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ATTACHMENTS

# 1.0 INTRODUCTION

## 1.1 Scope

This specification describes the general characteristics of connectors, contacts, and backshells intended for use in cabin systems commercial aircraft. ARINC 600, ARINC 404, and ARINC 801 connector specifications are published as independent standards.

This specification provides component standards necessary to achieve intermateability. The connectors, cables, and backshells described in this specification should be used for cabin equipment.

If there is no corresponding component in this specification, standardization, as described in Part 1 of ARINC Specification 800, may be initiated by the relevant equipment supplier.

This specification includes values for qualification tests and procedures for cabin-installed components. This specification does not provide a qualified product list.

## 1.2 Related Documents

The latest version of the following documents applies:

**ARINC Specification 404B:** *Connectors, Rack and Panel, Rectangular Rear Release Crimp Contacts*

**ARINC Specification 600:** *Air Transport Avionics Equipment Interfaces*

**ARINC Specification 664, Part 2:** *Aircraft Data Network, Ethernet Physical and Data Link Layer Specification*

**ARINC Specification 800, Part 1:** *Cabin Connectors and Cables, Description and Overview*

**ARINC Specification 800, Part 3:** *Cabin Connectors and Cables, Specification of Cables*

**ARINC Specification 800 Part 4:** *Cabin Connectors and Cables, Standard Test Methodology*

**ARINC Specification 801:** *Fiber Optic Connectors*

**ARINC Specification 802:** ***Fiber Optic Cables***

**ARINC Report 807:** *Fiber Optic Training Requirements*

**ARINC Specification 809:** *3GCN – Seat Distribution System*

**ARINC Specification 810:** *Definition of Standard Interfaces for Galley Insert (GAIN) Equipment, Physical Interfaces*

**ARINC Specification 845:** *Fiber Optic Expanded Beam Termini*

**ARINC Specification 846:** *Fiber Optic Ferrule, Mechanical Transfer*

**ASTM A342:** *Materials, Feebly Magnetic, Permeability of, Standard Test Methods for*

**ASTM B571:** *Standard Practice for Qualitative Adhesion Testing of Metallic Coatings*

**ASTM D3638:** *Standard Test Method for Comparative Tracking Index of Electrical Insulating Materials*

**EIA-364:** *Electrical Connector/Socket Test Procedures incl. Environmental Classifications*

**EIA-455:** *Fiber Optic, Fibers, Cables, Transducers, Sensors, Connecting and terminating Devices, and other Fiber Optic Components*

**EN 2591:** *Elements of electrical and optical connection, test methods*

**EN 3042:** *Quality Assurance. EN Aerospace Products. Qualification Procedure*

**EN 3375:** *Aerospace Series. Cable, Electrical, for Digital Data Transmission. Single Braid. CAN Bus. 120 Ohms. Type WX. Product Standard*

**EN 4165:** *Connectors, electrical, rectangular, modular, operating temperature 175 °C continuous*

**EN 4644:** *Connector, electrical and optical, rectangular, modular, rectangular inserts, operating temperature 175 °C continuous*

**EN 60512:** *Electromechanical Components for Electronic Equipment – Basic Testing Procedures and Measuring Methods*

**FAR 25.853, Appendix F, Part I:** *Test Criteria and Procedures for Showing Compliance with §25.853, or §25.855*

**ISO 2409:** *Paints and Varnishes – Cross-Cut Test*

**MIL-DTL-22520:** *Crimping Tools, Wire Termination, General Specification for*

**MIL-DTL-38999:** *Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification for*

**MIL-I-81969:** *Military Specification: Installing and Removal Tools, Connector Electrical Contact, General Specification For*

**MIL-PRF-39012:** *Connectors, Coaxial, Radio Frequency, General Specification for*

**MIL-STD-889:** *Dissimilar Metals*

**NAS1599:** *Cylindrical Bayonet Connectors, Crimp Rear Release Contacts*

**SAE-AMS 2404:** *Plating, Electroless Nickel*

**SAE-AMS QQ-N-290:** *Nickel Plating (Electrodeposited)*

**TIA/EIA–455:** *Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components*

**TIA/EIA–568:** *Commercial Building Telecommunications Cabling Standard*

# 2.0 TESTS

## 2.1 Test Definition

In general, electrical, mechanical, environmental, and optical tests are referenced in this specification. Tests are specified by the European Association of Aerospace Manufacturers by EN-standards or Electronic Industries Alliance by EIA-standards. Applicable component test methods are specified individually.

## 2.2 Test Methods

Components should be specified by requirements linked to applicable test methods that represent acceptance values.

**COMMENTARY**

The requirements identified herein are the minimum requirements needed for connectors installed in areas such as the cabin seat. The specific environmental conditions to which the connectors, cable, and associated equipment will be exposed, as well as additional requirements imposed by airframe manufacturers or regulatory organizations must be taken into account when these or any connectors are being selected for use.

Test methods can be grouped together in one or more test groups. Test groups form the basis for test plans for each component as guidance for qualification.

Applicable test methods include the following:

- EN2591-xxx – Elements of Electrical and Optical Connection Test Methods
- EIA-364-xx – Electrical Connector/Sockets Test Procedures including Environmental Classification

When these standard test methods are not applicable, additional test methods are described in this specification.

**COMMENTARY**

Referenced documentation will include applicable dash numbers as appropriate.

## 2.3 Flammability, Smoke, and Toxicity

Components containing non-metallic materials should be tested for Flammability, Smoke, and Toxicity (FST) in accordance with the requirements and test methods required by the certification authorities (i.e., FAA/EASA) in FAR/CS Section 25.853, Appendix F. The test methods and requirements from the certification authorities take precedence over those described herein.

Fire properties of connectors should be tested at the material level. Non-metallic material specimens should be provided as sheet material for test because results from sheet material testing can be used in lieu of numerous component tests where the same material is used.

The following procedures should be applied to connector FST testing:

<u>Material Qualification.</u> When appropriate samples are available, basic qualification of the flammable material constituents should be performed. For these tests, samples defined in the individual test methods should be taken from plates fabricated from the base material. A range of plate thicknesses should be tested in

order to provide a general material qualification. In policy statement PS-ANM-25.853-01, the FAA suggests testing at thicknesses of 0.5 mm, 1.5 mm, 2.5 mm, 6.0 mm, and 12.5 mm for general material qualification. As an alternative, a specific component application can be qualified by testing samples with the thickness of the original piece part of the component. Because FST properties can vary significantly, materials for structural molded parts should be differentiated from elastomeric materials.

Component Qualification. When material-level samples are not available, tests can be performed at the component level. This testing should comply with the certification authority small part definitions. For that definition, test components should fit inside a 50 x 50 x 50 mm or 75 x 75 x 12 mm area. For components out of that range, applicable test methods should be selected from FAR/CS Section 25.853, Appendix F.

Components with a metallic housing should be tested as a single part. Components consisting completely of multiple non-metallic materials should be tested as separate, but adjacent material samples.

**COMMENTARY**

Test methods and requirements should be established based on agreement with the airframe manufacturer.

## 2.3.1 Test Requirements

### 2.3.1.1 Flammability

#### 2.3.1.1.1 Connectors with Metallic Housing

When tested as specified in Section 2.3.2.1.1, the units under test should meet the following requirements:

a. Burning after removal of applied flame must extinguish with 15 seconds
b. After-glow must extinguish within 15 seconds
c. There must be no dripping that causes the flammable material to ignite
d. There must be no violent burning or explosive type fire

Note: Alternatively, this test can be performed as specified in Section 2.3.2.1.3 on test specimen of all non-metallic materials used in the connector.

#### 2.3.1.1.2 Connectors with Composite Housing

When tested as specified in Section 2.3.2.1.2, the units under test should meet the following requirements:

a. Burn length (average) must not exceed 203 mm (8 in)
b. After flame time (average) must not exceed 15 seconds
c. After flame time of drips (average) must not exceed 5 seconds

Note: Alternatively, this test can be performed as specified in Section 2.3.2.1.3 on a test specimen of all non-metallic materials used in the connector.

#### 2.3.1.1.3 Non-Metallic Materials Used in Connectors

When tested as specified in Section 2.3.2.1.3, the units under test should meet the following requirements:

a. Burn length (average) must not exceed 203 mm
b. After flame time (average) must not exceed 15 seconds
c. After flame time of drips (average) must not exceed 5 seconds

Note: This test is used to test the base material. It may be used as a material qualification.

#### 2.3.1.1.4 Elastomeric Parts Used in Connectors

When tested as specified in Section 2.3.2.1.3, the units under test should meet the following requirements:

a. Burn length (average) must not exceed 64 mm per minute

### 2.3.1.2 Specific Optical Smoke Density

When tested as specified in Section 2.3.2.2, the maximum Specific Optical Smoke Density (Average) should not exceed the applicable limits as follows:

a. Flaming mode $D_s = 200$
b. Non-flaming mode $D_s = 200$

### 2.3.1.3 Toxicity

When tested as specified in Section 2.3.2.3, the average concentration in parts per million of the following gas components of smoke should not exceed limits listed in Table 2-1.

**Table 2-1 – Toxicity Requirements**

| Gas Component | Limit of Concentration |
|---|---|
| Hydrogen Fluoride (HF) | < 100 ppm |
| Hydrogen Chloride (HCL) | < 150 ppm |
| Hydrogen Cyanide (HCN) | < 150 ppm |
| Sulfur Dioxide ($SO_2$) | < 100 ppm |
| Nitrous Gases ($NO/NO_2$) | < 100 ppm |
| Carbon Monoxide (CO) | < 1000 ppm |

## 2.3.2 Test Procedures

### 2.3.2.1 Flammability

#### 2.3.2.1.1 Connectors with Metallic Housing

See Section 2.3.1.1.1 for test requirements. Connectors should be tested in accordance with test procedure EIA 364-104, Condition C (10 seconds flame application time).

#### 2.3.2.1.2 Composite/Plastic Connectors

See Section 2.3.1.1.2 for test requirements. Testing should be conducted in accordance with FAA/EASA FAR/CS Appendix F, Part 1, (a) (1) (ii) and (b) (4) for vertical test. Flame should be applied for 12 seconds. EN3844-1 may be used for complementary test setup information. A minimum of 3 specimens should be tested. The test specimen should be mounted as described below and shown in Figure 2-1.

The set of connector test samples should be mounted in a row in the middle of a printed circuit board or on a metallic plate 75 mm wide x 305 mm long. The samples should be positioned along the long axis of the plate and placed on the substrate so that each connector sample is in contact with its neighbor. The connectors should occupy at least 203 mm of the board/plate, when measured from the top of the substrate. No varnish should be applied to the connector samples. Two boards/plates, populated with connectors, should be submitted for testing.

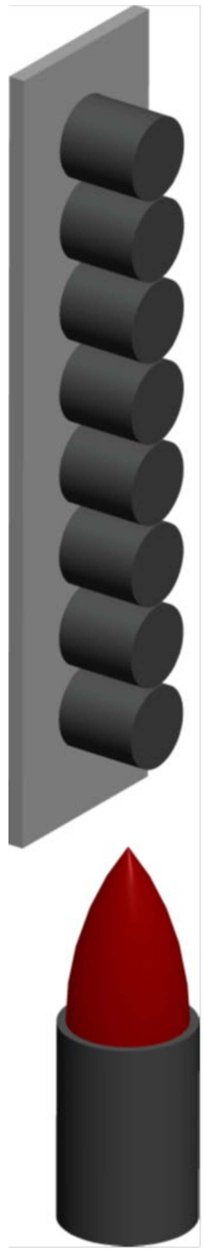

**Figure 2-1 – Mounting Arrangement of Composite/Plastic Test Specimens**

#### 2.3.2.1.3 Non-Metallic Materials Used in Connectors

See Section 2.3.1.1.3. Test specimen should be tested in accordance with test procedure EN3844, Code B (12 seconds flame application time).

### 2.3.2.2 Specific Optical Smoke Density

See Section 2.3.1.2. Test specimen of all non-metallic materials used in connectors submitted to qualification testing should be tested in accordance with test procedures EN2824 and EN2825.

### 2.3.2.3 Toxicity

See Section 2.3.1.3. Test specimen of all non-metallic materials used in connectors submitted to qualification testing should be tested in accordance with test procedures EN2824 and EN2826.

## 2.4 Fluid Susceptibility

This section of the specification defines fluids used in or present on the aircraft and may get in contact with the considered item. The fluid susceptibility test requires the compliance of the item with applicable fluids in the operational condition. Therefore, the operational temperature of the fluid should be considered. The fluids listed in Table 2-2 are typically used inside the pressurized fuselage as avionics bay, cabin, cargo compartment, etc.

Further fluids are specified in EN3909 which may, if applicable, be referenced in the specification of the individual component.

Material specimens can be tested as an alternative for verification. Each material of the item should be tested for fluid susceptibility.

**COMMENTARY**

Care should be taken since many fluids have flashpoints within the test temperature range causing possible fire and explosion. Further fluids can react with materials of the item under test and create toxic gases.

### 2.4.1 Test Requirements

When tested as specified in Section 2.4.2, the selected fluids should not affect the performance of the item under test. Further the item should show no evidence of damaged parts. A color change of the item is acceptable as long as it is not defined differently in the relevant specification. Successive tests need to be specified to validate the performance of the item. These tests need to be added to the fluid qualification test group in the specification of the item.

Table 2-2 describes classes of test fluids and fluid temperatures of the item with regards to the application and its location. The identified fluid classes should be considered as a minimum for the susceptibility test.

**Table 2-2 – Test Fluids in Pressurized Area**

| Class | Test Fluid Description | | Fluid Temp. | Remarks |
|---|---|---|---|---|
| | Fluid Standard | Commercial Fluids | (°C) | |
| Hydraulic fluid | NSA 307110 | | 70 | only in Avionics Bay |
| Cleaning agents | AIMS09-03-001 | Diestone DLS for metallic items from Socomor | 55 | |
| | AMS 1550 | Honey Bee 90 for plastic items from CeeBee | 55 | |
| | AMS 1550 | Alglas Visial for screen | 55 | |
| | SAN 50 | For oxygen masks | 55 | |
| | Iso Propyl Alcohol | | 55 | only in Avionics Bay |
| | MS1526 | Synclair A2 Gel (pure and diluted) from Socomor | | only in Cargo Compartment |
| Disinfectants | AMS1452 | Calla 1452 Zip Chem | 55 | |
| Extinguishing agents | | Halon 1211 | 23 | |
| | | Halon 1301 | 23 | only in Cargo Compartment |
| | | NOVEC1230 | 23 | only in Cargo Compartment |
| | Dry Chemical Fire extinguisher | Purple X | 23 | |
| Insecticides | AMS1450 | Callington One Shot | 30 | |
| Drinks | | Soda | 5 | |
| | | Coffee | 40 | |
| Heat Transfer fluid | | Galden HT 135 from Solvay | -20 | |
| | | Thermera from Fortum | -20 | |

### 2.4.2 Test Procedure

Items under test should comply with requirements specified in Section 2.4.1.

The component specification should define if the item under test will be immersed in, or be sprayed with, the fluid. Both test procedures are defined in RTCA DO-160, Section 11: Fluids Susceptibility and will be tested as defined in the component specification of the item.

The item under test is electrically and mechanically configured as defined in the component specification. Further, the item should be cleaned to be free of any protective film, grease, or other contaminants in order not to distort the test result.

For electrical connective items contact cavities should be wired according to the specification, whereas unused cavities are equipped with filler plugs. The electrical item will be subjected to the test at ambient room temperature whereas the test fluid is preheated to the temperature specified in Table 2-2.

Fluids should not be premixed. Each item under test should be subjected to one fluid only. The amount of items per fluid is defined in the component specification.

# 3.0 CONTACTS

## 3.1 Data Contacts

### 3.1.1 Parallel Twinax

#### 3.1.1.1 Introduction

The following subsections have been excerpted from ARINC Specifications 809 and 810. Applicable references to this specification will be included in ARINC Specifications 809 and 810. All future changes will be introduced in this specification.

#### 3.1.1.2 Scope

This section is intended to provide standardization of the design and fabrication of a parallel Twinax contact.

The contact can be used with ARINC 600, A800-P2-4.2, and EN4644 connectors.

#### 3.1.1.3 Contact Referencing Scheme

The referencing scheme, shown in Figure 3-1, requires definition of the contact type and description of the insert arrangement. The referencing scheme should not be used to purchase components.

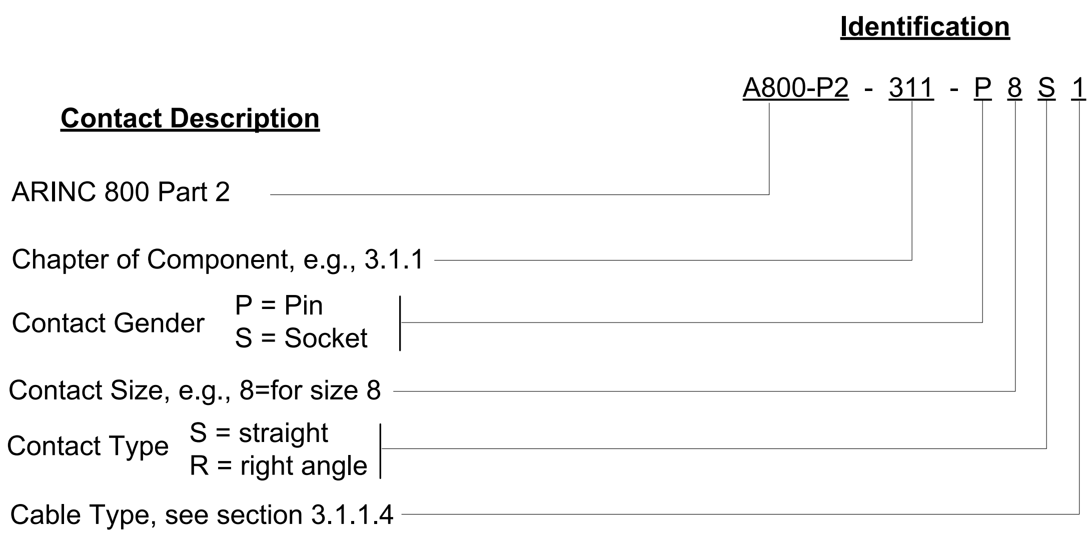


**Figure 3-1 – Contact Referencing Scheme**

#### 3.1.1.4 Cable

The following cables could be crimped to the contact:

- A800-P3-512M2S26
- EN3375-009

#### 3.1.1.5 Contact Requirements

Operating temperature range: -85 °F to +347 °F (-65 °C to +175 °C)

Short term maximum temperature range: -85 °F to +392 °F (-65 °C to +200 °C)

Impedance: 100 Ohm

Mating cycles: 500

#### 3.1.1.6 Contact Design

Contact design should conform to Appendix C, Figures C-1, C-2, and C-3. Dimensions are given to ensure interchangeability between suppliers of the contact.

#### 3.1.1.7 Material and Plating

The materials and plating described in Table 3-1 should be used for the piece parts of the contacts.

**Table 3-1 – Material and Plating**

| Piece parts | Material | Plating |
|---|---|---|
| Ferrule | Brass | Au |
| Contacts | Brass or Beryllium copper | Au |
| Insulator | PTFE | - |

Metallic piece parts that are not part of the conductive signal path of the contact can be plated differently, but need to meet the corrosion requirements.

#### 3.1.1.8 Tools

Crimping tool and positioners are indicated in Table 3-2.

**Table 3-2 – Crimping Tool for Twinax**

| Contact Size | Wire Size (AWG) | Crimping Tool | Positioner |
|---|---|---|---|
| 8 | 24 | Center contacts: M22520/2-01 Outer Body: M22520/5-01 | Center contacts: Daniels K709 Outer Body: M22520/5-45 |

Insertion and extraction tools are indicated in Table 3-3.

**Table 3-3 – Insertion and Extraction Tool for Twinax**

| Contact Size | Insertion and Extraction Tool |
|---|---|
| 8 | MIL-I-81969/14-06 or M81969/28.03 |

### 3.1.2 Quadrax

The quadrax contact is specified dimensionally in ARINC Specification 600, Attachment 20. This contact is compatible for use with ARINC 600, ARINC 404, EN3545, EN3682, EN4644, EN2997, and NAS1599 connectors.

Quadrax contacts EN3155-074 and -075 are compatible for use in connector types EN4165 and EN3645. Contact arrangements are marked with L and Q.

See ARINC Specification 664, Part 2, for Ethernet cabling guidelines.

### 3.1.3 8AX

#### 3.1.3.1 Objectives

This section defines a size 8 “8ax” high-speed copper contact for the air transport industry. The goal is to provide a 10GBASE-T interconnect solution in a size 8 form factor contact.

This will make 10GBASE-T retrofit, upgrade, and new designs easy by combining with many existing inserts of the most popular connectors series.

#### 3.1.3.2 Scope

This section is intended to provide standardization of the design and fabrication of an 8ax contact for 10GBASE-T Ethernet links.

The 8ax contact is a size 8 multi-pin contact into which eight signal pins are included to provide one 10GBASE-T Ethernet port per contact.

> Note: The target application for the 8ax contact is 10GBASE-T links, although it can be used for lower speed like 1000BASE-T applications.

#### 3.1.3.3 Benefits

The use of 8ax size 8 contact provides benefits such as:

- Up to 10GBASE-T with only one contact
- Replacing two quadrax contacts necessary to achieve 10GBASE-T Ethernet link by one single 8ax contact
- Reducing size of connector shells
- Reducing overall weight of cable harness

#### 3.1.3.4 Key Characteristics

The 8ax employs a reverse gender construction versus quadrax contacts described in Section 3.1.2.

The 8ax is the ‘pin-type’ outer shell, contains eight ‘socket’ signal contacts. The 8ax with the ‘socket-type’ outer shell, contains eight ‘pin’ signal contacts.

The 8ax, just like the quadrax contact, and for the same reasons related to the design of the connectors into which they are mounted, is available in the following two versions:

- Type 1: compatible with ARINC 600 series, EN4644, and EN3545 series
- Type 2: compatible with MIL-DTL-38999, EN4165

Dimensional details, as well as applicable tests and qualification procedures relevant for each version are also described here.

#### 3.1.3.5 Contact Design

The Type 1 and Type 2 versions are both size 8 contacts. They are differentiated by part numbers and physically by the coding key that provides anti-rotation of the contact inside the connector cavity (see Figure 3-2 for details).

The 8ax contact supports termination of wires up to 26 AWG.

All equipment using the 8ax contact for 10GBASE-T or 1000BASE-T should use the standard pin allocation illustrated in Figure 3-2. Refer to ARINC Specification 664 Part 2, for 10GBASE-T and 1000BASE-T applications for signal name to contact pin assignments. Wire implementation guidelines are included in ARINC Specification 664 Part 2.

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**Type 1: ARINC 600, EN4644, EN3545 compliant** | **Type 2: MIL-DTL-38999, EN4165 compliant**

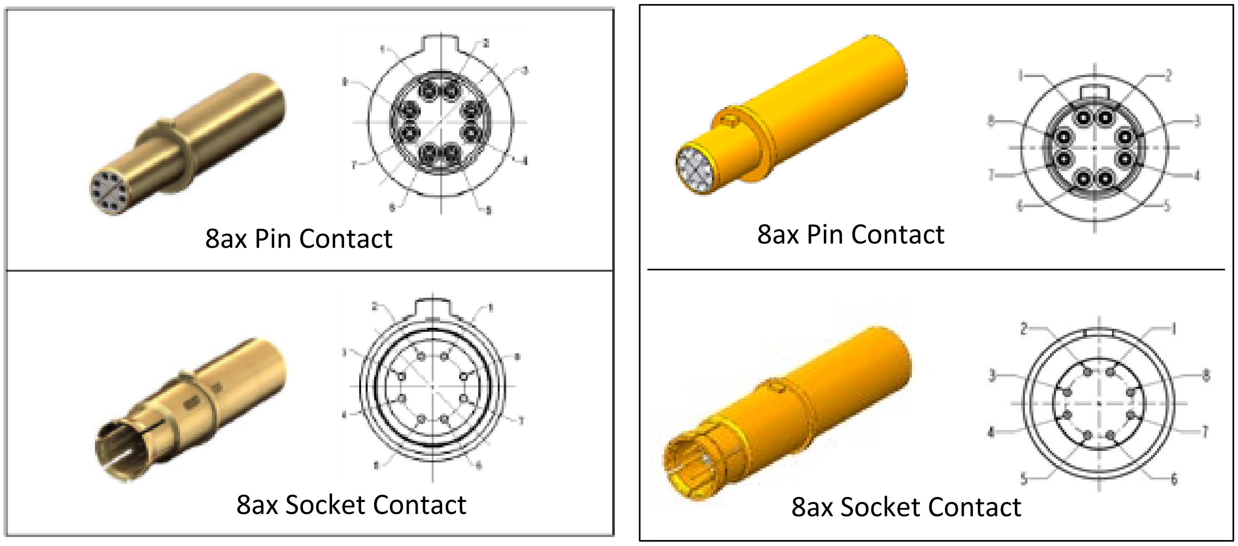


**Figure 3-2 – Definition of Contact Type and Characteristics**

**COMMENTARY**

Most connector types allow the use of either a pin or socket 8ax contact in both the plug and receptacle connector. However, some connector series have limited options (i.e., the plug connector will only accommodate sockets, and the receptacle will only support pins). The system integrator must consider these limitations when specifying the connectors used.

### 3.1.3.6 Contact Requirements

#### 3.1.3.6.1 Specific Characteristics

Coaxial, triaxial, bifilar, quadrax, and 8ax contacts have screening feature and specified high-frequency characteristics. Class R corresponds to an operating temperature range from -65 °C to 150 °C (-85 °F to 302 °F) per EN 3155.

8ax Mating durability: 500 mating cycles.

#### 3.1.3.6.2 Dimensions and Mass

Contact dimensions should conform to Appendix E, Figures E-1 and E-2. Appendix E, Figure E-3 shows dimensions for PCB drilling. Appendix E, Figure E-4 shows a front release, front removeable PCB contact. Dimensions are given to ensure interchangeability between suppliers of the contact.

Contact mass: 10 g, maximum.

Individual signal contacts are described in Appendix E, Figure E-5, and Table E-1.

#### 3.1.3.6.3 Marking of 8ax Contacts

##### 3.1.3.6.3.1 Size 8 Outer Contact Body

Marking by color code as shown in Figure 3-3.

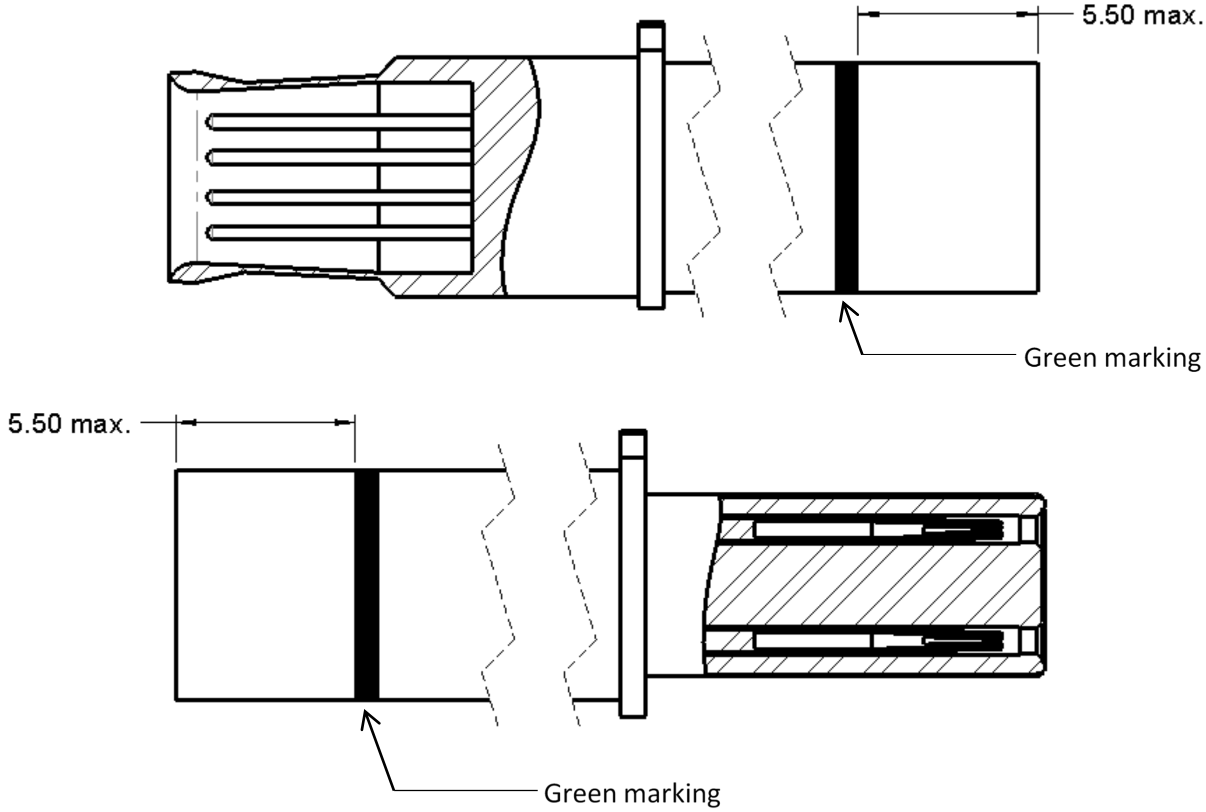


**Figure 3-3 – Marking of 8ax Contacts**

#### 3.1.3.6.3.2 Pin Location Identification

Due to the small size of the 8ax contact, there are no physical markings on the contact body that denote the numbering of the eight signal pins. This requires the installer to be reliant on supporting documentation to identify the location of the signal pins 1 thru 8, as shown in Figure 3-4. Refer to ARINC Specification 664, Part 2, Appendix N for wire termination guidelines.

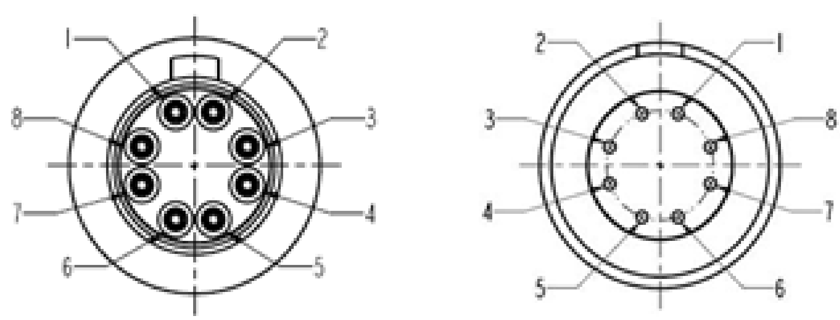


**Figure 3-4 – Location of Signal Pins and Sockets**

#### 3.1.3.6.4 Material, Surface Treatment

The materials and plating described in Table 3-4 should be used for the piece parts of the contacts.

**Table 3-4 – Material and Plating**

| Piece Parts | Material | Plating | Plating Thickness |
|---|---|---|---|
| Contact Body | Copper Alloy | Au | 0.8 µm, min. |
| Inner Contacts | Copper Alloy | Au | 0.8 µm, min. |
| Inner Bushing | Brass or Equivalent | Au | 0.8 µm, min. |
| Insulator | High-Grade Thermoplastic | - | - |

Metallic piece parts that are not part of the conductive signal path of the contact can be plated differently but need to meet the corrosion requirements.

### 3.1.3.7 Cable

The following cables could be crimped to the contact:

- A800P3-415-M-8-S-26 – Cat6A (4-pair), 26 AWG Data Cable in accordance with ARINC Specification 800, Part 3, Section 4.1.5

### 3.1.3.8 Tools

Crimping tool and positioners are indicated in Table 3-5.

**Table 3-5 – Crimping Tool for 8ax**

| Contact Size | Wire Size (AWG) | Crimping Tool | Positioner |
|---|---|---|---|
| 8 | 26 | Center contacts: M22520/2-01 Outer Body: M22520/5-01 | Center contacts: TBD Outer Body: M22520/5-45 |

Insertion and extraction tools are indicated in Table 3-6.

**Table 3-6 – Insertion and Extraction Tool for 8ax**

| Contact Type | Insertion and Extraction Tool |
|---|---|
| Contact 8ax Type 1 | M81969/14-06 |
| Contact 8ax Type 2 | M81969/14-12 |

### 3.1.3.9 Performance Requirements

#### 3.1.3.9.1 Qualification Tests

Contact qualification test requirements are provided in Table 3-7.

