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Standard Specification for Prediluted Aqueous Ethylene Glycol Base Low-Silicate Engine Coolant (50 Volume Percent Minimum) for Heavy-Duty Engines Requiring an Initial Charge of Supplemental Coolant Additive (SCA)[1]

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1. Scope

1.1 This specification covers the requirements for a prediluted aqueous ethylene glycol base low-silicate engine coolant (50 volume percent minimum) for cooling systems of heavy-duty engines. When used without further dilution, this product will function effectively during both summer and winter to provide protection from corrosion, freezing at least to − 36.7°C (−34.0°F), and boiling at least to 108°C (226°F).

1.2 Prediluted coolant meeting this specification requires both an initial charge of a supplemental coolant additive (SCA) and regular maintenance doses of an SCA to continue the protection in certain operating 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 or vehicle manufacturer. If they provide no instructions, follow the SCA supplier's recommended instructions.

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:*

D 512 Test Methods for Chloride Ion in Water[2]
D 516 Test Method for Sulfate Ion in Water[2]
D 1119 Test Method for Ash Content of Engine Coolants and Antirusts[3]
D 1120 Test Method for Boiling Point of Engine Coolants[3]
D 1121 Test Method for Reserve Alkalinity of Engine Coolants and Antirusts[3]
D 1122 Test Method for Density or Relative Density of Engine Coolants Concentrates and Engine Coolants by the Hydrometer[3]
D 1126 Test Method for Hardness in Water[2]
D 1177 Test Method for Freezing Point of Aqueous Engine Coolants[3]
D 1193 Specification for Reagent Water[2]
D 1287 Test Method for pH of Engine Coolants and Antirusts[3]
D 1293 Test Methods for pH of Water[2]
D 1384 Test Method for Corrosion Test for Engine Coolants in Glassware[3]
D 1881 Test Method for Foaming Tendencies of Engine Coolants in Glassware[3]
D 1882 Test Method for Effect of Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles[3]
D 1888 Test Methods for Particulate and Dissolved Matter in Water[4]
D 2570 Test Method for Simulated Service Corrosion Testing of Engine Coolants[3]
D 2809 Test Method for Cavitation Corrosion and Erosion-Corrosion Characteristics of Aluminum Pumps with Engine Coolants[3]
D 3306 Specification for Ethylene Glycol Base Engine Coolant for Automobile and Light Duty Service[3]
D 3321 Test Method for Use of the Refractometer for Field Test Determination of the Freezing Point of Aqueous Engine Coolants[3]
D 4327 Test Method for Anions in Water by Chemically Suppressed Ion Chromatography[2]
D 4656 Specification for a Prediluted Aqueous Ethylene Glycol Based Engine Coolant (50 Volume % Minimum) for Automobiles and Light-Duty Service[3]
D 4985 Specification for Low Silicate Ethylene Glycol Base Engine Coolant for Heavy Duty Engines Requiring a Pre-Charge of Supplemental Coolant Additive (SCA)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee D-15 on Engine Coolants and is the direct responsibility of Subcommittee D15.13 on Prediluted Engine Coolant.

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

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

[4] Discontinued—See 1990 *Annual Book of ASTM Standards*, Vol 11.01.

3.1.1 *heavy duty engine*—a diesel, gasoline, or similarly fueled internal combustion engine, having operating characteristics of a long duty cycle at or near maximum rated conditions.

3.1.2 *Discussion*—Such engines are typically used in off-highway machinery for agriculture, mining, earth-moving, and construction; Classes 5 through 8 over the road trucks and buses; high output stationary engine installations; and locomotive and marine installations (see Specifications D 3306 and D 4656 for coolant requirements for automobiles, vans, and pickup trucks, Classes 1 through 4).

3.1.3 *supplement coolant additive (SCA)*—a material added to the cooling system of a heavy-duty engine to provide additional cavitation protection and corrosion inhibition and to minimize deposits on heat transfer surfaces.

4. General Requirements

4.1 Prediluted aqueous ethylene glycol base engine coolant shall consist essentially of ethylene glycol and water and shall contain suitable corrosion inhibitors, dye, and a foam suppressor. Other glycols, such as propylene and diethylene, may be included up to a maximum of 15 % of the glycols contained in the product, if the chemical and physical properties in Table 1 are met. For example, 15 % of a 50 % aqueous glycol solution could contain up to 7.5 % of glycols other than ethylene glycol. The coolant also shall conform to the general requirements given in Table 2.

