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From: Director, CSIR-NPL
Tender No. 14-VI/GAB(1123)23PB/T-145

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CORRIGENDUM

With reference to NPL's Global Tender ID: **2023_CSIR_733727_1, some changes have been made in the technical specification of captioned tender. Revised specifications are as follows:**

RHEOMETER		
S.N.	I. Main Instrument	
1	**Measuring Head Type**	• Single rotational & oscillatory motor for combined motor transducer mode • The rheometer must offer the ability to test solid materials under oscillatory dynamic deformation in the linear direction under bending, tension, or compression modes • Needs to apply the axial oscillation under simultaneous rotational shear & oscillation (2D-SAOS) in orthogonal superposition
2	**Minimum Torque in Oscillation**	1 nNm or lower
3	**Minimum Torque in Steady**	5 nNm or lower
4	**Maximum Torque**	200 mNm or above
5	**~~Motor~~ Bearing Types**	Axial/Trust bearing type: Air or Magnetic bearing type Radial Bearing type: Air bearing
6	**Displacement transducer**	Dual or single -optical encoder with the angular displacement resolution of 2- 10 nrad
7	**Speed Range**	0 to 300 rad/s or better
8	**Frequency Range**	10E-6 to 100 Hz or better
9	**Normal Force Range**	0.005 to 50N or better
10	**Step strain response time**	≤ 15 ms or lower
11	**Step rate response time**	≤ 5 ms or lower
12	**Measurement types**	Rotational , Oscillatory, Linear and Transient (Creep & Relaxation)
	II. High Temperature Furnace	
13	**Temperature Range**	-150 deg C to 600 deg C or better
14	**Max. Heating Rate**	Up to 60 deg C/Min or better
15	**Max. Cooling Rate**	Up to 25 deg C/Min or better
16	Suitable accessories for low temperature maintenance with liquid nitrogen , including 50 L dewar vessel, should be quoted invariably	
17	The Furnace must offer parallel plate, cone and plate, DMA fixtures (for solids),	
18	Required geometries for the High temperature Furnace: The geometries should be of single-shaft individual geometry of each dimension, and the geometries may or may not be used for the both higher temperature as well as lower temperature oven 1- 8 mm Parallel Plate made of Stainless Steel (SS) – 1 Qty 2- 25 mm Parallel Plate made of stainless steel – 1 Qty	

		3- 25 mm 2° Cone made of stainless steel - 1 Qty 4- 40 mm parallel plate made of Stainless Steel – 1 Qty 5- 40 mm 2°Cone made of stainless steel – 1 Qty 6- Above geometries should be supplied with the auto-recognition by the rheometer software
	III. Dynamic Mechanical Thermal Analysis Attachments	
19	**Solid Rectangular Torsional Fixture**	Torsion Fixture for Rectangular Bars – 1 Qty • Length: 35 mm - 40 mm (max) • Width: 1 mm -10 mm • Thickness: 1 mm -5 mm
20	**Axial Dynamic Mechanical Thermal Analysis (DMA)**	• Force range: 0.005 to 40 N or above • Force resolution: 0.005 or better • Displacement range : 0.01 to 100 micron or above • Maximum Frequency range :15 Hz or above • Temperature range: -150 deg C to 450 deg C or above • Required DMA clamps: 1. Single- and dual- cantilever clamp – 1 Qty 2. 3-point bending clamp – 1 Qty 3. Linear Film tension clamp – 1 Qty 4. Compression clamp – 1 Qty
	IV. High Temperature Magneto-rheology Cell	
21	**Magnetic Field**	1- Applied Field -1 T to 1 T or better 2- Programmable through the same Rheometer Software
22.	**Temperature Range**	1- -10°C to 170° deg C or better 2- Accuracy: ± 0.5 deg C or better 3- The temperature control system should have suitable hood or not for the active temperature control
23.	**Measuring Systems**	1- Magento Rheology Parallel Plate 20 mm diameter – 1Qty 2- Magento Rheology Cone Plate 20 mm diameter 2 deg cone – 1 Qty
	V. Orthogonal Superposition (OSP) Accessory	
24	**Working Principle of OSP**	• OSP accessory applies axial oscillation under simultaneous rotational shear, providing direct measurements of G', G" and Tan Delta under the conditions relevant to real-world processing and performance • Measure changes in shear-sensitive microstructure of complex fluids with the enhanced force sensitivity of OSP Load Cell • Ensure data accuracy in both rotational and axial measurements, avoiding pumping and surface tension effects, with the specially designed OSP geometry
25	**2D-SAOS**	• -Small Amplitude Oscillatory Strain in axial and rotational direction simultaneously. • Measure viscoelastic properties (G', G" and Tan Delta in 2 different directions. • Characterize anisotropy resulting from shear-induced particle alignment Understand orientation of microstructure during a process, such as extrusion of a highly-filled paste.
26	**OSP Specification**	Oscillation Displacement 1 to 100 µm or above Oscillation Force 0.001 to 5 N Angular Frequency 0.001 to 100 rad/s or above Temperature -10 °C to 150 °C Sample Volume (approx.) 30 mL OSP Rotor with windows (Outer diameter = 30.73 mm;Inner Diameter 29.40 mm) & OSP Cup with windows (Outer Diameter = 32.58 mm; Inner Diameter =27.73 mm) A suitable alternative OSP rotor and cup can be quoted for the OSP studies of the structural-fluid samples
	VI. Peltier Temperature Controller for multiple application	

