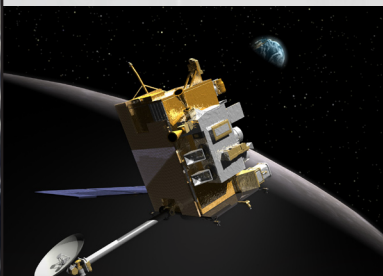
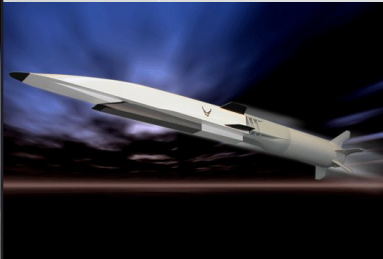
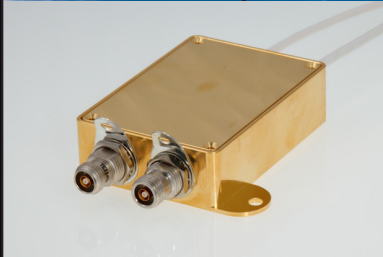
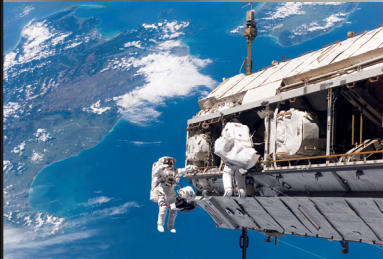




PHOENIX LOGISTICS INC.



# *Space Level Screening Services*

Phoenix Logistics, Inc., 2507 West Geneva Drive, Tempe, AZ 85282

Tel: 602-231-8616 | eMail: [space@phxlogistics.com](mailto:space@phxlogistics.com) | Web: [www.phxlogistics.com](http://www.phxlogistics.com)

Phoenix Logistics, Inc.

# EEE Components

Test Plan Suite

# TABLE OF CONTENTS

<b>1553 DATA BUS TWINAX CONNECTORS .....</b>	<b>6</b>
<b>VISUAL .....</b>	<b>6</b>
<b>MECHANICAL.....</b>	<b>7</b>
<b>DIELECTRIC WITHSTANDING VOLTAGE.....</b>	<b>8</b>
<b>INSULATION RESISTANCE.....</b>	<b>9</b>
<b>FORCE TO ENGAGE AND DISENGAGE(BAYONET AND THREADED) .....</b>	<b>10</b>
<b>COUPLING AND CABLE RETENTION .....</b>	<b>11</b>
<b>MATERIAL OUTGASSING EVALUATION.....</b>	<b>12</b>
<b>VACUUM OUTGAS BAKE-OUT.....</b>	<b>13</b>
<b>CONTACT ENGAGEMENT &amp; SEPARATION FORCE (PLI BAYONET AND THREADED)</b> <b>.....</b>	<b>14</b>
<b>MAGNETIC PERMEABILITY.....</b>	<b>15</b>
<b>COUPLING PROOF TORQUE(TRT THREADED PLUGS, ONLY) .....</b>	<b>16</b>
<b>VIBRATION – HIGH FREQUENCY .....</b>	<b>17</b>
<b>SHOCK.....</b>	<b>18</b>
<b>THERMAL SHOCK.....</b>	<b>19</b>
<b>INSULATED WIRE .....</b>	<b>20</b>
<b>VISUAL/MECHANICAL .....</b>	<b>20</b>
<b>INSULATION FLAWS.....</b>	<b>21</b>
<b>WRAP TEST (EXTRUDED INSULATIONS) .....</b>	<b>22</b>
<b>CROSSLINKING PROOF(CROSSLINKED ETFE INSULATIONS, ONLY).....</b>	<b>23</b>
<b>BEND .....</b>	<b>24</b>
<b>WET DIELECTRIC .....</b>	<b>25</b>
<b>LAMINATION SEALING(TAPE SINTERED INSULATIONS).....</b>	<b>26</b>
<b>CONDUCTOR RESISTANCE.....</b>	<b>27</b>
<b>INSULATION RESISTANCE.....</b>	<b>28</b>
<b>SOLDERABILITY(TIN OR SILVER COATED, ONLY).....</b>	<b>29</b>
<b>FLAMMABILITY.....</b>	<b>30</b>
<b>INSULATION BLOCKING .....</b>	<b>31</b>
<b>COLD BEND.....</b>	<b>32</b>
<b>CONCENTRICITY OF FINISHED WIRE .....</b>	<b>33</b>
<b>ELONGATION AND TENSILE STRENGTH.....</b>	<b>34</b>

