CSIR- NATIONAL PHYSICAL LABORATORY

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From: Director, CSIR-NPL
Ref No. 14-VIII/SS(7-GTE)2024PB/T-66 Dated : 28.10.2024

CORRIGENDUM

With reference to NPL's Global Tender ID: **2024_CSIR_770994_1**, Pre-Bid Conference (PBC) was concluded on 24.09.2024 for "Cryogen-Free Ultra-Low Noise Cryostat". Consequent upon the outcome of PBC, **some changes have been made in the technical specification of captioned tender. Revised specifications are as follows:**

DETAIL TECHNICAL SPECIFICATIONS

Original Specifications			**Final Specifications**
Component : Part A: Cryogen Free 2K Closed Cycle Cryostat (top loading system) equipped with 12T magnet and rf coupling			
Sub Components		**Parameters/ Specifications (original)**	**Parameters/ Specifications (final)**
1. Cryostat	1.1	Temperature range: from 2 K to 300 K, Sample temperature with DC and RF wiring≤ 2.2 K.	Temperature range: from 2 K to 300 K, the Sample temperature with **24 DC wiring and 4 RF wiring** ≤ 2.2 K.
	1.2	Frequency range for rf excitation Up to 40 GHz	Frequency range for RF excitation Up to 40 GHz **with semi-rigid stainless steel coaxial cables with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end.**
	1.3	Sample Exchange time≤ 2 hours	Sample exchange time ≤ 2 hours **by taking out the VTI while keeping the cryostat at low temperature.**
	1.4	Pumping system, Rotary pump for the airlock which is used for sample exchange. Dry pumping system supplied with connector lines and cables, Turbo pumping station with controller. Pump and gas reservoir Turbomolecular pump: 40 litre/second or more capacity; with suitable backing pump to get a base pressure of less than 10E-7 mbar, there should be isolation valve at the backing side of the rotary pump. Please mention in the price separately	Remains the same.

	1.5	Cooling power requirements: ≥40 watts @ 65 K (first stage) ≥ 1 watt @ 4.2 K (Second stage)	Cooling power requirements: ≥40 Watts @ 65 K (first stage); **≥1.5** Watt @ 4.2 K (Second stage).
	1.6	Sample Cool down time ≤ 10 hours. please mention the cooldown time upto 4 K	**The initial cool down of the complete system with the magnet down to 4.2K ≤ 25 hours.** (We have modified the spec#1.3.). The probe cool down time (spec#1.3) ≤ 2 hours.
	1.7	Integrated VTI with Ø50 mm(including gate-valve and airlock)	Integrated VTI with Ø50 mm (including gate-valve and airlock). **Sample insert should have the outer diameter ≥ 49 mm so that the sliding of the sample insert can be done easily.**
	1.8	Manual gas handling system	Remains the same.
	1.9	The vibration at the sample stage should be minimized with vibration isolation; the cryostatshould be configured with a suitable pulse tube refrigerator. The vibration on sample mountshould be less than 500 nm in the horizontal direction	The vibration at the sample stage should be minimized with vibration isolation. The expected vibration in the **lateral direction to be of the order approximately ~ 2 µm from the top plate of the cryostat.**
	1.10	Sample tube (sample Insert) outer dimensions 2 inches: 02 Nos of sample inserts are required. Sample tube should have provisions of RF/MW wiring termination and DC wiring termination near the sample stage	Sample tube (sample Insert) **should be such that it fits within the 50 mm VTI diameter of the main system. Detailed specifications of sample insert is given in the "insert" section.**
	1.11	Temperature control and stability at the sample stage, better than 50mK	Remains the same.
	1.12	Temperature controller specifications: 4 independent input channels, two independent heater output loops with 100 W and 50 W output power. Temperature controller should have USB and GPIB (IEEE-488) parallel computer interfaces: complete accessories and cables should be supplied to integrate with cryostat. Please mention the price separately	Temperature controller specifications: 4 independent input channels, two independent heater output loops with 100 W and 50 W output power. Temperature controller should have USB and/or GPIB (IEEE-488) parallel computer interfaces; complete accessories and cables should be supplied to integrate with cryostat. Please mention the price separately
2. Magnet		Integrated 12T Superconducting solenoid Magnetic stability / persistent mode decay rate ≤ 100ppm / hr Additional ultra low field / high central field homogeneity so that very low fields can be obtained with high resolution	Integrated 12T Superconducting solenoid **± 0.1% field homogeneity over a 10 mm diameter spherical volume.** **Fully protected against damage due to accidental quench** **Persistent mode switch installed** Magnetic stability / persistent mode