27	**Peltier Temperature Control for Parallel plate & Cone-Plate geometries**	-40 to 200 deg C or better,
28	**Heating Rate**	Up to 20 deg C/Min (max) or better
29	**Temperature accuracy**	0.1 deg C
30	**Peltier Temperature control range for the concentric cylinder**	-10 to 150 deg C or better
31	**Required Geometries for the Peltier Temperature device**	1. 25 mm sand-blasted parallel plate geometry made of SS – 1 Qty. 2. 20 mm 4° Cone geometry made of the SS – 1 Qty. 3. 50 mm 2 ° Cone geometry made of the SS – 1Qty. 4. 40 mm Parallel Plate geometry made of the SS – 1Qty. 5. 60 mm Parallel Plate geometry made of the SS – 1 Qty. 6. 60 mm 4° Cone geometry made of the SS – 1 Qty. 7. DIN Rotor & Cup made of the SS – 1 Qty. 8. VANE type rotor – 1 Qty 9. Double-wall concentric cylinder- 1 Qty 10. Solvent trap must be supplied for the parallel plate & cone-plate geometries and it should be in contact with Peltier heating surface to efficiently prevent evaporation of solvents without condensation. 11. The above listed geometries should have auto tool recognition by the rheometer software The geometries should be of single-shaft individual geometry of each dimension, and the geometries may or may not be used for the both higher temperature as well as lower temperature oven
	VII. Material Characterization Accessories	
A.	**Interfacial Rheology**	1- The interfacial rheology accessory with the DWR Measuring system/ Du Noüy ring geometry/ a similar alternative ring geometry to study the interfacial properties of the fluids
B.	**Tribology Attachment**	1. The rheometer must offer a tribology accessory for measuring coefficient of friction between two solid surfaces by using Ball on Three plates configuration. 2. The above listed tribology accessory should be compatible with the high temperature furnace of the rheometer to perform the temperature controlled test run • Axial Force/Friction force: 40N or above • Max. Torque range: 200 mNm • Temperature range RT-300 °C • Speed range: 0 to 300 rad/s • Force resolution: 0.005 or better
C.	**Microscopy Attachment**	1. The rheometer must offer a modular microscope accessory for viewing the sample in brightfield, polarization and fluorescence microscopy modes with piezo-ceramic objective positioning. 2. Field of View: 320 µm x 240 µm at 20x 3. Illumination: Blue-light LED 4. Image Capture: 640 x 480 pixels, 90fps 5. Geometries: Plates and Cones up to 40 mm diameter 6. Should include suitable microscope objectives 40 X Long WD and 50X short WD
D.	**Electro-rheology Attachment**	1- Type of temperature controller : Peltier Temperature Controller 2- Temperature range for the Peltier Plate: 0 to 200°C 3- Temperature range for the Peltier CC: 0 to 150°C 4- Electric field range: 0 to 4 KV or more 5- Insulated parallel plates 40mm and 25mm-01 each. 6- 25 mm DIN rotor and 30 mm cup for the Electrorheology study on the low-viscous fluids 7- A suitable alternative geometries and concentric cylinder cup & bob dimension can be supplied
E.	**Powder Rheology accessory**	1. The Powder Rheology Accessory should provides ambient measurements of both consolidated powder (Shear) and loose, free-flowing powder (Flowability). 2. Should be offered with the powder flow cell and powder

