Designation: D3319 – 06

Standard Practice for the Accelerated Polishing of Aggregates Using the British Wheel[1]

This standard is issued under the fixed designation D3319; 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 a laboratory procedure by which an estimate may be made of the extent to which different coarse aggregates may polish.

1.2 The values stated in inch-pound units are to be regarded as 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C778 Specification for Standard Sand

D75 Practice for Sampling Aggregates

D1415 Test Method for Rubber Property—International Hardness

E303 Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

E501 Specification for Rib Tire for Pavement Skid-Resistance Tests

3. Terminology

3.1 *Definitions:*

3.1.1 *initial friction value (PV-i)*—the initial British Pendulum Tester readings on the test specimens before they are polished in the accelerated polishing machine.

3.1.2 *polish value (PV-n)*—a measure of the state of polish reached by a test specimen subjected to the specified hours (n) of accelerated polishing using the materials, equipment, and procedures described in this method. The measurement is made using the British Pendulum Tester as described in 5.3 and Test Method E303.

3.1.3 *residual polish value, (RPV-n)*—the residual polish value is obtained when a constant *PV-n* is acheived four consecutive times with repeated swings of the pendulum.

4. Significance and Use

4.1 This practice simulates the polishing action of vehicular traffic on coarse aggregates used in bituminous pavements.

4.2 A polish value is determined that may be used to rate or classify coarse aggregates for their ability to resist polishing under traffic.

5. Apparatus

5.1 *Accelerated Polishing Machine*[3]—An accelerated polishing machine, also known as the British Wheel, and based upon a 1958 design by the Road Research Laboratory of Great Britain. This machine shall be mounted on a firm, rigid, and level base. The equipment shall include the following:

5.1.1 *Cylindrical Wheel*—Hereafter referred to as the road wheel, and having a flat-surface periphery and of such size and shape as to permit 14 specimens described below to be clamped onto the periphery to form a continuous surface of aggregate particles, 1¾ in. (44.45 mm) wide and 16 in. (406.4 mm) in diameter.

5.1.2 A means of rotating the road wheel about its own axis at a speed of 320 ± 5 rpm.

5.1.3 A means of bringing the surface of a rubber-tired wheel 8 in. (203.2 mm) in diameter and 2 in. (50.8 mm) wide to bear on the aggregate specimens mounted on the surface of the road wheel with a total load of 88 ± 1 lbf (391.44 ± 4.45 N). The tire shall be treated, if necessary, to obtain a true running surface. The tire shall be free to rotate about its own axis, which should be parallel to the axis of the road wheel. The plane of rotation of the tire shall coincide with that of the road wheel. Before a new tire is used on a test, it shall be conditioned by a preliminary run of 6 h with a 150-grit silicon carbide using dummy specimens (extra or used) on the road wheel.

[1] This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.51 on Aggregate Tests.

Current edition approved July 1, 2006. Published July 2006. Originally approved in 1974. Last previous edition approved in 2000 as D3319 – 00. DOI: 10.1520/D3319-06.

[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 Wessex Engineering and Metal Craft Co., Ltd., Merchants Barton, Frome, Somerset, England. 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 committee,[1] which you may attend.

5.1.3.1 *Alternate Tire No. 1*—An industrial 8 by 2 pneumatic smooth-tread hand-truck tire (Note 1). The tire rubber hardness shall be 55 ± 5 IRHD measured in accordance with Test Method D1415. The tire shall be inflated to a pressure of 45 ± 2 psi (310.26 ± 13.79 kPa).

NOTE 1—This is the tire originally supplied with the Accelerated Polishing Machine[3] and known by the tire manufacturer's designation Dunlop RLI 8 by 2. Dunlop discontinued manufacturing of this tire in February 1979. It is retained as an alternate in this practice for those users who may still have a supply and in the event that Dunlop should resume manufacturing it in the future.

5.1.3.2 *Alternate Tire No. 2*—An industrial 2.80 by 4 (8 in. OD by 4 in. ID), 4 NHS-4 ply, cross-hatch pattern tread hand-truck tire (Notes 2 and 3). The tire shall be inflated to a pressure of 35 ± 2 psi (241.32 ± 13.79 kPa).

NOTE 2—When it became known that the Dunlop tire (5.1.3.1) was no longer being manufactured, the necessity of finding a replacement tire for the practice was evident. A search and study by the Texas State Department of Highways and Public Transportation culminated in finding this tire, a Goodyear Industrial All Weather Hand-Truck tire size 2.80 by 4 (Goodyear Product Code 202-008-002), to give Polish Values equal to those obtained with the Dunlop tire.[4] A suitable inner tube such as Goodyear G250-4 (Product Code 199-010-700) is necessary. It was also found necessary to modify the 4-in. wheel furnished with the Accelerated Polish Machine[3] to facilitate mounting the Goodyear tire. Approximately 0.10 in. should be removed from the wheel diameter and a larger hole provided for the value stem. This did not affect mounting and use of the Dunlop tire. Goodyear is no longer manufacturing this tire.

