

## Product Specification

### PR022-01

Revision C0 3/2/2016

## Modular Products



# Stewart Connector

## 1.0 Objective

This document establishes the performance requirements and outlines qualification tests for shielded and unshielded modular connectors produced by Stewart Connector. These products are intended to be soldered onto a printed circuit board or terminated onto a cable and mated to a compatible Stewart Connector modular product.

## 2.0 Scope

This specification is applicable to shielded and unshielded modular products.

## 3.0 General

This document is comprised of the following sections (specifications subject to change without notice):

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**Table 1**  
**Qualification Testing Matrix**

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| Qualification Testing Matrix     |       | Test Groups          |                                                         |     |     |     |     |     |       |     |
|----------------------------------|-------|----------------------|---------------------------------------------------------|-----|-----|-----|-----|-----|-------|-----|
|                                  |       | 1                    | 2                                                       | 3   | 4   | 5   | 6   | 7   | 8 (4) | 9   |
| Test                             | Para. | Testing Sequence (3) |                                                         |     |     |     |     |     |       |     |
| Examination of Product           | 5.5   | 1,5                  | 1,5                                                     | 1,7 | 1,7 | 1,5 | 1,6 | 1,8 | 1,5   | 1,3 |
| Low Level Contact Resistance     | 9.1   | 2,4                  | 2,4                                                     |     | 2,6 | 2,4 | 2,4 | 2,4 | 2,4   |     |
| Temperature Rise vs. Current     | 9.2   | 3                    |                                                         |     |     |     |     |     |       |     |
| Durability                       | 10.1  |                      | 3                                                       |     |     |     |     |     |       |     |
| Gaging                           | 10.2  |                      |                                                         | 2   |     |     |     |     |       |     |
| PCB Insertion Force              | 10.3  |                      |                                                         | 3   |     |     |     |     |       |     |
| Mating / Unmating Force          | 10.4  |                      |                                                         | 4   |     |     |     |     |       |     |
| Discontinuity                    | 10.5  |                      |                                                         | 5   |     |     |     |     |       |     |
| Latch Strength                   | 10.6  |                      |                                                         | 6   |     |     |     |     |       |     |
| Mechanical Shock                 | 10.7  |                      |                                                         |     | 5   |     |     |     |       |     |
| Vibration (Sinusoidal)           | 10.8  |                      |                                                         |     | 3   |     |     |     |       |     |
| Vibration (Random)               | 10.9  |                      |                                                         |     | 4   |     |     |     |       |     |
| Temperature Life                 | 11.1  |                      |                                                         |     |     | 3   |     |     |       |     |
| Thermal Shock                    | 11.2  |                      |                                                         |     |     |     | 3   |     |       |     |
| Temperature/Humidity             | 11.3  |                      |                                                         |     |     |     |     | 3   |       |     |
| Insulation Resistance            | 9.3   |                      |                                                         |     |     |     | 5   | 5   |       |     |
| D. W. V. (Adj. Contacts) (2)     | 9.4   |                      |                                                         |     |     |     |     | 6   |       |     |
| D. W. V. (Contacts-Shield) (1,2) | 9.5   |                      |                                                         |     |     |     |     | 7   |       |     |
| RJ-11 Insertion (4)              | 10.10 |                      |                                                         |     |     |     |     |     | 3     |     |
| Rotational Test                  | 10.11 |                      |                                                         |     |     |     |     |     |       | 2   |
| Note:                            |       | 1                    | Only Applies to Shielded Product                        |     |     |     |     |     |       |     |
|                                  |       | 2                    | DWV stands for Dielectric Withstand Voltage             |     |     |     |     |     |       |     |
|                                  |       | 3                    | Numbers indicate sequence in which tests are performed. |     |     |     |     |     |       |     |
|                                  |       | 4                    | Test Group 8 Applies to RJ-45 style jacks only          |     |     |     |     |     |       |     |

# Stewart Connector

## 4.0 Applicable Documents

### 4.1 Stewart Connector Specifications:

- 4.1.1 Product Drawings
- 4.1.2 Customer Drawings
- 4.1.3 Test Specifications

### 4.2 Other Standards and Specifications (Applicable in Part):

- 4.2.1 UL94V-0 Flammability
- 4.2.2 EIA-364
- 4.2.3 EIA/TIA-568
- 4.2.4 EIA/TIA-570
- 4.2.5 IEC 60603-7
- 4.2.6 TIA 1096
- 4.2.7 IEEE 802.3

