Designation: D4366 – 16

Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests[1]

This standard is issued under the fixed designation D4366; 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 These test methods cover the use of pendulum damping testers in the determination of hardness of organic coatings that have been applied to acceptably plane rigid surfaces, such as a metal or glass panel.

1.2 Two test methods based on different pendulum types are covered as follows:

1.2.1 Test Method A—König Pendulum Hardness Test.

1.2.2 Test Method B—Persoz Pendulum Hardness Test.

1.3 This standard is similar in content (but not technically equivalent) to ISO 1522.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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]

D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels

D1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers

D3891 Practice for Preparation of Glass Panels for Testing Paint, Varnish, Lacquer, and Related Products

D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

2.2 *Other Standard:*[3]

ISO 1522 Paints and Varnishes Pendulum Damping Test

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *König hardness, n*—time in seconds for the swing amplitude of the König pendulum to decrease from 6 to 3°.

3.1.2 *Persoz hardness, n*—time in seconds for the swing amplitude of the Persoz pendulum to decrease from 12 to 4°.

4. Summary of Test Methods

4.1 A pendulum resting on a coating surface is set into oscillation (rocking) and the time for the oscillation amplitude to decrease by a specified amount measured. The damping time is influenced by a combination of physical properties, amongst hardness, elasticity, coefficient of friction and shore of the sample under test. The damping time decreases with the decrease of hardness or an increase of elasticity or coefficient of friction.

5. Significance and Use

5.1 The pendulum damping test has been found to have good sensitivity in detecting differences in coating hardness, where hardness is defined as resistance to deformation.

5.2 The two procedures given in these test methods embody the principle that the amplitude of oscillation of a pendulum touching a surface decreases more rapidly the softer the surface. However, these test methods differ in respect to pendulum dimensions, and period and amplitude of oscillation.

5.3 In general, the damping time of the König pendulum is approximately half that of the Persoz pendulum.

5.4 The Persoz pendulum has a greater degree of discrimination than the König for measuring the hardness of soft coatings, but it may not be as suitable for testing hard, slippery films because of its tendency to skid on surfaces with a low coefficient of friction.

5.5 The interaction between the pendulum and the paint film is complex, depending on both elastic and viscoelastic

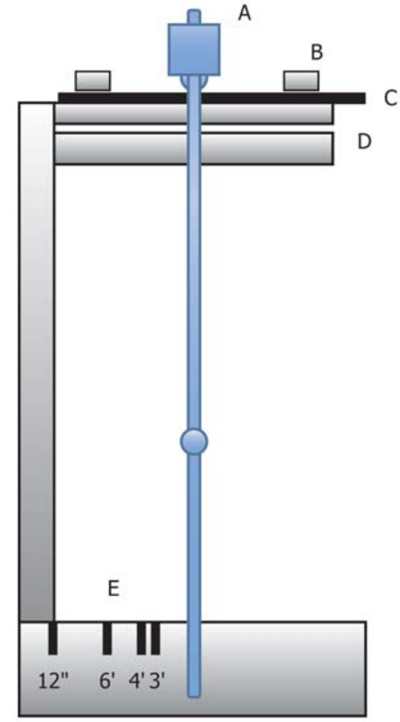
[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

Current edition approved Dec. 1, 2016. Published March 2017. Originally approved in 1984. Last previous edition approved in 2014 as D4366 – 14. DOI: 10.1520/D4366-16.

[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 National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

FIG. 1 Apparatus Fully Automated Type



Legend to Figure 3:
A) Pendulum (Persoz)
B) Panel holders
C) Test panel
D) Panel support
E) Scale

FIG. 3 Schematic Representation of a Pendulum Hardness Test

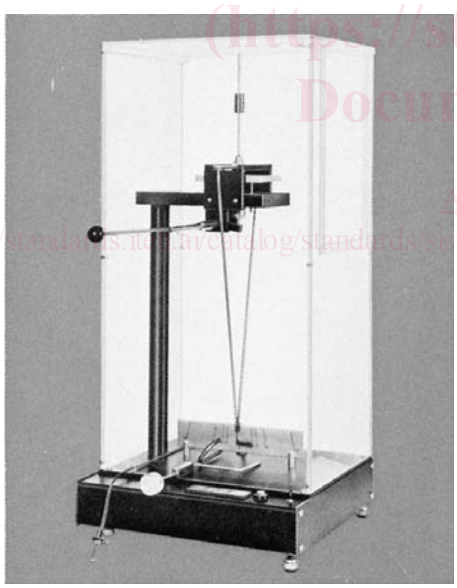


FIG. 2 Apparatus Manual Type

properties, and it may not be possible to establish a precise relationship between the two types of pendulum tests.

TEST METHOD A
KÖNIG PENDULUM HARDNESS TEST

6. Apparatus

6.1 *König Pendulum Tester*[4], consisting of a stand that supports a pendulum, a test panel, and a pendulum displacement scale. The stand has a stirrup to support the pendulum above the table and a mechanism for shock-free positioning of the pendulum onto the test panel. Pendulum Testers are divided in:

(1) Manual models: where both positioning of the pendulum and taking the number of counts and timing is done manually.

(2) Semi automated models: Where positioning of the pendulum is done manually and the number of counts and timing is measured automated.

(3) Fully automated models: Where both the positioning of the pendulum and the number of counts and timing is done automatically.

6.1.1 The use of fully automated models is recommended above that of semi automated models due to their increased repeatability. When using older manual models results can fluctuate depending on the operator. Typical apparatus are shown in Fig. 1 and Fig. 2.

6.1.2 Shown devices (Fig. 1 and Fig. 2) are functioning in the same way. Their essential components are displayed in schematic (Fig. 3).

6.2 *König Pendulum,* consisting of an open framework connected by a cross-bar, to the underface of which are two balls, 5 ± 0.005 mm in diameter of hardness 63 ± 3 HRC, inset to serve as the fulcrum. The lower end of the framework is formed into a pointer. A weight sliding on a vertical rod

[4] Available from various supply companies.