RESILIENT MODULUS ASPHALT TESTING SYSTEM

BE 104

The resilient modulus (Mr) is a critical material property in pavement engineering that measures the stiffness of asphalt concrete (also known as hot mix asphalt or HMA) under repeated loading conditions, simulating traffic loads. It represents the recoverable (elastic) deformation response of the material after unloading, analogous to Young's modulus in linear elastic models. This parameter is essential for predicting pavement performance, including fatigue cracking, rutting, and overall structural capacity, and is incorporated into design guides like the 1986 AASHTO Guide for Design of Pavement Structures.

For asphalt specifically, Mr values typically decrease with increasing temperature and frequency, while Poisson's ratio (a measure of lateral strain) increases with temperature and is higher for less viscous binders (AC-10 vs. AC-20 asphalt cements). Testing reveals that denser-graded mixtures with finer aggregates show lower variability in Mr compared to those with coarser aggregates.

FOOLOWING STANDARD

AASHTO T307, ASTM D7369, AASHTO T307

IMPORTANCE IN PAVEMENT DESIGN AND EVALUATION

Resilient modulus testing supports mechanistic-empirical pavement design by providing data for layer stiffness, structural coefficients, and performance predictions under varying moisture, temperature, and stress conditions. It's used in systems like the Asphalt Aggregate Mixture Analysis System (AAMAS) to evaluate mixture design, fatigue life, and field corroboration via nondestructive testing. No significant differences in Mr Computation arise from loading systems (pneumatic vs. hydraulic), but sample size and recovery time influence results, with coefficients of variation up to 20-30% in coarser mixes.

TESTING SYSTEMS AND EQUIPMENT

Commercial systems automate these tests under triaxial conditions, often with closed-loop control for axial load/displacement and confining pressure. Examples include

KEY FEATURES	SPECIMEN SIZES	TEMPERATURE CONTROL
Computer-controlled software with AASHTO/SHRP sequences, real-time Mr calculation, dynamic waveforms (up to 50 Hz), optional environmental chamber (-30°C to +150°C). Supports indirect tension and dynamic modulus fixtures.	2.8", 4", 6" diameter	Yes, with liquid N2 boost
Measures recoverable axial deformation for subgrade/base/asphalt under repeated loading	Varies (triaxial cells)	Optional
Tests permanent deformation and Mr of unbound/asphalt materials; quiet operation under high pressure/temperature.	Up to 150 mm	Yes
Automated for permanent deformation and Mr of soil/aggregate/asphalt; user-defined protocols.	Standard triaxial	Optional
Triaxial setup without loading frame; high-pressure/high-temp capable.	Varies	Yes

These systems use electro-hydraulic or pneumatic servo control, external/internal transducers, and export data for model fitting.

For implementation, consult ASTM D7369 for bituminous mixtures or AASHTO T307 for aggregates/soils, adaptable to asphalt.