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Standard Specification for Fully-Formulated Ethylene-Glycol-Base Engine Coolant for Heavy-Duty Engines[1]

This standard is issued under the fixed designation D 6210; 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 a fully-formulated ethylene-glycol-base coolant for cooling systems of heavy-duty engines. When concentrates are used at 40 to 60 % ethylene-glycol concentration by volume in water of suitable quality, (see Appendix X1), or when prediluted ethylene-glycol base engine coolants (50 % volume, % minimum) are used without further dilution, it will function effectively during both winter and summer to provide protection against corrosion, cavitation, freezing, and boiling.

1.2 This specification is intended to cover the requirements for engine coolants prepared from virgin or recycled ethylene glycol.

1.3 Both concentrated and prediluted products are covered by this specification.

1.4 Coolant concentrates meeting this specification do not require any addition of Supplemental Coolant Additive (SCA) until the first maintenance interval when a maintenance does 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.

1.5 This specification does not cover extended service interval coolants.

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

1.7 *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:*

D 1126 Test Method for Hardness in Water[2]

D 1293 Test Method for pH of Water[2]

D 3306 Specification for Ethylene Glycol Base Engine Coolant for Automobile and Light Duty Service[3]

D 4327 Test Method for Anions in Water by Chemically-Suppressed Ion Chromatography[2]

D 4656 Specification for Prediluted Ethylene Glycol-Based Engine Coolant (50 Volume % Minimum) for Automobiles and Light Duty Service[3]

D 5828 Test Method for Compatability of Supplemental Additives (SCA) and Engine Coolant Concentrates[3]

3. General Requirements

3.1 Concentrated coolant shall meet all of the requirements of Specification D 3306. Prediluted coolant shall meet all the requirements of Specification D 4656.

3.2 The coolant concentrate mixed with water or the prediluted coolant, when maintained with maintenance doses 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 one year (see Appendix X1).

4. Additional Requirements

4.1 The coolant concentrate 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 space, 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.

4.2 Both the concentrated and prediluted coolants shall contain less than 50 ppm sulfate ion.

4.3 Concentrated coolant must contain less than 4 % total dissolved solids as measured using Modified Federal Method

[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] *Annual Book of ASTM Standards*, Vol 11.01.

[3] *Annual Book of ASTM Standards*, Vol 15.05.

2540C.[4] Prediluted coolant must contain less than 2 % total dissolved solids using the same method.

[4] Federal Method 2540C, "Total Dissolved Solids Dried at 180°C," Standard Method for the Examination of Water and Wastewater, American Public Health Association, et al, 1015 15th Street, N.W., Washington, DC 20005.

5. Keywords

5.1 cavitation; fully-formulated heavy-duty engine coolant; supplemental coolant additive maintenance dose

ANNEX

(Mandatory Information)

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" or in engines fully integrated into an application, such as a vehicle, a power boat, or a stationary power source. One such test has been developed.[5]

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 these compositions are regarded as passing the requirements of A1.1.

A1.2.1 A minimum concentration of nitrite as NO_2 of 1200 ppm in the coolant.

A1.2.2 A minimum combined concentration of nitrite as NO_2 plus molybdate as MoO_4 in the coolant of 780 ppm. At least 300 ppm each of NO_2 and MoO_4 must be present.

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 products' 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 D 5828) has been approved and will be incorporated into the specification when limits are determined.

[5] "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.

APPENDIX

(Nonmandatory Information)

X1. COOLANT MAINTENANCE FOR HEAVY DUTY ENGINES

X1.1 *Engine Coolant*—Cooling system fill for a heavy duty engine consists of water and fully formulated heavy duty coolant or water, low-silicate coolant concentrate and supplemental coolant additive.

X1.1.1 *Water*:

X1.1.1.1 Water quality affects the efficiency of coolant additives. When untreated, all water is corrosive. Water having a high mineral content or corrosive materials is unfit for cooling system use.

X1.1.1.2 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 manufacture, see Table X1.1. Contact your local water department, the responsible

TABLE X1.1 Suggested Water Quality Limits[A]

Property	Specific Values	Test Method
Total solids, ppm (grains/gal)	340 (20) max	Fed Method 2540B[B]
Total hardness, ppm (grains/gal)	170 (10) max	D 1126
Chloride (Cl), ppm (grains/gal)	40 (2.4) max	D 4327
Sulfate (SO_4), ppm (grains/gal)	100 (5.9) max	D 4327
pH	5.5 to 9.0	D 1293

[A] Adopted from a survey by the D 15 Water Quality Task Force.

