

**Standard Practice for
Grading or Verifying the Performance Grade
of an Asphalt Binder**

AASHTO Designation: PP6-94^{1,2} (Reapproved 1996)

1. Scope

1.1 This practice describes the testing required to determine the performance grade of an asphalt binder. It presents two approaches. In the first, the performance grade of an unknown asphalt binder is determined. In the second, the nominal performance grade of an asphalt binder is verified. It also provides an estimate of the time required to complete a single test sequence.

1.2 This practice may involve hazardous materials, operations, and equipment. This practice does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this practice to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 AASHTO Standards:

- MP1 Specification for Performance-Graded Asphalt Binder
- PP1 Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
- T48 Flash and Fire Points by Cleveland Open Cup
- T240 Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)
- TP1 Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
- TP3 Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
- TP5 Determining Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

2.2 ASTM Standards:

D4402 Method for Viscosity Determinations of Unfilled Asphalt Using the Brookfield Thermosel Apparatus

3. Summary of the Practice

3.1 The tank (as-received) sample of asphalt binder is tested to determine the flash point in °C (T48), viscosity at 135°C (D4402), shear modulus (G^*) and phase angle (δ) (TP5).

3.2 The asphalt binder is aged in the rolling thin film oven (T240) and the residue is tested to determine the mass loss (T240) and the shear modulus (G^*) and phase angle (δ) (TP5).

3.3 The residue from the rolling thin film oven is aged in the pressurized aging vessel (PP1) and this residue is tested to determine the shear modulus (G^*) and phase angle (δ) (TP5), creep stiffness (S) and slope, m , of the log creep stiffness versus log time relationship at 60 seconds (TP1), the failure strain in direct tension (TP3), as necessary, and physical hardening measured by creep stiffness (S) and slope, m , of the log creep stiffness versus log time relationship at 1 and 24 hours (TP1).

3.4 Based on these test results the asphalt binder is graded according to MP1.

4. Significance and Use - This practice describes the testing required for grading or verifying the performance grade of an asphalt binder according to MP1.

5. Estimated Time Necessary for Testing - For both grading and verification, if the analysis is started at the beginning of a morning work shift, all testing and analysis should be completed during the afternoon of

¹This standard is based on SHRP Product P002.

² Approved in October 1993, this provisional standard was first published in January 1994. Reconfirmed in January 2001.

the next day. This schedule provides the 20 hours needed for PAV conditioning. (It takes 1 additional day to collect the physical hardening data as 24 hours of conditioning are required at the lowest grading test temperature to determine the extent of physical hardening.) Of course, samples can be aged and analyzed in parallel, and the productivity of the laboratory increased. However, for the purpose of this document, analysis of a single asphalt binder will be discussed.

6. Test Procedure for Grading an Unknown Asphalt Binder

6.1 Prepare samples and test specimens using the procedures specified in the test methods performed. In the case where the grade of the asphalt binder is unknown, approximately 400 g of unaged asphalt binder is required to complete the tests with the necessary replicates.

6.2 *Begin conditioning asphalt binder in the rolling thin film oven (RTFO).* Condition a sufficient amount of asphalt binder depending on the type and number of tests to be performed.

Note 1 -- Two BBR beams requiring PAV aged material are needed at each test temperature. In addition, four DT specimens requiring PAV aged material may also be needed at each test temperature. A minimum of two test temperatures will be required. Approximately 200 g of RTFO residue will be required.

6.3 Perform the DSR test (TP5) on the original asphalt binder beginning at 58°C, and increase or decrease the test temperature at 6.0°C increments until a value for $G^*/\sin \delta \leq 1.00$ kPa is obtained. The highest test temperature where the value for $G^*/\sin \delta$ is ≥ 1.00 kPa determines the starting PG grade.

Note 2 -- For example, if $G^*/\sin \delta$ is 0.6 kPa at 64°C and 1.2 kPa at 58°C, the starting asphalt binder grade is PG 58-.

6.4 Determine the flash point on a sample of original binder using T48. The flash point must be greater than 230°C to meet the requirements of MP1.

6.5 Determine the viscosity of the original asphalt binder at 135°C using ASTM D4402. The viscosity must not exceed 3 Pa·s to meet the requirements of

MP1.

6.6 After the RTFO test (T240) is complete, Determine the mass loss of the original asphalt binder. The mass loss must be ≤ 1.00 percent to meet the requirements of MP1.

6.7 If the original asphalt binder does not meet MP1 requirements for the tests in Sections 6.4 and 6.5, no further testing is required.

6.8 Perform the DSR test (TP5) on the RTFO residue at the test temperature used to determine the starting PG grade (Section 6.3) to confirm the high temperature grade of the asphalt binder (PG 46-, 52-, 58-, etc.). The value for $G^*/\sin \delta$ of the RTFO residue must be ≥ 2.20 kPa. Choose the lower performance grade in cases where the test values in Sections 6.3 and 6.8 give conflicting grades.

6.9 Age a sufficient quantity of RTFO residue in the PAV (PP1). Use an aging temperature of 90°C for starting grades PG 46-x and 52-x binders and 100°C for starting grades PG 58-x and higher. PAV temperature of 110°C is to be used in simulating desert environments.

Note 3 -- Two BBR beams (requiring PAV aged material) are required at each test temperature. In addition, four DT samples may also be needed at each test temperature. A minimum of two test temperatures will be required.

Note 4 -- Complete steps 6.1 through 6.9 during the first day of testing. This will allow further testing to begin on the second day, when PAV aging is complete.

6.10 At the conclusion of the PAV aging procedure, carefully remove the residue from the vessel, combine individual pans of the same aged asphalt binder, and prepare two bending beam specimens for each test temperature according to TP1. Retain sufficient residue to prepare four direct tension specimens for each test temperature if required.

6.11 Perform the DSR test (TP5) on the PAV residue beginning at a test temperature of 16 and 19°C respectively, for starting grades PG 52 and 58, 22°C for starting grade PG 64, and 28°C for starting grade PG 70, unless there is other information to suggest the temperature at which $G^*/\sin \delta$ is ≤ 5000 kPa. Decrease or increase the test temperature at 3.0°C increments until the value for $G^*/\sin \delta$ exceeds 5000