**Table 2**  
**IEC Modular Plug and Jack Standards**

| Category           | Type | Standard      |
|--------------------|------|---------------|
| Base Specification | UTP  | IEC 60603-7   |
|                    | ScTP | IEC 60603-7-1 |
| Category 5e        | UTP  | IEC 60603-7-2 |
| Category 5e        | ScTP | IEC 60603-7-3 |
| Category 6         | UTP  | IEC 60603-7-4 |
| Category 6         | ScTP | IEC 60603-7-5 |

UTP – Unshielded Twisted Pair

ScTP – Screened Twisted Pair

Additional specifications and standards may be referenced as applicable. The latest revisions of the above specifications available at the date of issue of this specification are used unless otherwise indicated.

# Stewart Connector

## 5.0 General Requirements

### 5.1 Qualification:

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

### 5.2 Material:

5.2.1 Plastic Housings: UL94V-0

5.2.2 Contacts: Copper Alloy

5.2.3 Shield: Copper Alloy

### 5.3 Finish:

5.3.1 Contacts: Gold Selectively Plated

5.3.2 Contacts: Nickel Plated All Over

5.3.3 Reference Customer Drawing for Contact Solder Tails

5.3.4 Shield: Tin or Nickel Plated All Over

### 5.4 Design and Construction:

Connectors shall be of the design, construction and physical dimensions as specified on the applicable product drawing and TIA 1096. In case of conflict between this specification and product drawings, the drawings shall take precedence. 50 μinch (1.27 μm) gold plated connectors compliant with TIA 1096 specifications.

### 5.5 Examination of Product:

Connectors shall meet all specified dimensions of product drawings and internal workmanship standards. There shall be no evidence of cracking, chipping, contamination or loose parts when inspected, without magnification, to the unaided eye.

### 5.6 Operating and Storage Temperature Range: -40 °C to 85 °C

### 5.7 Ratings:

5.7.1 Current: 1.5 amperes maximum at 25°C

5.7.2 Voltage: 150 VAC maximum

### 5.8 Minimum Number of Mating/Unmating Operations:

5.8.1 Performance Level 1: 750 Cycles

5.8.2 Performance Level 2: 2500 Cycles

### 5.9 Minimum Number of Cable Re-Terminations:

5.9.1 Refer to application drawings

# Stewart Connector

## 6.0 Soldering Process Requirements

### 6.1 Wave Solder:

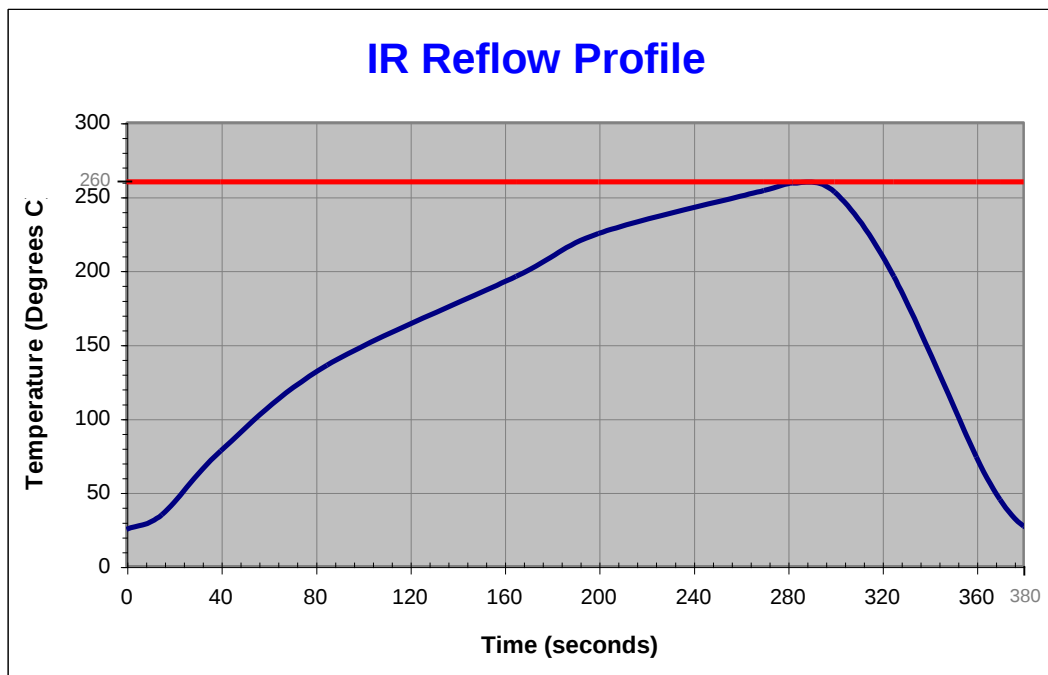
Modular connectors are capable of withstanding wave solder temperatures without any functional deterioration. See Table 3 below:

**Table 3**  
**Wave Solder Process Profile**

|                    | Maximum Temperature | Maximum Temperature Exposure Time |
|--------------------|---------------------|-----------------------------------|
| Low-Temp Products  | 428°F (220°C)       | 10 Seconds                        |
| High-Temp Products | 500°F (260°C)       | 10 Seconds                        |

### 6.2 IR Reflow Solder:

High-temperature modular connectors are capable of withstanding non-focused infrared (IR) reflow and equivalents at up to 500°F (260°C) without any functional deterioration. The modular jacks shall be exposed to profiles as specified in Figure 1 below:



**FIGURE 1**

\* Note: IR Profile may not apply to products with LEDs or light pipes. Please consult factory for specifics.

# Stewart Connector

## 7.0 Quality Assurance Provisions

### 7.1 Equipment Calibration:

All test equipment and inspection facilities used in the performance of any test shall be maintained and calibrated in accordance with Stewart Connector Operating Procedures and/or other applicable specifications.

### 7.2 Inspection Conditions:

Unless otherwise specified, all inspections shall be performed under the conditions noted. See Table 2 below:

**Table 4**  
**Inspection Conditions**

| Temperature<br>( $\pm 5$ °C) | Relative<br>Humidity<br>(%) | Barometric<br>Pressure |
|------------------------------|-----------------------------|------------------------|
| 25                           | 30 to 50                    | Local Ambient          |

### 7.3 Sample Quantity and Description:

The test samples required for groups 1 through 9 in Table 1 shall be chosen to comprise a group that consists of 80 contacts, on 10 ports, on two connectors minimum. For samples with multiple contact designs, there shall be 20 examples minimum of each individual contact design.

Test group 8 is only applicable to 8 and 10 position RJ-45 style jacks.

The test samples required for group 10 in Table 1 shall be chosen to comprise a group that consists of 16 total contacts on 2 connectors minimum.

### 7.4 Acceptance:

7.4.1 All samples tested in accordance with this product specification shall meet the stated requirements.

7.4.2 Failures attributed to equipment, test set-up, sample preparation problems, contaminants or operator error, should not disqualify the product. Corrective action will be taken and samples re-submitted for qualification.

## 8.0 Requalification of Products

### 8.1 Requalification Testing

If changes are made to the product, design or manufacturing process after initial product qualification that are judged by the management of Stewart Connector to materially affect the product form, fit or function, then new product samples shall be subject to full or partial requalification testing.

# Stewart Connector

## 9.0 Electrical Requirements

### 9.1 Low Level Contact Resistance (Board Mounted Product):

LLCR should be measured (mated with a Stewart Connector plug) in accordance with EIA-364-23 with a test current of 100 mA and a maximum open circuit voltage of 20 mVDC (dry circuit test). See Table 5 below:

**Table 5**  
**Low Level Contact Resistance**

| Contacts        |               | Shield Interface ** |               |
|-----------------|---------------|---------------------|---------------|
| Initial<br>(mΩ) | Final<br>(mΩ) | Initial<br>(mΩ)     | Final<br>(mΩ) |
| 100 *           | Δ20           | 20                  | 40            |

All values listed are maximum values.