[B] Federal Method 2540B, "Total Dissolved Solids Dried at 103–105°C," Standard Method for the Examination of Water and Wastewater, American Public Health Association, et al, 1015 15th Street, N.W. Washington, DC 20005.

government agency, or submit a water sample for analysis if there is a question on water quality

X1.1.2 *Coolant Concentrates*:

X1.1.2.1 The coolant concentration should be maintained between 40 and 60 % glycol by volume, depending on the engine operating environment. Freeze protection will be provided in accordance with Table X1.2.

X1.1.3 *Supplemental Coolant Additive*:

X1.1.3.1 SCAs extend the life of the coolant by replenishing the additives that deplete during normal operation. SCA's, however, do not extend the freeze protection provided by the coolant concentrate.

X1.1.3.2 Heavy-duty engine users experience has shown that compositions below those defined in Annex A1.2 may not provide long term protection against cavitation corrosion (liner pitting). User experience and published information shows the presence of nitrite in an SCA or fully-formulated heavy-duty coolant is particularly effective in providing maximum protection.

X1.1.3.3 New technology consisting of other chemistries may provide satisfactory protection. Such chemistries can be established by agreement between producers and users upon demonstration of performance. Such demonstrations can consist of comparative laboratory cavitation tests or comparative damage rating from testing in operating engines. One or both of these options may be applied as determined in a specific agreement between parties. An engine test has been developed.[5]

X1.2 *Coolant Maintenance Recommendations*:

X1.2.1 If any of the following recommendations differ, follow the engine or vehicle manufacturer's recommendations.

X1.2.2 Use the coolant concentration recommended in this specification.

X1.2.3 Drain and flush the cooling system as recommended by the engine or vehicle manufacturer.

X1.2.4 Use water that meets the requirement in Table X1.1.

X1.2.5 Use accurate, reliable equipment, such as a refractometer to measure coolant concentrate levels for freeze protections.

TABLE X1.2 Freeze Protection

Glycol Content, %	Freeze Protection Temperature, Ethylene Glycol, °C (°F)
40	–24 (–12)
50	–37 (–34)
60	–52 (–62)

X1.2.6 Use the SCA manufacturer's recommended test kit when testing the coolant for proper SCA concentration. Test kits shall indicate the degree of liner pitting protection present in the coolant.

X1.2.7 Check freezing point at two different levels when coolant concentrate and water is premixed and stored in bulk or drums to be sure mixing is complete before use.

X1.2.8 Use coolant mixed at the desired proportions for make-up.

X1.2.9 Use SCAs at the recommended maintenance dosage and intervals to control deposits, corrosion, water pump damage, and liner pitting.

X1.2.10 Periodically check bulk premixed coolant storage tanks for separation of chemicals and contamination.

X1.2.11 DO NOT add undiluted coolant concentrate as make-up coolant.

X1.2.12 DO NOT add plain water as make-up coolant.

X1.2.13 DO NOT substitute precharge coolant filters for service filters, this will result in over treatment (precharge filters contain more SCA than maintenance filters).

X1.2.14 DO NOT exceed 60 % coolant concentrate. A coolant concentrate level greater than 68 % actually reduces freeze protection in ethylene glycol base coolants. The maximum recommended coolant concentrate level is 60 % which provides the freeze protection shown in X1.1.2.

X1.2.15 DO NOT exceed the manufacturer's recommended dosage of SCA or the recommended concentration of coolant concentrate. Over concentration can result in plugged radiators, heater cores, and charge air coolers. Over concentration also can cause water pump seal leaks.

X1.2.16 DO NOT reuse coolant that has been drained from a vehicle where over concentration of coolant concentrate or over concentration of supplemental coolant additives has occurred, where the coolant is over one year old, or where the container is dirty.

X1.2.17 DO NOT precharge the cooling system with SCA when using fully-formulated heavy-duty engine coolant.

X1.2.18 DO NOT use soluble oil additives.

X1.2.19 DO NOT use methyl alcohol or methoxypropanol base coolant concentrates.

X1.2.20 DO NOT use anti-leak additives if engine cooling system is equipped with a coolant filter, as this may plug the filter element. For all other cooling systems, follow the recommendations of the engine or vehicle manufacturer.