



# Standard Specification for Recycled Glycol Base Engine Coolant Concentrate for Automobile and Light-Duty Service<sup>1</sup>

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## 1. Scope\*

1.1 This specification covers the requirements for recycled ethylene glycol base engine coolant concentrate and recycled propylene glycol base engine coolant concentrate for use in automobiles and light-duty vehicles. Committee D15 has developed this specification using experience, knowledge and research from recycling used aqueous base engine coolant and blends of used aqueous base engine coolant and virgin glycol. This standard does not apply to coolant produced from other glycol sources such as medical waste, distillation bottoms, airplane/airport deicers and polyester production waste. This specification provides a procedure for evaluating engine coolant recycling technologies through the recycling of a reference synthetic used engine coolant. It also specifies the chemical, physical, and performance requirements for the recycled glycol base engine coolant concentrate that is produced from that procedure. When used at 40 to 70 volume % in water, it will function effectively during both winter and summer. This material is intended to provide protection against freezing, boiling, and corrosion in automobile or other light-duty service cooling systems.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are approximate equivalents and provided for information only.

1.3 *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:<sup>2</sup>

[D512 Test Methods for Chloride Ion In Water](#)

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D15 on Engine Coolants and Related Fluids and is the direct responsibility of Subcommittee D15.15 on Recycled Engine Coolant.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- [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](#)
- [D1176 Practice for Sampling and Preparing Aqueous Solutions of Engine Coolants or Antirusts for Testing Purposes](#)
- [D1177 Test Method for Freezing Point of Aqueous Engine Coolants](#)
- [D1193 Specification for Reagent Water](#)
- [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](#)
- [D2847 Practice for Testing Engine Coolants in Car and Light Truck Service](#)
- [D3306 Specification for Glycol Base Engine Coolant for Automobile and Light-Duty Service](#)
- [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](#)
- [D5827 Test Method for Analysis of Engine Coolant for Chloride and Other Anions by Ion Chromatography](#)

\*A Summary of Changes section appears at the end of this standard

**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

**D6208** Test Method for Repassivation Potential of Aluminum and Its Alloys by Galvanostatic Measurement

**D6660** Test Method for Freezing Point of Aqueous Ethylene Glycol Base Engine Coolants by Automatic Phase Transition Method

**D6471** Specification for Recycled Prediluted Aqueous Glycol Base Engine Coolant (50 Volume % Minimum) for Automobile and Light-Duty Service

### 2.2 Other Documents:

**Federal Method 2540B** Total Dissolved Solids Dried at 103–105°C<sup>3</sup>

**GM 6043M**—Automotive Engine Coolant Concentrate—Ethylene Glycol Type<sup>4</sup>

**GM 1825M**—Automotive Engine Coolant Concentrate—Ethylene Glycol; §3.11 Storage Stability and Compatibility<sup>5</sup>

## 3. Reagents and Materials

3.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available<sup>6</sup>. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

3.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type IV of Specification **D1193**.

## 4. Procedure

4.1 In order to properly evaluate a coolant recycling technology, a reference synthetic used coolant (**Annex A1**) is to be used as the feed stock. The reference synthetic used coolant shall be prepared in accordance with **Annex A1**. An appropriately sized batch of reference synthetic used coolant is to be prepared and used to purge the recycling process components and yield enough consistent product to complete the testing specified within this specification

4.2 Prepare the coolant recycling equipment or technology in accordance with the manufacturer's directions and recommendations.

4.3 Vigorously stir or mix the reference synthetic used coolant using appropriate vessels and mixing equipment immediately prior to and during the processing through the coolant recycling process.

4.4 Recycle the reference synthetic used coolant according to the manufacturer's directions and recommendations.

4.5 Evaluate the recycled coolant according to the requirements listed in this specification.

## 5. General Requirements

5.1 The recycled glycol base engine coolant concentrate shall consist essentially of ethylene glycol or propylene glycol obtained from the processing of light-, medium- or heavy-duty engine coolant products. The recycled glycol base engine coolant concentrate can in part contain virgin glycol. It also shall contain suitable corrosion inhibitors, a foam suppressor, and sufficient water to dissolve the additives.