4.2 This product shall be prepared using deionized water that meets Type IV reagent water specifications (see Specification D 1193). This practice minimizes the formation of hard water scale and avoids the introduction of mineral components, such as chlorides and sulfates, which can increase the corrosion rate of aluminum and iron. The use of Type IV reagent water also minimizes interferences that may cause coolant instability or SCA compatibility problems.

4.3 When installed in accordance with the vehicle manufacturers' recommendations and those on the product label, this product shall be suitable for use in a properly maintained cooling system (see Appendix X1) in normal service for a minimum of 1 year without adversely affecting fluid flow and heat transfer.

5. Detailed Requirements

5.1 Prediluted aqueous ethylene glycol base engine coolant, before SCA addition, shall conform to the chemical and physical property requirements prescribed in Table 1 and to the general requirements prescribed in Table 2.

5.2 Prediluted aqueous ethylene glycol base engine coolant, after adjustment and before SCA addition, shall conform to the laboratory test performance requirements prescribed in Table 3.

5.3 Report the freezing point of the prediluted aqueous ethylene glycol base coolant as packaged. This freezing point shall be − 37°C (−34°F) or below.

5.4 Adjust the freezing point of the prediluted aqueous ethylene glycol base coolant to − 37°C (−34°F) with deionized water. Use this concentration-adjusted product for all of the performance requirements testing specified under this specification and listed in Table 3 and for Footnote A of Table 1.

TABLE 1 Chemical and Physical Requirements of the Unadjusted Prediliuted Product

Property	Specified Values	ASTM Test Method
Density or relative density, 15.5/15.5°C (60°F)	1.0650 min	D 1122
Freezing point, °C (°F)	−37 (−34) max or lower	D 1177
Boiling point, °C (°F)	108 (226) min	D 1120
Ash content, mass %	2.5 max	D 1119
pH	7.5 to 11.0[A]	D 1287
Reserve alkalinity, mL	5 min	D 1121
Chloride, ppm	25 max	D 3634
Silicon, ppm	125 max	under consideration
Effect on engine or vehicle finish	no effect	D 1882[B]

[A] Also report on the adjusted product.

[B] Currently, many heavy duty engine manufacturers and vehicle manufacturers that use these engines prepare test panels using the specific paint finishes employed on their actual products. Coolant and equipment builders should agree on the exact test procedures and acceptance criteria on an individual case basis.

TABLE 2 General Requirements of the Unadjusted Prediliuted Product

Property	Specified Values	ASTM Test Method
Color	Distinctive[A]	...
Effect on non-metals	No adverse affect	...
Storage stability	...	under consideration
Foaming		D 1881
Volume, mL	150 max	
Break time, s	5 max	

[A] Preferred color, green to blue-green.

6. Keywords

6.1 engine coolant; ethylene glycol; heavy-duty engine service; low-silicate coolant; prediluted

TABLE 3 Performance Requirements of the Adjusted[A] Prediluted Product

Property	Specified Values	ASTM Test Method
Corrosion in glassware		D 1384[B]
Weight loss, mg/specimen		
Copper	10 max	
Solder	30 max	
Brass	10 max	
Steel	10 max	
Cast iron	10 max	
Aluminum	30 max	
Simulated service test		D 2570[C]
Weight loss, mg/specimen		
Copper	20 max	
Solder	60 max	
Brass	20 max	
Steel	20 max	
Cast iron	20 max	
Aluminum	60 max	
Foaming		D 1881
Volume, mL	150 max	
Break time, s	5 max	
Cavitation-erosion	8 min	D 2809[D]
Rating for pitting cavitation or erosion of the water pump		

[A] See 5.4.

[B] The adjusted product shall be mixed with the proper quantity of Type IV reagent water (Specification D 1193) to provide the resulting solution with a freezing point of − 18 ± 1°C (0 ± 2°F). To each litre of test solution, add 99 mg of sodium sulfate, 110 mg of sodium chloride, and 92 mg of sodium bicarbonate.

[C] The adjusted product shall be mixed with the proper quantity of Type IV reagent water (Specification D 1193) to provide the resulting solution a freezing point of − 29± 1°C (−20 ± 2°F). To each litre of test solution, add 83 mg of sodium sulfate, 92 mg of sodium chloride, and 77 mg of sodium bicarbonate.

[D] One volume of the adjusted product shall be mixed with two volumes of Type IV reagent water (Specification D 1193). To each litre of test solution, add 123 mg of sodium sulfate, 137 mg of sodium chloride, and 115 mg of sodium bicarbonate.

