



Cryogenic Magnet Cooling Solutions

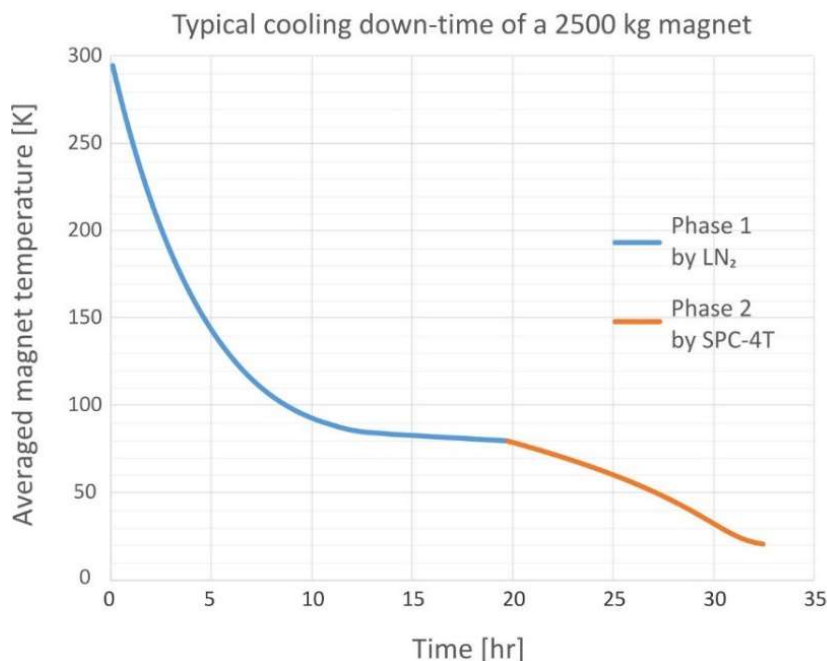
Stirling Cryogenics solutions for Magnet Cool-down

Efficient & fast Cool-down of warm Magnets

Warm magnets, new after production or after warming up for maintenance, need to be cooled down. Often for the first stage of cooling LN₂ is used as coolant, which then needs to be removed again. For the second part from 80 K, the internal cryocooler, cold helium gas or LHe is used. Using cold Helium of 4 K at high temperature is very inefficient causing this to be relative expensive because. Cooling periods by the internal cryocooler only will take a very long time.

When using a Stirling Cryogenerator with a closed He gas loop, a lot of cooling power becomes available especially in the range from ambient to 60K, the temperature range in which most of the energy needs to be removed.

From 60K and lower, cooling power drops but is still substantially more than the internal cryocooler. This results in a much faster cool-down. A typical cool-down time of a magnet of 2.500 kg will reduce from 5 to 1.5 days to reach 20K, after which the internal cryocooler will reach 4K.



Stirling Technology

For over sixty years Stirling Cryogenics has been designing and manufacturing systems for on-site production of cryogenic cooling power and various concepts of closed loop cryogenic cooling. We have served customers all over the world with different kinds of applications requiring cryogenic cooling under all possible conditions.

To cool these applications, Stirling Cryogenics offers several solutions based on its two product lines:

- Stirling Cryogenerators for the on-site production of cooling power starting from ambient temperature for cool-down, and to keep cold, down to 15 K.
- Cryogenic fluid pumps and CryoFans to create closed cooling loops for LN₂ and gaseous helium.

Stirling Cryogenics Cooling Solutions

Based on our brand components we provide various system concepts, adapted to the application requirements. Some examples of these systems for the cooling of Magnets are:

- Closed loop cooling by helium gas, which is cooled by either a liquid nitrogen bath or by our Cryogenerator from ambient temperature down to 80 K.
- Further cool down by helium gas flow with our two-stage Cryogenerator from 80K down to < 20K.
- These combined concepts will decrease the time of cool down of the magnet by at least 50% relative to the standard methods, without contamination of nitrogen.
- System solutions to provide distributed cooling power for shield cooling, surfaces for cryo-pumping or instrument cooling.



Helium gas cooling loops using CryoFans

To cool magnets or other devices down to 20 K, the medium of choice is pressurized helium gas. This is pumped around by our CryoFans, thermally connecting the application to the cold source. With this concept, cooling power can be distributed throughout the surface or mass to be cooled, minimizing temperature gradient. Our CryoFans are designed for minimal heat losses due to static heat in-leak and pump efficiency, maximizing available net cooling power.

Generation of cooling power by Stirling Cryogenerators

To generate cooling power the Stirling Cycle is used. In short, by compression and expansion of helium gas, cold is created which is used to cool a heat exchanger.

At the process side of this HX the cooling power is available for the process, for instance cooling of a helium gas flow.

Typical cooling capacities for different Stirling Cryogenerator types:

- 250 W @ 20 K
- 4 kW @ 77 K
- 12 kW @ 200 K

Magnet Applications

Typical use of our systems in Magnets applications are:

- Efficient and fast cool-down of magnets from
 - 300 K to 80 K in phase 1
 - 80 K to < 20 K in phase 2
- 20 & 80 K cooling of shrouds and current leads
- Instrument cooling

