Designation: D8085 – 17

Standard Specification for Non-Aqueous Engine Coolant for Automobile and Light-Duty Service[1]

This standard is issued under the fixed designation D8085; 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 non-aqueous engine coolants used in automobiles or other light-duty service cooling systems. Non-aqueous coolants that conform to the specification will function effectively to provide protection against freezing, boiling, and corrosion without any further dilution. This specification is based upon the knowledge of the performance of non-aqueous engine coolants prepared from new individual or mixtures of virgin industrial grade diols.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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.* See X1.4 for a specific warning statement.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

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

D1287 Test Method for pH of Engine Coolants and Antirusts

D1882 Test Method for Effect of Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles

D2983 Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield Viscometer

D3634 Test Method for Trace Chloride Ion in Engine Coolants

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

D7840 Test Method for Foaming Tendencies of Non-Aqueous Engine Coolants in Glassware

D7896 Test Method for Thermal Conductivity, Thermal Diffusivity and Volumetric Heat Capacity of Engine Coolants and Related Fluids by Transient Hot Wire Liquid Thermal Conductivity Method

D7934/D7934M Test Method for Corrosion of Cast Aluminum Alloys in Non-Aqueous Engine Coolants Under Heat-Rejecting Conditions

D7935/D7935M Test Method for Corrosion Test for Non-Aqueous Engine Coolants in Glassware

D8034/D8034M Test Method for Simulated Service Corrosion Testing of Non-Aqueous Engine Coolants

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 *Definitions:*

3.1.1 *non-aqueous coolant, n*—a glycol, diol, triol, or mixtures thereof, based heat transfer fluid containing less than 1.0 % water when formulated and intended for final use without dilution with water.

[1] This specification is under the jurisdiction of ASTM Committee D15 on Engine Coolants and Related Fluids and is the direct responsibility of Subcommittee D15.22 on Non-Aqueous Coolants.

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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.

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

4. General Requirements

4.1 Engine coolant consisting of a glycol, diol, triol, or mixtures thereof, and suitable corrosion inhibitors, dye, foam suppressor, if needed, bitterant, and less than 1.0 % water.

4.2 The engine coolant 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 When installed in accordance with the vehicle manufacturer's recommendations and those on the product label, non-aqueous 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 All non-aqueous engine coolants shall be in accordance with the physical and chemical requirements prescribed in Table 2.

5.2 All non-aqueous engine coolants shall conform to the performance requirements listed in Table 3.

TABLE 2 Physical and Chemical Requirements for Non-Aqueous Coolants

NOTE 1—Except as indicated in the Property column, any dilutions are part of the ASTM Test Methods indicated.

Property	Limits	ASTM Test Method
Relative density, 15.5/15.5 °C:	1.035 to 1.125	D1122, D5931
Dynamic viscosity at -40 °C,[A] Pa·s:	2.0 max	D2983
Boiling point, °C:	177 min	D1120
Thermal Conductivity at 20 °C, W/m·K:	0.24 min	D7896
Flash point, closed cup, °C:	115 min	D93
Ash content, mass %:	5 max	D1119
pH, 50 vol % in DI water:	7.5 to 11	D1287
Chloride, µ/g:	25 max	D3634, D5827[B]
Water, mass %:	1.0 max	D1123
Reserve alkalinity, mL:	report[C]	D1121
Effect on automotive finish (use clear coat thermoset urethane or acrylic urethane finish):	no effect	D1882[D]

[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] In case of dispute, Test Method D3634 shall be the preferred test method.
[C] Value as agreed upon between the supplier and the customer.
[D] 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 for Non-Aqueous Coolants[A]

Property	Specific Values	ASTM Test Method	Test Solution Concentration vol % product
Corrosion in glassware		D7935/D7935M	94
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		D8034/D8034M	94
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	D7934/D7934M	94
Foaming		D7840	100
Volume, mL	150 max		
Break time, s	5 max		

[A] All non-aqueous engine coolant test solutions in Table 3 shall be prepared in accordance with the directions provided in the individual ASTM test methods noted.

6. Keywords

6.1 light duty engine coolant; non-aqueous engine coolant; waterless engine coolant

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 If the pre-existing coolant is aqueous, special care should be taken to remove as much of the old coolant as possible, following the recommendations of the non-aqueous coolant manufacturer. Follow up the water removal with a glycol-based system preparation fluid to absorb remaining amounts of water. Operate the engine and then drain it out. Dispose of the used coolant and the used preparation fluid in accordance with all governmental regulations.

X1.1.3 Fill the system with the non-aqueous engine coolant. Do not combine water with the engine coolant.

X1.1.4 Example of using a preparation fluid to reduce water content of a retrofitted installation: Assume starting with an 8 L cooling system containing 50 % glycol and 50 % water and that one can drain 80 % from the system. *1*) Remaining after drain: 0.8 L old glycol and 0.8 L water; *2*) Add 6.4 L preparation fluid, operate engine, and drain 80 %, leaving 0.16 L old glycol and 0.16 L water; *3*) Fill system with the non-aqueous coolant. The remaining old glycol is 0.16/8 = 2.0 %. The remaining water is 0.16/8 = 2.0 %.

