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Standard Specification for Heat Transfer Fluids (HTF) for Heating and Air Conditioning (HVAC) Systems[1]

This standard is issued under the fixed designation D8039; 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 ethylene glycol, propylene glycol, 1,3 propanediol as well as glycerin base heat transfer fluids (HTF) used in heating and air conditioning (HVAC) systems. When concentrates are used at up to 65 % concentration by weight in water, or when prediluted heat transfer fluids (30 % by weight minimum) are used without further dilution, they will function effectively to provide protection against freezing, and corrosion.

1.2 The fluids described in this specification are not appropriate for use in systems where internal combustion engines (gasoline, diesel, or CNG/LPG) are used.

1.3 The heat transfer fluids governed by this specification are categorized as follows by the primary base of freeze depressant used:

Heat Transfer Fluid Type	Description
I	Ethylene glycol
II	Propylene glycol
III	1,3-Propanediol
IV	Glycerin

1.4 Heat transfer fluids meeting this specification shall be tested and fully comply with requirements listed in Table 1.

NOTE 1—This specification is based on the knowledge of the performance of heat transfer fluids prepared from new or virgin ingredients. This specification shall also apply to heat transfer fluids prepared using materials generated from recycled or reprocessed ingredients, provided that these ingredients meet the requirements of Specifications E1177 and D7388 for Glycols and Specification D7640 for Glycerin.

NOTE 2—This specification addresses concentrated inhibited glycols and glycerol that will be mixed with water for use in various climates and prediluted heat transfer fluids (HTF) that are factory-blended with purified water. A table of estimated freeze protection temperatures at appropriate dilutions is provided in Appendix X1.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D512 Test Methods for Chloride Ion In Water
D516 Test Method for Sulfate Ion in Water
D1121 Test Method for Reserve Alkalinity of Engine Coolants and Antirusts
D1122 Test Method for 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
D1881 Test Method for Foaming Tendencies of Engine Coolants in Glassware
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

[1] This specification is under the jurisdiction of ASTM Committee D15 on Engine Coolants and Related Fluids and is the direct responsibility of Subcommittee D15.30 on Industrial Heat Transfer Fluids.

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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.

TABLE 1 Physical and Chemical Requirements for Heat Transfer Fluids[A]

Property	Type 1 Ethylene Glycol	Type II Propylene Glycol	Type III 1,3-Propanediol	Type IV Glycerin	ASTM Test Method
Relative density 15.5/15.5 °C (60/60 °F)	report[B]	report[B]	report[B]	report[B]	D1122, D5931[C]
Freezing point,[D, B] °C (°F), undiluted	-16 °C (+4 °F) min	-13 °C (+9 °F) min	-13 °C (+9 °F) min	-10 °C (+15 °F) min	D1177, D6660[E]
pH, undiluted	7.5 to 11	7.5 to 11	7.5 to 11	7.5 to 11	D1287
Chloride, µg/g	30 max	30 max	30 max	30 max	D5827
Water, mass %[B]	70 max	70 max	70 max	70 max	D1123
Reserve alkalinity, mL	report[B]	report[B]	report[B]	report[B]	D1121

[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] Value as agreed upon between the supplier and the customer.
[C] In case of dispute, Test Method D1122 is the preferred test method.
[D] Test Methods D1177 and D6660 work with glycol/glycerin mixtures.
[E] In case of dispute, Test Method D1177 is the preferred test method.

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
D7388 Specification for Engine Coolant Grade 1,3-Propanediol (PDO)
D7640 Specification for Engine Coolant Grade Glycerin
D8040 Test Method for Corrosion Test for Heat Transfer Fluids in Glassware
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 Solids Dried at 103-105°C

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *glycerin, n*—Specification D7640 grade glycerin for engine coolant.

3.1.2 *heat transfer fluid concentrate, n*—a formulated liquid product intended to be diluted with water for use in heating and air conditioning systems.

3.1.3 *other glycols, n*—in ethylene glycol base heat transfer fluid, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropelene glycol, tripropelene glycol, and 1,3-propanediol.

3.1.4 *other glycols, n*—in propylene glycol base heat transfer fluids, ethylene glycol, triethylene glycol, tetraethylene glycol, dipropelene glycol, tripropelene glycol, and 1,3-propanediol.

3.1.5 *prediluted heat transfer fluid, n*—a commercially prepared uniform solution (30 % by weight minimum) of ethylene glycol, propylene glycol, 1,3-propanadiol or glycerin based heat transfer fluid concentrate and deionized water (demineralized).

3.1.6 *ready-to-use heat transfer fluid, n*—a formulated liquid product (30 % by weight minimum) of ethylene glycol, propylene glycol, 1,3-propanadiol or glycerin base intended to be used in heating and air conditioning system without any further dilution.

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

4. General Requirements

4.1 Heat transfer fluid concentrates or prediluted heat transfer fluids shall be formulated with glycols or glycerols (meeting the requirements of Specifications E1177 and D7388 for glycols and Specification D7640 for glycerin), water, suitable corrosion inhibitors, dye, and a foam suppressor.

