Specifications for Dynamic Shear Rheometer (DSR) to Conduct Asphalt Binder Characterization Mechanical Tests

- Test procedures should comply with ASTM and AASHTO standards
- A rotational dynamic shear rheometer capable of measuring the rheological properties of asphalt binders / bitumen, including a wide range of modified materials
- The instrument should include facilities to enable materials to be characterized under controlled stress and controlled strain conditions without the need for additional hardware or software
- The equipment must be able to perform major rheological test modes such as creep, oscillation, flow, stress-relaxation, LAS, etc. with an accurate thermal control sample test chamber
- Measurement motor: DC Motor / synchronous motor and ably supported by high quality sensitive air bearing system to give the optimum oscillatory response for a wide range of frequencies in both control shear stress and control shear strain operating modes: 10 nrad/s to 650 rad/s or better
- Angular deflection and speed measurement should be performed inside the motor with a high-resolution optical encoder. This should allow the user a range of angular speed and speed measurements: 10 nrad/s to 325 rad/s or better
- DSR should be equipped with a motor for direct strain oscillation and stress control with torque specifications:
    - Rotation: 6 nNm to 200 milli-Nm or better
    - Oscillation: 8 nNm to 200 milli-Nm or better
- Normal force range: 0.001 to 50 N or better
- Peltier Plate and Peltier temperature controllers: -40 to 200 °C or better with at least 0.01 °C resolution; and active Peltier hood with temperature range of -40 to 200 °C or better
- Measuring geometries: Copper-alloy coated measuring plates with one each of diameters 8 mm and 25 mm should be quoted
- Suitable measuring geometries should be quoted for Ground Tire Rubber (GTR) modified bitumen
- Rheometer should be equipped with automatic temperature calibration across the full AASHTO TP-315 procedure temperature range
- Air Compressor: Compact oil free air compressor with 100 psi, 3.5 cfm flow rate with necessary tubing, connector, and membrane air drier / filter
- Thermostat circulator:
    - Bath Volume: 3 to 5 liters
    - Accuracy: +/- 0.5 °C

- Pump: in-built for external circulation
- Temperature range: 0 to 100 °C

- Angular frequency range: 1 μHz to 100 Hz or better
- Dynamic Motor inertia: ≤ 13 $\mu N.m.s^2$ or better
- Normal force response time: < 10 ms or better
- Raw instrument variables: 5 kHz constant streaming data or better
- Power supply requirement should be suitable for Indian conditions
- Software Specifications:
  - Software must comply with ASTM and AASHTO standards on asphalt binder testing and automatically generate test results such as pass or fail criterion. The rheology software should have basic test templates for all types of variables to obtain data profiles such as:
    - Viscosity curve as a function of time, temperature, shear rate, and shear stress
    - Complex viscosity as a function of time, temperature, frequency, strain, and stress
    - Shear stress as a function of shear strain to identify the LVE (Linear Viscoelastic) range of samples
    - Elastic (G'), Loss (G"), Complex Modulus |G*|, tan δ as a function of time, temperature, frequency, strain, and stress in shear mode
    - Modelling and curve fitting facility to classify material behavior by various rheological models (flow, oscillation, and creep), and user-defined models with capability for built-in TTS facility is preferred
    - Software should have the capability to analyze the tested samples as per LAS/LAOS/raw data /Master curve tests
    - Software for control of the test and for continuous acquisition, storage and display of test data, temperatures, frequencies, and number of cycles of load applications
    - Free software upgrade for lifetime
    - Suitable computer and printer should be supplied.
- AMC for a minimum of three years