## Table 3-7 – 8ax Contact Performance Requirements

| EN 2591- | Test | Requirement |
|---|---|---|
| 101 | Visual Examination | Pass |
| 102 | Examination of Dimensions and Mass | 10 g, max. |
| 201 | Contact resistance, low level<br>Signal contacts, initial<br>Signal contacts, after test | <br>8 mΩ, maximum<br>10 mΩ, maximum<br>Note: Measurement should be made at a 30 cm distance. |
| 202 | Contact resistance, at rated current<br>Signal contacts, initial, ambient<br>Signal contacts, after test, ambient<br>Signal contacts, 200 °C<br>Outer body, initial, ambient<br>Outer body, after test, ambient<br>Outer body, 200 °C | <br>8 mΩ, maximum; test current 1 A<br>10 mΩ, maximum; test current 1 A<br>12 mΩ, maximum; test current 1 A<br>2 mΩ, maximum; test current 12 A<br>4 mΩ, maximum; test current 12 A<br>6 mΩ, maximum; test current 12 A |
| 204 | Discontinuity of contacts in the microsecond range | Method B:<br>Interruption ≤ 2 ns during tests<br>EN 2591-402 and EN 2591-403 |
| 205 | Housing (shell) electrical continuity | Measurements between housing of connectors and outer contact before and after tests.<br>Requirement: 10mΩ max |
| 206 | Measurement of insulation resistance | ≥ 5 000 MΩ<br>At maximum temperature: ≥ 1 000 MΩ at maximum specified temperature |
| 207 | Voltage Proof Test | Method C<br>Withstand voltage at sea level:<br>1000 Vrms between signal contacts<br>500 Vrms between signal contacts and outer body<br>Withstand voltage at altitude:<br>125 Vrms at a pressure of 4.7 kPa (21 000 m)<br>Leakage current: 2 mA |
| 210 | Electrical Overload | Not Applicable |
| 211 | Capacitance | Not Applicable |
| 212 | Surface transfer impedance | Not Applicable |
| | Insertion Loss | Refer to Section 3.1.3.9.2 |
| 223 | Measurement of characteristic impedance of a coaxial connector or contact | 100 ±10 Ω at 100 MHz |
| 301 | Endurance at temperature | Method B<br>T = 200 °C<br>Duration: 1000 h |
| 305 | Rapid change of temperature | Contacts wired and engaged:<br>$T_A$ = 200 ± 2 °C<br>$T_B$ = − 65 ± 2 °C |
| 306 | Mold growth | Pass |
| 307 | Salt Mist | Pass |
| 315 | Fluid Resistance | See Table 3-8 |
| 402 | Shock | To be done at connector performance level |

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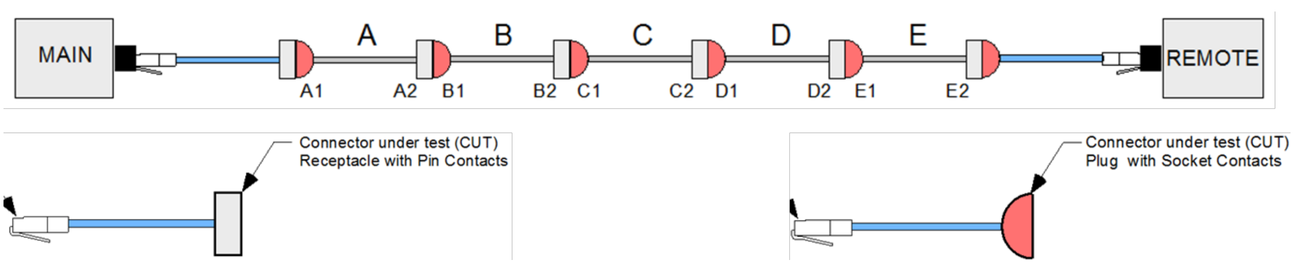
| EN 2591- | Test | Requirement |
|---|---|---|
| 403 | Sinusoidal and random vibration | To be done at connector performance level |
| 406 | Mechanical Endurance | 500 cycles |
| 415 | Test probe endurance | Pin only |
| 416 | Contact bending strength | Not Applicable |
| 417 | Tensile Strength (crimped connection)<br>Conductor<br>Shield | <br>45 N, min.<br>110 N, min. |
| 418 | Gauge insertion and extraction force | |
| | Insertion force - center contact<br>Insertion force - center contact (after cond.)<br>Extraction force - center contact<br>Extraction force - center contact (after cond.) | 3.33 N, max.<br>3.89 N, max.<br>0.14 N, min.<br>0.11 N, min. |
| | Type 1 - Insertion force - outer body<br>Type 1 - Insertion force - outer body (after cond.)<br>Type 1 - Extraction force - outer body<br>Type 1 - Extraction force - outer body (after cond.) | 5 N, max.<br>5 N, max.<br>1.20 N, min.<br>0.80 N, min. |
| | Type 2 - Insertion force - outer body<br>Type 2 - Insertion force - outer body (after cond.)<br>Type 2 - Extraction force - outer body<br>Type 2 - Extraction force - outer body (after cond.) | 13.6 N, max.<br>17 N, max.<br>0.85 N, min.<br>0.57 N, min. |
| 503 | Contact deformation after crimping | Cable size in accordance with<br>– Signal contacts concentricity tolerance shall not exceed 0.28.<br>– Signal contacts and outer body. Crimping zone shall not exceed 0.15 mm expansion. |
| 507 | Plating porosity | Pass |
| 508 | Measurement of thickness of coating on contacts | 0.1 µm, min., on active areas and transition areas. |
| | Center Pin Contact<br>Center Socket Contact<br>Outer Body of Pin Contact<br>Outer Body of Socket Contact | Y=3.81 mm, min<br>X=1.0 mm, min<br>Y=6.5 mm, min<br>X=1.90 mm, min |
| 513 | Magnetic permeability | Pass |

**Table 3-8 – Fluid Resistance Requirements**

| Fluid | | Immersion | | Stoving | Number of cycles |
|---|---|---|---|---|---|
| Category | EN3909 NUMBER | Duration min | Temp. °C | Temp. °C | |
| Fuel | 2 | 96 h | 25 | 15 | 3 |
| Mineral hydraulic fluid | 3 | 15 $^{+5}_{0}$ | 85 | 100 | 1 |
| Mineral lubricant | 7 | 15 $^{+5}_{0}$ | 120 | 125 | 1 |
| Synthetic lubricant | 9 | 15 $^{+5}_{0}$ | 150 | 125 | 5 |
| Cleaning products | 11 | 15 $^{+5}_{0}$ | 25 | 25 | 5 |
| | 13 | 15 $^{+2}_{0}$ | | | |
| De-icing fluid | 15 | 15 $^{+5}_{0}$ | 50 | 100 | 5 |
| Cooling fluid | 19 | 15 $^{+5}_{0}$ | 50 | 25 | 1 |

### 3.1.3.9.2 Link Level Performance (Channel Specification)

Link performance should be measured on a test article as shown in Figure 3-5.




| **Segment** | patch | A | B | C | D | E | patch | Total |
|---|---|---|---|---|---|---|---|---|
| **Length (m)** | 2 | 10 | 15 | 15 | 20 | 5 | 2 | 65 |

**Figure 3-5 – Link Performance Test Article.**

When tested in accordance with methodology described in ARINC Specification 800, Part 4, using the ANSI/TIA-568-C.2 Category 6A Channel criteria, the electrical performance should be as shown in Table 3-9

**Table 3-9 – Link Performance**

| Frequency (MHz) | Insertion Loss dB, max | Return Loss, min | NEXT dB, min | ACRF dB, min | PSNEXT dB, m min | PSACRF dB, min |
|---|---|---|---|---|---|---|
| 1.0 | 3 | 19.0 | 65.0 | 63.3 | 62.0 | 60.3 |
| 4.0 | 4.2 | 19.0 | 63.0 | 51.2 | 60.5 | 48.2 |
| 8.0 | 5.8 | 19.0 | 58.2 | 45.2 | 55.6 | 42.2 |
| 10.0 | 6.5 | 19.0 | 56.6 | 43.3 | 54.0 | 40.3 |
| 16.0 | 8.2 | 18.0 | 53.2 | 39.2 | 50.6 | 36.2 |
| 20.0 | 9.2 | 17.5 | 51.6 | 37.2 | 49.0 | 34.2 |
| 25.0 | 10.2 | 17.0 | 50.0 | 35.3 | 47.3 | 32.3 |
| 31.3 | 11.5 | 16.5 | 48.4 | 33.4 | 45.7 | 30.4 |
| 62.5 | 16.4 | 14.0 | 43.4 | 27.3 | 40.6 | 24.3 |
| 100.0 | 20.9 | 12.0 | 39.9 | 23.3 | 37.1 | 20.3 |
| 200.0 | 30.1 | 9.0 | 34.8 | 17.2 | 31.9 | 14.2 |
| 250.0 | 33.9 | 8.0 | 33.1 | 15.3 | 30.2 | 12.3 |
| 350.0 | 40.6 | 6.6 | 30.3 | 12.4 | 27.3 | 9.4 |
| 500.0 | 49.3 | 6.0 | 26.1 | 9.3 | 23.2 | 6.3 |

### 3.1.3.10 Contact Referencing Scheme

The referencing scheme, shown in Figure 3-6, requires definition of the contact type and description of the insert arrangement. The referencing scheme should not be used to purchase components.

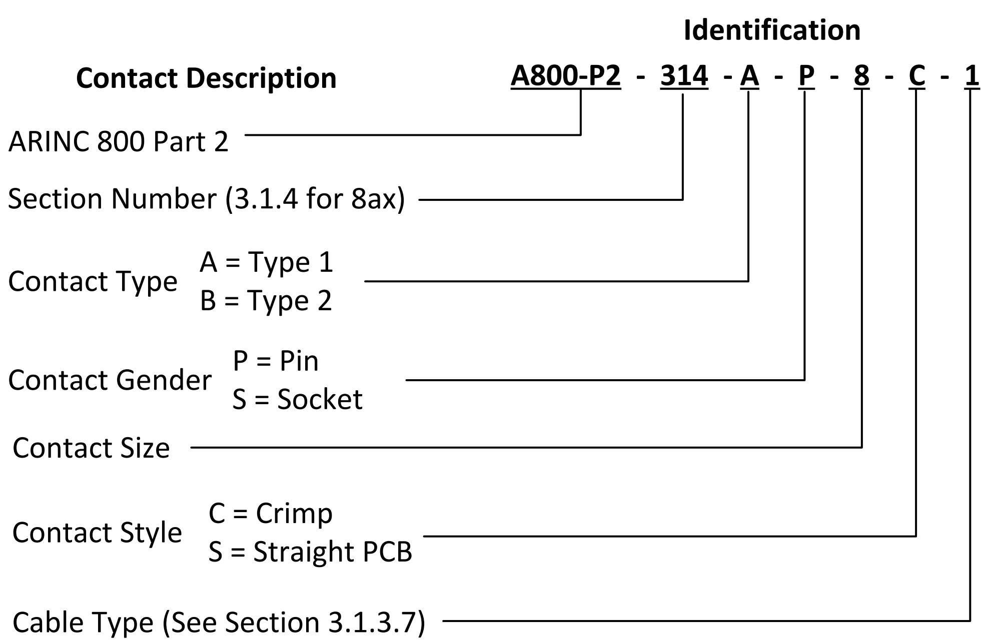



**Figure 3-6 – 8ax Contact Referencing**

### 3.1.4 Expanded Beam Fiber Optic Termini

Expanded Beam Fiber Optic termini are defined in ARINC Specification 845.

The currently-available fiber optic termini types fit into size 16 cavities and are compatible for use with EN4165 and D38999 connectors. Termini types compatible for use with EN4644 and ARINC 600 connectors may be considered in a future supplement to ARINC Specification 845.

The terminus design is compatible with ARINC Specification 802 loose and tight structure cables.

### 3.1.5 Fiber Optic Ferrule, Mechanical Transfer

Mechanical Transfer (MT) ferrules are defined in ARINC Specification 846.

The currently specified ferrule is a single MT in a size 8 quadrax contact. Other termini types may be considered in a future supplement to ARINC Specification 846.

The terminus design is compatible with ARINC Specification 802, Appendix K high-density cable.

# 4.0 MODULAR RECTANGULAR CONNECTORS

## 4.1 Monomodular Connector

### 4.1.1 Introduction

The following subsections have been excerpted from ARINC Specification 809. Applicable references to the specification will be included in ARINC Specification 809. All future changes will be introduced in this specification. Additionally, the modular connector shells and backshells are specified in EN4165-024, EN4165-025, and EN4165-026.

#### 4.1.1.1 Objectives

This section is intended to provide standardization of a push-pull connector shell design utilizing the EN4165-002 modular insert for the in-seat wiring of commercial transport airplanes. The specific intent of these connector shells is for use in the IFE system. The composite connector shell is intended for general use applications where the temperature extremes do not exceed -67 °F to +347 °F (-55 °C to +175 °C). The goal is to avoid the proliferation of different designs of connectors that serve the same functions on different aircraft models. This specification defines the push-pull connector needed for commercial aircraft. The connector is based on the EN4165-002 modular insert and associated contacts. This standardization effort is intended to reduce interconnect system costs by the use of a small number of configurations, thereby providing economies of scale. In addition, standardization will reduce the number of assembly procedures and tools, leading to savings in both actual maintenance costs and also in the training of maintenance technicians.

#### 4.1.1.2 Scope

This specification defines the dimensions, performance, and quality assurance criteria for the design, construction, performance, and testing of the push-pull connector. The connector shells should be manufactured from thermoplastic or thermoset resins, conductively plated, and utilize the modular insert defined in EN4165-002.

#### 4.1.1.3 Organization of this Specification

Section 4.1.1 introduces the objective and scope of this specification and identifies the types of connectors addressed within the section.

Section 4.1.2 provides the guidelines for the expected performance and physical characteristics of the connectors. These include material, construction criteria, and environmental performance.

Section 4.1.3 addresses qualification tests.

Appendix A defines the connector intermateability, rear accessory interface, and receptacle to panel interface dimensions.

#### 4.1.1.4 Relationship to Other Documents

Related documents that address various aspects of implementation of the rectangular push-pull connector and are intended to complement ARINC Specification 809 are listed in Section 4.1.2.

### 4.1.1.5 Connector Type(s) and Insert Arrangement(s)

#### 4.1.1.5.1 Connector Type(s)

This section covers the following connector type(s):

- Type 1 connectors are rectangular multi pin, Push – Pull coupling.

#### 4.1.1.5.2 Insert Arrangement(s)

EN4165 compliant inserts utilize the multi-pin insert arrangements defined by EN4165-002. Removable contacts that can be used are indicated in EN 3155-002.

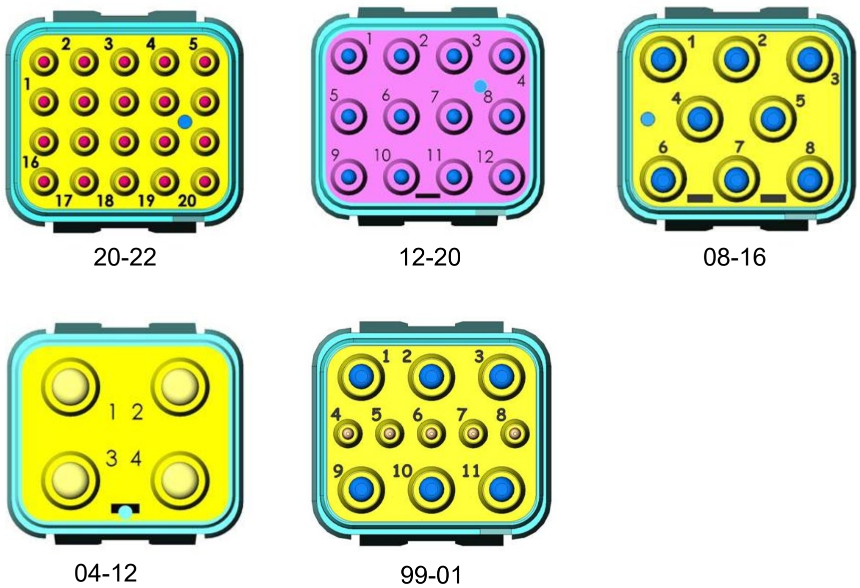
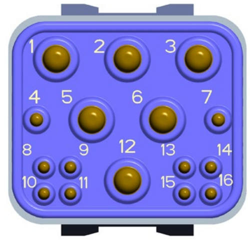



**Figure 4-1a – EN4165 Standard Insert Arrangements**

The envelope and form factor of the ARINC 800-specified inserts specified in Figure 4-1b are compliant with EN4165-002 and are defined in Appendix A. Contacts are compliant with EN3155-002, except as noted for each insert.

**4.0 MODULAR RECTANGULAR CONNECTORS**

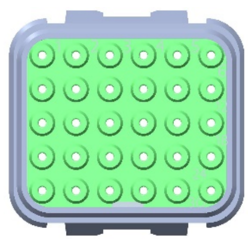



16-02

Notes:

1. This insert shall contain 6 size 16, 2 size 22, and 8 size 24 contacts.
2. This insert is intended for use with A800-P3-421M16S1x seat-to-seat cable. If other cables, e.g., quadrax cables with 24 AWG, are terminated to the insert, the feasibility of installation of the quadrax wires to the contact and to the insert should be reviewed. The wire insulation diameter must be compatible with the insert cavity dimension and the insertion/extraction tool.
3. AWG 24 contact interfaces are defined in Appendix A.
4. For size 24 contacts, insulation diameter for compatible wiring should be less than 0.038 in (0.96 mm).

**Figure 4-1b – ARINC 800 16-02 Insert Arrangement**



30-23

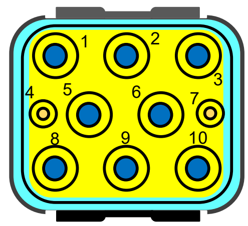
Notes:

1. This insert shall contain 30 size 23 contacts.
2. This insert is intended for use in applications where more than 20 contacts (e.g., 20-22 insert) are needed. Contacts can be used for any combination of data, discretes, and power.
3. Rear sealing must be compatible with standard 22, 24, and 26 AWG wire sizes as well as the larger dielectric of controlled impedance aircraft wires.
4. AWG 23 contacts are defined in Appendix A.
5. Insulation diameter for compatible wiring should be less than 0.042 in (1.07 mm).
6. Design of the contact cavity should accommodate the conductor insulation diameter noted and standard extraction tools for contact removal.

**Figure 4-1c – ARINC 800 30-23 Insert Arrangement**

**COMMENTARY**

Instead of standard 22, 24, and 26 AWG wire, aircraft manufacturers use controlled impedance twisted-wire cable for ARINC 664 Ethernet installations. These wires have thicker insulation than other types of standard wiring. For this reason, the insert designs should accommodate this larger insulation diameter as well as standard extraction tools for contact removal.




**16-10**

Note: This insert may contain 8 size 16 (copper or fiber) contacts and 2 size 22 contacts.

**Figure 4-1d – ARINC 800 16-10 Insert Arrangement**

### 4.1.1.5.3 Board Mounted Insert Arrangements

The dimensional details for the ARINC 800 inserts for straight or right angled Printed Circuit Board (PCB) mounting application shown in Figures 4-2a, 4-2b, and 4-2c are given as the generic and most commonly used values for such application. Those dimensions can be useful to mechanical engineers and printed circuit board designers for the purpose of board drilling and connector positioning. The reference point for calculation is the fixation clip of the insert. For the location of the fixation groove inside the connector shell, refer to EN4165.

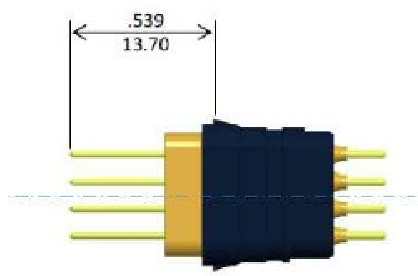



**Figure 4-2a – ARINC 800 Straight, Board-Mounted Insert**

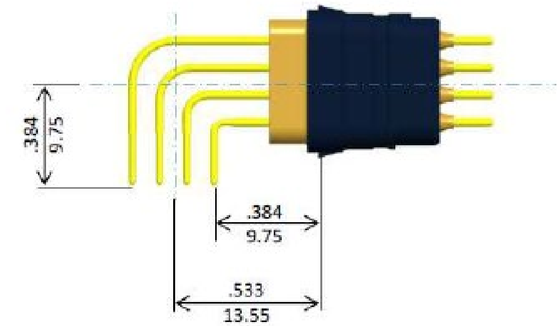



**Figure 4-2b – ARINC 800 Right-Angled, Board-Mounted Insert**

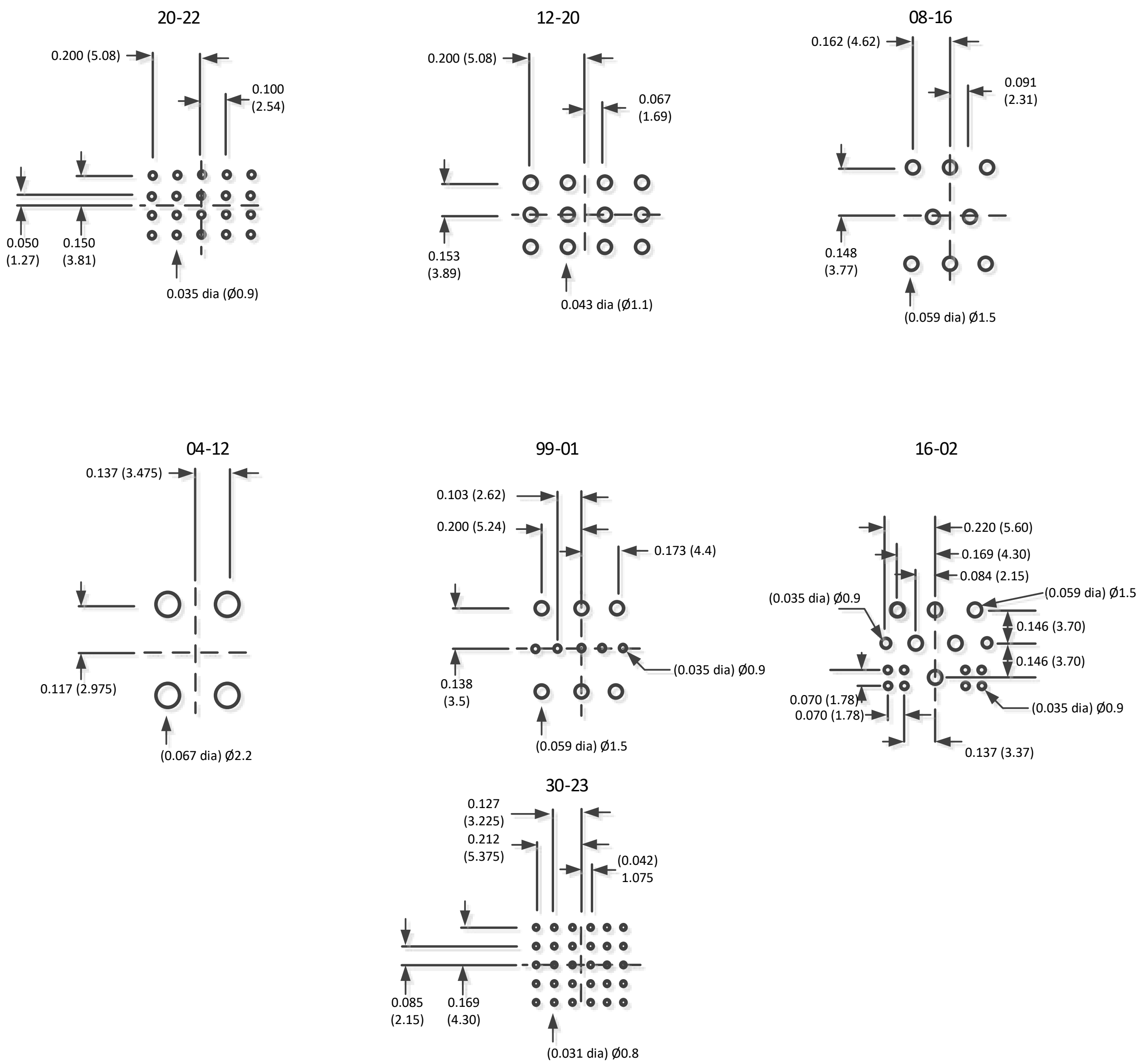



**Figure 4-2c – ARINC 800 PCB Layout Dimensions**

#### 4.1.1.5.4 Connector Referencing Scheme

The reference scheme in Figures 4-3, 4-4, and 4-5 should be used to define connector type and insert arrangement. This referencing scheme should not be used for purchasing of components.

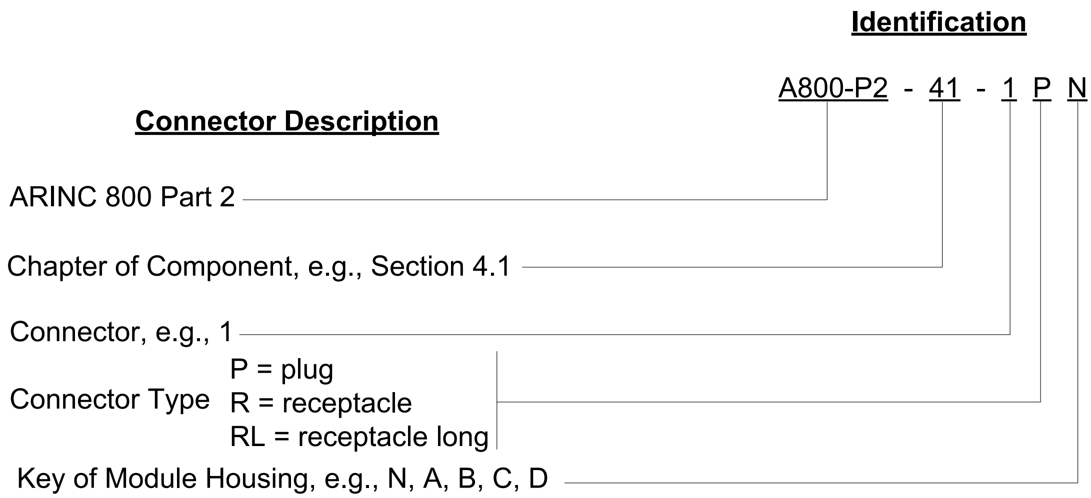



**Figure 4-3 – Connector Referencing Scheme**

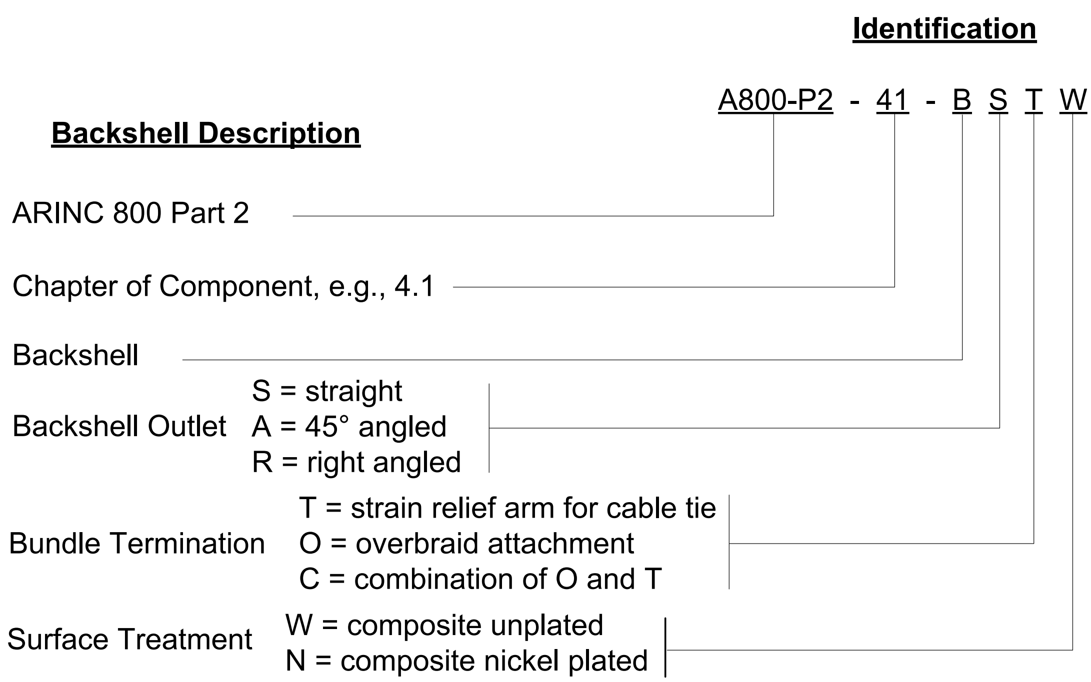



**Figure 4-4 – Backshell Referencing Scheme**

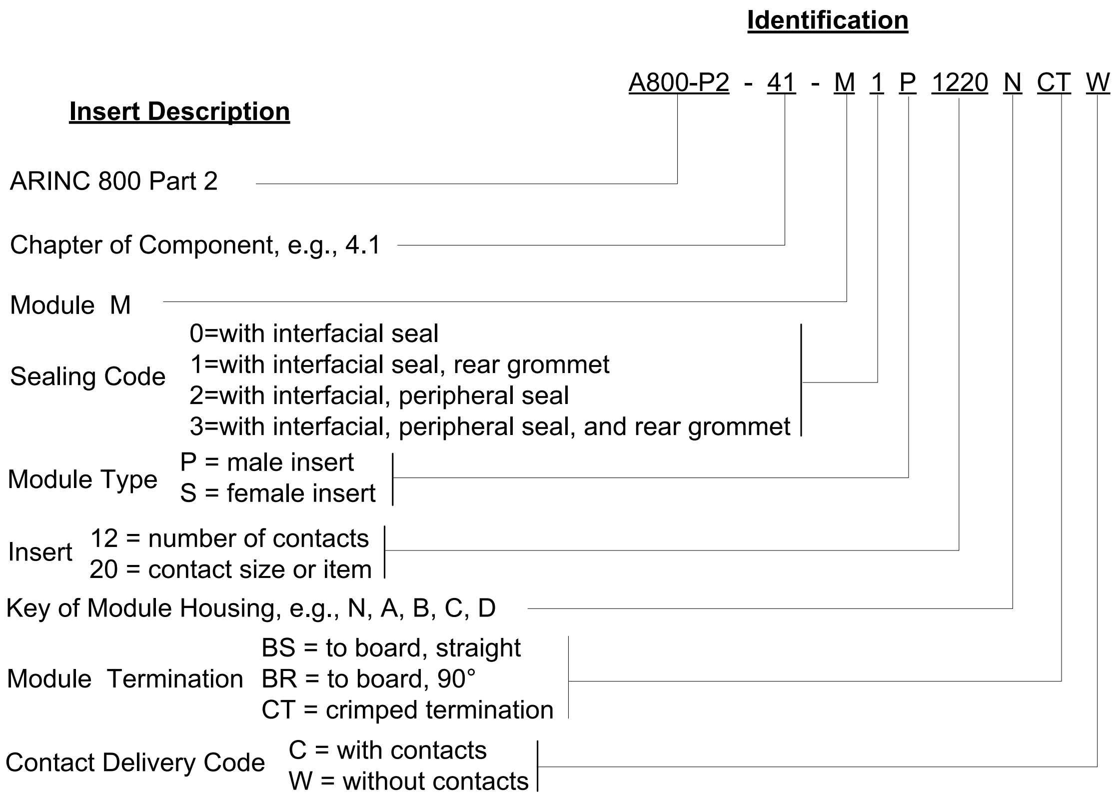



**Figure 4-5 – Insert Referencing Scheme**

### 4.1.2 Requirements

#### 4.1.2.1 Specification Sheets

The performance of individual items should be as specified herein and in accordance with the applicable attachment or specification drawing. In the event of any conflict between the guidelines of this specification and the drawings, the latter should be used.

#### 4.1.2.2 General Requirements

In case of conflicts with this specification and other documents, the guidelines of this specification should be used. The items furnished under this specification should be capable of passing the performance verification test specified herein. Unless otherwise specified, ambient temperature is 73.4 ±9 °F (23 ±5 °C).

##### 4.1.2.2.1 Mateability

Connector dimensions are provided herein to ensure that all products from various manufacturers will be intermateable with each other. It is the responsibility of each manufacturer to perform a tolerance analysis of their design to ensure that it will mate to any appropriate connector that is within specification tolerances.

Each new connector manufacturer should perform a connector interoperability test with connectors and modular inserts from existing and qualified manufacturers.

Dimensional information defining the connector rear accessory and receptacle-to-panel interface dimensions are defined in Appendix A.

#### 4.1.2.2.2 Basic Design and Materials

The design and materials should be compatible with the environmental conditions similar to those encountered in the various zones of commercial aircraft as defined in Section 4.1.3, i.e., pressure-altitude, temperature, humidity, vibration, and fluid exposure.

#### 4.1.2.2.3 Dissimilar Metals

Unless otherwise protected against electrolytic corrosion, dissimilar metals should not be employed in intimate contact with each other in a connector or in any mated pairs of connectors conforming to the specification. Dissimilar metals are defined in MIL-STD-889.

#### 4.1.2.2.4 Shell

The connector shell designs should provide provisions to accept either a strain relief or Electromagnetic Interference (EMI) enclosure for zero length cable shield terminations. Shells should be constructed to mechanically retain the EN4165-002 inserts and permit their removal by means specified in the EN4165 specification. Connector shell should be made from high-grade thermoplastic or thermoset materials. The material used for the connector housing should be durable, resilient plastic material with sufficient stiffness to minimize deflection and distortion when mated and will not deteriorate under normal conditions of operation and ageing. A key attribute that must be considered when selecting the material for the connector shell is the ability to accept a conductive metallic finish. The plug shell should incorporate the coupling mechanism. The receptacle should incorporate the specific features that when engaged with the plug latch mechanism, a mechanically rigid assembly is produced.

#### 4.1.2.2.4.1 Shell Finish

The connector shell should be plated with an electrically conductive finish of electrolytic nickel per SAE-AMS QQ-N-290 over an electroless nickel per SAE-AMS 2404 Class 3 or 4 and be capable of meeting the environmental and electrical requirements herein.

#### 4.1.2.2.4.2 Receptacle Shell Mounting Provisions

The receptacle shell design should incorporate specific design feature that provides a mechanical and electrical interface to the panel. The electrical ground path established by the mounting of the receptacle shell must maintain a stable, low resistance electrical ground path for the life of the installation. This electrical ground path that is provided by the mechanical mounting feature should not require preparations during the initial assembly processes or maintenance once in service.

#### 4.1.2.2.4.3 Coupling Mechanism

The plug shell should be mated to the receptacle shell by sliding the plug into the receptacle where the two shell halves engage. The latch mechanism will then engage the specific features located on the receptacle forcing the two connector shells together, creating a mechanically rigid assembly. The receptacle shell, when mated to the plug shell, provides a mechanically rigid assembly, establishing a 360° enclosure essential to the EMI shielding performance. The coupling mechanism and connector shell design should incorporate a means of providing a visual reference that the plug is fully mated to the receptacle. No tools should be required to activate the latch mechanism to either mate or unmate the plug and receptacle. The coupling mechanism should withstand 500 mating and unmating cycles.

#### 4.1.2.2.4.4 Ancillary Constituent Piece Parts

Ancillary constituent piece parts, such as strain relief, EMI backshell, latches, and latch releases, should be manufactured from suitable plastic that meets application requirements, flammability, and toxicity requirements specified herein.

#### 4.1.2.2.4.5 Insert Retention

Individual inserts should be positively retained within the connector shell. The inserts should be able to withstand being subjected to 10 cycles of being inserted and extracted from the connector shell without suffering any failures or compromising the mechanical properties of the insert retention mechanism.

#### 4.1.2.2.5 Non-Magnetic Materials

Non-magnetic material and components should be used to the greatest extent possible. The permeability of the basic connector assembly should be less than 2.0 MU. The permeability should be checked by the instrument described in ASTM A342, EN2591-513, or equivalent.

#### 4.1.2.2.6 Resilient Materials

Resilient materials should have Shore hardness, electrical, and mechanical characteristics suitable for the purpose intended.

#### 4.1.2.2.7 Weight

The connector, including backshell hardware, should be a minimum weight consistent with performance requirements and within the limitations of sound design practices.

#### 4.1.2.2.8 Durability

The connector should be designed and constructed to withstand handling and maintenance functions incident to installation and service.

#### 4.1.2.2.9 Marking

Marking techniques and materials selected for the marking of connectors should be permanent and of a color that contrasts with the material on which the marking is applied. Characters should be of sufficient size and resolution to be completely understood without magnification.

#### 4.1.2.2.10 Flammability

Materials used in items covered by this specification should not sustain combustion when tested as specified in FAR 25.853, Appendix F, Part (I)(a)(1)(ii), using the vertical test method. Non-metallic materials considered for use in items covered by this specification should be tested in accordance with Section 2.1.

#### 4.1.2.2.11 Smoke

The materials from which the plug, receptacle, backshells, or connector covers used to protect un-mated plugs and receptacle for applications where provisional wiring is installed, should comply with the applicable airframe manufacturer requirements for smoke.

#### 4.1.2.2.12 Toxicity

Materials used in connectors or other parts covered by this specification should release only non-toxic fumes when tested.

Toxic gas emissions should not exceed the limits established by applicable airframe manufacturer specifications.

#### 4.1.2.2.13 Arc Tracking

Materials used in the construction of the connector shells that will not incorporate the conductive finish and be exposed to a potential electrical arcing event should be made from materials that will not arc track (from current conducting tracks) when subjected to electrical arcs at 150 Vac or less when tested in accordance with ASTM D3638.

#### 4.1.2.2.14 Fungus

Items covered by this specification should be constructed of materials that are not nutrients for fungi and do not deteriorate over time to become fungus nutrients.

#### 4.1.2.2.15 Accessories

Backshell hardware should be designed to avoid the accumulation of or facilitate the ingress of contaminants (water, chemicals, etc.) and provide wire bundle stress relief. Backshells may require a conductive finish along with provisions for termination of individual cable shields and overbraid.

#### 4.1.2.2.16 Tools

Standard tools should be used for insertion and removal of the EN4165-002 inserts. There should be no tools required to mate and unmate the plug from the receptacle shell. Unique tools should not be required by any different connector manufacturers.

### 4.1.2.3 Electrical Requirements

#### 4.1.2.3.1 Contact Resistance at Rated Current

When tested in accordance with Section 4.1.3.2, the contact resistance values should not exceed the values listed in Table 4-1a for standard contacts and Table 4-1b for data contacts. Rated current values are specified in Table 4-2.

**Table 4-1a – Contact Resistance**

At ambient temperature:

| Contact Size | Initial | After Test | High Temperature +347 °F (175 °C) |
|---|---|---|---|
| #24 | 23 mΩ | 27 mΩ | 39 mΩ |
| #22 | 8 mΩ | 11 mΩ | 13.6 mΩ |
| #20 | 5 mΩ | 7 mΩ | 8.5 mΩ |
| #16 | 3 mΩ | 5 mΩ | 5.1 mΩ |
| ≥ #12 | 2 mΩ | 3 mΩ | 3.4 mΩ |

Note: These values are defined in Table 2 of EN3155-001. Size 24 contact resistance limits are from SAE AS39029C, Table 6, for Nickel-plated wire.

