



Designation: D 2847 – 99

## Standard Practice for Testing Engine Coolants in Car and Light Truck Service<sup>1</sup>

This standard is issued under the fixed designation D 2847; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice covers the procedure for evaluating corrosion protection and performance of an engine coolant in passenger car and light truck service.

NOTE 1—Coolant evaluation in vehicle service may require considerable time and expense; therefore, the product should be pretested in the laboratory for general acceptability. Tests may vary from small, closely controlled tests, to large tests where close control is not always practical.

1.2 The units quoted in this practice are to be regarded as standard. The values given in parentheses are approximate equivalents 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.* Specific precautionary statements are given in Section 7 and Note A1.1.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- D 1121 Test Method for Reserve Alkalinity of Engine Coolants and Antirusts<sup>2</sup>
- D 1287 Test Method for pH of Engine Coolants and Antirusts<sup>2</sup>
- D 1384 Test Method for Corrosion Test for Engine Coolants in Glassware<sup>2</sup>
- D 1881 Test Method for Foaming Tendencies of Engine Coolants in Glassware<sup>2</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *engine coolant*—a heat exchange fluid with good low-temperature properties used to transfer heat from an engine to the radiator, usually containing specific amounts of glycols, water, corrosion inhibitors, and a foam suppressor.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D-15 on Engine Coolants and is the direct responsibility of Subcommittee D15.10 on Dynamometer and Road Tests.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 15.05.

### 4. Summary of Practice

4.1 Standard metal corrosion specimens, mounted in special holders, are installed in the coolant flow of the test vehicles. The coolant is tested at the recommended concentration in a specified test water. A minimum of five test vehicles per coolant is required. The test duration in terms of time or mileage should be consistent with the recommended service life of the coolant. The vehicle, corrosion specimens, and coolant are inspected according to a prescribed schedule to provide the basis for coolant evaluation.

4.2 A detailed cleaning and conditioning procedure is essential to obtain statistically significant and reproducible results. New, or nearly new, vehicles are preferred for field tests.

### 5. Significance and Use

5.1 The data obtained from the use of this practice will provide a basis for the evaluation of coolant performance in passenger car and light truck service. The data obtained may also be used to provide added significance to the data obtained from simulated service and engine dynamometer tests.

### 6. Apparatus

6.1 *Test Vehicles*— In selecting vehicles to be used to conduct field tests of coolants intended for automobiles and light trucks, consideration should be given to the current range of cooling system designs and materials. It is advisable to include both brazed aluminum and soldered copper/brass radiators as well as engines made of cast iron and those with aluminum heads or blocks, or both. A matrix including every possible variable combination of such features is not required, especially if vehicles representing the extremes are included in the field tests. This includes aluminum engine with aluminum radiator and heater core, cast iron engine with copper/brass radiator and heater core, and a cast iron engine with an aluminum radiator and a copper/brass heater core. Pressurized surge tanks as well as unpressurized coolant overflow reservoirs should be tested. Select vehicles that will be subjected to a wide range of operating schedules. These ranges should include high-usage vehicles which accumulate miles rapidly, vehicles operationally biased toward higher temperatures, and low-mileage vehicles (<1000 miles/month) that can develop accelerated localized corrosion due to non-flowing coolant. No

single operating schedule is preferred over another. New, or nearly new, vehicles are preferred because of possible difficulties, explained in 9.2.1, in cleaning older cooling systems prior to test.

6.2 Metal Corrosion Specimens—The description, specification, preparation, cleaning, and weighing of the metal corrosion specimens used in this practice are given in detail in Test Method D 1384. The metal specimens are assembled for test as shown in Fig. 1. Each set of specimens is mounted in a canvas reinforced phenolic tube illustrated in Fig. 2. The specimen and tube assembly are placed in a capsule which is mounted in the vehicle cooling system. Two types of specimen capsules may be used; the by-pass (partial-flow) heater circuit type (Fig. 3) is the standard capsule, and the full-flow type (Fig. 4) is optional. The partial-flow heater circuit capsule is located between the heater supply and the heater-return line and shall contain two or more sets of specimens. The full-flow capsule is installed in the upper radiator hose and contains one or more sets of specimens.