<i>SHRINKAGE</i> .....	36
<i>MATERIAL OUTGASSING EVALUATION</i> .....	37
<b><i>RESISTORS – WIREWOUND</i></b> .....	<b>38</b>
<i>VISUAL INSPECTION</i> .....	38
<i>MECHANICAL</i> .....	39
<i>DC RESISTANCE</i> .....	40
<i>CONDITIONING</i> .....	41
<i>RADIOGRAPHIC INSPECTION</i> .....	42
<i>SOLDERABILITY</i> .....	43
<i>RESISTANCE TO SOLVENTS</i> .....	44
<i>THERMAL SHOCK</i> .....	45
<i>RESISTANCE TEMPERATURE CHARACTERISTIC</i> .....	46
<i>LOW TEMPERATURE STORAGE</i> .....	47
<i>LOW TEMPERATURE OPERATION</i> .....	48
<i>SHORT TIME OVERLOAD</i> .....	49
<i>TERMINAL STRENGTH</i> .....	50
<i>DIELECTRIC WITHSTANDING VOLTAGE</i> .....	51
<i>INSULATION RESISTANCE</i> .....	52
<i>MOISTURE RESISTANCE</i> .....	53
<i>SHOCK</i> .....	54
<i>VIBRATION – HIGH FREQUENCY</i> .....	55
<i>LIFE</i> .....	56
<i>HIGH TEMPERATURE EXPOSURE</i> .....	57
<b><i>RF COAXIAL CABLE</i></b> .....	<b>58</b>
<i>VISUAL/MECHANICAL</i> .....	58
<i>JACKET FLAWS</i> .....	59
<i>CONTINUITY</i> .....	60
<i>VOLTAGE WITHSTANDING</i> .....	61
<i>CHARACTERISTIC IMPEDANCE</i> .....	62
<i>ATTENUATION &amp; VSWR</i> .....	63
<i>CAPACITANCE</i> .....	64
<i>STRESS CRACK RESISTANCE</i> .....	65
<i>BENDABILITY(SEMI-RIGID, ONLY)</i> .....	66
<i>DIMENSIONAL STABILITY</i> .....	67

<i>FLAMMABILITY(FLEXIBLE, ONLY)</i> .....	68
<i>MATERIAL OUTGASSING EVALUATION</i> .....	69
<b><i>RF CONNECTORS</i></b> .....	<b>70</b>
<i>VISUAL</i> .....	70
<i>MECHANICAL</i> .....	71
<i>DIELECTRIC WITHSTANDING VOLTAGE</i> .....	72
<i>INSULATION RESISTANCE</i> .....	73
<i>FORCE TO ENGAGE AND DISENGAGE (BAYONET AND THREADED)</i> .....	74
<i>COUPLING PROOF TORQUE(THREADED PLUGS, ONLY)</i> .....	75
<i>HERMETIC SEAL TEST (COMMERCIAL PRESSURIZED, ONLY)</i> .....	76
<i>CENTER CONTACT RETENTION (CAPTIVATED CONTACT TYPES, ONLY)</i> .....	77
<i>MATERIAL OUTGASSING EVALUATION</i> .....	78
<i>VACUUM OUTGAS BAKE-OUT</i> .....	79
<i>MAGNETIC PERMEABILITY</i> .....	80
<i>THERMAL SHOCK</i> .....	81
<i>VIBRATION – HIGH FREQUENCY</i> .....	82
<i>SHOCK</i> .....	83
<i>CABLE RETENTION FORCE</i> .....	84
<b><i>TRANSFORMERS</i></b> .....	<b>85</b>
<i>VISUAL AND DIMENSIONAL INSPECTION</i> .....	85
<i>INSULATION RESISTANCE</i> .....	86
<i>DC RESISTANCE</i> .....	87
<i>WINDING INDUCTANCE</i> .....	88
<i>URNS RATIO &amp; POLARITY</i> .....	89
<i>THERMAL SHOCK</i> .....	90
<i>VIBRATION – HIGH FREQUENCY</i> .....	91
<i>POWER BURN-IN</i> .....	92
<i>DIELECTRIC WITHSTANDING VOLTAGE:</i> .....	93
<i>HIGH ALTITUDE</i> .....	93
<i>INDUCED VOLTAGE</i> .....	94
<i>RADIOGRAPHIC INSPECTION</i> .....	95
<i>TEMPERATURE RISE</i> .....	96
<i>OVERLOAD</i> .....	98
<i>RESISTANCE TO SOLDERING HEAT</i> .....	99

*TERMINAL STRENGTH*..... 100  
*SHOCK*..... 101  
*LIFE* ..... 102  
*MATERIAL OUTGASSING EVALUATION*..... 103  
***CONNECTOR: D-SUBMINIATURE***..... **104**  
*RESIDUAL MAGNETISM*..... 104  
***CONTACTS***..... **105**  
*RESIDUAL MAGNETISM*..... 105

# VISUAL

## 1553 DATA BUS TWINAX CONNECTORS

- 1.0 PURPOSE:** To visually inspect connectors for workmanship criteria. There shall be no evidence of defects as defined in the procedure.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section C2, Table 2I, 3I and 4A
- 3.0 TEST EQUIPMENT:**
  - 3.1** Microscope
- 4.0 PROCEDURE:**
  - 4.1** Perform the following inspections at 3X magnification, minimum, progressively higher magnification as necessary to examine anomalies on 100% of each lot for Screening or a sample of three (3), minimum, with zero (0) failures allowed for Qualification.
    - 4.1.1** Insert/Insulator Body – Insert to shell positioning and orientation, cracks, chips, blisters, pinholes and marking.
    - 4.1.2** Shell/Body – Cracks, dents, burrs, sharp edges, finish for peeled or blistered/ scratches/ exposed base metal/ corrosion or discoloration, marking completeness and legibility.
    - 4.1.3** Threads (when applicable) – Coupling for nicks/ dents/ voids or burrs and that hardware is attached.
    - 4.1.4** Adhesives/Molding Material – Excess bonding material(overflow) and voids
    - 4.1.5** Leads (when applicable) – Bent, nicked, cracked/broken leads, burrs and finish for peeling, corrosion or exposed base metal.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MECHANICAL

