



Standard Test Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Four-Ball Method)¹

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1. Scope

1.1 This test method covers the determination of the load-carrying properties of lubricating fluids. The following two determinations are made:

1.1.1 Load-wear index (formerly Mean-Hertz load) and

1.1.2 Weld point by means of the four-ball extreme-pressure (EP) tester.

1.2 *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.*

1.3 The values stated in either inch-pound units or SI (metric) units are to be regarded separately as standard. Within the text the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents, therefore each system must be used independently of the other. Combining values of the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

D 484 Specification for Hydrocarbon Drycleaning Solvents²

2.2 ANSI Standard:

B 3.12 Metal Balls³

3. Terminology

3.1 Definitions:

3.1.1 *load-wear index* (or the load-carrying property of a lubricant)—an index of the ability of a lubricant to minimize wear at applied loads. Under the conditions of this test, specific loadings in kilograms-force (or newtons) having intervals of approximately 0.1 logarithmic units, are applied to the three stationary balls for ten runs prior to welding. The load-wear

index is the average of the sum of the corrected loads determined for the ten applied loads immediately preceding the weld pair.

3.1.2 *weld point*—under the conditions of this test, the lowest applied load in kilograms at which the rotating ball welds to the three stationary balls, indicating the extreme-pressure level of the lubricants-force (or newtons) has been exceeded.

3.1.2.1 *Discussion*—Some lubricants do not allow true welding, and extreme scoring of the three stationary balls results. In such cases, the applied load which produces a maximum scar diameter of 4 mm is reported as the weld point.

3.1.3 *corrected load*—the load in kilograms-force (or newtons) for each run obtained by multiplying the applied load by the ratio of the Hertz scar diameter to the measured scar diameter at that load.

3.1.4 *Hertz scar diameter*—the average diameter, in millimetres, of an indentation caused by the deformation of the balls under static load (prior to test). It may be calculated from the equation

$$D_h = 8.73 \times 10^{-2}(P)^{1/3} \quad (1)$$

where:

D_h = Hertz diameter of the contact area, and,

P = the static applied load.

3.1.5 *compensation scar diameter*—the average diameter, in millimetres, of the wear scar on the stationary balls caused by the rotating ball under an applied load in the presence of a lubricant, but without causing either seizure or welding.

3.1.5.1 *Discussion*—The wear scar obtained shall be within 5 % of the values noted in Table 1, Column 3.

3.1.6 *Hertz line*—a line of plot on logarithmic paper, as shown in Fig. 1, where the coordinates are scar diameter in millimetres and applied load in kilograms-force (or newtons), obtained under static conditions.

3.1.7 *compensation line*—a line of plot on logarithmic paper, as shown in Fig. 1, where the coordinates are scar diameter in millimetres and applied load in kilograms-force (or newtons), obtained under dynamic conditions.

3.1.7.1 *Discussion*—Coordinates for the compensation line are found in Table 1, Columns 1 and 3.

3.1.7.2 *Discussion*—Some lubricants give coordinates which are above the compensation line. Known examples of such fluids are methyl phenyl silicone, chlorinated methyl

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² Discontinued; see 1984 Annual Book of ASTM Standards, Vol 05.01.

³ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.