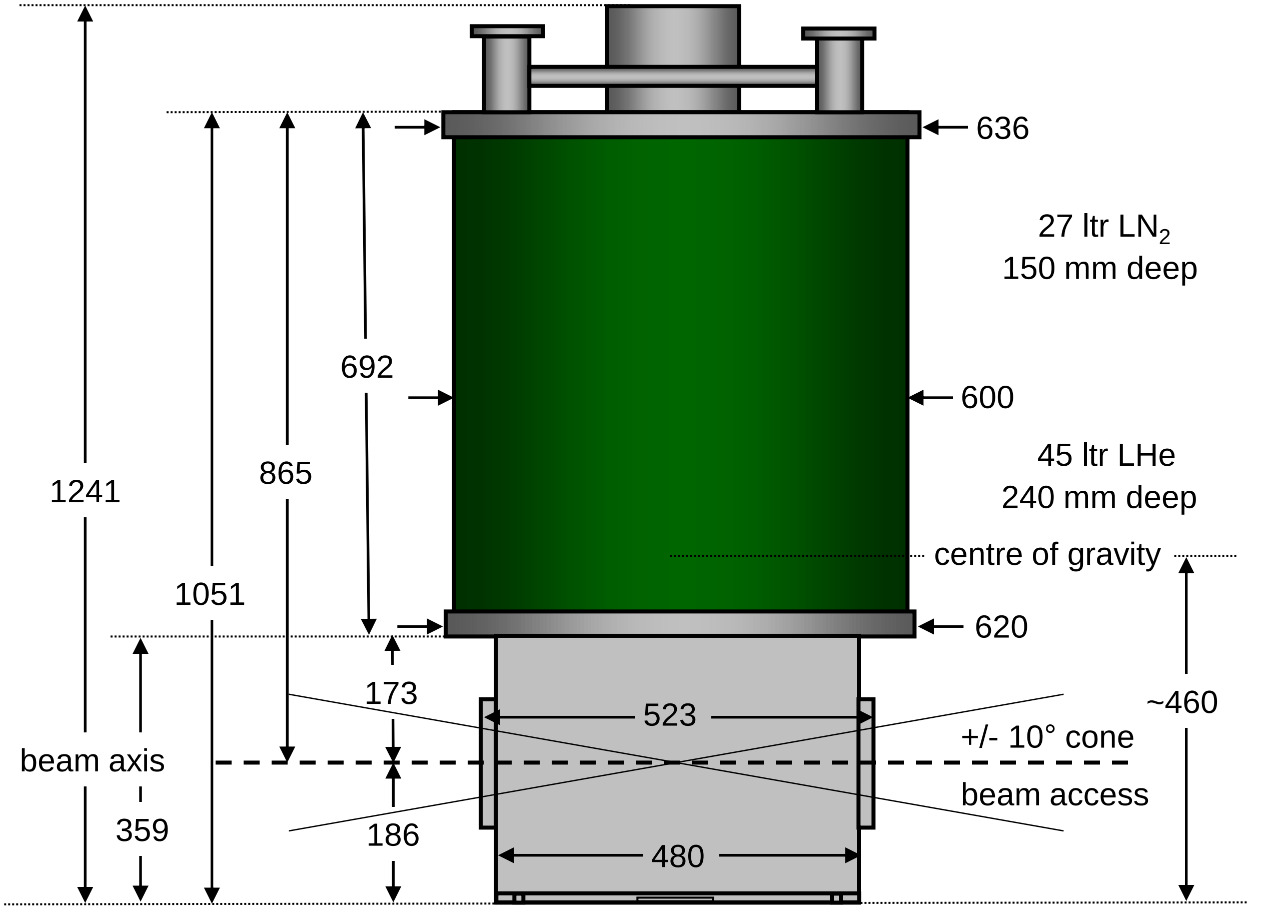
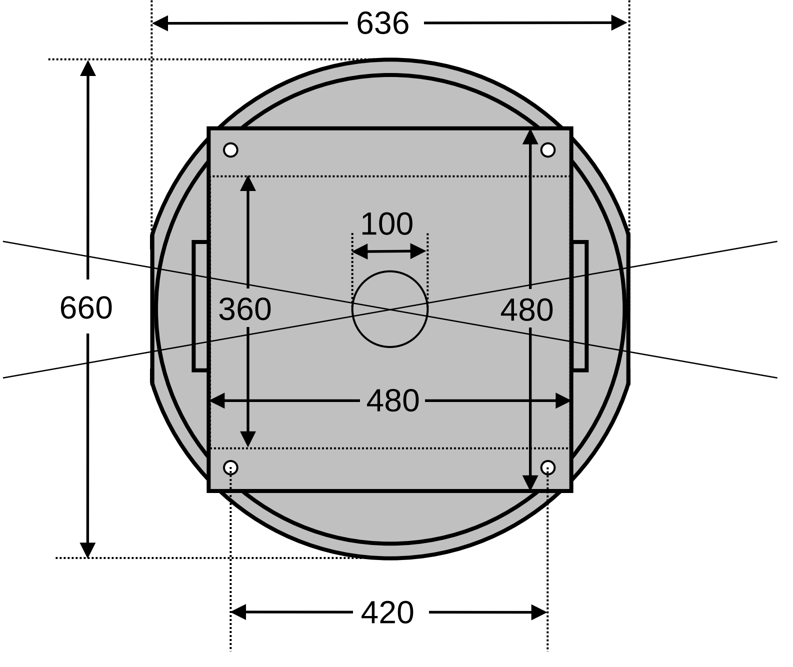
“17 TF” SANS/SAXS Magnet 1.6 – 300 K

