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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

EI42

**MULTIPROGRAM/PROJECT COMMON-USE
DOCUMENT**

**STANDARD FOR ELECTRICAL
CONTACTS, RETENTION CRITERIA**

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MSFC - Form 454 (Rev. October 1992)

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DOCUMENT HISTORY LOG

| Status (Baseline/ Revision/ Canceled) | Document Revision | Effective Date | Description |
|--|------------------------------|---------------------------|--|
| Baseline | - | 01/19/83 | Initial release |
| Revision | A | August 1, 2007 | Revised document throughout so that all requirements state "shall" to satisfy CAITS action #04-DA01-0387 |
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1. SCOPE

1.1 The purpose of this document is to provide criteria for retention testing of electrical crimp, insertable/removable contacts. This document provides criteria for retention testing of contacts in electrical connectors and distribution/bussing junction devices conforming to specifications 40M38277, 40M38294, 40M38298, 40M39569, 40M39589, 16A02980, and MIL-DTL-38999. This criteria shall also be used for similar generic devices covered by industry, military, and other NASA specifications. This criteria does not apply to coaxial, shielded, or twist pin contacts.

1.2 The implementation of this document shall be responsibility of MSFC and associated contractors.

2. APPLICABLE DOCUMENTS

2.1 The following form a part of this document to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

MARSHALL SPACE FLIGHT CENTER (MSFC) SPECIFICATIONS

| | |
|----------|--|
| 40M38277 | Specification for Connectors, Electrical, Circular Miniature High Density, Environment Resisting |
| 40M38294 | Specification for Connectors, Electrical, Circular, Cryogenic Environment Resisting |
| 40M39589 | Specification for Junctions and Junction Devices, Electrical Distribution and Bussing |
| 40M38298 | Specification for Connectors, Electrical, Special, Miniature Circular, Environment Resisting 200°C |
| 40M39569 | Specification for Connectors, Electrical, Miniature Circular, Environment Resisting 200°C |
| 16A02980 | Specification Control Drawing for Connectors, Electrical, Circular Miniature, Underwater |

MILITARY SPECIFICATIONS

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MIL-DTL-38999 Connectors, Electrical, Circular, High Density, Quick Disconnect, Environment Resistant, Removable Crimp Contacts

(Copies of specifications, standards, drawings, and publications required by contractors in connection with the application of this criteria should be obtained from the procuring activity or as directed by the contracting officer.)

3. ACRONYMS/DEFINITIONS

3.1 Acronyms used in this standard – The acronyms used in this standard are defined as follows:

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3.2 Definitions - The definitions used in this standard are defined as follows:

3.2.1 Connector, Electrical - A conductor terminating device which allows the separation of one or more electrical circuits and is capable of being mated or unmated to another connector. This document applies to both halves.

3.2.2 Connector, Plug - An electrical connector intended to be attached to the free end of a conductor, wire, cable or bundle and which couples or mates to a receptacle connector.

3.2.3 Connector, Receptacle - An electrical connector intended to be mounted or installed onto a fixed structure such as a panel, electrical or electronic box or chassis and which couples or mates to a plug connector.

3.2.4 Contact, Electrical - The conductive element in a connector or device which mates with a corresponding element to provide an electrical path or circuit.

3.2.5 Contact, Pin - A contact intended to make electrical engagement on its outer surface and which enters into a socket contact. Pin contacts can be located in either predetermined connector half, in either the connector plug or the connector receptacle.

3.2.6 Contact, Socket - A contact intended to make electrical engagement on its inner surface. Socket contacts can be located in either predetermined connector half, in either the connector plug or the connector receptacle.

3.2.7 Junction/Distribution and Bussing Device - A termination assembly having multiple contacts interconnected in parallel to form a common circuit or buss. It may contain one circuit or multiple, mutually insulated circuits.

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3.2.8 Junction/Distribution and Bussing Device Contact System - Contacts, conventionally crimped to wires, inserted and locked into junction device cavities and making contact with bussing segments rather than other contacts. The electrical circuit is completed by similar wired contacts making contact with the same bussing segment.

4. GENERAL REQUIREMENTS (CRITERIA)

4.1 Process Control. Using the appropriate contact insertion tool, insert the wired contacts straight into the contact/wire cavities.

4.1.1 An audible click and sensation (“feel”) followed by a firm stop is usually evident when the contacts lock into the metal retention clips or plastic wafer retention tines. Amplification of the locking sound or shock may be used as a contact installation manufacturing aid.

4.2 Retention Tests. Retention tests shall be performed on 100 percent of installed contacts to assure that they are properly installed and retained (locked in).

4.2.1 Push Tests. Push force contact retention testing shall be performed to the requirements of Table I and paragraph 4.2.3 on devices and applications in which the engaging (mating) ends of the pin or sockets are accessible.

4.2.2 Pull Tests. Pull force contact retention testing shall be performed only on devices and applications in which the contact engaging (mating) ends are not accessible. Pull force tests shall be performed by pulling, to the requirements of Table I and paragraph 4.2.4, on the wire that is terminated in the contact.