**Table 4-1b – Contact Resistance for Data Contacts**

For size 8 Twinax or Quadrax contacts:

| Contact | Maximum Contact Resistance | | | Rated Current Amps |
|---|---|---|---|---|
| | 73.4 ±9 °F (23 ±5 °C) | | 257+5.4/-0 °F (125 +3/-0 °C) | |
| | Initial | After Test | After Test | |
| Size 24 Signal contact | 6.0 mΩ | 7.5 mΩ | 10.0 mΩ | 1 |
| Outer body | 2.0 mΩ | 4.0 mΩ | 6.0 mΩ | 12 |

**Table 4-2 – Rated Current**

| Contact size | Barrel size | Conductor | Current Conductor Rating (Amps) |
|---|---|---|---|
| 24 | 24 | 24 | 3 |
| | | 26 | 2 |
| 22 | 22 | 22 | 5 |
| | | 24 | 3 |
| | | 26 | 2 |
| 20 | 20 | 20 | 7.5 |
| | | 22 | 5 |
| | | 24 | 3 |
| 20 | 18 | 18 | 7.5 |
| | | 20 | 7.5 |
| | | 22 | 5 |
| | | 24 | 3 |
| 16 | 16 | 16 | 15 |
| | | 18 | 10 |
| | | 20 | 7.5 |
| 16 | 14 | 14 | 15 |
| | | 16 | 15 |
| | | 18 | 10 |
| | | 20 | 7.5 |
| 12 | 12 | 12 | 23 |
| | | 14 | 17 |
| 12 | 14 | 14 | 17 |
| | | 16 | 15 |
| | | 18 | 10 |
| | | 20 | 7.5 |
| 5 | 8 | 8 | 46 |

#### 4.1.2.3.2 Low Level Contact Resistance

Not applicable to modular connectors.

#### 4.1.2.3.3 Quadraxial Contacts

Contacts should conform to the specification drawings contained in ARINC Specification 600, Attachment 20.

#### 4.1.2.3.4 Fiber Optic Termini

Optical termini should conform to the specification drawings contained in ARINC Specification 801.

### 4.1.2.4 Mechanical Requirements

#### 4.1.2.4.1 Coupling Forces

The coupling or mating forces should not exceed the allowable forces when measured per Section 4.1.3.3. The initial mating forces of the connectors with the EN4165-002 inserts and fully populated with contacts or optical termini should, not exceed the values specified in Table 4-1.

**Table 4-3 – Initial Coupling Forces**

| Mating Shell Part Numbers | EN4165 Insert Arrangement | Mating Forces lbf (N) |
|---|---|---|
| A809 Type 1 | 20-22 | 11.3 (50) |
| A809 Type 1 | 12-20 | 11.3 (50) |
| A809 Type 1 | 08-16 | 11.3 (50) |
| A809 Type 1 | 99-01 | 11.3 (50) |
| A800 Type 1 | 16-02 | 11.3 (50) |

At the completion of the 500 mating and unmating cycles, the mating forces should not exceed those values in Table 4-2.

**Table 4-4 – Post Testing Coupling Forces**

| Mating Shell Part Numbers | Insert Arrangement | Mating Forces lbf (N) |
|---|---|---|
| A809 Type 1 | 20-22 | 11.3 (50) |
| A809 Type 1 | 12-20 | 11.3 (50) |
| A809 Type 1 | 08-16 | 11.3 (50) |
| A809 Type 1 | 99-01 | 11.3 (50) |
| A800 Type 1 | 16-02 | 11.3 (50) |

#### 4.1.2.4.2 Coupling Mechanism Durability

The coupling mechanism should withstand 500 mating and unmating cycles per Section 4.1.3.4:

- The plug latch and receptacle bayonet pins should show no elongation or deformation that would compromise the security of the latch mechanism from maintaining shell to shell bottoming.
- There should be no evidence of uneven wear, galling, or removal of plating on the connector shells or the receptacle shell.

#### 4.1.2.4.3 Insert Retention

The inserts should be able to withstand being subjected to 10 cycles of being inserted and extracted when tested as specified in Section 4.1.3.16 without suffering any failures or compromising the mechanical properties of the insert retention clips, should show no damage detrimental to the operation of the connector, and at the completion of the durability test the insert should be able to meet the requirements of Section 4.1.2.5.12. Failure to complete this test because of mechanical malfunction of the connector/insert is cause for rejection.

### 4.1.2.4.4 Shell

When the plug and receptacle are fully mated, the space between the front of the plug shell and the adjacent receptacle flange should be a minimum of 0.295 in (7.5 mm) as shown in Figure 4-6. Minimum contact exposure should be maintained, but under no circumstances should the contacts extend beyond the shell.

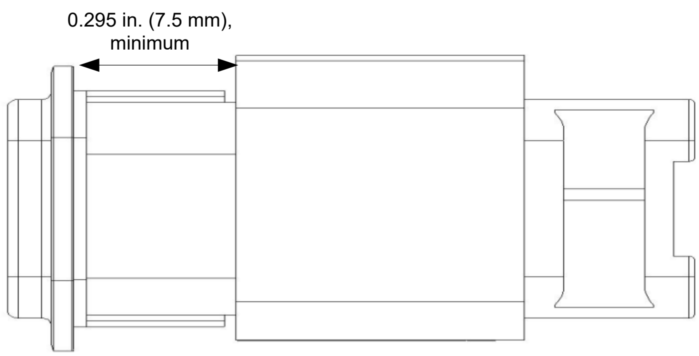



**Figure 4-6 – Minimum Space between Plug and Receptacle Flange**

### 4.1.2.4.5 Shell Polarization

Polarization of the connector shells provides a means of preventing mismating connectors in close proximity to one another. Shell polarization of the connector should be accomplished by means of integral keys and keyways. It should be impossible to mate a plug to a receptacle shell when these polarization keys are polarized differently. Polarization engagement should occur after initial shell engagement and before the pin makes contact with the socket contact. The connector shells should have a minimum of five polarizing positions and should use the code defined by this specification.

When color coding is used to identify the five polarization positions, the following colors are used:

N – Black

A – Red

B – Blue

C – Green

D – Yellow

### 4.1.2.4.6 Connector Mating Sequence

The connector mating sequence should be as follows:

- Shells – Polarization Keys – Contacts

When mated, the minimum engagement of contact should be 0.05 in (1.27 mm).

### 4.1.2.5 Performance Requirements

#### 4.1.2.5.1 Flammability

When tested in accordance with Section 4.1.3.1, the average burn length may not exceed 8 inches, and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

#### 4.1.2.5.2 Insulation Resistance (Ambient Temperature)

When tested in accordance with Section 4.1.3.5.1, the insulation resistance between any pair of contacts and between any contact and shell should be greater than 5000 MΩ (unmated connector) at ambient temperature.

#### 4.1.2.5.3 Insulation Resistance (Elevated Temperature)

When tested in accordance with Section 4.1.3.5.2, the insulation resistance value should be greater than 1000 M Ω at 347 °F (175 °C) between any pair of contacts and between any contact and connector shell and 100 MΩ during the temperature life test.

#### 4.1.2.5.4 Dielectric Withstanding Voltage (DWV)

When tested as specified in Sections 4.1.3.6 and 4.1.3.7, the connector assembly should be capable of withstanding the applicable voltage shown in Table 4-5 without flashover. The maximum leakage current should be 2 mA.

**Table 4-5 – Connector Voltage Rating**

| Suggested Operating Voltage (Sea Level) | |
|---|---|
| (Vac rms) | Vdc |
| 400 | 550 |

| Test Voltage (Vac rms) | | |
|---|---|---|
| Pressure | Mated | Unmated |
| Sea Level | (Size 24) 1000<br>(Size 22) 1300<br>(Other) 1500 | (Size 24) 1000<br>(Size 22) 1300<br>(Other) 1500 |
| 12.1 kPa 50,000 ft or (15240 mm) | 1000 | (other) 600<br>(Size 24) 125 |
| 4.7 kPa 70,000 ft or (21336 mm) | 1000 | 400 |

#### 4.1.2.5.5 Electrical Overload

When tested as specified in Section 4.1.3.8, the electrical overload should be applied according the values specified in Table 4-6. After application of overload conditions, the test articles should meet the requirements of EN2591-210.

**Table 4-6 – Electrical Overload**

| Contact Size | Current (A) | Duration (s) |
|---|---|---|
| 24 | 5<br>25 | 40<br>0.6 |
| 22 | 10<br>50 | 40<br>0.6 |
| 20 | 15<br>75 | 40<br>0.6 |
| 16 | 26<br>130 | 40<br>0.6 |
| 12 | 46<br>230 | 40<br>0.6 |
| 8 | 92<br>460 | 40<br>0.6 |

#### 4.1.2.5.6 Temperature Rise due to Rated Current

When tested in accordance with Section 4.1.3.9, the maximum temperature should not exceed the maximum operating temperature of 347 °F (175 °C).

#### 4.1.2.5.7 Moisture Resistance (Humidity)

When tested as specified in Section 4.1.3.10, the mated connector halves should have an insulation resistance greater than 1,000 MΩ when measured during the last 6 hours of the final cycle and greater than 5000 MΩ after 24 hours of conditioning at room ambient.

#### 4.1.2.5.8 Vibration

When tested as specified in Section 4.1.3.11, there should be no disengagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking, or loosening of parts. During the test, there should be no discontinuity in excess of one (1) microsecond. Upon test completion, shell to shell conductivity should be measured as per EN2591-205.

#### 4.1.2.5.9 Mechanical Shock

When tested as specified in Section 4.1.3.12, there should be no disengagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking, or loosening of parts. During the test, there should be no discontinuity in excess of one (1) microsecond. Upon test completion, shell to shell conductivity should be measured as per EN2591-205.

#### 4.1.2.5.10 Durability

When tested as specified in Section 4.1.3.4, connectors should show no damage detrimental to the operation of the connector and should meet the contact resistance requirements of Section 4.1.2.3.1 after the completion of 500 cycles of engagement and separation.

Failure to complete this test because of mechanical malfunction of the connector should be cause for rejection.

#### 4.1.2.5.11 Temperature Life

When tested as specified in Section 4.1.3.13, the connector should meet the performance requirements of the remaining test sequence shown in

Section 4.1.4.3.1, Table 4-9, Group 4 or Group 2 for the ARINC 800 Type16-02 insert.

#### 4.1.2.5.12 Salt Spray (Corrosion)

When tested as specified in Section 4.1.3.14, connectors and contacts should show no damage due to corrosion, which will adversely affect the electrical and/or mechanical integrity.

#### 4.1.2.5.13 Insert Retention

When tested as specified in Section 4.1.3.15, the connector insert should retain its normal position in the connector shell for the specified load. A displacement of the insert should not exceed 0.0118 in (0.3 mm). At the completion of the test, the insert should be able to be removed using the standard insert removal tool. The insert retention mechanism should be inspected and show no damage.

#### 4.1.2.5.14 Interfacial Sealing

When tested as specified in Section 4.1.3.17, the applied pressure should be 1.75 psi (12.1 kPa).

#### 4.1.2.5.15 Seal Leakage – Altitude Immersion

When tested in accordance with Section 4.1.3.18, the wired mated pair of connectors should meet the insulation resistance and dielectric withstanding voltage requirements in Sections 4.1.3.5.1 and 4.1.3.6 (sea level) after being subjected to an altitude of 50,000 feet (15,240 meters) or 1.75 psi (12.1 kPa).

#### 4.1.2.5.16 Fluid Immersion

A plug and receptacle shell should be tested as an assembly in accordance with Section 4.1.3.19. Both connector halves should be capable of being mated and unmated and their inserts removed and reinserted into the connector shell. No component part of the disassembled connector should show evidence of damage that will affect performance. Any evidence of cracking, loosening of parts, or missing parts should be cause for rejection. Insulation resistance should meet the requirements of Section 4.1.2.5.2 (not applicable to conductive fluids). Coupling forces should be as specified in Section 4.1.2.4.1.

#### 4.1.2.5.17 Voltage Standing Wave Ratio (Coax Contact Only)

The Voltage Standing Wave Ratio (VSWR) should not exceed values specified in Table 4-7 when tested as specified in Section 4.1.3.20.

**Table 4-7 – Coax Contact VSWR**

| Frequency Range (GHz) | VSWR (max) |
|---|---|
| 0-1 | 1.15:1 |
| 1-2 | 1.15:1 |

#### 4.1.2.5.18 RF Insertion Loss (Coax Contact Only)

The contact insertion loss should not exceed values specified in Table 4-8 when tested as specified in Section 4.1.3.21.

**Table 4-8 – Coax Contact Insertion Loss**

| Frequency Range (GHz) | Insertion Loss (dB max) |
|---|---|
| 0-1 | 0.15 |
| 1-2 | 0.15 |

### 4.1.2.5.19 Attenuation (Optical Termini Only)

To be added in a future supplement.

### 4.1.2.5.20 Shell to Shell Continuity

When tested in accordance with Section 4.1.3.23, the maximum resistance between the shells of the connector pair shown in Figure 4-7 should not exceed those values specified in Table 4-9.

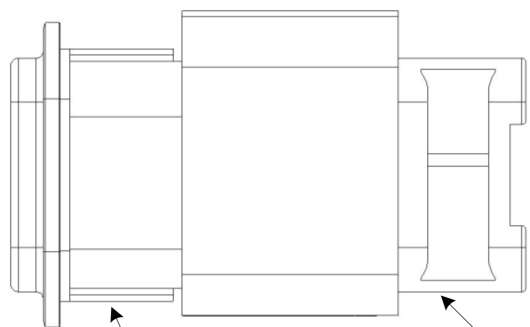



**Figure 4-7 – Illustration of Maximum Resistance between Shells of Connector Pair**

### 4.1.2.5.21 EMI Backshell to Shell Continuity

When tested in accordance with Section 4.1.3.24, the maximum resistance between the connector shell and the EMI Backshell should not exceed those value specified in Table 4-9.

**Table 4-9 – Conductivity Values**

| Max. Resistance | Initial | After Test |
|---|---|---|
| Metallized composite plug to receptacle shell | 3.0 mΩ | 6.0 mΩ |
| EMI Backshell to plug shell | 3.0 mΩ | 6.0 mΩ |

### 4.1.2.5.22 Resistance to Indirect Lightning Strikes

The mated plug and receptacle shells should be tested as specified in Section 4.1.3.25 for the ability to conduct indirect lightning currents through the metallic finish without damaging the base materials or causing the metallized finish from blistering or charring.

### 4.1.2.5.23 Low Frequency Shielding Effectiveness (Transfer Impedance)

A low resistance/impedance (transfer impedance) electrical bond is essential for applications where the electrical wiring will be subjected to Electromagnetic Interference (EMI), RF Interference, High Intensity Radiated Fields (HIRF), and indirect lightning strikes. The mated plug and receptacle shells should be tested as specified in Section 4.1.3.25.1 to measure the shielding transfer impedance.

The transfer impedance of mated connector shells should not be less than specified in Table 4-7 at the specified frequencies.

**Table 4-10 – EMI Shielding Effectiveness**

| Frequency (MHz) | Attenuation (dB) |
|---|---|
| 30 | 60 |
| 50 | 55 |
| 100 | 50 |
| 200 | 45 |
| 300 | 45 |
| 400 | 40 |
| 500 | 35 |

#### 4.1.2.5.24 Plating Adhesion

The plating, metallization process, should be tested in accordance with Section 4.1.3.26 to check the good adhesion of metallic coatings to the base thermoplastic or thermoset materials.

#### 4.1.2.5.25 Hydrolytic Stability

When tested as specified in Section 4.1.3.27, the connector should be without defects detrimental to mechanical performance. There should be no increase in the connector weight greater than 0.75 percent and there should be no evidence of cracking, breaking, or loosening of parts.

#### 4.1.2.5.26 Impact Test

When connector plugs with backshell hardware are tested as specified in Section 4.1.3.28, there should be no breaking or cracking of inserts or shells. Also, there should be no bending of contacts nor any damage which would prevent the connector from mating or unmating.

#### 4.1.2.5.27 Backshell Bending Moment

When tested as specified in Section 4.1.3.29, with an axial load or a bending moment, the backshell/connector shell should show no signs of deformation or evidence of damage.

At the end of the test, prior to removal, there should be no play between the accessory and the test fixture. The specimens should be examined visually after removal.

#### 4.1.2.5.28 Temperature Cycling

When tested as specified in Section 4.1.3.30, the wired mated connector assembly should show no evidence of blistering, peeling, or separation of plating or other damage detrimental to the operation of the connector.

#### 4.1.2.5.29 Maintenance Aging

When tested as specified in Section 4.1.3.31, contacts should show no damage detrimental to product performance after the completion of 10 cycles of insertion and extraction.

### 4.1.2.5.30 Contact Insertion and Extraction Forces

When tested as specified in Section 4.1.3.32, the insertion and extraction forces should not exceed the forces in Table 4-11.

**Table 4-11 – Insertion and Extraction Forces**

| Contact Size | Maximum Force, lbf (N) | | Number of Tested Contacts |
|---|---|---|---|
| | Insertion | Extraction | |
| 24 | 4.5 (20) | 4.5 (20) | 50% |
| 22 | 6.7 (30) | 6.7 (30) | 50% |
| 20 | 15.0 (67) | 15.0 (67) | 50% |
| 16 | 15.0 (67) | 15.0 (67) | 50% |
| 12 | 22.5 (100) | 22.5 (100) | 100% |
| 8 | 5.6 (25) | 5.6 (25) | 100% |

Note: The insertion and extraction forces of the size 8 contact are lower compared to the other contacts which are inserted through the rear grommet of the connector.

### 4.1.2.5.31 Durability of Contact Retention System and Seals

When tested as specified in Section 4.1.3.33, there must be no evidence of damage to the contacts and associated seals after the completion of 10 cycles of insertion and extraction.

### 4.1.2.5.32 Contact Retention

When tested as specified in Section 4.1.3.34, the insert should retain its normal position in the connector shell for the specified load. A displacement of the contact should not exceed 0.0118 in (0.3 mm). At the completion of the test, the contact should be able to be removed using the contact removal tool. If non-removable contacts are used, no contact removal is required.

### 4.1.2.5.33 Connecting Hardware Insertion Loss

The connector insertion loss should not exceed values specified in Table 4-12 when tested as specified in Section 4.1.3.35.

**Table 4-12 – Maximum Connecting Hardware Insertion Loss**

| Frequency Range (MHz) | Category 5e (dB) |
|---|---|
| 1.00 | 0.10 |
| 4.00 | 0.10 |
| 8.00 | 0.11 |
| 10.00 | 0.13 |
| 16.00 | 0.16 |
| 20.00 | 0.18 |
| 25.00 | 0.20 |
| 31.25 | 0.22 |
| 62.50 | 0.32 |
| 100.00 | 0.40 |

### 4.1.2.5.34 Connecting Hardware Return Loss

The connector return loss should not exceed values specified in Table 4-13 when tested as specified in Section 4.1.3.36.

**Table 4-13 – Minimum Connecting Hardware Return Loss**

| Frequency Range (MHz) | Category 5e (dB) |
|---|---|
| 1.00 | 30.0 |
| 4.00 | 30.0 |
| 8.00 | 30.0 |
| 10.00 | 30.0 |
| 16.00 | 30.0 |
| 20.00 | 30.0 |
| 25.00 | 30.0 |
| 31.25 | 30.0 |
| 62.50 | 24.1 |
| 100.00 | 20.0 |

#### 4.1.2.5.35 Connecting Hardware Near End Crosstalk (NEXT) Loss

The connector NEXT loss should not exceed values specified in Table 4-14 when tested as specified in Section 4.1.3.37.

**Table 4-14 – Minimum Connecting Hardware NEXT Loss**

| Frequency Range (MHz) | Category 5e (dB) |
|---|---|
| 1.00 | 65.0 |
| 4.00 | 65.0 |
| 8.00 | 64.9 |
| 10.00 | 63.0 |
| 16.00 | 58.9 |
| 20.00 | 57.0 |
| 25.00 | 55.0 |
| 31.25 | 53.1 |
| 62.50 | 47.1 |
| 100.00 | 43.0 |

#### 4.1.2.5.36 Connecting Hardware Far End Crosstalk (FEXT) Loss

The connector FEXT loss should not exceed values specified in Table 4-15 when tested as specified in Section 4.1.3.38.

**Table 4-15 – Minimum Connecting Hardware FEXT Loss**

| Frequency Range (MHz) | Category 5e (dB) |
|---|---|
| 1.00 | 65.0 |
| 4.00 | 63.1 |
| 8.00 | 57.0 |
| 10.00 | 55.1 |
| 16.00 | 51.0 |
| 20.00 | 49.1 |
| 25.00 | 47.1 |
| 31.25 | 45.2 |
| 62.50 | 39.2 |
| 100.00 | 35.1 |

#### 4.1.2.5.37 Use of Tools

When tested as specified in Section 4.1.3.39, the use of tools should be to applicable circular cavities. The force applied to the tool must be 2.9 lbf (13N).

#### 4.1.2.5.38 Visual Examination

When tested as specified in Section 4.1.3.40, connectors should show no evidence of blistering, peeling, or separation of plating or other damage detrimental to the operation of the connector.

On initial inspection, marking should show manufacturer's identification, identification of the product and manufacturing date. On other inspections, marking should remain visible and legible.

#### 4.1.2.5.39 Examination of Dimensions and Mass

When tested as specified in Section 4.1.3.41, the dimensions and mass of the plug, receptacle and backshell accessories should be checked by suitable measuring instruments.

### 4.1.3 Verification Test Procedures

#### 4.1.3.1 Flammability

For the vertical test method, specimens should be nominally 2 in by 12 in (50 mm by 305 mm) in size. If the actual part size is smaller than the standard specimen size, the actual part size may be used. Alternatively, test specimens larger than the actual part size may be used provided they are of the same construction as the part.

The specimen thickness should be the same as that in the part qualified for use in the airplane, except for the following.

Specimens should be conditioned at 70 ±5 °F (21 ±3 °C) and 50 ±5 percent relative humidity for a minimum of 24 hours prior to test. Only one specimen at a time should be removed from the conditioning chamber immediately before testing.

A minimum of three specimens must be tested and results averaged. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal 0.375 in (9.5 mm) I.D. tube adjusted to give a flame of 1.5 in (38.1 mm) in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550 °F (843.3 °C). The lower edge of the specimen must be 0.75 in (19.05 mm) above the top edge of the burner. The flame must be applied to the center line of the lower edge of the specimen. The flame must be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, may be recorded.

#### 4.1.3.2 Contact Resistance

#### 4.1.3.2.1 Contact Resistance at Rated Current

A mated pair, plug, and receptacle should be wired, contacts connected in series. The wire connecting the contacts together should be appropriate to the expected test current and temperature.

The electrical resistance should be measured in accordance with EN2591-202 with the exception that the connectors should be exposed to the maximum operating temperature of 347 ±5 °F (175 ±3 °C) for a minimum of 30 minutes prior to measurement (Inserts with data contacts are tested at room temperature).

Measurements should be made while the connectors are in the chamber at the specified temperature. The contact resistance values should be in accordance with Section 4.1.2.3.1.

#### 4.1.3.2.2 Low Level Contact Resistance

Not applicable to modular connectors.

### 4.1.3.3 Coupling Forces

The plug should be mated to the receptacle shell. Force should be applied to the rear of the plug as shown in Figure 4-8. The force that is required to fully engage the plug to the receptacle should be measured. The mating force should not exceed those values specified in Table 4-3 for the initial values and Table 4-4 for the values at the completion of the test sequence specified in Section 4.1.2.4.1.

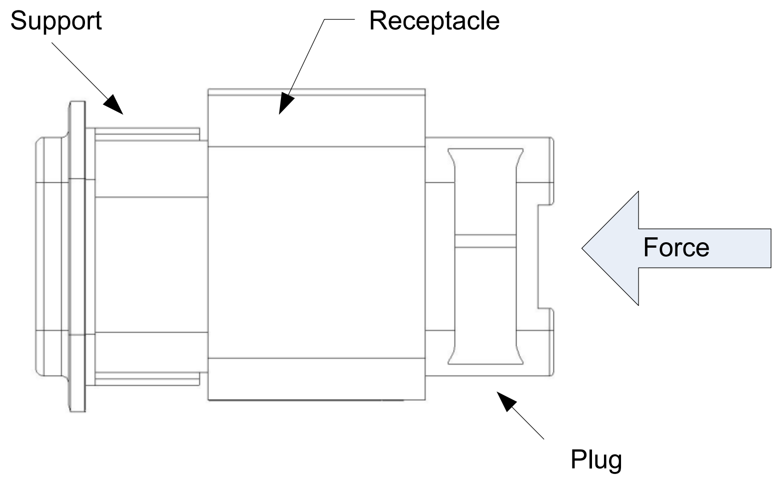



**Figure 4-8 – Illustration of Applied Force**

### 4.1.3.4 Mechanical Durability

The plug and receptacle populated with the appropriate insert arrangement should be submitted without electrical load to the mating and unmating operations at the specified rate. The plug and receptacle should be mated, locked, and unmated so that plug and receptacle are completely separated. This is defined as one cycle.

Mating and unmating may be carried out manually or, unless otherwise specified, with a mechanical device simulating manual operations, provided the latter does not induce any excessive stresses. A counter should record the number of mating and unmating operations. At the completion of the test, the plug and receptacle meet the requirements defined in Section 4.1.2.5.10.

### 4.1.3.5 Insulation Resistance

#### 4.1.3.5.1 Insulation Resistance (Ambient Temperature)

Connector assemblies should be tested in accordance with EIA–364, Test Procedure 21. The magnitude of the test voltage should be 500 Vac. The insulation resistance of wired, unmated, sealed connectors should be in accordance with Section 4.1.2.5.2, when measured separately between any pair of adjacent contacts, and between the shell and any contact.

#### 4.1.3.5.2 Insulation Resistance (Elevated Temperature)

The insulation resistance should be measured on mated connector assemblies with the exception that the connectors should be exposed to the maximum operating temperature of 347 ±5 °F (175 ±3 °C) for a minimum of 30 minutes prior to measurement. Measurements should be made while the connectors are in the chamber at the specified temperature. The insulation resistance values should be in accordance with Section 4.1.2.5.3.

### 4.1.3.6 Dielectric Withstanding Voltage (DWV)

Mated and unmated connector assemblies should be tested in accordance with EIA–364, Test Procedure 20, and Test Condition I. The following details should apply:

1. Test Voltage – Test voltage should be as specified in Table 4-5.
2. Points of Application – The test voltage should be applied between the contact under test and the closest adjacent contacts and between the shell and the contact under test. The same contact locations for a given assembly should be used each time the test is performed. Individual ends of terminated wires should be insulated or physically separated during the test to prevent flashover.

### 4.1.3.7 Dielectric Withstanding Voltage (DWV), Altitude

Mated connector assemblies should be tested in accordance with EIA–364, Test Procedure 20, Test Condition III and IV with the following details and exceptions:

1. Test voltage should be as specified in Table 4-5.
2. The chamber should be evacuated to the altitude pressure equivalent specified in Table 4-5.

### 4.1.3.8 Electrical Overload

The contacts mounted to the insert should be subjected to the electrical overload test per EN2591-210. Inserts are mounted to connector shells and tested in the mated condition. Contacts of the same size should be wired in series. The electrical overload conditions, as specified in Table 4-6 of Section 4.1.2.5.5, should be applied for each different contact size.

### 4.1.3.9 Temperature Rise due to Rated Current

Mated connector assemblies should be tested at room temperature for 24 hours under rated current, with measurements collected of the temperature on the connector shell and insert throughout the test.

### 4.1.3.10 Moisture Resistance (Humidity)

Wired, mated connectors should be subjected to the humidity test specified in EIA–364, Test Procedure 31, and Method IV. Cold shocks are applicable.

### 4.1.3.11 Vibration

The mated pair of plug and receptacle connector shells, assembled with inserts fully populated with contacts, should be equipped with the largest permissible wire gauge for the test. The mounting configuration per EN2591-402 should be tested as an assembly. The assembly should be vibrated along the three mutually perpendicular axes. Cable should be clamped at a distance of 6 in (200 mm) from the rear of the backshell. The connector should be tested per EN2591-403 and be subjected to the following vibration:

1. Method A (sine): Frequency range: 5 to 3000 Hz, Acceleration: 20 g, sweep rate: 1 oct/min, 4 hours per axis, ambient temperature.
2. Method B (random): Figure 2, Table 1, Level E, 4 hours per axis, ambient temperature.

During the testing, there should be no discontinuity greater than 1μs.

#### 4.1.3.12 Mechanical Shock

The connector shell with an EN4165-002 or ARINC 800 insert populated with wires and installed in a mounting fixture (rear mounted on a panel using the normal mounting device) should be tested as an assembly. The assembly should withstand the shock pulse defined in EN2591-402, Method A, Severity 100. The test is performed using the same electro dynamic shaker and test fixture as the vibration test. The assembly should be subjected to three shock pulses in both the (+) and (–) directions of three mutually perpendicular test axes, for a total of 18 shocks. All contacts should be connected in series with 0.1 ampere maximum flowing through the contacts. Connectors should be held together by the coupling mechanism. Cables should be clamped at a distance of 200 mm (6 in) from the rear of the backshell. A detector capable of detecting any discontinuities in excess of 1 microsecond should be used.

#### 4.1.3.13 Temperature Life

The connectors should be fully assembled and mated. All the contacts should be properly wired using the wire type defined in Section 4.1.4.2.2. The wired connector assembly should be subjected to the maximum operating temperature for 1000 hours minimum. Mated connector assemblies should be tested in accordance with EN2591-301, Method A, 347 °F (175 °C) or EIA-364-17, Method A.

#### 4.1.3.14 Salt Spray (Corrosion)

Wired connectors should be subjected to a Salt Spray test per EN2591-307. The connector should be suspended in the test chamber with non-metallic cords so that no accumulation of condensed saline solution can occur.

The test specimen should be:

- Subjected to 50 cycles of mating and unmating at a rate of five cycles/min.
- Exposed to salt mist:
  - Mated for 452 hours
  - Then unmated for 48 hours
- Subjected to 200 mating and unmating cycles at the rate of five cycles/min.

#### 4.1.3.15 Insert Stability and Insert Retention

The insert should be subjected to the insert retention test per EN2591-410 or EIA-364-35 with an ultimate test load as specified in Table 4-16.

**Table 4-16 – Insert Retention Forces**

| Insert Type | Load |
|---|---|
| Pin insert | 56.2 lbf (250N) |
| Socket insert | 56.2 lbf (250N) |

The load should be applied to the front of the insert which is installed in the connector shell. Displacement of the insert should be measured under load. The displacement should not exceed the values specified in Section 4.1.2.5.13. The test sample should be subjected to the test specified in EN2591-312, air leakage for sealed versions only. Following the test, remove the insert and inspect the insert retention mechanism for damage.

### 4.1.3.16 Insert Durability

The insert should be subjected to 10 cycles of being inserted and extracted from a connector shell using the insert extraction tool specified by the manufacturer. At the completion of the insert durability test, the insert with the connector shell that was used in the above test should pass the insert retention requirements specified in Section 4.1.2.5.13.

### 4.1.3.17 Interfacial Sealing

Connectors should be assembled and mated. All cavities are equipped with wired contacts or filler plugs except the center cavity. The connectors should be subjected to the interface sealing test per EN2591-324.The applied pressure is specified in Section 4.1.2.5.14.

### 4.1.3.18 Seal Leakage – Altitude Immersion

The wired mated pair of connectors should be subjected to the altitude immersion test in accordance with EIA–364, Test Procedure 03 (EN2591-314) with the following exceptions:

1. The connector assembly should be subjected to three cycles.
2. The pressure in the chamber should be reduced to an equivalent altitude of 1.75 psi (12.1 kPa).

After the third cycle, and while the specimens are still immersed, they should be subjected to the following test sequence:

- Insulation Resistance per Section 4.1.3.5.1
- Dielectric Withstanding Voltage (sea level) per Section 4.1.3.6

The test parts should then be removed from the salt solution, drained, carefully unmated, and be visually inspected with particular attention to salt water ingress and the condition of the seals.

> Note: Unless otherwise specified, 50% of cables should be of the minimum diameter, 50% of the maximum diameter, evenly distributed. A conductor should be connected to the shell to allow measurements to be carried out.

### 4.1.3.19 Fluid Immersion

(a) EN4165 Standard Insert

Inserts should be wired and installed in the connector shells. The wire should be the minimum size outer diameter for which the EN4165-002 inserts was designed. The test should be performed in accordance with EN2591-315 using the fluids defined in Table 4-17.

**Table 4-17 – Immersion Test Fluids**

| Fluid | | | Immersion | | Draining Time (h) | Stoving | | Number of Cycles |
|---|---|---|---|---|---|---|---|---|
| Category | Reference | | Duration (min) | Temps (°C) | | Time (h) | Temps (°C) | |
| Fuel | JP5 | NATO F-44 | 5 | 25 | 7 | 16 | 85 | 7 |
| Mineral hydraulic fluid | MIL-H-5606G | NATO H-515 | 15 | 85 | 7 | 16 | 100 | 5 |
| Synthetic hydraulic fluid | AS 1241 C | SKYDROL 500 B4 | 15 | 85 | 7 | 16 | 100 | 5 |
| | | SKYDROL LD 4 | | | | | | |
| Mineral lubricant | MIL-PRF-7870C | NATO O-142 | 15 | 120 | 7 | 16 | 125 | 5 |
| Synthetic lubricant | MIL-PRF-23699F | NATO O-156 | 15 | 150 | 7 | 16 | 125 | 5 |
| | MIL-PRF-7808L | NATO O-148 | | | | | | |
| Cleaning product | MIL-C-25769 J diluted | - | 15 | 25 | 7 | 16 | 25 | 5 |
| | 25% Propanol +75% white spirit | | | | | | | |
| | Methyl Propyl Ketone | - | 5 | | | | | 2 |
| De-icing fluid | MIL-A-8243 D | NATO S-742 | 15 | 50 | 7 | 16 | 100 | 5 |
| Cooling fluid | Coolanol | - | 15 | 50 | 7 | 16 | 25 | 5 |

### 4.1.3.20 Voltage Standing Wave Ratio (VSWR) (Coax Contact Only)

Test in accordance with MIL–PRF–39012. Frequency range should be 0 to 2 GHz. VSWR should not exceed the limits specified in Table 4-7.

### 4.1.3.21 RF Insertion Loss (Coax Contact Only)

Test in accordance with MIL–PRF–39012. Test frequency should be 0 to 2 GHz. Insertion loss should not exceed the limits specified in Table 4-8.

### 4.1.3.22 Attenuation (Optical Termini Only)

Attenuation should be measured in accordance with TIA/EIA–455–171A, Method D1. The maximum attenuation should be as defined in Section 4.1.2.5.19.

### 4.1.3.23 Shell to Shell Continuity

Mated connector assemblies should be tested in accordance with EN2591-205. A direct current of 1.0 ±0.1 ampere at 1.5 Volts dc should be caused to flow through the shells of the mated assembly. Using the voltmeter–ammeter method, measure the voltage drop between the rear of the plug shell and a point on the front face of the counterpart receptacle flange (mounting flange). The resulting resistance, calculated using the measured voltage drop and the specific current, should be in accordance with Table 4-9. For the shell to shell continuity, the measurements should be made between the rear ends of housings (shells) with spherical end probes.

### 4.1.3.24 EMI Backshell to Shell Continuity

EMI backshell to connector shell conductivity should be tested in accordance with EN2591-205. A direct current of 1.0 ±1 amperes at 1.5 Vdc maximum should be caused to flow through the EMI backshell–connector shell assembly. Using the voltmeter–ammeter method, measure the voltage drop between the rear of the backshell and a point on the front face of the connector flange. The test points are shown in Figure 4-9. The resulting resistance, calculated using the measured voltage drop and the specific current, should be in accordance with Table 4-9. The test probe should not puncture or otherwise damage the connector finish.