## 1553 DATA BUS TWINAX CONNECTORS

- 1.0 **PURPOSE:** To mechanically inspect the connector to ensure the dimensions conform to the Military Specification Sheet or Commercial Source Control Drawing of the connector under test, as applicable.
- 2.0 **TEST SPECIFICATIONS:**
  - 2.1 NASA EEE-INST-002, Section C2, Table 2I and 3I
- 3.0 **TEST EQUIPMENT:**
  - 3.1 Mechanical measuring equipment as required for type of measurement
- 4.0 **PROCEDURE:**
  - 4.1 Perform mechanical inspection of all dimensions and record on a sample of two (2), minimum, per lot with zero (0) failures allowed for Screening or a sample of (3) minimum with (0) failures allowed for Qualification.
- 5.0 **RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DIELECTRIC WITHSTANDING VOLTAGE

## 1553 DATA BUS TWINAX CONNECTORS

**1.0 PURPOSE:** To prove the connector can operate safely at its rated voltage and withstand momentary over potentials due to switching, surges and other similar phenomena. While voltage is applied there shall be no arcing or breakdown between terminal points and leakage current shall not exceed 2.0 mA.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 2I and 3I

**2.2** MIL-STD-202, Method 301

**3.0 TEST EQUIPMENT:** Biddle AC Hypot Tester, Model #230315; or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:** Perform testing on a sample of two (2) per lot, minimum, with zero (0) failures allowed for Screening or a sample of three (3), minimum, with zero (0) failures allowed for Qualification.

**4.1** Assemble connector onto cable prior to testing.

**4.2** Connect one Hypot lead to the center contact. Connect the other lead to the intermediate contact.

**4.3** Apply 1200 VRMS slowly (500 volts per second) at a uniform rate and maintain for 60 seconds then return to zero.

**4.4** While voltage is applied there shall be no arcing or breakdown between terminal points and leakage current shall not exceed 2.0 mA.

**4.5** Connect one Hypot lead to the intermediate contact. Connect the other lead to the shield or connector body.

**4.6** Apply 500 VRMS slowly and at a uniform rate and maintain for 60 seconds; then return to zero.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION RESISTANCE

## 1553 DATA BUS TWINAX CONNECTORS

**1.0 PURPOSE:** To measure the resistance offered by the insulating members of the connector under test. Resistance shall be equal to or greater than 5000 M Ohms.

**2.0 TEST SPECIFICATIONS:**

2.1 EIA 364.21

2.2 NASA EEE-INST-002, Section C2 Tables 2I and 3I

**3.0 TEST EQUIPMENT:** Megohm-meter; Beckman L-8 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:**

4.1 Perform testing on a sample of two (2) per lot, minimum, with zero (0) failures allowed for Screening or a sample of three (3), minimum, with zero (0) failures allowed for Qualification.

4.2 Connect one lead of the Megohm-meter to the center contact. Connect the other lead to the intermediate contact.

4.3 Set meter to 500 Volts. Depress the meter "TEST" button.

4.4 The Megohm meter will indicate an initial low reading; then go up and indicate a steady reading.

4.5 Repeat test between intermediate contact and either the shield, or the outer body.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# FORCE TO ENGAGE AND DISENGAGE

## 1553 DATA BUS TWINAX CONNECTORS - BAYONET AND THREADED

- 1.0 PURPOSE:** To assess the Engagement and Separation Force of the connector.
- 1.1** During the entire coupling/uncoupling cycle the forces or torques shall not exceed the following:
- 1.1.1** Bayonet Connectors – Longitudinal force shall not exceed 4 lbs, or as specified. Torque shall not exceed 2.5 in/lbs, or as specified.
  - 1.1.2** Threaded Connectors – Torque shall not exceed 2.5 in/lbs, or as specified.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** MIL-PRF-49142, paragraph 3.5.1
  - 2.2** NASA EEE-INST-002, Section C2, Table 2I and 3I
- 3.0 TEST EQUIPMENT:**
- 3.1** Qualified mating connector
  - 3.2** Force Gage/Torque Gage with uncertainty of 5% max of reading
- 4.0 PROCEDURE:**
- 4.1** Perform testing in accordance with MIL-PRF-49142, paragraph 4.6.2.1 on a sample of two (2) connectors per lot, minimum, with zero (0) failures allowed for Screening or a sample of three (3) connectors, minimum, with zero (0) failures allowed for Qualification.
  - 4.2** Secure one connector in a holding fixture and the other into an axial aligned fixture with a force gage attached.
  - 4.3** Mate connectors until fully engaged and then disengaged with the force or torque under constant monitoring during the coupling / uncoupling cycle.
    - 4.3.1** Bayonet connector is fully engaged when the bayonet studs have passed the detent and their reference planes coincide. No additional tightening torque shall be applied.
    - 4.3.2** Threaded connector is fully engaged when their reference planes coincide.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# COUPLING AND CABLE RETENTION

