INTERNATIONAL

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Standard Test Method for Nonrepetitive Static Plate Tests of Soils and Flexible Pavement Components for Use in Evaluation and Design of Airport and Highway Pavements[1]

This standard is issued under the fixed designation D1196/D1196M; 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 the apparatus and procedure for making nonrepetitive static plate load tests on subgrade soils and compacted pavement components, in either the compacted condition or the natural state, and is to provide data for use in the evaluation and design of rigid and flexible-type airport and highway pavements.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A572/A572M Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

2.2 *AASHTO Standard:*[3]

T 222 Standard Method of Test for Nonrepetitive Static Plate Load Tests of Soils and Flexible Pavement Components for Use in Evaluation and Design of Airport and Highway Pavements

2.3 *German Standard:*[4]

DIN 18134 Soil—Testing Procedures and Testing Equipment—Plate Load Test

3. Terminology

3.1 *Definitions:*

3.1.1 *deflection, n*—the amount of downward vertical movement of a surface due to the application of a load to the surface.

3.1.2 *modulus of subgrade reaction (k_s), n*—the ratio of the normal stress σ_0 under an area load to the associated settlements "s."

3.1.3 *plate load test, n*—a test in which a load is repeatedly applied and released in increments using a circular loading plate aided by a loading device, with the settlement of the loading plate being measured.

3.1.4 *rebound deflection, n*—the amount of vertical rebound of a surface that occurs when a load is removed from the surface.

3.1.5 *residual deflection, n*—the difference between original and final elevations of a surface resulting from the application and removal of one or more loads to and from the surface.

3.1.6 *strain modulus (E_v), n*—parameter expressing the deformation characteristics of a soil, calculated from the secants of the load settlement curves obtained from the first or repeat loading cycle between points $0.3 - \sigma_{0max}$ and $0.7 - \sigma_{0max}$.

4. Summary of Test Method

4.1 This test method covers the apparatus and procedure for making nonrepetitive static plate load tests on subgrade soils

[1] This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.41 on Pavement Testing and Evaluation.

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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, http://www.transportation.org.

[4] Available from Deutsches Institut für Normung e.V.(DIN), Am DIN-Platz, Burggrafenstrasse 6, 10787 Berlin, Germany, http://www.din.de.

and compacted pavement components, in either the compacted condition or the natural state, and is to provide data for use in the evaluation and design of rigid and flexible-type airport and highway pavements.

5. Significance and Use

5.1 Field, in-place nonrepetitive static plate load tests are used for the evaluation and design of pavement structures. Nonrepetitive static plate load tests are performed on soils and unbound base and subbase materials to determine the modulus of subgrade reaction or a measure of the shear strength of pavement components.

6. Apparatus

6.1 Presented below are analog and digital configurations with manual and electronic data collection methods. It is intended that either apparatus configuration is suitable for performing all of the test methods presented in Section 11.

6.2 The following apparatus describes the analog or dial gauge system that requires the data to be collected manually.

6.2.1 *Loading Device*—A truck or trailer or a combination of both a tractor-trailer, an anchored frame, or other structure loaded with sufficient weight to produce the desired reaction on the surface under test. The supporting points (wheels in the case of a truck or trailer) shall be at least 2.4 m [8 ft] from the circumference of the largest diameter bearing plate being used. The dead load shall be at least 5675 kg [25 000 lb].

6.2.2 *Hydraulic Jack Assembly,* with a spherical bearing attachment, capable of applying and releasing the load in increments. The jack shall have sufficient capacity for applying the maximum load required, and shall be equipped with an accurately calibrated gauge or proving ring that will indicate the magnitude of the applied load.

6.2.3 *Bearing Plates*—A set of circular steel bearing plates not less than 25.4 mm [1 in.] in thickness, machined so that they can be arranged in a pyramid fashion to ensure rigidity, and having diameters ranging from 152 to 762 mm [6 to 30 in.]. The diameters of adjacent plates in the pyramid arrangement shall not differ by more than 152 mm [6 in.].

NOTE 1—A minimum of four different plate sizes is recommended for pavement design or evaluation purposes. For evaluation purposes alone, a single plate may be used, provided that its area is equal to the tire-contact area corresponding to what may be considered as the most critical combination of conditions of wheel load and tire pressure. For the purpose of providing data indicative of bearing index (for example, the determination of relative subgrade support throughout a period of a year), a single plate of any selected size may be used.

6.2.4 *Dial Gauges,* three or more, graduated in units of 0.01 mm [0.001 in.] and capable of recording a maximum deflection of 25.4 mm [1 in.], or other equivalent deflection-measuring devices.

6.2.5 *Deflection Beam*—A beam upon which the dial gauges shall be mounted. The beam shall be a 64-mm [2½-in.] standard black pipe or a 76 by 76 by 6-mm [3 by 3 by ¼-in.] steel angle, or equivalent. It shall be at least 5.5 m [18 ft] long and shall rest on supports located at least 2.4 m [8 ft] from the circumference of the bearing plate or nearest wheel or supporting leg. The entire deflection-measuring system shall be adequately shaded from direct rays of the sun.

6.2.6 *Miscellaneous Tools,* including a spirit level, for preparation of the surface to be tested and for operation of the equipment.

6.2.7 Fig. 1 shows a typical analog system configuration with dial gauges and requires manual data collection.

6.3 This subsection describes the digital system using a displacement transducer and load cell to capture the data during the test procedure. The description below is in compliance with DIN 18134.

