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Standard Test Method for Durability Wear Testing of Separable Electrical Connector Systems Using Electrical Resistance Measurements[1]

This standard is issued under the fixed designation B 794; 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 test method covers the effects of repeated insertion and withdrawal of separable electrical connectors which are harmful to the electrical performance of the connector.

1.2 This test method is limited to electrical connectors designed for use in applications where the current through any one connection in the connector does not exceed 5 A, and where the connector may be separated a number of times during the life of the connector.

1.3 This test method is limited to electrical connectors intended for use in air ambients where the operating temperature is less than 65°C.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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 become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B 539 Test Methods for Measuring Resistance of Electrical Connections (Static ~~Contacts)~~Contacts)

2.2 *Military Standard:*[3]

MIL-STD-1344A Test Methods for Electrical Connectors

3. Summary of Test Method

3.1 Sample connectors are wired for precision resistance measurements of each test contact. The samples are divided into two groups; then resistance measurements are made of each test contact. The connectors in one group undergo a number of insertion/withdrawal cycles appropriate for the particular connector under test, and the resistances of these connectors are measured again. The connectors in the other group are not disturbed. All samples are subjected to an accelerated aging test; then the resistances are measured again. All samples are separated (withdrawn), exposed to an accelerated aging test in the uninserted condition, removed from the test, reinserted, and resistances measured again. The various resistance measurements are compared to detect effects of the wear and aging on electrical performance.

4. Significance and Use

4.1 Materials for electrical connector contacts must satisfy a number of requirements in the areas of electrical, mechanical, and economic characteristics. The stability of electrical properties is one of the most important of these characteristics. Wear of contact surfaces may adversely affect these electrical properties, especially in designs where the contact surfaces are relatively thin coatings. This test method provides a means to compare various material systems on a basis relevant to their application in electrical connector contacts.

4.2 Repeated insertion and withdrawal of a connector may cause wear or other mechanical damage to the electrical contact

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[1] This test method is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.11 on Electrical Contact Test Methods.

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~~[2] Annual Book of ASTM Standards, Vol 03.04.~~

[2] 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.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA ~~19111-5094, Attn: NPODS.~~19111-5098, http://www.dodssp.daps.mil.

surfaces, rendering those surfaces more susceptible to environmental degradation. This test method is intended to detect degradation of the electrical properties of the connector by such processes.

4.3 This test method describes procedures for conducting wear and durability testing of electrical connectors; the procedures produce quantitative results. These results may be used to compare the performance of different connector designs so that meaningful design choices can be made. Such results may also be used to compare the performance of a connector to a previously established standard to evaluate the quality of the samples under test.

4.4 The test results obtained from this test method are limited in their applicability to connector combinations that are equivalent in design and manufacture to those actually tested.

4.5 The user is cautioned that the conditions in this test should be compared to the conditions that the connector will experience in the intended application in order to determine the relevance of this test method to the particular needs of the user. For example, the environmental stress in this test method is less severe than certain industrial and marine environments and therefore test results are not directly applicable to predict the performance of product intended for use in such areas.

4.6 It is recommended that this test method be used in one of two ways. First, it may be used to evaluate and report the performance of a particular connector system. In such a case, it is appropriate to report the results in a table in the format shown in Fig. 1 and to state " The results shown in the table were obtained for (insert connector designation or description) when tested in accordance with ASTM Standard B 794, Method __ , Procedure __ ." Second, it may be used to impose requirements for acceptance of product. In this case, limits for the values shown in Fig. 1 must be established prior to product acceptance testing. Such limits may be established by various methods such as by evaluation of product which is known to be acceptable or by application of appropriate experience. These limits must be documented in a manner that the entity performing the product test can refer to the limits to determine if the test product conforms to such limits. A purchaser may wish to supply a table of limits and include on the purchase order a statement similar to: "The product, when tested in accordance with ASTM Standard B 794, Method __ , Procedure __ , shall meet the limits in the supplied table." This table supplied by the purchaser may set limits on all of the values in Fig. 1, or only on a subset of those values that the purchaser deems adequate to ensure the performance of the product.

5. Apparatus

5.1 *Environmental Test Chamber*, capable of controlling the test ambient in accordance with the sequence shown in Table 1. The test chamber shall be sufficiently large that each test sample shall be positioned with at least 100 mm separating it from the nearest wall of the test chamber. The test chamber design and operation procedure shall conform to the requirements contained in MIL-STD-1344A, Method 1002.2.

