

**Global Tender Notification for the procurement of a cryogen free dilution refrigerator (DR) with coaxial wiring**

**GTE Approval no:** IISc-GTE-2022-231

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A request for quotation from interested manufacturers for a cryogen free dilution refrigerator (DR) with coaxial wiring for microwave measurements. The quotation should clearly indicate the terms of delivery, delivery schedule, transportation charges (if any).

All interested vendors shall submit a response demonstrating their capabilities to produce the requested equipment to the primary point of contact listed below. **The last date for submission of proposals is 21-June-2023, 5:00pm.** Proposals should arrive at the Department of Physics, Indian Institute of Science, Bangalore-560012 (INDIA) with a clear mention of the reference no. on the envelope.

Any question/clarification concerning this tender can be made by sending email to Ms. Rekha Varadaraj at "[vrekha@iisc.ac.in](mailto:vrekha@iisc.ac.in)"

Enclose a compliance certificate along with the bid. This certificate should have a table that should describe your compliance in a "Yes" or "No" response against each of the items in the specifications listed below. If "No" is selected, the second column should state the extent of deviation. The third column should state the reasons for the deviation (if any). Please enclose a compliance statement along with the technical bid. Bids with no statement of compliance will be considered invalid.

The technical details of the system and general terms and conditions are given below.

**Technical specifications:**

Cryogen-free dilution refrigerator with the below technical and user specifications

**Mandatory requirements:**

1. Base temperature and total cool-down time: Guaranteed base temperature less than 10 mK at the sample position (away from the mixing chamber). This base temperature should be achieved with factory installed wiring and RF cabling (line item 17a to 17e). Total cool-down time should be less than **30 hours** to reach the base temperature from room temperature. Note that this includes the pre-cooling time, if any to an intermediate temperature stage. Please provide the plots of measurements of the system performance (such as cool-down vs time) clearly specifying the conditions under which the measurement was conducted.
2. Cooling power: **At least 14 microwatt** of cooling power at the sample position (measured away from the mixing chamber) at 20 mK, at least 400 microwatt of cooling power (measured away from the mixing chamber) at 100 mK. The system should have an appropriate amount of He3/He4 mixture to achieve the above-mentioned parameters. Please specify the amount of He3/He4 gases.
3. Pulse tube cryocooler: A pulse tube cryocooler (with compressor) having a cooling **power of at least 1.5W at 4.2 K.**
4. The frame should be easy to disassemble allowing easy relocation of the system in future.
5. Cryostat: The cryostat must have a single vacuum space with all hermetic seals such as O-ring seal at room temperature -- no exchange gas, no indium seal, no Kapton seal, light-weight outer vacuum jacket and radiation shields enabling one-person manual assembly.