6.2.1 The schematic of the specimen holder installation is shown in Fig. 5. Fig. 6 is a photograph of a typical installation of test capsules. The optional full-flow capsule should be mounted as low as possible in the upper radiator hose to ensure coolant coverage of the metal specimens when the vehicle is not in use. The partial-flow capsule must be mounted vertically to avoid trapped air. A pair of fabricated copper tees with 3/8-in

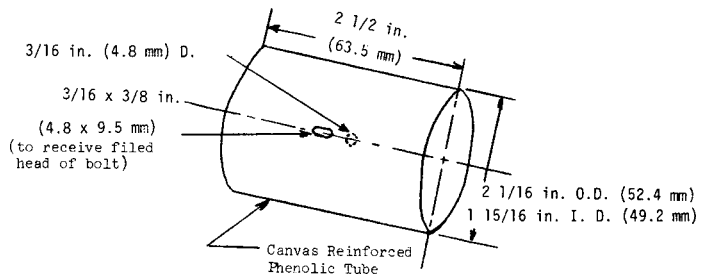


FIG. 2 Specimen Bundle Sleeve

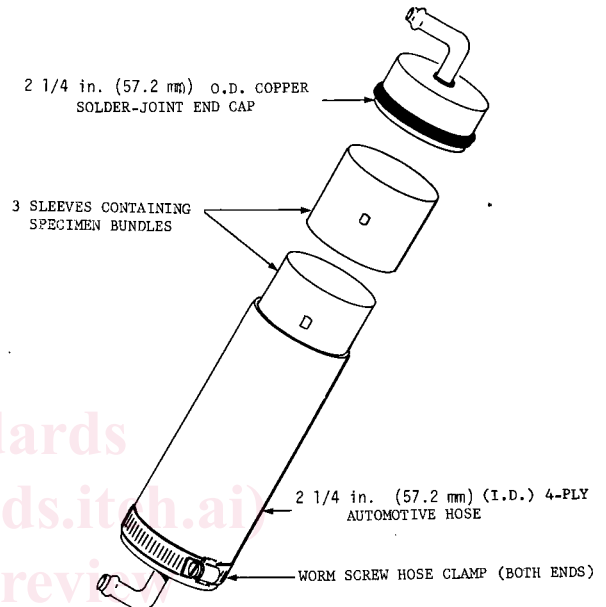
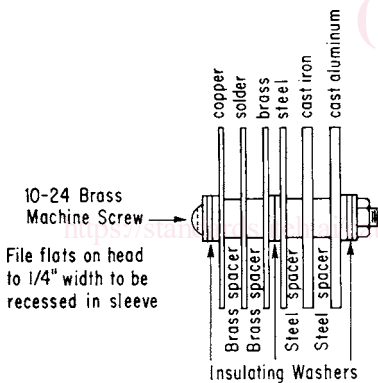


FIG. 3 By-Pass (Heater Circuit) Specimen Capsule



TYPICAL ASTM SPECIMEN BUNDLE

NOTE:  
TFE—Fluorocarbon or polypropylene tubing installed over brass bolt to prevent galvanic contact between any specimen and brass bolt

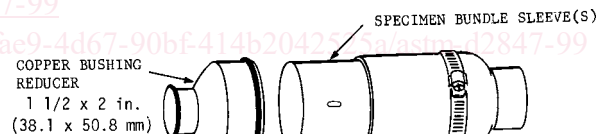


FIG. 4 Full-Flow Specimen Capsule

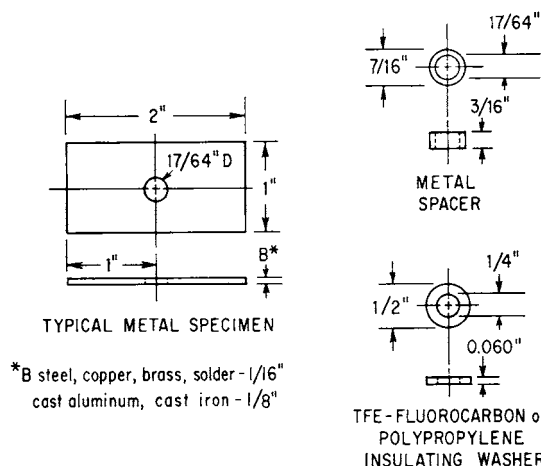


FIG. 1 Corrosion Specimen Bundle

\*B steel, copper, brass, solder - 1/16"  
cast aluminum, cast iron - 1/8"

