Designation: D4985 – 10 (Reapproved 2015)

Standard Specification for Low Silicate Ethylene Glycol Base Engine Coolant for Heavy Duty Engines Requiring a Pre-Charge of Supplemental Coolant Additive (SCA)[1]

This standard is issued under the fixed designation D4985; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers the requirements for low silicate ethylene glycol base engine coolants for cooling systems of heavy-duty engines. When concentrates are used at 40 to 60 % 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 corrosion, freezing to at least −36.4°C (−33.5°F), and boiling to at least 108°C (226°F).

NOTE 1—This specification is based on the knowledge of the performance of engine coolants prepared from new or virgin ingredients. A separate specification exists (Specification D6210) for heavy-duty engine coolants which may be prepared from recycled or reprocessed used coolant or reprocessed industrial-source ethylene glycol.

1.2 Coolants meeting this specification require an initial charge of a supplemental coolant additive (SCA) and require 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 manufacturer 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:*[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
D3306 Specification for Glycol Base Engine Coolant for Automobile and Light-Duty Service
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 Related Fluids 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 Suppressed Ion Chromatography
D4725 Terminology for Engine Coolants and Related Fluids
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
D6129 Test Method for Silicon in Engine Coolant Concentrates by Atomic Absorption Spectroscopy
D6130 Test Method for Determination of Silicon and Other Elements in Engine Coolant by Inductively Coupled Plasma-Atomic Emission Spectroscopy
D6210 Specification for Fully-Formulated Glycol Base Engine Coolant for Heavy-Duty Engines
D6660 Test Method for Freezing Point of Aqueous Ethylene Glycol Base Engine Coolants by Automatic Phase Transition Method
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
E1177 Specification for Engine Coolant Grade Glycol

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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. Such engines are typically used in off-highway machinery for agriculture, mining, earth-moving, and construction; Class 5 to 8 over the road trucks and buses; high output stationary engine installations; and locomotive and marine installations. (See Specification D3306 for coolant requirements for automobiles, vans, and pickup class trucks.)

3.1.2 *supplemental 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.

3.2 *Definitions:*

3.2.1 *other glycols, n*—in ethylene glycol base engine coolant, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, tripropylene glycol, and 1,3-propanediol.

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

4. General Requirements

4.1 Ethylene glycol base engine coolant concentrates or prediluted ethylene glycol base engine coolants shall be formulated with ethylene glycol meeting Specification E1177, water, and shall contain suitable corrosion inhibitors, dye, and a foam suppressor. Other glycols, such as propylene and diethylene, may be included in concentrates up to a maximum of 15 % (7.5 % for prediluted coolants) if the physical and chemical properties in Table 1 are met.

4.2 All ethylene glycol base engine coolants shall conform to the general requirements in Table 2.

4.3 Prediluted coolants shall be prepared using deionized water that meets the following requirements:

Property	Specific Values	ASTM Test Method
Chlorides, µg/g (ppm (grains/gal))	25 (1.5) max	D5827, D512, D4327
Sulfate, µg/g (ppm (grains/gal))	50 (3.0) max	D5827, D516, D4327
Hardness, as $CaCO_3$, µg/g (ppm (grains/gal))	20 (1.2) max	D6130, D1126
pH	5.5 to 8.5	D1287, D1293
Iron, µg/g (ppm (grains/gal))	1.0 (0.06) max	D6130, E394

NOTE 2—Prediluted coolants are intended for direct addition to an engine cooling system with no further dilution.

This practice minimizes the formation of hard water scale and avoids the introduction of mineral components, such as

TABLE 1 Physical and Chemical Requirements

Property	Specific Values		ASTM Test Method
	Concentrate	Predilute	
Relative density, 15.5/15.5°C (60/60°F)	1.110 to 1.145	1.065 min	D1122, D5931
Freezing point,[A] °C (°F):			D1177, D6660
50 vol % in DI water	–36.4 (–33.5) max		
Undiluted		–36.4 (–33.5) max	
Boiling point,[B] °C (°F):			D1120
Undiluted	163 (325) min	108 (226) min	
50 vol % in DI water	108 (226) min		
Ash content, mass %	5 max	2.5 max	D1119
pH:			D1287
50 vol % in DI water	7.5 to 11		
Undiluted		7.5 to 11	
Reserve alkalinity, mL	report[C]	report[C]	D1121
Water, mass %	5 max	not applicable	D1123
Chloride ion, µg/g	25 max	25 max	D3634, D5827[D]
Silicon, µg/g	250 max	125 max	D6129, D6130
Effect on engine or vehicle 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 method. This should not be cause for rejection.
[C] Value as agreed upon between the supplier and the customer.
[D] In case of dispute, Test Method D3634 shall be the preferred test method.
[E] 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 suppliers and equipment builders should agree on the exact test procedures and acceptance criteria on an individual case basis.

