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Standard Test Method for Compatibility of Supplemental Coolant Additives (SCAs) and Engine Coolant Concentrates[1]

This standard is issued under the fixed designation D5828; 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—Editorial corrections to Section 7 were made in June 2011.~~

INTRODUCTION

Supplemental coolant additives (SCAs) are used to impart special properties, usually resistance to cavitation corrosion, to engine coolants used in diesel engines with replaceable cylinder liner sleeves. Engines with this design require additives that are not normally found in commercial engine coolant concentrates.

1. Scope

1.1 This test method covers determination of the compatibility of commercial SCA and commercial ethylene and propylene glycol engine coolant concentrates. This test method focuses on the solubility of specific chemical species formed in the engine coolant. The short duration of the test (24 h), among other restrictions, makes the test method of limited use for sorting out a variety of chemical compatibility problems in which a component of the SCA may react with a component of the coolant additive package. The test as currently written also does not deal with the issue of hard water compatibility, in which a component of the coolant or SCA additive package reacts with the hardness (Ca and Mg) to form a precipitate.

1.2 The values stated in SI units are to be regarded as ~~the~~ standard. The values given in parentheses are ~~for information only.~~mathematical conversions to inch-pound units that 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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

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]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
D1193 Specification for Reagent Water
D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)
D3585 Specification for ASTM Reference Fluid for Coolant Tests

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *engine coolant concentrate*—an undiluted ethylene or propylene glycol containing additives and only a small amount of water, usually less than 5 %.

[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 D15.11 on Heavy Duty Coolants.

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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.

3.1.2 *reference engine coolant concentrate*—a standard material prepared according to the formulary given in Annex A2 of this test method. This material should not be confused with reference coolant in accordance with Specification D3585.

3.1.3 *reference supplemental coolant additive (SCA)*—a standard SCA prepared according to the formulary given in Annex A1 of this test method.

3.1.4 *supplemental coolant additive*—a liquid or solid material that is added to a coolant at a specified concentration.

4. Summary of Test Method

4.1 A mixture of engine coolant concentrate and deionized water containing approximately twice the recommended concentration of SCA is heated to ~~88°C (190°F)~~88 °C (190 °F) for 24 h. The solution is centrifuged after returning to ambient temperature, and the amount of insoluble material is determined volumetrically and compared to the amount of insolubles obtained with a mixture of standard reference SCA and reference engine coolant.

5. Significance and Use

5.1 This test was developed to mimic the formation of insolubles observed in some heavy-duty diesel cooling systems during the mid 1980s. It measures the compatibility of SCA and coolant concentrate solutions according to their tendency to form insolubles in service.[3] Such insoluble materials may accumulate within a cooling system, restrict heat transfer through radiator cores, and contribute to the damage of components such as water pumps.

6. Apparatus

6.1 *Two-pan General Laboratory Balance,* ~~1~~1- to 2-kg capacity.

6.2 *Centrifuge Tube,* 100-mL capacity in accordance with Test Method D1796.

6.3 *Centrifuge,* capable of maintaining 500 rcf, with trunnions and specimen holders suitable for the tube described in 6.2.

6.4 *Constant Temperature Oil Bath,* or equivalent, capable of maintaining the test temperature at ~~88°C (190°F), within ±1°C (2°F).~~88 °C (190 °F), within ±1 °C (2 °F).

6.5 *Condenser Tube,* glass, approximately 5-mm outside diameter by 3-mm inside diameter by 300-mm long.

6.6 *Rubber Stoppers,* to fit the centrifuge tube with a single hole for the glass condenser tube.

6.7 *Rubber Stoppers,* as above but without a hole.

6.8 *Graduated Cylinder,* 100-mL capacity to deliver.

6.9 *Pipette,* to deliver volumes from 1 to 10 mL in 1-mL increments.

6.10 *Analytical Balance,* for preparing reference materials and capable of weighing within an accuracy of ±0.2 mg or better.

7. Reagents and Materials

7.1 *Purity of Reagents*—Regent grade chemicals shall be used in all tests. Unless otherwise indicated, 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.[4] 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.

7.2 *Coolant Concentrate,* and SCA for evaluation.

7.3 *Reference SCA,* and coolant concentrate solutions (see Annex A1 and Annex A2).

7.4 *Deionized Water,* in accordance with Specification D1193.

7.5 *Nichrome Wire,* or stainless steel wire.

