



## Material Properties and Conductivity Assessment: Static Soak In Ethylene Glycol Based Fuel Cell Coolant

### 1 Scope

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**1.1 Purpose.** This test method covers a simple beaker-type procedure for evaluating the effects of corrosion products and leachants of materials in contact with fuel cell coolant on the coolant conductivity under controlled laboratory conditions.

**1.2 Foreword.** Materials of cooling system components considered for use in various fuel cell applications come in contact with low conductive fuel cell coolants. There is concern around contaminating the coolant with corrosion products and leachants, which have the potential of increasing the coolant electrical conductivity.

This test procedure will generally distinguish between materials that contribute detrimentally to the conductivity of the fuel cell coolant. However, the results of this test method cannot stand alone in determining if the material is appropriate for use within the fuel cell coolant loop.

**1.3 Applicability.** This test procedure is applicable for any material in contact with the fuel cell coolant within the fuel cell coolant loop. The materials can be classified into two distinct groups, solids and thixotropic (semi-fluid) materials. The solid materials can be classified into two distinct subgroups, metallic and polymeric. The thixotropic materials can be classified into two distinct subgroups, curable materials such as epoxies and some adhesives and non-curable materials such as lubricants, greases and some adhesives.

### 2 References

**Note:** Only the latest approved standards are applicable unless otherwise specified.

#### 2.1 External Standards/Specifications.

ASTM D1384                      ISO 294                      ISO 1874-1

#### 2.2 GM Standards/Specifications.

GMW3221

#### 2.3 Additional References.

GM7505754 - Low conductive fuel cell coolant

### 3 Resources

**3.1 Facilities.** Not applicable.

#### 3.2 Equipment.

- Powder free examination gloves
- Analytical balance capable of measuring to 0.0001 g
- 20.3 cm (8 in) tweezers or size as needed
- 20.3 cm (8 in) spatula or size as needed
- Calipers capable of measuring to 0.01 mm

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- Container: A 1000 mL or suitable sized tall form sealable heat resistant glass container, for containing the coolant and test pieces. Lid seal materials must be evaluated for possible contribution to increase in conductivity.
- Containment tray capable of withstanding 120 °C temperature
- Oven: Convective oven capable of maintaining 90 °C temperature to  $\pm 2.0$  °C. Polypropylene caps with Polytetrafluoroethylene (PTFE) seals have been used in the past
- Conductivity Meter: Calibrated conductivity meter capable of measuring between  $< 1.0 \mu\text{S/cm}$  to  $100 \mu\text{S/cm}$  in temperature range from 20 °C to 100 °C (accuracy  $\pm 0.1 \mu\text{S/cm}$ ), where  $\mu\text{S/cm}$  is the measurement for specific conductivity.

### 3.2.1 Chemicals.

- Test fluid (low conductive fuel cell coolant, GM7505754), hereafter referred to as **coolant** or as specified and documented in test report
- Deionized water
- Reagent Grade Polar Solvent, (e.g., 70% isopropyl alcohol, acetone) for removal of residual polar processing lubricants and contaminants
- Reagent Grade Non-Polar Solvent, (e.g., hexane, heptane, toluene) for removal of residual non-polar processing lubricants and contaminants.

**3.3 Test Material/Test Piece.** This test procedure is based upon using a constant surface area to volume ratio of  $30 \text{ mm}^2$  per 1.0 mL of coolant, unless otherwise specified. The following test piece sizes should be used whenever possible with exceptions noted in the test report. A minimum of  $4500 \text{ mm}^2$  area is required.

For 3.3.1 through 3.3.4:

**3.3.1 Solid Metallic.** Nine (9) test pieces shall be cut to  $25 \text{ mm} \times 50 \text{ mm}$  from 2 mm stock material for a calculated surface area of  $2800 \text{ mm}^2$  each, with a total surface area of  $25\,200 \text{ mm}^2$ .

**3.3.2 Solid Polymeric.** Nine (9) test pieces shall be cut to  $25 \text{ mm} \times 50 \text{ mm}$  from 2 mm from injection molded plaques for a calculated surface area of  $2800 \text{ mm}^2$  each, with a total surface area of  $25\,200 \text{ mm}^2$ . Unless otherwise specified, injection molding of test pieces shall be accomplished per ISO 294 with the conditions for injection molding from ISO 1874-1. Other manufacturing processes can be used to make plaques and shall be documented in the test report.

**3.3.3 Thixotropic Curable.** Material shall be dispensed, leveled, and cured on an inert, rigid, removable surface such as a PTFE sheet per the suppliers recommend schedule unless otherwise specified and to be noted in the test report. Nine (9) test pieces shall be cut to  $25 \text{ mm} \times 50 \text{ mm}$  from 2 mm thick slabs for a calculated surface area of  $2800 \text{ mm}^2$  each, with a total surface area of  $25\,200 \text{ mm}^2$ . These materials upon curing can be classified as solid polymeric.

**3.3.4 Thixotropic Non-curable.** Material shall be spread evenly on an inert rigid surface such as a PTFE sheet or glass plaques/slides, with a total surface area of  $25\,200 \text{ mm}^2$ .

**Note:** If test material cannot be obtained in the sample shape as described above, use the material sample as provided (e.g., O-ring). The amount of sample is based on maintaining a ratio of  $30 \text{ mm}^2$  surface area of sample to 1.0 mL extracting solution. A minimum of 150 mL of solution is required for the subsequent analytical techniques that are going to be performed, thus a minimum of  $4500 \text{ mm}^2$  of sample surface area is required for each preparation. Record the surface area of sample being used and determine the amount of extracting solution required for the sample preparation.

**3.4 Test Time.** Each test piece is to be exposed to coolant for a minimum of 1008 h with readings of conductivity performed at intervals of 168 h, or as close to this time as possible. Record the soak time hours at time of measurement. Testing may be stopped if the conductivity measurement exceeds the limits as specified.

Calendar time: 43 days

Test hours: 1008 h

Coordination hours: 8 h

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