view from side



view from below



Dimensions

The outside dimensions are shown in the diagrams. The solenoid is within the “box” part which is 480 mm long by 360 mm wide. The base of the box is a 480 mm square plate which will be used to mount the magnet on a beamline. It has four 13 mm holes on a 420 mm square to take M12 mounting bolts with a small amount of clearance. The base-plate has a circular centring recess which will take a 100 mm diameter 5 mm high boss, if required. The neutron axis is 186 mm above the base. The cryostat weighs ~350 kg & has its centre of gravity ~ 460 mm above the base,

Field & beam access

The maximum field at the sample position is 17 T horizontal, parallel to the beam, with 0.1% homogeneity over a 10 mm diameter spherical volume. The input neutron access is a cone extending $\pm 10^{\circ}$ around the horizontal field axis, illuminating a 10 mm diameter sample. The output scattering angles can extend to a cone $\pm 11^{\circ}$ around the horizontal axis. The magnet is tilt-able by $\pm 10^{\circ}$ at field and able to operate with horizontal forces up to 100 kg and vertical forces up to 50 kg.

With a central field of 17 T, the field at the windows is calculated to be 1.8 T. At 1 m from the centre of the coil, along the axis, it is 25 mT. At 1 m perpendicular to the axis, the field is -12 mT. At larger distances, these fields are in the ratio 2 : -1 and fall off as $1 / r^3$, as expected for a dipole.

Sample

The sample temperature is controllable from 1.8 to 300 K. Sample exchange is “side loading”, with the sample holder loaded into the cryostat vacuum (while the magnet is cold) using a demountable dedicated manipulator. For sample change, the cryostat is rotated so that its axis is 90° to the beam, to allow the manipulator to insert the sample holder along the magnet axis. There are 16 low-current leads to the sample holder; 4 of these are for a sample thermometer; others can be used for additional thermometry, in-situ measurements, the application of electric fields, etc.

There is an optional sample holder allowing in-situ sample-rotation about a vertical axis using an attocube®. This uses an additional 7 leads for drive and angle measurement, leaving 5 spare.

There is an optional re-entrant “room temperature bore”, which gives access to the magnet centre at a temperature controllable just above room temperature at atmospheric pressure. This has input access reduced to $\pm 7^{\circ}$, output $\pm 11^{\circ}$, a 20 mm diam. sapphire window at the sample position and no Al LN_2 shields. It can be added or removed while the magnet is cold.

Material in the beam

The cryostat has a very low background, since the only materials in the beam (apart from the sample) are the vacuum windows and LN_2T windows. For neutron use, the vacuum windows are 2 x 5 mm thick silicon (aluminised on the inside to reduce transmission of thermal radiation). For optical (or neutron) use, these can be replaced by sapphire. For X-rays, thin aluminium or kapton vacuum windows are available. The LN_2 windows are 2 x 2 layers of pure Al “cooking foil” for neutrons and hard X-rays and 2 x 2 layers of aluminised mylar for softer X-rays. All vacuum and LN_2 windows can be changed while the magnet is cold.

Facilities required

Single phase electrical supply. Crane to lift ~ 350 kg weight of cryostat. Goniometer for tilting, with motors not too close to magnet. Reasonably non-magnetic surroundings to reduce magnetic forces (Motors and forces may have to be tested offline before use). Liquid nitrogen & liquid helium filling, which should give an autonomy for at least 3 days. 16 m^3 /hr or greater helium rotary pump for VTI cooling. Turbo pump to evacuate sample change manipulator.