

High Voltage Connector Performance Supplement to SAE/USCAR-2

SAE/USCAR-37
August 2008



ISBN: 978-0-7680-2098-4

HIGH VOLTAGE CONNECTOR PERFORMANCE SUPPLEMENT TO SAE/USCAR-2

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*****WARNING*****

No electrical connector, terminal, or related component may be represented as having met USCAR/EWCAP specifications unless conformance to all applicable requirements of this specification have been verified and documented. All required verification and documentation must be done by the supplier of the part or parts. If testing is performed by another source, it does not relieve the primary supplier of responsibility for documentation of all test results and for verification that all samples tested met all applicable Acceptance Criteria.

1. SCOPE

Procedures included within this specification supplement are, when used in conjunction with SAE/USCAR 2, intended to cover performance testing at all phases of development, production, and field analysis of electrical terminals, connectors, and components that constitute the electrical connection systems in high voltage (60~600V) road vehicle applications. These procedures are applicable to terminals used for In-Line, Header, and Device Connector systems with and without Shorting Bars.

This supplement applies to both sealed and unsealed connection systems.

IMPORTANT NOTICE: In any intended vehicle application, if the products covered by this specification are, or may be, subjected to conditions beyond those described in this document, they must pass special tests simulating the actual conditions to be encountered before they can be considered acceptable for actual vehicle application. By way of example only, this includes products that may be subjected to conditions beyond the extremes of Classes as defined in Tables 5.1.4.1, ~ 5.1.4.5 or those that may be subjected to shock or vibration in the un-sprung portions of a vehicle, such as the wheel hub. Products certified by their supplier as having passed specific applicable portions of this specification are not to be used in applications where conditions may exceed those for which the product has been satisfactorily tested.

The Authorized Person is the final authority as to what tests are to be performed on his or her parts and for what purpose these tests are required. He or she is also the final authority for resolving any questions related to testing to this specification and to authorizing any deviations to the equipment or procedures contained in this specification. Any such deviation must be documented and included in the final test report.

Guidance as to the recommended tests for selected purposes is given in the charts in SAE/USCAR 2 Appendix C and D. In the absence of contrary direction from the Authorized Person in the test request/order, all electrical connectors and their associated terminals and other components are required to meet all applicable portions of SAE/USCAR 2 and this supplement document with the following exception:

Specific tests that are not required or additional test requirements as specified in any document in the hierarchy of Section 3.0.

2. OUTLINE & GLOSSARY OF TERMS

2.1 General

Diagrams are provided where necessary to clarify the details of the various test procedures. The tests in each section must be performed in the order given unless otherwise specified in the test request/order. Construction details for selected test fixtures and equipment are provided in this specification.

A glossary of terms is provided in USCAR 2, Appendix B. Terms defined in the definitions or glossary are capitalized (i.e. Room Temperature, Steady State, PLR, etc.). A list of definitions is provided in USCAR 2, Appendix A.

3. REFERENCED DOCUMENTS

3.1 Document Hierarchy

In the event there is a conflict between performance specifications, part drawings, and other related standards or specifications, the requirements shall be prioritized as follows:

- 1st - Applicable FMVSS requirements and other applicable state and Federal requirements.
- 2nd - Applicable part drawings
- 3rd - Applicable product design specification(s).
- 4th - Automotive Industry Action Group (AIAG) Production Part Approval Process (PPAP)
- 5th - Applicable USCAR/EWCAP performance specifications
- 6th - Other applicable standards and specifications

3.2 Part Drawing

The part drawing for each connection system component should contain or reference:

- All dimensional requirements (which must be in GD&T format).
- Performance requirements.
- Component part number.
- Reference to applicable portions of this specification.
- The quantity and part number of terminals used.
- The typical mating connector.
- Classes per tables 5.1.4.1 ~ 5.1.4.5 for which the part is intended or has been successfully tested.

3.3 Product Design Specification

The product design specification may or may not be an integral part of the part drawing. Instructions must be included in the product design specification for any special tests required for the associated part and for any exceptions or modifications to the general specifications and requirements in this document.

3.4 Test Request/Order

3.4.1 Samples, Test Type and Special Tests

The laboratory test request/order shall provide location and documentation of test samples, identify the type of test to be performed (development, validation, special purpose, etc.) and describe any special tests that are not a part of this specification. Any required revisions to, or deviations from any tests in this specification must include detailed instructions for each change.

3.4.2 Test Request/Order Instructions

Instructions must be included in the test request/order concerning applicable tests and the order in which the tests are to be performed if different than outlined by this specification.

3.4.3 Performance and Durability Test Instructions

Instructions must be given in the test request/order concerning limits for performance and durability tests, including definition of the conditions under which those limits apply, if they are different than outlined in this specification.

3.4.4 Development Tests

Development tests are frequently used to evaluate specific areas of the design. They are tools for evaluating design alternatives, proposed improvements, cost reduction proposals, or determining root causes of field problems.

3.4.5 Validation Tests

Validation tests or sample approval tests are acceptance type tests. Consideration must be given to the inherent repeatability or subjectivity of certain tests outlined by this specification before designating it as a validation or compliance test.

3.4.6 Special Purpose Tests

Portions of this specification may be useful for special purpose testing. For example, verifying a process or material change may, in the judgment of the Authorized Person, require only one or two specific tests, or a portion of a test, to verify that no adverse consequence resulted from the change. Any portion of a test or any combination of tests contained in this specification may be used individually or may be combined with other testing, described outside this specification, in any phase of product development, production testing, or analysis of parts from the field.