4.2 Ethylene glycol base heat transfer fluid concentrate (Type I) may contain a maximum of 15 % other glycols, as long as the physical, chemical, and performance requirements of this specification can be met. Similarly, prediluted ethylene glycol base heat transfer fluids (30 % by weight minimum) may contain a maximum 4.5 % other glycols as long as all of the requirements of this specification can be met.

4.3 Propylene glycol and 1,3-propanediol base heat transfer fluid concentrates (Types II and III) may contain a combined maximum of 1 % other glycols (less than 0.3 % for prediluted base heat transfer fluids) as long as the physical, chemical, and performance requirements of this specification can be met.

4.4 Glycerin base heat transfer fluid (Type IV) may contain a combined maximum of 99.5 % glycerin but not less than less than 30 % for prediluted base heat transfer fluids as long as the physical, chemical, and performance requirements of this specification can be met.

4.5 All heat transfer fluids concentrates or prediluted base heat transfer fluids shall conform to the general requirements given in Table 1 and performance specifications given in Table 2.

[3] Method from *Standard Methods for the Examination of Water and Wastewater*, latest edition. Available from The Standard Methods Organization, http://www.standardmethods.org.

TABLE 2 Performance Requirements[A]

Property	Specific Values	ASTM Test Method
Corrosion in glassware		D8040[A]
Weight loss, mg/specimen:		
copper	10 max	
solder	30 max	
brass	10 max	
steel	10 max	
cast iron	10 max	
aluminum	30 max	
Foaming:		D1881[B]
Volume, mL	150 max	
Break time, s	5 max	

[A] HTF test solutions shall be prepared as outlined in the test method.
[B] Test the solution as it is intended to be used without the corrosive salts.

4.6 Prediluted heat transfer fluids (Types I through IV) shall be formulated using water that meets the requirements of Table 3.

4.7 When diluting heat transfer concentrates for actual service, use deionized (demineralized) or distilled water, or a low mineral content tap water (Table 4). 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.

TABLE 3 Requirements for Water Used in Prediluted HTFs

Property	Specific Values	ASTM Test Method
Total hardness, µg/g	20 max	D6130, D1126
Chloride (Cl^-), µg/g	25 max	D5827, D512, D4327
Sulfate (SO_4^{-2}), µg/g	50 max	D5827, D516, D4327
pH	5.5 to 8.5	D1287, D1293
Iron, ppm	1.0 max	D6130, E394

TABLE 4 Suggested Water Quality Limits

Property	Specific Values	ASTM Test Method
Total solids, µg/g	340 max	Fed. Method 2540B
Total hardness, µg/g	170 max	D6130, D1126
Chloride (Cl^-), µg/g	40 max	D5827, D512, D4327
Sulfate (SO_4^{-2}), µg/g	100 max	D5827, D516, D4327
pH	5.5 to 9.0	D1287, D1293

4.8 When installed in accordance with the HVAC system or fluid manufacturer's recommendations, HTF concentrates or prediluted HTFs shall be suitable for use in a properly maintained heat transfer system (Appendix X1) in normal service for a minimum of one year without adversely affecting fluid flow and heat transfer.

5. Detailed Requirements

5.1 Glycol and glycerol heat transfer fluid concentrates and prediluted HTFs shall conform to the physical and chemical requirements prescribed in Tables 1 and 2 depending on heat transfer fluid type (see 1.3).

5.2 HTF concentrates shall be diluted for performance testing as described in the individual ASTM test methods.

5.3 Prediluted heat transfer fluid (30 % by weight minimum) for all types, shall be prepared as described in Table 2, Footnotes A and B.

6. Keywords

6.1 1,3-propanediol; ethylene glycol; glycerin; heating and air conditioning system (HVAC); heat transfer fluid (HTF); heat transfer fluid concentrate; prediluted heat transfer fluid; propylene glycol; ready-to-use heat transfer fluid

APPENDIX

(Nonmandatory Information)

X1. FLUID MAINTENANCE FOR HEATING AND AIR CONDITIONING SYSTEMS

X1.1 Before installing the heat transfer fluid, the HVAC system should be inspected and necessary service work completed.

X1.2 The HVAC system fill should consist of heat transfer fluid concentrate and water (30 % by weight minimum) or prediluted heat transfer fluid (30 % by weight minimum) of Types I through IV.

X1.3 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 HVAC system manufacturer, see Table 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.

X1.4 The recommended ready-to-use heat transfer fluid concentration range is 30 % to 65 %.

X1.5 Check heat transfer fluid level and condition. Replace HTF at service intervals recommended by the HVAC system manufacturer or designated service organization. Follow the recommended practices.

X1.6 Mix heat transfer fluid concentrate and water before adding to the HVAC system.

X1.7 When preparing additions or when replacing the heat transfer fluid in the system, use clean, low mineral content water.

X1.8 If propylene glycol (PG), 1,3 propanediol (PDO), or ethylene glycol (EG) base HTFs are mixed with glycerin in the HVAC system, problems may result when attempting to determine the freezing point in the field.

X1.9 The use of a calibrated temperature, self-adjusted refractometer can provide the most accurate method for measuring freeze points in the field. Dip-and-read test strips are