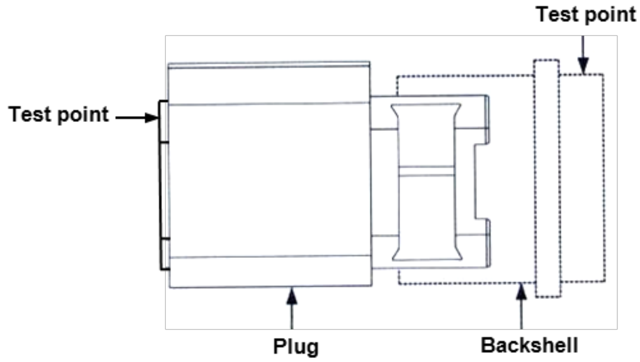



**Figure 4-9 – Test Points for Backshell-to-Shell Continuity Measurement**

### 4.1.3.25 Resistance to Indirect Lightning Strikes

The objective of this test is to ensure that the composite connector shell does not show any evidence of damage that would prevent the connector assembly from functioning properly. The mated plug and receptacle shells should be tested as specified per EIA–364, Test Procedure 75, Type B Test Levels 1 (3.6kA); ten positive polarity transients should be applied followed by ten negative polarity transients. The spacing between individual transients is not critical. All transients should be applied at the applicable peak amplitude level. All transients should be applied at the applicable peak amplitude level with t1 = 40 microseconds + 20% and t2 = 120 microseconds + 20%. The parts should be visually inspected for any damage to the metallic plating. There should be no evidence of blistering or charring. The connector shell should also be inspected to ensure that the thermoplastic or thermoset material was not damaged by the thermal energy developed during testing.

#### 4.1.3.25.1 Low Frequency Shielding Effectiveness (Transfer Impedance) – EN2591-212; EN2591-213

Preparation of specimens: Specimens should be prepared in accordance with EN60512-23-3.

Apparatus: The apparatus should be in accordance with EN60512-23-3.

Procedure: The test should be carried out in accordance with EN60512-23-3.

The following details should be specified:

- Surface transfer impedance, outside diameter of cable screen and construction of cable, if fitted
- The frequency range over which the measurements were carried out
- Any limitations on the effective frequency range of the test due to resonances

### 4.1.3.26 Plating Adhesion

Test in accordance with ASTM B 571, paragraph 13.0 (Scribe–Grid Test Procedure) to verify that the coating should not show separation from the substrate. The tool used to scribe the plating should be per paragraph 13.1 of ASTM B 571 (no chisel or other tool type). The tool should be used to scribe parallel lines in the plating with a spacing of 0.078 in (2 mm).

EN ISO 2409 is a potential alternative test method.

The test has to be performed on representative coupons 0.059 x 2.36 x 0.98 in (1.5 x 60 x 25 mm) minimum.

#### 4.1.3.27 Hydrolytic Stability

Mated connector shells without inserts, ground block, and mounting rail should be subjected to the test as specified in EN2591-515, method A, for long-term immersion. Immediately following the immersion, the mated connectors should be weighed and the percent increase in weight calculated.

#### 4.1.3.28 Impact Test

Connector plugs with backshell hardware should be tested as specified in EIA–364, Test Procedure 42. The following conditions apply:

1. Drop height should be 35.4 in (0.9 m).
2. Number of drops should be 8.
3. Rotate 45° after each drop to ensure all 8 corners and edges of connector have been subjected to the drop.
4. Plugs should have no caps or covers installed.
5. The impact surface should be a concrete slab at least 3.94 in (100 mm) thick.

#### 4.1.3.29 Backshell Bending Moment

The connector accessory should be mounted as in normal service to a rigid panel as shown in Figure 4-10. For the bending moment test, the load should be applied to point “P.” The load should be applied at a rate of approximately 4.5 lbf (20N) per second until the required bending moment of 44.25 lbf in (5 Nm) is achieved. The applied load should be held for 1 minute, and then released. The load should be applied as shown in two axes 90 degrees apart, at different times for straight and angled connector accessories. For the tensile test, the load should be applied to point “P.” The load should be applied at a rate of approximately 4.5 lbf (20N) per second until the required load of 22.5 lbf (100N) is achieved. The applied load should be held for 1 minute, and then released.

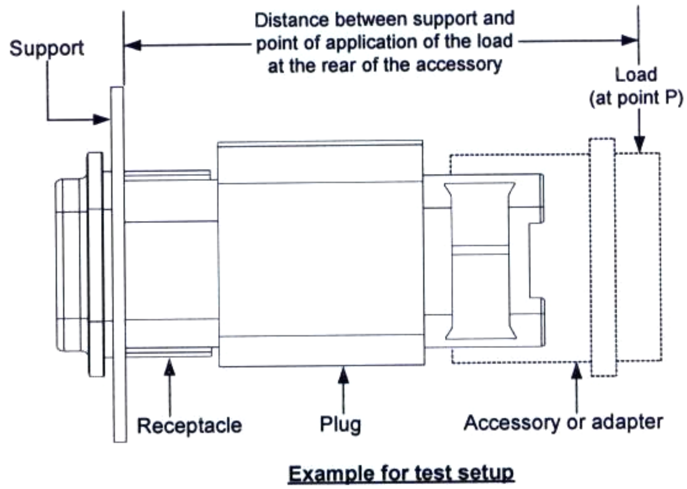



**Figure 4-10 – Example of Test Setup**

### 4.1.3.30 Temperature Cycling

Wired, mated connector assemblies should be tested in accordance with EIA–364, Test Procedure 32, Test Condition IV. The temperature at step 1 should be -67 °F +0 -9 °F (–55 °C +0 -5 °C) and the temperature at step 3 should be 347 °F +9 -0 °F (175 °C +5 -0 °C). Ten (10) cycles should be performed.

### 4.1.3.31 Maintenance Ageing

The contact should be subjected to 10 cycles of being inserted and extracted from an ARINC 800 insert assembly using the insert extraction tool specified by the manufacturer. At the completion of the insert durability test, the contact should pass the contact retention requirements specified in Section 4.1.2.5.29.

### 4.1.3.32 Contact Insertion and Extraction Forces

The contacts mounted to the insert should be subjected to the contact retention and extraction test per EN2591-412. Insertion and extraction forces should be measured at the first and last insertion and extraction cycle. Cycles are defined in the test method. Measurements should be recorded for each contact size. The forces should not exceed the values specified in Section 4.1.2.5.30.

### 4.1.3.33 Durability of Contact Retention System and Seals

The contact should be inserted and extracted from an ARINC 800 insert assembly using the extraction tool specified by the manufacturer. At the completion of the contact retention test specified as per EN2591-407, the contact should pass the contact retention requirements specified in Section 4.1.2.5.31.

### 4.1.3.34 Contact Retention

The contact should be subjected to a contact retention test per EIA-364-29 or EN2591-409. Test loads are specified in Table 4-18. The specified load should be applied to the front of the contact in an axial direction that would tend to cause the contact to dislodge from the housing. There should be no damage to contact retention mechanism. At the completion of the contact retention test the contact should pass the requirements specified in Section 4.1.2.5.32.

**Table 4-18 – Contact Retention Loads**

| Contact Size | Load |
|---|---|
| 24 | 4.0 lbf (18 N) |
| 23 | 10.0 lbf (44 N) |
| 22 | 10.0 lbf (44 N) |
| 20 | 15.0 lbf (67 N) |
| 16 | 24.7 lbf (110 N) |
| 12 | 24.7 lbf (110 N) |
| 8 | 24.7 lbf (110 N) |

#### 4.1.3.35 Connecting Hardware Insertion Loss

Connecting hardware insertion loss should be measured in accordance with TIA/EIA–568. The maximum link insertion loss should be as defined in Section 4.1.2.5.33.

#### 4.1.3.36 Connecting Hardware Return Loss

Connecting hardware return loss should be measured in accordance with TIA/EIA–568. The minimum link insertion loss should be as defined in Section 4.1.2.5.34.

#### 4.1.3.37 Connecting Hardware NEXT Loss

Connecting hardware NEXT loss should be measured in accordance with TIA/EIA–568. The maximum link insertion loss should be as defined in Section 4.1.2.5.35.

#### 4.1.3.38 Connecting Hardware FEXT Loss

Connecting hardware FEXT loss should be measured in accordance with TIA/EIA–568. The minimum connecting hardware FEXT loss should be as defined in Section 4.1.2.5.36.

#### 4.1.3.39 Use of Tools

The insertion and extraction tools should be used as described per test EN2591-506. If the applied tool is damaged during the test, it should be replaced and the test should be finalized with a new one. The test report should indicate if a tool broke down. The applied force on the tool is specified in Section 4.1.2.5.37.

#### 4.1.3.40 Visual Examination

Unmated connectors (and backshell if any) should be visually inspected without magnification under suitable conditions for viewing. This inspection should be conducted according to EN2591-101 or EIA-364-18 and should mainly focus on the general aspect of the parts and on the marking.

#### 4.1.3.41 Examination of Dimensions and Mass

The plug, receptacle, and connector accessories should be dimensionally conformed to the part interfaces defined in Appendix A. The mass of each part should be measured to ensure the maximum part weights do not exceed the weights defined in Appendix A, Table A-1.

### 4.1.4 Quality Assurance Provisions

#### 4.1.4.1 Configuration Control

Connectors and other items qualified to this specification should be configuration controlled by suppliers listed as approved sources of supply on the applicable ARINC Standards. Supplier engineering drawings, process specifications, manufacturing, and quality plans should be baselined after qualification and maintained. Any changes to the connector shells, dust caps, or other items covered by this specification that would influence the intermateability, mechanical or electrical performance, or adversely impact the parts in meeting their intended function after baseline approval should be submitted to the approving authority for review and prior to implementation.

#### 4.1.4.2 Quality Conformance Test

The manufacturer is responsible for the performance of all qualification and acceptance tests specified herein. All inspection testing should be accomplished by an authorized inspector. Records of all inspection to meet requirements of this specification should be kept on file for two years (EN3042).

##### 4.1.4.2.1 Qualification Sampling and Definition of Specimens

The qualification below is divided into two qualification variants. One describes a full connector qualification and the other an insert qualification with already qualified connector shells.

Qualification specimens should be tested by the manufacturer in the quantities specified in Table 4-19a for the full connector qualification and Table 4-19b for the insert qualification only.

**Table 4-19a – Qualification Specimen Quantities for Full Qualification**

| Test Group No. | Qty | Notes: |
|---|---|---|
| 0 | 27 | All samples groups 1 thru 6 |
| 1 | 3 | Complete specimens (plug and receptacle) |
| 2 | 3 | Complete specimens (plug and receptacle) |
| 3 | 12 | Complete specimens (plug and receptacle) |
| 4 | 3 | Complete specimens (plug and receptacle) |
| 5 | 3 | Complete specimens (plug and receptacle) |
| 6 | 3 | Complete specimens (plug and receptacle) |
| 7 | 3 | Complete specimens (plug and receptacle) |
| 8 | 3 | Plugs |
| 9 | 3 | Plugs and receptacles without insert |
| 10 | 3 | Plugs and receptacles without insert |
| 11 | 3 | Representative coupons |

**Table 4-19b – Qualification Specimen Quantities for Insert Qualification**

| Test Group No. | Qty | Notes: |
|---|---|---|
| 1 | 6 | Complete specimens (plug and receptacle) |
| 2 | 6 | Complete specimens (plug and receptacle) |
| 3 | 6 | Complete specimens (plug and receptacle) |
| 4 | 6 | Complete specimens (plug and receptacle) |
| 5 | 6 | Complete specimens (plug and receptacle) |
| 6 | 6 | Complete specimens (plug and receptacle) |
| 7 | 10 | Complete specimens (plug and receptacle) |
| 8 | 6 | Complete specimens (plug and receptacle) |

If connectors or inserts from other manufacturers having the same Part Number have been qualified and approved, six mated connector assemblies and insert arrangement from each manufacturer should be included.

#### 4.1.4.2.2 Qualification Test Specimen Configuration

This specification defines the design, construction, and performance requirements for the plug, receptacle, and backshells. For testing purposes, the connectors and backshells should be tested as a complete assembly using EN4165-002 inserts and the appropriate contacts defined in EN4165-001. The qualification test specimens should be wired with cables, the outside diameter which is in accordance with the maximum indicated in EN4165-002.

The connectors should be wired with round cables free from any roughness likely to contribute to the penetration of humidity or liquid to the inside of the connector. The cables should conform to qualified cables for general use. Their length should be adjusted to the need of the tests.

#### 4.1.4.3 Qualification Testing

Connectors and associated components covered by this specification should obtain approval when proof has been provided that documents the successful completion of the applicable test defined in the qualification testing matrix and submitted to the approving authority for review and approval. The manufacturer should submit the following data for approval before qualification testing can be effected:

1. Top Assembly Drawing: The manufacturer’s final assembly drawing used in manufacture of the part and which references the next lower assembly drawing(s).
2. Detailed qualification test procedures, including a complete list of procedures and diagrams of test circuits to be used, plus a test schedule.

When data from tests that have been conducted on similar parts are to be submitted for certain tests of the qualification procedure, this data should be listed in the proper place in the subject procedures with the test report containing this data identified and referenced. All such existing data should be included as an appendix to the Qualification Test Procedures along with a complete description of the similarity of parts involved.

### 4.1.4.3.1 Qualification Tests

Connector specimens representative of the manufacturer's normal production should be submitted to the following qualification test. Unless otherwise exempted, specimens in the quantity indicated in Section 4.1.4.2.1 are required for testing as specified below for each connector configuration submitted for approval.

The connector specimens of Section 4.1.4.2.1 should be divided into 11 groups and subjected to the qualification tests in the order given for groups 0 through 11 in Table 4-20.

Further tests groups defined in Table 4-21 describe qualification tests for insert qualification only. Connectors used for qualification should necessarily be qualified in Table 4-20 or according to EN4165.

The specimens of Section 4.1.4.2.1 should be divided into 8 groups and subjected to the qualification tests in the order given for groups 1 through 8 in Table 4-21.

**Table 4-20 – EN4165 Complete Qualification Testing Sequences (Connector and Insert)**
**GROUP 0 (All Samples Except Groups 7 thru 11)**

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| 102 | Section 4.1.3.41 | Examination of dimensions and mass |
| 513 | NA | Magnetic permeability |
| 408 | Section 4.1.3.3 | Coupling forces |
| 410 | Section 4.1.3.15 | Insert stability and insert retention |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3.24 | EMI backshell to shell continuity |
| 206 | Section 4.1.3.5.1 | Insulation resistance (ambient temperature) |
| 207 | Section 4.1.3.6 | Dielectric withstanding voltage (sea level) |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| NA | Section 4.1.3.20 | Voltage Standing Wave Ratio (coax contact only) |
| NA | Section 4.1.3.21 | RF insertion loss (coax contact only) |
| NA | Section 4.1.3.22 | Attenuation (optical contact only) |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 1 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 307 | Section 4.1.3.14 | Salt spray (dynamic test) |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3.24 | EMI backshell to shell continuity |
| 408 | Section 4.1.3.3 | Coupling forces |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 2 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| NA | Section 4.1.3.16 | Insert durability |
| 408 | Section 4.1.3.3 | Coupling forces |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 403 | Section 4.1.3.11 | Sinusoidal and random vibrations |
| 402 | Section 4.1.3.12 | Shock |
| 408 | Section 4.1.3.3 | Coupling forces |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3.24 | EMI backshell to shell continuity |
| NA | Section 4.1.3.10 | Humidity |
| 206 | Section 4.1.3.5.1 | Insulation resistance (ambient temperature) |
| 207 | Section 4.1.3.6 | Dielectric withstanding voltage (sea level) |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| NA | Section 4.1.3.20 | Voltage Standing Wave Ratio (coax contact only) |
| NA | Section 4.1.3.21 | RF insertion loss (coax contact only) |
| NA | Section 4.1.3.22 | Attenuation (optical contact only) |
| 420 | Section 4.1.3.29 | Backshell bending moment |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 3 (12 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 315 | Section 4.1.3.19 | Fluid resistance |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3.24 | EMI backshell to shell continuity |
| 408 | Section 4.1.3.3 | Coupling forces |
| 410 | Section 4.1.3.15 | Insert stability and insert retention |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 4 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 305 | Section 4.1.3.30 | Temperature cycling |
| NA | Section 4.1.3.9 | Temperature rise due to rated current |
| 301 | Section 4.1.3.13 | Temperature life |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3. 24 | EMI backshell to shell |
| 206 | Section 4.1.3.5.1 | Insulation resistance (ambient temperature) |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 5 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 305 | Section 4.1.3.30 | Temperature cycling |
| 206 | Section 4.1.3.5.2 | Insulation resistance (elevated temperature) |
| 207 | Section 4.1.3.7 | Dielectric withstanding voltage (altitude) |
| 408 | Section 4.1.3.3 | Coupling forces |
| 406 | Section 4.1.3.4 | Coupling mechanism durability (mechanical durability) |
| 408 | Section 4.1.3.3 | Coupling forces |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| 202 | Section 4.1.3.2 | Contact resistance at rated current |
| 314 | Section 4.1.3.18 | Altitude immersion |
| 206 | Section 4.1.3.5.1 | Insulation resistance (ambient temperature) |
| 207 | Section 4.1.3.6 | Dielectric withstanding voltage (sea level) |
| NA | Section 4.1.3.20 | Voltage Standing Wave Ratio (coax contact only) |

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| NA | Section 4.1.3.21 | RF insertion loss (coax contact only) |
| NA | Section 4.1.3.22 | Attenuation (optical contact only) |
| 410 | Section 4.1.3.15 | Insert stability and insert retention |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 6 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 212/213 | Section 4.1.3.25.1 | Surface transfer impedance<br>(30 to 500 MHz) |
| 214 | Section 4.1.3.25 | Resistance to indirect lightning strikes |
| 205 | Section 4.1.3.23 | Shell to shell continuity |
| NA | Section 4.1.3.24 | EMI backshell to shell continuity |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 7 (3 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| 317 | Section 4.1.3.1 | Flammability |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 8 (3 Plugs)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| NA | Section 4.1.3.28 | Impact test |
| 408 | Section 4.1.3.3 | Coupling forces |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 9 (3 Shells without Inserts)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| 306 | Section 4.1.2.2.14 | Fungus Resistance |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 10 (3 Shells without Inserts)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| 515 | Section 4.1.3.27 | Hydrolytic stability |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 11 (3 Representative Coupons)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| NA | Section 4.1.3.26 | Plating adhesion |
| 101 | Section 4.1.3.40 | Visual examination |

## Table 4-21 – Insert Qualification Testing
## GROUP 1 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 412 | Section 4.1.3.32 | Contact insertion and extraction forces |
| 101 | Section 4.1.3.40 | Visual examination |
| 406 | Section 4.1.3.4 | Mechanical durability |
| 101 | Section 4.1.3.40 | Visual examination |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 206 | Section 4.1.3.5.2 | Insulation resistance at elevated temp. |
| 207 | Section 4.1.3.7 | DWV at 50,000 feet |
| 407 | Section 4.1.3.33 | Durability of Contact Retention System and Seals |
| 409 | Section 4.1.3.34 | Contact retention |
| 412 | Section 4.1.3.32 | Contact insertion and extraction forces |
| 101 | Section 4.1.3.40 | Visual examination |
| 305 | Section 4.1.3.30 | Temperature cycling |
| 207 | Section 4.1.3.7 | DWV at 50,000 feet |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 101 | Section 4.1.3.40 | Visual examination |
| 408 | Section 4.1.3.3 | Coupling forces |
| 314 | Section 4.1.3.18 | Altitude immersion |
| 207 | Section 4.1.3.7 | DWV at 50,000 feet |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 2 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 412 | Section 4.1.3.32 | Contact insertion and extraction forces |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 101 | Section 4.1.3.40 | Visual examination |
| 305 | Section 4.1.3.30 | Temperature cycling |
| 207 | Section 4.1.3.7 | DWV at 50,000 feet |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 101 | Section 4.1.3.40 | Visual examination |
| 408 | Section 4.1.3.3 | Coupling forces |
| 407 | Section 4.1.3.33 | Durability of Contact Retention System and Seals |
| 409 | Section 4.1.3.34 | Contact retention |
| 412 | Section 4.1.3.32 | Contact insertion and extraction forces |
| 101 | Section 4.1.3.40 | Visual examination |
| 406 | Section 4.1.3.4 | Mechanical durability |
| 101 | Section 4.1.3.40 | Visual examination |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 206 | Section 4.1.3.5.2 | Insulation resistance at elevated temp. |
| 207 | Section 4.1.3.7 | DWV at 50,000 feet |
| 402 | Section 4.1.3.12 | Mechanical shock |
| 101 | Section 4.1.3.40 | Visual examination |
| 403 | Section 4.1.3.11 | Sinusoidal and random vibrations |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 101 | Section 4.1.3.40 | Visual examination |
| NA | Section 4.1.3.9 | Temperature rise due to rated current |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 3 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 315 | Section 4.1.3.19 | Fluid resistance |
| 101 | Section 4.1.3.40 | Visual examination |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 408 | Section 4.1.3.3 | Coupling forces |
| 409 | Section 4.1.3.34 | Contact retention |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 4 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 210 | Section 4.1.3.8 | Electrical overload |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 207 | Section 4.1.3.6 | DWV at sea level |
| 408 | Section 4.1.3.3 | Coupling forces |
| 101 | Section 4.1.3.40 | Visual examination |
| 301 | Section 4.1.3.13 | Temperature Life |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 409 | Section 4.1.3.34 | Contact retention |
| 101 | Section 4.1.3.40 | Visual examination |

## GROUP 5 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 412 | Section 4.1.3.32 | Contact insertion and extraction forces |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 506 | Section 4.1.3.39 | Use of tool |
| 101 | Section 4.1.3.40 | Visual examination |
| 409 | Section 4.1.3.34 | Contact retention |
| 410 | Section 4.1.3.15 | Insert stability and insert retention |
| 312 | Section 4.1.3.18 | Air leakage |
| NA | Section 4.1.3.10 | Moisture resistance (humidity) |
| 202 | Section 4.1.3.2.1 | Contact resistance at rated current |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 207 | Section 4.1.3.6 | DWV at sea level |
| 408 | Section 4.1.3.3 | Coupling forces |
| 101 | Section 4.1.3.40 | Visual examination |
| 324 | Section 4.1.3.16 | Interfacial sealing |
| 206 | Section 4.1.3.5.1 | Insulation resistance at ambient |
| 207 | Section 4.1.3.6 | DWV at sea level |

## GROUP 6 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 317 | Section 4.1.3.1 | Flammability |
| 207 | Section 4.1.3.6 | DWV at sea level |
| 101 | Section 4.1.3.40 | Visual examination |
| 409 | Section 4.1.3.34 | Contact retention |

## GROUP 7 (10 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 306 | Section 4.1.2.2.14 | Fungus Resistance |

GROUP 8 (6 Pairs of Connectors)

| TEST EN2591 | ARINC 800, Part 2, Ref | TEST DESIGNATION |
|---|---|---|
| 101 | Section 4.1.3.40 | Visual examination |
| TIA/EIA–568 | Section 4.1.3.35 | Insertion loss |
| TIA/EIA–568 | Section 4.1.3.36 | Return loss |
| TIA/EIA–568 | Section 4.1.3.37 | NEXT |
| TIA/EIA–568 | Section 4.1.3.38 | FEXT |
| 101 | Section 4.1.3.40 | Visual examination |

## 4.2 Connector with Two Modular Cavities, Rack Mounted

### 4.2.1 Introduction

The following subsections have been excerpted from ARINC Specification 810. Applicable references to this specification will be included in ARINC Specification 810. All future changes will be introduced in this specification.

#### 4.2.1.1 Objectives

This section provides standardization, design, and fabrication details for a modular rack mountable connector shell utilizing modular inserts.

The connectors are designed for applications with a temperature range depending on the insert used. All inserts should perform in the temperature range from -85 °F to +347 °F (-65 °C to +175 °C) except those with fiber optic contacts, which should perform in the temperature range from -67 °F to + 275 °F (-55 °C to 135 °C).

Note: If the chosen twinax cable is limited to -67 °F (-55 °C), the test limits should be adjusted accordingly.

The intended use of the connector is for rack mounted equipment installation. The plug has the ability to account for dimensional variations within the tolerances of the rack system by a spring-loaded float mount system. Nevertheless, tolerances should be evaluated to ensure that the connector system is compatible with the tolerances.

#### 4.2.1.2 Scope

This section defines the dimensions, performance, and quality assurance criteria for the design, construction, performance, and testing of the modular connector. The connector shell does not comply with EN4644 and is, therefore, specially designed. Further inserts that fit in the connector shell are defined in EN4644-002. Electrical contacts are defined in EN3155-076 and EN3155-077. Optical contacts are defined in ARINC Specification 801 and EN4639-101.

#### 4.2.1.3 Connector and Insert Arrangement Referencing Scheme

The reference scheme in Figures 4-11, 4-12, and 4-13 should be used to define connector type and insert arrangement. This referencing scheme should not be used for purchasing of components.

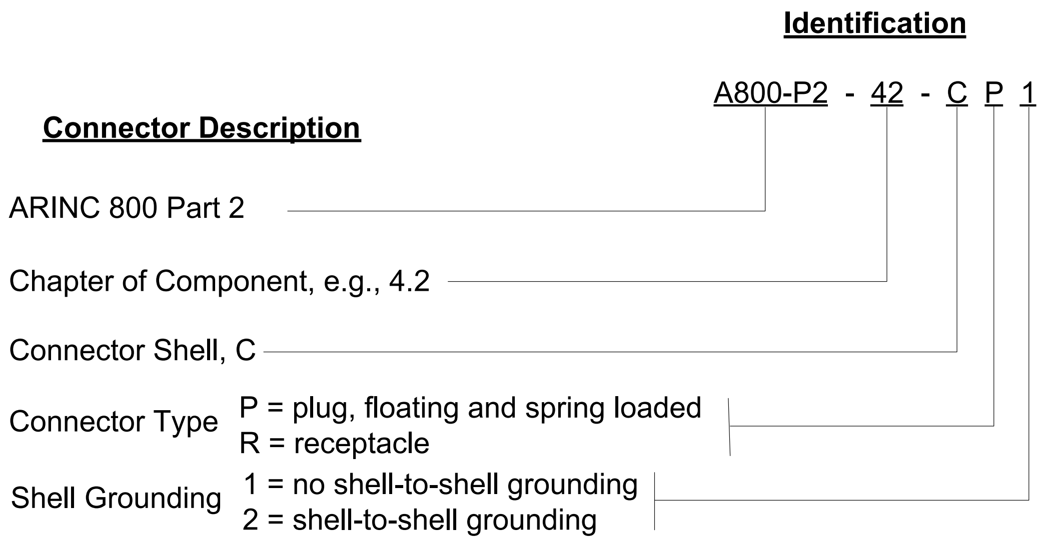



**Figure 4-11 – Connector Referencing Scheme**

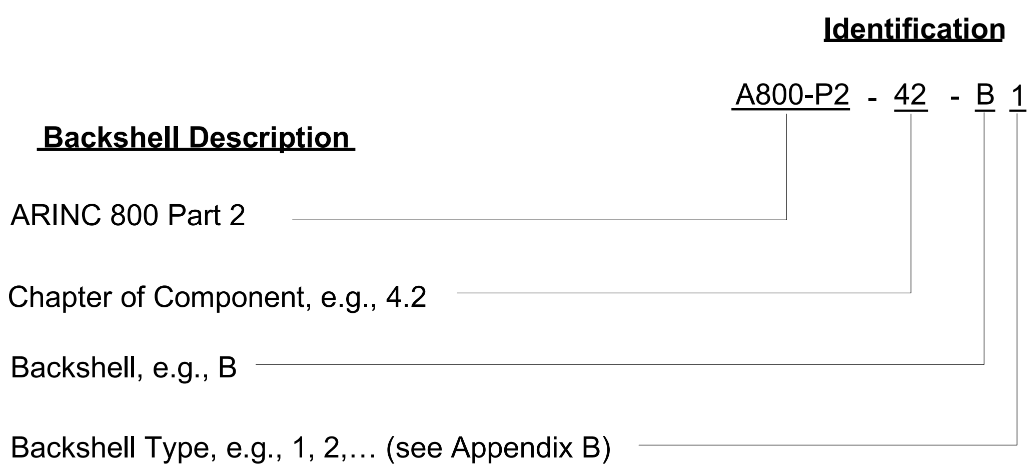



**Figure 4-12 – Backshell Referencing Scheme**

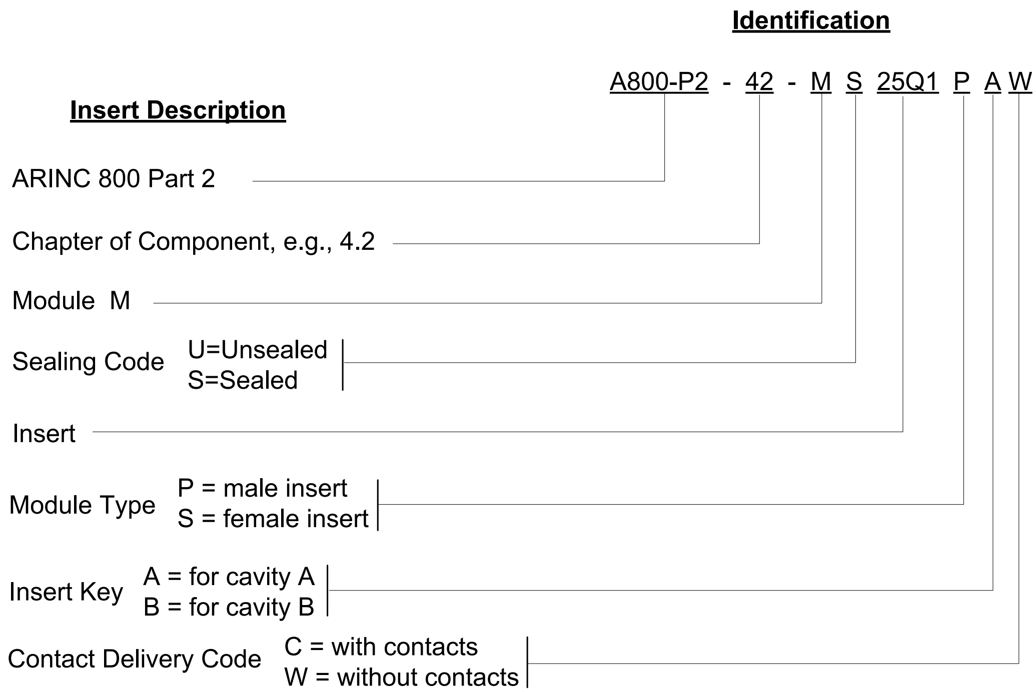



**Figure 4-13 – Insert Referencing Scheme**

### 4.2.1.4 Design Principle

The design of receptacle and plug should be as shown in Figure 4-14.

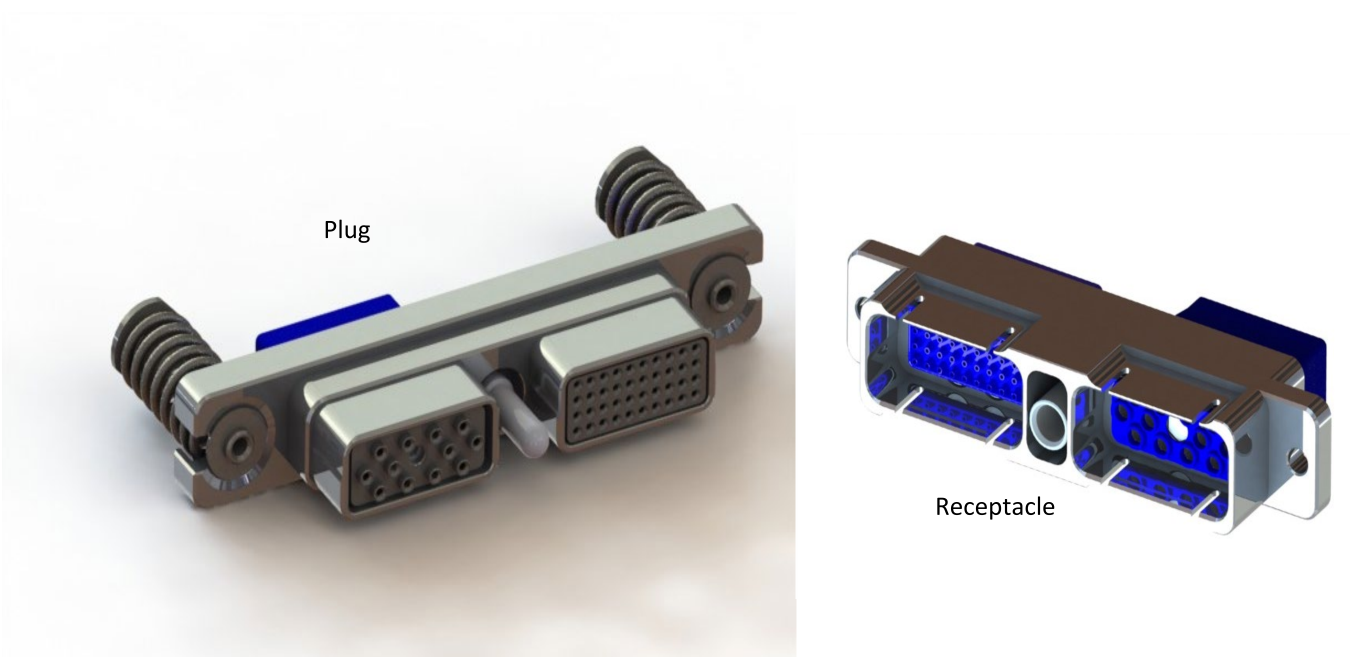



**Figure 4-14 – Receptacle and Plug Design Principle**

### 4.2.2 Requirements

In case of conflicts with this specification and other documents, the provisions of this specification should take precedence.

Connector dimensions are provided in this document to ensure that connectors from other manufacturers will be intermateable and interchangeable with the selected manufacturers, and each other. Inserts, contacts, and backshells should be interchangeable.

The design and material should be compatible with environmental conditions similar to those encountered in the galley area located in the pressurized area of a commercial aircraft.

Unless otherwise protected against electrolytic corrosion, dissimilar metals should not be employed in intimate contact with each other in a connector or in any mated pairs of connectors conforming to the specification.

Non-magnetic materials and components should be used to the greatest extent possible. The permeability of the basic connector assembly should be less than 2.0 MU. The permeability should be checked using the instrument described in ASTM A 342, EN2591-513, or equivalent.

Insert requirements are specified in EN4644 and EN4639.

#### 4.2.2.1 Shell

The connector shell should conform to dimensions shown in Appendix B:

- Figure B-1 – Receptacle Outer Dimensions
- Figure B-3 – Receptacle Panel Cut-Out
- Figure B-4 – Receptacle Interface for Backshell
- Figure B-5 – Plug Outer Dimension for Size 1 and 2
- Figure B-6 – Plug Panel Cut-Out
- Figures B-7 and B-8 – Plug Interface for Strain Relief and Backshell

The shell material should be of high-grade materials that provide dimensional stability compatible with connector mateability. The shell should be made of corrosion resistant materials or be protected to meet the performance of this specification.

The weight of the connector shell should be minimized consistent with performance requirements and within the limitations of sound design practices.

The shell should be designed and constructed to withstand handling and maintenance functions during installation and service.

The shell design should provide for physical barriers for circuit separation. The shell design should have two cavities to accommodate the inserts described in Section 4.2.2.2. One cavity is polarized with key A, the other with key B to ensure a defined position of the insert in the connector shell. Inserts should be defined with the correct keying. The shell should accommodate a strain relief backshell as depicted in Appendix B, Figures B-9, B-10, and B-11.

The receptacle connector should provide a surface for the bottoming of the plug shell to ensure full connector mating. The specified receptacles are front panel mount versions.

The plug shell should be fitted with spring loaded float-mounted eyelets and should be fitted with inserts for socket contacts. The corresponding contact should be a parallel twinax contact (see Section 3.1.1). The plug shell should be installed on the galley side (e.g., coffee maker rail). The receptacle shell should be fixed-mounted on the galley insert side (e.g., coffee maker unit).

The shell should be designed to allow a maximum axial displacement along the mating direction, Z, of ±0.0394 in (±1 mm) up to ±0.1575 in (±4 mm). The X and Y maximum misalignment are ±0.079 in (±2 mm) and the maximum angular misalignment is ±2°. See Figure B-14.

The shell grounding type of plug and receptacle requires a suitable shell-to-shell conductivity. Because mating force is limited to 45 lbf (200N) minimum for manual installation, the shell to shell conductivity is ensured with some additive shell ground springs on the receptacle. Dimensions are provided in Figure B-2. The grounding springs are designed to have a correct balance between conductivity and friction.

Shell polarization to prevent 180° mismating should be accomplished by an off-center pin guide on the plug and the mating guide bushing on the receptacle. Polarization should occur prior to contact mating.

