

Test Procedure for Electrical Ground Attachments

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TEST PROCEDURE FOR ELECTRICAL GROUND ATTACHMENTS

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1. SCOPE

This test procedure is intended to evaluate and/or validate electrical ground schemes for use on the body or chassis. There are two classes based on the expected environmental conditions. **Exposed** Grounds can be located anywhere in the vehicle (except on the powertrain) and is the class for which most schemes should be tested. **Unexposed** Grounds can only be used in the passenger compartment or trunk and as such are special cases.

This procedure as written is not intended for testing powertrain grounds where high temperatures and vibration levels may be encountered. These situations may require modifications to this procedure and are left to the Responsible Engineer to determine.

This specification does not specifically address validation of terminal to wire electrical crimps. Crimps are tested to SAE/USCAR-21

2. REFERENCES

ASTM B-117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
SAE/USCAR-2 Performance Specification for Automotive Electrical Connector Systems

Refer to SAE/USCAR-2 for other Reference Documents Required.

3. DEFINITIONS

Exposed Ground Points - Exposed Ground Points can be located anywhere in the vehicle. Most ground schemes should be tested to this profile.

Unexposed Ground Points - Unexposed Ground Points can only be used in the passenger compartment or trunk and as such are special cases.

Life Cycle - The number of life cycles run during the conditioning procedure depends on the desired confidence and reliability levels. For purposes of this document, one life cycle equals 6 years/100,000 miles.

4. GENERAL REQUIREMENTS

Refer to SAE/USCAR-2 for General Requirements. The test equipment list is replaced with the following:

4.1. Test Equipment and Tolerances

4.1.1. Test tolerances are per SAE/USCAR-2 except as noted.

4.1.2. Test equipment required is shown in table 1

Equipment	Description
Temperature/Humidity Cabinet	Temperature control of +/-2° C up to 65° C and relative humidity control of +/-2% up to 90%
Thermal shock equipment	-40°C to 85°C or +125°C per para. 4.4
Power Supply for biasing samples	Per paragraph 4.3.1.
Power Supply for taking measurements.	Capable of sustaining 5 volts at a minimum of 10 amps shall be set to current limit at 10 ± 0.1 A
Milli-volt meter	Capable of measuring at least 0.01 mV
Dry-off Environment: Temperature Humidity	60°C +/-2° 40-50% RH
Salt Fog Chamber	Per ASTM B117 (+40°C)

Table 1 – Test Equipment and Conditions

4.1.3. Test Fixture

All conditioning and testing shall be conducted with the test specimens mounted to a test fixture made from a thermally non-conductive material. The test fixture shall be designed so that test samples will remain mounted to the same fixture throughout the entire test. (If a fixture becomes unusable once the test has started and the samples are transferred to a different fixture, this should be recorded along with the data.)

The test fixture shall have provisions to securely fix all wires to the fixture such that the wire length from the terminal to the fixture attachment point shall be 150 +/- 50mm.

4.2. Test Samples

4.2.1. Sample Quantity

For validation, the number of required samples to be tested without failure is 20. Larger sample quantities may be tested depending upon the desired reliability and confidence levels. The number of samples tested and life cycles run shall be recorded as part of the test data. Running this test for only one life cycle is unacceptable for validation.

For evaluation testing, one, two or three life cycle can be used with any number of samples - though a minimum of ten is recommended.

4.2.2. Test Coupons

The actual shape of the test coupon is not critical, but the size should be kept at a minimum to reduce the thermal mass. Figure 1 shows one possible configuration.

The number of parts attached to a coupon is also not critical, but again the coupon size should be kept at a minimum.

When performing a test to compare parameters, all coupons in the test shall be the same size. Coupons should be made of 0.8 mm galvanized steel for general fastener testing. Where specific fastener or vehicle location requirements dictate otherwise, coupons should simulate the actual mating material to be used in production. (i.e. cast iron, aluminum.)

The coupons shall be treated with production intent coating and processes. The actual formulation and methods of application shall be included as part of the test data. Provided the area of attachment is properly coated, incomplete sample coverage is not a concern.

4.2.3. Terminal Preparation

The samples will be tested using a four-wire scheme; therefore each terminal shall have two wires attached to it.

All wires shall be multi-strand 0.5mm² with cross-linked insulation, unless the purpose of this test dictates otherwise. Wires with PVC insulation shall not be tested.

The two wires shall both be directly attached to the terminal and either soldered or welded in place (see Figure 2a).

4.2.4. Ground Wire Attachment to Test Coupon

Two ground wires shall be attached to each test coupon. They shall be the same size and have the same type of insulation as the power wires.

Both wires shall be directly attached to the test coupon and either soldered or welded in place. The voltage sense wire shall be located within 30mm of the attachment point (see Figure 2b).

Provided the above criteria are met:

- a. If multiple parts are attached to the same coupon, they may share both ground wires. One ground wire may be daisy chained from coupon to coupon, but a separate voltage sense wire shall be used for each attachment/coupon.
- b. The area of attachment to the coupons may be coated.

4.2.5. Assembly of Test Samples

Terminals shall lie parallel with respect to all mating surfaces (see Figure 2c). Additionally, if terminals are stacked, they shall be arranged so that there is no interference between crimp barrels (see Figure 2d).

