



Standard Practice for Determining Low-Temperature Performance Grade (PG) of Asphalt Binders¹

This standard is issued under the fixed designation D 6816; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the calculation of low-temperature properties of asphalt binders using data from the bending beam rheometer (see Test Method D 6648) (BBR) and the direct tension tester (see Test Method D 6723) (DTT). It can be used on data from unaged material or from material aged using Test Method D 2872 (RTFOT), Practice D 6521 (PAV), or Test Method D 2872 (RTFOT) and Practice D 6521 (PAV). It can be used on data generated within the temperature range from +6°C to -36°C. This practice generates data suitable for use in binder specifications such as Specification D 6373.

1.2 This practice is only valid for data on materials that fall within the scope of suitability for both Test Method D 6648 and Test Method D 6723.

1.3 This practice can be used to determine the following:

- 1.3.1 Critical cracking temperature of an asphalt binder, and
- 1.3.2 Whether or not the failure stress exceeds the thermal stress in a binder at a given temperature.

1.4 This practice determines the critical cracking temperature for a typical asphalt binder based on the determination of the temperature where the asphalt binder's strength equals its thermal stress as calculated by this practice. The temperature so determined is intended to yield a low temperature PG Grade of the sample being tested. The low temperature PG grade is intended for use in purchase specifications and is not intended to be a performance prediction of the HMA (Hot Mix Asphalt) in which the asphalt binder is used.

1.5 The development of this standard was based on SI units. In cases where units have been omitted, SI units are implied.

1.6 *This standard may involve hazardous materials, operations, and equipment. 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.*

NOTE 1—The algorithms contained in this standard require implementation by a person trained in the subject of numerical methods and viscoelasticity. However, due to the complexity of the calculations they

must, of necessity, be performed on a computer. Software to perform the calculation may be written, purchased as a spreadsheet, or as a stand-alone program.²

2. Referenced Documents

2.1 ASTM Standards:

- C 670 Practice for Preparing Precision and Bias Statements for Test Methods of Construction Materials³
- D 8 Terminology Relating to Materials for Roads and Pavements⁴
- D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)⁴
- D 6373 Specification for Performance Graded Binders⁴
- D 6521 Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)⁴
- D 6648 Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)⁴
- D 6723 Test Method for Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)⁴

3. Terminology

3.1 *Definitions*—For definitions of general terms used in this standard, refer to Terminology D 8.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Arrhenius parameter, a_1 , n* —this is the constant coefficient in the Arrhenius model for shift factors: $\ln(a_T) = a_1 \cdot ((1/T) - (1/T_{ref}))$.

3.2.2 *coefficient of linear thermal expansion, α , n* —the fractional change in size in one dimension associated with a temperature increase of 1°C.

3.2.3 *creep compliance, $D(T, t)$, n* —the reciprocal of the stiffness of a material, $1/S(T, t)$, at temperature T and time t , which may also be expressed using reduced time, ξ , as $D(T_{ref}, \xi)$.

3.2.4 *critical cracking temperature, T_{cr} , n* —the temperature, estimated using this practice, at which the induced

¹ This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.44 on Rheological Tests.

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² The sole source of supply of the software package TSAR known to the committee at this time is Abatech, Incorporated. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee¹, which you may attend.

³ *Annual Book of ASTM Standards*, Vol 04.02.

⁴ *Annual Book of ASTM Standards*, Vol 04.03.