(9.5-mm) outside diameter copper tubing side taps (Fig. 7) are spliced into the heater hose lines to provide a constant bypass flow through the specimen capsule. The circuit must be so arranged that coolant flows through the capsule whenever the vehicle is in operation. On air-conditioned vehicles with a vacuum-operated heater flow control valve, the by-pass tee must be installed ahead of the flow control valve to insure constant flow.

7. Safety Precautions

7.1 All coolant concentrates and their solutions should be considered harmful or fatal if swallowed.

7.2 Caution should be used when removing the radiator cap from a hot cooling system.

7.3 All installations shall be made with the engine cooled to ambient air temperature to avoid burns.

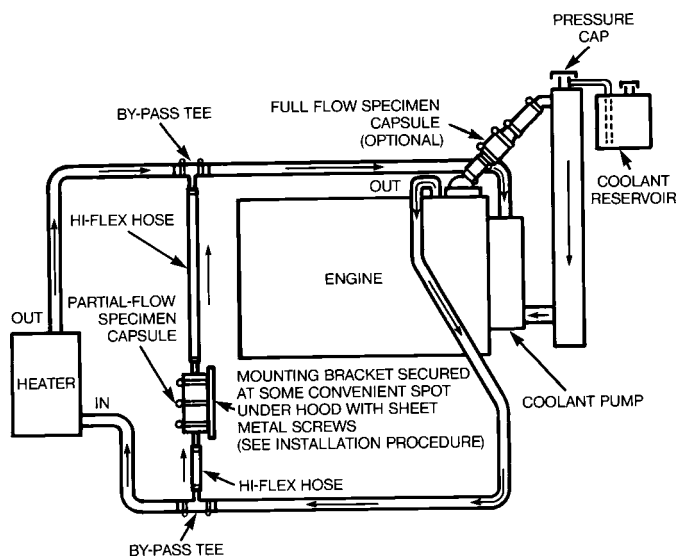


FIG. 5 Schematic of Specimen Capsule Installation

7.4 Disconnect the hot (positive) battery lead to prevent the engine from starting to avoid hand injury by drive belts or fan blades.

7.5 The engine exhaust should be vented when the engine is run indoors at normal temperatures to check for cooling system leaks.

## 8. Sampling

8.1 Coolant samples are removed from the test vehicle through the sample valve mounted on the partial-flow capsule. The 6-oz (180-mL) coolant samples are kept in polyethylene bottles equipped with screw caps and suitable labels. A reserve supply of pre-mixed coolant is used to replace the coolant samples. If foaming tendency is not checked, a 2-oz (60-mL) sample is adequate.

## 9. Preparation of Apparatus

### 9.1 Engine Reconditioning:

9.1.1 Inspect the engine of the test vehicle carefully and complete any necessary repairs. Check the cooling system for the following common defects: cylinder head gasket failure resulting in exhaust gas contamination of the coolant, and air inducted into the coolant due to a worn coolant pump face seal or defective lower radiator hose connection.

### 9.2 Cooling System Preparation:

9.2.1 Vehicles subject to field tests must have cooling systems that can be satisfactorily cleaned initially with mild chelate or detergent type commercial cleansers. Such cleaners may allow small concentrations of some chemicals to carry over into the coolant to be tested, and this factor may be appraised from analyses of the initial and periodic coolant samples. New, or nearly new, vehicles are preferred to minimize cleaning and possible carryover problems. It is possible to clean older cooling systems with oxalic acid, and a procedure for that alternative is included in the appendixes. However, considerable caution must be exercised in cleaning, neutralizing, and inspecting systems cleaned with oxalic acid. Some researchers have reported deleterious carryover effects that

persist during tests conducted after oxalic acid cleaning. Engines that have cooling systems that are heavily rusted, pitted, or porous are more susceptible to such carryover. The presence of oil or grease accumulations in the cooling system may justify exclusion of the vehicle from test if the oil cannot be removed by the cleaner selected.