NOTE 3—A1998 study conducted by the Texas Department of Transportation shows that the use of cross-hatch tire results in differential wear of the test specimen surface that mirrors the pattern of the tire. This differential wear pattern produces falsely higher polish values, particularly for softer aggregates. Other research has shown that increased tire wear has an effect of accentuating the polishing of the test specimens and resulting in lower polish values. Laboratory control specimens should be used to monitor the effect of the tire wear on accelerated polishing and tests results.

5.1.3.3 *Alternate Tire No. 3*—An 8-in. diameter solid rubber tire (Note 4). The tire rubber hardness shall be 69 ± 3 IRHD measured in accordance with Test Method D1415. It is necessary to move the cylindrical wheel approximately 3⁄16 in. away from the polishing machine to allow the tire to center over the test specimens. The tire shall be replaced when the *RPV-10* of the control specimens described in 7.2have decreased by more than four points from the *RPV-10* obtained from a new tire.

NOTE 4—This is the tire presently supplied by the manufacturer of the Accelerated Polishing Machine.[3] Research has shown that increased tire wear has an effect of accentuating the polishing of the test specimens and resulting in lower polish values. Laboratory control specimens should be used to monitor the effect of the tire wear on accelerated polishing and test results.

5.1.4 A means to feed the 150-grit silicon carbide abrasive at the rate given in 8.5. The grit shall be fed continuously and with a uniform distribution across the width of the specimens. The grit shall be applied directly onto the road wheel surface ahead of the point of contact with the rubber-tired wheel.

5.1.5 A means to feed the water at the rate given in 8.5 in such a way that the water is spread continuously and uniformly over the surface of the road wheel ahead of the point of contact with the rubber-tired wheel.

5.2 *Metal Molds*—A number of accurately machined metal molds for preparing specimens. The specimen formed is 3.5 by 1.75 by 0.63 in. (88.90 by 44.45 by 16.0 mm) and shall be curved to fit on a surface having an 8-in. (203-mm) radius of curvature.

5.3 *British Pendulum Tester*—A friction-measuring device. The British Pendulum Tester used shall conform to Method E303.

5.3.1 The slider contact path shall be 3 ± 1⁄16 in. (76.20 ± 1.59 mm).

5.3.2 The slider width shall be 1¼ in. (31.75 mm).

5.3.3 The rubber that is bonded to the slider shall be ¼ by 1 by 1¼ in. (6.35 by 25.4 by 31.75 mm).

5.3.4 The rubber shall meet the requirements of Specification E501.

5.3.5 The zero adjustment shall be checked before and after testing the specimens and as often as the operator deems necessary.

5.3.6 The calibration procedures of Test Method E303 shall be used. However, after calibration the small slider shall be inserted.

5.3.7 *Sanding Block*—A rigid metal block with a planed surface of 7.5-in. (190-mm) radius of curvature that is consistent with the radius of curvature of the road wheel bearing surface.

6. Materials and Supplies

6.1 *Water*—A supply of tap water for use where water is required for any purpose in this method.

6.2 *Fine Sand*—A supply of fine sand for sifting into the interstices of the aggregate prior to placing of the bonding material. Standard sand conforming to Specification C778 has been found suitable for this purpose.

6.3 *Mold Release Agent*—The use of a mold release agent is optional. A mold release agent may be used to prevent bonding between the mold and the bonding material. Silicon release agent and paste wax as used for automobiles and floors has been found suitable. The user should use care to prevent this agent from being absorbed by the aggregate as it could affect the measured polish value.

6.4 *Silicon Carbide Grit*—A supply of silicon carbide grit (150-grit size) to be used as the polishing agent. Grit should be checked for gradation using Nos. 100 (150 µm), 140 (106 µm) and 200 (75 µm) sieves and separated if necessary to maintain a uniform gradation passing the 100 (150 µm) sieve and retained on the 200 (75 µm) sieve.

6.5 *Bonding Agent*—A supply of polyester resin and catalyst (or another suitable bonding material, such as an epoxy resin) having a pot life of 20 to 30 min and a curing time of 3 to 6 h. This bonding agent shall not be so fluid as to flow through the fine sand.

6.5.1 An optional bonding agent may be used to eliminate use of the fine sand. This bonding agent must be quite viscous so that it will not flow completely around the aggregate

[4] Supporting Data are available from ASTM Headquarters. Request D04-1002.