ILK Dresden

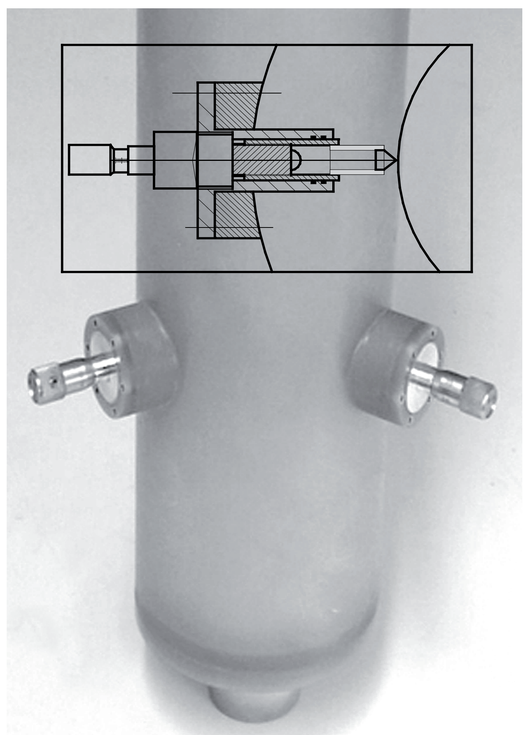
NEW DEVELOPMENTS OF NON-METALLIC CRYOSTATS FOR HTc-SQUID DEVICES

For some applications of HTc-SQUIDs there is the demand of special geometries between sensor and testing area, and furthermore position independence and mobility. Typical fields of applications are:

- medicine ➔ e.g. measurements of currents of heart and brain (i.e., biomagnetic measurements with SQUIDs)
- mate0rial tests ➔ e.g. detection of micro defects in materials by non-destructive evaluation
- geology ➔ e.g. surveying of the earth in the vicinity of the surface, specification of building ground and ground water
- science ➔ e.g. biophysical and standard investigation at and with SQUIDs, scanning tunnelling microscopy, etc.

At the ILK Dresden a series of special non-metallic cryostats has been developed to meet these demands. The cryostats are made from glass fibre reinforced epoxy materials and using liquid nitrogen as cooling agent.

- The design of thermal insulation and integrated shielding were adopted to the special requirements, such as transparency for high-frequency radiation, very low intrinsic noise, unusual geometrical conditions, long operating time, suitable for field tests, and low fabrication and maintenance costs.
- The construction of the inner vessel allows reliable cooling of a SQUID in vacuum referring to liquid level and stability of temperature and when the cryostat is turned around its transverse axis.
- The SQUID, placed in vacuum on a sapphire rod, is mounted on a heat transfer area (Cu) cooled by the cryogenic liquids.
- The smallest possible distance between SQUID and object of measurement can be only 4 mm.
- For universal use of the cryostats special inserts are developed for filling and refilling, made of different non-metallic materials.
- The SQUIDs can be changed without warming-up the cryostat. Continuous measurements are possible by use of automatic filling stations.