9.2.2 In addition to monitoring changes in the properties of the coolant and measuring corrosion rates by means of the metal coupons, an appraisal of the long term effects on the cooling system parts may be an added objective. This may include an evaluation of radiator tube plugging, solder blooming, seal leakage, accumulations of sediment and the effects on iron and aluminum engine parts subjected to higher thermal stress than on the corresponding metal coupons. Parts of the cooling system of particular interest may appropriately be replaced with new parts during the initial preparations.

9.2.2.1 A Cooling System Flush and Fill Kit<sup>3</sup> (see Fig. A1.1) will permit quick and effective flushing of the system.

9.2.2.2 With system filled with tap water, pressure test to check for external leaks.

9.2.2.3 Pressure test radiator cap and examine radiator filler neck seat for dents or nicks. The pressure rating of the cap and filler neck combination may be tested by removing the temperature sensing unit and attaching the pressure tester to a suitable threaded fitting.

9.2.2.4 Drain cooling system as thoroughly as possible.

9.2.2.5 Repair any leaks. Examine radiator, heater, and coolant recovery reservoir hoses, and replace if necessary. Install new hose for evaluation of coolant effects on elastomeric materials.

9.2.2.6 Install the by-pass tees, the extra hoses and the full and partial flow capsules, but not the coupons, as illustrated in Fig. 5 and Fig. 7. This will allow cleaning of these components at the same time the rest of the cooling system is cleaned.

9.2.2.7 Clean the cooling system with a commercial automotive chelate or detergent-type cleaner, following the manufacturer's directions. The expansion reservoir must also be drained and cleaned. Follow this by flushing the system twice with distilled or deionized water. Then drain the cooling system as completely as possible. By opening appropriate hose connections, the heater core and the by-pass capsule hoses may be blown out with dry, oil free, compressed air. Inspect the interior surfaces of the cooling system. This may require some disassembly such as removal of the coolant outlet, the coolant pump, and accessible core hole plugs. Fiber optic inspection equipment may be useful. The extent of such inspections shall be commensurate with the test requirements and must necessarily be in accordance with agreement of the parties involved.

9.2.2.8 Remove the flushing tee and reassemble the cooling system for normal operation. The preweighed metal coupons should be installed in the full flow and partial flow capsules.

9.2.2.9 Fill the cooling system with test coolant prepared with glycol antifreeze and corrosive water as described in Test Method D 1384. The glycol concentration should give a freeze point of  $-20 \pm 2^\circ\text{F}$  ( $-29 \pm 1^\circ\text{C}$ ), which corresponds to 44 % by volume of ethylene glycol (or other percentages of other

<sup>3</sup> "Prestone" Flush and Fill Kit, or equivalent.