TABLE I. CONTACT RETENTION TEST FORCES

| <u>Contact Sizes</u> | <u>Push Test Force (pounds)</u> | <u>Pull Test Force (pounds)</u> |
|----------------------|---------------------------------|---------------------------------|
| 22, 22D and 22M | 4.0 to 6.0 | 3.0 to 5.0 |
| 20 | 5.0 to 7.0 | 3.0 to 5.0 |
| 16 | 8.0 to 10.0 | 4.0 to 7.0 |
| 12 | 10.0 to 12.0 | 4.0 to 7.0 |

CAUTION: Wires shall not be pulled to a force in excess of 80 percent of the specified minimum crimp tensile requirement. This requirement must be met to avoid damage to the crimp joint. In case of conflict with Table I and the 80 percent value, the latter shall take precedence.

4.2.3 Push Test Detailed Requirements

4.2.3.1 Visually examine connector device and contacts for anomalies. Unlocked contacts can sometimes be detected by uneven pin tips or socket front ends.

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4.2.3.2 Calibrated tools, adapters, fixtures, instrumentation, and verified procedures shall be used to perform the push force tests.

4.2.3.3 Tools, associated hardware, and procedure shall be such that a straight push force can be applied to the front portion of the contacts without any side loading of the contact, contact bending and any contact or connector device damage.

4.2.3.4 Tools shall be controlled so that no damage to connector device is possible, should a contact push back.

4.2.3.5 Push test shall be performed with wires and contact rears free to move without excessive restraints that could give a false indication of passing the force test or cause wire damage.

4.2.3.6 Push tests shall be performed prior to potting, molding, or encapsulating of the wires or contacts at the rear of the connector device.

4.2.3.7 Positive indication of application, conformance, and nonconformance to the forces specified in Table I shall be accomplished.

4.2.3.8 Any contacts that are visually discovered to be unlocked or that fail the force test shall be reinserted and force tested again.

4.2.3.9 If a second failure occurs, the hardware shall be examined for damage or anomalies with the contact, wire (strands or insulation), the crimp termination, or the connector device. If damage or anomaly is found, appropriate action shall be taken to repair or replace the hardware and assure that adequate failure analysis is performed and reported.

4.2.3.10 If no damage or anomaly is found, the contact shall be inserted a third time and reasonable attempts to lock it shall be accomplished.

4.2.3.11 Any further failure to lock shall be cause for rejection and replacement of hardware. Failure analysis shall be performed and reported.

4.2.3.12 The results of the push tests of each individual contact shall be recorded on appropriate data sheets

4.2.4 Pull Test Detailed Requirements

4.2.4.1 Visually examine connector device and contacts for anomalies. Unlocked contacts can sometimes be detected by uneven pin tips or socket front ends.

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4.2.4.2 Calibrated tools, adapters, fixtures instrumentation, and verified procedures shall be used to perform the pull force tests.

4.2.4.3 Tools and procedures shall be such that a straight pull force can be applied axially to the contact by gripping the insulated wire and pulling perpendicularly to the wire exit face of the connector device.

4.2.4.4 Never pull the wire at an angle exceeding 5°.

4.2.4.5 The wires to be pulled shall be free of string ties, plastic ties, harness clamps, or any wire harness holding devices within approximately 5 inches of the connector device wire exit face.

4.2.4.6 Tools shall be controlled so that no damage to connector device, crimp joints, wire, wire insulation or adjacent hardware occurs.

4.2.4.7 Positive indication of application, conformance, and nonconformance to the forces specified in Table I shall be accomplished.

4.2.4.8 Wires shall not be pulled to a force in excess of 80 percent of the specified minimum, crimp tensile requirement. This requirement shall be met to avoid damage to the wire/contact crimp joint.

4.2.4.9 Perform steps h, i, j, and k of paragraph 4.2.3.

4.2.4.10 The results of the pull test of each individual contact shall be recorded on appropriate data sheets.

4.3 Verification - Quality Assurance shall verify the following minimum requirements necessitated by this document are accomplished. The quality assurance personnel's stamp on the data sheets shall be evidence that verification requirements have been fulfilled or accomplished.

4.3.1 Quality Assurance personnel shall perform and/or witness all tests and recording of all data required by paragraphs 4.2.3 and 4.2.4 of this document.

4.3.2 Quality Assurance shall verify the following minimum requirements:

4.3.2.1 That all personnel performing the tests have been instructed in the manner that the work shall be accomplished and have demonstrated their ability to successfully accomplish the defined tests and examinations defined in this document.

4.3.2.2 That force test tools and gauges are calibrated and within proper calibration period.

4.3.2.3 That data sheets are included in the manufacturing "as built" records for each unit.

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4.3.2.4 That proper contact insertion and extraction tools are used.

4.3.2.5 That all contact insertions are made in accordance with acceptable procedures and workmanship standards.

4.3.2.6 That there is no damage to contacts, connector devices, or wires. Some slight distortion to wire insulation similar to approved mechanical stripping operations is acceptable when pull tests are performed. Slight burnishing of contact plating surface is acceptable when push force tests are performed.