## 1553 DATA BUS TWINAX CONNECTORS

- 1.0** **PURPOSE:** To verify cable and connector termination will withstand the applied force without effect to electrical continuity through connections or mating and de-mating.
- 2.0** **TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section C2, Table 2I & 3I
- 3.0** **TEST EQUIPMENT:**
  - 3.1** Qualified mating connector
  - 3.2** Push/Pull Fixture
  - 3.3** Force Gage with uncertainty of 5% max of reading
- 4.0** **PROCEDURE:**
  - 4.1** Perform testing on a sample of two (2) connectors minimum per lot with zero (0) failures allowed for Screening and a sample of three (3) connectors minimum with zero (0) failures allowed for Qualification.
  - 4.2** Terminate connectors to their proper cables and mate.
  - 4.3** Secure one cable in the Push/Pull Fixture clamp. Secure the other end into the clamp on the other end of the Push/Pull Fixture clamp attached to the force gage.
  - 4.4** Pull longitudinally away from the mated connectors in such a manner that the cable remains unbent and twisted.
  - 4.5** Apply a force of 40 lbs, minimum or as otherwise specified and hold for 30 seconds, minimum.
  - 4.6** After test, inspect connector for mechanical failures, loosening, or rupture and test for continuity.
- 5.0** **RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MATERIAL OUTGASSING EVALUATION

## ALL EEE COMPONENTS

- 1.0 PURPOSE:** To verify all nonmetal materials outgassing properties do not exceed the limits of 1% TML or 0.1% CVCM. This evaluation shall be performed during the initial design review process. Outgassing can occur in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can also become more rigid or brittle.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002
  - 2.2 ASTM-E595
  - 2.3 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
- 3.1 N/A; verification by analysis
- 4.0 PROCEDURE:**
- 4.1 Evaluate all nonmetal materials for outgassing properties during the initial design review process of an assembly that will incorporate said materials.
  - 4.2 Materials to be used in a design shall be selected from NASA Reference Publication 1124 at <http://outgassing.nasa.gov>
    - 4.2.1 Materials listed in NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.
      - 4.2.1.1 Materials listed that meet TML and CVCM limits may have been baked out prior to evaluation in order to reduce Outgassing, if so the Outgassing bake out may have to be performed to achieve acceptable levels of Outgassing; reference VACUUM OUTGAS BAKE-OUT Test Plan.
    - 4.2.2 Perform testing in accordance with ASTM-E595 for any material planned for use in a design that is not listed as acceptable.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VACUUM OUTGAS BAKE-OUT

## ALL NONMETAL MATERIALS

- 1.0 PURPOSE:** To control outgassing of all nonmetal materials utilized in a finished part assembly or finish part component. This test is required at the component level per NASA EEE-INST-002. After vacuum outgas bake-out, materials shall not exceed 1% (TML) or 0.1% (CVCM).
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002
  - 2.2 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
- 3.1 Vacuum evacuation oven chamber
  - 3.2 Torr Indicator Gauge
- 4.0 PROCEDURE:**
- 4.1 Perform vacuum outgassing bake-out on all finished part assemblies and finished part components that utilize any nonmetal material following completion of all manufacturing processes and prior to final test for shipment.
    - 4.1.1 Expose test specimens to 125 ° C at 10 to the -6 Torr vacuum for 24 hours.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CONTACT ENGAGEMENT & SEPARATION FORCE

## 1553 DATA BUS TWINAX CONNECTORS

### PLI-MANUFACTURED; BAYONET AND THREADED

**1.0 PURPOSE** – To measure the force required to fully engage and separate standard test pins with individual contacts. After forces are applied, the inside diameter of the contact shall meet specification requirements.

#### **2.0 TEST SPECIFICATIONS**

**2.1** ANSI/EIA-364-37, Method A

**3.0 TEST EQUIPMENT:** Contact member holding fixture, Force Gage with uncertainty of 5% Max of reading and the following Test Pins: TL1000-001 through TL1000-006 as indicated in TABLE 1

**TABLE 1**

Part No.	Description	Engagement Max Test Pin	Test Criteria	Separation Min Test Pin	Test Criteria
Q40125-001	Center Socket of Q30164-001	TL1000-001 .0245"	16 oz Max	TL1000-002 .0235"	0.5 oz Min.
Q40124-001	Outer Body of Q30163-001	TL1000-003 .074"	64 oz Max	TL1000-004 .072"	1.0 oz Min
Q40121-001	Inner Housing of Threaded Plug Connector	TL1000-005 .241"	64 oz Max	TL1000-006 .239"	1.0 oz Min

**4.0 PROCEDURE:** Refer to Table 1 and EIA-364-37

**4.1** Perform testing in accordance with EIA-364-37, Method A on 100% of the lot for Screening or a sample of three (3), minimum, with zero (0) failures allowed for Qualification with the following details:

**4.1.1** Clean test pins prior to use and again every 10 cycles.

**4.1.2** Condition the contact prior to test by inserting and removing the maximum test pin one time.

**4.1.3** Place the socket member into a holding fixture and align axially with the test pin connected to the force gage.

