
Standard Method of Test for

Determination of Performance Grade of Physically Aged Asphalt Binder Using Extended Bending Beam Rheometer (BBR) Method

AASHTO Designation: T 406-23¹

Adopted without Revisions: 2023

Technical Subcommittee: 2b, Liquid Asphalt



American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This test method covers the determination of the low-temperature performance grade (i.e., minimum design pavement temperature) of asphalt binders by means of a bending beam rheometer after going through a physical aging (physical hardening) process. It is applicable to material having a flexural stiffness value from 20 MPa to 1 GPa (creep compliance values in the range of 50 nPa-1 to 1 nPa-1) and can be used with material aged using T 240 (RTFO) or R 28 (PAV) or with recovered asphalt binder. The test apparatus is designed for testing within the temperature range from -36 to 0°C.
- 1.2. The bending beam rheometer method used in T 313 conditions samples for 1 h and tests at a temperature 10°C warmer than the low-temperature performance grade to determine if the asphalt binder passes the low-temperature requirement. This standard requires testing at two temperatures, to determine by extrapolation a limiting temperature for each of the three conditioning times and two conditioning temperatures.
- 1.3. Low-temperature physical aging of asphalt varies as a function of temperature and time. This standard conditions at 10°C and 20°C warmer than the low-temperature performance grade for periods of 1 h, 24 h, and 72 h to simulate the effect of extended conditioning at two different cold temperatures.
- 1.4. Test results are not valid for beams of asphalt binder that deflect more than 4 mm or less than 0.08 mm when tested in accordance with this method.
- 1.5. The values stated in SI units are to be regarded as the standard.
- 1.6. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*
- 1.7. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend*

on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- < M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- < R 28, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
- < R 29, Grading or Verifying the Performance Grade (PG) of an Asphalt Binder
- < T 240, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
- < T 313, Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)

2.2. *ASTM Standards:*

- < E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- < E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- < E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers

2.3. *International Electrotechnical Commission Standard:*

- < IEC 60751: 2008 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

3. TERMINOLOGY

3.1. *Definitions:*

- 3.1.1. *asphalt binder*—an asphalt-based cement that is produced from petroleum residue either with or without the addition of organic modifiers that are dissolved, dispersed, or reacted to enhance performance.
- 3.1.2. *performance grade (PG XX-YY)*—the performance grade of an asphalt binder with grading designations “XX” related to the number of degree days over 10°C and “-YY” related to the minimum design pavement temperature.
- 3.1.3. *physical hardening*—a time-dependent stiffening of asphalt binder that results from the time-delayed increase in stiffness when the asphalt binder is stored at low temperatures. The increase in stiffness due to physical hardening is reversible when the temperature is raised above the glass transition temperature region.

3.2. *Descriptions of Terms Specific to This Standard:*

- 3.2.1. *conditioning time (t)*—the time the sample is to be conditioned when placed in the air-cooled freezer prior to each round of testing.
- 3.2.2. *grade loss*—the difference between the limiting grade at 1 h for T_{LC} and the LTLG, ($T_{LBBR} - LTLG$).