



Designation: D7517 – 09

Standard Specification for Fully-Formulated 1,3 Propanediol (PDO) Base Engine Coolant for Heavy-Duty Engines¹

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1. Scope

1.1 This specification covers the requirements for fully-formulated glycol base coolants for cooling systems of heavy-duty engines. When concentrates are used at 40 to 60 % PDO concentration by volume in water of suitable quality, (see [Appendix X1](#)), or when prediluted PDO base engine coolants (50 volume % minimum) are used without further dilution, they will function effectively during both winter and summer to provide protection against corrosion, cavitation, freezing, and boiling.

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

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

1.3 Coolant concentrates meeting this specification do not require any addition of Supplemental Coolant Additive (SCA) until the first maintenance interval when a maintenance dose of SCA is required to continue protection in certain heavy-duty engine cooling systems, particularly those of the wet cylinder liner-in-block design. The SCA additions are defined by and are the primary responsibility of the engine manufacturer or vehicle manufacturer. If they provide no instructions, follow the SCA supplier's instructions.

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

1.5 *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.*

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. Referenced Documents

2.1 ASTM Standards:²

- D512 Test Methods for Chloride Ion in Water
- D516 Test Method for Sulfate Ion in Water
- D1126 Test Method for Hardness in Water
- D1287 Test Method for pH of Engine Coolants and Antirusts
- D1293 Test Methods for pH of Water
- D4327 Test Method for Anions in Water by Suppressed Ion Chromatography
- D4725 Terminology for Engine Coolants
- D5827 Test Method for Analysis of Engine Coolant for Chloride and Other Anions by Ion Chromatography
- D5828 Test Method for Compatibility of Supplemental Coolant Additives (SCAs) and Engine Coolant Concentrates
- D6130 Test Method for Determination of Silicon and Other Elements in Engine Coolant by Inductively Coupled Plasma-Atomic Emission Spectroscopy
- D7518 Specification for 1,3 Propanediol (PDO) Base Engine Coolant for Automobile and Light-Duty Service
- E394 Test Method for Iron in Trace Quantities Using the 1,10-Phenanthroline Method

2.2 Other Documents³

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

3. Terminology

3.1 Definitions:

3.1.1 *supplemental coolant additive (SCA), n*—an additive used in conventionally inhibited heavy-duty engine coolants required to maintain protection against general corrosion, cylinder liner pitting, and scaling in heavy-duty engines.

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 Standard Method for the Examination of Water and Wastewater, American Public Health Association, et al, 1015 15th Street, N.W. Washington, DC 20005.

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

4. General Requirements

4.1 Concentrated and prediluted coolants shall meet all of the respective requirements of Specification **D7518**.

4.2 The coolant concentrate mixed with water or the prediluted coolant, when maintained with maintenance does of SCA in accordance with the engine manufacturer's recommendations, and those on the product label, shall be suitable for use in a properly maintained cooling system in normal service for a minimum of two years (See **Appendix X1**).

5. Additional Requirements

5.1 The coolant concentrate or prediluted coolant additionally shall provide protection in operating engines against

cavitation corrosion (also termed liner pitting) and against scaling of internal engine hot surfaces. Hot surfaces typically are within the engine head, head spacer, upper cylinder liner, or liquid cooled exhaust manifold. ASTM has test methods under development for both cavitation corrosion and hot surface scaling. Until these procedures are approved as ASTM standards, the mandatory requirements of **Annex A1** shall apply.

5.2 Both the concentrated and prediluted coolants shall contain less than 50 µg/g sulfate ion.

6. Keywords

6.1 1,3-propanediol; cavitation; fully-formulated heavy-duty engine coolant; maintenance dose; PDO; supplemental coolant additive

ANNEX

A1. CHEMICAL REQUIREMENTS FOR FULLY FORMULATED HEAVY-DUTY ENGINE COOLANT

A1.1 Laboratory data or in-service experience demonstrating a positive influence on reducing cavitation corrosion in an operating engine is required.

A1.1.1 In-service qualification tests may consist of single- or multiple-cylinder engine tests. At the option of the engine or vehicle manufacturer, such testing may be conducted in "loose engines (that is, engines modified to induce liner cavitation)" or in engines fully integrated into an application, such as a vehicle, a powerboat, or a stationary power source. One such test has been developed.⁴

A1.2 Several chemical compositions have been tested extensively by producers and users and satisfactorily minimize cylinder liner cavitation in actual test engines. Coolants meeting either of the following compositions are regarded as passing the requirements of **A1.1**.

A1.2.1 A minimum concentration of nitrite (as NO_2^-) of 1200 µg/g in the 50 volume % predilute coolant, or

A1.2.2 A minimum combined concentration of nitrite (as NO_2^-) plus molybdate (as MoO_4^{-2}) in the 50 volume %

predilute coolant of 780 µg/g. At least 300 µg/g each of NO_2^- and MoO_4^{-2} must be present.

A1.2.3 The above concentrations are doubled for coolant temperature.

A1.3 Chemical composition requirements for cavitation corrosion protection will be removed from this specification and replaced with an ASTM test method when a test method is developed and adopted.

A1.4 Both concentrated and prediluted coolants under this specification must contain additives to minimize hot surface scaling deposits. Certain additives (polyacrylate and other types) minimize the deposition of calcium and magnesium compounds on heat rejecting surfaces. No specific chemical requirements for hot surface scaling and deposits resistance have been established at this time. A test procedure is under development and will be incorporated into the specification when a procedure is approved by ASTM.

A1.5 Lack of compatibility between the coolant and SCA product's chemistry results in chemical ingredient dropout from solution, with potential adverse effects in the vehicle or engine cooling system. A test procedure for compatibility (Test Method **D5828**) has been approved and will be incorporated into the specification when limits are determined.

⁴"A Comparison of Engine Coolant in an Accelerated Heavy-Duty Engine Cavitation Test," SAE Technical Paper 960883, SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.