**4.1.4** Engage (insert) the maximum test pin at the specified rate to the specified depth while measuring the force required, and then remove.

**4.1.4.1** Apply force gradually at a rate of 2" per minute maximum to a depth of .100 +/- .010".

**4.1.5** Engage (insert) the minimum test pin to the specified depth and then separate at the specified rate while measuring the force required.

**4.1.5.1** Apply force gradually at a rate of 2" per minute maximum to a depth of .100 +/- .010".

**4.1.6** Measure inside diameter after force test to ensure it is still within specification tolerance.

**5.0 RECORD DATA:** Document test results on the following data sheets or within an attached test report.

# MAGNETIC PERMEABILITY

## 1553 DATA BUS CONNECTORS / RF CONNECTORS

**1.0 PURPOSE:** To determine whether the magnetic permeability of the specimen is below a specified value. The indicator magnet shall not pull out of the indicator during application to the surfaces of the connector.

**2.0 TEST SPECIFICATIONS:**

2.1 ANSI/EIA-364, Test Procedure 54

**3.0 TEST EQUIPMENT:**

3.1 Permeability Indicator, Low-Mu: Severn Engineering Co., Permeability Indicator #3904, or equivalent

**4.0 PROCEDURE:**

4.1 Perform testing on a fully assembled connector, connector components, or contacts; as specified.

4.2 Use a 2.0 Mu pellet (Indicator insert) unless otherwise specified by the customer.

4.3 Apply the magnet of the indicator to and delicately remove from all areas of the connector.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# COUPLING PROOF TORQUE

## 1553 DATA BUS TWINAX CONNECTORS

### TRT THREADED PLUGS, ONLY

- 1.0 PURPOSE:** To ensure when the connector is engaged to the specified torque value of the MIL-PRF-49142 specification sheet for the connector under test. The coupling mechanism shall not be dislodged and the connector shall still conform to the dimensional and force to engage/disengage requirements.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1 MIL-PRF-49142, paragraph 4.6.3
  - 2.2 NASA EEE-INST-002, Section C2, Table 3I
- 3.0 TEST EQUIPMENT:**
  - 3.1 Mating Standard Part – Steel jig containing the critical interface dimensions finished to the tolerances specified in MIL-STD-348
  - 3.2 Force Gage/Torque Gage with uncertainty of 5% maximum of reading
- 4.0 PROCEDURE:**
  - 4.1 Perform testing in accordance with MIL-PRF-49142, paragraph 4.6.3 and the MIL-PRF-49142 specification sheet for the connector under test on a sample of three (3), minimum, with zero (0) failures allowed for Qualification.
  - 4.2 Engage the connector under test with the Mating Standard Part and tighten the coupling nut to the torque value of the MIL-PRF-49142 specification sheet of the connector under test.
  - 4.3 Let the connector stand mated for one minute, then disengage it.
  - 4.4 Post-test:
    - 4.4.1 Perform FORCE TO ENGAGE/DISENGAGE–DATA BUS TWINAX CONNECTORS testing per its Test Plan and the MIL-PRF-49142 specification sheet for the connector under test and attach test data.
    - 4.4.2 Following the Force to Engage/Disengage test inspect interface dimensions per the MIL-PRF-49142 specification sheet for the connector under test.
- 5.0 RECORD DATA:** Document test results on the following data sheets or within an attached test report.

# VIBRATION – HIGH FREQUENCY

## 1553 TWINAX DATA BUS CONNECTORS

**1.0 PURPOSE:** To assess the ability of the connector components to withstand specified severities of vibration that may be encountered during the life of the connector. There shall be no damage or loosening of connector parts and no discontinuities greater than one microsecond as a result of vibration.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 3I

**2.2** MIL-STD-202, Method 204, Test Condition B

**2.2.1** Or ANSI/EIA-364-28, Test Plan 28, Test Condition IV (except at 15g peak)

**3.0 TEST EQUIPMENT:**

**3.1** Vibration System

**3.2** Voltage Generator

**3.3** Oscilloscope; or equivalent

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-202, Method 204, Test Condition D or ANSI/EIA-364-28, Test Condition IV (except at 15g peak) on a sample of three (3), minimum, with zero (0) failures allowed as follows:

**4.1.1** Assemble connectors onto cable and mate.

**4.1.2** Wire the inner and outer conductors in a series circuit with 100 mA of current flow applied.

**4.1.3** Monitor connectors for discontinuities throughout testing.

**4.1.4** Examine connector after vibration for damage or loosening of connector parts.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHOCK

## 1553 TWINAX DATA BUS CONNECTORS

- 1.0 PURPOSE:** To determine the ability of the component to withstand applied mechanical shocks to simulate field environments. Throughout testing there shall be no discontinuities greater than one microsecond. As a result of shock pulses there shall be no damage or loosening of the connector parts.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section C2, Table 3I
  - 2.2** MIL-STD-202, Method 213, Test Condition I (100 Gs)
- 3.0 TEST EQUIPMENT:**
  - 3.1** Shock Machine
  - 3.2** Transducers; one for each connector
  - 3.3** Oscilloscope, or equivalent
- 4.0 PROCEDURE:**
  - 4.1** Perform testing in accordance with MIL-STD-202, Method 213, Test Condition I (100G Sawtooth) on a test sample of three (3), minimum, with zero (0) failures allowed for Qualification with the following details:
    - 4.1.1** Assemble connectors onto cable and mate.
    - 4.1.2** Wire the inner and outer conductors in a series circuit with 100 mA of current flow applied.
    - 4.1.3** Apply one shock to each direction of three mutually perpendicular axes of specimen.
    - 4.1.4** Monitor connectors for discontinuities throughout testing.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# THERMAL SHOCK

