Compact 1100K Furnaces for Eulerian Cradles & Automated Power Racks for 1900K ILL Furnaces

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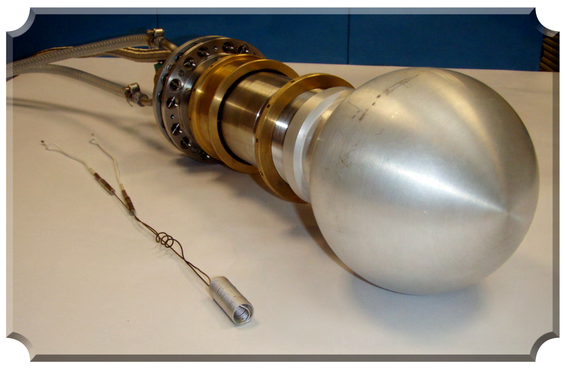
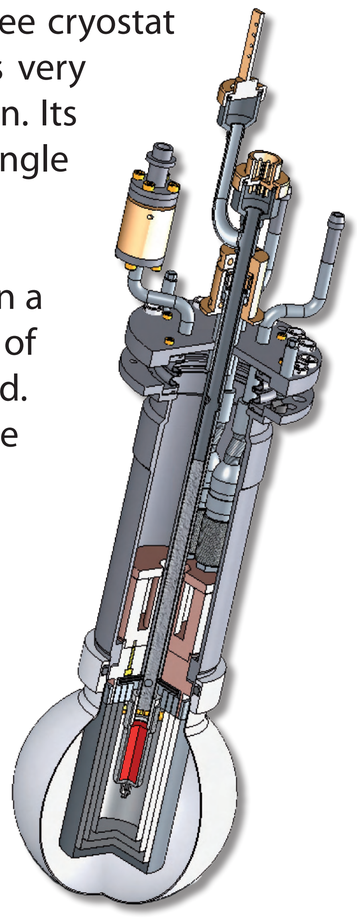


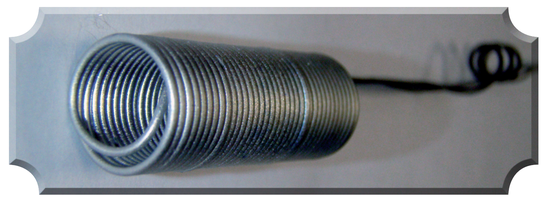
Single crystal diffractometers do need compact devices covering large temperature ranges and which can be mounted on a cradle. In order to satisfy our users, we have built a 1.8K cryogen-free cryostat and more recently a 1100K furnace. This furnace is very compact and compatible with the cold-head fixation. Its geometry is also compatible with the large solid-angle required on four-circle diffractometers.



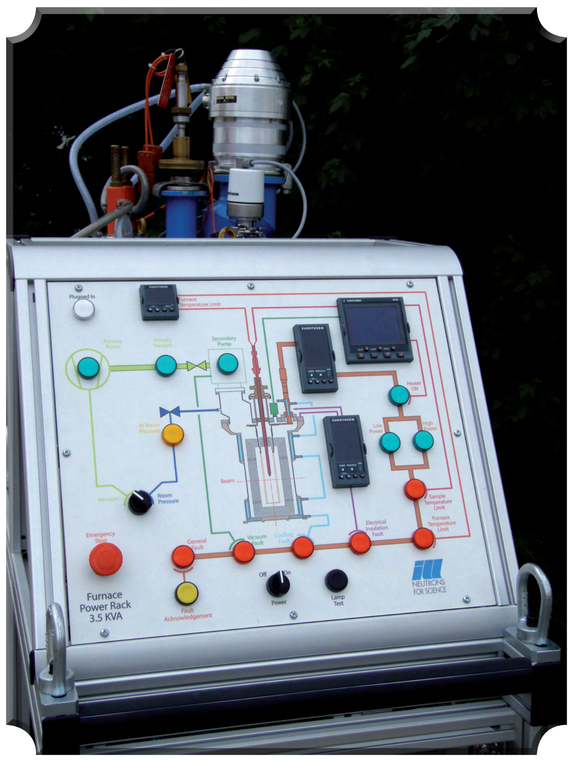
The heater is a135W/50V heating element inserted in a 1.5m long Ø1mm capillary winded in jointed whorls. It looks like a Ø14±.0.5 mm solenoid of 35 mm length. The capillary is made of 304L stainless steel and the whorls are laser welded. In the future, it is planned to use Inconel instead of stainless steel for improving the lifetime of the heater.

