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Standard Specification for 1,3 Propanediol (PDO) Base Engine Coolant for Automobile and Light-Duty Service[1]

This standard is issued under the fixed designation D7518; 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 specification covers the requirements for 1,3 propanediol base engine coolants used in automobiles or other light-duty service cooling systems. When concentrates are used at 40 to 70 % concentration by volume in water, or when prediluted glycol base engine coolants (50 volume % minimum) are used without further dilution, they will function effectively to provide protection against freezing, boiling, and corrosion.

1.2 The coolants governed by this specification are categorized as follows:

Coolant Type	Description
I	1,3 Propanediol base concentrate
II	1,3 Propanediol predilute (50 vol %)

NOTE 1—This specification is based on the knowledge of the performance of engine coolants prepared from new or virgin ingredients.
NOTE 2—This specification applies to automobiles and light-duty service. A specification for heavy-duty engine service is under development.

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

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D512 Test Methods for Chloride Ion In Water
D516 Test Method for Sulfate Ion in Water
D1119 Test Method for Percent Ash Content of Engine Coolants
D1120 Test Method for Boiling Point of Engine Coolants
D1121 Test Method for Reserve Alkalinity of Engine Coolants and Antirusts
D1122 Test Method for Density or Relative Density of Engine Coolant Concentrates and Engine Coolants By The Hydrometer
D1123 Test Methods for Water in Engine Coolant Concentrate by the Karl Fischer Reagent Method
D1126 Test Method for Hardness in Water
D1177 Test Method for Freezing Point of Aqueous Engine Coolants
D1287 Test Method for pH of Engine Coolants and Antirusts
D1293 Test Methods for pH of Water
D1384 Test Method for Corrosion Test for Engine Coolants in Glassware
D1881 Test Method for Foaming Tendencies of Engine Coolants in Glassware
D1882 Test Method for Effect of Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles
~~D1888Methods of Test for Particulate and Dissolved Matter in Water~~
D2570 Test Method for Simulated Service Corrosion Testing of Engine Coolants
D2809 Test Method for Cavitation Corrosion and Erosion-Corrosion Characteristics of Aluminum Pumps With Engine Coolants
D3321 Test Method for Use of the Refractometer for Field Test Determination of the Freezing Point of Aqueous Engine Coolants
D3634 Test Method for Trace Chloride Ion in Engine Coolants

[1] This specification is under the jurisdiction of ASTM Committee D15 on Engine Coolants and is the direct responsibility of Subcommittee D15.07 on Specifications.
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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.

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

D4327 Test Method for Anions in Water by Chemically Suppressed Ion Chromatography
D4340 Test Method for Corrosion of Cast Aluminum Alloys in Engine Coolants Under Heat-Rejecting Conditions
D4725 Terminology for Engine Coolants
D5827 Test Method for Analysis of Engine Coolant for Chloride and Other Anions by Ion Chromatography
D5931 Test Method for Density and Relative Density of Engine Coolant Concentrates and Aqueous Engine Coolants by Digital Density Meter
D6130 Test Method for Determination of Silicon and Other Elements in Engine Coolant by Inductively Coupled Plasma-Atomic Emission Spectroscopy
D6660 Test Method for Freezing Point of Aqueous Ethylene Glycol Base Engine Coolants by Automatic Phase Transition Method
D7388 Specification for Engine Coolant Grade 1,3-Propanediol (PDO)
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E394 Test Method for Iron in Trace Quantities Using the 1,10-Phenanthroline Method

2.2 *Other Documents:*
Federal Method 2540B Total Dissolved Solids Dried at 103–105°C[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *PDO base engine coolant*, *n*—an engine coolant in which the freeze point depressant is 1,3 propylene, with inhibitors to minimize foaming and corrosion.

3.1.2 For definitions of other terms used in this specification, refer to Terminology D4725.

4. General Requirements

4.1 Engine coolant concentrates or prediluted PDO base engine coolants shall be formulated with 1,3 propanediol meeting Specification D7388, water, and suitable corrosion inhibitors, dye, and a foam suppressor.

4.2 PDO base engine coolant concentrates (Type I) may not contain ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol. Similarly, prediulted PDO base coolants (Type II) may not contain ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol.

4.3 All engine coolant concentrates or prediluted PDO base engine coolants shall conform to the general requirements given in Table 1.