## 1553 DATA BUS CONNECTORS / RF CONNECTORS

- 1.0 PURPOSE:** To determine the stability of a component when exposed to extremes of high and low temperature. Permanent changes in a component's operating characteristics and physical damage produced during thermal shock usually result from variations in dimensions and other physical properties such as mechanical displacement or rupture of conductors or insulating materials. After cycling is complete there shall be no evidence of damage detrimental to connector operation.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** MIL-STD-202, Method 107, Test Condition B
  - 2.2** NASA EEE-INST-002, Section C2 Tables 3I and 3E
- 3.0 TEST EQUIPMENT:**
- 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 107, Test Condition B on a sample of three (3), minimum, with zero (0) failures allowed for Data Bus Connector Qualification and a sample of four (4) minimum of Group A with zero (0) failures allowed for RF Connector Qualification with the following details:
- 4.1** For examination utilizing an environmental chamber, place connectors into the chamber so there is no obstruction to the flow of air across and around the specimen. Minimize direct heat conduction to the specimen.
  - 4.2** For examination utilizing a liquid bath, see the following:
    - 4.2.1** The liquid method is more severe and may damage some components that would not be damaged by the air method. It is not intended for non-hermetically sealed components.
    - 4.2.2** Do not use a liquid media without prior approval of the qualifying activity.
  - 4.3** Test temperature extremes are -55° C and +125° C.
  - 4.4** Visually examine the connector for damage that is detrimental to the connector operation.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VISUAL/MECHANICAL

## INSULATED WIRE

**1.0 PURPOSE:** To visually inspect wire and its components for material and workmanship criteria. There shall be no evidence of defects as defined in the procedure.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section W1, Table 2A and 3A

**3.0 TEST EQUIPMENT:**

3.1 Microscope

**4.0 PROCEDURE:**

4.1 Perform the following inspections at 3X magnification, minimum; use progressively higher magnification as necessary to examine anomalies and adequate lighting level on a sample of 1 foot per spool, minimum, of each lot with zero (0) failures allowed for Screening.

4.1.1 Require a certificate of compliance from the wire manufacturer that certifies the proper conductor material and finish were used in manufacturing; verify they meet the specification of the wire under test.

4.1.2 Inspect wire samples for the following:

4.1.2.1 Wire insulation – Marking and/or color coding, and workmanship for cracks or splits.

4.1.2.2 Finished wire diameter – Conforms to the specification of the wire under test.

4.1.2.3 Wire strands – Number of strands and AWG of strands conform to the specification of the wire under test, and workmanship for no discoloration, corrosion of the strands, or plating that flakes off with normal flexing.

4.1.2.4 Weight of finished wire, as applicable – Conforms to the specification of the wire under test.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION FLAWS

## INSULATED WIRE

**1.0 PURPOSE:** To detect and remove insulation defects in finished wires.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section W1, Tables 2A

**2.2** MIL-STD-2223, Method 3002 or 3008

**3.0 TEST EQUIPMENT:**

**3.1** AC voltage Generator

**3.2** Bead Chain Electrode

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-2223, either Method referenced, on 100 % of each lot with zero (0) failures allowed for Screening.

**4.1.1** This test is normally performed by the cable manufacturer on 100% of each lot during final winding of the wire on spools. A certificate of compliance from the manufacturer certifying that all wire shipped was subjected to and passed this test is sufficient to meet this requirement.

**4.1.2** If the wire is procured from a QPL manufacturer to military specification, re-screening using one of the above referenced test specifications is not required, but may be performed at the user's discretion.

**4.2** Apply voltage at the required value of the specification of the wire under test, between the electrode and the conductor.

**4.3** Remove all wire lengths where insulation failed.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# WRAP TEST

## INSULATED WIRE – EXTRUDED INSULATIONS

**1.0 PURPOSE:** To determine if the wire is susceptible to cracking when wrapped around its own diameter then exposed to heat. As a result of wrapping and baking, there shall be no evidence of cracking of the insulation.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section W1 Tables 2A

2.2 SAE-AS22759, paragraph 3.6.2.1

2.3 MIL-STD-2223, Method 2003

**3.0 TEST EQUIPMENT:**

3.1 Air Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements

**4.0 PROCEDURE:**

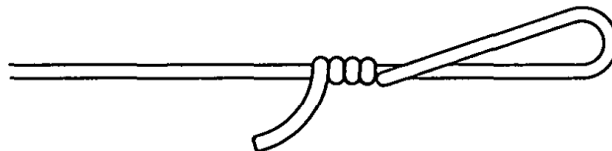
4.1 Perform testing in accordance with SAE-AS22759, paragraph 3.6.2.1 on a sample of 1 foot per spool, minimum, of each lot (plus extra for winding) with zero (0) failures allowed for Screening.