		shear cell 3. Software should able to measure the total flow energy, Stability index, flow rate index, cohesion, flow function, yield strength, angle of internal friction 4. Temperature range 10°C to 120°C or above for the powder shear cell
F.	**Building Material Cell (BMC)**	1. The Building Materials Cell with the concentric cylinder cup and rotor for testing samples with large particles such as concrete slurries and mixes. 2. Should have a paddle type rotor, slotted cage, and the large diameter 3. cup for the adequate sample mixing while preventing sample slip at both the cup and rotor surfaces 4. Temperature range 10°C to 120°C or above
G.	**Kit for Asphalt and Bitumen**	1. Dry Asphalt Kit for the studying the Asphalt binders. 2. Temperature range -20°C to 150°C 3. Geometry: 8 mm and 25 mm parallel plate 4. Should have an automated Temperature calibration 5. Should supply the standard oil N2700000SP 6. The Asphalt kit should comply to both IS and/or ISO standards that are relevant to asphalt testing
H.	**Viscosity Range (Newtonian /Non-Newtonian Materials)**	1mPas to 10^{+9} mPas or better
I.	**Calibration Fluids**	Certified Reference Material with the traceable certificates Two set of standard Oils • S60 • S600
	VIII. Utilities	
A.	**Air Compressor**	1- Max pressure: 8 bar or better 2- Noise level: : 62 DBA or better 3- Oil free compressor
B.	**Air Dryer**	Multistage with micro filters
C.	**Circulator**	1- Temperature range : -5 to 60 deg C or better 2- 450 W cooling capacity 3- Bath volume : 3 - 4 litres
D.	**Computer**	i7, 2.67 GHz, 8 GB RAM, SSD with 240 GB with two monitor s
	IX. Rheology Software	
A.	**Testing Protocols**	TESTING PROTOCOLS 1) Oscillation Mode Tests: a. Torque/Stress sweep (linear or log) at single frequency b. Frequency sweep (linear or log) at single torque c. Frequency sweep (linear or log) at single strain d. Strain/angular displacement sweep (linear or log) at single frequency e. Temperature sweep at single frequency/torque f. Superimposed stress oscillation and steady shear g. Superimposed strain oscillation and steady shear h. Multiple simultaneous frequencies superimposed on above modes 2) Flow Mode Tests: a. Controlled stress or torque sweeps. b. Controlled rate (1/s) or speed (rad/s) sweeps. c. Stress stepped flow. d. Equilibrium stress stepped flow (ensures material has time to respond to each level of stress). e. Temperature sweeps at constant stress or rate. f. Squeeze flow and pull off. 3) Creep Mode Tests: a. Constant stress creep and recovery. b. Automatic sensing of steady state during creep test.

		4) Stress relaxation a. Constant strain and stress relaxation test • All raw data or instrument parameters must be accessible at anytime. • The instrument software must report absolute uncorrected torque applied by the motor (not sample torque corrected for moment of inertia) in addition to the stress applied by the motor and the inertia corrected stress applied to the sample. • The instrument software must report both raw phase angle and corrected phase angle for oscillation measurements for validation of data quality. Viewing these signals enable full understanding of the effect of moment of inertia on measured data for acceptance. The rheometer system must display the oscillation waveforms real-time and store the waveform for each data point. The waveform should be viewable to provide an indication of the amount of noise, slip, or inertial correction for each point.
B.	**Warranty**	One year + 2 years additional warranty. The Warranty should cover the labour and the parts during the warranty period. Assurance of the availability of service, consumables & essential spare parts of the equipment for the period of 7 years.
	X. General Conditions	
A	The supplier should provide training for two weeks after installation to 2-3 people at CSIR- National Physical Laboratory, New Delhi.	

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

Sr. Controller of Stores & Purchase