			decay rate ≤ 100ppm / hr Additional ultra low field optionswith a maximum field ~40-50mT with 1microT resolution. Or, Integrated 12T Superconducting solenoid with high central field homogeneity of ±10ppm over a 10 mm DSV so that very low fields can be obtained with high resolution Fully protected against damage due to accidental quench Persistent mode switch installed persistent mode drift rate < 10 ppm/hour.
3. Insert	3.1	The price of this sample insert should be mentioned separately. One Sample insert with DC and RF termination (please mention the details if separate probes are provided to carry out DC and AC measurements with and without optical fiber). If possible, kindly mention in-plane and out of plane sample orientation w.r.t. the field. 24 DC wires (12 pairs in twisted pair combination), 02 optical fibers (single mode optical fiber) along with suitable coupling/connections from top to the sample stage, 04 Nos of RF (0 to 40 GHz frequency) cabling and coupling from the top plate to the sample stage along with suitable connectors to facilitate connection to the sample. This insert should have its own temperature sensors and heater connections. Temperature sensor should be compatible with magnetic field and the temperature range	The price of these sample inserts should be mentioned separately. No. of sample Inserts= 03 • Configuration for the sample inserts: Insert Probe 1 (sample in plane and out of plane field options): -12 twisted pair DC/AC lines -2x optical fibres (wavelength 1550nm) -A calibrated 1.4-325K Cernox temperature sensor along with a heater should be wired onto the sample plate of the probe. Insert Probe 2 (sample out of plane): -10 twisted pair DC/AC lines -4 RF semi-rigid cables permitting measurements up to 40 GHz with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end. -A calibrated 1.4-325K Cernox temperature sensor along with a heater should be wired onto the

			sample plate of the probe. Insert Probe 3 (Helium-3, sample out of plane): -10 twisted pair DC/AC lines
	3.1		-4 RF semi-rigid cables permitting measurements up to 40 GHz with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end. A calibrated Cernox 0.3-325K sensor along with a heater should be wired on the He-3 pot. All the above mentioned sample inserts should be supplied with sensors, heaters and wiring required to operate the system
	3.2	Extra two calibrated spare sensors with calibrated graph	Extra two calibrated spare sensors (i) a calibrated 1.4-325K Cernox sensor and (ii) a calibrated Cernox 0.3-325K sensor with respective calibrated graphs

	3.3	RF compatible He3 insert for measurements to 300mK, Please mention the temperature stability of sample stage and He3 insert in the quote. Temperature < 300 mK, He-3 Sample space ≥ 40mm, 4 x RF Semi rigid cables (DC to 18 GHz or more (40GHz)), Calibrated Cernox temperature sensor at He3 pot, He-3 cold probe cool down, RF compatibility please mention the cooldown time from 4 K to the lowest temperature (300mK for the He3 insert)	RF compatible He-3 insert with -base temperature ≤ 350mK, -hold time @ base temperature ≥ 24 hours -He-3 Sample space ≥ 40mm, 4 RF semi-rigid cables permitting measurements up to 18 GHz or more (40 GHz preferred) with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMA (SMPM for 40 GHz) connector at the cold end - calibrated Cernox 0.3-325K sensor along with a heater should be wired on the He-3 pot - He-3 recondensation time < 1 hour
Water chiller for the compressor		with a capacity of 5TR or more, Please mention the price separately	Remains the same.
Warranty/AMC after warranty expiry		01 years warranty (for the complete system) with support for spares and accessories continuously for upto 10 years from the date of Installation, Please mention in the price separately	Remains the same.

Component: Part B: Quantum Transport measurements system: Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, etc.)

Sub Components (original)	Parameters/ Specifications (original)	Sub Components (final)	Parameters/ Specifications (final)
❖ Computer for control under LabVIEW, Cryogenic Virtual instruments incorporated into computer operating system	Display (screen size of 30 inches or higher) should be supplied to install the software for both the cryostat and measurement electronics and to generate user defined software modules for measurement purpose. Note: Please provide detailed DC / AC measurement possible with your Electrical Property Measurement Options. The electronics should be capable to carry out following measurements : • DC Resistivity, AC Resistance and Hall Effect module probe with sample-out-of- plane, • normal transport measurements such as current-voltage sweep, differential conductance gate biased measurements, Hall measurements etc. • DC and AC resistivity, Impedance and capabilities to Hall and differential conductance measurements	❖ Computer for control under LabVIEW and virtual instrumentation incorporated into computer operating system.	Display (screen size of 30 inches or higher) should be supplied to install the software for both the cryostat and measurement electronics and to generate user defined software modules for measurement purpose. Note: Please provide the detailed description of DC / AC measurement schemes/modules that are possible with your Electrical Property Measurement Options.

