
Standard Practice for Long-Term Laboratory Conditioning of Asphalt Mixtures

AASHTO Designation: R 121-24¹

First Published: 2024

Technical Subcommittee: 2c, Asphalt–Aggregate Mixtures



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004**

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1. SCOPE

- 1.1. This standard practice describes procedures for long-term laboratory conditioning of compacted and uncompacted asphalt mixtures for mixture mechanical property testing. This standard practice includes five long-term mixture conditioning methods, with Method A using compacted mixture specimens and Method B, C, D, and E using uncompacted mixture. The long-term conditioning procedures for mixture mechanical property testing are preceded by the procedure for short-term conditioning according to R 30.
- 1.2. The values stated in SI units are to be regarded as the standard.
- 1.3. *This standard practice may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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. *AASHTO Standards:*
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 30, Short-Term Laboratory Conditioning of Asphalt Mixtures
 - R 68, Preparation of Asphalt Mixtures by Means of the Marshall Apparatus
 - T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
- 2.2. *ASTM Standards:*
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- 2.3. *International Electrotechnical Commission Standard:*
- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

2.4.

Transportation Research Board:

- Chen, C., F. Yin, P. Turner, R. C. West, and N. Tran. Selecting a Laboratory Loose Mix Aging Procedure for the NCAT Top-Down Cracking Experiment. In *Transportation Research Record 2672*. Transportation Research Board, National Research Council, Washington, DC, Vol. 28, 2018, pp. 359–371.
- Kim, Y. R., C. Castorena, M. D. Elwardany, F. Y. Rad, S. Underwood, G. Akshay, P. Gudipudi, M. J. Farrar, and R. R. Glaser. *NCHRP Research Report 871: Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, 2017.
- Kim, Y. R., C. Castorena, N. F. Saleh, E. Braswell, M. Elwardany, and F. Y. Rad. *NCHRP Research Report 973: Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction: Phase III Results*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, 2021.
- Newcomb, D., E. Arámbula-Mercado, A. E. Martin, M. Yuan, N. Tran, and F. Yin. *NCHRP Research Report 919: Field Verification of Proposed Changes to the AASHTO R 30 Procedures for Laboratory Conditioning of Asphalt Mixtures*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, 2019.
- Newcomb, D., Martin, A. E., Yin, F., Arambula, E., Park, E. S., Chowdhury, A., Brown, R., Rodezno, C., Tran, N., Coleri, E., Jones, D., Harvey, J. T., and Jones, D. *NCHRP Report 815: Short-Term Laboratory Conditioning of Asphalt Mixtures*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, 2015.

2.5.

Other Documents:

- Bahia, H. U., H. Sadek, M. Z. Rahaman, Z. Lemke, D. Swiertz, and S. Reichelt. *Field Aging and Oil Modification Study*. 0092-17-04. Wisconsin Department of Transportation, Madison, WI, 2018.
- Chen, C., F. Yin, A. Andriescu, R. Moraes, D. Mensching, N. Tran, A. Taylor, and R. C. West. Preliminary Validation of the Critical Aging Procedure for NCAT Top-Down Cracking Experiment. *Journal of the Association of Asphalt Paving Technologists*, Vol. 89, 2020.
- Zhou, F., W. Mogawer, M. Elwardany, D. Mensching, and E. Mahmoud. (2022). Development of a Laboratory Operations-Friendly Long-Term Loose Mix Aging Procedure for New Asphalt Pavements. Presented at the 2022 Association of Asphalt Paving Technologists (AAPT) Annual Meeting, San Antonio, Texas.

3. SUMMARY OF PRACTICE

- 3.1. This standard practice provides different methods for long-term laboratory conditioning of asphalt mixtures for mechanical property testing, which include:
 - 3.1.1. Conditioning a compacted mixture of aggregate and binder in a forced-draft oven for five days at 85°C (Method A; see Section 7.1);
 - 3.1.2. Conditioning an uncompacted mixture of aggregate and binder in a forced-draft oven for five days at 85°C (Method B; see Section 7.2);
 - 3.1.3. Conditioning an uncompacted mixture of aggregate and binder in a forced-draft oven for a selected duration at 95°C (Method C; see Section 7.3);
 - 3.1.4. Conditioning an uncompacted mixture of aggregate and binder in a forced-draft oven for 20 h at a selected temperature between 100 and 125°C (Method D; see Section 7.4); and

- 3.1.5. Conditioning an uncompacted mixture of aggregate and binder in a forced-draft oven for 6 or 8 h at 135°C (Method E; see Section 7.5).

4. SIGNIFICANCE AND USE

- 4.1. The properties and performance, especially the field cracking resistance, of asphalt mixtures can be predicted more accurately by using long-term laboratory-conditioned test samples. All the long-term conditioning procedures are intended to simulate a certain level of field aging of an asphalt pavement that occurs during its in-service period. However, the targeted level of field aging simulated by the different conditioning procedures varies significantly and it is recognized that there is no single strategy will work in all situations. Therefore, agencies and practitioners should consider local climate and environmental conditions and how test results from aged specimens will be utilized when choosing one of the aging protocols discussed in this standard.

