Designation: D5752 – 10 (Reapproved 2017)

Standard Specification for Supplemental Coolant Additives (SCAs) for Use in Precharging Coolants for Heavy-Duty Engines[1,2]

This standard is issued under the fixed designation D5752; 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 general, physical, chemical, and performance requirements for Supplemental Coolant Additives (SCAs) at a precharged level in the cooling systems of heavy-duty engines.

NOTE 1—After precharging, SCAs are customarily used periodically to service cooling systems at ¼ to ⅓ the precharged dosage to compensate for additives lost through dilution and depletion.

1.2 The SCA products meeting this specification are intended for use with water, with recommended dilutions of coolant concentrates, with prediluted engine coolants, or to upgrade the performance of light-duty engine coolants to meet the heav-duty requirements of Specification D6210. Engine coolant products shall be of the low-silicate type and, if ethylene glycol based, shall meet Specification D4985. Propylene glycol base low-silicate type coolant products may also be used, if these materials meet the chemical and performance requirements of Specification D4985.

1.3 The SCA concentrate, before dissolution, may be in either liquid, solid, or slurry form. The form is as agreed upon between the manufacturer and the user.

1.4 The values stated in SI units are to be regarded as standard. The inch-pound units in parentheses are approximate equivalents provided for information only.

1.5 *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.*

1.6 *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:*[3]

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
D1121 Test Method for Reserve Alkalinity of Engine Coolants and Antirusts
D1126 Test Method for Hardness in Water
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
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
D4985 Specification for Low Silicate Ethylene Glycol Base Engine Coolant for Heavy Duty Engines Requiring a Pre-Charge of Supplemental Coolant Additive (SCA)
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.

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[2] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report: RR:D15-1024.

[3] 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**

D5828 Test Method for Compatibility of Supplemental Coolant Additives (SCAs) and Engine Coolant Concentrates
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
D6471 Specification for Recycled Prediluted Aqueous Glycol Base Engine Coolant (50 Volume % Minimum) for Automobile and Light-Duty Service
D6472 Specification for Recycled Glycol Base Engine Coolant Concentrate for Automobile and Light-Duty Service
E1177 Specification for Engine Coolant Grade Glycol
G32 Test Method for Cavitation Erosion Using Vibratory Apparatus

2.2 *Other Document:*
Federal Method 2540B Total Dissolved Solids Dried at 103–105°C[4]

3. General Requirements

3.1 The SCA concentrate upon addition to water or water/glycol mixtures at the SCA manufacturer's recommended addition level shall provide the same performance as coolants meeting Specification D6210, except for freeze and boil protection.

3.2 Liquid SCA concentrates shall be storable in the manufacturer's original container at temperatures from −7 to +55 °C (20 to 130 °F) without chemical change. Any precipitation of ingredients evidenced by the dropout of solid material or liquid turbidity shall disappear upon agitation and warming of the solution to a temperature exceeding 2 °C (35 °F).

3.3 Solid, slurry, and paste forms of SCA concentrate shall be so formulated and packaged as to prevent chemical or physical change during storage before use. This requirement applies to storage temperatures of −7 to +55 °C (20 to 130 °F), regardless of humidity.

3.4 The SCA concentrates, when used according to the manufacturer's recommendations, shall dissolve totally in the test solutions required in this specification. A light haze is permitted.

3.5 If an engine, vehicle, or servicing organization recommends adding a precharge dosage of an SCA product to a fully formulated coolant governed by Specification D6210, that organization assumes responsibility for determining the compatibility and conducting suitable tests. ASTM has developed a compatibility test (Test Method D5828), which may be used. At the present time, it is recommended that precharge doses of SCAs be used only in conjunction with coolant products meeting Specification D4985.

4. Preparation of Test Solutions

4.1 The preparation of test solutions for this specification is listed in Table 1. The glycol used, either ethylene glycol or propylene glycol, shall meet Specification E1177. Where distilled water is required, it shall conform to Type IV of Specification D1193.

4.2 The quantity of any freshly prepared test solution required in this specification shall be sufficient to perform the specific tests. However, no test solution shall be stored longer than 96 h before initiation of a specific procedure.

