

# American Magnetics

Excellence in Magnetics and Cryogenics, Since 1968



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## CRYOGEN FREE SUPERCONDUCTING MAGNET SYSTEMS

Cryogen-free superconducting magnets have become increasingly popular in research and industry due to their ease and simplicity of operation as compared to traditional liquid helium cooled magnet systems. These magnets are manufactured in a variety of configurations and sizes to accommodate requirements of most imaginative scientists or engineers. Cryogen free magnet systems use a closed cycle helium refrigerator to cool the cryogenic assemblies to temperatures close to 4K. In certain configurations the magnet is conductively cooled in a vacuum whereas some geometries use traditional LHe cooling with a cryocooler to recondense liquid Helium; thereby resulting in near zero loss system (ReCon™). Based on customer's experimental requirements either a Gifford-McMahon or a pulse tube cryocooler is used. Some of the most widely used types of cryogen free magnet systems are listed and discussed below.

- Room Temperature Bore (RTB) Solenoid Systems (Vertical or Horizontal geometry)
- RTB Radial Access Magnet Systems (Magneto-Optic systems)
- RTB MAxis™ Multi-axis Magnet systems
- Variable Field Variable Temperature (VFVT) magnet systems
- ReCon™ style systems

### Room Temperature Bore Solenoid Systems



Pulse tube based RT bore system

These style systems are available in wide range of bore sizes and fields up to 15T and are designed in both horizontal and vertical geometries. The thermal mass is cooled by a Gifford-McMahon or a pulse tube cryocooler depending on the individual application. Pulse tube based cryocooled systems are recommended for applications that might have concerns with vibrations, however they have higher initial costs but lower long term maintenance costs. In case of pulse tube configuration, it is possible to reduce vibration levels even further by adding bellows assembly and positioning motor remotely. Some of the most common applications include material processing, beam line studies or use with existing sample inserts. Materials processing customers have found this geometry very suitable for annealing samples in presence of magnetic field.

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## Room Temperature Bore Radial Access Magnet System



Magnet system mounted on Huber Goniometer



Radial access RTB magnet system

The radial access port magnets allow perpendicular access to the magnetic field. These types of magnet systems are ideally suited for performing angular dependent studies on samples in presence of magnetic field. Systems with vacuum bore are ideal for spectroscopy studies. Spectroscopy is at the forefront in investigating mechanisms driving magnetic properties. The compact nature of cryogen free magnet systems has made it easier for positioning them in beam lines or optical benches and they are typically mounted on diffractometers in use at Synchrotron or Neutron diffraction facilities around the world. One of the systems shown here is used at ESRF and it has been mounted in both horizontal and vertical field configurations. Such geometry is ideal for use with powder x-ray diffractometers.

Radial access magnets are made of NbTi / Nb3-Sn with wide angular access for accessing the transmitted or reflected beams. These systems are available for fields up to 10T with active shielding. An extension of these are our popular CF MAXes™ systems. These use combination of two or more split coils to produce 2-axis or 3-axis geometries. An OptiMAXes™ uses 3 conduction cooled split coils to provide optical access in two planes. CF MAXes™ magnets have also been produced for our OEM's who have integrated them with Cryogen free dilution refrigerators.

- Radial access cryogen free magnet systems available up to 10T
- RTB MAXes systems available in 2 or 3-axis geometries
- Actively shielded magnet systems available for spectroscopy applications including Mossbauer studies
- Custom designs available for x-ray & neutron diffraction

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## Variable Field Variable Temperature (VFVT) Cryogen Free Magnet System

VFVT system is one of the most desired cryogen free magnet system for use in material science and condensed matter physics laboratory. The system uses a single cryocooler (Gifford-McMahon or pulse tube) to cool the sample space and superconducting magnet, thereby eliminating need for liquid helium and associated expensive recovery systems. Custom designed configurations are available for exotic experimental needs.



Low vibration VFVT system  
with remote motor option



VFVT Radial access magnet system

Information Brief

- Available in vertical fields up to 14T.
- Available in horizontal fields up to 10T
- 30 mm sample space with 2K to 325K operation using He exchange gas
- Systems available with customer defined window material for spectroscopy studies
- CF MAxes™ systems available with vector field up to 5T
- CF OptiMAxes™ systems available with vector fields up to 2T
- Unique dual-axis configuration available for positioning sample in vertical or horizontal field configuration
- Turnkey system with software controlled VFVT environment



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## ReCon™ Magnet Systems



200mm RTB ReCon system

Based on heat load and size of the superconducting magnet either a dry conduction cooled or ReCon™ style geometry is recommended. ReCon™ style magnet systems use cooling power of a closed cycle 4K cryocooler to recondense gaseous helium back into the liquid Dewar. The evaporating gas is liquefied in a thermodynamically effective manner and the cryocooler is strategically located in the Dewar. The first stage of the cryocooler is used to cool the shields of the Dewar thereby eliminating the need for any liquid Nitrogen. ReCon™ magnet systems offer combined benefits of traditional LHe systems with near zero helium boil-off. These style systems are ideally suited for retrofitting existing magnets and sample inserts into a re-engineered Dewar with a suitable gas handling system. Pulse tube cryocoolers are ideal for applications that desire lower vibrations.

- ReCon™ solenoid systems available in vertical or horizontal geometries with fields up to 16T and wide bore sizes
- ReCon Maxes™ systems are available with vector fields up to 6T
- ReCon OptiMAxes™ systems are available in 2 or 3-axis geometries
- ReCon™ split coil systems available in optical and non-optical configurations with fields up to 10T
- ReCon™ systems with customized gas handling system is available with 1.5K/He3 insert or with a dilution refrigerator