4.2 Bend wire sample back onto itself at the mid-portion and wind one end tightly around the other, as a mandrel, for four close turns. Do not secure ends of the wire; allow unhampered relaxation of the turns. See FIGURE 1.

4.3 Place test samples into chamber and bake for two hours at the temperature required by the specification of the wire under test.

4.4 Remove test samples from the chamber, allow them to cool and then examine them, with no magnification, for cracks in the insulation.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

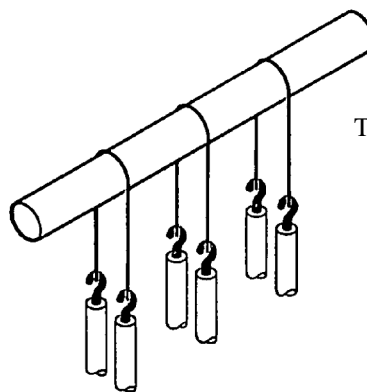


**FIGURE 1**

# CROSSLINKING PROOF

## INSULATED WIRE - CROSSLINKED ETFE INSULATIONS, ONLY

- 1.0 PURPOSE:** To determine if the wire insulation has been converted to a thermoset material by polymer crosslinking. As a result of this test, there shall be no evidence of discoloration or pitting of the insulation and the test sample shall pass both the Bend test and the Wet Dielectric test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1 Tables 2A
  - 2.2 MIL-STD-2223, Method 4001, 2006, and 3005
- 3.0 TEST EQUIPMENT:**
- 3.1 Air Circulating Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements; the air velocity of chamber shall be capable of being maintained at 100-200 feet per minute, as determined at room temperature
  - 3.2 Test Mandrel Rod at a diameter as required by the specification of the wire under test, it may be coated with PTFE to prevent the wire from sticking
  - 3.3 Calibrated Weights
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with MIL-STD-2223, Method 4003 on a sample of 2 feet per lot, minimum, with zero (0) failures allowed for Screening.
  - 4.2 Remove one inch of insulation from both ends of test sample and drape it over the mandrel, approximately centered on the wire.
  - 4.3 Secure test weights, with a value as required by the specification of the wire under test, to each end of the wire.
  - 4.4 Hang mandrel horizontally in the chamber, secure to minimize mechanical movement or vibration during the heating cycle, and bake for seven hours at 300° C, or as required by the specification of the wire under test.
  - 4.5 Remove test sample from the chamber, allow sample to cool and then examine, with no magnification, for color retention and pitting in the insulation.
  - 4.6 Remove weights from wires and remove wires from mandrel and straighten wire.
  - 4.7 Immediately perform and record Bend testing, followed by Wet Dielectric testing in accordance with their respective Test Plans, attach test data.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.



Typical sample arrangement

# BEND

## INSULATED WIRE

- 1.0 PURPOSE:** This test is used as a post-test to mechanically stress the insulation of a wire after environmental or thermal testing. As a result of testing, there shall be no evidence of cracking of the wire insulation.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1 Tables 2A
  - 2.2 MIL-STD-2223, Method 2006
- 3.0 TEST EQUIPMENT:**
- 3.1 Test Mandrel, at a diameter as required by the specification of the wire under test
  - 3.2 Calibrated Weights
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with MIL-STD-2223, Method 2006 at room ambient temperature on a sample of 2 feet per lot, minimum, with zero (0) failures allowed for Screening.
  - 4.2 Once the test sample has reached room ambient temperature following completion of environment or thermal testing, strip wire of approximately 1” of insulation, if not already stripped.
  - 4.3 Secure one end of the wire to a Test Mandrel with a diameter as required by the specification of the wire under test. Secure the other end of the wire to a calibrated weight with a value as required by the specification of the wire under test.
  - 4.4 Rotate mandrel until the full length of the test sample is wrapped around the mandrel, is under the tension from the weight, and all the adjoining coils are in contact.
  - 4.5 Rotate mandrel in reverse until the test sample unwinds and then winds in the opposite direction until the full length of the test sample is wrapped around the mandrel, is under the tension from the weight, and all the adjoining coils are in contact.
  - 4.6 Repeat both rotations one time, so that the test sample has been bent in each direction twice.
  - 4.7 Examine insulation of wire for evidence of cracking of the wire insulation.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# WET DIELECTRIC

## INSULATED WIRE

**1.0 PURPOSE:** To determine the dielectric integrity of the wire insulation following environmental or thermal testing. While voltage is applied there shall be no arcing or breakdown between terminal points.