APPENDIX

(Nonmandatory Information)

X1. COOLING SYSTEM MAINTENANCE

X1.1 Dilution of this product is not recommended. However, if circumstances require addition and prediluted aqueous engine coolant is not available, use an ethylene glycol base coolant concentrate diluted to 50 volume % with water of at least the quality outlined in Table X1.1.

X1.2 It is recommended that products meeting this specification shall have the following information on the package label:

X1.2.1 Prediluted engine coolant.

X1.2.2 Do not add water.

X1.2.3 Meets ASTM Specification D 5345.

X1.2.4 **Caution**—The freezing point of the new coolant is dependent on the amount of old coolant remaining in the cooling system at the time of filling. To determine the freezing point accurately, run the engine one hour or until the new and old coolants have mixed adequately.

X1.3 *Supplemental Coolant Additive (SCA)*—SCAs are used to provide additional protection from deposits, corrosion, and pitting, which may not be provided adequately by additives in the prediluted coolant. SCAs also extend the life of the coolant by adding to and replenishing the additives that deplete during normal operation. However, SCAs do not extend the freeze protection provided by the prediluted coolant.

X1.4 *Cooling Maintenance Recommendation:*

X1.4.1 If any of the following recommendations differ from the engine or vehicle manufacturer's recommendations, follow the latter's instructions.

X1.4.2 Use prediluted coolant meeting this specification or coolant prepared from concentrate meeting Specification D 4985.

X1.4.3 Drain and flush the cooling system annually, or as recommended by the vehicle manufacturer.

X1.4.4 Follow the engine or vehicle manufacturer's recommendations for SCA precharging of the cooling system after draining and flushing.

X1.4.5 Use accurate, reliable equipment such as a refractometer to measure ethylene glycol concentration for freeze protection.[5]

X1.4.6 Use the SCA manufacturer's recommended test kit when testing the coolant for proper SCA concentration. Test kits indicate the degree of liner pitting protection present in the coolant.

X1.4.7 Use prediluted coolant or coolant mixed at the desired proportions for makeup. Use distilled or deionized water or water of the quality given in Table X1.1 to dilute coolant concentrate.

X1.4.8 Use SCAs at recommended dosage to control deposits, corrosion, and pitting.

X1.4.9 Check bulk diluted coolant storage tanks periodically for separation of chemicals and contamination.

X1.4.10 *Do not* add undiluted coolant concentrate as make-up coolant.

X1.4.11 *Do not* add tap water as make-up coolant.

X1.4.12 *Do not* substitute precharge coolant filters for service filters; this will result in over treatment (pre-charge filters contain more SCA than maintenance filters).

X1.4.13 The maximum recommended ethylene glycol level is 60 % by volume, which provides freeze protection of − 52°C (−62°F). A coolant concentrate level greater than 68 % actually reduces freeze protection in ethylene glycol base coolants. Coolant containing 50 % by volume ethylene glycol provides freeze protection to − 37°C (−34°F).

X1.4.14 *Do not* exceed the recommended dosage of SCA or the recommended concentration of ethylene glycol. Over concentration can result in plugged radiators, heater cores, and charge air coolers. Over concentration can cause water pump seal leaks.

X1.4.15 *Do not* reuse coolant that has been drained from a vehicle where over concentration of ethylene glycol or over concentration of supplemental coolant additives has occurred, where the coolant is over one year old, or where the coolant collection container is dirty.

X1.4.16 *Do not* precharge the cooling system with SCA if the coolant is drained and reused.

X1.4.17 *Do not* use soluble oil additives.

X1.4.18 *Do not* use methyl alcohol or methoxy propanol base coolant concentrates.

X1.4.19 *Do not* use antileak additives if the 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.

TABLE X1.1 Suggested Water Quality Limits[A]

Property	Specified Values	ASTM Test Method
Total solids, ppm (grains/gal)	340 (20) max	D 1888
Total hardness, ppm (grains/gal)	170 (10) max	D 1126
Chloride, ppm (grains/gal)	40 (2.4) max	D 512, D 4327
Sulfate, ppm (grains/gal)	100 (5.9) max	D 516, D 4327
pH	5.5 to 9.0	D 1293

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

[5] Ethylene glycol concentration/freezing point may be determined using a refractometer (see Specification D 3321). Refractometers with the appropriate scales are available from the following: Misco Products, Division of Mercury Iron and Steel Co., 3401 Virginia Road, Cleveland, OH 44122; and Leica, Inc., P.O. Box 123, Buffalo, NY 14240.