6. Dimensions of the cold plate and sample space: The cold plate at mixing chamber should be at least **290 mm** in diameter and it should have at least **320 mm** of vertical space below the mixing chamber plate (till the inner most radiation shield).
7. Temperature Controller: Fully automated temperature control with appropriate temperature sensors, heaters, and heat-switches.
8. Pumping system: Suitable dry pumping system for the dilution unit having turbo molecular pump with oil free backing pump, compressor for the mixture. Please specify the specification of all pumps and compressors. Please specify if the same pumping system can also be used to evacuate the sample vacuum space.
9. Suitable gas handling system: With required pressure gauges and overpressure valves etc. The pumps should be electrically isolated from the cryostat. The gas handling system should have appropriate pressure release valves to collect the mixture back to the dump in the event of power failure or emergencies.
10. Cold trap: Appropriate cold traps to operate the fridge for long durations (> 6 months) without blockage issues in the circulation loop.
11. Mixture compressor bypass manifold to allow circulation of mixture after condensation without requiring the mixture to go through the compressor.
12. Support feature: Floor mounted standard support frame for the pumping bellows and the cryostat
13. Mechanical Vibrations: Less than 100 nm amplitude near 100 Hz (in both horizontal and vertical directions) at the mixing chamber plate while the fridge is in operation.
14. Isolation: Pulse tube should have **mechanical vibration isolation** from the rest of the cryostat. Pulse tube and compressor should be **electrically isolated** from the cryostat.
15. Cooldown procedure, safety, and control software: Automatic cool down to base temperature. Safety interlocks allowing unattended operation; remote control operation; continuous monitoring and logging of the system parameters. Control software should be based on windows 10 or higher version operating system architecture. Free upgrades of software.
16. Testing and training should be done during onsite installation
17. Provide soft and hard copy of the manual and supporting documents
18. Wiring:
  - (a) **Input lines:** 32x 0.86mm SCuNi-CuNi (centre conductor is silver plated) attenuated semi-rigid SMA (18 GHz) coaxial lines from RT to mK flange with suitable thermalization at different intermediate flanges. All coaxial lines must have enough flexibility and length to accommodate the insertion or removal of fixed cryo-attenuator with values specified in optional line item below. The breakout of different cryogenic attenuators is given under point (d) below.
  - (b) **Return Lines:** 6x 0.86mm SCuNi-CuNi (centre conductor is silver plated) attenuated semi-rigid SMA (18 GHz) coaxial line from room temperature to 4K flange (part of the output lines)
  - (c) **Return Lines:** 6x 0.86mm NbTi-NbTi semirigid superconducting SMA (18GHz) co-axial line from 4K flange to mixing chamber. All coaxial lines must have enough spacing, flexibility and length to accommodate the insertion of cryo-compatible isolators at different stages, and low noise amplifiers at 4K stage.
  - (d) **Cryo-attenuators** -- 32 sets of cryo-compatible fixed attenuators consisting of 10dB@70K, 20dB@4K, 10 dB@Still plate, 10dB@cold plate, 20dB@mixing chamber plate.
  - (e) **DC-wiring** – All wires should be terminated with suitable connectors at room temperature, 4K plate, and at mixing chamber plate. All wires should have proper thermal anchoring at each temperature stage. (i) 12x twisted pair experimental wiring (24 wires 36 AWG Copper) from room temperature to 4K to power the low noise amplifiers. (ii) 12x twisted pair experimental wiring Cu (from RT to 4K) and NbTi from 4K to the mixing chamber

#### Optional items:

1. **Cryogenic low noise amplifiers** – 6 units of Model LNC4\_8C from Low Noise Factory. Include the appropriate power supply.

2. **Cryogenic microwave isolators** – 6 units of LNF-ISISC4\_12A with magnetic shielding. Mounting position of components can be provided upon request.
3. A cryogenic magnetic shield for the base plate.
4. Warm up heaters to reduce the warmup time from base temperature to room temperature (if not included in the standard unit).
5. Include a 3-part shields and outer vacuum can system (if it is not a part of the basic system with specification given above) to extend the vertical sample space beyond 320 mm.
6. Include quotation for 10% extra He3-He4 mixture (in the same ratio as in a standard system) added to the main tank.

**Warranty:** Comprehensive warranty and support for at least 3 years. Include option for extended warranty for two additional years.

**DELIVERY TIME:** Maximum 8 months from the date of Order Acknowledgment (OA). The vendor must provide the OA within 3 weeks after receiving the purchase order. The delivery time should be mentioned in the technical and commercial bids.

**General terms and conditions:**

- Vendor must have prior experience in manufacturing similar system and must submit list of at least 5 customers with contact information, and details of the supplied system.
- Payment terms should be mentioned in the technical bid.
- The commercial bid and technical bids must be submitted in two separate envelopes. A technical bid must contain a point-by-point technical compliance document. The technical bid **must not contain** any price information.
- In the commercial bid, the price should be inclusive of all discounts.
- Please quote the price of each optional line item, separately.
- The purchaser reserves the right to accept or reject any bid and to annul the bidding process and reject all bids at any time before the award of contract without thereby incurring any liability of the affected bidder or bidders.
- The bids can be addressed to “The Chairperson, Dept. of Physics, Indian Institute of Science Bangalore-560012”