Appendix B, Figures B-12 and B-13, defines the receptacle and plug mating dimensions, respectively. Appendix B, Figure B-14 defines the mating conditions.

### 4.2.2.2 Inserts

Rigid insert materials should have properties that conform to the electrical and mechanical requirements of this specification.

The inserts should be designed and constructed with proper sections and radii, such that they will not readily chip, crack, or break in assembly or normal service. Hollow-type inserts should not be used. Inserts should have two polarizations, A and B, for keying.

Inserts from different suppliers should be intermateable and interchangeable.

The insert sealing members (rear grommet and interfacial seal) should be molded with resilient dielectric or elastomeric materials of high dielectric quality and should provide sealing for the wires described in Table 4-22.

**Table 4-22 – Insert Sealing Provisions**

| Contact Size | Sealing Range Inches (mm) | |
|---|---|---|
| 22 | 0.034 (0.86) | 0.057 (1.45) |
| 16 spl (see note 2) | 0.069 (1.75) | 0.103 (2.62) |
| 12 | 0.097 (2.46) | 0.135 (3.43) |
| 8 | See note 1 | See note 1 |

Notes:

1. Sealing of the data bus cable is achieved through the use of a sealing boot delivered with the size 8 Twinax contact.
2. Contacts size 16 spl are special contacts that are only installed in the hybrid insert 12F6.

The inserts should be rear snapped into the shell and rear released using the extraction tool shown in Figure B-15 of Appendix B.

The inserts should be designed for positive locking of the contacts in the inserts. Inserts should be capable of allowing contacts insertion and extraction using MIL-I-81969 insertion/extraction tools described in Table 4-23.

**Table 4-23 – Insertion and Extraction Tool Specification**

| Contact Size | Insertion Tool | Extraction Tool |
|---|---|---|
| 22 | M81969/1-01 | M81969/1-01 |
| 16 spl | M81969/14-03 | M81969/14-03 |
| 12 | M81969/28-02 | M81969/28-02 |
| 8 | M81969/28-03 | M81969/28-03 |

Inserts should conform to the dimensions shown in Figures B-18, B-19, B-20, B-21, B-22, B-23, B-24, B-25, and B-26 of Appendix B.

Specific insert arrangements are shown in Appendix B, Figures B-22 (Insert 06), B-23 (Insert 25Q1), B-24 (12F6), and B-26 (40). Figure B-25 shows the sleeve holder for Insert 12F6.

### 4.2.2.3 Contacts and Crimping

Contact mating action should be designed to provide a forward wiped and, where possible, back wiped surface contact.

#### 4.2.2.3.1 Signal and Power Contacts

Appendix B, Figure B-27 specifies the design of the pin contact. Figure B-28 specifies the design of the socket contact.

Size 22 and 12 pin and socket contacts should be rear-release, rear-removable, and provide for crimp termination conforming to Figure B-18 of Appendix B.

Table 4-24 specifies the cable accommodation for the signal and power contacts.

**Table 4-24 – Cable Accommodations**

<table>
<tr><th>Contact Size</th><th>Wire Size (AWG)</th><th>Crimping Tool</th><th>Positioner</th></tr>
<tr><td rowspan="3">22</td><td>26</td><td rowspan="3">M22520/2-01</td><td rowspan="3">M22520/2-23</td></tr>
<tr><td>24</td></tr>
<tr><td>22</td></tr>
<tr><td>16spl</td><td>16</td><td>M22520/1-01</td><td>See Appendix B,<br>Figure B-29</td></tr>
<tr><td rowspan="3">12</td><td>16</td><td rowspan="3">M22520/1-01</td><td rowspan="3">M22520/1-02</td></tr>
<tr><td>14</td></tr>
<tr><td>12</td></tr>
<tr><td>8</td><td>24</td><td>Center contacts:<br>M22520/2-01<br>Outer Body:<br>M22520/5-01</td><td>Center contacts:<br>Daniels K709<br>Outer Body:<br>M22520/5-45</td></tr>
</table>

Size 8 Twinax contact should be rear-release and rear-removable for crimping on the Size 24 cable. The Size 8 Twinax is specified in Section 3.1.1 of this specification.

Provision should be made to accommodate the following combinations of contacts:

- Size 22 signal contacts with 5 A, x V, y Hz continuous duty.
- Size 12 contacts with 23 A, x V, y Hz continuous duty.

Contacts should have the nominal electrical characteristics specified in Table 4-25.

**Table 4-25 – Contact Electrical Characteristics**

| Contact Size | Amperes (A) |
|---|---|
| 22 | 5 |
| 16 spl | 10.0 |
| 12 | 23.0 |
| 8 | Outer body: 12 |
| | Center contact: 1 |

Contacts should be positioned in the connector such that the length of pin surface being wiped by the spring member of the socket contact should not be less than the value shown in Table 4-26.

**Table 4-26 – Contact Minimum Engagement Provisions**

| Contact Size | Minimal Engagement Inches (mm) |
|---|---|
| 22 | 0.050 (1.27) |
| 16 spl | 0.035 (0.90) |
| 12 | 0.059 (1.50) |
| 8 | Outer body: 0.224 (5.70) |
| | Center contacts: 0.148 (3.75) |

Note: A 12-pin contact size is for power and a 22-contact size is for data.

### 4.2.3 Electrical Cable

Data cables for galley inserts should provide the principle characteristics specified in ARINC Specification 800, Part 3, Section 4.1.2.

### 4.2.4 Requirements

#### 4.2.4.1 Visual Examination

The connector should be free of foreign parts, corrosion, cracks, and burrs and should show no loose parts.

#### 4.2.4.2 Examination of Dimensions and Mass

The sample dimensions should conform to the dimensions shown in Appendix B. Weight maximums are included in Table 4-27.

**Table 4-27 – Weight Maximum of Connectors without Contacts and Backshells**

| P1, lbs (g) | P2, lbs (g) | R1, lbs (g) | R2, lbs (g) |
|---|---|---|---|
| 0.2425 (110) with strain relief | 0.221 (100) | 0.1874 (85) | 0.1874 (85) |

### 4.2.4.3 Contact Resistance

#### 4.2.4.3.1 Low Signal Level Contact Resistance

When tested in accordance with Section 4.2.6.3.1, the contact resistance values should not exceed the values in Table 4-28.

**Table 4-28 – Contact Resistance Low Signal Level**

| Contact Size | Initial (mΩ) | After Test (mΩ) |
|---|---|---|
| 22 | 8.0 | 11.0 |

#### 4.2.4.3.2 Contact Resistance at Rated Current

When tested in accordance with Section 4.2.6.3.1, the contact resistance values should not exceed the values listed in Table 4-29.

Rated current is 5A for size 22 contacts, 13A for size 16 contacts, 10A for size 16 spl, 12A for the size 8 twinax outer body, and 1A for the size 8 twinax center contacts.

**Table 4-29 – Contact Resistance at Rated Current (Silver Plated Wires)**

| Contact Size | Wire Size (AWG) | Test Current (A) | Initial (mΩ) | After Test (mΩ) |
|---|---|---|---|---|
| 22 | 22 | 5 | 8.0 | 11.0 |
| 22 | 24 | 3 | 8.0 | 11.0 |
| 22 | 26 | 2 | 8.0 | 11.0 |
| 16 Spl | 16 | 10 | 3.0 | 5.0 |
| 12 | 12 | 23 | 2.0 | 3.0 |
| 12 | 14 | 17 | 2.0 | 3.0 |
| 8 twinax outer body | braid | 12 | 2.0 | 4.0 |
| 8 twinax center parallel contact | 24 | 1 | 6.0 | 7.5 |

### 4.2.4.4 Mating and Unmating Forces

The spring force and the operating range should be maintained over the minimum and maximum distance defined in Appendix B, Figure B-14.

### 4.2.4.5 Insulation Resistance

When tested in accordance with Section 4.2.6.5, the connector assembly should have an insulation resistance greater than 5000 MΩ (unmated connector) at ambient temperature and 1000 MΩ at elevated temperature between any pair of contacts and between any contact and connector shell.

Refer to Section 4.2.1.1 for the suitable maximum temperatures.

### 4.2.4.6 Dielectric Withstanding Voltage (Sea Level and Altitude)

When tested in accordance with Sections 4.2.6.7 and 4.2.6.8, the connector assemblies should withstand the applicable voltage without flashover. The maximum leakage current should be 2 mA.

### 4.2.4.7 Altitude Immersion

Wired mated pairs of connectors should be tested per Section 4.2.6.9 after being subjected to an altitude of 25,000 ft (7620 m). The mated pair of connectors should have an insulation resistance greater than 1000 MΩ and should meet the dielectric withstanding voltage requirements of Section 4.2.4.6.

#### 4.2.4.8 Mold Growth

There should be no traces of mold growth on the materials.

#### 4.2.4.9 Salt Spray

When a wired connector assembly is tested as specified in Section 4.2.6.11, it should not show any evidence of corrosion.

#### 4.2.4.10 Temperature Cycling

When tested as specified in Section 4.2.6.12, the wired mated connectors should show no evidence of blistering, peeling, or separation of plating or other damage detrimental to the operation of the connector.

#### 4.2.4.11 Temperature Life

When tested in accordance with Section 4.2.6.13, the connector should meet the temperature life requirement with a maximum temperature according to Section 4.2.1.1.

#### 4.2.4.12 Humidity

When tested as specified in Section 4.2.6.14, the insulation resistance should be 100MΩ or greater. Connectors should show no damage that will adversely affect performance.

#### 4.2.4.13 Maintenance Aging

When tested as specified in Section 4.2.6.15, the connector should meet the insertion/extraction forces shown in Table 4-30.

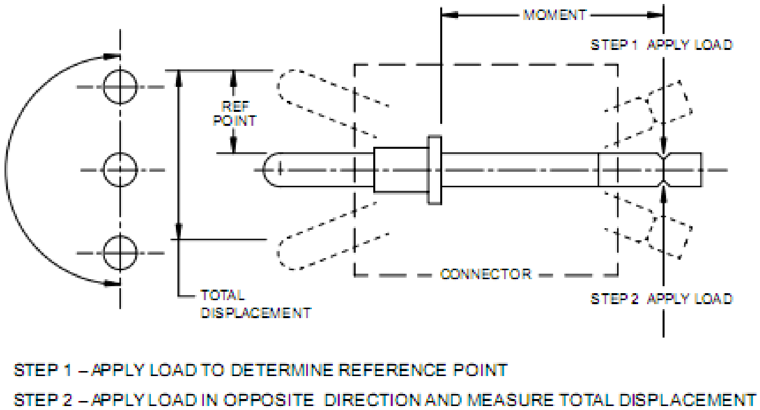
**Table 4-30 – Insertion and Removal Forces**

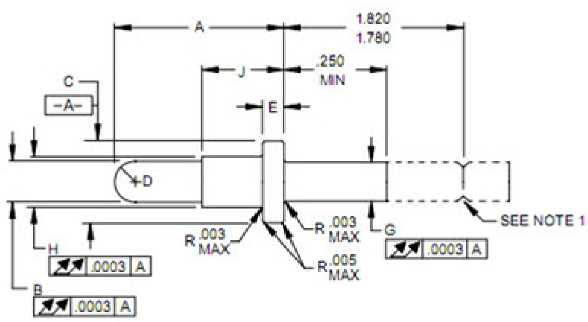
| Contact Size | Insertion, lbf (N) | Removal, lbf (N) |
|---|---|---|
| 22 | 10 (44.5) | 8 (35.6) |
| 16 SPL | 20 (89) | 15 (67) |
| 12 | 25 (111.2) | 20 (89) |

#### 4.2.4.14 Contact Stability

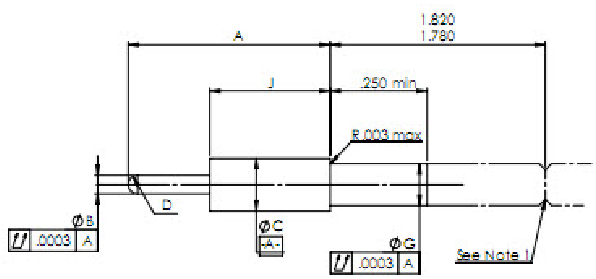
The unmated receptacle connector should have 10%, but not less than one contact cavity in each insert subjected to this test. Gage pins conforming to Figure 4-15 should be used in place of actual contacts. When tested in accordance with Section 4.2.6.16, the total tip displacement of the contact tip end should not exceed 0.052 in (1.3 mm) for size 22, 0.062 in (1.6 mm) for sizes 16 spl and 12.

**4.0 MODULAR RECTANGULAR CONNECTORS**




**Gage pin size 22 and 12**




**Gage pin size 16 spl.**

| Contact Size | A +0.0005 -0.0000 | B +0.0002 -0.0000 | ØC +0.0002 -0.0000 | D Rad | E +0.0000 -0.0002 | ØG +0.0000 -0.0002 | ØH +0.0002 -0.0000 | J +0.0005 -0.0000 |
|---|---|---|---|---|---|---|---|---|
| 22 | 0.419 | 0.029 | 0.069 | SPHERICAL | .032 | 0.050 | 0.049 | 0.135 |
| 16 SPL | 0.520 | 0.048 | 0.134 | SPHERICAL | | 0.107 | | 0.310 |
| 12 | 0.477 | 0.092 | 0.186 | SPHERICAL | .046 | 0.155 | 0.150 | 0.154 |

Notes:

1. Design of rear extension is optional but must have a groove provided.
2. Material: Hardened tool steel
3. Finish: 32 microinches polished

**Figure 4-15 – Gage Pin Configuration**

### 4.2.4.15 Insert Retention

When tested as specified in Section 4.2.6.17, the connector insert should retain its normal position in the connector shell for the specified load. A displacement of the insert should not exceed 0.012 in (0.3 mm). At the completion of the test, the insert should be able to be removed using the standard insert removal tool. The insert retention mechanism should be inspected and should show no damage.

### 4.2.4.16 Mechanical Strength of Rear Accessories

When tested as specified in Section 4.2.6.18, with a bending force of 15lbs (67 N) minimum, the backshell or strain relief must show no signs of loosening or evidence of damage.

### 4.2.4.17 Contact Retention

When tested in accordance with Section 4.2.6.19, the signal contacts in a wired unmated connector should withstand an axial load as specified in Table 4-31. The axial displacement of the contact should not exceed 0.012 in (0.3 mm), and there should be no dislodging or damage to the contact, insert, or the contact retention mechanism.

**Table 4-31 – Contact Retention**

| Contact Size | Axial Load lbf (N) |
|---|---|
| 22 | 12 (53) |
| 16 spl | 12 (53) |
| 12 | 30 (133) |
| 8 | 30 (133) |

### 4.2.4.18 Shock

Mated connectors should be subjected to the shock test as specified in Section 4.2.6.20. There should not be any disengagement of the mated connectors, evidence of cracking, breaking, or loosening of parts.

There should be no electrical or optical discontinuities greater than 1µs.

There should be no optical discontinuities greater than 1µs/1 dB.

There should be no electrical discontinuities greater than 10 ns for twinax contacts.

### 4.2.4.19 Vibration

When tested in accordance with Section 4.2.6.21, there should not be any disengagement of the connectors, evidence of cracking, breaking, or loosening of parts.

There should be no electrical discontinuities greater than 1µs.

There should be no optical discontinuities greater than 1µs/1dB.

There should be no electrical discontinuities upper than 10 ns for twinax contacts.

### 4.2.4.20 Electrical Overload

When tested as specified in Section 4.2.6.22, the mated pair of connector should show after test the characteristics conform to the EIA2591-210 requirements.

#### 4.2.4.21 Flammability

During the duration of the test, no flaming part should fall from the sample under test.

#### 4.2.4.22 Durability

After test, the connector should meet the requirements of the subsequent group tests.

#### 4.2.4.23 Insert Durability

When subjected first to 10 cycles of being inserted and extracted and then tested as specified in Section 4.2.6.25, the insert should not suffer any failures or degradation of the mechanical properties of the insert retention clips and should show no damage detrimental to the operation of the connector. At the completion of the durability test, the insert should be able to meet the requirements of Section 4.2.6.17. Failure to complete this test because of mechanical malfunction of the connector/insert should be cause for rejection.

#### 4.2.4.24 Attenuation (Optical Termini Only)

Maximum attenuation = 0.5 dB

Maximum average attenuation = 0.3 dB

#### 4.2.4.25 Shell to Shell Continuity

When tested per Section 4.2.6.27, the maximum resistance between the shells of the mated connector should be 3 mΩ.

Note: This test is performed with the minimum connector spring compression.

### 4.2.5 Qualification

#### 4.2.5.1 Qualification Samples

Qualification samples should be tested by the manufacturer in the quantities specified in Table 4-32.

Each mated pair of sample consists of a plug and receptacle shell as described in Appendix B.

The connectors should be fully populated with contacts.

Size 22, 16, and 12 crimp contacts wired on minimum cable diameter. Refer to Table 4-22 for minimum cable diameter. Silver plating is advised for qualification tests.

Size 8 non-concentric twinax contact wired on a cable as defined in Section 3.1.1.

Note: Samples of group 7 should be wired with the following cables:

1. Size 22 contacts will be wired on AWG24 wire (e.g., S280W502-1)
2. Size 12 contacts will be wired on AWG12 wire (e.g., BMS13-58, Type 1, Cl 1)

## Table 4-32 – Qualification Samples

| Test Group | QTY | Comments |
|---|---|---|
| 1 | 3 | mated pair |
| 2 | 3 | mated pair |
| 3 | 3 | mated pair |
| 4 | 3 | mated pair |
| 5 | 3 | mated pair |
| 6 | 3 | mated pair |
| 7 | 2 | mated pair |

## Table 4-33 – Qualification Test Matrix

| Test | Group Number | | | | | | | Requirement | Procedure |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Section | Section |
| Visual examination | X | X | X | X | X | X | X | 4.2.4.1 | 4.2.6.1 |
| Examination of dimensions and mass | X | X | X | X | X | X | X | 4.2.4.2 | 4.2.6.2 |
| Low signal level contact resistance | | X | X | X | X | | X | 4.2.4.3.1 | 4.2.6.3.1 |
| Contact resistance at rated current | | X | X | X | X | | X | 4.2.4.3.2 | 4.2.6.3.2 |
| Shell to shell continuity (CP2/CR2 only) | | X | X | X | X | | | 4.2.4.25 | 4.2.6.27 |
| Attenuation (optical) (CP2/CR2 only) | | X | | X | X | | | 4.2.4.24 | 4.2.6.26 |
| Durability | | X | | | | | | 4.2.4.22 | 4.2.6.24 |
| Contact resistance at rated current | | X | | | | | | 4.2.4.3.2 | 4.2.6.3.2 |
| Insulation resistance | | X | | | | | | 4.2.4.5 | 4.2.6.5 |
| DWV | | X | | | | | | 4.2.4.6 | 4.2.6.7 |
| Mating/unmating forces | | X | | | | | | 4.2.4.4 | 4.2.6.4 |
| DWV altitude | | X | | | | | | 4.2.4.6 | 4.2.6.8 |
| Insulation resistance at elevated temperature | | X | | | | | | 4.2.4.5 | 4.2.6.6 |
| Altitude immersion | | X | | | | | | 4.2.4.7 | 4.2.6.9 |
| Mold Growth | | | | | | X | | 4.2.4.8 | 4.2.6.10 |
| Salt spray | | | X | | | | | 4.2.4.9 | 4.2.6.11 |
| Temperature life | | | | | X | | | 4.2.4.11 | 4.2.6.13 |
| Contact resistance at rated current | | | | | X | | | 4.2.4.3.2 | 4.2.6.3.2 |
| Insulation resistance | | | | | X | | | 4.2.4.5 | 4.2.6.5 |
| DWV | | | | | X | | | 4.2.4.6 | 4.2.6.7 |
| Temperature cycling | | | | | X | | | 4.2.4.10 | 4.2.6.12 |
| Humidity | | | | | X | | | 4.2.4.12 | 4.2.6.14 |
| Maintenance aging | X | | | | | | | 4.2.4.13 | 4.2.6.15 |
| Contact stability | X | | | | | | | 4.2.4.14 | 4.2.6.16 |
| Insert Durability | X | | | | | | | 4.2.4.23 | 4.2.6.25 |
| Insert retention | X | | | | | | | 4.2.4.15 | 4.2.6.17 |
| Mechanical strength of rear accessories | X | | | | | | | 4.2.4.16 | 4.2.6.18 |
| Contact retention | X | | | | | | | 4.2.4.17 | 4.2.6.19 |
| Shock | | | | X | | | | 4.2.4.18 | 4.2.6.20 |
| Vibration | | | | X | | | | 4.2.4.19 | 4.2.6.21 |
| Insulation resistance | | | | | X | | | 4.2.4.5 | 4.2.6.5 |
| DWV | | | | X | X | | | 4.2.4.6 | 4.2.6.7 |
| Shell to shell continuity (CP2/CR2 only) | | X | X | X | X | | | 4.2.4.25 | 4.2.6.27 |
| Attenuation (optical) | | X | | X | X | | | 4.2.4.24 | 4.2.6.26 |
| Contact resistance at rated current | | | | X | X | | | 4.2.4.3.2 | 4.2.6.3.2 |
| Mating/unmating forces | | | | X | | | | 4.2.4.4 | 4.2.6.4 |
| Electrical overload | | | | | | | X | 4.2.4.20 | 4.2.6.22 |
| Contact resistance at rated current | | | | | | | X | 4.2.4.3.2 | 4.2.6.3.2 |
| Flammability | X | | | | | | | 4.2.4.21 | 4.2.6.23 |
| Visual examination | X | | X | X | X | X | X | 4.2.4.1 | 4.2.6.1 |

## 4.2.6 Qualification Methods

### 4.2.6.1 Visual Examination

The visual examination should be made with the unaided eye. Inspection should be done in accordance with Section 4.2.4.1.

### 4.2.6.2 Examination of Dimensions and Mass

The examination should be performed with regular measurement equipment having the required accuracy.

### 4.2.6.3 Contact Resistance

#### 4.2.6.3.1 Low Signal Level Contact Resistance

50 percent of only the size 22 contacts of each mated connector assembly should be tested in accordance with EN2591-201. This test is performed with the minimum connector spring compression.

#### 4.2.6.3.2 Contact Resistance at Rated Current

50 percent of the contacts of each mated connector assembly should be tested in accordance with EN2591-202. This test is performed with the minimum connector spring compression.

### 4.2.6.4 Mating and Unmating Forces

The connectors should be tested in accordance with EIA-364-13. This test is performed at both minimum and maximum spring compression in accordance with Section 4.2.4.4.

### 4.2.6.5 Insulation Resistance

Connector assemblies should be tested in accordance with EIA-364-21. The insulation resistance of wired, unmated, sealed connectors should be in accordance with Section 4.2.4.5, when measured separately between any pair of adjacent contacts and between the shell and any contact.

### 4.2.6.6 Insulation Resistance at Elevated Temperature

The insulation resistance should be measured in accordance with Section 4.2.4.5 on unmated connector assemblies with the exception that the connectors should be exposed to the maximum operating temperature, per Section 4.2.1.1, for a minimum of 30 minutes prior to measurement. Measurements should be made while the connectors are in the chamber at the specified temperature. The insulation resistance should be in accordance with Section 4.2.4.5.

### 4.2.6.7 Dielectric Withstanding Voltage

Unmated connectors should be tested in accordance with EIA-364-20. For Twinax contacts, the test voltage should be 1000 Vrms between contacts and 500 Vrms between the shell and contact under test. For all other contacts, the test voltages should be 1500 Vrms.

The test voltage should be applied between the contact under test and the closest adjacent contacts and between the shell and the contact under test.

#### 4.2.6.8 Dielectric Withstanding Voltage Altitude

Mated connectors should be tested in accordance with EIA-364-20 at 25,000 feet (7620 m). For Twinax contacts, the test voltage should be 125 Vrms. For all other contacts, the test voltage should be 300 Vrms.

This test is performed with the minimum connector spring compression.

#### 4.2.6.9 Altitude Immersion

The wired mated connectors should be subjected to the altitude immersion test in accordance with EIA-364-03 with the following exceptions:

- The pressure in the chamber should be reduced to an equivalent altitude of 25,000 feet.
- The connectors should be held together with mating distance according to Appendix B, Figure B-14, which is the maximum value.

#### 4.2.6.10 Mold Growth

The test has to be performed on materials according to EN2591-306 (Method B, 28 days). If the materials used comply with group 1 fungus inert material of MIL-HDBK-454 requirement 4, test EN2591-306 is not performed.

#### 4.2.6.11 Salt Spray

Wired connectors should be subjected to the salt spray test specified in EIA-364-26. The connector should be subjected to 50 mating/unmating cycles at a rate of 5 cycles/min, exposed mated for 96H to salt spray, then examined mated for evidence of corrosion. This test is performed with the minimum connector spring compression.

#### 4.2.6.12 Temperature Cycling

Wired mated connectors should be tested in accordance with EIA-364-32, test condition A. Five cycles should be completed. This test is performed with the maximum connector spring compression.

#### 4.2.6.13 Temperature Life

The connectors are subjected to the maximum operating per Section 4.2.1.1 for 1000 hours. Wired, mated connectors should be tested in accordance with EIA-364-17, Method A. This test is performed with the maximum connector spring compression.

#### 4.2.6.14 Humidity

Wired mated connectors should be subjected to the humidity test specified in EIA-364-31, Method 4 should be used. This test is performed with the minimum connector spring compression.

#### 4.2.6.15 Maintenance Aging

The connector should be tested in accordance with EIA-364-24. A minimum of 20%, but not fewer than 5 of each contact size in each insert should be removed and inserted ten times using the appropriate insertion/removal tool (Only one size 8 non-concentric twinax contact is tested). The first and the tenth insertion/removal cycle should meet the requirements of Section 4.2.4.13.

### 4.2.6.16 Contact Stability

The contact stability should be measured by using an unmated receptacle as defined in Section 4.2.4.14. The connector should be held in a holding device. The moment specified should be applied to the exposed gage pins as shown in Figure 4-15. The rate of load application should not exceed 1.0 ounce-inch ($7.06 \times 10^{-3}$ Nm) per minute. The total tip displacement should be measured as shown in Table 4-34. The total tip displacement of the contact tip end should not exceed the dimension specified in Section 4.2.4.14.

**Table 4-34 – Contact Stability Measurement**

| Contact Size | Moment ozf-in (N-cm) |
|---|---|
| 22 | 4 (2.8) |
| 20 | 16 (11.3) |
| 16 spl | 24 (16.8) |
| 12 | 32 (22.6) |
| 8 | 35 (133) |

### 4.2.6.17 Insert Retention

The insert should be subjected to the insert retention test per EIA-364-35, with an ultimate test load of 90 lbf (400N). The load should be applied to the front of the insert which is installed in the connector shell. The load should be applied at a rate of approximately 10 pound-force per square inch (69 kN/$m^2$) and held for 5 to 10 seconds. Displacement of the insert should not exceed the values specified in Section 4.2.4.14. Following the test, remove the insert and inspect the insert retention mechanism for damages in accordance with Section 4.2.4.15.

### 4.2.6.18 Mechanical Strength of Rear Accessories

The connector backshell should be tested for mechanical strength with the moment specified in Section 4.2.4.16. The connector shell should be secured over a panel or another device. The backshell should be installed on the connector shell. The load should be applied to each end of the backshell cable strain relief arm, one at the time, at a rate of 1 lbf (4.45N) per second until the required load is achieved. The load should be held for 1 minute and then released. The force should be applied in the two principal directions perpendicular to the connector length.

### 4.2.6.19 Contact Retention

Contact retention test should be performed in accordance with EIA-364-29 on terminated connectors. The contacts should support loads in either direction as specified in Table 4-31. The total axial displacement measured should be less than 0.012 in (0.3 mm) after the removal of the load.

### 4.2.6.20 Shock

Mated connectors at minimum spring compression length should be subjected to the shock test in accordance with EIA 364-27, test condition A. Three shocks in each direction should be applied along the three mutually perpendicular axes of the test specimen (total of 18 shocks). All contacts should be connected in series with 0.1A maximum flowing through the contacts. The connectors should be held together with mating distance being at its maximum value. See Appendix B, Figure B-14. Wires and cables should be supported 3 in (7.62 cm) or further from the connectors. A detector capable of detecting any discontinuities in excess of 1 $\mu$s should be used.

### 4.2.6.21 Vibration

The mated pair of connector should be submitted to the vibration test according to EIA364-28 test condition V, letter B. The vibration should be applied for 8 hours for each of the 3 principal axes. The connectors should be held together with mating distance at the maximum value according to Appendix B, Figure B-14. Wires and cables should be supported 3 in (7.62 cm) or further from the connectors. A detector capable of detecting any discontinuities in excess of 1 μs should be used.

### 4.2.6.22 Electrical Overload

The mated pair of connectors should be tested according to EN2591-210.

**Table 4-35 – Electrical Overload Tests**

| Contact Size | Current (Amps) | Duration (Seconds) |
|---|---|---|
| 22 | 10<br>50 | 40<br>0.6 |
| 16 spl | 20<br>100 | 40<br>0.6 |
| 12 | 46<br>230 | 40<br>0.6 |

### 4.2.6.23 Flammability

The mated pair of connectors should be submitted to the flammability test according to EIA-364-104, Method A.

### 4.2.6.24 Durability

The test should be performed according to EIA-364-09. The number of mating and unmating cycles should be 2000 for electrical contacts and 500 for optical contacts; the rate should not exceed 5 cycles/min. This test is performed with the maximum connector spring compression.

### 4.2.6.25 Insert Durability

The insert should be subjected to 10 cycles of being inserted and extracted from a connector shell using the insert extraction tool specified in ARINC Specification 810, Figure 3-10. At the completion of the durability test, the insert with the connector shell that was used in the above test should pass the insert retention test requirement specified in Section 4.2.4.15.

### 4.2.6.26 Attenuation (Optical Termini Only)

Attenuation should be measured in accordance with TIA/EIA–455–171A, Method B1, with the following conditions:

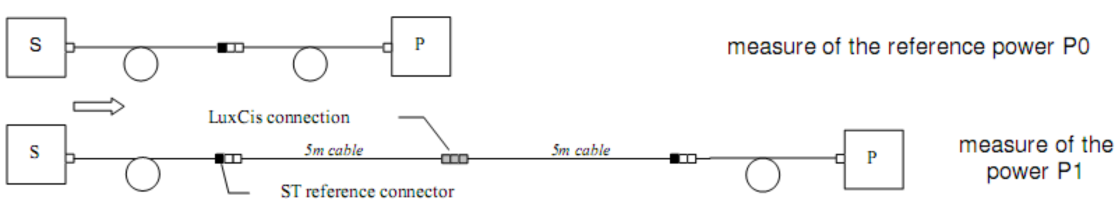



**Figure 4-16 – Attenuation Test Conditions**

The attenuation values are equal to P1 – P0 (two ways measures).

#### 4.2.6.27 Shell to Shell Continuity

Mated connector assemblies should be tested. A direct current of 1.0 ± 0.1 ampere at 1.5 Vdc should be caused to flow through the shells of the mated assembly. Using the voltmeter-ammeter method, measure the voltage drop between the rear of the plug shell and a point on the front face of the counterpart flange of receptacle. This test is performed with the minimum connector spring compression. The resulting resistance calculated using the measured voltage drop and the specific current should be less than the value specified in Section 4.2.4.25.

## 4.3 Shielded Multi-Way Connectors

### 4.3.1 Introduction

**The connector shells, connector performance and insert contact arrangements described in this specification shall conform to EN4165-001 and EN4165-002.**

***CSS needs to know what to reference for performance.***

#### 4.3.1.1 Objectives

**This section is intended to provide standardization, requirement, and deliverables for a range of Shielded Small Form Factor (SSFF) multi-way push-pull mating connectors. The shielded connectors will include a 'banding platform' region for terminating the cable shielded braid via band strap, and a lip and groove for securing a protective heatshrink boot or sleeving.**

**The composite connector shell is intended for general use applications where the temperature extremes do not exceed -67 °F to +347 °F (-55 °C to +175 °C).**

##### 4.3.1.1.1 Scope

**This specification defines the dimensions, performance, and quality assurance criteria for the design, construction, performance, and testing of the Shielded Small Form Factor connector. The connector shells should be manufactured from thermoplastic or thermoset resins, conductively plated, and utilize the insert derived from that defined in EN4165-002.**

#### 4.3.1.2 Organization of this Section

- **Section 4.3.1 introduces the objective and scope of this specification and identifies the types of connectors addressed within the section.**
- **Section 4.3.2 provides the guidelines for the expected performance and physical characteristics of the connectors. These include material, construction criteria, and environmental performance.**
- **Section 4.3.3 addresses qualification tests.**
- **Appendix F defines the connector intermateability and rear interface.**

#### 4.3.1.3 Connector Type(s) and Insert Arrangement(s)

**TBD**

##### 4.3.1.3.1 Connector Type(s)

**This section covers the following connector type(s):**

- **Shielded multi-way connectors are rectangular multi-pin, push-pull coupling**
- **A positive lock mechanism can be felt and/or heard during mating**

- Unmating requires a retention mechanism to be pressed to unlock
- A mated connector can be secured with a cable tie
- The cable tie can be installed without tools, and to add a level of tamper resistance
- Plug and receptacle allows for accessories to secure access
- The receptacle allows for PCB contacts to be installed

#### 4.3.1.3.2 Insert Arrangement(s)

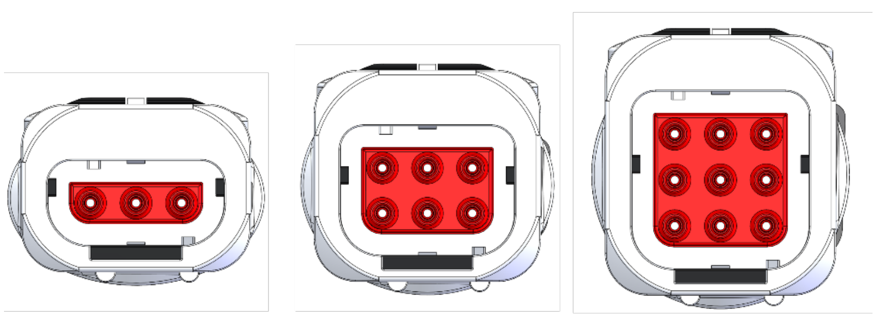
Insert arrangements of the shielded multiway connector shall conform to those described in EN4165-002.

The specific planforms described in this section are specific to the Shielded small form factor connector range and as such are not listed in EN4165-002, however the insert arrangements shall meet the performance requirements of EN4165-002. The insert construction must include a rear sealing grommet for both pin and socket variants and an interfacial seal for the pin variant made from silicone.

Removable contacts that can be used are qualified to and described in MIL-DTL-38999, MIL-DTL-MS39029/XX, and EN 4165.

Table 4-36 – Contact Types

| Contact Size | Wire Range | Type | Specifications |
|---|---|---|---|
| 22 | 26-22 AWG | Pin | M39029/58-360 |
| | | Socket | M39029/57-354 |
| 20/22 | 24-20 AWG | Pin | EN3155-070M2220 |
| | | Socket | EN3155-071F2220 |



3-Way 6-Way 9-Way

Figure 4-17 – Shielded Small Form Factor Connector Insert Arrangements

#### 4.3.1.3.3 Connector Referencing Scheme

The referencing scheme in Figure 4-** should be used to define connector type and insert arrangement. This referencing scheme should not be used for purchasing of components.

