



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

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1. Scope

1.1 This test method, the Forschungstelle für Zähräder 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 standard. No other units of measurement are included in this 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.* For specific safety information, see Section 7, Section 8, 9.2, 9.3.1, and Annex A1.

2. Referenced Documents

2.1 ASTM Standards:²

D235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

G40 Terminology Relating to Wear and Erosion

2.2 DIN Standard:³

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

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 Fluids and Lubricants.

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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 Beuth Verlag GmbH (DIN-- DIN Deutsches Institut für Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany.

3. Terminology

3.1 Definitions:

3.1.1 See also Terminology G40.

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.

3.1.5 *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.

3.2 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