Designation: D 6521 – 05

Standard Practice for Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)[1]

This standard is issued under the fixed designation D 6521; 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 accelerated aging (oxidation) of asphalt binders by means of pressurized air and elevated temperature. This is intended to simulate the type of changes which occur in asphalt binders during in-service oxidative aging but may not accurately simulate the relative rates of aging. It is intended for use with residue from Test Method D 2872 (RTFOT), which is designed to simulate plant aging.

NOTE 1—Modified asphalt binders may phase separate or form skins during oven conditioning in Test Method D 2872 (RTFOT); the results from subsequent testing of this residue may not be representative of modified asphalts short-term aged under field conditions. Phase separation, or formation of skins, or both can also occur during PAV aging. Therefore, the practice may not be suitable for some modified asphalts.

NOTE 2—PAV has not been validated for materials containing particulate materials.

1.2 The aging of asphalt binders during service is affected by ambient temperature and air pressure and by mixture-associated variables, such as the volumetric proportions of the mix, the permeability of the mix, properties of the aggregates, and possibly other factors. This conditioning process is intended to provide an evaluation of the relative resistance of different asphalt binders to oxidative aging at selected elevated aging temperatures and pressures, but cannot account for mixture variables or provide the relative resistance to aging at in-service conditions.

1.3 The values stated in SI units are to be regarded as the standard. Values in parentheses in inch-pound units are provided for informational purposes only.

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 8 Terminology Relating to Materials for Roads and Pavements

D 1754 Test Method for Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)

D 2872 Test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

D 4753 Guide for Evaluating, Selecting and Specifying Balances and Standard Masses for Use in Soil, Rock and Construction Materials Testing

D 6373 Specification for Performance Graded Asphalt Binder

E 1137/E 1137M Specification for Industrial Platinum Resistance Thermometers

2.2 *AASHTO Standards:*[3]

M 320 Specification for Performance-Graded Asphalt Binder

MP 1a Specification for Performance-Graded Asphalt Binder

2.3 *CGA Standards:*[4]

CGA G-7.1–1997 Commodity Specification for Air, Fourth Edition

3. Terminology

3.1 *Definitions*:

3.1.1 Definitions of terms used in this practice may be found in Terminology D 8 determined from common English usage, or combinations of both.

[1] This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.46 on Durability and Distillation Tests.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.

[4] Available from Compressed Gas Association (CGA), 1725 Jefferson Davis Hwy., Suite 1004, Arlington, VA 22202-4102.

4. Summary of Practice

4.1 Asphalt binder is first aged using Test Method D 2872 (RTFOT). A specified thickness of residue from the RTFOT is then placed in standard TFOT stainless steel pans and aged at the specified aging temperature for 20 h in a vessel pressurized with air to 2.10 MPa. Aging temperature is selected according to the grade of this asphalt binder. The residue is then vacuum degassed.

5. Significance and Use

5.1 This practice is designed to simulate the type of in-service oxidative aging that occurs in asphalt binders during pavement service. Residue from this conditioning practice may be used to estimate the physical or chemical properties of asphalt binders after several years of in-service aging in the field.

5.2 Binders aged using this practice are used to determine specification properties in accordance with Specification D 6373, AASHTO M 320, or AASHTO MP 1a.

5.3 For asphalt binders of different grades or from different sources, there is no unique correlation between the aging time and temperature in this conditioning practice and in-service pavement age and temperature. Therefore, for a given set of in-service climatic conditions, it is not possible to select a single PAV aging time and elevated temperature and pressure that will predict the properties or the relative rankings of the properties of all asphalt binders after a specific set of in-service exposure conditions.

5.4 The relative degree of hardening of different asphalt binders varies with aging temperatures and pressures in the PAV. Therefore, two asphalt binders may age at a similar rate at one condition of temperature and pressure, but age differently at another condition. Hence, the relative rates of aging for a set of asphalts at PAV conditions may differ significantly from the actual in-service relative rates at lower temperatures and pressures.

6. Apparatus

6.1 An equipment system consisting of a pressure vessel, ovens, pressure-controlling devices, temperature-controlling devices, pressure and temperature measuring devices, and a temperature and pressure recording system (see Fig. 1).