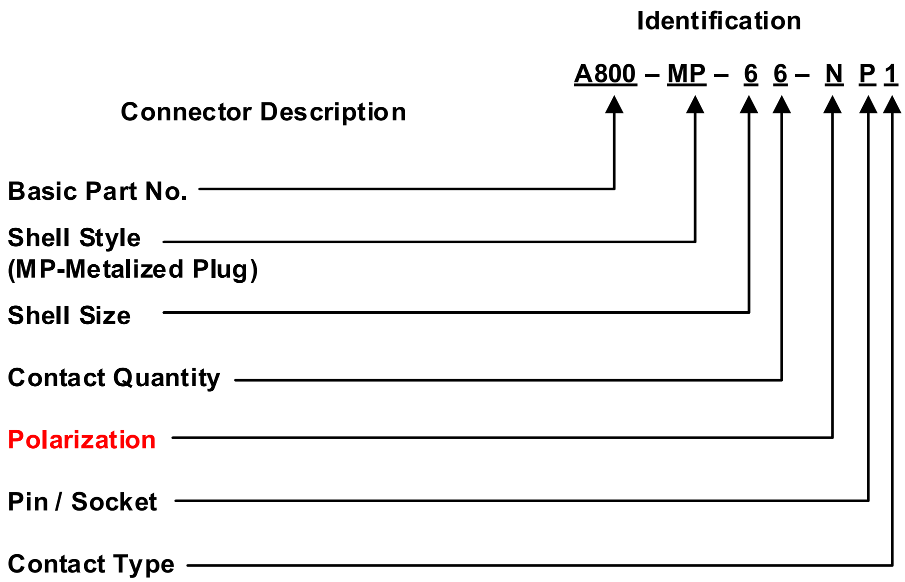



**Figure 4-18 – Shielded Multi-Way Connector Referencing Scheme**

## 4.3.2 Requirements for 3, 6, and 9-Way Connectors

### 4.3.2.1 Specification Sheets

The performance of individual items should be as specified herein and in accordance with the applicable attachment or specification drawing. In the event of any conflict between the guidelines of this specification and the drawings, the latter should be used.

### 4.3.2.2 General Requirements

In case of conflicts with this specification and other documents, the guidelines of this specification should be used. The items furnished under this specification should be capable of passing the performance verification test specified herein. Unless otherwise specified, ambient temperature is 73.4 ±9 °F (23 ±5 °C).

#### 4.3.2.2.1 Mateability

Enough dimensional information concerning the connector design is provided herein to ensure that all products from various manufacturers will be intermateable with each other. It is the responsibility of each manufacturer to perform a tolerance analysis of their design to ensure that it will mate to any appropriate connector that is within specification tolerances.

Each new connector manufacturer should perform a connector interoperability test with connectors and modular inserts from existing and qualified manufacturers.

*CSS: Need dimensional data for pin location. Airbus will moderate with TE and connector manufacturers for a reasonable solution.*

#### 4.3.2.2.2 Basic Design and Materials

The design and materials should be compatible with the environmental conditions similar to those encountered in the various zones of commercial aircraft as defined in Section 4.3.3**, i.e., pressure-altitude, temperature, humidity, vibration, and fluid exposure.

#### 4.3.2.2.3 Shell

The connector shell design should include a banding platform region for terminating a cable shielded braid, via band strap, and a lip and groove feature for securing a protective heatshrink boot or sleeving. Shells should be constructed to mechanically retain the inserts.

The connector shell should be made from high grade thermoplastic or thermoset materials. The material used for the connector housing should be durable, resilient plastic material with sufficient stiffness to minimize deflection and distortion when mated and will not deteriorate under normal conditions of operation and ageing.

A key attribute that must be considered when selecting the material for the connector shell is the ability to accept a conductive metallic finish. The plug shell should incorporate the coupling mechanism. The receptacle should incorporate the specific features that when engaged with the plug latch mechanism, a mechanically rigid assembly is produced.

##### 4.3.2.2.3.1 Shell Finish

The connector shell should be plated with an electrically conductive finish of electrolytic nickel per SAE-AMS QQ N-290 over an electroless nickel per SAE-AMS 2404 Class 3 or 4 and be capable of meeting the environmental and electrical requirements herein.

##### 4.3.2.2.3.2 Shell Mounting Provisions

The plug connector should include provision to be mounted with the use of a zip-tie via an aperture in the plug shell. When the mounting feature is used on a mated pair of connectors, the zip-tie will also provide a locking mechanism for plug to receptacle to avoid accidental uncoupling of the mated pair.

The receptacle connector should incorporate a visual indicator to show the mated condition of the connector pair. The indicator should be visible when unmated and not visible when mated. See Figure 4-19 for detail. If any or all of the visual indicator is visible, the connector pair is in the unmated state.

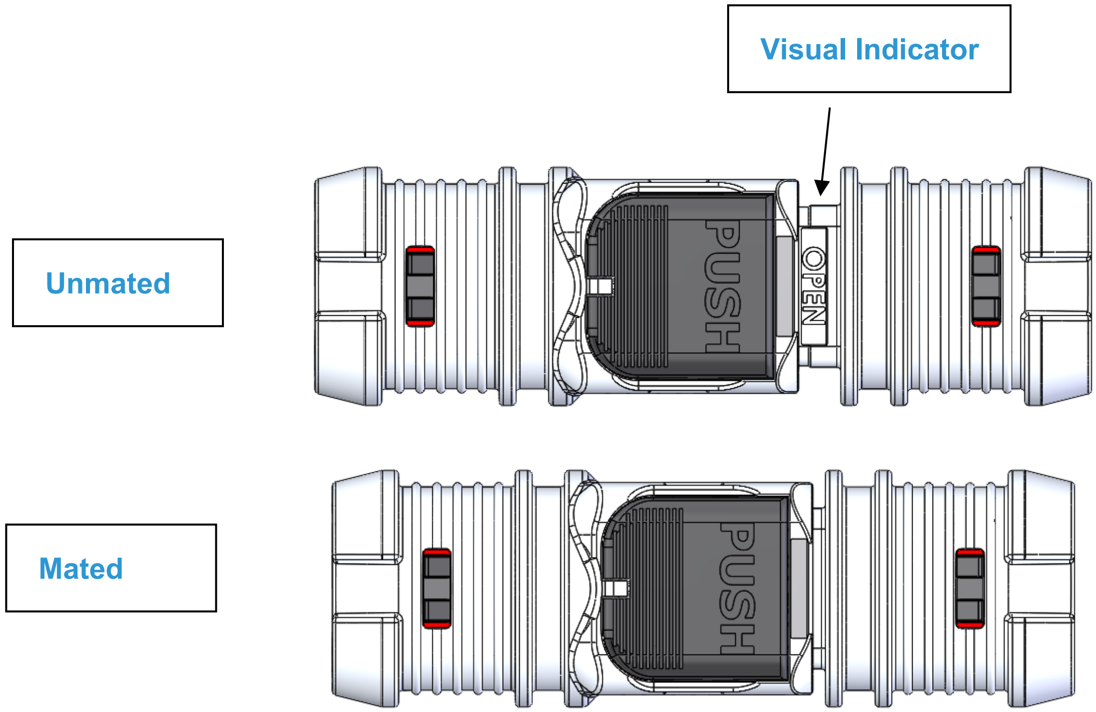



Figure 4-19 – Connector Pair Visual Indicator Detail

#### 4.3.2.2.3.3 Coupling Mechanism

The plug shell should be mated to the receptacle shell by sliding the plug onto the receptacle where the two shell halves engage. The latch mechanism will then engage the specific features located on the receptacle ensuring the two shells are mated, creating a mechanically rigid assembly.

The receptacle shell, when mated to the plug shell, provides a mechanically rigid assembly, establishing a 360° enclosure essential to the EMI shielding performance.

The coupling mechanism and connector shell design should incorporate a means of providing a visual reference that the plug is fully mated to the receptacle. No tools should be required to activate the latch mechanism to either mate or unmate the plug and receptacle. The coupling mechanism should withstand a minimum of 500 mating and unmating cycles.

#### 4.3.2.2.3.4 Locking Mechanism

The plug shell should include a latch feature to lock the plug to the receptacle. The latch feature should comprise a push button requiring a force to unmate the connectors to avoid accidental uncoupling. See section 4.3.2.2.3.3. for further locking mechanism provision.

#### 4.3.2.2.3.5 Insert Retention

Inserts should be positively retained within the connector shell by means of a rear retaining part. Once seated in the shell, the insert should not be removed. The insert and rear retainer shall be factory assembled. The retaining part shall include a clip feature for locking to the shell. No provision for removing the retainer is necessary.

#### 4.3.2.2.3.6 Weight

The connector should be a minimum weight consistent with performance requirements and within the limitations of sound design practices.

#### 4.3.2.2.3.7 Marking

Marking techniques and materials selected for the marking of connectors should be permanent and of a color that contrasts with the material on which the marking is applied. Characters should be of sufficient size and resolution to be completely understood without magnification.

#### 4.3.2.2.3.8 Airworthiness Standards

The connectors and materials must meet the requirements of and be in accordance with FAA Airworthiness standards:

- FAA: Meet CFR 14, Part 25, Subpart H, §25.1713 (Fire Protection: EWIS)
- FAA: Meet CFR 14, Part 25, Subpart D, §25.853 (a) and (c) (Fire Protection: Compartment Interiors)
- Meet relevant requirements of ABD 0031

#### 4.3.2.2.3.9 Flammability

The materials used in items covered by this specification should not sustain combustion when tested as specified in section 4.3.2.2.3.11.

#### 4.3.2.2.3.10 Smoke

The materials from which the plug, receptacle or connector covers use to protect un-mated plugs and receptacle for applications where provisional wiring is installed, should comply with the applicable airframe manufacturer requirements for smoke.

#### 4.3.2.2.3.11 Toxicity

Materials used in connectors or other parts covered by this specification should release only non-toxic fumes when tested.

Toxic gas emissions should not exceed the limits established by applicable airframe manufacturer specification.

#### 4.3.2.2.3.12 Arc-Tracking

EN4165

#### 4.3.2.2.3.13 Fungus

Items covered by this specification should be constructed of materials that are not nutrients for fungi and do not deteriorate over time to become fungus nutrients.

#### 4.3.2.2.3.14 Accessories

TBD

#### 4.3.2.2.3.15 Tools

There should be no tools required to mate and unmate the plug from the receptacle shell. Unique tools should not be required by any different connector manufacturers.

### 4.3.2.3 Electrical Requirements for 3, 6, and 9-Way Connectors

#### 4.3.2.3.1 Contact Resistance at Rated Current

(Ref. to MIL-C-38999)

When tested in accordance with Section 4.3.3.*.*, the contact resistance values should not exceed the values listed in Table 4-** for standard contacts. Rated current values are specified in Table 4-**.

Table 4-37a – Contact Resistance at Rated Current

| Contact Size | Initial mΩ | After Test mΩ | High Temperature +347° F (+175° C) |
|---|---|---|---|
| #22 | 8 | 11 | TBA |
| #20 | 5 | 7 | TBA |

Note: These values defined in Table XXXX of MIL-38999.

Table 4-37b – Low Level Contact Resistance

| Contact Size | Initial mΩ | After Test mΩ | High Temperature +347° F (+175° C) |
|---|---|---|---|
| #22 | 8 | 11 | TBA |
| #20 | 5 | 7 | TBA |

Note: These values defined in Table XXXX of MIL-38999.

Table 4-38 – Rated Current

| Contact Size | Barrel Size | Conductor | Current Conductor Rating (Amps) |
|---|---|---|---|
| #22 | #22 | 22 | 5 |
| | | 24 | 3 |
| | | 26 | 2 |
| #20 | #20 | 20 | 7.5 |
| | | 22 | 5 |
| | | 24 | 3 |

#### 4.3.2.3.2 Low Level Contact Resistance

EN4165

### 4.3.2.4 Mechanical Requirements for 3, 6, and 9-Way Connectors

#### 4.3.2.4.1 Coupling Forces

**The coupling or mating forces should not exceed the allowable forces when measured per Section 4.3.3.3. The mating forces of the small form factor connectors fully populated with contacts should not exceed the values specified in Table 4-39, and the push button mechanism engagement force should not exceed those values in Table 4-40. All values are based on a mating rate of 5 cycles/minute maximum.**

**Table 4-39 – Mating/Coupling Forces (without actioning the push button)**

| Mating Shell Part Numbers | Insert Arrangements | Max. Mating Force (N) | Max. Unmating Force (N) | Min. Unmating Force (N) |
|---|---|---|---|---|
| A800-M*-33-*** | 3 Way | 60 | 39.5 | 0.6 |
| A800-M*-66-*** | 6 Way | 60 | 39.5 | 0.6 |
| A800-M*-99-*** | 9-Way | 60 | 39.5 | 0.6 |

**Table 4-40 – Push Button Engagement Forces**

| Mating Shell Part Numbers | Min. Engagement Force (N) | Max. Engagement Force (N) |
|---|---|---|
| A800-M*-33-*** | 2.3 | 80 |
| A800-M*-66-*** | 2.3 | 80 |
| A800-M*-99-*** | 2.3 | 80 |

#### 4.3.2.4.2 Coupling Mechanism Durability

**The coupling mechanism should withstand a minimum of 500 mating and unmating cycles per Section 4.3.3.*:**

- **The plug latch and receptacle latching feature should show no elongation or deformation that would compromise the security of the latch mechanism from maintaining shell to shell mating integrity**
- **There should be no evidence of uneven wear, galling, or removal of plating on the plug or receptacle shells**

#### 4.3.2.4.3 Insert Retention

**NOT APPLICABLE**

#### 4.3.2.4.4 Shell

**There should be no minimum space requirement between plug shell and receptacle shell flange. There should be an audible click to signify the fully mated condition.**

#### 4.3.2.4.5 Shell Polarization

**Polarization ~~(orientation)~~ of the connector shells provides a means of preventing mismatching connectors in close proximity to one another. Shell polarization of the connector should be accomplished by means of integral keys and keyways.**

**It should be impossible to mate a plug to a receptacle shell when these polarization keys are polarized differently.**

**Polarization engagement should occur after initial shell engagement and before the pin makes contact with the socket contact.**

The connector shells should have a minimum of five polarizing positions and should use the code defined by this specification.

If color coding is used to identify the five polarization positions, the following colors will be used:

- N – Black
- A – Red
- B – Blue
- C – Green
- D – Yellow

#### 4.3.2.4.6 Connector Mating Sequence

The connector mating sequence should be as follows:

- Shells
- Polarization Keys
- Contacts

When mated, the minimum engagement of contact should be 1.27 mm.

### 4.3.2.5 Performance Requirements for 3, 6, and 9-Way Connectors

The Performance requirements are broadly in line with the schedule detailed within EN4165-001, Section 12.3, with the exclusion of certain tests deemed irrelevant to the Shielded Small Form Factor connector range.

#### 4.3.2.5.1 Flammability

When tested in accordance with Section 4.3.3.1. the performance should be per EN2591-317 Section 5.2.

#### 4.3.2.5.2 Insulation Resistance (Ambient Temperature)

When tested in accordance with Section 4.3.3.5.1, the performance should be per EN4165-001.

#### 4.3.2.5.3 Insulation Resistance (Elevated Temperature)

When tested in accordance with Section 4.3.3.5.2, the performance should be per EN4165-001.

#### 4.3.2.5.4 Dielectric Withstanding Voltage (DWV)

When tested as specified in Sections 4.3.3.6. and 4.3.3.7, the performance should be per EN4165-001.

#### 4.3.2.5.5 Electrical Overload

When tested as specified in Section 4.3.3.8., the performance after application of overload conditions, the test articles should meet the requirements of EN2591-210.

#### 4.3.2.5.6 Moisture Resistance (Humidity)

When tested as specified in Section 4.3.3.9, the mated connector halves should Perform per EN4165-001.

#### 4.3.2.5.7 Vibration

When tested as specified in Section 4.3.3.10, performance should be per EN4165-001. Upon test completion, shell to shell conductivity should be measured as per EN2591-101, EN2591-204 and EN2591-202.

### 4.3.2.6 Mechanical Shock

When tested as specified in Section 4.3.3.11, performance should be per EN4165-001. Upon test completion, shell to shell conductivity should be measured as per EN2591-101 and EN2591-204.

#### 4.3.2.6.1 Durability

When tested as specified in Section 4.3.3.4, connectors should show no damage detrimental to the operation of the connector and should meet the contact resistance requirements of Section 4.3.2.3.1 after the completion of 500 cycles of engagement and separation.

#### 4.3.2.6.2 Temperature Life

When tested as specified in Section 4.3.3.12, the connector should meet the performance requirements of the remaining test sequence per EN4165-001.

#### 4.3.2.6.3 Salt Spray (Corrosion)

When tested as specified in Section 4.3.3.13, unmated connectors and contacts should show no damage due to corrosion, which will adversely affect the electrical and/or mechanical integrity per EN4165-001.

#### 4.3.2.6.4 Insert Retention

When tested as specified in Section 4.3.3.14, the connector insert should retain its normal position in the connector shell for the specified load. A displacement of the insert should not exceed 0.0295 inches (0.75 mm) during testing and 0.0118 inches (0.3 mm) after the application of load. Only the receptacle side shall be tested, or whichever side contains the socket insert assembly.

#### 4.3.2.6.5 Seal Leakage – Altitude Immersion

When tested in accordance with Section 4.3.3.15, the wired mated pair of connectors should meet the insulation resistance and dielectric withstanding voltage requirements in Sections 4.3.3.5.1 and 4.3.3.6 (sea level) after being subjected to an altitude of 50,000 feet (15,240 meters) or (12.1 kPa).

#### 4.3.2.6.6 Fluid Immersion

A plug and receptacle shell should be tested as an assembly in accordance with Section 4.3.3.16. Both connector halves should be capable of being mated and unmated. Any evidence of cracking, loosening of parts, or missing parts should be cause for rejection. Insulation resistance should meet the requirements of Section 4.3.2.5.2 (not applicable to conductive fluids). Coupling forces should be as specified in Section 4.3.2.4.1.

#### 4.3.2.6.7 Shell to Shell Continuity

When tested in accordance with Section 4.3.3.17, the maximum resistance between the shells of the connector pair shown in Figure 4-19 should not exceed those values specified in Table 4-XX~~41~~.

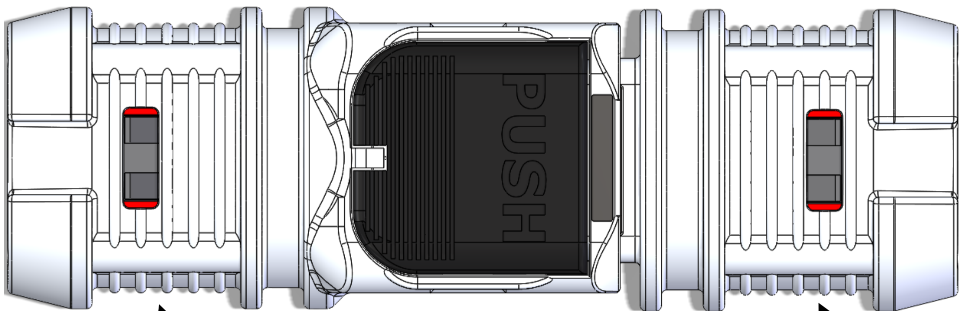



Figure 4-19 – Illustration of Maximum Resistance Between Shells of Connector Pair

Table 4-41 Conductivity Values

| Max Resistance | Initial | After Test |
|---|---|---|
| Plug to Receptacle Shell | 12 mΩ | 24 mΩ |

#### 4.3.2.6.8 Resistance to Indirect Lightning Strikes

The mated plug and receptacle shells should be tested as specified in Section 4.3.3.18 for the ability to conduct indirect lightning currents through the metallic finish without damaging the base materials or causing the metallized finish from blistering or charring.

#### 4.3.2.6.9 Shielding Effectiveness from 150 MHz to 10 GHz (EIA-364-66A)

The mated plug and receptacle shells should be tested as specified in Section 4.3.3.18.1 to measure the shielding effectiveness.

The mated pair of shielded connector shells shall be subject to the defined frequencies and measured for their attenuation to the limits specified in Table 4-42.

Table 4-42 – EMI Shielding Effectiveness

| Frequency MHz | Minimum Attenuation (dB) |
|---|---|
| 150 | 65 |
| 200 | 60 |
| 300 | 55 |
| 400 | 55 |
| 800 | 45 |
| 1000 | 43 |
| 1500 | 40 |
| 2000 | 37 |

| Frequency MHz | Minimum Attenuation (dB) |
|---|---|
| 3000 | 35 |
| 4000 | 33 |
| 6000 | 30 |
| 10000 | 20 |

#### 4.3.2.6.10 Plating Adhesion

The plating, metallization process, should be tested in accordance with Section 4.3.3.19 to check the good adhesion of metallic coatings to the base thermoplastic or thermoset materials.

#### 4.3.2.6.11 Temperature Cycling – Rapid Change of Temperature

When tested as specified in Section 4.3.3.20, the wired mated connector assembly should show no evidence of blistering, peeling, or separation of plating or other damage detrimental to the operation of the connector per EN4165-001.

#### 4.3.2.6.12 Maintenance Ageing

When tested as specified in Section 4.3.3.21, contacts should show no damage detrimental to product performance after the completion of 10 cycles of insertion and extraction.

#### 4.3.2.6.13 Contact Insertion and Extraction Forces

When tested as specified in Section 4.3.3.22, the insertion and extraction forces should not exceed the forces in Table 4-43.

Table 4-43 – Insertion and Extraction Forces

| Contact Size | Maximum Force (N) | | Number of Tested Contacts |
|---|---|---|---|
| | Insertion | Extraction | |
| 22 | 10 | 10 | 50% |

#### 4.3.2.6.14 Durability of Contact Retention System and Seals

When tested as specified in Section 4.3.3.23, there must be no evidence of damage to the contacts and associated seals after the completion of 10 cycles of insertion and extraction.

#### 4.3.2.6.15 Contact Retention

When tested as specified in Section 4.3.3.24, the performance should be per EN4165-001. At the completion of the test, the contact should be able to be removed using the contact removal tool.

#### 4.3.2.6.16 Use of Tools

When tested as specified in Section 4.3.3.25, the use of tools should be to applicable circular cavities.

#### 4.3.2.6.17 Visual Examination

Unmated connectors should be visually inspected without magnification under suitable conditions for viewing. This inspection should be conducted according to EN2591-101 or and should mainly focus on the general aspect of the parts and on the marking.

#### 4.3.2.6.18 Examination of Dimensions and Mass

The plug, receptacle, and connector accessories should be dimensionally conformed to the part interfaces defined in Appendix F. The mass of each part should be measured to ensure the maximum part weights do not exceed the weights defined in Appendix F, Table F-1.

#### 4.3.2.6.19 Contact Retention System Effectiveness

When tested in accordance with section 4.3.3.28 and per EN2591-426, the following forces shall be applied to the contact;

Table 4-44 – Contact Retention Effectiveness Forces

| Contact Size | Force (N) |
|---|---|
| 22 | 13 |
| 20 | 13 |

#### 4.3.2.6.20 Sand and Dust

When tested in accordance with Section 4.3.3.29 and per EN2591-308, section 4, the connector pair should have no signs of excessive plating degradation that would adversely affect performance. For other criteria see Visual Examination (EN2591-101).

#### 4.3.2.6.21 Contact Protection Effectiveness – Scoop-Proof

When tested in accordance with Section 4.3.3.30 and per EN2591-505, Section 4.1, Figure 1, no interference shall be observed between the housing (shell) and the contacts.

#### 4.3.2.6.22 Pin Contact Stability

When tested in accordance with Section 4.3.3.31 and per EN2591-419, Section 5.2, Figure 1 and Per EN4165, Section 10.2, Figure 37 – the performance should be per EN4165-001.

#### 4.3.2.6.23 Ingress Protection – IPX7

The purpose of this test is to ensure that the mated connector pair is sealed against the ingress of water when immersed at a depth of 1 m for 30 minutes (IPX7 Rating).

When testing in accordance with Section 4.3.3.32 and per IEC60529, the specimens shall be subjected to the following tests:

- Measurement of insulation resistance, mated (EN2591-206)
- Voltage proof test, mated (EN2591-207)
- Visual examination (EN2591-101)

#### 4.3.2.6.24 External Bending Moment

When tested in accordance with Section 4.3.3.33 and per EN2591-404, there should be no discontinuity greater than 1 µs, and the specimen shall be subjected to visual inspection per EN2591-101.

#### 4.3.2.6.25 Surface Transfer Impedance (EIA-364-80)

To measure shielding transfer impedance of mated cable connectors in the frequency range; 10 kHz to 100 MHz.

When tested in accordance with Section 4.3.3.18.2, the measured impedance results shall be less than those stated for the given frequencies in Table 4-45.

Table 4-45 – Low Frequency Transfer Impedance Values

| 1 kHz | 1 MHz | 10 MHz | 100 MHz |
|---|---|---|---|
| 5 mΩ | 10 mΩ | 20 mΩ | 150 mΩ |

#### 4.3.2.6.26 Fan Blade 'Off' Qualification Procedure (GVII-GER-1264)

To assess the capability of elements of connection to withstand vibration environment associated with wind milling conditions due to sustained engine imbalance. Additionally, to determine the ability to withstand the high-power imbalance condition of a partial blade loss.

Test samples shall be tested in accordance with Section 4.3.3.34.

During the test, the specimen shall be monitored for electrical discontinuities as per EN2591-204 with no discontinuities exceeding 1 μs.

Once the test has been completed, the specimens shall be tested for insulation resistance (EN2591-206 5000MR), voltage proof (EN2591-207 Sea level) and visual inspection (EN2591-101).

### 4.3.3 Verification Test Procedures for 3, 6, and 9-Way Connectors

#### 4.3.3.1 Flammability

Connectors are to be tested per EN2591-317.

#### 4.3.3.2 Contact Resistance

#### 4.3.3.2.1 Contact Resistance at Rated Current

The electrical resistance should be measured in accordance with EN2591-202 with the exception that the connectors should be exposed to the maximum operating temperature of 347 ±5 °F (175 ±3 °C) for a minimum of 30 minutes prior to measurement. Measurements should be made while the connectors are in the chamber at the specified temperature. The contact resistance values should be in accordance with Section 4.3.2.3.1.

#### 4.3.3.2.2 Low Level Contact Resistance

The specimen shall not be unmated while the measuring voltage is applied. During the measurements, care shall be taken to avoid movement of the test cables in order to eliminate stresses on the contacts. The resistance of the cable or wire used shall be subtracted from the measured value. The corrected value shall be recorded. The measurement shall be made three times in each direction of current. The value retained is the average of the three cycles (i.e., six measurements). 5.4 Requirement. The mean value and the value of each measurement shall not exceed the values specified in EN4165-001.

#### 4.3.3.3 Coupling Forces

The plug should be mated to the receptacle shell. Force should be applied to the rear of the plug as shown in Figure 4-20. Ref. EN2591-408. The force that is required to fully engage the plug to the receptacle should be measured. The mating force should not exceed those values specified in Table TBD. Push button engagement force not to exceed those stated in Table TBD.

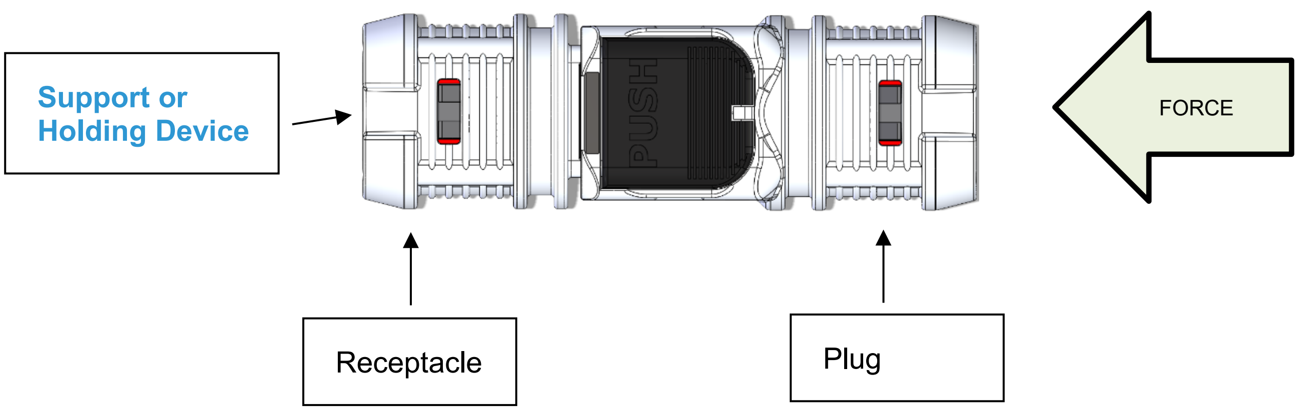



Figure 4-20 – Illustration of Applied Force

#### 4.3.3.4 Mechanical Durability

Connectors to be tested in accordance with EN2591-406.

#### 4.3.3.5 Insulation Resistance

##### 4.3.3.5.1 Insulation Resistance (Ambient Temperature)

Connector assemblies should be tested in accordance with EN 2591-206, Test Method A. The magnitude of the test voltage should be 500 Vdc. The insulation resistance of wired, unmated, sealed connectors should be in accordance with section 4.3.2.5.2, when measured separately between any pair of adjacent contacts, and between the shell and any contact.

##### 4.3.3.5.2 Insulation Resistance (Elevated Temperature)

The insulation resistance should be measured on mated connector assemblies as per 4.3.3.5.1. with the exception that the connectors should be exposed to the maximum operating temperature of 347 ±5 °F (175 ±3 °C) for a minimum of 30 minutes prior to measurement. Measurements should be made while the connectors are in the chamber at the specified temperature. The insulation resistance values should be in accordance with Section 4.3.2.5.3.

#### 4.3.3.6 Dielectric Withstanding Voltage (DWV)

Mated and unmated connector assemblies should be tested in accordance with EN 2591-207, Test Method A. The following details should apply:

1. Points of Application – The test voltage should be applied between the contact under test and the closest adjacent contacts and between the shell and the contact under test. The same contact locations for a given assembly should be used each time the test is performed. Individual ends of terminated wires should be insulated or physically separated during the test to prevent flashover.

#### 4.3.3.7 Dielectric Withstanding Voltage (DWV), Altitude

Mated connector assemblies should be tested in accordance with EN 2591-207.

#### 4.3.3.8 Electrical Overload

The contacts mounted to the insert should be subjected to the electrical overload test per EN2591 210. Inserts are mounted to connector shells and tested in the mated condition. Contacts of the same size should be wired in series. The electrical overload conditions, as specified in EN4165-001, should be applied for each different contact size.

#### 4.3.3.9 Moisture Resistance (Humidity)

Wired, mated connectors should be subjected to the humidity test specified in EN 2591-321 for two full cycles.

#### 4.3.3.10 Vibration

The mounting configuration per EN2591-402 should be tested as an assembly. The assembly should be vibrated along the three mutually perpendicular axes. The connector should be tested per EN2591-403 and be subjected to the following vibration:

1. Method B (random): Figure 3, Table 2, Level E, 8 hours per axis, ambient temperature.

#### 4.3.3.11 Mechanical Shock

The full connector assembly, populated with wired contacts and mounted via the zip tie feature of the plug shell, should be tested as an assembly. The assembly should withstand the shock pulse defined in EN 2591-402, Method A, Severity 100. The test is performed using the same electro dynamic shaker and test fixture as the vibration test.

#### 4.3.3.12 Temperature Life

The connectors should be fully assembled and mated. All the contacts should be properly wired using the wire type defined in Section 4.3.4.2.2. Mated connector assemblies should be tested in accordance with EN2591-301, Method B, 347 °F (175 °C).

#### 4.3.3.13 Salt Spray (Corrosion)

Wired unmated connectors should be subjected to a Salt Spray test per EN2591-307. Subjected to 50 cycles of mating and unmating at a rate of five cycles/minute. Then;

- Exposed to salt mist:
  - Mated for 96 hours
- Subjected to 200 mating and unmating cycles at the rate of five cycles/minute

#### 4.3.3.13.1 Insert Stability and Retention

The insert should be subjected to the insert retention test as per EN2591-410 with an ultimate test load as specified in Table 4-46.

Table 4-46 – Insert Retention Forces

| Connector Style | Force (N) |
|---|---|
| Size 3, 3-Way | 20.2 |
| Size 6, 6-Way | 44.9 |
| Size 9, 9-Way | 69.7 |

The load should be applied to the front of the insert which is installed in the connector shell. Displacement of the insert should be measured under load. The displacement should not exceed the values specified in Section 4.3.2.5.12.

#### 4.3.3.14 Seal Leakage – Altitude Immersion

The wired mated pair of connectors should be subjected to the altitude immersion test in accordance with EN2591-314, with the following exceptions:

1. The connector assembly should be subjected to three cycles.
2. The pressure in the chamber should be reduced to an equivalent altitude of 12.1 kPa.

After the third cycle and while the specimens are still immersed, they should be subjected to the following test sequence:

- Insulation Resistance per Section 4.3.3.5.1.
- Dielectric Withstanding Voltage (sea level) per Section 4.3.3.6.

The test parts should then be removed from the salt solution, drained, carefully unmated, and be visually inspected with particular attention to saltwater ingress and the condition of the seals.

#### 4.3.3.15 Fluid Immersion

Inserts should be wired and installed in the connector shells. The wire should be the minimum size outer diameter for which the Shielded Small Form Factor connector range was designed. The test should be performed in accordance with EN2591-315 using the fluids defined in Table 4-46.

Table 4-47 – List of Test Fluids

| Fluid Category | Fluid Reference See EN 3909 | Immersion | | Stoving Temp. (°C) | Number Of Cycles |
|---|---|---|---|---|---|
| | | Duration (Minutes) | Temp. (°C) | | |
| Fuel | 2 | 5 +2/-0 | 25 | 85 | 7 |
| Mineral hydraulic fluid | 5 | 15 +5/-0 | 85 | 100 | 5 |
| Synthetic hydraulic fluid | 3 | 15 +5/-0 | 85 | 100 | 5 |
| Mineral lubricant | 7 | 15 +5/-0 | 120 | 125 | 5 |
| Synthetic lubricant | 9 | 15 +5/-0 | 150 | 125 | 5 |
| Cleaning products | 11 | 15 +5/-0 | 25 | 25 | 5 |
| | 12 | | | | 5 |
| | 13 | 5 +2/-0 | | | 2 |
| De-icing fluid | 15 | 15 +5/-0 | 50 | 100 | 5 |
| Extinguishing fluid | 17 | 15 +5/-0 | 15 | 25 | 5 |
| Cooling fluid | 19 | 15 +5/-0 | 50 | 25 | 5 |
| Solvent for cleaning purposes | - | 5 +2/-0 | 23 | N/A | 5 |
| Insecticide | - | 5 +2/-0 | 23 | N/A | 7 |

### 4.3.3.16 Shell to Shell Continuity

**Mated connector assemblies should be tested in accordance with EN2591-205. A direct current of 1.0 ±0.1 ampere at 1.5 Volts dc should be caused to flow through the shells of the mated assembly. Using the voltmeter–ammeter method, measure the voltage drop between the rear of the plug shell and the rear or the receptacle. The resulting resistance, calculated using the measured voltage drop and the specific current, should be in accordance with Table 4-38. For the shell to shell continuity, the measurements should be made between the rear ends of housings (shells) with spherical end probes.**

### 4.3.3.17 Resistance to Indirect Lightning Strikes

**The mated plug and receptacle shells should be tested as specified per EIA–364, Test Procedure 75, Type B Test Levels 1 (3.6kA). The parts should be visually inspected for any damage to the metallic plating. There should be no evidence of blistering or charring. The connector shell should also be inspected to ensure that the thermoplastic or thermoset material was not damaged by the thermal energy developed during testing.**

#### 4.3.3.17.1 Shielding Effectiveness from 150 MHz to 10 GHz (EIA-364-66A)

**Test samples per EIA-364-66A. Measured attenuation results before and after test should not exceed those values defined in Section 4.3.2.5.17.**

**The test procedure is described in EIA-364-66A with the exception that the equipment used is capable of testing down to a frequency of 150 MHz, meaning the test will be carried out beyond the limits of the specification.**

#### 4.3.3.17.2 Surface Transfer Impedance (EIA-364-80)

**Test Samples per EIA-364-80. Measured impedance results before and after test should not exceed those values defined in Section 4.3.2.5.33.**

The test specimens shall be void of contacts.

The test specimen shall be installed into the chamber as per EIA-364-80, Sections 2 and 3, Method A.

#### 4.3.3.18 Plating Adhesion

Test in accordance with ASTM B 571, paragraph 13.0 (Scribe–Grid Test Procedure) to verify that the coating should not show separation from the substrate. The tool used to scribe the plating should be per paragraph 13.1 of ASTM B 571 (no chisel or other tool type). The tool should be used to scribe parallel lines in the plating with a spacing of 0.078 in (2 mm). EN ISO 2409 is a potential alternative test method. The test has to be performed on representative coupons 0.059 x 2.36 x 0.98 in (1.5 x 60 x 25 mm) minimum.

