

SUPER CONDUCTING MAGNET

For the proper use of the instrument, be sure to read this instruction manual. Even after you read it, please keep the manual on hand so that you can consult it whenever necessary.

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1 GENERAL

This manual describes a typical superconducting magnet (SCM). The details of the positions of the parts (such as the liquid-helium inlet and liquid-nitrogen inlet as well as the external appearance of the SCM and internal structure) differ from one type to another.

1.1 Function of SCM

This SCM is used for FT-NMR. It provides a highly homogeneous and stable magnetic field. There is a vertical hole (the bore) that goes right through the center of the closed cylindrical tank. The magnet generates a strong magnetic field in the center of the bore. Multiple tanks are concentrically arranged inside and a group of coils made of superconducting wires is in the innermost liquid-helium vessel. The permanent current in the superconducting wire of the SCM will maintain the magnetic field without connection to any external power supply. In order to reduce liquid helium boil-off, a liquid-nitrogen vessel surrounds the helium vessel. All of the liquefied-gas vessels are inside the outer stainless steel vacuum jacket for thermal insulation. Pipes on top of the jacket are used as an outlet for evaporated gasses and an inlet to refill with liquefied-gasses. Fig. 1 shows the structure of the SCM vessel.

1.2 Inside SCM and External View

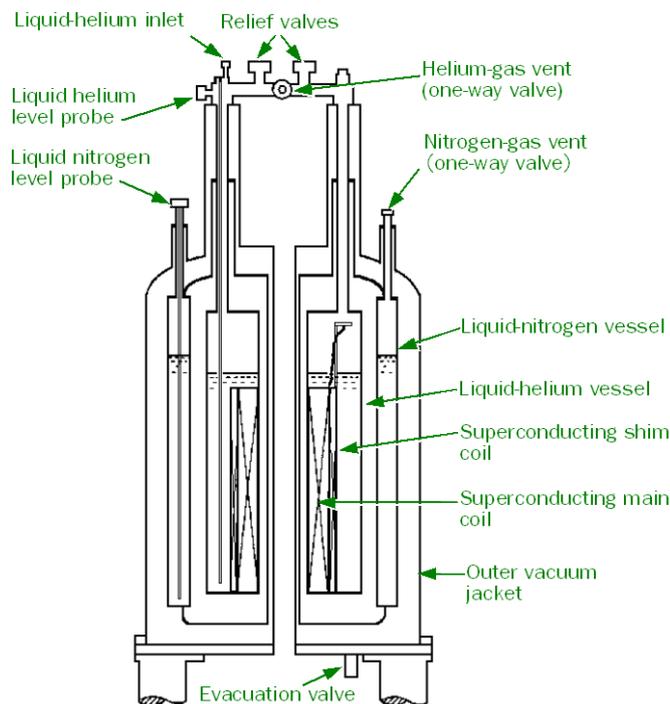


Fig. 1 Structure of SCM

WARNING

Do not open the evacuation valve. If you open it, the thermal insulation of the SCM will be lost and cryogenic gas will be rapidly discharged. This causes oxygen deficiency in the room and damages the magnet.

1.3 Accessories

1.3.1 Warning labels

Two warning labels are provided. One is a warning for equipment that might be influenced by the magnetic field (Fig.2). Please post it at the entrance of the restricted area around the SCM. The other is a warning for the strong attracting force from the magnetic field. Please post it on or near the SCM.



Fig. 2 Warning label for strong magnetic force

2 MAINTENANCE

2.1 How to Refill the SCM with Liquid Helium

2.1.1 Points to keep in mind when refilling

- Check the specification sheets to find the refill interval and necessary amount of helium. They differ depending on the type of magnet and when it was manufactured.

Normally refill more often than the specified interval as shown in table 1.

Table 1 Examples of liquid helium refill schedule

SCM type	Refill interval in specification	Actual refill interval
300 MHz	– days	– months
400 MHz	– days	– months
500 MHz	– days	– months
600 MHz	– days	– months

- Check the location of the refill port.
 -  The location of the refill port and some details of the external appearance differ depending on the SCM type.
 -  Refer to the instruction manual supplied by the manufacturer with each product.