❖ Source meter, nV meter and lock-in amplifier	A suitable measurement electronics with integrated measurement software for transport measurements should be supplied along with the system for monitoring of four samples simultaneously in dual voltage and current biasing module to measure. Measurement electronics should also have the capability of operation in the lock-in mode for phase sensitive detection of signals either with an internal reference signal or external reference signal mode Source channels should have bias functions such as DC and AC with a frequency of ~100 kHz (or higher).	❖ Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, ultra-low noise preamplifiers etc.)	Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, ultra-low noise preamplifiers etc.) A suitable measurement electronics with integrated measurement software for transport measurements should be supplied along with the system for monitoring of ≥ 3 samples simultaneously in dual voltage and current biasing module to carrying out the following measurements: - DC and AC resistivity, magnetoresistance (MR), Impedance and capabilities to Hall and differential conductance measurements - Normal transport measurements such as current-voltage sweep, differential conductance measurements simultaneously with respect to source-drain bias voltage and gate bias voltage under magnetic field, Hall measurements etc.

			- The resistivity, differential conductance, current-voltage sweep etc. should be carried out in magnetic field sweeping mode and/or persistent mode Measurement electronics should also have the capability of operation in the lock-in mode for phase sensitive detection of signals either with an internal reference signal or external reference signal mode. Source channels should have bias functions such as DC and AC with a frequency of ~100 kHz (or higher).
DC Voltage source resolution and accuracy	Resolution: ~10 µV or lesser, accuracy: +/-0.05% or better	Remains the same.	Remains the same.
DC/AC voltage source range	0 to 10 V or higher for DC, 0-5 V rms for AC	Remains the same.	Remains the same.
DC Voltage measurement accuracy	0.5% of reading or better	Remains the same.	Remains the same.
Voltage Measure Noise	200 nV RMS or better	Remains the same.	Remains the same.
Voltage measure input impedance	>10 GΩ (DC coupled)	Remains the same.	Remains the same.
DC/AC current source range	0-100 mA	Remains the same.	Remains the same.
DC current Sourcing Accuracy	with a minimum resolution of 1 nA or better0.8% or for DC as well as lock-in-configuration	Remains the same.	with a minimum resolution of 1 nA or better for DC as well as lock-in-configuration

Annexure-1 (Final specifications)

Date: 28.10.2024

Component : Part A: Cryogen Free 2K Closed Cycle Cryostat (top loading system) equipped with 12T magnet and rf coupling		
Sub Components		**Parameters/ Specifications**
1. Cryostat	1.1	Temperature range: from 2 K to 300 K, the Sample temperature with 24 DC wiring and 4 RF wiring ≤ 2.2 K.
	1.2	Frequency range for RF excitation Up to 40 GHz with semi-rigid stainless steel coaxial cables with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end.
	1.3	Sample exchange time ≤ 2 hours by taking out the VTI while keeping the cryostat at low temperature.
	1.4	Pumping system, Rotary pump for the airlock which is used for sample exchange. Dry pumping system supplied with connector lines and cables, Turbo pumping station with controller. Pump and gas reservoir Turbomolecular pump: 40 litre/second or more capacity; with suitable backing pump to get a base pressure of less than 10E-7 mbar, there should be isolation valve at the backing side of the rotary pump. Please mention in the price separately
	1.5	Cooling power requirements: ≥40 Watts @ 65 K (first stage); ≥1.5 Watt @ 4.2 K (Second stage).
	1.6	The initial cool down of the complete system with the magnet down to 4.2K ≤ 25 hours. (We have modified the spec#1.3.). The probe cool down time (spec#1.3) ≤ 2 hours.
	1.7	Integrated VTI with O50 mm (including gate-valve and airlock). Sample insert should have the outer diameter ≥ 49 mm so that the sliding of the sample insert can be done easily.
	1.8	Manual gas handling system
	1.9	The vibration at the sample stage should be minimized with vibration isolation. The expected vibration in the lateral direction to be of the order approximately ~ 2 μm from the top plate of the cryostat.
	1.10	Sample tube (sample Insert) should be such that it fits within the 50 mm VTI diameter of the main system. Detailed specifications of sample insert is given in the "insert" section.
	1.11	Temperature control and stability at the sample stage, better than 50mK.
	1.12	Temperature controller specifications: 4 independent input channels, two independent heater output loops with 100 W and 50 W output power. Temperature controller should have USB and/or GPIB (IEEE-488) parallel computer interfaces; complete accessories and cables should be supplied to integrate with cryostat. Please mention the price separately
2. Magnet		Integrated 12T Superconducting solenoid ± 0.1% field homogeneity over a 10 mm diameter spherical volume. Fully protected against damage due to accidental quench Persistent mode switch installed Magnetic stability / persistent mode decay rate ≤ 100ppm / hr Additional ultra-low field options with a maximum field ~ 40-50mT with 1microT resolution. Or, Integrated 12T Superconducting solenoid with high central field homogeneity of ±10ppm over a 10 mm DSV so that very low fields can be obtained with high resolution

