Technical Specifications

1. ## Strain Controlled Rheometer :

Rheometer modes :   Rotational and Oscillation mode rheometer with the Separate Motor & Transducer technology and High resolution optical encoder

Rheometer Design : Rheometer design must utilize separate, frictionless brushless DC servo air bearing actuator (motor) and Force/torque Rebalance Transducer (FRT) components, thereby eliminating inertia contributions of the actuator

The instrument must include automatic environmental system recognition and offer environmental systems to test materials from low viscosity volatile liquids to high modulus solids.

The instrument must have a LCD touch panel integral to the instrument (i.e. at the test station) which provides a constant readout of torque, axial force, temperature, gap, etc.

Motor : Brushless DC

Maximum Motor Torque : Greater than 750 mNm

Bearing : Air bearing

Minimum transducer torque in oscillation : less than 0.075 µNm

Minimum transducer torque in steady shear : less than 0.25 µ Nm

Maximum transducer torque : 200 mNm or better

Torque Resolution : 1nN.m or better

Strain Resolution : 0.05 µrad or better

Minimum angular displacement in Oscillation : 1µrad

Step change in shear rate : 5 ms

Step change in strain : 10 ms

Normal/Axial Force range : 0.001 to 20N or better

Angular Velocity Range : 1×10^{-6} rad/s to 300 rad/s or better

Shear rate range : Up to 5000 s-1 or above

Angular Frequency Range : Up to 628 rad/s

Temperature range : Advanced Peltier System with the concentric cylinder must also allow for inclusion of temperature-controlled plates for the parallel plate and cone-plate as a single temperature accessory to cover the temperature range of -10°C to 150°C or above

Advanced Peltier system with gap size changes / adjustments and mode in both controlled shear rate plus stress

Solvent trap must be quoted for all the advanced Peltier system geometries – which includes both the parallel plate/ cone-plate as well as the concentric cylinder

Special Software specifications (must be quoted with the Rheometer)

- LAOS and FT rheology

- Multi-wave & Arbitrary Waveform

- Squeeze-Flow/ Axial Testing

Other Software requirement :

- The instrument control & data analysis software should be based on Windows 7/8 operating system.

- Automatic determination of rheological parameters such as Zero shear viscosity, Plateau Modulus, etc.

- All raw data or instrument parameters must be accessible at all data points

- The waveform & Lissajous of each dynamic data point must be displayed in real time and is able to be saved with each data point for data validation

- Data analysis options must include the following curve modeling functions:

- Mathematical model: Polynomial, exponential, sine/cosine, Fourier series,

- Flow: Newtonian, Casson, Bingham, Herschel-Buckley, Power Law, Sisko, Cross, Williamson, Ellis, Carreau, Best fit Polynomial.

- Creep: discrete retardation spectrum, Burger model.

- Oscillation: Discrete and continuous relaxation spectrum, Spriggs, Oldroyd and Coz-Merz

- Stress relaxation: Discrete and continuous relaxation spectrum

- User defined model

- Software must include transformations software transformations of G', G", G(t), J', J", J.

- Time-Temperature Superposition, with automatic horizontal and vertical shift. Automatically generates master curves. After fitting with WLF or Arrhenius, curves can be generated for any temperature within the range tested. Shift parameters in the scalar database other than temperature can be chosen. Shifting direction (horizontal, diagonal) can be set for the selected curves. Time/Temp Superposition capability must be built into the software package and not a third party program.

2. **Orthogonal Superposition (OSP) :**

- The rheometer should capable to perform the rheological testing by simultaneous deformation in the angular and axial directions with the below listed testing modes

- Steady shearing deformation coupled with the axial oscillatory deformation

- Two-dimensional small amplitude oscillatory shear (2D-SAOS) for study the anisotropy

Geometries for orthogonal superposition (OSP)

Hard Anodized Aluminum, 34 mm Dia., OSP Slotted Double Gap Cup together with Titanium, OSP Slotted Double Gap Bob for the Advanced Peltier System

3. **Linear Dynamic Mechanical Analysis (DMA) :**

- Linear DMA clamp for the Force convention oven:

- Axial linear dynamic mechanical analysis (DMA) with axial bending, tension and compression without having any additional need of linear motor/actuator

- 3-point bending clamp

- Film/Fiber Tension clamp

- Single and dual cantilever clamp

- Parallel Plate compression clamp

4. **Interfacial accessories :**

- Interfacial shear rheology of thin layers at liquid-liquid or liquid-gas interfaces for application such as pharmaceuticals, foods, personal care products and coatings

- Double Wall Ring (DWR) made of Platinum-iridium for inert and ease of cleaning

- To measure the surface viscosities as low as 10-5 Pa.s.m without any correction

- 200 litres pressurised Dewar for cooling the system.

5. **High Temperature Accessories :**

Geometries required for Peltier system :

- 25 mm sandblasted plate made of Stainless steel

- 40 mm sandblasted & Cross hatched plate made of Stainless steel

- 50 mm 2° Stainless-steel cone

- 30 mm diameter concentric cylinder cup made of Stainless Steel

- 27.7 mm diameter DIN bob made of Stainless steel

- Hard Anodized Aluminum, 34 mm Dia., Double Gap Cup

- 25 mm and 40mm profiled geometry with 0.5 mm groove .

- Narrow Gap Double Gap Bob: Inner Dia. = 28.6 mm, Outer Dia. = 33 mm,

Height = 49.5 mm, Sample Volume = 5.0 mL

- Solvent trap cover for the above geometries

Geometries required for high temperature convection oven:

- Forced Convention Oven for High temperature range from RT to 600°C, including Liquid nitrogen cooling system to extend the lower temperature down to -150 °C

- Controlled heating/cooling rate of up to 60 °C/min

- Geometries made of Stainless steel for the polymer melt rheology with 25 mm parallel plate and 25 mm with 1° cone

- The temperature sensor for lower plate and upper plate must be available in direct contact with both plates with wireless signal transmission to assure uniform and accurate sample temperature

- **Warranty :**   Two-year comprehensive warranty

6. **AMC :** Three years AMC after completion of warranty period