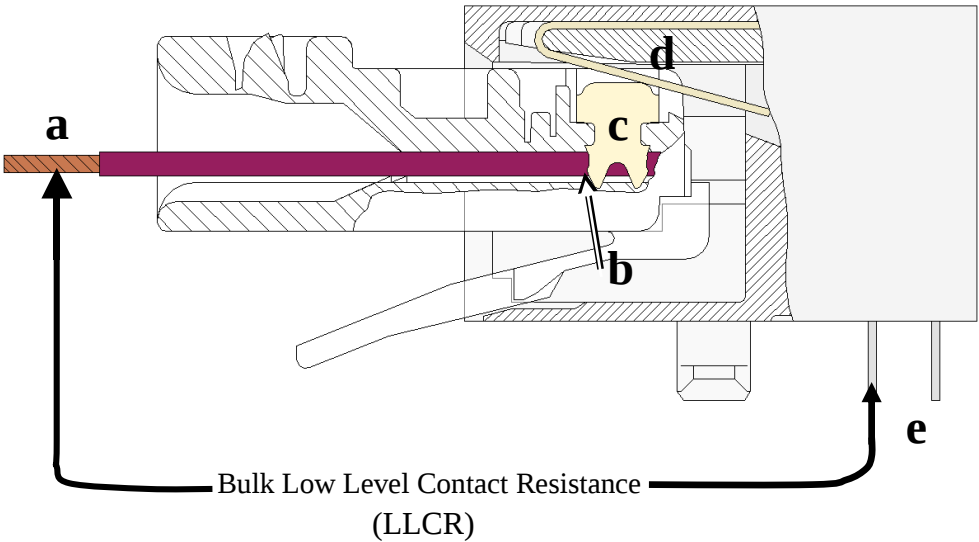
\* 100 mΩ Initial LLCR Includes Bulk

\*\* Shield Interface LLCR Not Applicable to Unshielded Connectors

Low Level Contact Resistance (LLCR) is measured on a mated Plug and Jack. Measurements are generally performed before and after environmental exposure or mechanical conditioning. Bulk LLCR is measured between a mated Plug conductor and Jack printed wiring board (PWB) pin. Bulk resistance consists of the following four (4) components. Refer to Figure 2 below.

$$\text{Contacts } R_{\text{Bulk}} = R_{\text{ab}} + R_{\text{bc}} + R_{\text{cd}} + R_{\text{de}}$$

- (1) (**R<sub>ab</sub>**) Plug Conductor Resistance
- (2) (**R<sub>bc</sub>**) Plug Blade/Conductor Contact Resistance
- (3) (**R<sub>cd</sub>**) Plug Blade/Jack Wire Contact Resistance
- (4) (**R<sub>de</sub>**) Jack Wire Resistance



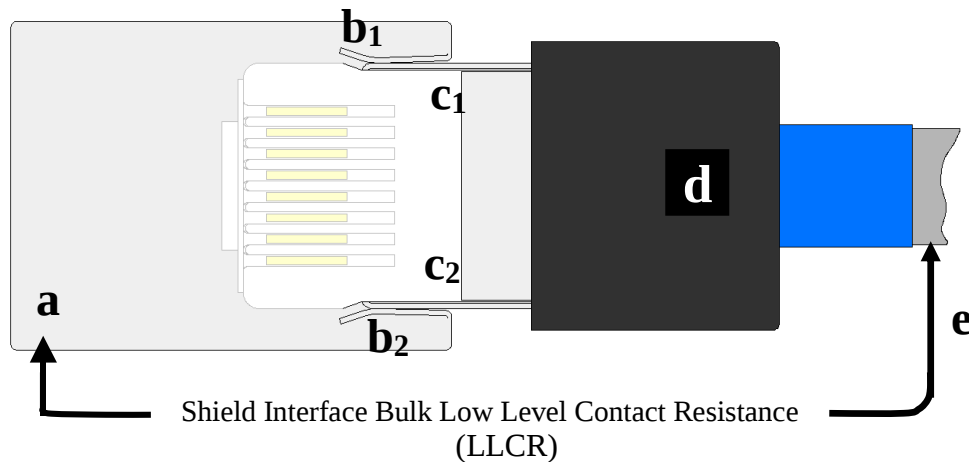
**FIGURE 2**

# Stewart Connector

## 9.1 Low Level Contact Resistance: (Cont.)

$$\text{Shield Interface } R_{\text{Bulk}} = R_{\text{ab}} + R_{\text{bc}} + R_{\text{cd}} + R_{\text{de}}$$