5. Detailed Requirements

5.1 Test solutions prepared according to Table 1 shall meet the performance requirements in Table 2, the general requirements in Table 3, and the physical and chemical requirements in Table 4.

5.2 The SCAs shall additionally provide added protection in operating engines against cavitation corrosion (also termed liner pitting) and against scaling of internal engine hot surfaces. Hot surfaces are typically within the engine head, head spacer, or liquid-cooled exhaust manifold, oil coolers, after coolers, and exhaust gas recirculation (EGR) coolers. The American Society for Testing and Materials has test methods under development for both cavitation corrosion and hot surfaces scaling. Until these procedures are adopted as ASTM standards, the mandatory requirements of Annex A1 shall apply.

6. Keywords

6.1 heavy-duty engine coolants; precharging heavy-duty engines; SCA; supplemental coolant additives

TABLE 1 Composition of Test Solutions for Table 2 Performance Requirements[A]

Test Method	SCA Concentrate	Solvent Mixture
D1384	one-half manufacturer's recommended precharged level	standard corrosive water[B]
D1384	three times manufacturer's recommended precharged level	33 vol % glycol in standard corrosive water[B, C]
D1881	manufacturer's recommended precharge level	33 vol % glycol in standard corrosive water[B, C]
D2570	manufacturer's recommended precharge level	44 vol % glycol in standard corrosive water[B, C]
D2809	manufacturer's recommended precharge level	16.7 vol % glycol in standard corrosive water[B, C]
D4340	manufacturer's recommended precharge level	165-mg/L NaCl dissolved in a 1-L solution of 25 vol % glycol in deionized water[C, D]

[A] Test solution to be prepared according to Section 4.
[B] See Section 7 of Test Method D2570 for composition and method of preparation of standard corrosive water.
[C] The glycol used shall be ethylene glycol or propylene glycol and each shall meet Specification E1177.
[D] Water conforming to Type IV of Specification D1193 is acceptable.

[4] *Standard Method for the Examination of Water and Wastewater*, American Public Health Association, et al, 1015 15th Street, N.W. Washington, DC 20005.

TABLE 2 Performance Requirements[A]

Property	Specific Values	Test Method
Corrosion in glassware mass loss, mg/specimen		D1384
Copper	10 max	
Solder	30 max	
Brass	10 max	
Steel	10 max	
Cast iron	10 max	
Aluminum	30 max	
Simulated service test mass loss, mg/specimen		D2570
Copper	20 max	
Solder	60 max	
Brass	20 max	
Steel	20 max	
Cast iron	20 max	
Aluminum	60 max	
Foaming		D1881
Volume, mL	150 max	
Break time, s	5 max	
Water pump cavitation erosion-corrosion rating	8 min	D2809
Corrosion of cast aluminum alloys at heat-rejecting surfaces, mg/cm^2/week	1.0 max	D4340
Ultrasonic cavitation resistance	see Annex A1	under development
SCA-glycol base coolant compatibility	[B]	D5828
Hot surface scaling and deposits resistance[C]	...	under development

[A] Test solutions for use in meeting Table 2 performance requirements are to be prepared according to Table 1.
[B] SCA products may be required to meet a compatibility requirement. Although Test Method D5828 has been developed, ASTM has not established allowable limits. Until allowable limits have been approved, an agreement must be established between the SCA manufacturer and engine or vehicle user. This agreement shall include a definition of the test procedure, acceptable equipment, and the performance rating criteria.
[C] See Appendix X2 for additional information.

TABLE 3 General Requirements

Property	Specific Value	Test Method
Effect on nonmetals[A]	no adverse effect	under consideration
Storage stability	see 3.2 and 3.3	...

[A] Evaluate using the SCA concentrate at the manufacturer's recommended precharge level in a 50:50 volume mixture of distilled water and ethylene glycol or distilled water and propylene glycol, each glycol conforming to Specification E1177.