3.5 Other Referenced Documents

SAE/USCAR 2: Performance specification for automotive electrical connector systems

SAE/USCAR-21: Performance Specification for Cable-to-Terminal Electrical Crimps.

SAE/USCAR – 25 Electrical Connector Assembly Ergonomic Design Criteria.

IEC 62153 part 4-7

ASTM B117

4. GENERAL REQUIREMENTS AND INFORMATION

See USCAR 2

5. TEST & ACCEPTANCE REQUIREMENTS

5.1 General

The tests detailed in this specification are qualitative in nature and are not expected to stress any part beyond its anticipated application limit, except where tests to failure are specified.

5.1.1 Performance requirements

Connection systems must meet all performance test requirements for the appropriate Class as listed in Tables 5.1.4.1~5.1.4.5

5.1.2 Dimensional characteristics

Part construction shall conform to the dimensions, shape, and detail attributes specified on the latest revision of the applicable part drawing(s).

5.1.3 Material Characteristics

Parts are intended to be in their "as furnished for vehicle assembly" condition when testing begins, unless specific instructions as to any pre-test "conditioning" are contained in the test request/order. For example, electrical terminals typically have residual die lubricant on them when finally assembled into a vehicle. This same condition must prevail for test samples unless part cleaning is specified in the Test Request/Order.

All material used in each test sample shall conform to the material specifications shown on the latest revision of the applicable part drawing(s).

The material hardness specified for electrical terminals refers to the blank strip material and not the finished product because the terminal manufacturing process can modify the hardness values.

5.1.4 Classifications

Connection systems shall be assigned a class designation from the following categories.

5.1.4.1 Temperature classifications

Components to be tested must be assigned a class from the table below according to the expected environment in their intended vehicle application. "Rise" is defined as the temperature rise due to electrical heating caused by the maximum Steady State current flow expected for the component under test. Care must be taken to ensure that the conductor and insulation selected for the application or any test will itself withstand the maximum temperature for the class selected without exceeding the conductor manufacturer's maximum temperature recommendations.

Note also that terminals packaged such that they are surrounded by other terminals will dissipate heat more slowly, and thus experience a higher temperature "rise" with the same current flow, than terminals located on the periphery of a connector. See USCAR 2 Appendix F (design notes)

When "Maximum Temperature" is mentioned with respect to Table 5.1.4.1, the highest ambient temperature in the right column, "Ambient Temperature Range" is to be used unless otherwise specified. If not specified in the Test Request/Order, the Authorized Person is expected to select the appropriate Temperature Classification. Considering the cost of testing and the time it takes, it generally will be best to qualify a given terminal and connector system to the highest possible Temperature Classification.

Class	Ambient Temperature Range
1	-40° C to + 85° C
2	-40° C to +100° C
3	-40° C to +125° C
4	-40° C to +150° C
5	-40° C to +175° C

Table 5.1.4.1: Component Temperature Classes

5.1.4.2 Sealing classifications

Components to be tested must be assigned a class from the table below according to the expected environment in their intended vehicle application.

- S1: Unsealed connectors are suitable for use in passenger compartment or other dry areas on a vehicle such as the trunk.
- S2: Sealed connectors must meet the all requirements of 5.9.7, the Sealed connector environmental test sequence.
- S3: Sealed (plus pressure spray) connectors must meet all of the requirements of 5.9.7 plus the requirements of 5.8.1, High pressure spray.

Class	Application Type
S1	Unsealed
S2	Sealed
S3	Sealed plus pressure spray

Table 5.1.4.2: Component Sealing Classes

5.1.4.3 Vibration Classification

Components to be tested must be assigned a class from the table below according to the expected location in their intended vehicle application.

V1: Components intended for use on sprung portions of the vehicle and not coupled to the engine shall be tested to vibration profile figure 5.4.6.3 E. and meet the requirements of 5.4.6.4.

V2: Components intended for use coupled to the engine shall be tested to vibration profile figure 5.4.6.3.D and meet the requirements of 5.4.6.4.

V3: Components intended for use in extreme vibration levels shall be tested to vibration profile figures 5.8.2.3.B and 5.8.2.3.C. and meet the requirements of 5.4.6.4.

Class	Typical application
V1	Components on sprung portions of vehicle not coupled to Engine.
V2	Components coupled to Engine.
V3	Components subject to severe vibration.

Table 5.1.4.3 Component Vibration Classes

5.1.4.4 Ergonomic Classification

Refer to SAE/USCAR 25 for requirements necessary to assign an Ergonomic class to the component under test. This class designation shall be documented in the test plan and listed on the component drawing.

5.1.4.5 Connector mating cycle classification

Connection systems must be assigned a mating cycle classification based on the application descriptions in Table 5.1.4.5. This classification designation shall be documented in the test plan, test report, and identified on the component drawing.

Class	Typical application
M1	In-lines and headers not normally disconnected for service. These are permanent connection systems and are not expected to be disconnected after the vehicle is assembled. Example: Bulk head connectors, harness to harness connectors, etc. M1 connectors will be mated 10 cycles prior to testing. (same as USCAR 2)
M2	In-line or header connection systems that are normally disconnected and reconnected when a vehicle is serviced. Example: service disconnect or safety disconnect. M2 connectors will be mated 50 cycles prior to testing
M3	In-line or header connectors that are disconnected and reconnected as a normal function of the part. Example: Charge port, etc. It is the responsibility of the test requester or responsible person to establish the required number of mating cycles for M3 connection systems. The number of conditioning cycles shall be documented in the test report.

Table 5.1.4.5 Connection system mating cycle classification