5. APPARATUS

- 5.1. *Oven*—A forced-draft oven, thermostatically controlled, capable of maintaining any desired temperature setting from 85°C to 135°C within $\pm 3^\circ\text{C}$. Oven(s) shall be capable of operation at the temperatures required, as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range.
- 5.2. *Thermometers*—Thermometers for measuring the oven conditioning temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 25 to 185°C and an accuracy of $\pm 0.75^\circ\text{C}$ (see Note 1).
- Note 1**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.
- 5.3. *Miscellaneous*—A shallow metal pan for heating uncompacted asphalt mixtures, a metal spatula or spoon, a timer, and personal protective equipment (PPE) including gloves for handling hot equipment.

6. HAZARDS

- 6.1. This standard involves the handling of hot binder, aggregate, and asphalt mixtures, which can cause severe burns if allowed to contact skin. Follow standard safety precautions to avoid burns.

7. LONG-TERM MIXTURE CONDITIONING PROCEDURES

- 7.1. *Method A—Conditioning of Compacted Mixture Specimens at 85°C:*
- 7.1.1. This long-term conditioning procedure applies to:
- 7.1.1.1. Laboratory-prepared asphalt mixtures that have been subjected to the short-term conditioning procedure described in Section 7.1 of R 30,
- 7.1.1.2. Plant-mixed asphalt mixtures, and
- 7.1.1.3. Compacted roadway specimens.
- Note 2**—According to NCHRP Reports 815 and 919 (Newcomb et al., 2015 and 2019), this procedure is expected to simulate approximately 23,000 cumulative degree days (CDD) of field

aging for surface asphalt mixtures, which corresponds to one to two years of field aging for warmer climates based on sites in Florida and two to three years of field aging for colder climates based on sites in Indiana.

7.1.2. *Preparing Compacted Mixture Specimens for Long-Term Mixture Conditioning:*

7.1.2.1. When preparing compacted specimens from loose asphalt mixtures, compact the specimens in accordance with one of the following methods: Superpave Gyratory Compactor (T 312) or Marshall Apparatus (R 68). Following compaction, cool the test specimens to room temperature.

Note 3—Specimen cooling may be scheduled as an overnight step but may be accelerated by placing the specimen in front of a fan.

7.1.2.2. Prior to long-term conditioning of field cores, samples must be cut, trimmed, and dried to a constant mass.

7.1.3. Place the compacted test specimens in the conditioning oven for 120 ± 0.5 h at a temperature of $85 \pm 3^\circ\text{C}$.

7.1.4. After 120 ± 0.5 h, turn the oven off, open the doors, and allow the test specimen to cool to room temperature. Do not touch or remove the specimen until it has cooled to room temperature.

Note 4—Cooling to room temperature will take approximately 16 h.

7.1.5. After cooling to room temperature, remove the test specimen from the oven. The long-term-conditioned specimen is now ready for testing as required.

7.2. *Method B—Conditioning of Uncompacted Loose Mixture at 85°C :*

7.2.1. This long-term conditioning procedure is not applicable to compacted roadway specimens. It applies to:

7.2.1.1. Laboratory-prepared asphalt mixtures that have been subjected to the short-term conditioning procedure described in Section 7.1 of R 30 and

7.2.1.2. Plant-mixed asphalt mixtures.

Note 5—This procedure was recommended in NCHRP Report 919 (Newcomb et al., 2019). It is expected to simulate approximately 134,000 CDD of field aging for surface asphalt mixtures, which corresponds to seven to ten years of field aging for warmer climates based on sites in Florida, Texas, and New Mexico and 12 to 14 years of field aging for colder climates based on sites in Connecticut, Indiana, Iowa, South Dakota, and Wyoming.

7.2.2. Break down any large chunks of asphalt mixtures, taking care to avoid fracturing the aggregate, so that the clusters of the fine aggregate portion are no larger than the nominal maximum aggregate size (NMAS). This step needs to be performed shortly after short-term conditioning of laboratory-prepared mixture samples or appropriate reheating of plant-mixed mixture samples to ensure that the asphalt mixture is sufficiently soft to be separated into pans for oven conditioning. If an asphalt mixture sample is not sufficiently soft to be separated manually, then place it in a pan and warm it in an oven until it can be separated as described.

7.2.3. Place the loose mixture in a pan, and spread it to an even thickness ranging between 25 and 50 mm. Place the mixture and pan in the conditioning oven for 120 ± 0.5 h at a temperature of $85 \pm 3^\circ\text{C}$.

7.2.4. Stir the mixture every 24 h to maintain uniform conditioning.