X1.2 Essential Cooling System Service

X1.2.1 Check coolant water content (a good aftermarket installation will contain 3 % water or less.) Water content above 6 % may be termed excessive. Excessive water decreases the high boiling point of the non-aqueous coolant. Excessive water may cause corrosion. Excessive amounts of water, even hugely excessive amounts (for example, as much as 40 %) will not cause the coolant to freeze at temperatures above -40 °C. The easiest method for determining water content is to use test strips offered by the coolant manufacturer.

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.

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 If non-aqueous coolant needs to be added, never add water as well.

X1.4 **Warning—**Do not remove the cooling system pressure cap when the engine is hot. Always treat a hot cooling system with caution and respect. The cooling system may be under pressure. When the engine has cooled, carefully loosen the pressure cap 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. LABELING

X2.1 It is recommended that non-aqueous engine coolants meeting this specification have the following information on the package label:

X2.1.1 Non-aqueous (or waterless) engine coolant.

X2.1.2 Do not add water.

X3. THERE IS NO PUMP CAVITATION TEST FOR THIS SPECIFICATION

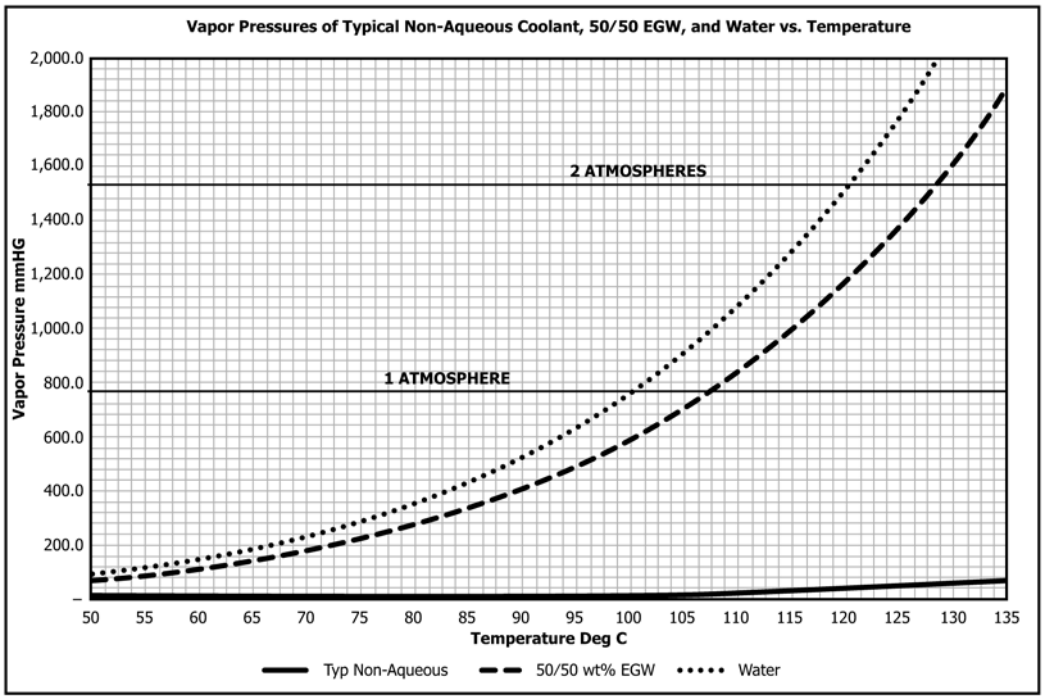

FIG. X3.1 Vapor Pressures of Typical Non-Aqueous Coolant, 50/50 EGW, and Water vs. Temperature

X3.1 ASTM specifications for aqueous coolants routinely include a pump cavitation performance test requirement. Pump cavitation is the formation and subsequent collapse or implosion of coolant vapor in the pump. Coolant pumps are centrifugal pumps and they produce a low pressure area at the inlet and a high pressure area at the outlet. If the absolute pressure on the coolant at the low pressure area is less than the vapor pressure of the coolant, vaporization of the coolant will occur. Coolant vapor that moves to the high pressure area of the pump collapses violently in an abrupt condensation. The violence of the implosion of coolant vapor causes erosion and pitting inside the pump. Non-aqueous coolants that conform to the herein specification will not vaporize inside of a pump because of their high boiling points and very low vapor pressures at all reasonable coolant temperatures. Fig. X3.1 shows the vapor pressure relationships between water, 50/50 EGW, and a typical non-aqueous engine coolant.

X4. ABOUT THE DYNAMIC VISCOSITY TEST AT -40 °C

X4.1 Passing the dynamic viscosity test at -40 °C establishes that the dynamic viscosity does not exceed 2.0 Pa·s at that temperature. It also establishes that the non-aqueous coolant has no freezing symptoms at -40 °C. If a non-aqueous coolant were to have any incipient freezing characteristics whatever at -40 °C, it could not pass the 2.0 Pa·s requirement.

NOTE X4.1—Typically, a mixture of EG, together with a second diol in the range of 10 to 30 weight percent, may meet the 2.0 Pa·s requirement at -40 °C.