6.1.1 *Pressure Vessel*—A stainless steel pressure vessel designed to operate at 2.1 ± 0.1 MPa between 90 and 110°C with interior dimensions adequate to hold ten TFOT pans and a pan holder. The pressure vessel shall contain a pan holder capable of holding ten TFOT stainless steel pans in a horizontal (level) position, such that the asphalt binder film thickness is reasonably uniform. The holder shall be designed for easy insertion and removal from the vessel when the holder, pans,

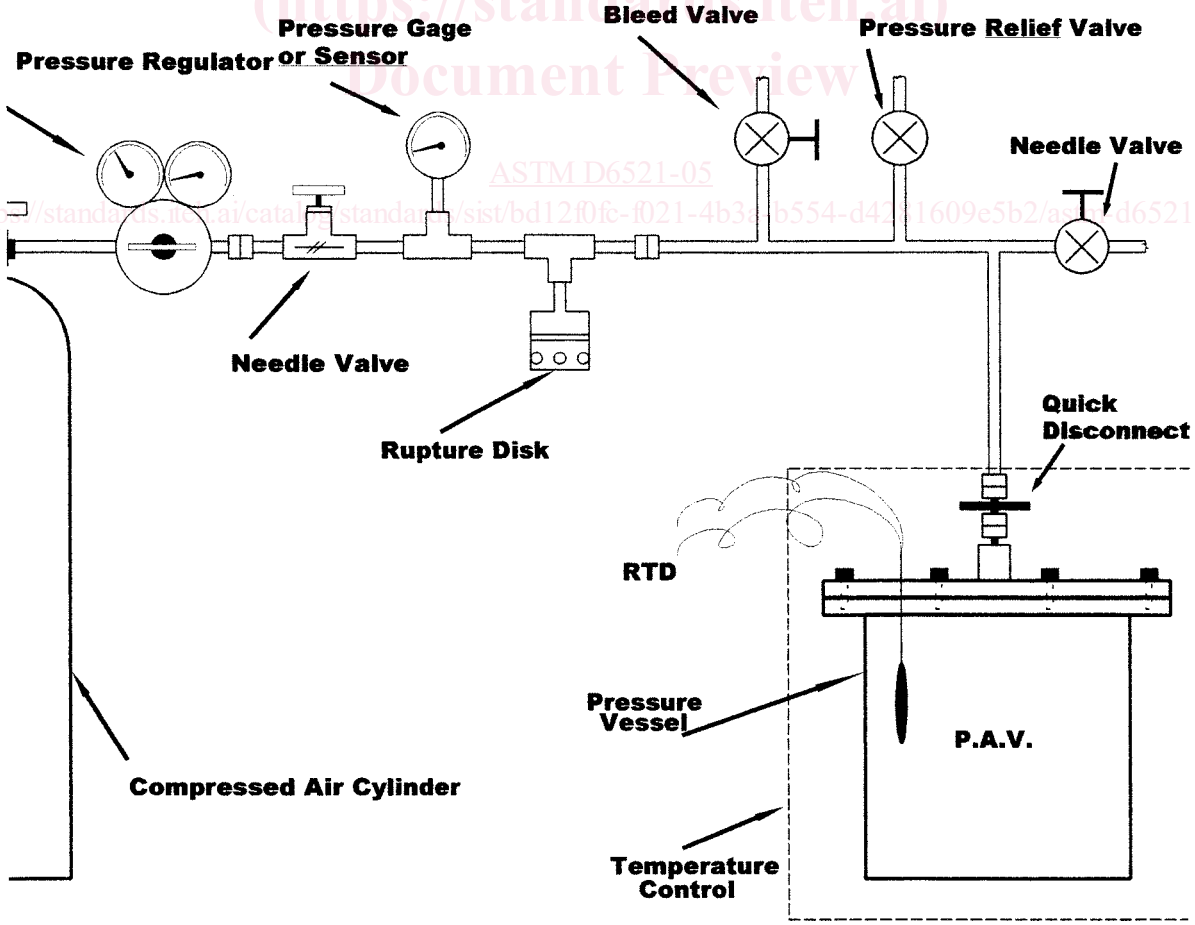


FIG. 1 Schematic of PAV Test System

and asphalt binder are at the aging temperature. A schematic showing a possible configuration of the vessel, pan holder and pans, and specifying dimensional requirements is shown in Fig. 2.

NOTE 3—The vessel may be a separate unit to be placed in a forced draft oven for conditioning the asphalt binders or an integral part of the temperature control system (for example, by direct heating of the vessel or by surrounding the vessel with a permanently affixed heating unit, forced air oven, or liquid bath). For practical purposes, it is recommended that the vessel have the dimensions of 250 mm in diameter and 265 mm in height. Research has shown that the volume of the vessel is not an important factor in hardening due to aging.

6.1.2 *Pressure and Temperature Controlling Devices:*

6.1.2.1 A pressure relief valve that prevents pressure in the vessel from exceeding the design pressure of the vessel, but in no case exceeding 2.5 MPa during the aging procedure.

6.1.2.2 A pressure regulator or regulating system capable of controlling the pressure within the vessel to ±0.02 MPa, and with a capacity adequate to reduce the pressure from the source of compressed air, so that the pressure within the loaded pressure vessel is maintained at 2.1 ± 0.1 MPa gage (relative) pressure during the aging process.

6.1.2.3 A slow-release bleed valve that allows the pressure in the vessel at the completion of the conditioning procedure to be reduced from 2.1 MPa to local atmospheric pressure within 8 to 15 min.

