Designation: D7518 – 10 (Reapproved 2015)ε1

# 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.

ε[1] NOTE—Caution statement in X1.5 was changed to a Warning statement editorially in June 2015.

## 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

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

D4327 Test Method for Anions in Water by Suppressed Ion Chromatography

D4340 Test Method for Corrosion of Cast Aluminum Alloys in Engine Coolants Under Heat-Rejecting Conditions

D4725 Terminology for Engine Coolants and Related Fluids

D5827 Test Method for Analysis of Engine Coolant for Chloride and Other Anions by Ion Chromatography

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

Current edition approved May 1, 2015. Published June 2015. Originally approved in 2009. Last previous edition approved in 2010 as D7518– 10. DOI: 10.1520/D7518-10R15E01.

[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**

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 Document:*[3]

Federal Method 2540B Total Dissolved Solids Dried at 103–105°C

## 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:

[3] Standard Methods for the Examination of Water and Wastewater. American Public Health Association, et al, 801 I Street, N.W. Washington, DC 20001, http://www.apha.org.

**TABLE 1 General Requirements**

| Property | Specific Values | ASTM Test Method |
|---|---|---|
| Color | Distinctive | ... |
| Effect on nonmetals | No adverse effect | under consideration |
| 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 accordance 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 (X1.1) in normal light-duty service for a minimum of one year without adversely affecting fluid flow and heat transfer.

## 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, Test Method 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.

**TABLE 3 Performance Requirements[A]**

| Property | Specific Values | ASTM Test Method | Test Solution Concentration, vol % Glycol |
|---|---|---|---|
| Corrosion in glassware | | D1384[B] | 33 |
| Weight loss, mg/specimen | 10 max | | |
| copper | 30 max | | |
| solder | 10 max | | |
| brass | 10 max | | |
| steel | 10 max | | |
| cast iron | 30 max | | |
| aluminum | | | |
| Simulated service test | | | |
| Weight loss, mg/specimen | 20 max | D2570[C] | 44 |
| copper | 60 max | | |
| solder | 20 max | | |
| brass | 20 max | | |
| steel | 20 max | | |
| cast iron | 60 max | | |
| aluminum | | | |
| Corrosion of Cast Aluminum Alloys at Heat-Rejecting Surfaces, mg/cm$^2$/week | 1.0 max | D4340[D] | 25 |
| Foaming | 150 max | D1881[E] | 33 |
| Volume, mL | 5 max | | |
| Break time, s | | | |
| Cavitation-Erosion | 8 min | D2809[F] | 17 |
| Rating for pitting, cavitation, and erosion of the water pump | | | |

[A] For engine-coolant concentrates, test solutions shall be prepared in accordance with the directions provided in the individual ASTM test methods noted. For prediluted engine coolants, prepare test solutions using the directions provided in footnotes B through F.
[B] For prediluted coolants, prepare the test solution by mixing 67 volume % of the adjusted (see 4.6) prediluted product with 33 volume % ASTM Type IV reagent water. Add 99 mg of sodium sulfate, 110 mg of sodium chloride, and 92 mg of sodium bicarbonate per litre of test solution.
[C] For prediluted coolants, prepare the test solution by mixing 88 volume % of the adjusted (see 4.6) prediluted product with 12 volume % ASTM Type IV reagent water. Add 83 mg of sodium sulfate, 92 mg of sodium chloride, and 77 mg of sodium bicarbonate per litre of test solution.
[D] For prediluted coolants, prepare the test solution by mixing 50 volume % of the adjusted (see 4.6) prediluted product with 50 volume % ASTM Type IV reagent water. Add 165 mg of sodium chloride per litre of test solution.
[E] For prediluted coolants, prepare the test solution by mixing 67 volume % of the adjusted (see 4.6) prediluted product with 33 volume % ASTM Type II reagent water.
[F] For prediluted coolants, prepare the test solution by mixing 33 volume % of the adjusted (see 4.6) prediluted product with 67 volume % ASTM Type IV reagent water. Add 123 mg of sodium sulfate, 137 mg of sodium chloride, and 115 mg of sodium bicarbonate per litre of test solution.

# APPENDIXES

## X1. COOLANT SYSTEM MAINTENANCE

X1.1 *Filling the Cooling System*:

X1.1.1 Before installing engine coolant, the cooling system should be inspected and necessary service work completed.

X1.1.2 Cooling system fill should consist of coolant concentrate and water or prediluted glycol-base engine coolant (50 volume % minimum).

X1.1.3 When preparing solutions, the water should be of such quality that it does not contain excessive solids, hardness salts, sulfates, or chlorides. In the absence of specific recommendations from the engine or vehicle manufacturer, see Table X1.1. Contact your local water department, the responsible government agency, or submit a water sample for analysis, if there is a question on water quality.

X1.1.4 The recommneded coolant concentration is 40 to 70 %.