TABLE 4 Physical and Chemical Properties

Property[A]	Specific Values	Test Method
Ash content, dissolved in distilled water, mass, %	5 max	D1119
pH, in distilled water	7.5 to 11.0	D1287
Reserve alkalinity, in distilled water	report[B]	D1121
Chloride ion, in distilled water, ppm	25 max	D3634, D5827[C]
Silicon, in distilled water, ppm	250 max	D6129, D6130
Effect on vehicle finish	no effect[D]	D1882

[A] Property must be met with the specified solution, at an SCA precharge addition level recommended by the SCA manufacturer. (This is usually 3 % by volume.)
[B] Value agreed upon between the supplier and the customer.
[C] In case of dispute, Test Method D3634 shall be the preferred test method.
[D] Currently, many heavy-duty engine manufacturers and vehicle manufacturers that use these engines prepare test panels using the specific paint finishes used on their actual products. Coolant product manufacturers and equipment builders should agree on the exact test procedures and acceptance criteria on an individual case basis.

ANNEX

(Mandatory Information)

A1. CHEMICAL REQUIREMENTS FOR SCAs

A1.1 Test methods to determine cavitation corrosion resistance are under development. Several chemical compositions of SCAs have been extensively tested by producers and users and found to minimize satisfactorily cylinder liner cavitation in actual test engines. Until such time as an ASTM procedure is adopted that effectively evaluates cylinder liner cavitation corrosion, SCA formulations under this specification shall provide the following when used at the SCA manufacturer's recommended precharge addition level:

A1.1.1 A minimum concentration of nitrite as (NO_2^-) in the cooling system of 1200 ppm, or

A1.1.2 A minimum combined concentration of nitrite as (NO_2^-) plus molybdate as (MoO_4^{-2}) in the cooling system of 780 ppm. At least 300 ppm each of NO_2^- and MoO_4^{-2} must be present.

A1.1.3 Concentrations below the minimums detailed in A1.1.1 and A1.1.2 may not provide sufficient protection. (See X1.1.3.2 for further information.)

A1.2 Composition limits in A1.1 are waived provided:

A1.2.1 The SCA producer and engine manufacturer agree to specified composition limits for one or more chemical ingredients other than those stated in A1.1.

A1.2.2 Both parties agree to accept laboratory data or in-service performance experience demonstrating that the alternate composition exerts a positive influence on reducing cavitation corrosion in an operating engine.

A1.2.3 In-service qualification tests may consist of single- or multiple-cylinder engine tests. At the option of the engine or vehicle manufacturer, such testing may be conducted in "loose engines" or in engines fully integrated into an application such as a vehicle, a power boat, or a stationary power source. One such test has been developed.[5]

A1.3 Chemical composition requirements for cavitation corrosion protection will be removed from this specification and replaced with an ASTM test method when a test method is developed and adopted.

A1.4 No specific chemical composition requirements for hot surface scaling and deposit resistance have been established at this time. A test procedure for this property is under development and will be incorporated into Table 2 when a procedure is approved by ASTM.

A1.5 Lack of compatibility between the coolant and SCA product's chemistry results in chemical ingredient dropout from solution, with potential adverse effects in the vehicle or engine cooling system. A test procedure for compatibility has been developed, Test Method D5828, and may be used to establish compatibility between the coolant and the SCA product.

[5] "A Comparison of Engine Coolant in an Accelerated Heavy-Duty Engine Cavitation Test," SAE Technical Paper 960883, SAE International, 400 Commonwealth Drive, Warrendale, PA 15096.

APPENDIXES

(Nonmandatory Information)

X1. COOLANT MAINTENANCE FOR HEAVY-DUTY ENGINES

X1.1 *Engine Coolant*—Cooling system fill for a heavy-duty engine consists of water, coolant concentrate (antifreeze), or prediulted 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 coolant mixtures, 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. Contact your local water department, the responsible government agency, or submit a water sample for analyses if there is a question on water quality.