[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 2 General Requirements

Property	Specific Values	ASTM Test Method
Color	distinctive	. . .
Effect on nonmetals	no adverse effect	under consideration

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.

4.4 When diluting engine coolant concentrates for actual service, municipal (treated) or a low-mineral content well water should be used (see Appendix X1, Table X1.1).

4.5 Diluted coolant concentrates or prediluted coolants, when mixed with 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).

5. Detailed Requirements

5.1 Ethylene glycol base engine coolant concentrate shall conform to the physical and chemical requirements in Table 1 and the performance requirements in Table 3.

5.2 Prediluted aqueous ethylene glycol base engine coolants (50 volume % minimum) shall conform to the physical and chemical property requirements in Table 1. The requirements listed in Table 1 for prediluted coolants are prescribed for the coolant as packaged, without further dilution or adjustment.

5.3 The freezing point of prediluted aqueous ethylene glycol base engine coolants, as packaged, shall be −36.4°C (−33.5°F) or lower.

5.4 If necessary, adjust the freezing point of the prediluted aqueous coolant to −36.4°C (−33.5°F) with deionized water before proceeding with performance testing.

5.5 Prediluted aqueous ethylene glycol base engine coolants shall conform to the performance requirements prescribed in Table 3, after any needed concentration adjustment.

6. Keywords

6.1 coolant requiring SCA pre-charge; engine coolant; ethylene glycol; heavy duty engine coolant; heavy duty engine service; low silicate engine coolant; prediluted

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:			
copper	10 max		
solder	30 max		
brass	10 max		
steel	10 max		
cast iron	10 max		
aluminum	30 max		
Simulated service test		D2570[C]	44
weight loss, mg/specimen:			
copper	20 max		
solder	60 max		
brass	20 max		
steel	20 max		
cast iron	20 max		
aluminum	60 max		
Foaming:		D1881[D]	33
Volume, mL	150 max		
Break time, s	5 max		
Cavitation-Erosion	8 min	D2809[E]	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. For prediluted engine coolants, prepare the test solutions using the directions provided in Footnotes B through E.

[B] For prediluted coolants, prepare the test solution by mixing 67 volume % of the adjusted (see 4.5) 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 4.5) 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 67 volume % of the adjusted (see 4.5) prediluted product with 33 volume % ASTM Type II reagent water.

[E] For prediluted coolants, prepare the test solution by mixing 33 volume % of the adjusted (see 4.5) 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.

APPENDIX

(Nonmandatory Information)

X1. COOLANT MAINTENANCE FOR HEAVY DUTY ENGINES

X1.1 *Engine Coolant*—Cooling system fill for a heavy-duty engine consists either of water, coolant concentrate (antifreeze) and supplemental coolant additive (SCA), or prediluted engine coolant and SCA.

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 for actual service, the water should be of such quality that it does not contain excessive solids, hardness, salts, sulfates, or chlorides. Contact your local water department, responsible government agency, or submit a water sample for analysis if there is any question about water quality. Follow the specific water quality recommendations of the engine or vehicle manufacturer or responsible servicing organization. In the absence of such recommendations, see Table X1.1.

X1.1.2 *Coolant Concentrate*—Ethylene glycol-base concentrate meeting this specification is recommended for freeze, boil-over, and corrosion protection. Maintain coolant concentrate (anti-freeze) concentration between 40 % (freeze protection to −24.4°C (−12.0°F)) and 60 % (freeze protection to −52.2°C (−62.0°F)), depending on operating environment.