5.1.1 Recycled ethylene glycol base engine coolant concentrates may be packaged and should be able to be poured at temperatures as low as –18°C (0°F). Other glycols such as propylene and diethylene glycol may be included up to a maximum of 15 % if the chemical and physical properties in **Table 1** are met.

5.1.2 Recycled propylene glycol base engine coolant concentrates may contain glycols other than propylene glycol up to 1 % provided the chemical and physical properties of **Table 1** are met..

5.2 The recycled glycol base engine coolant concentrate shall conform to the chemical and physical properties in **Table**

**TABLE 1 Physical and Chemical Requirements**

| Property   | Ethylene Glycol Base Specific Values | Propylene Glycol Base Specific Values | ASTM Test Method                |
|--|--------------------------------------|---------------------------------------|---------------------------------|
| Relative density, 15.5°C (60/60°F)   | 1.110 to 1.145                       | 1.030 to 1.065                        | <b>D1122, D5931</b>             |
| Freezing point, 50 volume % in distilled water, C ( )                                      | –36.4 (–33.5) max or lower           | –31 (–23.8) max or lower              | <b>D1177, D6660</b>             |
| Boiling point <sup>A</sup> , undiluted, °C (°F) 50 volume % in distilled water             | 163 (325) min<br>107.8 (226) min     | 152 (305) min<br>104 (219) min        | <b>D1120</b><br><b>D1120</b>    |
| Effect on automotive finish (use clear coat thermoset urethane or acrylic urethane finish) | no effect                            | no effect                             | <b>D1882<sup>B</sup></b>        |
| Ash content, mass %  | 5 max                                | 5 max                                 | <b>D1119</b>                    |
| pH, 50 volume % in distilled water   | 7.5 to 11.0                          | 7.5 to 11.0                           | <b>D1287</b>                    |
| Chloride, ppm  | 25 max                               | 25 max                                | <b>D3634<sup>C</sup>, D5827</b> |
| Sulfate, ppm   | 100 max                              | 100 max                               | <b>D5827</b>                    |
| Water, mass %  | 5 max                                | 5 max                                 | <b>D1123</b>                    |
| Reserve alkalinity, mL   | Report <sup>D</sup>                  | Report <sup>D</sup>                   | <b>D1121</b>                    |

<sup>A</sup>Some precipitate may be observed at the end of the test. This should not be cause for rejection.

<sup>B</sup>Currently, many vehicle manufacturers prepare test panels using the specific paint finishes employed on their actual product. Coolant suppliers and vehicle manufacturers should agree on the exact test procedures and acceptance criteria on an individual basis.

<sup>C</sup>In case of dispute, Test Method **D3634** shall be the preferred method.

<sup>D</sup>Agreed value between the supplier and the customer.

<sup>3</sup> Standard Method for the Examination of Water and Wastewater. American Public Health Association, et al, 1015 15th Street, N.W. Washington, DC 20005.

<sup>4</sup> Applicable rewrite available in Annex A2.

<sup>5</sup> Applicable rewrite available in Annex A3.

<sup>6</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

1. If the recycled glycol base engine coolant concentrate contains chloride, or sulfate levels greater than the requirements specified in [Table 1](#), fleet testing requirements described in [Section 6](#) shall be met. If the chloride, or sulfate requirements, or both, in [Table 1](#) are met, fleet testing is not required.

NOTE 1—The intention of conducting fleet testing is to verify that the effects of residual contaminants left in the recycled glycol base engine coolant are neutralized through real world application in a fleet test. Due to the fact that there are not enough industry field test data available to support setting hard specification limits, the fleet test requirements in [Section 6](#) specify a protocol and limits based on comparing the recycled glycol base engine coolant to an industry standard reference engine coolant that is known to adequately protect modern day cooling systems from corrosion.

5.3 The recycled glycol base engine coolant concentrate shall conform to the general requirements in [Table 2](#).

**TABLE 2 General Requirements**

| Property            | Specified Values  | ASTM Test Method |
|---------------------|-------------------|------------------|
| Color               | Distinctive       | —                |
| Effect on nonmetals | No adverse affect | —                |

5.4 The recycled glycol base engine coolant concentrate shall be in accordance with the performance requirements in [Table 3](#).