TABLE X1.1 Suggested Water Quality Limits[A]

Property	Specific Values	Test Method
Total solids, ppm (grns/gal)	340 (20) max	Federal Method 2540B
Total hardness, ppm (grns/gal)	170 (10) max	D1126
Chloride (Cl), ppm (grns/gal)	40 (2.4) max	D512, D4327
Sulfate (SO_4), ppm (grns/gal)	100 (5.9) max	D516, D4327
pH	5.5 to 9.0	D1293

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

X1.1.2 *Coolant Concentrates:*

X1.1.2.1 SCAs may be used in conjunction with either ethylene glycol or propylene glycol base coolant concentrates, and in dilute versions of each. Ethylene glycol base coolant products should meet Specification D4985. ASTM specifications have not been established for low-silicate propylene glycol base coolants for heavy-duty engines requiring a precharge of SCAs. However, such products are available in the marketplace.

X1.1.2.2 The coolant concentration (antifreeze) should be maintained between 40 and 60 % by volume, depending on the engine operating environment. Freeze protection will be provided according to the following:

	Freeze Protection Temperature, °C (°F)	
Glycol Content, %	Ethylene Glycol	Propylene Glycol
40	–24 (–12)	–21 (–6)
50	–37 (–34)	–33 (–27)
60	–52 (–62)	–49 (–56)

NOTE X1.1—Coolant Specification D4985 was developed based on the knowledge of the performance of engine coolants and their ingredients prepared from virgin materials. As such, these specifications do not address the potential effects, if any, of residual contaminants that could have been introduced if the coolants were prepared from recycled or reprocessed used automotive coolants or industrial glycol materials.

X1.1.2.3 The ASTM Committee on Engine Coolants is in the process of investigating the effect(s) of potential contaminants, if not removed in the reprocessing cycle, and has established standard specifications for reprocessed or recycled coolants (Specifications D6471 and D6472). It is desirable that users of coolant products be fully advised when any coolant has been produced from reprocessed materials.

X1.1.3 *Supplemental Coolant Additive:*

X1.1.3.1 The SCAs are used to provide additional protection against deposits, corrosion, and pitting which may not be provided by the additives in the coolant concentrate or prediluted engine coolant. SCAs also extend the life of the coolant by adding to and replenishing the additives that deplete during normal operation. The SCAs, however, do not extend the freeze protection provided by the coolant concentrate.

X1.1.3.2 Heavy-duty engine users' experience has shown that SCA compositions below those defined in A1.1 may not provide long-term protection against cavitation corrosion (liner pitting). User experience and published information shows the presence of nitrite (NO_2^-) in an SCA is particularly effective in providing maximum protection.

X1.1.3.3 New technology consisting of other chemistries may provide satisfactory protection. Such chemistries can be substituted for those listed in A1.1 by agreement between the producers and the users upon demonstration of performance. Such demonstrations can consist of comparative laboratory cavitation tests or comparative damage rating from testing in operating engines. One or both of these options may be applied in accordance with a specific agreement between parties.

X1.1.3.4 These evaluations shall be at the SCA manufacturer's recommended precharge concentration in diluted, low-silicate coolant concentrates.

X1.1.3.5 The SCAs should not be stored below 7 °C (120 °F) or above 55 °C (130 °F). Temperatures below –7 °C (20 °F) can lead, in liquid SCAs, to crystallization of components and nonhomogeneity in large containers. Temperatures above 55 °C (130 °F) may cause chemical changes that render the product unsuitable for use.

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 Use coolant concentration recommended in this specification.

X1.2.3 Drain and flush the cooling system as recommended by the engine or vehicle manufacturer, or every two years, whichever occurs first.

X1.2.4 Follow the engine or vehicle manufacturer's recommendations for SCA precharging of the cooling system after draining and flushing.

X1.2.5 Use water that meets the requirement in Table X1.1.

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

X1.2.7 Use the SCA manufacturer's recommended test kit when testing the coolant for proper additive concentration. Test kits shall indicate the degree of liner pitting protection present in the coolant.

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

X1.2.9 Use coolant mixed at the desired proportions for makeup.

X1.2.10 Use SCAs at recommended dosage to control deposits, corrosion, water pump damage, 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 makeup coolant.

X1.2.13 DO NOT add plain water as makeup coolant.

X1.2.14 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 shown in X1.1.2.

X1.2.15 DO NOT exceed the manufacturer's recommended dosage of SCA or the recommended concentration of coolant concentrate. Over-concentration can result in plugged radiators, heater cores, and charge air coolers and can also cause water pump seal leaks.

