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Standard Test Methods for Cone Penetration of Lubricating Grease[1]

This standard is issued under the fixed designation D217; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 These test methods cover four procedures for measuring the consistency of lubricating greases by the penetration of a cone of specified dimensions, mass, and finish. The penetration is measured in tenths of a millimetre.

NOTE 1—The National Lubricating Grease Institute (NLGI)[2] classified greases according to their consistency as measured by the worked penetration. The classification system is as follows:

NLGI Consistency Number	Worked Penetration Range, 25 °C (77 °F)
000	445 to 475
00	400 to 430
0	355 to 385
1	310 to 340
2	265 to 295
3	220 to 250
4	175 to 205
5	130 to 160
6	85 to 115

1.1.1 The procedures for unworked, worked, and prolonged worked penetration are applicable to greases having penetrations between 85 and 475, that is, to greases with consistency numbers between NLGI 6 and NLGI 000. An undisturbed penetration test, described in Appendix X1, is similar to the unworked penetration test.

1.1.2 The block penetration procedure is applicable to greases that are sufficiently hard to hold their shape. Such greases usually have penetrations below eighty-five tenths of a millimetre.

1.1.3 Unworked penetrations do not generally represent the consistency of greases in use as effectively as do worked penetrations. The latter are usually preferred for inspecting lubricating greases.

1.2 None of the four procedures is considered suitable for the measurement of the consistency of petrolatums by penetration. Test Method D937 should be used for such products.

[1] These test methods are the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and are the direct responsibility of Subcommittee D02.G0.02 on Consistency and Related Rheological Tests. In the IP, these test methods are under the jurisdiction of the Standardization Committee. These test methods were adopted as a joint ASTM-IP standard in 1969.

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[2] National Lubricating Grease Institute, 4635 Wyandotte St., Kansas City, MO 64112-1596.

***A Summary of Changes section appears at the end of this standard**

1.3 The dimensions of the equipment described in these test methods are given in SI units as the primary unit of measure with equivalent imperial units as accetpable alternatives where applicable. In cases where equivalent SI conversions are not known, notes are added for clarification. Temperatures and other dimensions are given in the preferred SI units; the values shown in parentheses are provided for information.

1.4 *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.*

1.5 *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:*[3]

D937 Test Method for Cone Penetration of Petrolatum

D1403 Test Methods for Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

3. Terminology

3.1 *Definitions:*

3.1.1 *consistency, n*—of lubricating grease, the degree of resistance to movement under stress.

3.1.1.1 *Discussion*—

The term consistency is used somewhat synonymously with penetration. Generally, consistency refers to the worked penetration of a grease.

3.1.2 *lubricant, n*—any material interposed between two surfaces that reduces the friction or wear between them. **D4175**

3.1.3 *lubricating grease, n*—a semi-fluid to solid product of a dispersion of a thickener in a liquid lubricant.

3.1.3.1 *Discussion*—

The dispersion of the thickener forms a two-phase system and immobilizes the liquid lubricant by surface tension and other physical forces. Other ingredients are commonly included to impart special properties.

3.1.4 *penetration, n—of lubricating grease*, the depth that the standard cone enters the sample when released to fall under its own weight for 5 s.

3.1.5 *penetrometer, n*—an instrument that measures the consistency or hardness of semiliquid to semisolid materials by measuring the depth to which a specified cone or needle under a given force falls into the material.

3.1.6 *prolonged worked penetration, n—of lubricating grease*, the penetration of a sample after it has been worked more than 60 double strokes in a standard grease worker at a temperature of 15 °C to 30 °C (59 °F to 86 °F).

3.1.6.1 *Discussion*—

After the prescribed number of double strokes, the worker and contents are brought to 25 °C (77 °F), worked an additional 60 double strokes, and penetrated without delay.

3.1.7 *semi-solid, n*—a seemingly solid material that deforms under a force equal to or greater than the force of gravity and that can be made to flow by the application of such a force so long as it exceeds the yield stress of the material.

3.1.7.1 *Discussion*—

In the petroleum industry, lubricating grease, petrolatum, slack wax, and bitumen are recognized as semi-solids. (**Synonyms**—*semi-liquid* and *semi-fluid*.)

[3] 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.

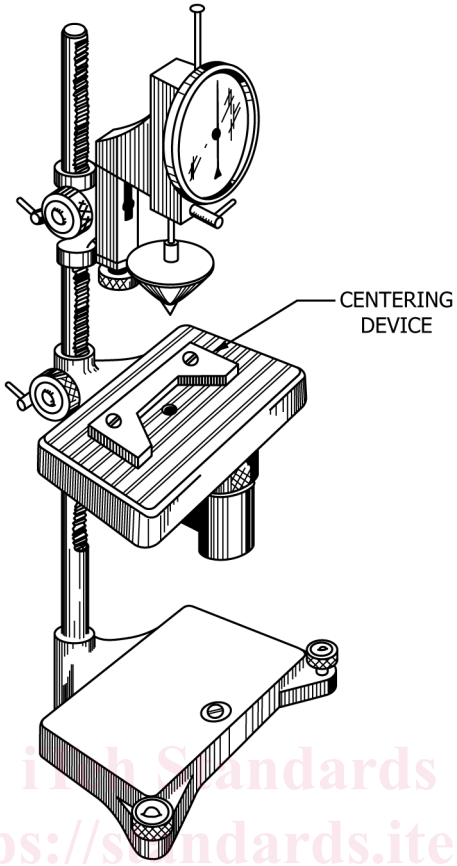

FIG. 1 Penetrometer

3.1.8 *thickener, n—in lubricating grease*, a substance composed of finely divided particles dispersed in a liquid lubricant to form the product's structure.

3.1.8.1 *Discussion—*

The thickener can be fibers (such as various metallic soaps) or plates or spheres (such as certain non-soap thickeners) which are insoluble or, at most, only very slightly soluble in the liquid lubricant. The general requirements are that the solid particles be extremely small, uniformly dispersed, and capable of forming a relatively stable, gel-like structure with the liquid lubricant.

3.1.9 *unworked penetration, n—of lubricating grease*, the penetration at 25 °C (77 °F) of a sample that has received only minimum disturbance in transferring to a grease worker cup or dimensionally equivalent rigid container.

3.1.10 *worked penetration, n—of lubricating grease*, the penetration at 25 °C (77 °F), without delay, of a sample after 60 double strokes in a standard grease worker.

3.1.11 *working, n—of lubricating grease*, the subjection of a sample to the shearing action of the standard grease worker.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *block penetration, n—of lubricating grease*, the penetration at 25 °C (77 °F) determined on the freshly prepared face of a cube cut from a sample that is sufficiently hard to hold its shape.

3.2.2 *penetrometer, n*—an instrument (see Fig. 1) designed to measure the depth to which the standard cone falls into the grease.

3.2.2.1 *Discussion—*

In this test method, either a standard penetrometer (6.2) or an optional penetrometer cone (A1.3) can be used to determine the consistency of lubricating greases. The penetration force is determined by the mass of the cone and the shaft.