INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

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Specifications for Cryofree 9 Tesla Superconducting Magnet.

RFx No. 61000006751 (Reference No. 1000016789)

Specifications for a cryofree, sweepable 9 Tesla superconducting magnet and a cryofree variable temperature insert. The magnet + VTI combination detailed below will be used together with an NMR spectrometer (tendered separately) to perform NMR experiments on solid samples at variable temperature and magnetic field.

I. Magnet, VTI, and cryocooler

1. The superconducting magnet should have a vertical bore of ID greater than 50 mm so that the VTI (detailed below after item 8) can be integrated with the magnet. The magnet should be rated to produce a maximum magnetic field of 9 Tesla or more.
2. The homogeneity of the magnetic field should be better than 10 parts per million (0.001%) over a 1 cm dia sphere. The above should be validated and documented using an NMR probe during factory testing/validation. The stray field map of the magnet should be provided.
3. You should provide an engineering drawing of the magnet assembly.
4. It should be possible to put the magnet in persistent mode (with the provision of a persistent switch) at any field upto the highest rated field. When in persistent mode, the drift should be lower than 0.1 ppm per hour.

5. Adequate quench protection should be provided for any accidental quench.
6. With the magnet power supply (having serial/USB interfaces), routine programmable sweeping (ramping) of the field in the full range (0 to 9 Tesla) should be possible. A minimum sweep rate 60 Oe per min should be possible. On the higher side a sweep rate of 1500 Oe per minute (or more) should be possible. Ramping the magnetic field at any of the above rates should not affect the temperature stability in the sample space of the VTI at any temperature. Device drivers for automation and control of the magnet power supply should be provided for standard software suites such as ActiveX, OLE, Windows scripts, VB Basic, Labview, Matlab, etc.
7. The magnet should be of a dry, cryofree type and no liquid cryogens should be required to cool the magnet.
8. The cooling of the magnet should be achieved by a two-stage pulse tube cryocooler of minimum 1 Watt power at 4.2 K and 40 W at 45 K. Specify the make and model of the pulse tube refrigerator system. The necessary compressor (fully charged with high purity helium gas) with at least 10 m long flexible SS lines and other items needed to make the system fully functional should be included and quoted (see accessories for water chiller quote).
9. A top loading variable temperature insert (VTI) with a temperature range of 1.6 K-300 K (or more) is to be provided which is integrated with the above magnet. The VTI should also be cryofree.
10. The VTI should have a KF50 or equivalent flange at the top and the inner diameter (ID) of the VTI should be 49 mm or more. You should provide a precise value for the ID accompanied by an engineering drawing. The VTI must be made of non-magnetic materials.
11. The VTI should be equipped with suitable heaters, needle valve, and magnetic field independent temperature sensors to control the temperature.
12. A compatible temperature controller also to be provided. Temperature controller should have standard serial/USB ports for interfacing with a computer. At least two extra channels should be available on the temperature controller; one for

connecting to the NMR sample probehead to monitor the sample temperature and another spare one for redundancy. Device drivers for automation and control of the temperature controller should be provided for standard software suites such as ActiveX, OLE, Windows scripts, VB Basic, Labview, Matlab, etc.

13. You will provide necessary cables to connect the various instruments to a computer.
14. It should be possible to hold and stabilize the sample space at any temperature between 1.6 and 300 K (with a stability of 0.1 K) for more than 12 hours.
15. You should provide vacuum pumps (dry/oil-free) needed for regular operation of the magnet and the VTI.
16. The vibrations at the sample position inside the VTI should be less than 10 micrometer amplitude especially at low frequencies (0-1 kHz).
17. A floor to ceiling height of about 2.75 m (9 feet) is available in the room where the magnet + VTI will be installed. The top of the magnet+ VTI assembly should be less than 60 inches from the floor. It should be possible to assemble, install, and perform routine measurements with the above equipment given the above dimensions. It should be possible to remove the VTI from the magnet, if needed, in the available height. You should justify the above with relevant drawings.
18. A proposed schematic layout of the magnet + VTI and the pulse tube cryocooler with compressor should be provided for an approximately 10 ft x 30 ft space together with power supply requirements for the above equipment together with a water chiller. The height is about 9 ft.
19. You will be required to work together with the NMR spectrometer supplier (separate tender) to enable interfacing of the magnet power supply and temperature controller with the NMR software. Availability of device drivers for commonly used software will facilitate this interfacing. A similar clause is included in the tender for the NMR spectrometer.
20. Pumping station with turbo pump and backing pump for evacuation of cryostat and sample space.

21. An electronics rack (made of non-magnetic materials) to house various units above.
22. Where single phase power supply is needed, equipment should be compatible with a 220 V, 50 Hz ac power supply. Likewise, where 3-phase power supply is needed, the equivalent of the above will be needed.

II. Accessories with above magnet + VTI + cryocooler

1. Water chiller of 5 TR cooling capacity (minimum) needed for item no. 8 (cryocooler) in the specifications of the cryofree 9 Tesla magnet. Required flow rate 50 LPM at 3 bar pressure or equivalent. Required entry media temperature to process is 15 C.
2. An online UPS of suitable rating (25 kW or more) and batteries with 2 hours backup to support magnet power supply, cryocooler, compressor, water chiller, various temperature controllers, pumps, etc. mentioned in the specifications for the cryofree 9 Tesla magnet.

Terms and conditions

1. The vendor should have a proven track record in terms of prior installations and technical support in India. (Please furnish the contact details of the customers).
2. The vendor should have qualified technical service personnel for the equipment based in India.
3. The clauses of on-site installation and training need to be specified, and ideally provided free of cost.
4. The instrument must carry a comprehensive warranty of 3 years from the date of installation.