X1.2 *Essential Cooling System Service*:

X1.2.1 Check coolant concentration (freeze point). The most accurate and preferred means of determining coolant concentration is by the refractometer (see X2.1 and Table X2.1).

**TABLE X1.1 Suggested Water Quality Limits[A]**

| Property | Specific Values | ASTM Test Method |
|---|---|---|
| Total solids, µg/g (ppm (grains/gal)) | 340 (20) max | Federal Method 2540B |
| Total hardness, µg/g (ppm (grains/gal)) | 170 (10) max | D1126, D6130 |
| Chlorides, µg/g (ppm (grains/gal)) | 40 (2.4) max | D512, D4327, D5827 |
| Sulfate, µg/g (ppm (grains/gal)) | 100 (5.9) max | D516, D4327, D5827 |
| pH | 5.5 – 9.0 | D1287, D1293 |

[A] Adopted from a survey by the Committee D15 Water Quality Task Force.

X1.2.2 Check coolant level and condition. Replace coolant at service intervals recommended by the engine manufacturer, vehicle manufacturer, or designated service organization. Follow recommended practices.

X1.2.3 Pressure test system for leaks (preferably when cold).

X1.2.4 Test pressure cap and inspect radiator filler neck.

X1.2.5 Inspect hoses and tighten hose connections.

X1.2.6 Inspect drive belts and check for proper tension.

X1.2.7 Test thermostat if the engine is running too hot or too cold. Replace with a thermostat recommended by the manufacturer.

X1.3 Premix coolant concentrate and water before adding to the cooling system.

X1.4 When preparing additions or when replacing the coolant in the engine system, use only clean, low mineral content water. Table X1.1 provides suggestions for proper water quality limits.

X1.5 (**Warning—**Do not remove the radiator pressure cap when the engine is hot. The cooling system will likely be under pressure. When the engine has cooled, carefully turn to the first notch to vent the system pressure, and then remove. If coolant overflows when the cup is vented, immediately retighten and permit the system to cool further.)

**TABLE X2.1 Methods for Determining Freeze Points**

| Method | 1,3 Propanediol | Ethylene | Propylene | Mixture |
|---|---|---|---|---|
| Refractometer | yes[A] | yes | yes[A] | yes[B] |
| Hydrometer | yes[C] | yes[D] | yes[C] | no |
| Test Strips | yes | yes | yes | yes |

[A] Must be a refractometer with either a PG freeze point scale or a dual scale with both PG and EG.
[B] Approximate freeze point determinations can probably be made for mixtures of PDO, EG and PG base coolants by calculating the average of readings on each scale. Research is ongoing but previous investigations involving EG and PG on freeze point determined by this method were found to be within ±4°C (7°F), regardless of whether the coolant is all EG or PG or a mixture of both. PDO is an isomer of PG and the refractive index is very similar to that of PG.
[C] Hydrometer shall be specifically calibrated for use with PDO ro PG base coolants.
[D] Conventional field service hydrometers calibrated for use with ethylene glycol base coolants.

## X2. DETERMINATION OF FREEZE POINT

X2.1 If 1,3 propanediol (PDO), propylene glycol (PG) base coolants and ethylene glycol (EG) base coolants are mixed in a cooling system, problems may result when attempting to determine the freezing point in the field. The hydrometers used in North America are calibrated to the higher relative density of EG base coolants. These hydrometers cannot be used to determine the freeze point of PDO or PG base engine coolants or mixtures of PDO, PG and EG coolants. Using this type of hydrometer to determine the freeze point is likely to result in a high coolant to water mix ratio (for example, 80/20), which, in turn may cause engine and cooling system problems. A hydrometer specifically calibrated to the relative density of PDO or PG must be used to determine the freezing point of PG base coolants. A convenient and preferred means of determining the freeze points for PDO coolants or mixtures of PDO, PG and EG coolants is by the refractometer (see Test Method D3321). Table X2.1 lists methods for determining the freeze point of PDO base engine coolants when used either alone in the cooling system or mixed with PG or EG base coolants. The refractometer provides the most accurate method for measuring freeze points in the field. Dip-and-read test strips will provide only an approximation of freeze point.

X2.2 It is recommended that PDO base coolant (either Type I or II) containers be labeled with an appropriate cautionary statement to alert the user to the differences described in X1.1. It is also recommended that a peel-off label be attached to the filler-neck of the radiator to advise the user that the system has been charged with a PDO base coolant.

## X3. LABELING

X3.1 It is recommended that prediluted coolants (Type II) meeting this specification have the following information on the package label:

X3.1.1 Prediluted engine coolant,

X3.1.2 Ready for use, do not add water, and

X3.1.3 (**Warning—**The freezing point of the final coolant in the cooling system is determined by the extent of dilution of this product with any liquid remaining in the cooling system at the time of filling.)

## SUMMARY OF CHANGES

Committee D15 has identified the location of selected changes to this standard since the last issue (D7518-09) that may impact the use of this standard.

*(1)* Replaced total solids test method, D1888, in Table X1.1 with Federal Method 2540B.