Designation: D7714 – 11 (Reapproved 2016)ε1

Standard Specification for Glycerin Base Engine Coolant for Automobile and Light-Duty Service[1]

This standard is issued under the fixed designation D7714; 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 and Table X1.1 was editorially corrected in May 2016.

1. Scope

1.1 This specification covers the requirements for glycerin base engine coolants used in automobiles or other light duty service cooling systems. When concentrates are used at 50 to 60 % concentration by volume in water, or when prediluted glycerin 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	Glycerin base concentrate
II	Glycerin predilute (50 to 60 volume %)

NOTE 1—This specification is based on the knowledge of the performance of engine coolants prepared from new or virgin ingredients that comply with Specification D7640.

1.3 The values stated in SI units are to be regarded as the standard. The values 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.* See X1.5 and X3.1.3 for specific warning statements.

NOTE 2—This specification applies to automobiles and light duty service. A glycerin based specification for heavy duty engine service is under development.

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 April 1, 2016. Published May 2016. Originally approved in 2011. Last previous edition approved in 2011 as D7714-11. DOI: 10.1520/D7714-11R16E01.

[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.

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
D7640 Specification for Engine Coolant Grade Glycerin
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 Standards:*[3]
Federal Method 2540B Total Dissolved Solids Dried at 103-105°C

3. Terminology

3.1 *Definitions:*

3.1.1 *glycerin base engine coolant, n*—engine coolant in which the freeze point depressant is 1,2,3 propanetriol, with inhibitors to minimize foaming and corrosion.

3.1.2 *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.

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

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

4. General Requirements

4.1 Engine coolant concentrates or prediluted glycerin base engine coolants shall be formulated with glycerin meeting Specification D7640, water, and suitable corrosion inhibitors, dye, and a foam suppressor.

4.2 All engine coolant concentrates or prediluted glycerin base engine coolants shall be in accordance with the general requirements given in Table 1.

TABLE 1 General Requirements

Property	Specified Values	ASTM Test Method
Color	Distinctive	. . .
Effect on nonmetals	No adverse effect	Under consideration

4.3 Prediluted glycerin (Type II) base engine coolants shall be formulated using 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 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 not 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.

4.4 When diluting engine coolant concentrates for actual service, use municipal (treated) water, or low-mineral content well water (see Appendix X1, 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.

4.5 When installed in accordance with the vehicle manufacturer's recommendations and those on the product label, engine coolant concentrates or prediluted glycerin base engine coolants shall be suitable for use in a properly maintained cooling system (Appendix X1) in normal light-duty service for a minimum of one year without adversely affecting fluid flow and heat transfer.

5. Detailed Requirements

5.1 Glycerin base coolant concentrates and prediluted coolants shall be in accordance with 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 glycerin base coolants (Type II) shall be −°27.0°C (−°16.6°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 engine coolant; engine coolant concentrate; glycerin; light duty engine coolant; prediluted engine coolant

[3] *Standard Method for the Examination of Water and Wastewater,* American Public Health Association, et al, 800 I Street, NW, Washington, DC 20001, http://www.apha.org.

TABLE 2 Physical and Chemical Requirements

Property	Type I	Type II	ASTM Test Method
Relative density, 15.5/15.5°C (60/60°F)	1.249 to 1.265	1.130 min	
Relative density, 25/25°C (77/77°F)	1.252 to 1.262	1.127 min	D1122, D5931
Freezing Point, [A, B] °C (°F):			
50 % (vol) in DI water	-27.0 (-16.6) max		D1177, D6660
Undiluted		-27.0 (-16.6) max	
Boiling point,[C] °C (°F):			D1120
50 % (vol) in DI water	106 (223) min		
Undiluted	172 (342) min	106 (223) 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	
Chloride, µg/g	25 max	25 max	D3634, D5827[D]
Water, mass %	5 max	not applicable	D1123
Reserve alkalinity, mL	report[E]	report[E]	D1121
Effect on automotive finish (use clear coat thermoset urethane or acrylic urethane finish)	no effect	no effect	D1882[F]

[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] The blender/user should be advised that due to the relatively high density of glycerin; % vol and % mass are not interchangeable. For example, 50 % solution by volume is equivalent to 56 % by weight.
[C] Some precipitate may be observed at the end of the test. This should not be cause for rejection.
[D] In case of dispute, Test Method D3634 shall be the preferred test method.
[E] Value as agreed upon between the supplier and the customer.
[F] 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 % Glycerin Antifreeze
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		
Corrosion of cast aluminum alloys at heat-rejecting surfaces, mg/cm^2/week	1.0 max	D4340[D]	25
Foaming		D1881[E]	33
Volume, mL	150 max		
Break time, s	5 max		
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 4.4) 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 4.4) 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 4.4) 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 4.4) 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 4.4) 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

(Nonmandatory Information)

X1. COOLING 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 glycerin 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.

X1.1.4 Contact your local water department, the responsible government agency, or submit a water sample for analyses, if there is a question on water quality.

X1.1.5 The recommended coolant concentration range is 50 to 60 %.

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 X1.2).

TABLE X1.1 Suggested Water Quality Limits[A]

Property	Specific Values	Test Method
Total solids, †µg/g (ppm, grains/gal)	340 (20) max	Fed 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), †µg/g (ppm, grains/gal)	100 (5.9) max	D5827, D516, D4327
pH	5.5 to 9.0	D1287, D1293
Iron (Fe), †µg/g (ppm, grains/gal)	1.0 (0.6) max	D6130, E394

†Editorially corrected.

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

TABLE X1.2 Methods for Determining Freeze Points

Method	Glycerin
Refractometer[A]	yes
Hydrometer[B]	no
Test Strips[B]	no

[A] Shall be a refractometer with a glycerin freeze point scale.
[B] Field hydrometers and test strips have been developed by some manufacturers.

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 or equivalent.

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.

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, then remove. If coolant overflows when the cap is vented, immediately retighten and permit the system to cool further.

X2. DETERMINATION OF FREEZE POINT

X2.1 If glycerin, 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 relative density of EG base coolants. These hydrometers cannot be used to determine the freeze point of glycerin or PG base engine coolants or mixtures of glycerin, 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 glycerin shall be used to determine the freezing point of glycerin base coolants. A convenient and preferred means of determining the freeze points for glycerin coolants is by the refractometer (see Test Method D3321). Table X1.2 lists methods for determining the freeze point of glycerin base engine coolants. The refractometer provides the most accurate method for measuring freeze points in the field. Handheld refractometers are available for glycerin/water solutions. Dip–and-read test strips will provide only an approximation of freeze point for glycerin. Field test instruments for glycerin base coolants have been developed by some coolant manufacturers and are under development for wider market availability.

X2.2 It is recommended that glycerin 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 glycerin base coolant.

X3. LABELING

X3.1 It is recommended that prediluted engine 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.

X4. HANDLING

X4.1 Glycerin concentrate (Type I) engine coolant has a much higher viscosity than traditional glycol base engine coolants. It is recommended that the coolant manufacturer provide guidelines to the customer on proper handling and storage. In general, warm Type I glycerin concentrate to 110 to 120°F (43 to 49°C).