5.5 When preparing solutions for actual service, use municipal (treated) water, or low mineral content well water. If such water is not available, then use deionized (demineralized) or distilled water. This practice will minimize the formation of hard water scale and avoid the introduction of aggressive contaminants, such as chlorides and sulfates, that can increase

**TABLE 3 Performance Requirements**

| Property  | Specific Values                                     | ASTM Test Method |
|---|---|------------------|
| Corrosion in glassware; weight loss, mg/specimen  |   | D1384            |
| Copper  | 10 max  |                  |
| Solder  | 30 max  |                  |
| Brass   | 10 max  |                  |
| Steel   | 10 max  |                  |
| Cast iron   | 10 max  |                  |
| Cast aluminum   | 30 max  |                  |
| Simulated service test; weight loss, mg/specimen  |   | D2570            |
| Copper  | 20 max  |                  |
| Solder  | 60 max  |                  |
| Brass   | 20 max  |                  |
| Steel   | 20 max  |                  |
| Cast iron   | 20 max  |                  |
| Cast aluminum   | 60 max  |                  |
| Corrosion of cast aluminum alloys at heat-rejecting surfaces; weight loss, mg/cm <sup>2</sup> /week | 1.0 max   | D4340            |
| Foaming   |   | D1881            |
| Volume, mL  | 150 max   |                  |
| Break time, s   | 5 max   |                  |
| Cavitation-Erosion rating for pitting, cavitation, or Erosion of the water pump, rating             | 8 min   | D2809            |
| Aluminum galvanostatic pitting potential, V v SHE   | –0.40 min   | D6208            |
| Fleet Test  | see <a href="#">6.8</a> and appropriate subsections |                  |

the corrosion rate of aluminum and iron (see [Appendix X1](#) for additional information).

5.6 The product, when installed in accordance with the recommendations of the manufacturer of the vehicle or the coolant recycling process, and those on the product label, shall be suitable for use in a properly maintained cooling system (see [Appendix X1](#)) in normal passenger car service for a minimum of one year without adversely affecting fluid flow and heat transfer.

## 6. Fleet Testing Requirements

6.1 *Engine Coolants*—Reference engine coolant concentrate (see [Annex A2](#)) and recycled engine coolant concentrate shall be used to conduct the fleet testing.

6.2 *Vehicles*—A minimum of fourteen vehicles is recommended to start the test: seven containing reference engine coolant concentrate (control vehicles) and seven containing recycled engine coolant concentrate (test vehicles). A minimum of five control vehicles and five test vehicles shall finish the test. Starting with fourteen vehicles allows for vehicles to drop out of the test for various reasons, that is, mechanical failure, coolant contamination, etc.

6.2.1 *Vehicle Selection*—All vehicle cooling systems should be inspected prior to selection. Vehicles with corroded cooling systems should not be used for testing purposes. Vehicle selection shall be made as follows:

6.2.1.1 Control vehicles and test vehicles shall be matched pairs and be new or have similar low mileage accumulation.

6.2.1.2 Same year, make, and model.

6.2.1.3 Similar mileage and cooling system conditions.

6.2.1.4 Same cooling system and power train configuration.

6.2.1.5 Aluminum head(s), aluminum radiator, aluminum heater core, and aluminum water pump (housing).

6.2.1.6 Cast iron block (optional).

NOTE 2—Vehicles equipped with cast iron heads may be tested in addition to those specified above. A minimum of five control vehicles and five test vehicles, equipped with aluminum heads, shall complete the test and be included in the conclusive analysis report.

6.2.2 *Vehicle Setup*—All vehicles shall be set up in accordance with [Practice D2847](#) unless otherwise specified within this specification.

6.2.2.1 All vehicles shall be set up with a new aluminum head(s), aluminum radiator, aluminum water pump, thermostat, hoses, belts and radiator/cooling system cap. Installation of new heater cores is recommended. New aluminum heads and radiators are required, as they will be sectioned for evaluation at the end of the test.

6.2.2.2 Each vehicle shall be set up with six coupon bundles in the bypass heater circuit coupon bundle capsule(s). Once the test has been started, no additional or replacement corrosion coupon bundles can be added to any of the vehicle cooling systems. The coupon bundle capsule(s) should be arranged in the cooling system to minimize the amount of coolant spillage when bundles are removed throughout the testing period. More than one coupon bundle capsule may be used in the bypass heater circuit in series if the vehicle design does not accommodate the incorporation of a single capsule.