



Standard Test Method for Evaluating the Scuffing Load Capacity of Oils (FZG Visual Method)¹

This standard is issued under the fixed designation D 5182; 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.

ε¹ NOTE—Warning notes were placed in the text editorially in May 2002.

1. Scope

1.1 This test method, the Forschungstelle für Zährnräder und Getriebebau (Research Site for Gears and Transmissions) Visual Method, commonly referred to as the FZG Visual Method, is intended to measure the scuffing load capacity of oils used to lubricate hardened steel gears. Scoring, a form of abrasive wear, is also included as a failure criteria in this test method. It is primarily used to assess the resistance to scuffing of mild additive treated oils such as industrial gear oils, transmission fluids, and hydraulic fluids. High EP type oils, for example, those oils meeting the requirements of API GL-4 and GL-5, generally exceed the capacity of the test rig and, therefore, cannot be differentiated with this test method.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

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.* For specific safety information, see Section 7, Section 8, 9.2, and 9.3.1.

2. Referenced Documents

2.1 ASTM Standards:

D 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)²

G 40 Terminology Relating to Erosion and Wear³

2.2 DIN Standard:⁴

DIN 51 354 Teil 1: FZG Zahnrad Verspannungs Prüfmaschine—Allgemeine Arbeitsgrundlagen

3. Terminology

3.1 Definitions:

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.L0.11 on Tribological Properties of Industrial Fluid Lubricants.

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² Annual Book of ASTM Standards, Vol 06.04.

³ Annual Book of ASTM Standards, Vol 03.02.

⁴ Available from Deutsches Institut für Normung e. V., Beuth Verlag GmbH 10772 Berlin, Federal Republic of Germany.

3.1.1 *scratches*—the result of mechanical removal or displacement, or both, of material from a surface by the action of abrasive particles or protuberances sliding across the surfaces.

3.1.2 *abrasive wear*—wear due to hard particles or hard protuberances forced against and moving along a solid surface.

3.1.3 *adhesive wear (scuffing)*—wear due to localized bonding between contacting solid surfaces leading to material transfer between the two surfaces or loss from either surface.

3.1.4 *scoring*—a severe form of wear characterized by the formation of extensive grooves and scratches in the direction of sliding.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *polishing*—a mild form of abrasive wear resulting in minor loss of material and typically characterized by a smooth finish and removal of all or part of the initial grinding marks.

4. Summary of Test Method

4.1 An FZG Gear Test Machine is operated at constant speed (1450 rpm) for a fixed period (21700 revolutions—approximately 15 min) at successively increasing loads until the failure criteria is reached; the initial oil temperature is 90°C beginning at load stage four (see Table 1). The test gears are examined initially and after the prescribed duration at each load stage for cumulative damage (scuffing) to the gear tooth flanks.

5. Significance and Use

5.1 The transmission of power in many automotive and industrial applications is accomplished through the use of geared systems. At higher operating speeds it is well known that the lubricant/additive system can be a significant factor in preventing scuffing (adhesive wear) damage to gears. This test method is used to screen the scuffing load capacity of oils used to lubricate spur and helical (parallel axis) gear units.

5.2 The test method is limited by the capabilities of the equipment (test rig and gears), and the performance observed may not directly relate to scuffing performance observed with spiral bevel on hypoid gearing. It is also limited to discriminating between oils with mild EP additives or less. Lubricants containing higher levels of additives, that is, those meeting the requirements of API GL4 or GL5, generally exceed the