Tests have been performed between room temperature and 1100K for determining the PID parameters of the power supply. With overshoots less than 5K for any set point chosen in the temperature range, it takes about one hour to reach 500K from room temperature and 30 min more for reaching 1100K. About 30 min are required to cool down from 1100K to 650K, 60 min more for reaching 350K. We can speed up the temperature variations but oscillations are then observed around the set points.

furnace with shields and spare heater apart



Produced by AS-Scientific in Great-Britain, the standard ILL furnaces are used at many facilities worldwide. ILL owns about 20 copies. These top-loading furnaces are characterised by their flexibility and transparency to neutrons. The outer furnace body is made of aluminium for use under high vacuum or insert gas atmosphere. All internal components in the neutron beam are made of thin vanadium or niobium foils. Heating is achieved by resistance heaters using low voltage (0-15V) and high current (0-250A).

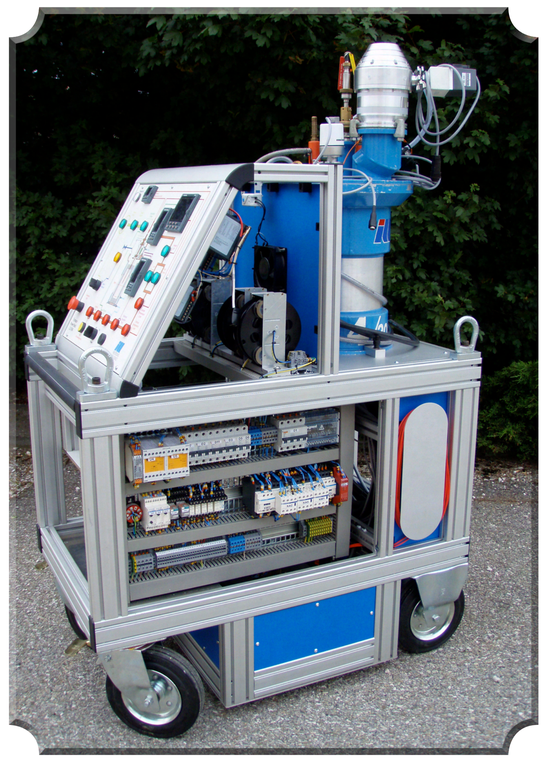


1: Switch on the rack,
2: Evacuate the sample chamber,
3: Enter the set point and wait…