X1.1.3 *Prediluted Engine Coolant*—Prediluted ethylene glycol base coolant (50 volume % antifreeze minimum) meeting this specification is recommended for freeze, boil-over, and corrosion protection. This product, as packaged, will provide freeze protection to −36.4°C (−33.5°F). Further dilution 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

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	D6130, D1126
Chloride (Cl^-), µg/g (ppm (grains/gal))	40 (2.4) max	D5827, D512, D4327
Sulfate (SO_4^{-2}), µg/g (ppm (grains/gal))	100 (5.9) max	D5827, D516, D4327
pH	5.5 to 9.0	D1287, D1293
Iron, µg/g (ppm (grains/gal))	1.0 (0.06) max	D6130, E394

[A]Suggested by the Engine Manufacturers' Association coolants subcommittee based on a survey of service recommendations of North American heavy duty diesel engine manufacturers.

X1.1.4 *Supplemental Coolant Additive (SCA)*—The SCAs are used to provide additional protection against deposits, corrosion, and pitting which may not be provided by the additives in coolant concentrates or prediluted engine coolants. The SCAs also extend the life of the coolant by adding to and replenishing the additives that deplete during normal operation. SCAs, however, do not extend the freeze protection provided by the coolant concentrate or the prediluted coolant.

X1.1.5 *Nonvirgin Coolants:*

X1.1.5.1 Current coolant product specifications are based on performance experience developed when these products are prepared from new or virgin ingredients. Therefore, this specification does not take into account the effect(s), if any, of any elements or chemical compounds that may have been added or may be residual, if the coolant product is prepared from recycled or reprocessed used coolant, or reprocessed reused industrial sourced glycols.

X1.1.5.2 ASTM Committee D15 has investigated the effects of potential contaminants and has established specifications for recycled and reformulated coolants.

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 Replace coolant at service intervals recommended by the engine manufacturer.

X1.2.3 Follow the engine or vehicle manufacturer's recommendations for SCA pre-charging of the cooling system after draining and flushing.

X1.2.4 Consult the coolant manufacturer, the SCA producer, and the engine manufacturer for recommendations on compatible SCAs.

X1.2.5 Use water that does not contain excessive solids, hardness, chloride, or sulfate.

X1.2.6 Use accurate, reliable equipment such as a refractometer to measure coolant concentrate levels for freeze protection.

X1.2.7 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. A service coolant analyses program can also be used to ensure proper maintenance of the engine or vehicle cooling system. Such analyses programs are available commercially.

X1.2.8 Check freezing point at two different levels when coolant concentrate and water is premixed and stored in bulk or drums to ensure mixing is complete before use.

X1.2.9 Use coolant mixed at the desired proportions for make-up.

X1.2.10 Use SCAs at recommended dosage to control deposits, corrosion, and pitting.

X1.2.11 Periodically check bulk premixed coolant storage tanks for separation of chemicals and contamination.

X1.2.12 DO NOT add undiluted coolant concentrate as make-up coolant.

X1.2.13 DO NOT add plain water as make-up coolant.

X1.2.14 DO NOT substitute pre-charge coolant filters for service filters; this will result in over treatment, (pre-charge filters contain more SCA than maintenance filters).

X1.2.15 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 freeze protection to −52.2°C (−62.0°F). Coolants containing 50 % coolant concentrate, or prediluted coolants (50 volume % minimum), provide freeze protection to −36.4°C (−33.5°F).

X1.2.16 DO NOT exceed the recommended dosage of SCA or the recommended concentrate of coolant concentrate. Over concentration can result in plugged radiators, heater cores, and charge air coolers. Over concentration can also cause water pump seal leaks.

X1.2.17 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.

X1.2.18 DO NOT pre-charge the cooling system with SCA if the coolant is drained and reused.

X1.2.19 DO NOT use soluble oil additives.

X1.2.20 DO NOT use methyl alcohol or methoxy propanol base coolant concentrates.

X1.2.21 DO NOT use antileak 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.

X1.3 *Prediluted Engine Coolants*:

X1.3.1 It is recommended that prediluted engine coolant products meeting this specification have the following information on the package label:

X1.3.1.1 Prediluted engine coolant,

X1.3.1.2 Do not add water,

X1.3.1.3 Meets ASTM Specification D4985, and

X1.3.1.4 (**Warning—**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.)

SUMMARY OF CHANGES

Committee D15 has identified the location of selected changes to this standard since the last issue (D4985-09) that may impact the use of this standard.

(1) A statement (X1.2.4) about coolant /SCA compatibility has been added to the nonmandatory Appendix X1 with a renumbering of subsequent sections.

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