Refilling Magnets with Liquid Helium

Caution:
Helium (He) is an asphyxiant.
Release of helium gas or liquid helium in an enclosed area with poor ventilation can lead to possible suffocation.
Liquid helium is very cold! The temperature of liquid helium is -269° C or 4.2 K and will cause severe burns to the skin.
If burns occur, treat the injury just like a heat burn, and consult a physician immediately.
High liquid-to-gas expansion ratio giving potential risk of over-pressurization of holding vessels and explosion.

Care:
Avoid rapid change in pressure of He in magnet.
Avoid moisture getting into magnet bore or helium can.
Green pressure release valve on dewar should always be open except when are pressurizing dewar and doing actual magnet fill.

1. Protective Equipment required for those performing magnet fills:
   Stout shoes
   Eye protection
   Laboratory coat
   Thermal (e.g. thick dry leather) gloves for handling cryogens (check for any holes before use)

2. Personnel requirements: 2 people, one acting as a back-up to ensure safety of the person performing the fill procedure.
   Must have immediate access to phone to contact Emergency Control Centre on 2-5050 in event of injury.

3. Pre task actions:
   Check and carry personal oxygen deficiency sensor
   Wedge open door to room to maximize ventilation
   Ensure spanners and electric dryer are available - BEWARE - magnetic field will interfere with action of hair dryer
   Bring the He gas cylinder into room but well away from magnet if needed - BEWARE - He gas cylinder is magnetic.

4. Prepare transfer line
   Attach o-ring, threaded cap and, if appropriate, extension tubes to the arms of the He transfer line.

5. Prepare transport dewar
   Vent dewar via vent valve to release pressure. Do not allow a white ‘flame’ to form (He is being wasted)
   Determine the helium volume using a "thumper tube".
   The "thumper tube" is a long tube with a round cup fitted at one end. When the tube is lowered into liquid helium, a vibration is felt by resting a finger on the end of the cup.
   1. Lower the thumper tube to the bottom of the helium transport Dewar and mark the thumper tube shaft in relation to the top of the Dewar valve.
   2. Raise the tube until a dramatic change in frequency occurs. Mark the tube at this point.
   3. The distance between the two marks can be translated from inches to liters using the chart that is mounted on the side of the transport Dewar.
      NB. A piece of thin latex can be stretched over the top of the thumper tube to enhance the feeling of the vibration or moisture on your finger may serve the same purpose.
   4. Record the volume of helium measured.
   Attach transfer line adapter to fill port on top of transport dewar.
   Close the safety valve adapter to fill port on top of transport dewar.

6. Prepare magnet
   Remove the black cap on the He filling port and replace it with the 'top hat' part.
   Vent helium can of magnet to 1 atm pressure by opening the one-way valve on the He exhaust (open gently at first – danger of quench). When pressure has dropped, remove vent end-piece and push tissue gently into exhaust end to prevent ingress of air.
   Put He level meter on and flick to a low measurement repeat rate to avoid undue heating effects.
either
Starting fill and pressurizing where magnet is very high up
Attach green line from He gas cylinder to regulator at base of flow rate monitor
Pressurize dewar by turning on He gas flow to 1.5 psi (read from regulator not other pressure indicators).
Put long end of transfer hose into dewar:
With 'vent' valve open, feed long end down through top valve on dewar SLOWLY.
Lower until it hits bottom – slowly so don’t disturb ice and then lift up a cm.
Pull o-ring down, screw hose in place and close ‘vent’ and green pressure release valves
When a regular plume forms, put into magnet
Adjust pressure slowly to 2psi – if He flow rate indicated on the regulator is zero, there may be a blockage and you will need to remove hose from magnet and then from dewar, warm, dry and start again for a He flow rate of ~4l/h

Or
7. Starting fill with dewar pressure less then 1.5 psi and a good plume
   Slowly lower the long end of the He transfer line into the He transport dewar, until the blue ‘flame' appears at the other end.
   Lift the transfer line up at the He transport dewar end, so that the other person can put the shorter end of the transfer line into the He fill port of the magnet.
   Lower both halves of the transfer line at the same time. A plume of He gas will push the tissue from the exhaust vent.

8. Pressurizing the transport dewar with He gas to maintain good flow
   Attach the gas cylinder to the pressurizing port of the He transport dewar and increase the pressure in the He transport dewar slowly to a maximum of 2psi, by opening the gas cylinder.

then
When magnet is full
When the magnet is full, the blue ‘flame' of liquid Helium will appear at the exhaust vent and liquid air starts to drip off the manifold.
Release the pressure in the He transport dewar by opening the pressurizing port. BEWARE He gas exhaust
Remove the transfer line from both the magnet and the transport dewar (VERY COLD), at the same time if possible (not possible for V600/G64).
Replace the cap on the He fill port, replace end-piece on exhaust and close the exhaust vent valve?? . CARE, if using the hair dryer, not to blow air INTO any of the He ports
Open green pressure release valve on transport dewar. Return dewar to storage
Transfer hose back on rack
When magnet has warmed up, tighten valves etc.

In the event of any disruption to this procedure the fill tap on the dewar should be closed immediately to prevent further liquid cryogen transfer.

In the event of a significant spillage of cryogen - leave the room immediately. One person should report the incident to senior management while the other prevents access to the room by others until the atmosphere is safe to enter.