7.6 *Filter Paper,* Whatman No. 4 or equivalent.

7.7 *Plastic Containers,* to store solutions. Polyethylene or polypropylene containers with screw caps are satisfactory.

7.8 *Acetone.* **Warning—** Acetone is flammable~~WARNING.: Acetone is flammable.~~

7.9 *Isopropyl Alcohol.*

[3] Hercamp and Hudgens, "Silicate Gelation in Heavy-Duty Engine Cooling Systems," Paper No. 852327, *Society of Automotive Engineers*, December 1985.

[4] *Reagant Chemicals, American Chemical Society Specifications*, 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.

8. Procedure

8.1 Compatibility testing of SCA shall be conducted using a ratio of 60 parts of coolant concentrate to 40 parts of a water-SCA mixture. The level of SCA in the total 60:40 mixture will be approximately twice the SCA manufacturer's recommended concentration.

8.2 Fill a 100-mL centrifuge tube to the 60-mL mark with coolant concentrate.

8.3 Determine the volume of water to be added based on the physical state and the recommended concentration of SCA to be evaluated. Add this volume of water to the centrifuge tube using a graduated cylinder. For example, if the SCA is a liquid to be added at the recommended concentration of 3 % by volume, twice the recommended concentration is 6 % or 6 mL. The volume of water to be added is 34 mL. This is 100 mL (volume of the centrifuge tube) less 60 mL (volume of coolant concentrate required) less 6 mL (volume of SCA required).

NOTE 1—Using hard water will greatly influence the amount of solubles formed. Testing the purity of the water with a conductivity meter is recommended.

NOTE 2—If the SCA is a solid, prepare a sufficient volume of a concentrated solution of the SCA in deionized water.

8.4 Pipette the required volume of SCA into the mixture of coolant concentrate and water. The sequence of mixing must be as follows: coolant concentrate, water, SCA solution. Cap with a solid rubber stopper and agitate thoroughly.

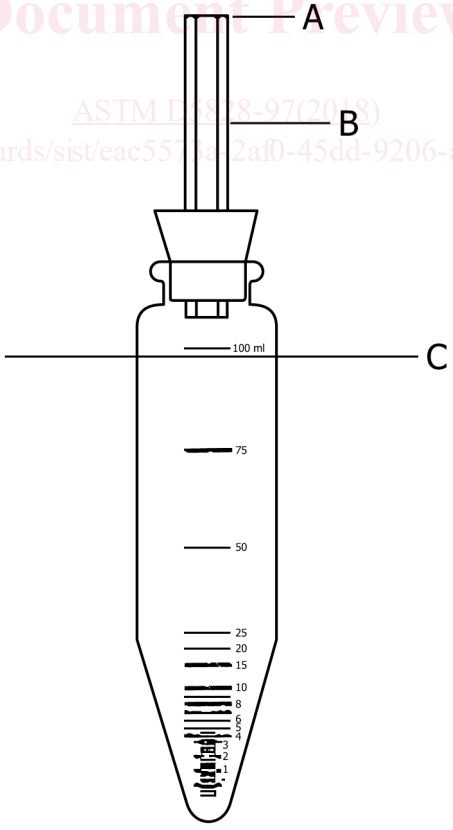
NOTE 3—Glycol and water mixtures exhibit a volume contraction due to the partial molal volume effect. The final volume of the mixture should be less than 100 mL, as indicated in Fig. 1.

8.5 In a similar manner, add 60 mL of reference coolant concentrate, 34 mL of deionized water, and 6 mL of reference SCA solution to a second 100-mL centrifuge tube, and agitate thoroughly. The reference coolant must be used within 30 days of preparation. Discard and prepare a new reference if any insoluble material is observed.

8.6 Replace the rubber stoppers with clean air condensers prepared by inserting a 300-mm (12-in.) length of glass tubing through a properly sized one-hole stopper.

8.7 Insert a length of dry Nichrome or stainless steel wire into the condenser past the bottom of the condenser tube. Immerse the centrifuge tube to the level of the solution in a constant temperature bath at ~~88°C (190°F)~~88 °C (190 °F) for 24 h (see Fig. 1).

NOTE 4—The purpose of the wire is to provide a means of directing condensate back to the centrifuge tube.



NOTE 1—(*A*) nichrome wire, (*B*) condenser tube, and (*C*) immersion level.

FIG. 1 Apparatus Assembly