#### 4.3.3.19 Temperature Cycling – Rapid Change of Temperature

Wired, mated connector assemblies should be tested in accordance with EN2591-305. Ten cycles should be performed.

#### 4.3.3.20 Maintenance Ageing

The contact should be subjected to 10 cycles of being inserted and extracted from the insert using the insert extraction tool specified by the manufacturer. Per EN2591-407. At the completion of the insert durability test, the contact should pass the contact retention requirements specified in Section 4.3.2.5.20.

#### 4.3.3.21 Contact Insertion and Extraction Forces

The contacts mounted to the insert should be subjected to the contact retention and extraction test per EN2591-412. Insertion and extraction forces should be measured at the first and last insertion and extraction cycle. Cycles are defined in the test method. Measurements should be recorded for each contact size. The forces should not exceed the values specified in Section 4.3.2.5.21.

#### 4.3.3.22 Durability of Contact Retention System and Seals

The contact should be subjected to 10 cycles of being inserted and extracted from the insert using the insert extraction tool specified by the manufacturer. Per EN2591-412. At the completion of the insert durability test, the contact should pass the contact retention requirements specified in Section 4.3.2.5.22.

#### 4.3.3.23 Contact Retention

The contact should be subjected to a contact retention test per EN2591-409 and EN4165-001. At the completion of the contact retention test the contact should pass the requirements specified in Section 4.3.2.5.23.

#### 4.3.3.24 Use of Tools

The insertion and extraction tools should be used as described per test EN2591-506. If the applied tool is damaged during the test, it should be replaced, and the test should be finalized with a new one. The test report should indicate if a tool broke down. The applied force on the tool is specified is per EN4165-001.

#### 4.3.3.25 Visual Examination

Unmated connectors should be visually inspected without magnification under suitable conditions for viewing. This inspection should be conducted according to EN2591-101 or and should mainly focus on the general aspect of the parts and on the marking.

#### 4.3.3.26 Examination of Dimensions and Mass

The plug and receptacle should be dimensionally conformed to the part interfaces defined in Appendix F. The mass of each part should be measured to ensure the maximum part weights do not exceed the weights defined in Appendix F, Table F-1.

#### 4.3.3.27 Contact Retention System Effectiveness

Test contacts per EN2591-426, Section 5, Figure 1. When the forces are applied as defined in Table 4-42, the contact shall not become dislodged from its cavity.

The specimen shall be subjected to 100 rotations at 10-20 rpm in one direction. The initial orientation of the specimen shall remain unchanged during the test.

#### 4.3.3.28 Sand and Dust

The mated connectors shall be arranged so that their longitudinal axis is parallel to the wind direction, with the rear of the plug facing into the wind. The test apparatus shall be setup in accordance with EN2591-308, Section 4.

The test article shall be tested for one cycle lasting three hours per EN2591-308 and EN4165-001.

#### 4.3.3.29 Contact Protection Effectiveness – Scoop Proof

The test specimens shall be assembled per section 4.3.4.2.2 and shall be in an unmated condition. No tooling will be required, the test only requires visual observation. A receptacle fitted with female contacts (sockets) shall be presented on a plug fitted with male contacts (pins) at the most unfavorable angles per EN2591-505, Section 4.1, Figure 1. Only test per Phase A.

#### 4.3.3.30 Pin Contact Stability

The test specimens shall be assembled per section 4.3.4.2.2 and shall be in an unmated condition. Only the pin variant shall be tested. Using an appropriate test fixture to attach the part to the table of a Tinius Olssen Tensometer or similar force gauge, attach horizontally so that the force gauge as specified in EN2591-419, Section 5.2, Figure 1 and EN4165-001, Section 10.2, Figure 37 can be applied to the pin contact. Select appropriate probe to apply force to gauge stated above.

##### 4.3.3.30.1 Ingress Protection – IPX7

A suitable vessel should be used such that the water can be contained to a height of at least 1 m. Immerse the test article mated connector pair in water to a depth of 1 m, ensuring the ends of the wires are above the surface of the water. The specimens shall remain submerged in the water for a period of 30 minutes and then subjected to the following inspection.

Once the test is complete and the specimens have been removed from the vessel, follow the test sequence described in Section 4.3.2.5.31.

#### 4.3.3.30.2 External Bending Moment

The test specimens shall be assembled per section 4.3.4.2.2, shall be in a mated condition and tested per EN2591-404.

#### 4.3.3.30.3 Fan Blade 'Off' Qualification Procedure (GVII-GER-1264)

The test specimens shall be fitted with contacts and wires. The test equipment shall adhere to the specifications laid out in GVIIGER-1264, Section 4, Zone 13.

The test procedure shall adhere to that which is specified in GVIIGER-1264, Section 5, Zone 13.

### 4.3.4 Quality Assurance Provisions

#### 4.3.4.1 Configuration Control

Connectors and other items qualified to this specification should be configuration controlled by suppliers listed as approved sources of supply on the applicable ARINC Standards. Supplier engineering drawings, process specifications, manufacturing, and quality plans should be baselined after qualification and maintained. Any changes to the connector shells, dust caps, or other items covered by this specification that would influence the intermateability, mechanical or electrical performance, or adversely impact the parts in meeting their intended function after baseline approval should be submitted to the approving authority for review and prior to implementation.

#### 4.3.4.2 Quality Conformance Test

The manufacturer is responsible for the performance of all qualification and acceptance tests specified herein. All inspection testing should be accomplished by an authorized inspector. Records of all inspection to meet requirements of this specification should be kept on file for two years (EN3042).

#### 4.3.4.2.1 Qualification Sampling and Definition of Specimens

Qualification specimens should be tested by the manufacturer in the quantities and specified in Table 5-48 for the full connector qualification.

Table 4-48 – Qualification Specimen Quantities for Full Qualification

Grouping and Specimen Table TBD

If connectors or inserts from other manufacturers having the same Part Number have been qualified and approved, six mated connector assemblies and insert arrangement from each manufacturer should be included.

#### 4.3.4.2.2 Qualification Test Specimen Configuration

This specification defines the design, construction, and performance requirements for the plug and receptacle.

The connectors should be wired with round cables free from any roughness likely to contribute to the penetration of humidity or liquid to the inside of the connector. The cables should conform to qualified cables for general use. Their length should be adjusted to the need of the tests.

### 4.3.4.3 Qualification Testing

#### 4.3.4.3.1 Qualification Tests – Test Groups

Table 1 - Table 4-47 – Sequences for Shielded Small Form Factor Connector Range (Group 1a)

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 1A<br>Visual examination | 101 | | 2 |
| Measurement of insulation resistance (unmated) | 206 | | " |
| Voltage proof test (mated) | 207 | | " |
| Voltage proof test (unmated | 207 | | " |
| Rapid change of temperature | 305 | 10 cycles, -55°C to +175°C | " |
| Measurement of insulation resistance (mated) | 206 | >5GΩ @500VDC | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |
| Random vibration | 403 | 50Hz-2kHz, $0.2g^2$/Hz PSD, 8h/axis | " |
| Shock | 402 | Half sine, 100g, 6ms | " |
| Visual examination | 101 | | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Humidity | 321 | 2 cycles | " |
| Measurement of insulation resistance (mated) | 206 | >100MΩ @500VDC | " |
| Visual examination | 101 | | " |
| Magnetic permeability | 513 | 2.0μ maximum | " |
| Engagement of contacts | 216 | 0.86mm engagement min. | " |
| Contact insertion and extraction forces | 412 | 50% minimum 6, 10N max force, 3 cycles | " |
| Push Button unmating force | 408 | 2.3N to 80N force on button to unlatch | " |

| | | | |
|---|---|---|---|
| Mating and unmating forces | 408 | Engage 60N max, disengage 39.5N max & 0.6N min | " |
| Visual examination | 101 | | " |

## Table 2 - Table 4-47 – Sequences for Shielded Small Form Factor Connector Range (Group 1b)

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 1B | | | |
| Visual examination | 101 | | 2 |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Rapid change of temperature | 305 | 10 cycles, -55°C to +175°C | " |
| Measurement of insulation resistance (mated) | 206 | >5GΩ @500VDC | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |
| Mechanical endurance | 406 | 50 matings | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |
| Immersion at low air pressure | 314 | 7.24kPa (60000ft) | " |
| Measurement of insulation resistance (mated) | 206 | >1GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |
| Insert retention in housing (axial) | 410 | Receptacles only, 69.7N load, post-test displacement 0.3mm max | " |
| Visual examination | 101 | | " |

## Table 3 - Table 4-47 – Sequences for Shielded Small Form Factor Connector Range (Group 2)

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 2<br>Fluid resistance | 315 | Fluids per Table 4-45 | 12 |
| Visual examination | 101 | | " |
| Measurement of insulation resistance (unmated) 9/ | 206 | >100MΩ @500VDC | " |
| Mating and unmating forces | 408 | Engage 60N max, disengage 39.5N max & 0.6N min | " |
| Push Button unmating force | 408 | 2.3N to 80N force on button | " |
| Contact retention in insert | 409 | 44N | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Mechanical endurance | 406 | 50 matings | " |
| Visual examination | 101 | | " |
| Contact resistance - low level | 201 | 10mA, 11mΩ maximum, 50% of contacts | " |
| Contact retention system effectiveness | 426 | 1 contact, 13N load, 100 rotations | " |
| Mating and unmating forces | 408 | Engage 60N max, disengage 39.5N max & 0.6N min | " |
| Push Button unmating force | 408 | 2.3N to 80N force on button | " |
| Insert retention in housing (axial) | 410 | Receptacles only, 69.7N load, post-test displacement 0.3mm max | " |
| Visual examination | 101 | | " |

## Table 4-52 – Sequences for Shielded Small Form Factor Connector Range – Group 3

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 3<br>Endurance at temperature | 301 | 175°c for 1000 hours | 2 |

## Table 4-53 – Sequences for Shielded Small Form Factor Connector Range – Group 4

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 4<br>Sand and dust | 308 | | 2 |
| Visual examination | 101 | | " |

## Table 4-54 – Sequences for Shielded Small Form Factor Connector Range – Group 5

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 5<br>Contact protection effectiveness (scoop-proof) | 505 | | 2 |
| Electrical overload | 210 | 8 cycles of 10A, 40 secs & 50A, 0.6 sec, all contacts in series | " |
| Contact resistance - rated current | 202 | 5A applied, 11mΩ maximum, all contacts | " |
| Measurement of insulation resistance (mated) | 206 | >5GΩ @500VDC | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |
| Contact resistance – Low level | 201 | 1A applied, 8mΩ maximum, all contacts | " |
| Pin contact stability | 419 | 1.2N load, total deflection 0.76mm max | " |
| Use of tools | 506 | 13N load, 4 cycles | " |
| Visual examination | 101 | | " |

| | | | |
|---|---|---|---|
| Contact retention in insert | 409 | 44N axial load, all contacts | " |
| Contact resistance – Low level | 201 | 1A applied, 8mΩ maximum, all contacts | " |
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | " |
| Ingress protection | (IPX7) | 1 meter immersion, 30 minutes | " |
| Measurement of insulation resistance (mated) | 206 | >500MΩ @500VDC | " |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | " |
| Visual examination | 101 | | " |

## Table 4-55 – Sequences for Shielded Small Form Factor Connector Range – Group 6

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement (mated pairs) |
|---|---|---|---|
| GROUP 6<br>External bending moment | 404 | 0.5Nm for 1 minute | 2 |
| Visual examination | 101 | | " |
| Durability of contact retention system and seals (maintenance ageing) | 407 | 6 contacts, 10 cycles | " |
| Contact insertion and extraction forces | 412 | 10N max. | " |
| Contact retention in insert | 409 | 44N axial load, 6 contacts | " |
| Visual examination | 101 | | " |

## Table 4-56 – Sequences for Shielded Small Form Factor Connector Range – Group 7

| Designation of Test | EN2591- | ARINC Specification 800, Part 2 Reference. | Test Cable Configuration |
|---|---|---|---|
| Test group sequence TBD. Will include – Shielding Effectiveness | | | |

## Table 4-57 – Sequences for Shielded Small Form Factor Connector Range – Group 8

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement |
|---|---|---|---|

| | | | (mated pairs) |
|---|---|---|---|
| GROUP 8<br><br>Shielding effectiveness from 150 MHz to 10 GHz | EIA-364-66A | | 2 |
| Surface transfer impedance | EIA-364-80 | 1KHz to 100MHz | " |
| Shell to shell electrical continuity | 205 | 12mΩ max | " |
| Visual examination | 101 | | " |

## Table 4-58 – Sequences for Shielded Small Form Factor Connector Range – Group 10

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement<br><br>(mated pairs) |
|---|---|---|---|
| GROUP 10<br><br>Shell to shell electrical continuity | 205 | 12mΩ max | 2 |
| Salt spray (dynamic test) | 307 | 25 matings, 96hrs salt mist, 25 matings | " |
| Visual examination | 101 | | " |
| Shell to shell electrical continuity | 205 | 24mΩ max | " |

## Table 4-58 – Sequences for Shielded Small Form Factor Connector Range – Group 12

| Designation of the test | EN 2591- | Remarks | Test Specimen Requirement<br><br>(mated pairs) |
|---|---|---|---|
| GROUP 12<br><br>Fan Blade 'Off' | GVII-GER-1264 | 1 sine sweep, Zone 13, 3 axes, | 2 |

| | | | |
|---|---|---|---|
| Measurement of insulation resistance (unmated) | 206 | >5GΩ @500VDC | “ |
| Voltage proof test (mated) | 207 | <2mA @1300V RMS | “ |
| Voltage proof test (unmated) | 207 | <2mA @1300V RMS | “ |
| Visual examination | 101 | | “ |

# 5.0 RECTANGULAR CONNECTORS

## 5.1 Connector, D-Sub

### 5.1.1 Introduction

The following subsections have been excerpted from ARINC Specification 628, Part 4A. Applicable references to this specification will be included in ARINC Specification 628, Part 4A. All future changes will be introduced in this specification.

### 5.1.2 Connector Referencing Scheme

The part reference scheme in Figure 5-1 should be used to define connector type and insert arrangement. This referencing scheme should not be used for purchasing components.

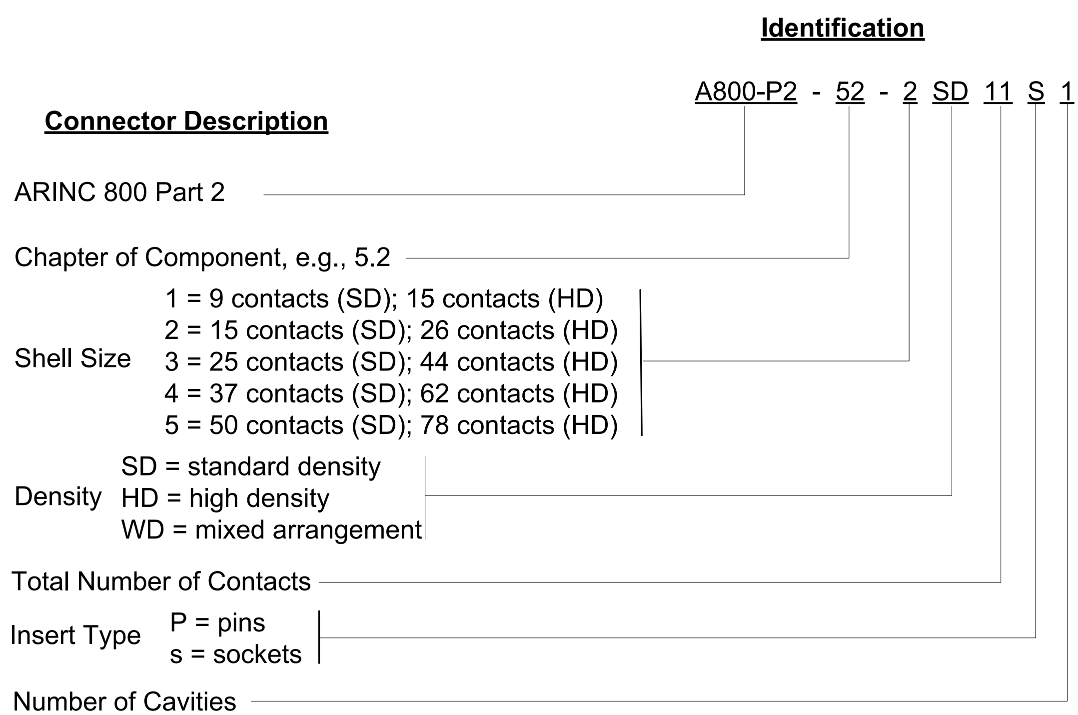



**Figure 5-1 – Connector Referencing Scheme**

### 5.1.3 Insert Arrangement(s) and Accessories

Insert arrangements are shown in Figure 5-2. Accessories are specified in Appendix D.

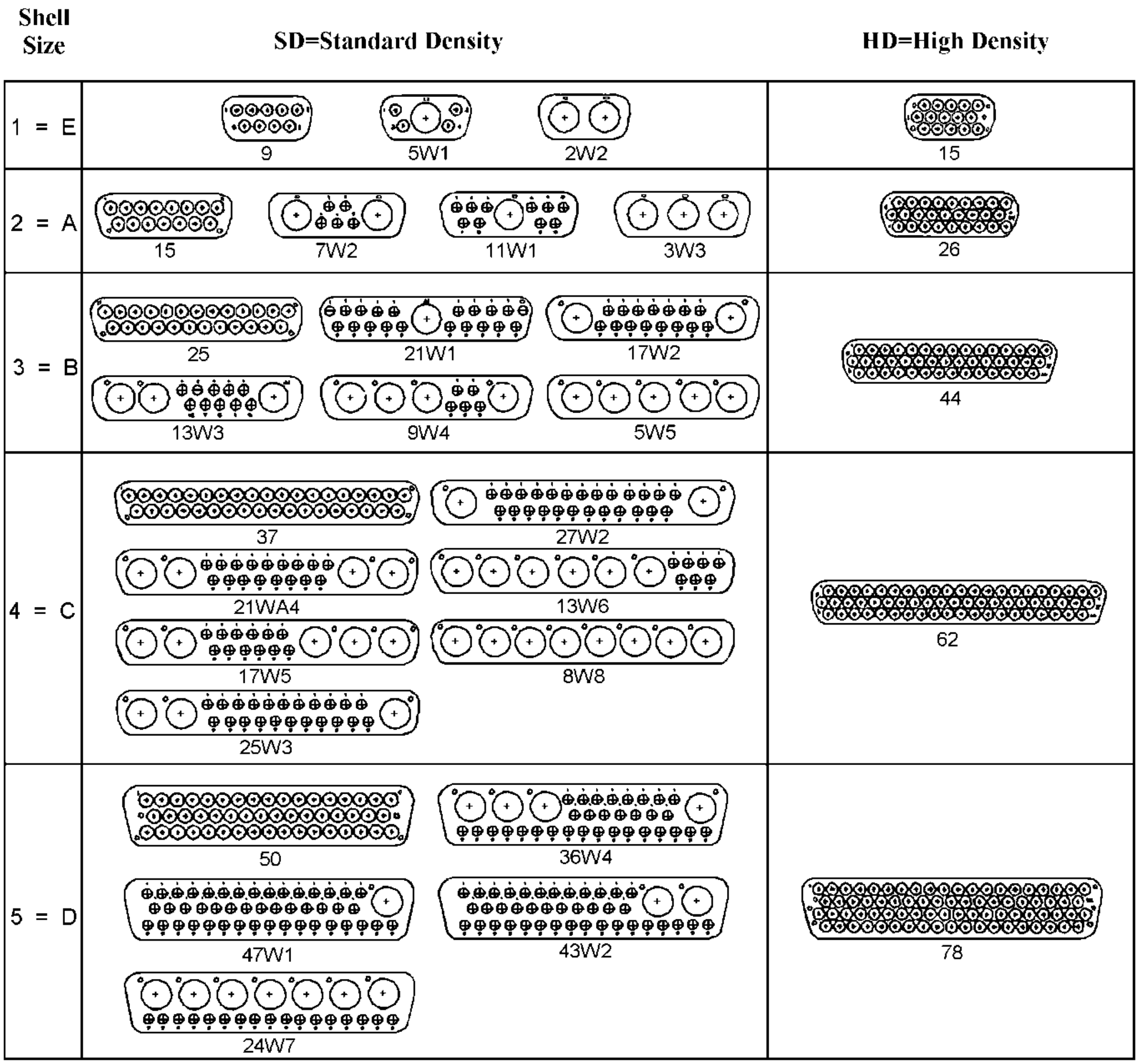



**Figure 5-2 – D-Sub Insert Arrangements, Standard and High Density**

# 6.0 CIRCULAR CONNECTORS

## 6.1 Connector, Receptacle, Thru-Bulkhead Mounting, D38999, Series III Style

### 6.1.1 Introduction

#### 6.1.1.1 Objectives

This section is intended to provide standardization of a thru-bulkhead receptacle connectors utilizing MIL-DTL-38999, Series III mating interface for bulkhead applications in commercial aircraft. Connectors are used for pressure tight electrical connections from pressurized to unpressurized areas. The connectors are designed for general use applications where the temperature extremes do not exceed -67 °F to +347 °F (-55 °C to +175 °C) and thru-bulkhead helium leak rate of $6x10^{-9}$ $in^3$/sec ($1x10^{-7}$ $cm^3$/sec) is required.

#### 6.1.1.2 Scope

This specification defines the physical dimensions of the thru-bulkhead mounting connector to ensure interchangeability, pertinent characteristics necessary for design, and performance requirements necessary for qualifying the product for use in unpressurized areas of commercial aircraft.

#### 6.1.1.3 Organization of this Specification

Section 6.1.1 introduces the objective and scope of this specification.

Section 6.1.2 provides the guidelines for the expected general requirements and physical characteristics of the connectors. These include materials and construction criteria.

Section 6.1.3 addresses qualification testing.

#### 6.1.1.4 Connector Referencing Scheme

The component reference scheme in Figure 6-1 should be used to define connector size and insert arrangement. This referencing scheme should not be used for purchasing of components.

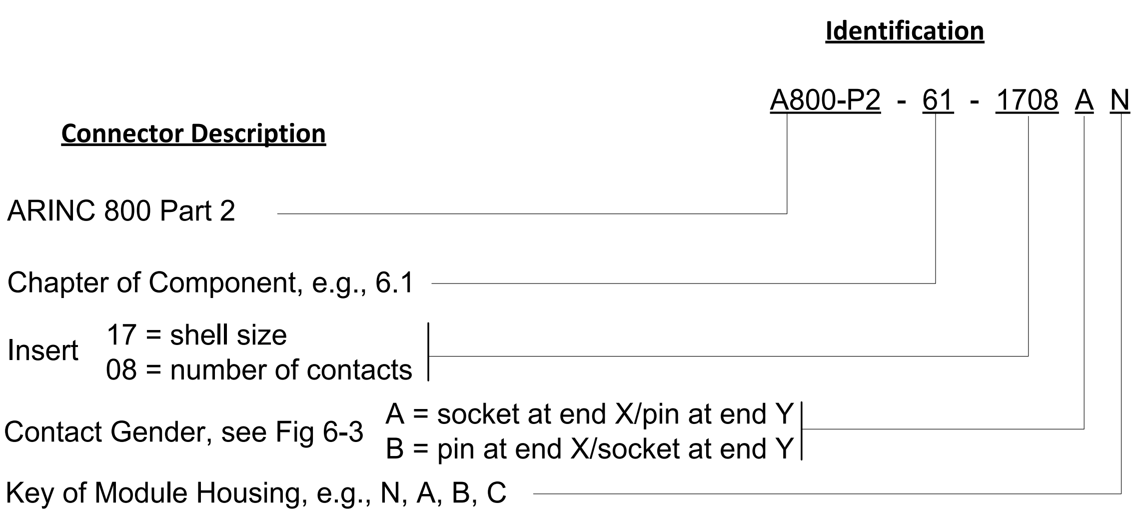



**Figure 6-1 – Connector Referencing Scheme**

### 6.1.2 Requirements

#### 6.1.2.1 Performance

The performance of individual items should be as specified herein and in applicable figures and tables.

#### 6.1.2.2 General Requirements

In case of conflicts with this specification and other documents, the guidelines of this specification should be used. The items furnished under this specification should be capable of passing the performance verification test specified herein. Unless otherwise specified, ambient temperature is 73.4 ±9 ºF (23 ±5 ºC).

##### 6.1.2.2.1 Mateability

Enough dimensional information concerning the connector design is provided herein to ensure that all products from various manufacturers will be intermateable with each other. It is the responsibility of each manufacturer to perform a tolerance analysis of their design to ensure that it will mate to any appropriate connector that is within specification tolerances.

##### 6.1.2.2.2 Configuration Interface

Connector interface dimensions should conform to MIL-DTL-38999 and appropriate slash sheets. For all other dimensions and configurations refer to Figure 6-3.

##### 6.1.2.2.3 Connector Mounting

The mounting of the connector should be at the discretion of the system supplier and/or the airframe manufacturer. The assembly of the connector to the structure is shown in Figure 6-2. If a conductive bonding path is required via the connector shell to the structure, the mounting area on the structure should be conductive. Bonding of the connector is realized when the connector is torqued so that the gasket ring is compressed and the connector flange is in contact with the conductive structure.

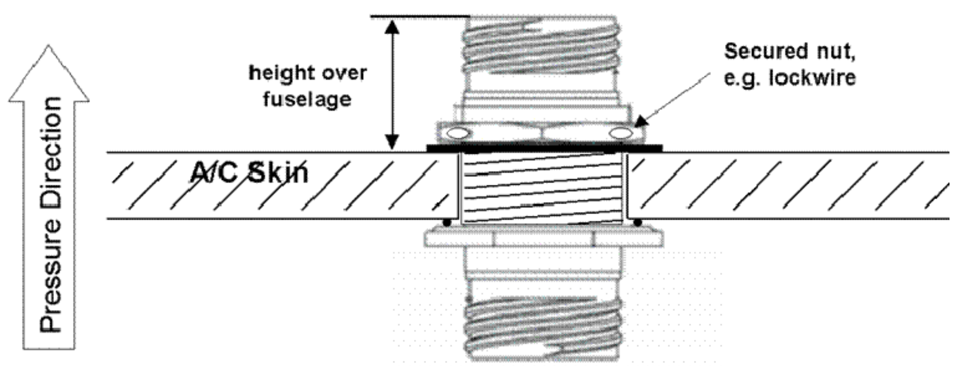



**Figure 6-2 – Connector Mounting Principle**

##### 6.1.2.2.4 Contacts

Contacts should be non-removable and should meet the 39029 mating end dimensional requirements and the location in accordance with MIL-DTL-38999.

### 6.1.2.2.5 Materials

Materials should be as specified herein. If materials other than those specified are used, the supplier should ensure that the substitute material enables the connectors to meet the requirements of this specification. Acceptance or approval of any constituent material should not be construed as a guaranty of acceptance of the product. When a definite material is not specified, a material should be used which will enable the connector to meet the requirements of this specification.

### 6.1.2.2.6 Components

Materials for specific components of the connector should be as follows:

| | |
|---|---|
| a. Shell | Corrosion resistant steel, passivated |
| b. Insert | Reinforced epoxy resin, other suitable rigid dielectric material or glass |
| c. Elastomeric Seal | Silicone or fluorosilicone elastomer |
| d. Jam Nut | Corrosion resistant steel, passivated |
| e. Contacts | Gold over nickel plated copper alloy or nickel-iron alloy for pin side and copper alloy for the socket side |

### 6.1.2.2.7 Recommended Panel Cutout Dimensions

Recommended panel cutout dimensions should conform to MIL-DTL-38999 and are shown in Figure 6-5.

### 6.1.2.2.8 Fungus Resistance

Materials used in the construction of these connectors should be fungus inert.

### 6.1.2.3 Temperature Cycling

When tested as specified in Section 6.1.3.3, there should be no blistering, peeling, or separation of plating or other damage detrimental to the operation of the connector.

### 6.1.2.4 Air Leakage

When tested as specified in Section 6.1.3.4, there should be no evidence of leakage in excess of $1 \times 10^{-7}$ $cm^3$/sec.

### 6.1.2.5 Coupling Torque

When tested as specified in Section 6.1.3.5, the coupling torque for mating and unmating of the counterpart connectors should meet the requirements in Table 6-3.

### 6.1.2.6 Durability

When tested as specified in Section 6.1.3.6, the connectors should show no defects detrimental to the operation of the connectors.

### 6.1.2.7 Insulation Resistance

### 6.1.2.7.1 Insulation Resistance at Ambient Temperature

When tested as specified in Section 6.1.3.7.1, the Insulation Resistance (IR) between any pair of contacts and between any contact and the shell should be greater than 5,000 mΩ. Insulation resistance after humidity should be 100 mΩ minimum.

### 6.1.2.7.2 Insulation Resistance at Elevated Temperature

When tested as specified in Section 6.1.3.7.2, the insulation resistance between any pair of contacts and between any contact and the shell should be greater than 200 mΩ.

### 6.1.2.8 Dielectric Withstanding Voltage

When tested as specified in Sections 6.1.3.8, the maximum leakage current should be 2 milliamperes, and there should be no evidence of electric breakdown or flashover.

### 6.1.2.9 Salt Spray (Corrosion)

When tested as specified in Section 6.1.3.9, unmated connectors should show no lifting of plated coating or exposure of basis material under three power (3X) magnification which adversely affects performance when evaluated in accordance with EIA-364-26 or EN60068-2-11.

### 6.1.2.10 Contact Resistance

When tested as specified in Section 6.1.3.10, contacts in the mated condition should meet the contact resistance requirements in Table 6-4. Appropriate compensation may be made for resistance in the measured value which is due to and additional length of wire included in the measurement.

### 6.1.2.11 Vibration

When tested as specified in Section 6.1.3.11, there should be no electrical discontinuity and there should be no disengagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking, or loosening of parts.

### 6.1.2.12 Shock

When tested as specified in Section 6.1.3.12, there should be no electrical discontinuity and there should be no disengagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking, or loosening of parts.

### 6.1.2.13 Shell to Shell Continuity

When tested as specified in Section 6.1.3.13, the maximum resistance between the shells of the connector pair should be 10 mΩ. Probes should not puncture or otherwise damage the connector finish.

### 6.1.2.14 Braid to Shell Continuity

When tested as specified in Section 6.1.3.15, the maximum resistance between the mated assemblies should be 20 mΩ. Probes should not puncture or otherwise damage the connector finish.

### 6.1.2.15 Humidity

When tested as specified in Section 6.1.3.15, wired, mated connectors should show no deterioration which will adversely affect performance of the connector. During the final cycle, insulation resistance should be 100 mΩ or greater.

### 6.1.2.16 Ozone Exposure

When tested as specified in Section 6.1.3.16, connectors should show no evidence of cracking of dielectric material or other damage due to ozone exposure that will adversely affect performance.

### 6.1.2.17 Fluid Immersion

When tested as specified in Section 6.1.3.17, connectors should meet the requirements for coupling torque and dielectric withstanding voltage.

### 6.1.2.18 Resistance to Indirect Lightning Strike

When tested as specified in Section 6.1.3.18, wired and mated connectors should meet braid shield braid-to-shell conductivity, coupling and uncoupling torque, insulation resistance at ambient temperature, and dielectric withstanding voltage at sea level. Connectors should show no damage or degradation in the finish or base material that would affect subsequent use. Damage or hardening of sealing members affecting sealing should be considered a failure.

### 6.1.3 Qualification

For qualification responsibilities refer to ARINC Specification 800, Part 1, Section 7.0.

### 6.1.3.1 Qualification Test Matrix

Portions of the Qualification Test Matrix shown in Table 6-2, including performance requirements and test procedures, have been extracted from MIL-DTL-38999. The following test groups of this document closely mimic those in MIL-DTL-38999 as follows:

| | |
|---|---|
| Group 1 (This Document) | Group 3 (MIL-DTL-38999) |
| Group 2 (This Document) | Group 5 (MIL-DTL-38999) |
| Group 3 (This Document) | Group 14 (MIL-DTL-38999) |

The thru-bulkhead connectors described in this document should meet the applicable requirements specified in the Qualification Test Matrix below. The last column of the matrix contains the Approval Method that may be employed to satisfy the corresponding requirements. Any requirement that has a corresponding method of “Test” should be physically tested as part of the qualification test. Any requirement that has a corresponding method of “Analysis” may be qualified through engineering analysis that may include but is not limited to similarity to an existing MIL-DTL-38999 qualified product.

### 6.1.3.2 Qualification Samples and Definition

Qualification samples should be tested by the manufacturer in the quantities specified in Table 6-1.

The qualification test aids (e.g., mating connectors, cables, etc.) should be qualified products listed by SAE-MIL or AECMA-CERT. Test aids are chosen with a similar or higher classification to the tested component.

## Table 6-1 – Qualification Samples

| Test Group # | QTY | Comments |
|---|---|---|
| 1 | 1 | Complete Assembly – 1 Thru-Bulkhead Receptacle, 2 Mating Plugs |
| 2 | 1 | 10 Thru-Bulkhead Receptacles |
| 3 | 1 | Complete Assembly – 1 Thru-Bulkhead Receptacle, 2 Mating Plugs |
| 4 | 1 | 1 Thru-Bulkhead Receptacle, 1 Mating Plug, 1 Sealed Cover |
| 5 | 3 | Thru-Bulkhead Receptacles |
| 6 | 3 | Material test coupons |

## Table 6-2 – Qualification Test Sequences

| Test Group 1 | Requirement | Procedure | EN 2591 Ref | Approval Method |
|---|---|---|---|---|
| Temperature Cycling | Section 6.1.2.3 | Section 6.1.3.3 | 305 | Test |
| Air Leakage | Section 6.1.2.4 | Section 6.1.3.4 | 307 | Test |
| IR at Elevated Temperature | Section 6.1.2.7.2 | Section 6.1.3.7.2 | 206 | Test |
| Durability | Section 6.1.2.6 | Section 6.1.3.6 | 406 | Analysis |
| Coupling Torque | Section 6.1.2.5 | Section 6.1.3.5 | 408 | Analysis |
| Vibration | Section 6.1.2.11 | Section 6.1.3.11 | 403 | Test |
| Standard Shock | Section 6.1.2.12 | Section 6.1.3.12 | 402 | Test |
| IR at Ambient Temperature | Section 6.1.2.7.1 | Section 6.1.3.7.1 | 206 | Test |
| DWV at Sea Level | Section 6.1.2.8 | Section 6.1.3.8 | 207 | Test |
| Humidity | Section 6.1.3.15 | Section 6.1.3.15 | NA | Test |
| IR at Ambient Temperature | Section 6.1.2.7.1 | Section 6.1.3.7.1 | 206 | Test |
| DWV at Sea Level | Section 6.1.2.8 | Section 6.1.3.8 | 207 | Test |
| Contact Resistance | Section 6.1.2.10 | Section 6.1.3.10 | 202 | Test |

## Table 6-2 – Qualification Test Sequences – Continued

| Test Group 2 | Requirement | Procedure | EN 2591 Ref | Approval Method |
|---|---|---|---|---|
| Ozone Exposure | Section 6.1.3.16 | Section 6.1.3.16 | 316 | Analysis |
| IR at Ambient Temperature | Section 6.1.2.7.1 | Section 6.1.3.7.1 | 206 | Analysis |
| DWV at Sea Level | Section 6.1.2.8 | Section 6.1.3.8 | 207 | Analysis |
| Fluid Immersion | Section 6.1.3.17 | Section 6.1.3.17 | 315 | Analysis |
| DWV at Sea Level | Section 6.1.2.8 | Section 6.1.3.8 | 207 | Analysis |
| Coupling Torque | Section 6.1.2.5 | Section 6.1.3.5 | 408 | Analysis |

| Test Group 3 | Requirement | Procedure | EN 2591 Ref | Approval Method |
|---|---|---|---|---|
| Coupling Torque | Section 6.1.2.5 | Section 6.1.3.5 | 408 | Analysis |
| Backshell Shield Braid-to-Shell-Continuity | Section 6.1.2.14 | Section 6.1.3.14 | NA | Test |
| Resistance to Indirect Lightning Strike | Section 6.1.2.18 | Section 6.1.3.18 | 214 | Test |
| Backshell Shield Braid-to-Shell-Continuity | Section 6.1.2.14 | Section 6.1.3.15 | NA | Test |
| Coupling Torque | Section 6.1.2.5 | Section 6.1.3.5 | 408 | Analysis |
| IR at Ambient Temperature | Section 6.1.2.7.1 | Section 6.1.3.7.1 | 206 | Test |
| DWV at Sea Level | Section 6.1.2.8 | Section 6.1.3.8 | 207 | Test |

| Test Group 4 | Requirement | Procedure | EN 2591 Ref | Approval Method |
|---|---|---|---|---|
| Shell-to-Shell Continuity | Section 6.1.2.13 | Section 6.1.3.13 | 205 | Analysis |
| Salt Spray (Corrosion Resistance) | Section 6.1.2.9 | Section 6.1.3.9 | EN60068-2-11 | Analysis |
| Shell-to-Shell Continuity | Section 6.1.2.13 | Section 6.1.3.13 | 205 | Analysis |
| Coupling Torque | Section 6.1.2.5 | Section 6.1.3.5 | 408 | Analysis |

| Test Group 5 | Requirement | Procedure | EN 2591 Ref | Approval Method |
|---|---|---|---|---|
| Fungus Resistance | Section 6.1.2.2.7 | Section 6.1.3.19 | 308 | Analysis |

**Table 6-2 – Qualification Test Sequences – Continued**

| Test Group 6 | Requirement | Procedure | Approval Method |
|---|---|---|---|
| Flammability | Section 2.3.1.1 | Section 2.3.2.1 | Test |
| Specific Optical Smoke Density | Section 2.3.1.2 | Section 2.3.2.2 | Test |
| Toxicity | Section 2.3.1.3 | Section 2.3.2.3 | Test |

**Table 6-3 – Coupling Torque**

| Housing Size | Coupling Torque (lbf-ft [N-m]), max. | Uncoupling Torque (lbf-ft [N-m]), min. |
|---|---|---|
| 09 | 0.66 [0.9] | 0.15 [0.2] |
| 11 | 1.03 [1.4] | 0.15 [0.2] |
| 13 | 1.33 [1.8] | 0.15 [0.2] |
| 15 | 1.70 [2.3] | 0.22 [0.3] |
| 17 | 1.99 [2.7] | 0.22 [0.3] |
| 19 | 2.36 [3.2] | 0.22 [0.3] |
| 21 | 2.65 [3.6] | 0.44 [0.6] |
| 23 | 3.02 [4.1] | 0.44 [0.6] |
| 25 | 3.32 [4.5] | 0.44 [0.6] |

### 6.1.3.3 Temperature Cycling

See Section 6.1.2.3. Mated connectors should be tested in accordance with test procedure EIA-364-32, test condition A, except that steps 2 and 4 should be of 2-minute maximum duration. The temperature of step 1 should be -67 °F +0/-9 °F (-55 °C +0/-5 °C). The temperature of step 3 should be 347 °F (175 °C).