6.3.1 *Plate Loading Apparatus,* consisting of a loading plate, an adjustable spirit level, and a loading system with hydraulic pump and jack assembly with high-pressure hose.

FIG. 1 Analog System Configuration

6.3.2 Devices for measuring the load applied and the settlement of the loading plate at right angles to the loaded surface; means of calculating the strain modulus.

6.3.3 The reaction loading system shall produce a reaction load which is at least 10 kN greater than the maximum test load required. It may be a loaded truck or roller or any other object of sufficient mass.

6.3.4 Loading plates shall be made of Specification A572/A572M Gr. 50 (EN10025 grade S355J0) steel or equivalent material with the same stiffness and hardness. They shall be machined so as to have the flatness and roughness tolerances in accordance with Figs. 2 and 3. The loading plate shall have two handles (see Fig. 2).

6.3.5 Loading plates with a diameter of 300 mm shall have a minimum thickness of 25 mm.

6.3.6 Loading plates with a diameter of 600 mm or 762 mm shall have a minimum thickness of 20 mm and be provided with equally spaced stiffeners with even upper faces parallel to the plate bottom face to allow the 300-mm plate to be placed on top of it. Centering pins, and also clamps, if necessary, shall be provided to hold the upper plate in position (see Fig. 3).

6.3.7 *Loading System:*

6.3.7.1 The loading system consists of a hydraulic pump connected to a hydraulic jack via a high-pressure hose with a minimum length of 2 m. The system shall be capable of applying and releasing the load in stages.

6.3.7.2 For the pressure to be properly applied, the hydraulic jack shall be hinged on both sides and secured against tilting. The pressure piston shall act through at least 150 mm.

6.3.7.3 The height of the plate loading apparatus during operation should not exceed 600 mm. In order to compensate for differences in the heights of the vehicles used as reaction loads, elements shall be provided that allow the initial length of the hydraulic jack to be increased to at least 1.000 mm. Suitable means shall be provided to prevent buckling of these elements.

6.3.8 *Force-Measuring Apparatus:*

6.3.8.1 A mechanical or electrical force transducer shall be fitted between the loading plate and the hydraulic jack. It shall measure the load on the plate with a maximum permissible error of 1 % of the maximum test load.

6.3.8.2 The stress shall be indicated at a resolution of at least 0.001 MPa for a 300-mm loading plate and at least 0.0001 MPa for 600-mm and 762-mm loading plates.

6.3.8.3 The resolution of the force-measuring system shall be equivalent to that of the force transducer. The above requirements apply for temperatures from 0 °C to 40 °C.

6.3.9 *Settlement-Measuring Device:*

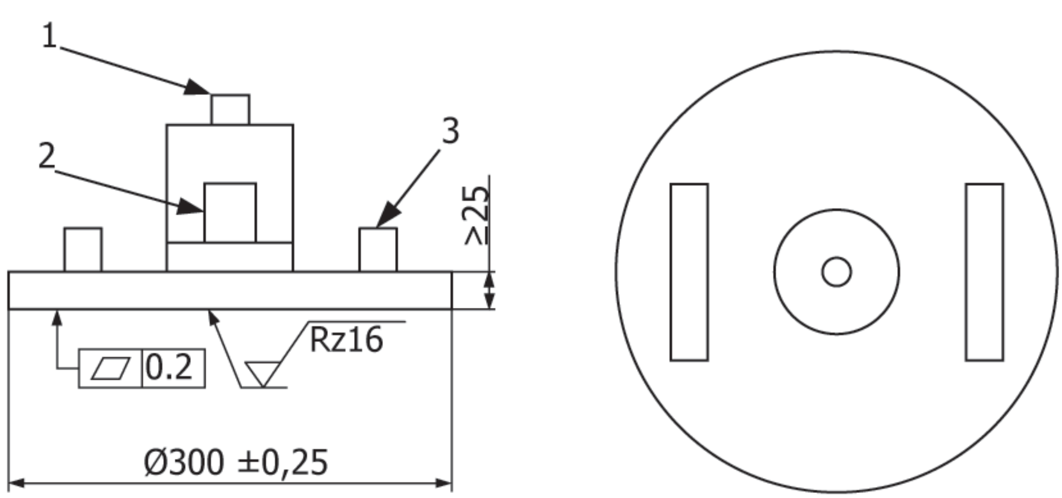
6.3.9.1 The arrangement in Fig. 4 shows a settlement-measuring device with a rotatable contact arm (see Fig. 4(a)) and one with a contact arm capable of being moved horizontally in axial direction (that is, with a slide bearing, see Fig. 4(b)) or direct measurement with gauge (Fig. 4(1b)) in the middle of the plate.

6.3.9.2 The measuring device with a rotatable contact arm is only suitable for tests in excavations up to 0.3 m deep. The measuring device with a contact arm capable of being moved horizontally in axial direction—or direct measuring—can also be used in deeper excavations.

6.3.10 The settlement-measuring device consists of:

6.3.10.1 A frame supported at three points (see "2" in Fig. 4).

6.3.10.2 A vertically adjustable, torsion-proof, rigid contact arm (see "4" in Fig. 4), a displacement transducer, or dial gauge (see "1," "1a," or "1b" in Fig. 4).



Dimensions in mm, General tolerances: ISO 2769-mL
Key
1 – Centering pin to hold the force transducer
2 – Measuring tunnel
3 – Handles

FIG. 2 300-mm Loading Plate with Measuring Tunnel