

# DYNAMIC SHEAR RHEOMETER

## **BE 106**

Dynamic Shear Rheometer (DSR) is a specialized laboratory instrument used to measure the rheological properties—specifically the viscoelastic behavior—of materials like asphalt binders, polymers, and other fluids or semi-solids. It applies controlled oscillatory shear stress or strain to a sample and analyzes its response to determine parameters such as the complex shear modulus ( $G^*$ , which combines elastic and viscous components) and phase angle ( $\delta$ , which indicates the balance between elasticity and viscosity). The DSR is particularly vital in asphalt testing under standards like AASHTO T 315 for Superpave performance-graded (PG) binder specifications, simulating real-world pavement stresses at various temperatures (typically 3–88°C) and frequencies (e.g., 10 rad/s to mimic traffic loading).

## FOLOWING STANDARD

AASHTO T 315

## KEY COMPONENTS

The DSR apparatus typically includes the following modular components, often integrated into a single unit for precision and automation

COMPONENT	DETAILS
Parallel Plates	Upper and lower metal disks (25-mm diameter for unaged/RTFO-aged asphalt; 8-mm for PAV-aged). Gap: 1 mm (25-mm plates) or 2 mm (8-mm plates). Apply shear to the sample
Environmental Chamber	Air- or liquid-filled enclosure (Peltier device or water bath) for precise temperature control ( $\pm 0.1^\circ\text{C}$ ) from $-20^\circ\text{C}$ to $150^\circ\text{C}$ .
Loading Device	Electromagnetic or pneumatic actuator for applying oscillatory shear stress/strain. Supports stress- or strain-controlled modes.
Control & Data Acquisition System	Software-driven interface for automation, calibration, and real-time analysis. Includes transducers for torque, displacement, and normal force.
Sample Preparation Tools	Silicone molds, heated trimming tools, and cleaning solvents (toluene, acetone) for specimen handling
Optional Accessories	Tool master for quick geometry swaps, Quick Connect for fast setup, and reference fluids for calibration

## SETUP AND OPERATION

1. **Calibration:** Verify loading device and temperature system every 6 months using standard reference fluids and thermometers.
2. **Sample Preparation:** Heat binder to pourable state (e.g.,  $163^\circ\text{C}$ ), pour between preheated plates, trim excess, and set gap (e.g., 1 mm).
3. **Testing:** Stabilize at test temperature for 10 minutes in the chamber. Run 10 conditioning cycles, then 10 data cycles at specified frequency/strain. Software auto-computes  $G^*$  and  $\delta$ .
4. **Cleanup:** Wipe plates with solvents to prevent contamination.