Torque all fasteners to the low end of their respective torque ranges, unless torque variation is a consideration of the test. The torque for each fastener shall be included as part of the test data. The method, tool and tool settings used to torque the fasteners shall be the same for all similar fasteners, unless method and/or tool variability is a consideration of the test. The method, tool and tool settings used shall be included as part of the test data.

Each attachment point shall be given a unique designation to be used for recording data. This designation shall be permanently marked on the test coupon. If terminals are stacked, a uniform method of distinguishing the position of each terminal shall be used (e.g. #24t is the top terminal on fastener #24).

4.2.6. Grouping of Samples

When performing a test to compare parameters and multiple groups of samples are to be tested, samples of each configuration shall be divided among all the groups. As a result, each group will be comprised of samples from each of the test configurations.

4.3. Test Procedures

4.3.1. Biasing Samples

Samples shall be powered (biased) during all phases of the conditioning procedures except Thermal Shock and vibration.

Any number of samples may be connected in parallel to reduce the number of power supplies required. Each power supply shall be set to current limit based on the number of samples connected to it:

- a. For 1 to 5 samples, the current limit shall be set to x amps \pm 0.1 amps, where x is the number of samples.
- b. For more than 5 samples, the current limit shall be set to x amps \pm 0.5 amps, where x is the number of samples.

4.3.2. Test Schedule

Repeat the cycle shown in figure 2 on the electrically biased samples. Additional life cycles may be run at the option of the test requestor. The test can be continued throughout weekends to decrease the overall test time.

Samples shall be oriented with surfaces of the coupons horizontal so that water does not readily drain away during the Temperature/Humidity and Salt Fog conditioning procedures.

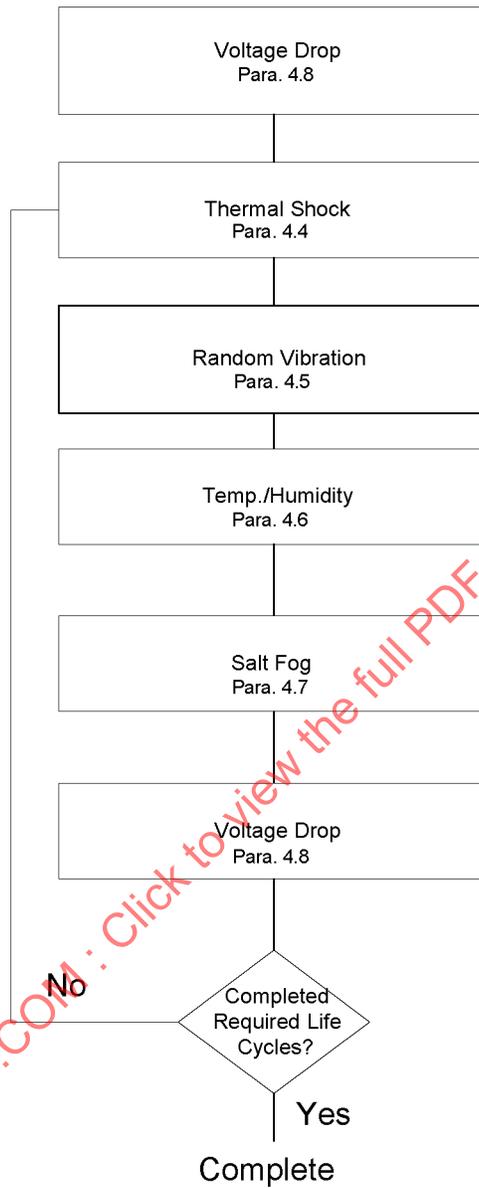


Figure 2 – Test Schedule

4.4. Thermal Shock

Subject the samples to 50 cycles of the following:

2 hours at -40°C

2 hours at T_{max} , where $T_{\text{max}} = +125^{\circ}\text{C}$ for Exposed Grounds
 $+85^{\circ}\text{C}$ for Un-exposed Grounds

4.5. Random Vibration

Subject samples to random vibration profile for “Sprung Portions of Vehicle Not Coupled to Engine” per SAE/USCAR-2 (1.81G rms) for 8 hours in each of the three mutually perpendicular axes. Total exposure time is 24 hours.

4.6. Temperature/Humidity Cycling

Each sample shall be exposed to 25 cycles of the Temperature/Humidity Cycle per SAE/USCAR-2. Test Temperatures shall be 125°C for Exposed Grounds and 85°C for Unexposed Grounds. Power shall be applied throughout this test as described in paragraph 4.3.1.

4.7. Salt Fog

Each sample shall be exposed to salt fog per ASTM B117 at +40°C.

Exposure shall be 96 hours for schemes used in Exposed areas and 48 hours for schemes used only in Unexposed areas.

Power shall be applied throughout this test as described in paragraph 4.3.1

4.8. Resistance Measurement

The following procedure shall be performed separately on each sample. Connect the measurement power supply as described in Table 1 to the sample using two of the leads.

Using a mV meter as specified in Table 1, measure and record the voltage drop across the other two leads on each sample.

Complete the Visual Examination procedure as specified in SAE/USCAR-2.

5. ACCEPTANCE CRITERIA

1. The maximum voltage drop recorded in paragraph 4.8 shall not exceed 1 mV per amp.
2. The change in voltage drop (Δ) from beginning to end of all conditioning procedures shall not exceed 0.5mV per amp.
3. Samples shall not exhibit heavy corrosion that could result in mechanical or electrical failure.
4. Sample groups shall conform to the statistical requirements of paragraph 4.2.1.