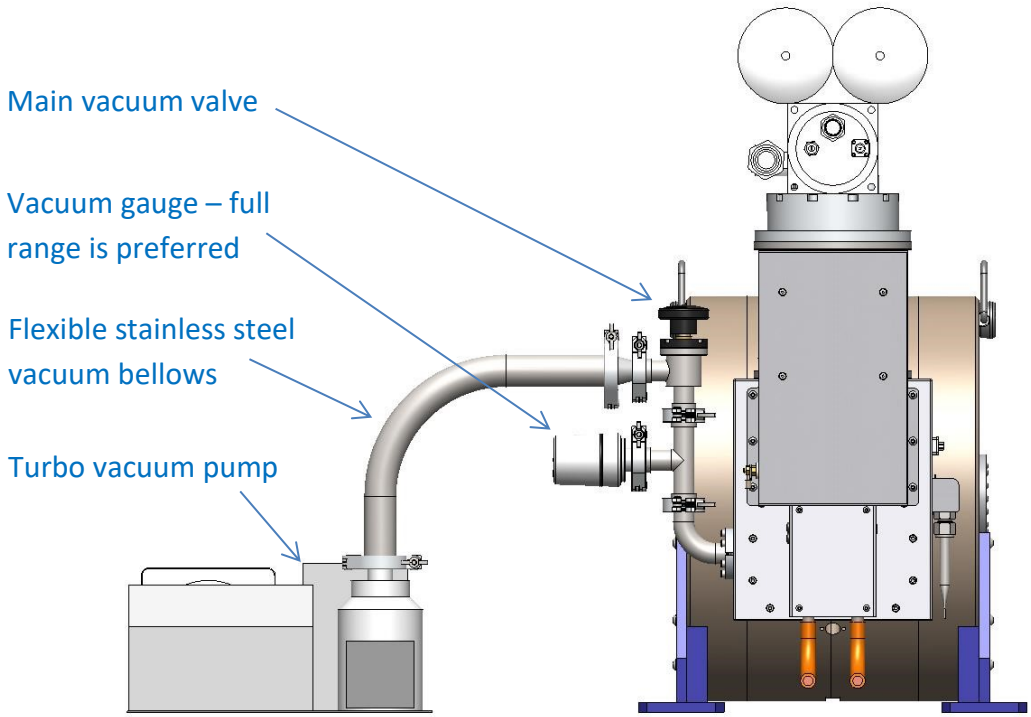
Turning off an HTS-110 Superconducting electromagnet

This document is designed to be a guide to safely and efficiently turning off an HTS-110 electromagnet. HTS-110 recommends turning off the system if it will not be needed for more than 2-3months as this will extend the lifetime of the cryocooler, power supplies and vacuum pump. It also allows for scheduled maintenance on the system.



To turn off an HTS magnet system:

1) Ramp the magnet down to 0A and switch off the power supplies.
2) With the main vacuum valve closed, switch on the vacuum pump and wait for the turbo to be at speed and the vacuum level to stabilise (needs to be $<10^{-3}$ mbar)
3) Slowly open up the main valve and wait for the vacuum to stabilise again (may take a minute or two).
4) Switch off the cryocooler compressor by toggling the main switch on the front panel.
5) Allow the system to warm up to room temperature. This may take several days; we don't recommend rushing this step if possible. Do not turn off the vacuum pump

during this time as it will be removing any contaminants that are released from the cold space.

6) Once the magnet is at room temperature (>280K on all sensors) you can close the main vacuum valve and switch off the vacuum pump.

To turn an HTS system back on:

1) Turn on the vacuum pump and wait for the vacuum level to stabilise.
2) Slowly open the main vacuum valve and wait for the vacuum level to stabilise again.
3) Once the pressure is less than 10^{-3} mbar you can switch on the cryocooler.
4) Wait for the magnet to cool. (Refer to magnet operator's manual for cool down time)
5) Once the cryocooler is operating, the observed cryostat pressure will rapidly drop to around 10^{-6}mbar because of cryo-pumping of residual gases by the coldhead.
6) Once the temperatures have bottomed out (steady blue light on the magnet monitor) you can close the main vacuum valve and turn the vacuum pump off.
7) You can now switch on the power supplies and begin ramping to field when desired.

A good vacuum is essential for the magnet to reach its normal operating temperatures. Over time gases can diffuse through the magnets O-ring seals and there will also be outgassing of components inside the magnet. The result of this will be a reduction in the efficiency of the cryostat's insulation which will result in a temperature rise in the magnet from normal operating levels. The performance of the cryogenic system may also be impeded by contamination such as back streaming vapour which will condense on the cryogenic manifold. For this reason a turbo molecular pumping station should be used which utilises an oil free backing pump or, alternatively, an in-line trap between the backing pump and the turbo-pump. In normal operation, the vacuum level of the system can be checked by simply switching on the power to the vacuum system and reading the gauge pressure on the display screen.

HTS-110 recommends pumping on the cryostat once every month or two or if a temperature rise across all temperature sensors is seen. Similar to the steps above; turn on the vacuum pump and once the vacuum pump is at speed, slowly open the vacuum valve on the magnet and leave the system pumping for several hours (overnight if possible). When finished, close the vacuum valve and then turn vacuum pump off. A vacuum of around 10^{-6} mbar should be observed and the temperatures should drop to their normal values.

If the above approach does not help it may be necessary to bring the system up to room temperature to make sure all contaminants are removed before re-cooling. This is best done when the magnet is not being used for an extended period of time. To do this follow the steps from the start of this document.

Should you need any further assistance then please contact us at service@hts-110.com