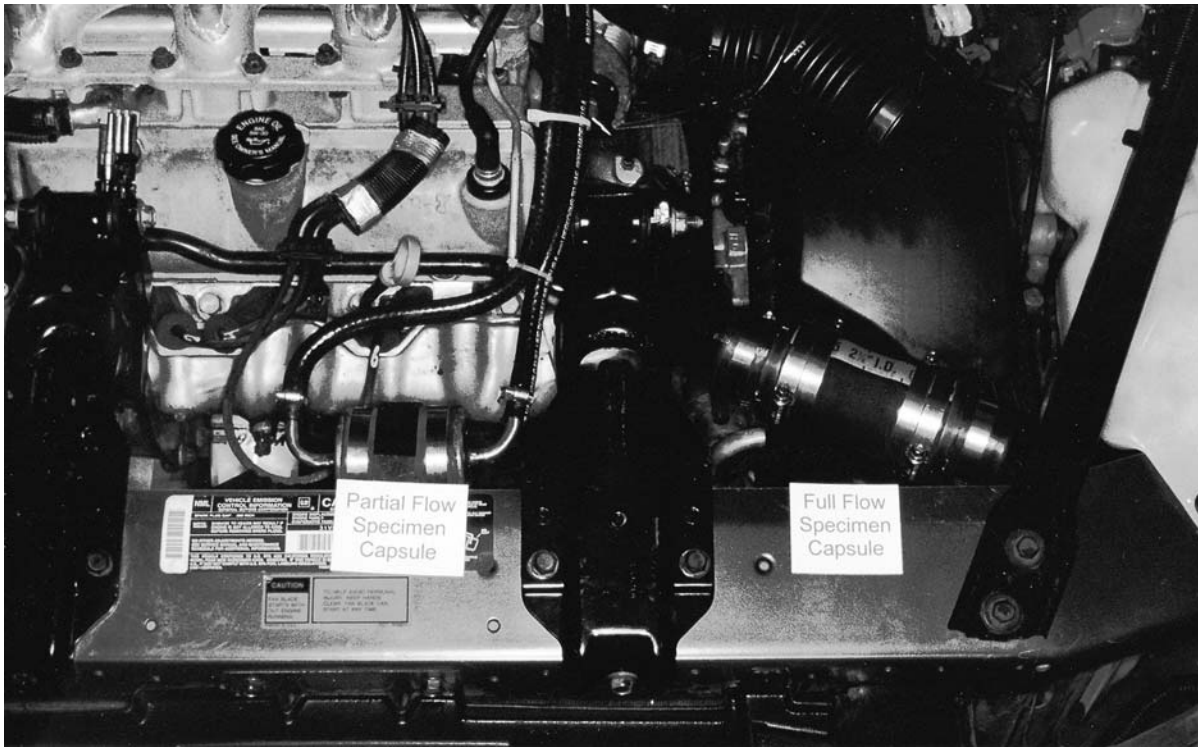
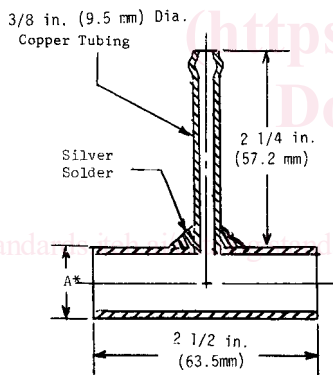


FIG. 6 Full-Flow and Partial-Flow Specimen Capsules



NOTE 1—Dimension A is 19.1 or 16.0 mm (3/4 or 5/8 in.) diameter depending on size of heater hose.

FIG. 7 By-Pass Tee

glycols) unless climatic extremes require lower freeze points. The expansion reservoir shall be filled to the marked level with the same coolant solution. Run the engine long enough to ensure that any air trapped in the system is expelled, and check the system for leaks. Upon cool down, the coolant level in the expansion reservoir will need to be checked and brought to the proper level.

9.2.2.10 Label the radiator and expansion reservoir fill caps conspicuously to show a coolant test is being conducted, and include instructions with whom to contact in case coolant additions are needed or other problems occur. Obtain the initial coolant sample and record the start-of-test date, odometer reading, and engine hour reading.

10. Procedure

10.1 Test the coolant being evaluated in a minimum of five vehicles at the recommended concentration.

10.2 Vehicle operating conditions may vary considerably in any test fleet; therefore, record the type of service for each vehicle. Mileage accumulation rates may vary considerably; therefore, the recommended inspections in 10.5 may be difficult to schedule. Alternative inspection and sampling schedules may be developed to suit the needs and circumstances of the test.

10.3 The recommended concentration for coolant is listed below. Weather conditions in Northern areas may require testing at a higher concentration. Evaluate other cooling system products at the recommended or implied concentration, in the product use directions. Coolant concentrations and normal coolant operating temperature ranges are as follows:

Concentration, volume %, or	44
Freezing point, °F (°C)	-20 (-29)
Range for normal operating temperature of engine coolant, °F (°C)	180 to 235 (82 to 113)

10.4 Use a synthetic corrosive water as described in Annex A2 to dilute the coolant. Additions to the cooling system during the test should be the prescribed mixture of coolant and corrosive water.

10.5 Perform periodic inspections throughout the test as given in Table 1.

11. Calculation

11.1 Record the corrosion data in milligrams per specimen. If it is desired to convert these values to millimetres of metal