X1.2.16 DO NOT reuse coolant that has been drained from a vehicle in which over-concentration of coolant concentrate or over-concentration of supplemental coolant additives has occurred, in which the coolant is over one year old, or in which the container is dirty.

X1.2.17 DO NOT precharge the cooling system with SCA if the coolant is drained and reused.

X1.2.18 DO NOT use soluble oil additives.

X1.2.19 DO NOT use methyl alcohol or methoxy propanol base coolant concentrates.

X1.2.20 DO NOT use antileak additives if the 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.

X2. CAVITATION CORROSION AND SCALING RESISTANCE TESTING OF SUPPLEMENTAL COOLANT ADDITIVES

X2.1 *Cavitation Corrosion Resistance:*

X2.1.1 Vehicle and engine manufacturers use a variety of different procedures for determining resistances of engine cylinder liner and engine block material to cavitation corrosion (also referred to as liner pitting). These tests are specific for different manufacturers, and industry has not established a standard accepted procedure or test apparatus. These manufacturers have developed correlations between a given procedure and damage rate for their specific engine designs.

X2.1.2 The most widely used test method is based upon a modification of Test Method G32, that uses ultrasonic vibratory equipment and a standard size metal specimen for comparing cavitation resistance of either engine materials or engine coolant formulations.

X2.1.3 A vibratory cavitation screening test method for application to engine coolants is currently under development by ASTM Committee D15. Since a standard procedure, recommended equipment, and tolerance ranges have not been established, application of any procedure must be by specific agreement between the coolant concentrate or SCA manufacturer and the user of these products. Such agreements are usually defined by specific purchasing agreements.

X2.2 *Hot-Surface Scale Resistance:*

X2.2.1 Unstable additives in coolant or SCA concentrate and excessive mineral content in coolant system makeup water tend to deposit on hot engine surfaces. This reduces heat transfer causing engine component overheating.

X2.2.2 Although no standard test has been adopted by ASTM, and deposit limits are therefore undefined, a procedure is under development in ASTM Committee D15.

X2.2.3 The test under consideration consists of a circulating rig for heating and cooling a test solution and subsequent passing of that solution over a heated element. The element is weighed before and after a specified operating time to determine the mass increase as a result of deposit buildup.

X2.2.4 Apparatus for this procedure can be procured from several sources. A number of commercial testing laboratories are also equipped to perform testing using this equipment. Further information is available by contacting ASTM Committee D15.

X2.2.5 The use of this test procedure and the establishment of acceptance limits is subject to agreement between the coolant concentrate or SCA concentrate manufacturer and the user of a specific manufacturer's products.

X2.2.6 As an alternative, the producer and user can establish limits of composition for special additives, determined by the manufacturer of the concentrates as effective deposit and scale inhibitors.

X2.2.7 Requirements defined in X2.2.5 or X2.2.6 usually apply to concentrates diluted into a cooling system at the manufacturer's recommended addition levels.

X2.3 *Compatibility With Engine Coolants:*

X2.3.1 Interference, called incompatibility, between the chemical additives in formulated coolants and a specific SCA product can result in chemical precipitations in the engine-cooling system. The result is sludge that reduces cooling system efficiencies, increases wear and leakage in the water pump, and reduces protection of metal surfaces.

X2.3.2 These conditions can be minimized by following the recommendations of the SCA and the engine or vehicle manufacturer on the correct quantities of SCA for precharging or maintenance application. Do not increase the dosage or frequency of use of SCA products without specific recommendations.

X2.3.3 A test method for compatibility, D5828, has recently been developed and adopted by ASTM Committee D15. This test method measures the quantity of precipitates formed upon heating, mixtures of coolant, and SCA products. The greater the quantity of chemical precipitate, the lower is the compatibility of the ingredients. When this test method is standardized and allowable limits are established by ASTM, this test method could become a required part of this SCA specification.

X2.3.4 Producers and users of SCA products can agree to use the tentative procedure described in X2.3.3 or other methods to determine compatibility.

SUMMARY OF CHANGES

Committee D15 has identified the location of selected changes to this standard since the last issue (D4985-05) that may impact the use of this standard.

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