6.1.3 *Temperature Controlling Device*—A digital temperature control device as described in 6.1.4.1 or 6.1.4.2 for maintaining the temperature during the aging procedure within the pressure vessel at the aging temperature ±0.5°C.

6.1.3.1 A heating device (forced-draft oven or fluid bath) capable of restoring the aging temperature within the vessel after loading the pans and the pan holder and prior to pressurizing the vessel within 2 h of placing the loaded vessel in the heating device. Maintain the temperature within the pressure vessel at the aging temperature ±0.5°C. If an oven is used, the oven shall have sufficiently large interior dimensions to allow forced air to freely circulate within the oven and around the pressure vessel when the vessel is placed in the oven. The oven shall contain a stand or shelf that supports the loaded pressure vessel in a level position above the lower surface of the oven.

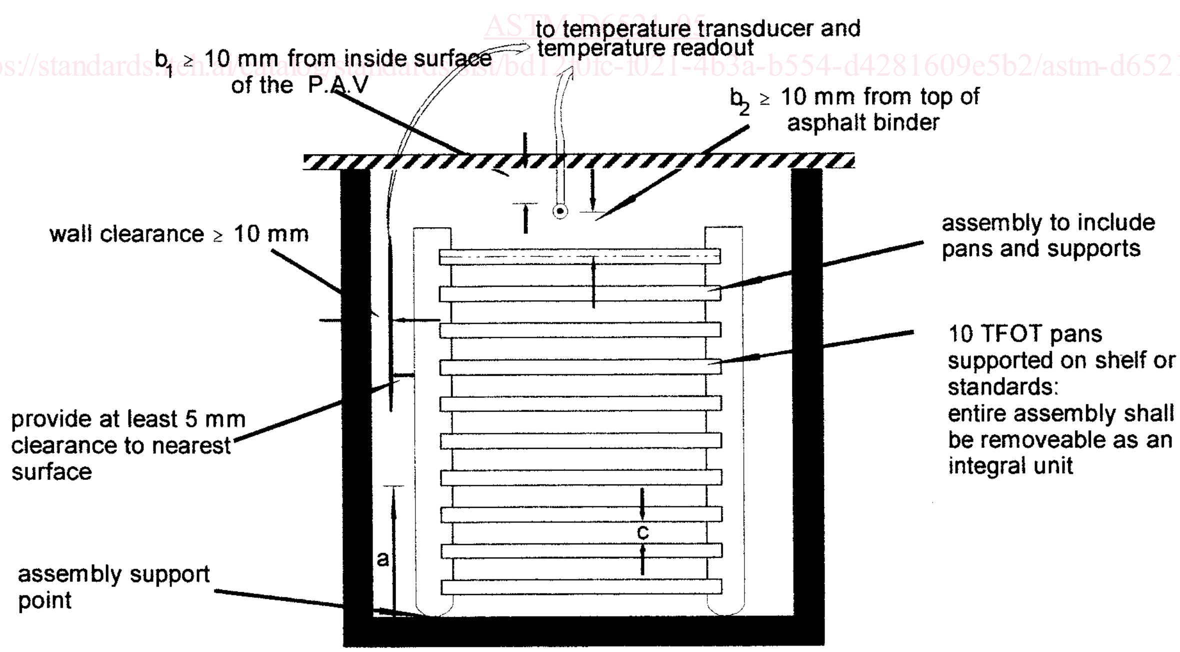
6.1.3.2 A pressure vessel with an integral temperature control system that is capable of restoring the pre-aging temperature, as determined in , within the vessel after loading the pans and the pan holder, prior to pressurizing the vessel within 2 hours of placing the loaded vessel in the heating device, and maintaining the temperature within the pressure vessel at the aging temperature ±0.5°C.

NOTE 4—Preheating the pressure vessel may be necessary to achieve the aging temperature within the required 2-h period.

6.1.4 *Temperature and Pressure Measuring Devices*:

6.1.4.1 A platinum RTD accurate to the nearest 0.1°C and in accordance with Specification E 1137 (IEC 751), or equal, for measuring temperature inside the pressure vessel. The RTD shall be calibrated as an integral unit with its respective metre or electronic circuitry.

6.1.4.2 *Temperature Recording Device*—A strip chart recorder or other data acquisition system capable of recording temperature throughout the aging process to within ±0.1°C. As an alternative, an electronic device capable of reporting only maximum and minimum temperatures (accurate to ±0.1°C) may be used.



NOTE 1—Distance "a" controls the levelness of the pan. The assembly shall be supported at three or more support points. The distance "a", measured from each assembly support point to the bottom of the pan (top of shelf or pan support point), shall be controlled to ±0.05 mm.

NOTE 2—Distances b_1 and b_2 shall be such that any active portion of the temperature transducer is ≥10 mm from any adjacent surface.

NOTE 3—Distance "c" shall be ≥12 mm.

FIG. 2 Schematic Showing Location of Pans and RTD Within PAV