- (1) ( $R_{\text{ab}}$ ) Jack Shield Resistance
- (2) ( $R_{\text{bc}}$ ) Jack Shield/Plug Shield Contact Resistance
- (3) ( $R_{\text{cd}}$ ) Plug Shield/Cable Shield Contact Resistance
- (4) ( $R_{\text{de}}$ ) Cable Shield Resistance



**FIGURE 3**

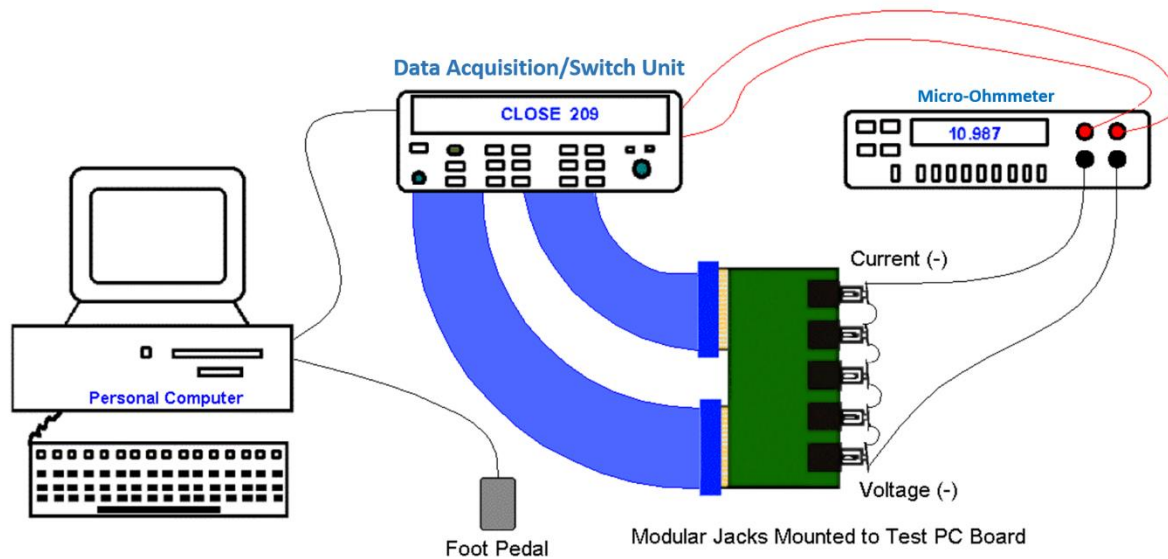
Typical Bulk contact resistance of a mated plug and jack can range between 20 to 50 mΩ. Stewart Connector product specification requirement is a bulk contact resistance change after conditioning. In most cases, the maximum allowable change in bulk contact resistance after environmental conditioning is 20 mΩ.

LLCR measurements are conducted utilizing a four (4) wire dry circuit test method. Implementation consists of a 100 mA DC current source with a maximum open circuit voltage of 20 mV. Measurements are performed using low current and voltage levels to preserve oxides and films that may form during environmental conditioning.

In practice, Jacks are mounted on PWB boards, which are design to interface with automated switching and measuring equipment. Stewart Connector LLCR measuring system consists of a Micro-Ohmmeter and a Hewlett Packard Data Acquisition Switch Unit. Automation software is utilized to fully control the measurement sequence. Refer to measurement configuration in Figure 4 below.

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## 9.1 Low Level Contact Resistance: (Cont.)



**FIGURE 4**

## 9.2 Temperature Rise versus Current:

The temperature rise above ambient (25°C) shall not exceed 30 °C at any point on the connector when all contacts are powered in series with 1.5 Amps DC in accordance with EIA-364-70.

## 9.3 Insulation Resistance:

The insulation resistance of the unmated connectors shall be measured in accordance with EIA-364-21. See Table 6 below:

**Table 6**  
**Insulation Resistance**

| Test Voltage (VDC) | Test Duration (Minutes) | Requirement (MΩ) | Points of Measurement         |
|--------------------|-------------------------|------------------|-------------------------------|
| 500                | 1                       | 500              | Between adjacent contacts     |
| 500                | 1                       | 500              | Between contacts and shield** |

\*\* Not Applicable to Unshielded Connectors

# Stewart Connector

## 9.4 Dielectric Withstanding Voltage (DWV) Adjacent Contacts:

There shall be no arc over, insulation breakdown or excessive leakage (>1 mA) when tested in accordance with EIA-364-20 on mated connectors. See Table 7 below:

**Table 7**  
**DWV – Adjacent Contacts**

| Test Voltage                        | Test Duration (Minutes) | Points of Measurement     |
|-------------------------------------|-------------------------|---------------------------|
| 1000 VAC <sub>RMS</sub> or 1414 VDC | 1                       | Between adjacent contacts |

## 9.5 \*\* Dielectric Withstanding Voltage (DWV) Contact to Shield:

There shall be no arc over, insulation breakdown or excessive leakage (>1 mA) when tested in accordance with EIA-364-20 on mated connectors. See Table 8 below:

**Table 8**  
**DWV – Contact to Shield**

| Connector      | Test Voltage                        | Test Duration (Minutes) | Points of Measurement       |
|----------------|-------------------------------------|-------------------------|-----------------------------|
| All Connectors | 1500 VAC <sub>RMS</sub> or 2121 VDC | 1                       | Between contacts and shield |

\*\* Not Applicable to Unshielded Connectors

## 10.0 Mechanical Requirements

### 10.1 Durability:

The durability of a connector is a conditioning sequence that is to be evaluated with reference to a change in LLCR as specified in EIA-364-15. See Table 9 below:

**Table 9**  
**Mechanical Durability**

| Performance Level | Rate of Travel (cycles/hour) | Cycles (number of times) |
|-------------------|------------------------------|--------------------------|
| PL 1              | 600                          | 750 Total                |
| PL 2              | 600                          | 2500 Total               |

Mated to compatible Stewart Connector  
Attributable to the separable contact interface.

### 10.2 Gauging:

Samples must pass all gauges and forces in accordance with IEC 60603-7. Samples shall not be capable of mating with the IEC specified No-Go gauges more than 0.070" (1.78 mm) when a force of 2 lbs (8.9 N) is applied. Samples must be capable of mating with the IEC specified Go gauges within the force limits in Table 10.

**Table 10**  
**Gauging – Go Gauges**

|       | Max Insertion Force | Max Removal Force |
|-------|---------------------|-------------------|
| Jacks | 2 Lbs (8.9 N)       | 2 Lbs (8.9 N)     |
| Plugs | 4.5 Lbs (20 N)      | 4.5 Lbs (20 N)    |

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## 10.3 PCB Insertion Force:

A connector, not including shield solder tails or signal contacts, shall require no more than 15 lbs (67 N) of insertion force when inserted into a minimum sized PCB hole specified on the customer print when using pushing force rate of 0.5 inches (12.7 mm) per minute.

## 10.4 Mating / Unmating Force.

Mating and Unmating forces are to be measured after one cycle pre-conditioning as specified in IEC 60603-7. See Table 11 below:

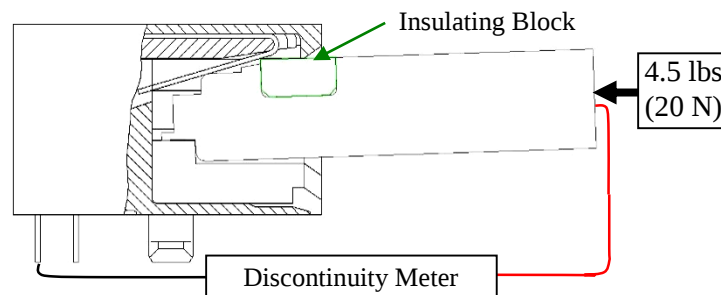
**Table 11**  
**Mating / Unmating Force**

| Item                         | Speed                         | Mating Force     | Unmating Force   |
|------------------------------|-------------------------------|------------------|------------------|
| Unshielded Modular Connector | 0.4 inch/sec,<br>10.16 mm/sec | 4.5 lbs,<br>20 N | 4.5 lbs,<br>20 N |
| Shielded Modular Connector   | 0.4 inch/sec,<br>10.16 mm/sec | 6.7 lbs,<br>30 N | 6.7 lbs,<br>30 N |

All values listed are maximum values.  
Modular plug tested with the latch depressed.