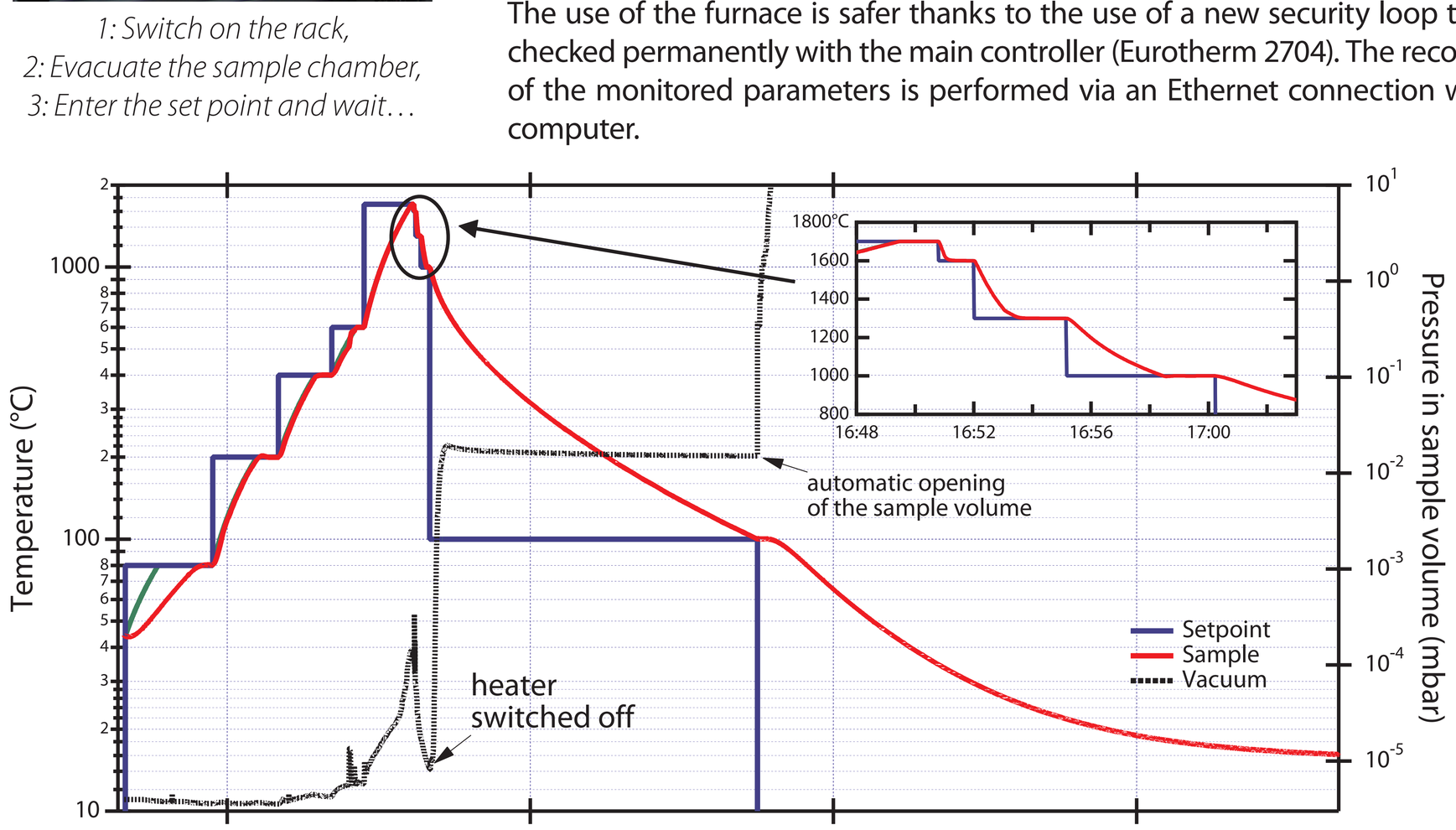
The temperature ranges from ambient to 1900K. A thermally decoupled heater and up to eight thermal shields guarantee small temperature gradients. Long term stability is typically 0.1% of the actual temperature and gradients are in the order of 0.1 to 0.5%. The heater element and an adjustable sample support allow for large samples (Ø35 mm x 50 mm). Most of the furnaces provide 360° horizontal access and ±20° vertical access to the neutron beam. Many different types of sample holders can be provided on demand.

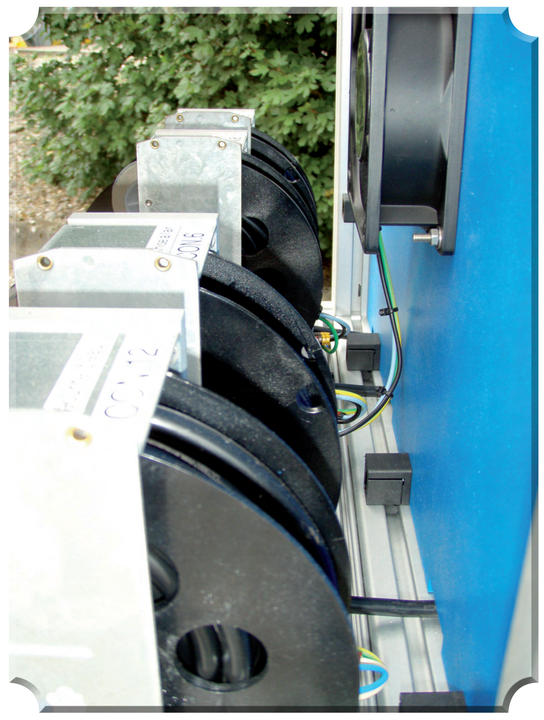
We have designed and built a power rack featuring automatic monitoring and control of the primary and secondary pumps, water cooling circuit and temperature readings. The interface of the cabinet presents a synoptic of the device onto which the user finds the very few buttons necessary for powering the system, evacuating/filling the vacuum chamber, acknowledging the detected defaults and setting the temperature. The PID parameters are of course set and adpated automatically.

The use of the furnace is safer thanks to the use of a new security loop that is checked permanently with the main controller (Eurotherm 2704). The recording of the monitored parameters is performed via an Ethernet connection with a computer.



easy access to all components





all cables enrolled inside