Designation: D7820 – 19 (Reapproved 2024)

Standard Test Method for Engine Coolant Corrosion Protection Under Accelerated Thermal and Oxidizing Conditions Using a Rotating Pressure Vessel[1]

This standard is issued under the fixed designation D7820; 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.

1. Scope

1.1 This test method covers determination of engine coolant corrosion protection and stability under accelerated thermal and oxidizing conditions using a rotary pressure vessel.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses after SI units are provided for information only and are not considered 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific hazard statements are given in 6.2, 6.3, 6.4, 6.5, 6.7, 6.8, 6.9, 6.10, 11.1, 12.8, 12.9, and 12.10.

1.4 *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:*[2]

B32 Specification for Solder Metal

D1176 Practice for Sampling and Preparing Aqueous Solutions of Engine Coolants or Antirusts for Testing Purposes

D1193 Specification for Reagent Water

D1384 Test Method for Corrosion Test for Engine Coolants in Glassware

D2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel

E1 Specification for ASTM Liquid-in-Glass Thermometers

E230/E230M Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

3. Summary of Test Method

3.1 The engine coolant test fluid and a metal coupon bundle are placed in a covered glassware container in a pressure vessel equipped with a pressure gauge. The pressure vessel is charged with air or oxygen to a gauge pressure of 620 kPa (90 psi, 6.2 bar) (see conversion factor 1), placed in a constant-temperature oil bath set at a controlled temperature (typically 115 °C (239 °F) or 150 °C (302 °F)) and rotated axially at 100 rpm at an angle of 30° from horizontal for 168 h. The use of air or oxygen and test temperature is left to the discretion of the user of the test. Engine coolant performance is assessed for corrosion protection based on changes in metal coupon weights and coolant stability is evaluated based on changes in coolant physical and compositional properties. The test method is based on a combination of Test Method D1384 (modified metal coupon bundle) and Test Method D2272 (glassware, pressure vessel, and bath apparatus) test procedures.

$$100\ \text{kPa} = 1.00\ \text{bar} = 14.5\ \text{psi} \quad (1)$$

4. Significance and Use

4.1 Engines operating under severe conditions involving high temperatures, hot spot areas, entrained air, or small cooling systems, or combinations thereof, are placing greater emphasis on engine coolant oxidation stability and corrosion protection. This test method provides an accelerated test method to assess engine coolant performance under high temperature oxidizing test conditions of new, used, or recycled engine coolants, or combinations thereof. The test method may also serve as a screening tool to determine oxidation stability. The test results of this method cannot stand alone as evidence of satisfactory oxidation stability and corrosion protection. The actual service of an engine coolant formulation can be determined only by more comprehensive bench, dynamometer, and field tests.

[1] This test method is under the jurisdiction of ASTM Committee D15 on Engine Coolants and Related Fluids and is the direct responsibility of Subcommittee D15.21 on Extended Life Coolants.

Current edition approved March 1, 2024. Published March 2024. Originally approved in 2012. Last previous edition approved in 2019 as D7820 – 19. DOI: 10.1520/D7820-19R24.

[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.

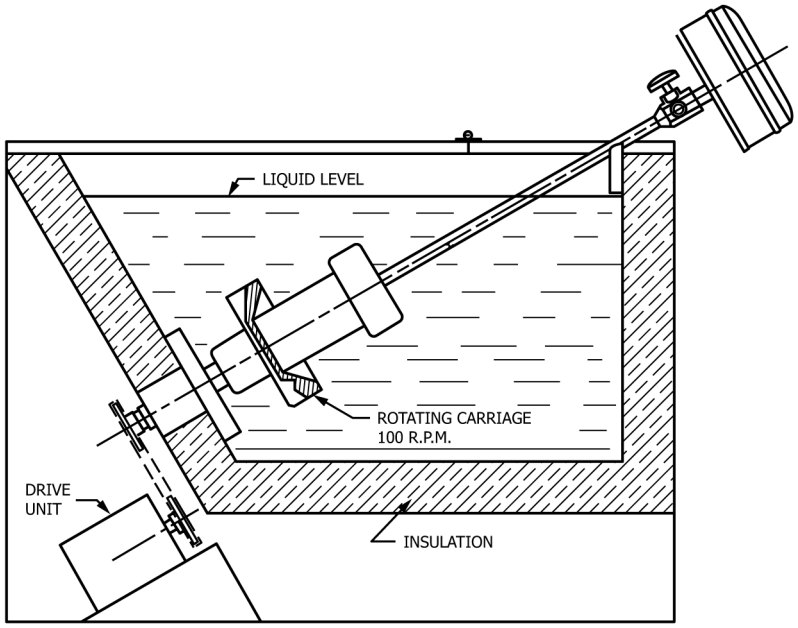

FIG. 1 Schematic Drawing of Rotary Pressure Vessel Test Apparatus

5. Apparatus

5.1 *Oxidation Vessel, Glass Sample Container with Four-Hole Polytetrafluoroethylene (PTFE) Disk, Hold-Down Spring, Pressure Gauge, and Test Bath,* as described in Annex A1. The assembled apparatus is shown schematically in Fig. 1 and Fig. A1.5.

5.2 *Temperature-Measuring Instrument (Environmentally Safe Thermometer or Thermocouple)*—An ASTM partial immersion temperature-measuring instrument having a range from –20 °C to 150 °C (0 °F to 302 °F) and conforming to the requirements for Thermometer 1C (1F), as prescribed in Specification E1 or thermocouple as summarized in Specification E230/E230M.

6. Reagents and Materials

6.1 *Purity of Reagents*—Reagent-grade chemicals shall be used in all tests. Unless otherwise specified, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[3] Other grades may be used provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Acetone,* reagent grade. (**Warning—**Flammable, health hazard.)

6.3 *Glacial Acetic Acid Concentrate,* reagent grade. (**Warning—**Avoid contact with skin and eyes. Handle in a fume hood.)

6.4 *Hydrochloric Acid,* concentrated HCl (specific gravity (sp gr) 1.19). (**Warning—**HCl is a strong acid. Avoid contact with skin and eyes. Handle in a fume hood.)

6.5 *Isopropyl Alcohol,* reagent grade. (**Warning—**Flammable, health hazard.)

6.6 *Liquid Detergent.*

6.7 *n-Heptane,* 99.0 minimum mol% (pure grade). (**Warning—**Flammable, health hazard.)

6.8 *Nitric Acid,* HNO_3 70% mass. (**Warning—**HNO3 is a strong toxic oxidant and acid. Avoid contact with skin, eyes, and clothing. Do not breathe vapor. Handle in a fume hood.)

6.9 *Oxygen,* 99.5 % with pressure regulation to 620 kPa (90 psi, 6.2 bar). (**Warning—**Vigorously accelerates combustion.)

6.10 *Potassium Hydroxide, Alcohol Solution (1 mass %)*—Dissolve 12 g of potassium hydroxide (KOH) pellets in 1 L of the isopropyl alcohol. (**Warning—**Flammable, health hazard.)

6.11 *Silicone Stopcock Grease.*

7. Test Specimens

NOTE 1—The specimens prescribed in this test method have been accepted by automobile manufacturers, but their composition may not be the same as that of alloys currently used for engine-cooling system components. Therefore, specimens other than those designated in this test method may be used by mutual agreement of the parties involved.

7.1 *Type*—The following metal test specimens,[4] representative of cooling system metals, shall be used.

[3] *ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[4] The sole source of supply of metal test specimens (complete sets or individual) known to the committee at this time is The Metaspec Company, P.O. Box 27707, San Antonio, TX 78227. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.