## 10.5 Discontinuity:

The mated pair shall have no discontinuities greater than 10  $\mu$ s when pulled against the plastic walls in the lower (opposite latch tab) position with 4.5 lbs (20 N) minimum applied in the axial direction. Gauge dimensions and test details are in accordance with IEC 60603-7, Annex A. See Figure 5 below:



**FIGURE 5**

## 10.6 Latch Strength.

Latch Strength will be measured in accordance with EIA-364-98. Samples shall be mounted in a panel cutout as specified on the Customer Print as applicable. The connected pair shall withstand an axial load of 20 pounds minimum at a rate of 0.5 inches per minute.

# Stewart Connector

## 10.7 Mechanical Shock:

Mechanical Shock shall be measured in accordance with EIA-364-27, condition A, with assembled connectors mounted rigidly to table and no discontinuities of >1 microsecond. See Table 12 below:

**Table 12**  
**Mechanical Shock**

| Wave Type | Velocity Change (ft/s) | Number of shocks per direction | Duration Each Face (milliseconds) | Applied Energy (g) | Mutually Perpendicular Axis |
|-----------|------------------------|--------------------------------|-----------------------------------|--------------------|-----------------------------|
| Half Sine | 11.3                   | 6                              | 11                                | 50                 | 3                           |

## 10.8 Vibration (Sinusoidal):

Sinusoidal Vibration shall be measured in accordance with EIA-364-28 Test Condition I, with assembled connectors mounted rigidly to vibrating table and no discontinuities of >1 microsecond. See Table 13 below:

**Table 13**  
**Sinusoidal Vibration**

| Wave Type | Amplitude  | Frequency (Hz) | Duration Each Face (hours) | Mutually Perpendicular Axis |
|-----------|------------|----------------|----------------------------|-----------------------------|
| Sine      | .06 in. DA | 10 to 55       | 2                          | 3                           |

## 10.9 Vibration (Random):

Random Vibration shall be measured in accordance with EIA-364-28 Test Condition V Letter D, with assembled connectors mounted rigidly to vibrating table and no discontinuities of >1 microsecond. See Table 14 below:

**Table 14**  
**Random Vibration**

| Frequency (Hz) | Duration Each Face (minutes) | Overall rms (g) | Mutually Perpendicular Axis |
|----------------|------------------------------|-----------------|-----------------------------|
| 50 to 2000     | 90                           | 11.95           | 3                           |

## 10.10 RJ-11 Insertion:

Eight and Ten position RJ-45 jack samples shall withstand being mated 200 times with a properly terminated six-position RJ-11 plug as specified in EIA/TIA-570.

# Stewart Connector

## 10.11 Rotational Test:

Samples shall exhibit no discontinuities of >1 microsecond when subjected to the following test sequence. See Table 15 below:

**Table 15**  
**Rotational Test**

| Plug | Plug Blade Height | Weight          | Angle | Cycle Time | Cycles |
|------|-------------------|-----------------|-------|------------|--------|
| RJ45 | 0.242" / 6.15 mm  | 10 lbs / 44.5 N | 45°   | 6 sec      | 3 CW   |
| RJ45 | 0.242" / 6.15 mm  | 10 lbs / 44.5 N | 45°   | 6 sec      | 3 CCW  |

## 11.0 Environmental Conditions

Note: Unless otherwise specified, all environmental testing is to be done with the connector in the mated state.

## 11.1 Temperature Life:

Temperature life shall be measured in accordance with EIA-364-17, per method A. See Table 16 below:

**Table 16**  
**Temperature Life**

| Temperature (°C) | Duration (hours) |
|------------------|------------------|
| 85±2             | 500              |

## 11.2 Thermal Shock:

Thermal Shock shall be measured in accordance with EIA/TIA-568. See Table 17 below:

**Table 17**  
**Thermal Shock**

| Temperature (±3 °C) | Number of Cycles | Duration at Each Extreme (Minutes) | Test Condition |
|---------------------|------------------|------------------------------------|----------------|
| -40 to +85          | 25               | 30                                 | 1              |

## 11.3 Temperature / Humidity:

Temperature / Humidity shall be measured in accordance with TIA-568 and EIA-364-31, per method A. See Table 18 below:

**Table 18**  
**Temperature / Humidity**

| Relative Humidity (±3 %) | Low Temperature (±2 °C) | High Temperature (±2 °C) | Cold Sub-cycle (±2 °C) | Cycle Time (hours) | Number Of Cycles |
|--------------------------|-------------------------|--------------------------|------------------------|--------------------|------------------|
| 93                       | 25                      | 65                       | -10                    | 24                 | 21               |