a clean vacuum station with a pump capable of achieving a vacuum of at least 10^{-4} torr (0.1 millitorr). A good two-stage mechanical pump with a cryogenic trap is adequate, but a turbomolecular pump is recommended.

A vacuum valve operator is provided in the event the camera head requires repair or re-pumping.

Precautions

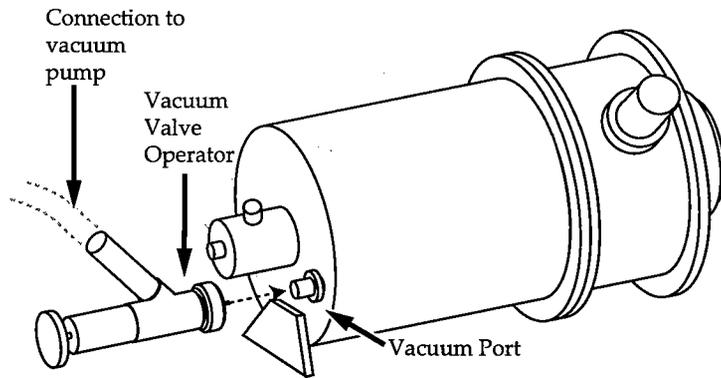
- Never open the vacuum port unless it is connected to a vacuum pump and the vacuum line is evacuated.
- If you inadvertently open the vacuum port when it is not connected to a vacuum pump, do not close the port until the dewar has reached room temperature (approximately 24 hours).
- Do not try to evacuate the dewar if you are not experienced with vacuum systems.
- The dewar must be emptied of liquid nitrogen and warmed to room temperature before you evacuate it. *Do this in a well-ventilated room.*
- Do not suddenly apply vacuum to the dewar, or suddenly open a dewar under vacuum to atmospheric pressure. This rapid change in pressure creates a dangerous rush of air that can damage the CCD.
- *Never open or close the vacuum port when the dewar is cold.* If the port has been opened and then re-closed when the dewar is cold, the internal pressure of the dewar will rise as the air inside warms to room temperature. This "pressure cooker" creates a very dangerous condition that can lead to personal injury.

Note: If the vacuum port has been either opened or closed when the dewar is cold, call Photometrics Customer Service for instructions.

Evacuation Procedure

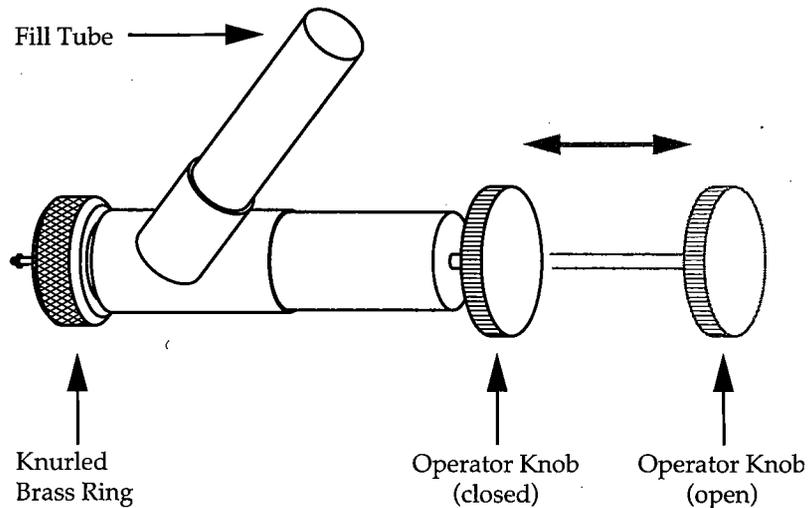
1. Empty the CH360 dewar by aiming the dewar away from yourself, rotating it 30° to the right, tilting it down slightly, and pouring out all the nitrogen. *Do this in a well-ventilated room.*
2. Bring the dewar up to room temperature. Using dry compressed air, this takes about one hour; otherwise, allow about six hours.
3. Unscrew and remove the plastic vacuum port cap (yellow or black) from the vacuum port.

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4. On the vacuum valve operator, pull the operator knob out, then position the operator over the vacuum port. Screw the knurled brass ring clockwise until it is tight.

Vacuum Valve Operator for CH360



5. Attach the vacuum pump to the fill tube of the vacuum valve operator using a 5/8-inch Cajon-style adapter or equivalent hose, clamped securely. Push in the knob of the vacuum valve operator until the hex-shaped plunger drops into the hex receptacle of the vacuum port plug. You will feel some resistance as it drops into place.
6. With the vacuum valve operator closed (pushed in), pump out the line connecting the dewar to the pump.
7. Use the valve operator knob to *slowly* open the vacuum port by unscrewing it counter-clockwise while applying a slight downward force. Any difference in pressure between the dewar and the line under vacuum will become noticeable as the plug is unscrewed. You will be able to feel when the plug is completely unscrewed and free from its housing, and you will also hear a clicking sound. Slowly pull out the vacuum port plug using the vacuum valve operator knob. Any further pressure variances will soon be equalized.
8. Operate the pump for 24 hours or more to a vacuum of at least 10^{-4} torr. Do not allow oil to backstream into the dewar and contaminate the molecular sieve. If oil does contaminate the sieve, the dewar must be returned to Photometrics for disassembly.
9. With the pump running, reinsert the plug into the vacuum port by pushing in the vacuum valve operator knob and turning the knob clockwise until the vacuum port plug is securely screwed into its threaded housing. The knob should travel into the dewar until the plug is secured. Pull the knob straight out without rotating to disengage the plunger from the vacuum port plug.
10. Cut off the vacuum to the line and detach the line from the vacuum valve operator. Remove the vacuum valve operator from the dewar by unscrewing the knurled brass ring. Replace the plastic cap.

Operational Requirements *Ambient temperature:* from 0°C to 40°C

Relative humidity: from 0% to 80%, noncondensing

Storage Requirements *Ambient temperature:* from -20°C to 50°C

Relative humidity: from 0% to 90%, noncondensing

Dewar Capacity 1.1 liters (2.0- and 2.5-liter dewars are also available for longer hold times); autofill system available

Cryogen Boil-off Rate Dependent on CCD.

CCD Operating Temperature Dependent on CCD.