4.4 Prediluted PDO (Type II) base engine coolants shall be formulated using water that meets the following requirements:

Property	Specific Values	ASTM Test Method
Chlorides, µg/g (ppm (grains/gal))	25 (1.5) max	D512, D4327, D5827
Sulfate, µg/g (ppm (grains/gal))	50 (3.0) max	D516, D4327, D5827
Hardness, as $CaCo_3$, µg/g (ppm (grains/gal))	20 (1.2) max	D1126, D6130
pH	5.5 to 8.5	D1287, D1293
Iron, µg/g (ppm (grains/gal))	1.0 (0.06) max	D6130, E394

NOTE 3—Prediluted coolants are intended for direct addition to an engine-cooling system with no further dilution. However, if circumstances require addition and prediluted aqueous engine coolant is no available, use the appropriate engine-coolant concentrate (Type I) diluted to 50 volume % with water of at least the quality outlined in Table X1.1.

4.5 When diluting engine-coolant concentrates for actual service, the water should be of such quality that it does not contain excessive solids, hardness salts, or chlorides. In the absence of specific recommendations from the engine or vehicle manufacturers, see Appendix X1, or Table X1.1. If such water is not available, use deionized (demineralized) or distilled water. This procedure will minimize the formation of hard-water scale and avoid the introduction of mineral components, such as chlorides and sulfates, which can increase the corrosion rate of aluminum and iron.

4.6 When installed in accordande with the vehicle manufacturer's recommendations and those on the product label, engine coolant concentrates or prediluted glycol-base engine coolants shall be suitable for use in a properly maintained cooling system (Appendix X1.1) in normal light-duty service for a minimum of one year without adversely affecting fluid flow and heat transfer.

[3] ~~Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.~~
[3] Standard Method for the Examination of Water and Wastewater. American Public Health Association, et al, 1015 15th Street, N.W. Washington, DC 20005.

TABLE 1 General Requirements

Property	Specific Values	ASTM Test Method
Color	Distinctive	...
Effect on nonmetals	No adverse effect	under consideration

5. Detailed Requirements

5.1 Glycol-base coolant concentrates and prediluted coolants shall conform to the physical and chemical requirements prescribed in Table 2 depending on coolant type (see 1.2).

5.2 The requirements listed in Table 2 for prediluted coolant (Type II) are prescribed for the coolant as packaged, without further dilution or adjustment.

5.3 All coolant concentrates and prediluted coolants shall conform to the performance requirements listed in Table 3.

5.4 Coolant concentrates shall be diluted for performance testing as described in the individual ASTM test methods.

5.5 If necessary, the freezing point of prediluted coolants shall be adjusted with deionized water before proceeding with performance testing. The freezing point of prediluted PDO base coolants (Type II) shall be −27.8°C (−18.0°F).

5.6 Adjusted, prediluted engine-coolant performance test solutions shall be prepared as described in Table 3, Footnotes B through F.

6. Keywords

6.1 1,3-propanediol; engine coolant; engine coolant concentrate; light-duty engine coolant; PDO; prediluted engine coolant

TABLE 2 Physical and Chemical Requirements

Property	Type I	Type II	ASTM Test Method
Relative density, 15.5/15.5°C (60/60°F)	1.050 to 1.065	1.025 min	D1122, D5931
Freezing point,[A] °C (°F):			D1177, D6660
50 vol % in DI water	–27.8 (–18.0) max		
Undiluted		–27.8 (–18.0) max	
Boiling point[B] °C (°F):			D1120
50 vol % in DI water	102 (215) min		
Undiluted	180 (356) min	102 (215) min	
Ash content, mass %	5 max		D1119
pH:			D1287
50 vol % in DI water	7.5 to 11		
Undiluted		7.5 to 11	
Chloride, µg.g	25 max	25 max	D3634[C], D5827[C]
Water, mass %	5 max	not applicable	D1123
Reserve alkalinity, mL	report[D]	report[D]	D1121
Effect on automobile finish (use clear coat thermoset urethane or acrylic urethane finish)	no effect	no effect	D1882[E]

[A] For purposes of determining conformance with this specification, an observed value shall be rounded "to the nearest unit" in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of Practice E29.

[B] Some precipitate may be observed at the end of the test. This should not be cause for rejection.

[C] In case of dispute, D3634 shall be the preferred test method.

[D] Value as agreed upon between the supplier and the customer.

[E] Currently, many vehicle manufacturers prepare test panels using the specific paint finishes employed on their actual products. Coolant suppliers and vehicle manufacturers should agree on the exact test procedures and acceptance criteria on an individual basis.