Designation: D 3497 – 79 (Reapproved 2003)

# Standard Test Method for Dynamic Modulus of Asphalt Mixtures[1]

This standard is issued under the fixed designation D 3497; 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 test method covers procedures for preparing and testing asphalt mixtures to determine dynamic modulus values. The procedure described covers a range of both temperature and loading frequency. The minimum recommended test series consists of testing at 41, 77, and 104°F (5, 25, and 40°C) at loading frequencies of 1, 4, and 16 Hz for each temperature.

1.2 This method is applicable to asphalt paving mixtures similar to mixes 3A, 4A, 5A, 6A, and 7A, as defined by Specification D 3515.

1.3 *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]

C 617 Practice for Capping Cylindrical Concrete Specimens

D 3496 Method for Preparation of Bituminous Mixture Specimens for Dynamic Modulus Testing

D 3515 Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

## 3. Terminology

3.1 *Definitions:*

3.1.1 *dynamic modulus*—the absolute value of the complex modulus that defines the elastic properties of a linear viscoelastic material subjected to a sinusoidal loading, $|E^*|$

3.1.2 *complex modulus*—a complex number that defines the relationship between stress and strain for a linear viscoelastic material, $E^*$.

3.1.3 *linear material*—a material whose stress to strain ratio is independent of the loading stress applied.

## 4. Summary of Test Method

4.1 A sinusoidal (haversine) axial compression stress is applied to a specimen of asphalt concrete at a given temperature and loading frequency. The resulting recoverable axial strain response of the specimen is measured and used to calculate dynamic modulus.

## 5. Significance and Use

5.1 The values of dynamic modulus can be used for both asphalt paving mixture design and asphalt pavement thickness design.

## 6. Apparatus

6.1 *Testing Machine*—An electro-hydraulic testing machine with a function generator capable of producing a haversine wave form has proven to be most suitable for use in dynamic modulus testing. The testing machine should have the capability of applying the loads over a range of frequencies from 0.1 to 20 Hz and stress levels up to 100 psi (690 kPa).

6.2 *Temperature-Control System*—The temperature-control system should be capable of a temperature range from 32 to 120 ± 1°F (0 to 50 ± 0.5°C). The temperature chamber should be large enough to hold six specimens.

6.3 *Measurement System*—The measurement system consists of a two-channel recorder, stress- and strain-measuring devices, a suitable signal amplification, and excitation equipment. The measurement system should have the capability for determining loading up to 3000 lbf (13.3 kN) from a recording with a minimum sensitivity of 2 % of the test load per millimetre of chart paper. This system should also be capable for use in determining strains over a range of full-scale recorder outputs from 300 to 5000 micro units of strain. At the highest sensitivity setting, the system should be able to display 4 micro strain units or less per millimetre on the recorded chart.

6.3.1 *Recorder*—The recorder amplitude should be independent of frequency for tests conducted up to 20 Hz.

6.3.2 *Strain Measurement*—The values of axial strain are measured by bonding two wire strain gages[3] at mid-height opposite each other on the specimens. The gages are wired in a Wheatstone Bridge circuit with two active gages on the test specimen and two temperature-compensating gages on an

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road Paving Materials and is the direct responsibility of Subcommittee D04.26 on Fundamental/Mechanistic 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] The Baldwin-Lima-Hamilton SR-4 Type A-1S 13 strain gage has been found satisfactory for this purpose.