Table 2 Items needed for liquid helium refill

Item	Description
Liquid helium	Specified amount
Transfer tube	Provided
Plastic bag	A long transparent bag with a volume of 1 to 2 L
Balloon	Commercial product
Nozzle	Provided (fit a 30 to 50 cm length of hose)
Dipstick	Provided
2 pairs of gloves	Heat-proof leather gloves
Heat gun	A commercial plastic hair dryer

2.1.2 Refilling using a balloon

You can pressurize the liquid helium Dewar using the pressure in a rubber balloon. This is the safest way to transfer liquid helium as the applied pressure is modest and the transfer is slow.

- ✂ Since the maximum inflating pressure of the balloon is limited to 0.006 MPa, use of helium gas as discussed in a later section will increase the efficiency of refilling a larger SCM or a SCM with a higher refilling pressure.

■ Procedure

1. Open a window and turn on the ventilating fan.
2. Set up the spectrometer as needed to display the liquid helium level during the refill. The level during refilling cannot be displayed correctly without this setup.
 - ☞ For details on how to set it up, refer to the instruction manual of your spectrometer.
3. Put on protective gloves.

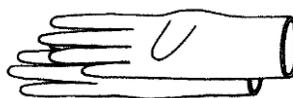


Fig. 3 Protective gloves

4. Use a dipstick to check the amount of liquid helium in the Dewar.
You are not allowed to refill the SCM with helium if the amount of helium in the Dewar is less than 10 L.
5. Place the balloon on the liquid helium vent of the liquid helium Dewar (Fig. 12).

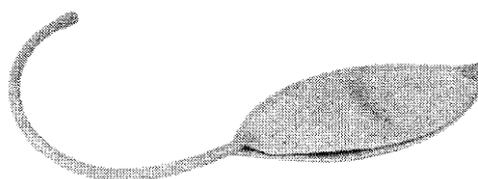


Fig. 4 Balloon

6. Slowly put the long leg of the transfer tube into the liquid helium Dewar.

⚠ CAUTION

If you put the transfer tube into the Dewar too rapidly, the balloon will rapidly inflate and blow out. It may cause injury.

If the balloon over-inflates, pinch the rubber tube portion of the balloon to stop further inflation.

✂ Helium gas will blow out at the end of the short leg and the inside of the transfer tube will cool down.

7. Cover the end of the short leg with a plastic bag and hold it with your hand. When the balloon has shrunk and gas flow has diminished, press the balloon with both of your hands. Then it will begin to be inflated again.

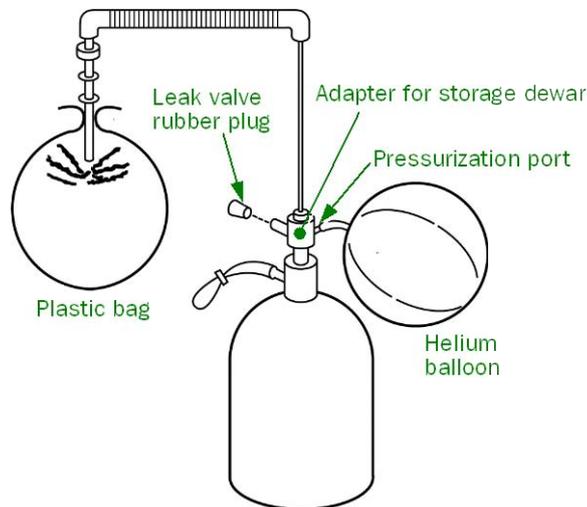


Fig. 5 Pre-cooling transfer tube

In about a minute you will hear an intermittent sound of gas flow. Intermittent frequency will get longer and within about 2 minutes it will turn to a continuous sound. In about 3 minutes the gas flow will turn into a visible white fog that will change to a bluish tint within about 3.5 minutes and air will condense at the end of the tube. Cooling is completed if you can see dripping air condensation in the bag.

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