

CRYO

Cryofree[®] Magnet and Helium Recondensing Systems

Capability guide



OXFORD
INSTRUMENTS

The Business of Science[®]



Superconducting magnets without liquid helium

Magnet capability guide



Integrated Cryofree dilution refrigerator and magnet system

Magnets tailored to your experimental needs

- Cryofree solenoids up to 18 T
- Split pair magnets up to 14 T
- Vector magnets: including. 9/1/1, 9/3/3 and 3/3/3 T combinations
- Fastest magnet ramp rate commercially available using Oxford Instruments unique Nb₃Sn wire designs
- Robust technology adaptable to your experimental needs
- Integrated Cryofree dilution refrigerator/³He insert/variable temperature insert and magnet systems
- Cryofree variable temperature sample environments from 7 mK to 350 K
- No liquid helium handling necessary reducing cost, time and health and safety issues
- No system downtime during refills, magnet can be kept cold
- Automatic operation via LabVIEW software
- Easy to use, plug and play operation



15 T integrated Cryofree magnet with variable temperature insert

Cryofree[®] magnet systems



Oxford Instruments led the way when the first commercial superconducting magnet was developed in 1962 by its founder, Sir Martin Wood. Since then Oxford Instruments has built an impressive customer base worldwide and we are proud to have pioneered the design and manufacture of some of the most complex superconducting magnets ever built.

A range of Cryofree magnets which cover most applications

With Oxford Instruments' experience in superconducting magnets from wire development to full system expertise the technology has developed so that any application for superconducting magnets can be considered Cryofree.

Cryofree magnets require no helium refill so optimise your experimental time while reducing issues of skilled infrastructure and support.

Typical Cryofree Magnets:

Solenoid magnets up to 18 T	<ul style="list-style-type: none">● 57 mm cold bore● 1 in 10^3 homogeneity
Split pair magnets up to 14 T	Various splits and sample access available
Vector magnets eg. 9/1/1 T, 9/3/3 T and 3/3/3 T	Different combinations of fields on up to 3 axis

Standard features and options

- Top-loading and sample in exchange gas
- Sample space up to 30 mm
- Temperature range: 1.5 K to 300 K
- Magnet ramps from zero to 15 T in less than 30 minutes
- Wide range of windows for optical, neutron scattering applications to choose from

We have a wide experience in custom projects. Please contact us for special requirements

"I am delighted with the convenience of my Cryofree magnet system. Preparation of the magnet for an experiment only involves the usual pumping, and switching on of the cryocooler a couple of days before we start. The magnet works well, and is a key component in our unique experiment for confocal magneto-optical studies of quantum dots with arbitrary orientation with respect to the magnetic field."

Dr Richard Phillips, Cambridge University

Cryofree magneto-optical system



Cryofree[®] magnets

System capability guide

New integrated Cryofree dilution refrigerator, ³He insert, variable temperature insert and magnet systems up to 15 T

- Modular design: means the different inserts are interchangeable giving you more flexibility for future experiments
- Load-lock option for fast sample change
- Fast ramping capability: it takes less than 30 minutes to go from 0 to 15 T

This is achieved by using the latest high field, low loss Nb₃Sn developed by Oxford Instruments. This wire allows high energisation rates while keeping conductor losses low.

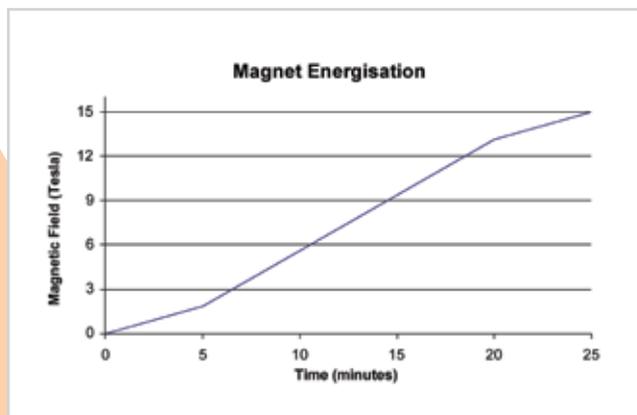


World's first 12 T integrated Cryofree dilution refrigerator and magnet system delivered to the University of Leeds

This system operates without liquid helium and only uses a single pulse tube refrigerator. It offers the unique ability to control temperatures from below 10 mK to 30 K and magnetic fields up to 12 T on the same instrument without any external manipulation of the sample environment. This is a breakthrough for applications such as neutron scattering where sample alignment is paramount. Having a single piece of equipment saves experimental space and time and will bring new research capabilities. For many families of novel materials, tracking phenomena such as spin ordering and antiferromagnetism over wide temperature ranges in a magnetic field, is key to understanding their intrinsic behaviour. This tool holds great promise for the development of future new materials.

