



Designation: D7528 – 22

# Standard Test Method for Bench Oxidation of Engine Oils by ROBO Apparatus<sup>1</sup>

This standard is issued under the fixed designation D7528; 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.

## INTRODUCTION

This test method is written for use by laboratories that make use of ASTM Test Monitoring Center (TMC)<sup>2</sup> services (see [Annex A1](#) – [Annex A4](#)).

The TMC provides reference oils, and engineering and statistical services to laboratories that desire to produce test results that are statistically similar to those produced by laboratories previously calibrated by the TMC.

In general, the Test Purchaser decides if a calibrated test stand is to be used. Organizations such as the American Chemistry Council require that a laboratory utilize the TMC services as part of their test registration process. In addition, the American Petroleum Institute and the Gear Lubricant Review Committee of the Lubricant Review Institute (SAE International) require that a laboratory use the TMC services in seeking qualification of oils against their specifications.

The advantage of using the TMC services to calibrate test stands is that the test laboratory (and hence the Test Purchaser) has an assurance that the test stand was operating at the proper level of test severity. It should also be borne in mind that results obtained in a non-calibrated test stand may not be the same as those obtained in a test stand participating in the ASTM TMC services process.

## 1. Scope\*

1.1 This test method describes a bench procedure to simulate the oil aging encountered in Test Method [D7320](#), the Sequence IIIG engine test method. These aged oils are then tested for kinematic viscosity and for low-temperature pumpability properties as described in the Sequence IIIGA engine test, Appendix X1 of Test Method [D7320](#).

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.2.1 *Exceptions*—There are no SI equivalents for some apparatus in [Section 6](#), and there are some figures where inch units are to be regarded as standard.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.B0.07](#) on Development and Surveillance of Bench Tests Methods.

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<sup>2</sup> Until the next revision of this test method, the ASTM Test Monitoring Center will update changes in the test method by means of information letters. Information letters may be obtained from the ASTM Test Monitoring Center, 203 Armstrong Drive, Freeport, PA 16229, [www.astmtmc.org](http://www.astmtmc.org). Attention: Director. This edition incorporates revisions in all information letters through No. 21-1.

1.3 This test method is arranged as follows:

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

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 Charging the Liquid Nitrogen Dioxide  
 Nitrogen Dioxide Precision Needle Valve  
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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.* Specific warning statements are given in Sections 7 and 8.

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:<sup>3</sup>

**D445** Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

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

**D4485** Specification for Performance of Active API Service Category Engine Oils

**D4684** Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature

**D5293** Test Method for Apparent Viscosity of Engine Oils and Base Stocks Between –10 °C and –35 °C Using Cold-Cranking Simulator

**D7320** Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIG, Spark-Ignition Engine

### 2.2 SAE Standard:<sup>4</sup>

**SAE J300** Engine Oil Viscosity Classification

## 3. Terminology

### 3.1 Definitions:

3.1.1 *candidate oil, n*—an oil that is intended to have the performance characteristics necessary to satisfy a specification and is to be tested against that specification. **D4175**

3.1.2 *non-reference oil, n*—any oil other than a reference oil, such as a research formulation, commercial oil or candidate oil. **D4175**

3.1.3 *reference oil, n*—an oil of known performance characteristics, used as a basis for comparison.

3.1.3.1 *Discussion*—Reference oils are used to calibrate testing facilities, to compare the performance of other oils, or

to evaluate other materials (such as seals) that interact with oils. **D4175**

3.1.4 *test oil, n*—any oil subjected to evaluation in an established procedure. **D4175**

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aged oil, n*—a test oil after it has been subjected to the 40 h aging process in a ROBO apparatus.

### 3.3 Acronyms:

3.3.1 *ROBO, n*—Romaszewski Oil Bench Oxidation<sup>5</sup>

## 4. Summary of Test Method

4.1 The test oil is combined with a small amount of iron ferrocene catalyst and placed in a 1 L reaction vessel. That mixture is stirred and heated for 40 h at 170 °C with air flowing across the liquid surface under negative pressure. In addition, nitrogen dioxide and air are introduced below the reaction surface. After cooling, the oxidized, concentrated test oil is subjected to pertinent viscometric tests. Evaporated oil is condensed in order to weigh it and calculate evaporative loss.

## 5. Significance and Use

5.1 This bench test method is intended to produce comparable oil aging characteristics to those obtained with ASTM TMC Sequence IIIGA matrix reference oils 434, 435, and 438 after aging in the Sequence IIIG engine test.

5.2 To the extent that the method generates aged oils comparable to those from the Sequence IIIG engine test, the measured increases in kinematic and MRV viscosity indicate the tendency of an oil to thicken because of volatilization and oxidation, as in the Sequence IIIG and IIIGA (see Appendix X1 in Test Method **D7320**) engine tests, respectively.

5.3 This bench test procedure has potential use in specifications and classifications of engine lubricating oils, such as Specification **D4485**.

5.4 The results of this test method are valid when seeking qualification of oils against published specifications only when run on a test stand that has successfully met the calibration requirements specified under the TMC's ROBO test monitoring program.

## 6. Apparatus

### 6.1 Balances:

6.1.1 *Analytical Balance*—Capable of weighing 200 g with a minimum indication resolution of 0.1 g.

6.1.2 *Analytical Balance*—Capable of weighing 0.1 g with a minimum indication resolution of 0.001 g.

6.2 *Fume Hood*, that vents to the outside atmosphere (see Section 8).

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, <http://www.sae.org>.

<sup>5</sup> Kinker, B. G., Romaszewski, R. A., and Palmer, P. A., "ROBO—A Bench Procedure to Replace Sequence IIIGA Engine Test," *Journal of ASTM International (JAI)*, Vol. 4, No. 10, 2007, Paper ID JAI 100916. Available online from [www.astm.org](http://www.astm.org).