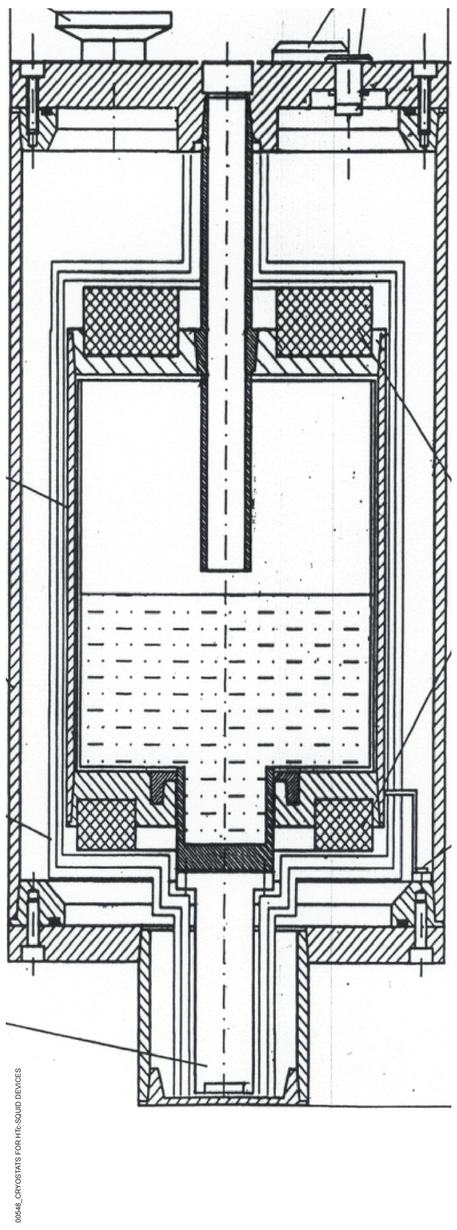


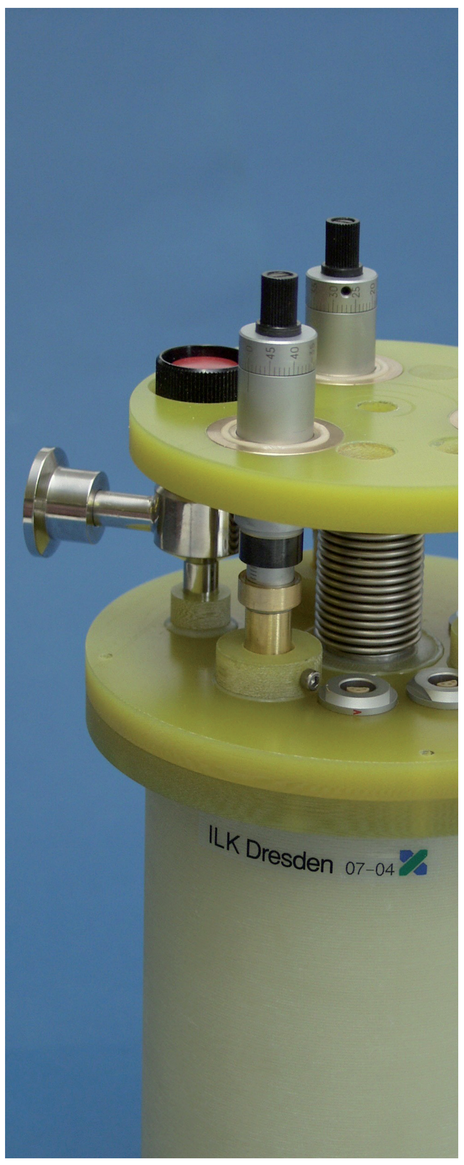
The position between SQUID and cryostat itself can be varied both in horizontal and vertical direction (xyz-plane)

- Distance variation via spring bellows mounted on top of the cryostat. In this way the whole liquid nitrogen vessel is moved relative to the outer vacuum vessel. Variation between 1 mm and several 10 mm.
- The isolation vacuum usually holds more than 6 months and the evaporation rate is less than 7% per day of LN2.

Picture of a position independent cryostat. In addition, the distance and plane between SQUID and vacuum vessel is variable and can be inclined.

- Position independent cryostats are designed in such way, that they can be turned around their axis by 360°.
- The construction of the inner vessel allows reliable cooling of the sensor with respect to liquid level and stability of temperature. Changes of temperature are less than 0.2 K.
- By turning the cryostat there are no significant changes of the evaporation rate and maximum working time.





For some application of SQUIDs (e.g., magnetic non-destructive material tests) the cryostat should be as small as possible and rotatable.

- The smallest cryostat, which we developed, had a diameter of about 60 mm and height of about 140 mm. The weight of the cryostat is less than 500 g. The operational time is three hours in thermal equilibrium, when filled with about 36 ml of liquid nitrogen.
- Working temperature: depends on position and varies from 77.5 K to 78 K when the cryostat is turned around its axis.
  Stability of the temperature in one position is about 0.1 K.

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