"Our 12 T integrated Cryofree dilution refrigerator and magnet system from Oxford Instruments brings a unique capability to Leeds University. It allows access to the millikelvin temperature range at very high magnetic fields without the need for liquid cryogens. We are very impressed by the performance of the system which permits long run times at very high cooling power and in a low-noise sample environment without any user intervention."

Dr John Cunningham, University of Leeds



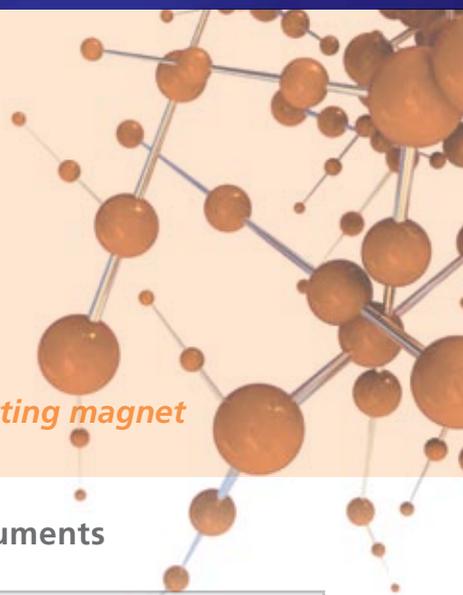
Cryofree[®] magnets

Work with a world leader

Applications

- Superconducting transitions, critical currents in magnetic fields
- Hall effect, magnetic and electrical properties
- Magneto-optical effects
- Neutron scattering etc.

Anything that would use a traditional helium cooled superconducting magnet



Cryofree technology and product milestones from Oxford Instruments

1995	Manufacture of the first OI Cryofree magnet
1995 onwards	Continued development of a number of customised magnet and cryostat systems developing the technology to design robust Cryofree systems
2004	Launch of the first Cryofree ³ He refrigerator (Heliox [™] AC-V) with patented adiabatic multi-expansion technology. Unique compact product requiring no liquid helium or pumps to operate
2007	Launch of the first Cryofree dilution refrigerator (Triton [™] DR) with patented "Multistage expansion", "dew mitigation" and "valveless Multistage Expansion" technology. Unique compact dilution refrigerator requiring no helium, pumps, gas handling system to operate and achieving 20 mK base temperature
2008	Launch of the Triton200, Cryofree dilution refrigerator achieving less than 10 mK base temperature
2009	50th Cryofree dilution refrigerator shipped
2009	World's first 12 T integrated Cryofree dilution refrigerator and magnet system
2009	First three high field helium recondensing split pairs
2010	World's first 15 T integrated Cryofree dilution refrigerator and magnet system



He Helium Recondensing Solutions

Capability guide

Recondensing options

- Alternative solution to Cryofree technology
- Based on a recondensing dewar with a zero-static boil off
- Allows stringent magnet duty cycles
- Compatible with the full superconducting magnet product range



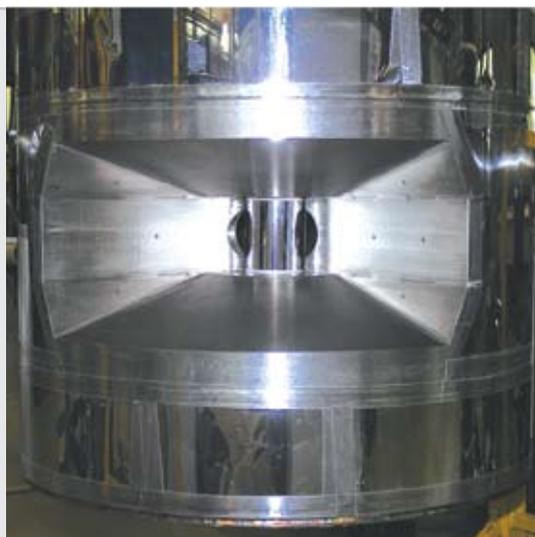
Recondensing dewars use a cryocooler to capture evaporated gas and turn it back into liquid helium. Using recondensing technology considerably decreases the helium consumption of these magnets. The cryostat is filled once with liquid helium, then the system can be kept cold continuously with virtually no helium consumption.