### 6.1.3.4 Air Leakage

See Section 6.1.2.4. The connector should be subjected to test procedure EIA-364-02 or EN2591-307, Method A, except the minimum period of measurement should be 10 seconds. Testing should be conducted at a pressure differential of 1 atmosphere across the connector.

### 6.1.3.5 Coupling Torque

See Section 6.1.2.5. Mating connectors should be coupled and uncoupled and the torque, which must be applied to facilitate full coupling and uncoupling, should be measured and recorded. Coupling is tested in accordance with test procedure EN2591-408.

### 6.1.3.6 Durability

See Section 6.1.2.6. The wired, assembled plugs and receptacles should be mated and unmated 100 cycles at a rate of 300 cycles per hour maximum. The mating and unmating should be accomplished so that the plug and receptacle are completely separated during each cycle. Test procedure in accordance with EN2591-406.

### 6.1.3.7 Insulation Resistance

#### 6.1.3.7.1 Insulation Resistance at Ambient Temperature

See Section 6.1.2.7.1. Unmated connectors should be tested in accordance with test procedure EIA-364-21 or EN2591-206 method A. The following details and exceptions apply:

a. The tolerance on the applied voltage should be ±10 percent.
b. Connectors should be mated when testing after humidity.

#### 6.1.3.7.2 Insulation Resistance at Elevated Temperature

See Section 6.1.2.7.2. Unmated connectors should be tested in accordance with test procedure EIA-364-21 or EN2591-206 method A. The following details and exceptions apply:

a. The tolerance on the applied voltage should be ±10 percent.
b. Applicable elevated temperature for 30 minutes should be 347 °F (175 ºC).
c. Measurements should be made while the connectors are still in the chamber at the specified temperature.

### 6.1.3.8 Dielectric withstanding Voltage at Sea Level

See Section 6.1.2.7.1. Unmated connectors should be tested in accordance with test procedure EIA-364-21. Wired, unmated connectors should be tested in accordance with test procedure EIA-364-20, Method A or EN2591-207 Method A. The following details and exceptions apply:

a. The magnitude of the test voltage should be1300 V RMS.
b. The test voltage should be maintained at the specified value for 2 seconds minimum.

### 6.1.3.9 Salt Spray (Corrosion)

See Section 6.1.2.9. Unmated connectors should be tested in accordance with test procedure EIA-364-26 or EN60068-2-11. The following details and exceptions should apply:

a. Exposure should be 96 hours.
b. The samples should not be mounted but should be suspended from the top of the chamber using waxed twine or string, glass rods, or glass cord.
c. Wire ends must be protected to prevent salt migration.

### 6.1.3.10 Contact Resistance

See Section 6.1.2.10. Contacts of mated connectors should be tested in accordance with test procedure EIA-364-06 or EN2591-202.

#### 6.1.3.11 Vibration

See Section 6.1.2.11. Connectors should be tested in accordance with test procedure EIA-364-28 or EN2591-403. The following details should apply:

a. Test condition V – Using the vibration envelope shown on Figure 6-6.
b. Vibration to be conducted at ambient temperature.
c. Duration should be 4 hours in the longitudinal direction and 4 hours in a perpendicular direction for a total of 8 hours.

#### 6.1.3.12 Shock

See Section 6.1.2.12. Connectors should be tested in accordance with test procedure EIA-364-27 or EN2591-402. The following details should apply:

a. The pulse should be an approximate half sine wave of 300 G ±15 percent magnitude with duration of 3 ±1 milliseconds.
b. The wire bundle should be clamped to fixed points at least 8 in (203.2 mm) from the rear of the connector.

#### 6.1.3.13 Shell to Shell Continuity

See Section 6.1.2.13. Mated connectors should be tested in accordance with test procedure EIA-364-83 or EN2591-205.

#### 6.1.3.14 Braid to Shell Continuity

See Section 6.1.2.14. Mated connectors should be tested in accordance with test procedure EIA-364-83, except that measurement should be made between the plug backshell shield braid on one end and the plug backshell shield braid on the other end of the thru-bulkhead mounting receptacle. Backshells in accordance with SAE-AS85049 should be utilized.

#### 6.1.3.15 Humidity

See Section 6.1.2.15. Wired, mated connectors should be tested in accordance with test procedure EIA-364-31. The following details and exceptions should apply:

a. Test method IV.
b. The mated connectors should be mounted in a vertical position.
c. Step 7a should be performed during the last 5 cycles.
d. Three hours minimum after the start of step 7a during the final cycle and while the connectors are still subjected to high humidity, insulation resistance and dielectric withstanding voltage should be measured when the chamber temperature reaches 68 ±9 °F (20 ±5 °C) and condensation is observed on the connector.
e. For qualification testing, insulation resistance readings should be made on a minimum of 50 percent of the circuits. Outer circuits should be measured to the connector shell.

#### 6.1.3.16 Ozone

See Section 6.1.2.16, Ozone Exposure. Wired, mated connectors should be tested in accordance with test procedure EIA-364-14 or EN2591-316.

### 6.1.3.17 Fluid Immersion

See Section 6.1.2.17. Connector samples should be tested in accordance with test procedure EIA-364-10 (one sample per fluid) or EN2591-315.

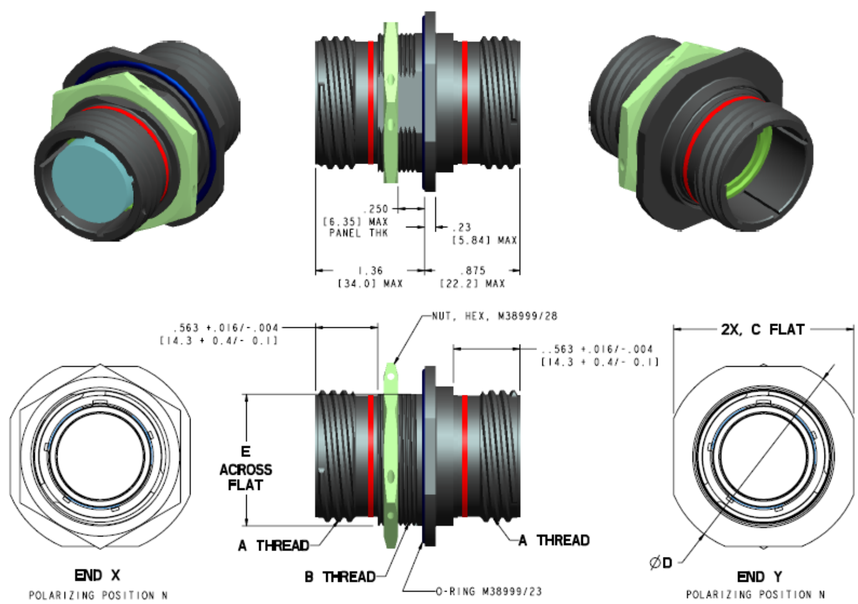
### 6.1.3.18 Resistance to Indirect Lightning Strike

See Section 6.1.2.18. Mated connectors should be tested in accordance with test procedure EIA-364-75 or EN2591-214 with the following details and exceptions:

a. Each specimen should be subjected to three current pulses in each polarity (a total of six pulses). After each current pulse, the connectors should be unscrewed ½ turn counter-clockwise without removing or unmating in order to break any weld points that may have occurred. Connectors should then be re-tightened ½ turn, back to the fully mated position.
b. Visual examination should be conducted under three-to-five power (3-5X) magnification in accordance with test procedure EIA-364-75.
c. The waveform for indirect lightning strike effects, as specified on Figure 6-7, should be utilized.

### 6.1.3.19 Fungus Resistance Certification

Certification to method 508.6 of MIL-STD-810 is required.

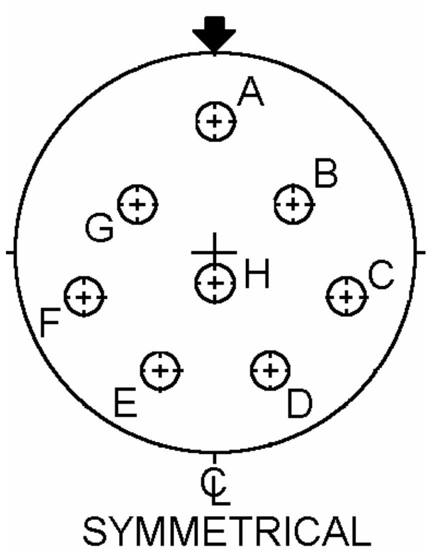



| Shell Size | A Thread | B Thread | C Flat ±.016 (0.4) | Ø D ±.012 (0.3) | E Flat +.004 (.10) -.006 (.15) |
|---|---|---|---|---|---|
| 17 | 1.1875-0, IP-0, 3L-TS-2A | M32 x 1-6g 0.100R (See Note) | 1.626 (41.3) | 1.752 (44.5) | 1.187 (30.15) |
| 19 | 1.2500-0, IP-0, 3L-TS-2A | M35 x 1-6g 0.100R | 1.811 (46.0) | 1.937 (49.2) | 1.312 (33.32) |

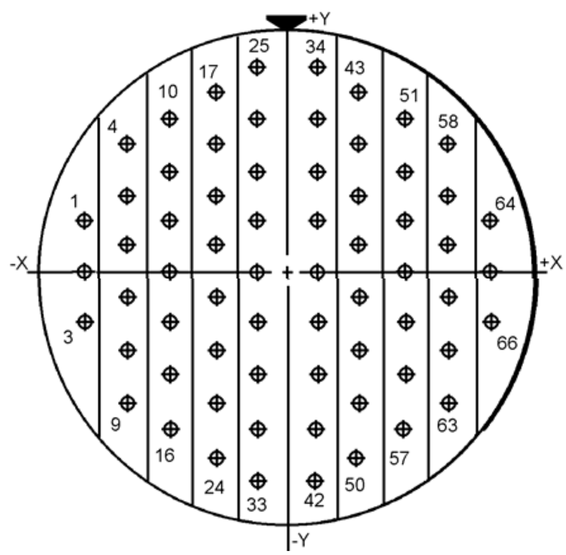
Note: Modified major diameter: 1.258 – 1.255 (31.05 – 31.80)

**Figure 6-3 – Connector Dimensions and Configuration**

**17-8**



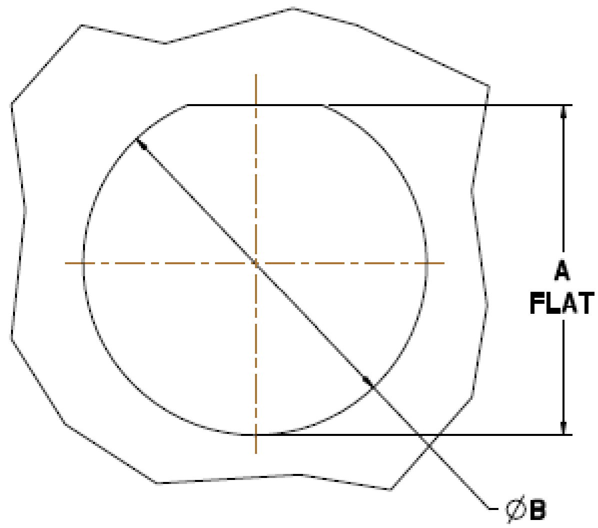

**19-35**




| Insert Arrangement per MIL-STD-1560 | Shell Size | Number of Contacts | Contact Size |
|---|---|---|---|
| 17-8 | 17 | 8 | 16 |
| 19-35 | 19 | 66 | 22D |

Note: Contact cavity markings of front face of pin insert shown. Socket insert markings are inverted along Y-axis.

**Figure 6-4 – Insert Arrangements**




| Shell Size | A<br>+0.00/-0.06<br>(+.000/-.0024) | Ø B<br>+0.25/-0.00<br>(+.010/-.000) |
|---|---|---|
| 17 | 30.73<br>(1.210) | 32.01<br>(1.260) |
| 19 | 33.91<br>(1.335) | 35.18<br>(1.385) |

**Figure 6-5 – Recommended Panel Cutout Dimensions**

**Table 6-4 – Contact Resistance**

| Contact Size | Wire Size | Test Amperes | Millivolt Drop Maximum | |
|---|---|---|---|---|
| | | | Initial | After Conditioning |
| 12 | 12 | 17 | 85 | 100 |
| 16 | 16 | 10 | 85 | 100 |
| 20 | 20 | 5 | 60 | 75 |
| 20D | 22 | 3 | 85 | 85 |

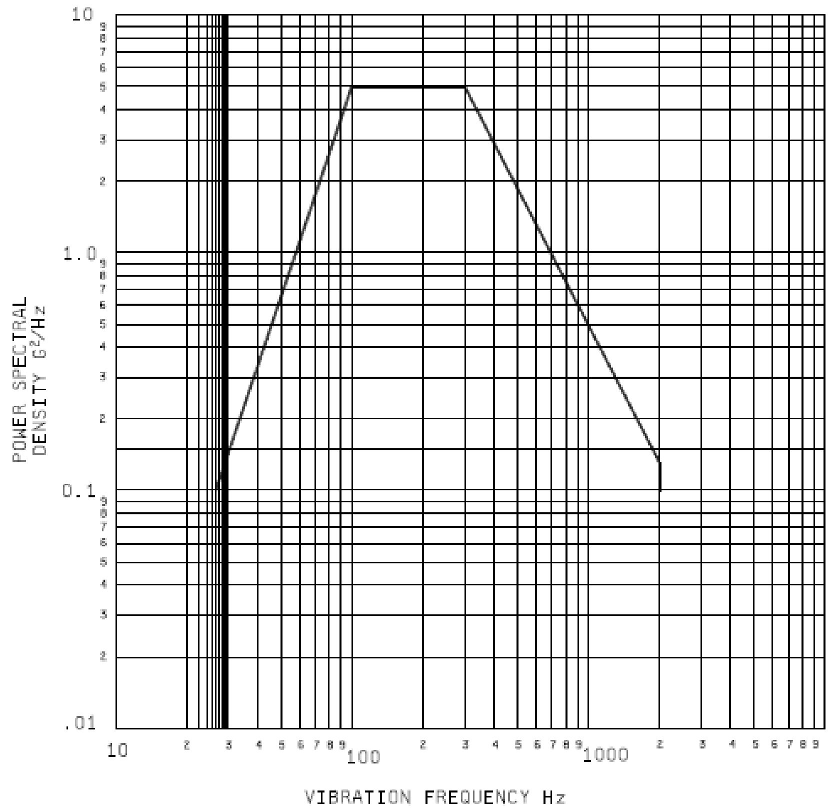



**Figure 6-6 – Random Vibration**

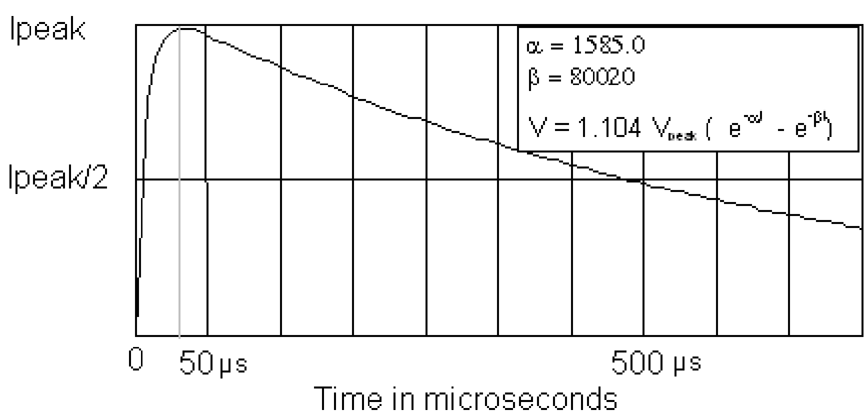



**Figure 6-7 – Waveform for Indirect Lightning Strike**

# 7.0 QUALIFICATION

Each cabin system supplier or user of the component is responsible for ensuring that only qualified components are used in cabin system.

Applicable component manufacturers are responsible for qualification tests. Component qualification tests do not replace equipment qualification tests.

Note: The definition and reference to components in this standard should not be construed as “qualification.” Qualification is the responsibility of the user.

# 8.0 MARKING

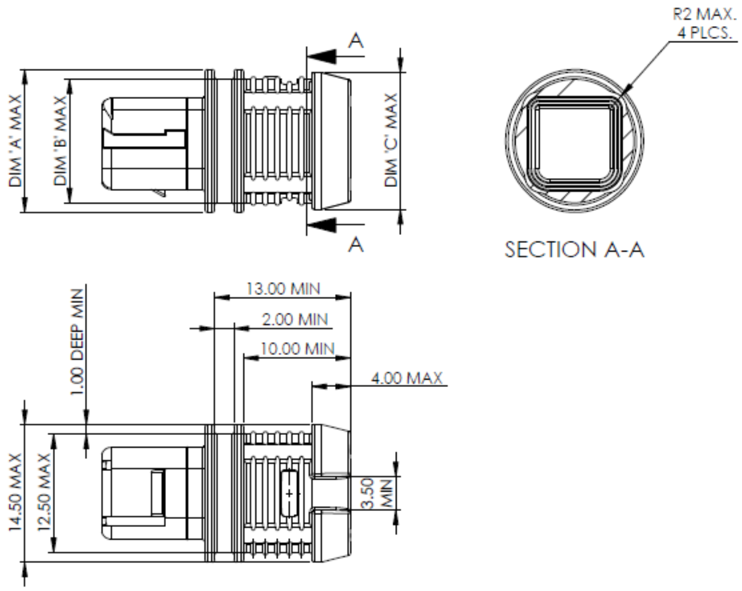
Parts should be marked in accordance with the manufacturer's designation. A compliance sheet should be submitted with each delivery to indicate compliance with this standard.

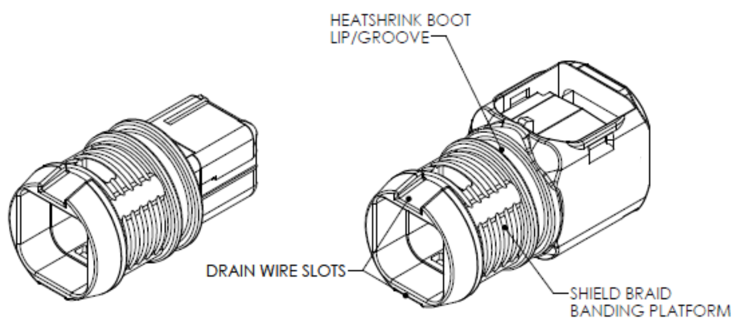
# ATTACHMENT 1 ACRONYM LIST

| | |
|---|---|
| ACRF | Attenuation-to-Crosstalk Ratio – Far End |
| AWG | American Wire Gage |
| DWV | Dielectric Withstanding Voltage |
| EMI | Electromagnetic Interference |
| FEXT | Far End Crosstalk |
| FST | Flammability, Smoke, and Toxicity |
| HIRF | High Intensity Radiated Fields |
| IFE | In-Flight Entertainment |
| NEXT | Near End Crosstalk |
| PCB | Printed Circuit Board |
| PSACRF | Power Sum ACRF |
| PSNEXT | Power Sum NEXT |
| PTFE | Polytetrafluoroethylene |
| VSWR | Voltage Standing Wave Ratio |

# APPENDIX F SHIELDED MULTI-WAY CONNECTORS

## F-1 Connector Details




| SHELL SIZE | DIM 'A' | DIM 'B' | DIM 'C' |
|---|---|---|---|
| SIZE 3, 3 WAY | 10.20 | 8.20 | 9.60 |
| SIZE 6, 6 WAY | 12.70 | 10.70 | 12.00 |
| SIZE 9, 9 WAY | 15.20 | 13.20 | 14.50 |

All dimensions are in millimeters

**Figure F-1 – Shell Rear/ Braid, Strap, Boot, and Jacket Interface (Plug and Receptacle)**

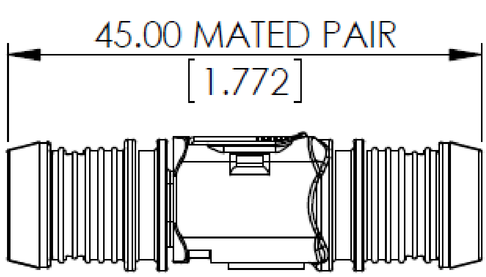
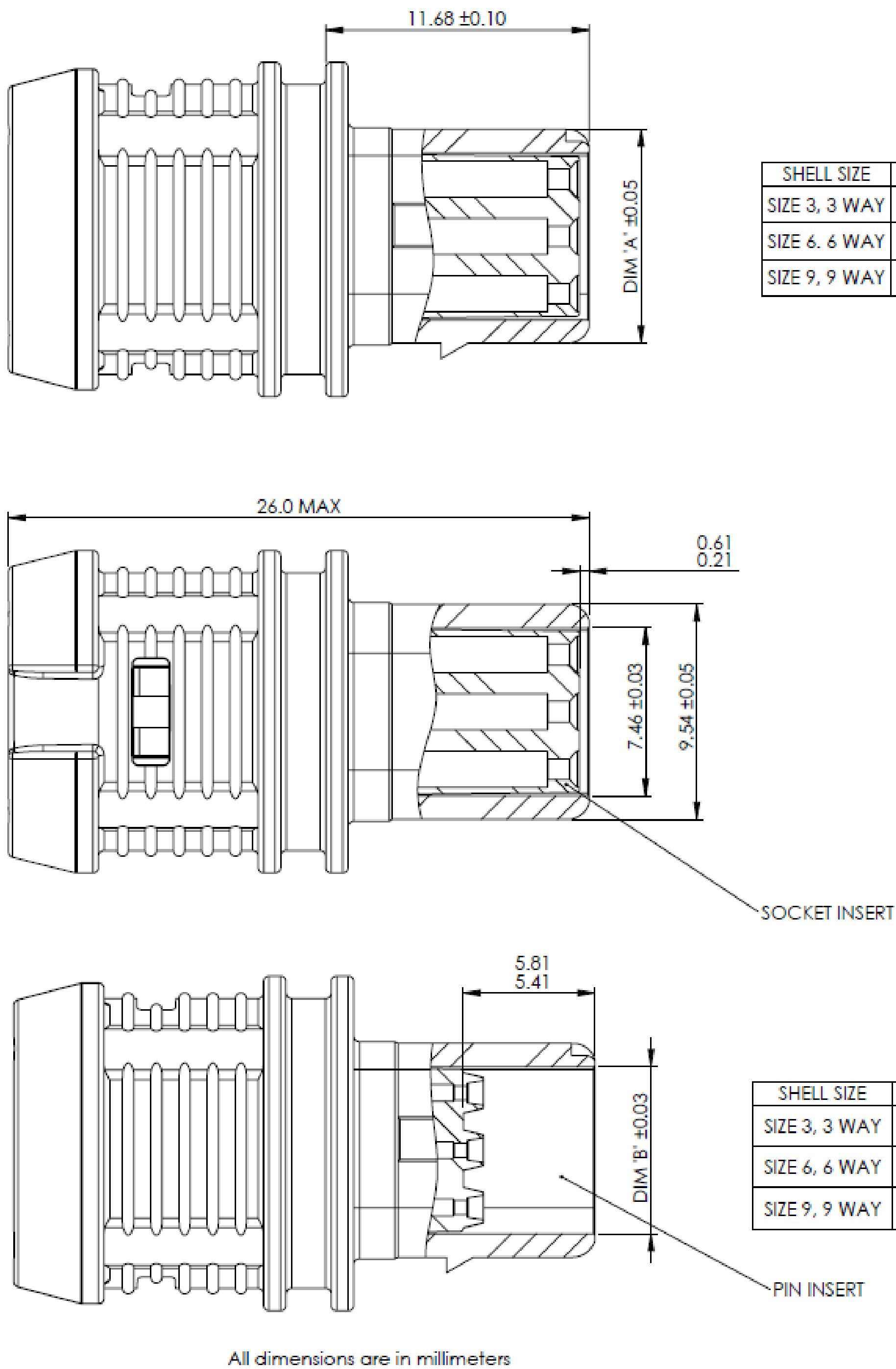



**Figure F-2 – Mated Pair Overall Length (Plug & Receptacle)**

**APPENDIX F**
**SHEILDED MULTI-WAY CONNECTORS**

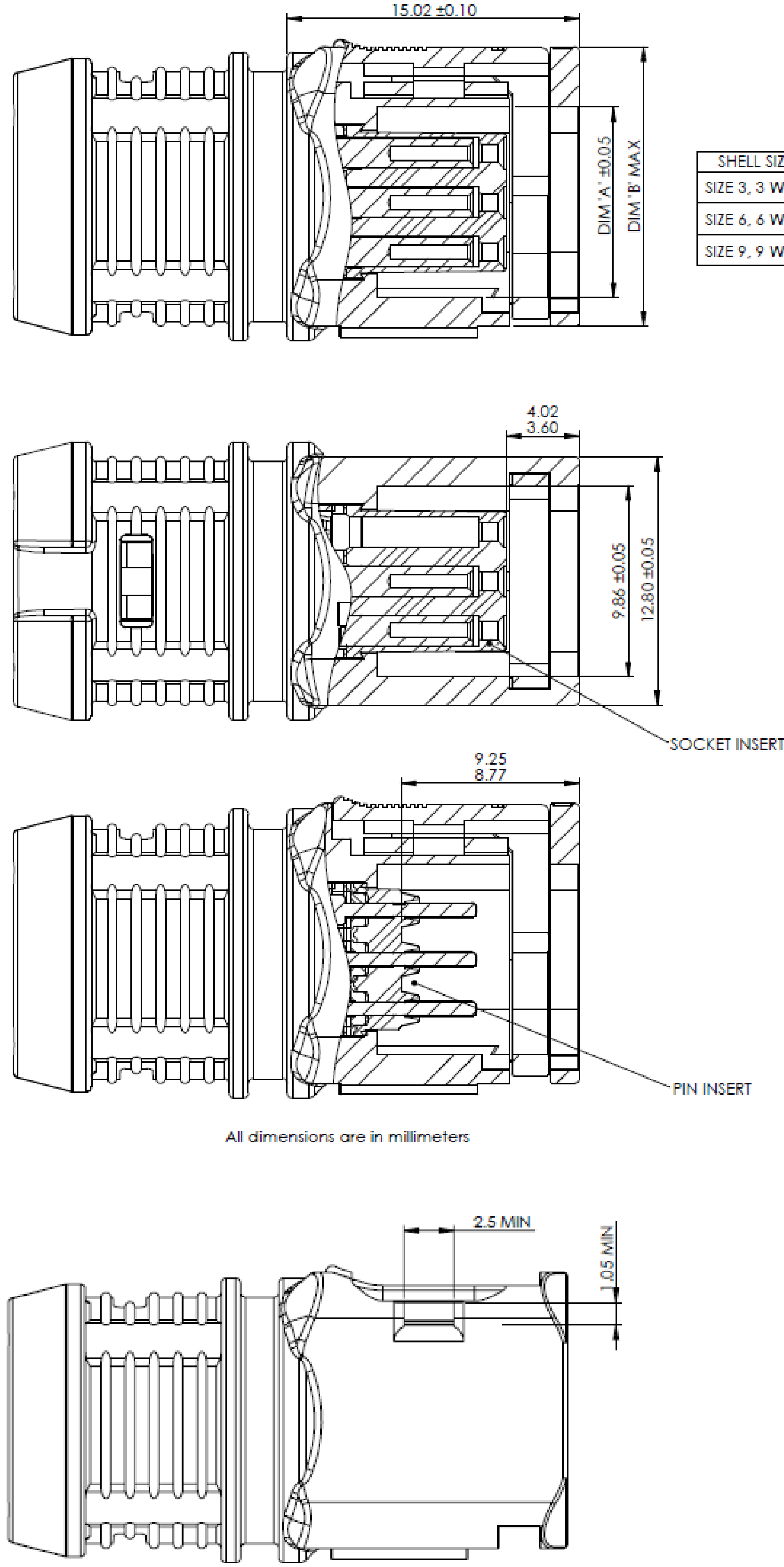



| SHELL SIZE | DIM 'A' |
|---|---|
| SIZE 3, 3 WAY | 4.4 |
| SIZE 6. 6 WAY | 6.94 |
| SIZE 9, 9 WAY | 9.48 |

| SHELL SIZE | DIM'B' |
|---|---|
| SIZE 3, 3 WAY | 2.32 |
| SIZE 6, 6 WAY | 4.86 |
| SIZE 9, 9 WAY | 7.40 |

**Figure F-3 – Receptacle – Shell and Interface Dimensions**

**APPENDIX F**
**SHEILDED MULTI-WAY CONNECTORS**




| SHELL SIZE | DIM 'A' | DIM 'B' |
|---|---|---|
| SIZE 3, 3 WAY | 4.72 | 9.36 |
| SIZE 6, 6 WAY | 7.26 | 11.95 |
| SIZE 9, 9 WAY | 9.80 | 14.55 |

Figure F-4 – Plug – Shell and Interface Dimensions

APPENDIX F
SHEILDED MULTI-WAY CONNECTORS

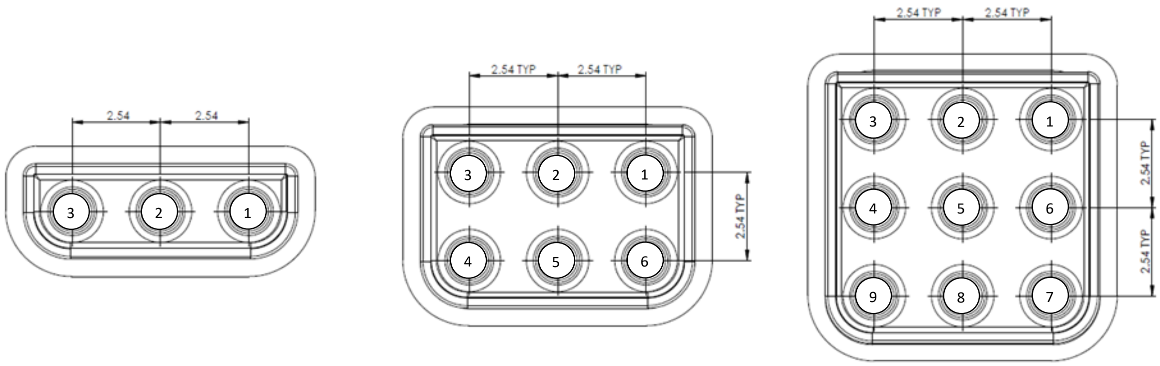



Figure F-5 – Insert Arrangement and Contact Position – Pin Insert

**Note:** Contact position identification can be shown via the shell or the real seal by means of marking or printing. The views shown in Figure F-5 are from the rear of the connector

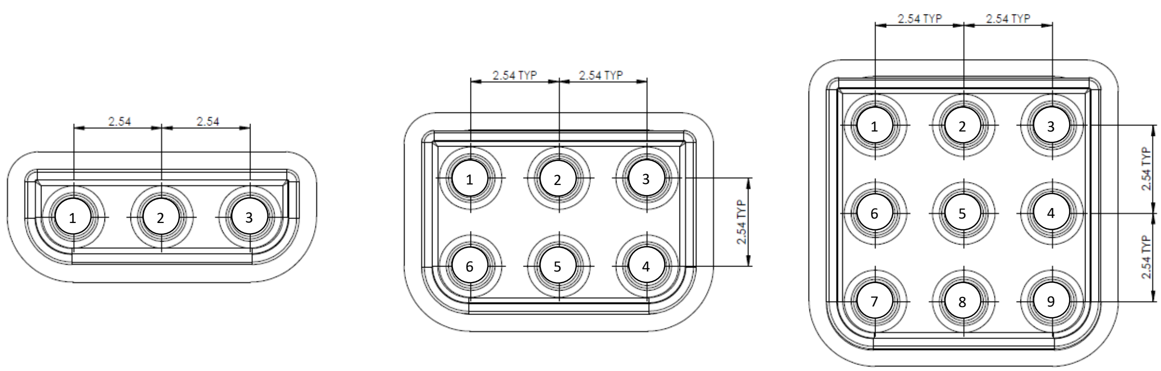



Figure F-6 – Insert Arrangement and Contact Position – Socket Insert

**Note:** Contact position identification can be shown via the shell or the real seal by means of marking or printing. The views shown in Figure F-6 are from the rear of the connector.

APPENDIX F
SHEILDED MULTI-WAY CONNECTORS

## Table F-1 Product Weights

| Connector Type | Part No. Format | Max. Weight (g) | |
|---|---|---|---|
| | | Pin | Socket |
| 3-Way Plug | A800-MP-33-*** | 3.4 | 3.5 |
| 3-Way Receptacle | A800-MR-33-*** | 2.5 | 2.5 |
| 6-Way Plug | A800-MP-66-*** | 3.9 | 4.1 |
| 6-Way Receptacle | A800-MR-66-*** | 2.9 | 2.8 |
| 9-Way Plug | A800-MR-99-*** | 4.5 | 4.7 |
| 9-Way Receptacle | A800-MR-99-*** | 3.5 | 3.4 |

**Note: All weights are without contacts.**

## Table F-2 – Shell Keying

| Shell Keying | |
|---|---|
| Orientation | Color Coding Stripe |
| N | Black |
| A | Dark Red |
| B | Dark Blue |
| C | Dark Green |
| D | Yellow |