5.2 An instrument is required for measuring resistance by the four-wire method. This instrument shall operate within the limits on current and open-circuit voltage set forth in Test Methods B 539, Test Method C. The instrument shall be capable of measuring

SUMMARY OF RESULTS FOR ALL CONTACTS						
Section 1: Wear Test Samples, Total Insertions = __						
Value Reported (data set)	Minimum	Mean	Median	Maximum	Stnd Dev.	N*
Initial Resistance (M1)	—	—	—	—	—	—
Resistance Change after added wear cycles (C1)	—	—	—	—	—	—
Resistance Change after 10 days in environmental test in the connected condition (C2)	—	—	—	—	—	—
Resistance Change after additional 10 days in environmental test in the unconnected condition (C3)	—	—	—	—	—	—
Section 2: Control Samples, Total Insertions = 2						
Value Reported (data set)	Minimum	Mean	Median	Maximum	Stnd Dev.	N*
Initial Resistance (M1)	—	—	—	—	—	—
Resistance Change after 10 days in environmental test in the connected condition (C2)	—	—	—	—	—	—
Resistance Change after additional 10 days in environmental test in the unconnected condition (C3)	—	—	—	—	—	—

* Number of contacts measured

Note: A value is to be entered in the table at each location indicated by "__"

FIG. 1 Sample Format for Reporting Results

TABLE 1 Environmental Test Sequence

NOTE 1—Tolerance on temperature control is ±2°.

Step	Elapsed Time, h	Temperature, °C	Relative Humidity, %
1	0–2.5	ascending, 25–65	92 ± 3
2	2.5–5.5	65	92 ± 3
3	5.5–8	descending, 65–25	87 ± 8
4	8–10.5	ascending, 25–65	92 ± 3
5	10.5–13.5	65	92 ± 3
6	13.5–16	descending, 65–25	87 ± 8
7	16–24	25	92 ± 3

a resistance less than 0.100 Ω with a resolution of 0.0001 Ω. For a resistance 0.100 Ω or larger, the instrument shall be capable of measuring it with a resolution of 0.1 % of the resistance value.

6. Sampling and Test Specimens

6.1 *Selection of Sample Connectors*—Obtain sufficient sample connectors so that the electrical resistance of at least 200 contacts contained in at least 20 separate connectors will be measured in the test. Obtain sample connectors that are representative of those that will be used in the intended application. Recognize that a connector consists of two halves and both halves must be representative of the product to be used. In some cases one half will be a conductive area or pad on a printed wiring-board surface, therefore printed wiring boards must be obtained that have representative conductive pads. Specifically, the conductive pads shall be manufactured to the same requirements as those that will be required of parts to be used in the system application. These requirements will normally cover the manufacturing process, thickness, composition, hardness, and roughness of both the finish coating and of any underplating or undercoating. Protective treatments, if used, shall also be specified. For the purpose of connector testing, such printed wiring boards are generally fabricated with appropriate circuitry to permit four-wire resistance measurements.

6.2 *Selection of Sample Contacts*—In the case where the samples are multicontact connectors and electrical measurements are performed only on a fraction of the total number of contacts, the contacts measured shall be distributed throughout the field of contacts. Measure the corresponding contacts in each sample connector.

7. Conditioning

7.1 An electrical measurement laboratory is required in which the ambient temperature is controlled to 23 ± 5°C and the relative humidity is held below 60 %. This laboratory need not be dedicated to this test program to the exclusion of other uses so long as those other uses do not degrade the quality of data obtained on the connector test samples.

8. Procedure

8.1 *Selection of Test Method*—Select a test method from the following table which is appropriate for connector design and application.

Method	Number of Insertions
A	5
B	10
C	25
D	50
E	100
F	200
G	400
H	(number selected per agreement between producer and user)

8.2 *Sample Preparation*:

8.2.1 Assemble the connectors into mounting plates, guides, fixtures, racks, or similar apparatus if such apparatus is generally used in the actual application of the connector. Perform such assembly at the time in the sample wiring process that best simulates the typical manner in which the connectors are assembled into a system.

8.2.2 Wire samples for evaluation by this test method for electrical resistance measurements before the two connector halves are plugged together. The wiring and resistance measuring circuitry shall be of the four-wire type as described in Test Methods B 539. Do the wiring in a manner that is typical of the way the connector would be wired in service, and especially in a manner that does not introduce unrealistic contaminants or mechanical stresses on the connector. Do not perform cleaning, lubrication, or other treatments of the connector unless such treatments are specified by the connector manufacturer or user as the required procedure for the application of the particular connector under test.

8.2.3 Wire at least one reference resistor for resistance measurements in such a manner that its resistance may be measured using the same instrumentation and procedures as are used for the test contacts. It is suggested that this reference resistor be a length of wire or a path on a printed wiring board with a resistance of the same order of magnitude as that of typical test contacts. Measure