They also enable stringent magnet designs required by some applications such as neutron scattering. A major advantage of recondensing dewars is that they are compatible with all the standard range of wet dilution refrigerators, ^3He inserts, variable temperature inserts and magnets. This means you can upgrade your existing system with minimum investment and disruption to your experiments.

High field recondensing magnets:

Oxford Instruments has collaborated with two World-class neutron scattering facilities, the ISIS Neutron Source (STFC Rutherford Appleton Laboratory, Didcot) and the ILL Neutron facility (Institut Laue-Langevin, Grenoble) to deliver the first three high field helium recondensing magnets.

The ISIS Neutron Source purchased two recondensing neutron scattering magnets including a 9 T wide angle and 14 T at 4.2 K. These magnets will be used on the Let, Merlin and Wish instruments at ISIS.



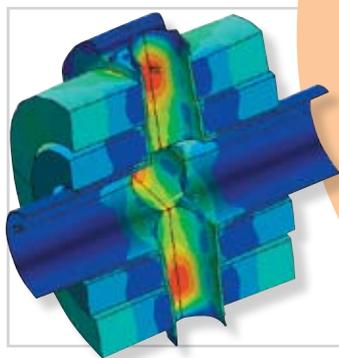
Helium Recondensing Solutions

Capability guide

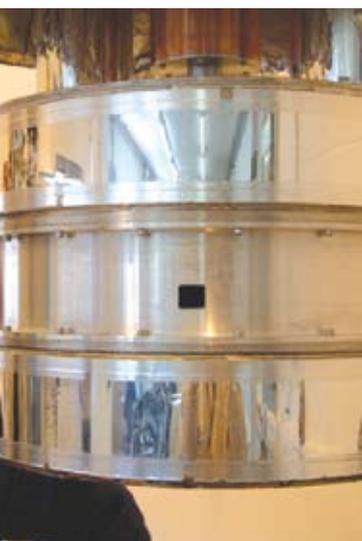
High field recondensing magnets

The ILL received a 10 T asymmetric split pair coil magnet for their three-axis spectrometers.

Dr Eddy Lelièvre-Berna,
Advanced Neutron
Environment Team Leader
at ILL, commented:



"With this new design, the superconducting coils are reliably maintained at low temperature within a liquid helium bath while considerably reducing the boil-off. Compared with dry systems, the absence of room-temperature bore provides a much larger sample space. It also reduces the amount of material in the beam and avoids unwanted neutron absorption and neutrons scattered to the detectors. Together, we have really made a step forward. Among the many topics to be investigated with this magnet are multiferroic properties, quantum phase transitions and excitations in single-molecule magnets. Our satisfaction is such that we have decided to order another magnet for studying the magnetic substrates of our future hard disks."



Dr. Oleg Kirichek, Sample
Environment Group Leader at
ISIS, Rutherford Appleton
Laboratory commented:

"Having a recondensing system allows us to considerably reduce our helium cost and health and safety issues. It also provides a homogeneous temperature distribution, which is crucial for optimum magnet performance. With these magnets, we should be able to provide our users with high magnetic field sample environments for neutron scattering experiments in a number of research areas such as high temperature superconductors, quantum magnets, spintronic materials, spin frustrated systems, heavy fermions, nanomagnetic materials and the recently discovered iron-based high-temperature superconductors."

Service™ – ServiceWise

By choosing Oxford Instruments as the supplier of your next Cryofree or helium recondensing system, not only are you getting a reliable product but also access to a service support team.

This includes:

- A team of 12 service engineers based in four different countries, dedicated to the NanoScience division
- Five people dedicated to helpdesk
- Bespoke Cryospares service

All of our products are supported by a 12-month warranty including parts, labour, on-site visits and third party items like pumps or electronics. Extended warranty are available on request.

ServiceWise service contracts:

Cryofree magnets and recondensing dewars use pulse tube or GM coolers which require regular maintenance to ensure optimum performance. Oxford Instruments has support packages for complete peace of mind.



visit www.oxford-instruments.com for more information

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