		Fully protected against damage due to accidental quench Persistent mode switch installed persistent mode drift rate < 10 ppm/hour.
3. Insert	3.1	The price of these sample inserts should be mentioned separately. No. of sample Inserts= 03 • Configuration for the sample inserts: **Insert Probe 1 (sample in plane and out of plane field options):** -12 twisted pair DC/AC lines -2x optical fibres (wavelength 1550 nm) -A calibrated 1.4-325K Cernox temperature sensor along with a heater should be wired onto the sample plate of the probe. **Insert Probe 2 (sample out of plane):** -10 twisted pair DC/AC lines -4 RF semi-rigid cables permitting measurements up to 40 GHz with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end. -A calibrated 1.4-325K Cernox temperature sensor along with a heater should be wired onto the sample plate of the probe. **Insert Probe 3 (Helium-3, sample out of plane):** -10 twisted pair DC/AC lines -4 RF semi-rigid cables permitting measurements up to 40 GHz with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMPM connector at the cold end. A calibrated Cernox 0.3-325K sensor along with a heater should be wired on the He-3 pot. All the above mentioned sample inserts should be supplied with sensors, heaters and wiring required to operate the system
	3.2	Extra two calibrated spare sensors (i) a calibrated 1.4-325K Cernox sensor and (ii) a calibrated Cernox 0.3-325K sensor with respective calibrated graphs

	3.3	RF compatible He-3 insert with -base temperature ≤ 350mK, -hold time @ base temperature ≥ 24 hours -He-3 Sample space ≥ 40mm, 4 RF semi-rigid cables permitting measurements up to 18 GHz or more (40 GHz preferred) with hermetically sealed 2.9mm (K-type) SMA connector at room temperature, terminated with SMA (SMPM for 40 GHz) connector at the cold end - calibrated Cernox 0.3-325K sensor along with a heater should be wired on the He-3 pot - He-3 recondensation time < 1 hour
Water chiller for the compressor		with a capacity of 5TR or more, Please mention the price separately
Warranty/AMC after warranty expiry		01 years warranty (for the complete system) with support for spares and accessories continuously for upto 10 years from the date of Installation, Please mention in the price separately

Component: Part B: Quantum Transport measurements system: Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, etc.)

Sub Components	Parameters/ Specifications
❖ Computer for control under LabVIEW and virtual instrumentation incorporated into computer operating system.	Display (screen size of 30 inches or higher) should be supplied to install the software for both the cryostat and measurement electronics and to generate user defined software modules for measurement purpose. Note: Please provide the detailed description of DC / AC measurement schemes/modules that are possible with your Electrical Property Measurement Options.

❖ Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, ultra-low noise preamplifiers etc.)	Ultra–low noise electronics setup for quantum transport measurements (lock-in amplifiers, SMUs, DC voltage source, low current measurement unit, nanovoltmeter, temperature controller, ultra-low noise preamplifiers etc.) A suitable measurement electronics with integrated measurement software for transport measurements should be supplied along with the system for monitoring of ≥ 3 samples simultaneously in dual voltage and current biasing module to carrying out the following measurements: - DC and AC resistivity, magnetoresistance (MR), Impedance and capabilities to Hall and differential conductance measurements - Normal transport measurements such as current-voltage sweep, differential conductance measurements simultaneously with respect to source-drain bias voltage and gate bias voltage under magnetic field, Hall measurements etc. - The resistivity, differential conductance, current-voltage sweep etc. should be carried out in magnetic field sweeping mode and/or persistent mode Measurement electronics should also have the capability of operation in the lock-in mode for phase sensitive detection of signals either with an internal reference signal or external reference signal mode. Source channels should have bias functions such as DC and AC with a frequency of ~100 kHz (or higher).
DC Voltage source resolution and accuracy	Resolution: ~10 μV or lesser, accuracy: +/-0.05% or better
DC/AC voltage source range	0 to 10 V or higher for DC, 0-5 V rms for AC
DC Voltage measurement accuracy	0.5% of reading or better
Voltage Measure Noise	200 nV RMS or better
Voltage measure input impedance	>10 GΩ (DC coupled)
DC/AC current source range	0-100 mA
DC current Sourcing Accuracy	with a minimum resolution of 1 nA or better for DC as well as lock-in-configuration

Therefore, following extension in due date of submission & date of opening of the said tender may be read exactly as follows:

Due date & time of tender submission

For : 05.11.2024 up to 3.00PM (IST)
Read as : 18.11.2024 up to 3.00PM (IST)

Date & Time of Tender Opening

For : 06.11.2024 at 3:00PM (IST)
Read as : 19.11.2024 upto 3.00PM (IST)

All other terms & conditions of said tender will remain the same.

28/10

Sr. Controller of Stores & Purchase

28/10/24