**2.0 TEST SPECIFICATIONS:**

- 2.1 MIL-STD-2223, Method 3005
- 2.2 NASA EEE-INST-002, Section W1, Table 2A

**3.0 TEST EQUIPMENT:**

- 3.1 Biddle AC Hypot Tester; Model #230315 or equivalent
- 3.2 Water bath, filled with distilled water and 5% by weight of sodium chloride

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK. DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:**

- 4.1 Perform testing in accordance with MIL-STD-2223, Method 3005, at room ambient temperature, on a sample of 2 feet per lot, minimum, with zero (0) failures allowed for Screening.
- 4.2 Following completion of environment or thermal testing, strip wire of approximately 1” of insulation from both ends of wire, if not already stripped; twist the un-insulated ends together and connect to one lead of the Hypot tester. Connect the other lead of the Hypot tester to the bar immersed in the water bath.
- 4.3 Immerse test specimen into the water bath to within 3 inches of the stripped ends and allow to dwell for five hours, minimum.
- 4.4 After dwell time, apply voltage by rotating “Voltage Control” clockwise to the required voltage of the specification for the wire under test, at 60 Hz, slowly and at a uniform rate within 30 seconds, maintain for 5 minutes while monitoring for arcing or breakdown, then return to zero slowly and at a uniform rate within 30 seconds.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# LAMINATION SEALING

## INSULATED WIRE – TAPE SINTERED INSULATIONS

- 1.0 PURPOSE:** To determine if the wire insulation is under sintered and could have degraded properties. As a result of baking, there shall be no evidence of de-lamination (separation of the layers) of the insulation, either along the insulation or at the ends.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1 NASA EEE-INST-002, Section W1 Tables 2A and 3A
  - 2.2 MIL-DTL-81381, paragraph 4.6.4.10
- 3.0 TEST EQUIPMENT:**
  - 3.1 Air Circulating Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:**
  - 4.1 Perform testing in accordance with MIL-DTL-81381, paragraph 4.6.4.10 on a sample of 1 foot per spool, minimum, with zero (0) failures allowed for Screening or for Qualification.
  - 4.2 Test samples shall be cut with the conductor and insulation flush at both ends.
  - 4.3 Place test samples into chamber and bake for 48 hours at the temperature required by the specification of the wire under test.
  - 4.4 Remove test samples from the chamber, allow them to cool, and then examine them, with no magnification, for de-lamination of the insulation, either along the insulation or at the ends.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CONDUCTOR RESISTANCE

## INSULATED WIRE

- 1.0 PURPOSE:** To determine the electrical resistance of solid or stranded conductors. Converted resistance, in ohms/1,000 ft @20° C, shall conform to SAE-AS22759, Table II.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1, Table 2A and 3A
  - 2.2 FED-STD-228, Method 6021.1
  - 2.3 SAE-AS22759, Table II
- 3.0 TEST EQUIPMENT:**
- 3.1 Kelvin Bridge, or equivalent, with an accuracy of 0.1% of reading for wire rated at less than 1 Ohm
  - 3.2 Wheatstone Bridge, or equivalent, with an accuracy of 1% of reading for wire rated at 1 Ohm or above
  - 3.3 Digital thermometer, or equivalent, with accuracy of +/- 0.5° C (0.9° F)
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with FED-STD-228, Method 6021.1 on 40 inches of each spool of each lot, minimum, with zero (0) failures allowed for Screening or Qualification with the following details:
    - 4.1.1 Perform test at 20° C and allow test sample to come to that temperature prior to testing.
    - 4.1.2 Cut test sample at 40" +/- 0.08" and record length.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION RESISTANCE

## INSULATED WIRE

**1.0 PURPOSE:** To determine the insulation resistance of a finished wire sample. While voltage is applied there shall be no arcing or breakdown between terminal points. Insulation resistance shall conform to the specification of the wire under test.

**2.0 TEST SPECIFICATIONS:**

- 2.1 NASA EEE-INST-002, Section W1, Table 3A
- 2.2 MIL-STD-2223, Method 3003

**3.0 TEST EQUIPMENT:**

- 3.1 DC Voltage Generator
- 3.2 Megohm-meter, Beckman L-8 or equivalent
- 3.3 Water bath, filled with distilled water and 5% by weight of sodium chloride

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.**  
**DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:**

- 4.1 Perform testing in accordance with MIL-STD-2223, Method 3003, at room ambient temperature, on a sample of 26 feet per lot, minimum, with zero (0) rejects allowed for Qualification.
- 4.2 Strip wire of approximately 1" of insulation from both ends of wire, twist the un-insulated ends together, and connect to one lead of the Megohm-meter. Connect the other lead of the Megohm-meter to the bar immersed in the water bath.
- 4.3 Immerse test specimen into the water bath to within 6 inches of the stripped ends and allow to dwell for four hours, minimum.
- 4.4 After dwell time, apply 500 VDC +/- 10%.
- 4.5 After 1 minute of applied voltage, measure and record insulation resistance.
- 4.6 Convert to megohms per foot using the following formula:

$$\text{Insulation Resistance of M Ohms/1,000 FT} = \frac{\text{Measured Resistance} \times \text{Immersed Length}}{1,000 \text{ feet}}$$

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SOLDERABILITY

## INSULATED WIRE – TIN OR SILVER COATED, ONLY

- 1.0 PURPOSE:** To determine the solderability of all terminations which are normally joined by a soldering operation. Following the test, the preassembly lead finish of the resistor leads shall show evidence of good wetting with no evidence of pin holes, proving to provide a solderable surface of sufficient quality to enable satisfactory soldering.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1, Table 3A
  - 2.2 MIL-STD-202, Method 208
  - 2.3 ANSI/J-STD-002 and ANSI/J-STD-006
- 3.0 TEST EQUIPMENT:**
- 3.1 Solder pot, maintained in accordance with ANSI/J-STD-002, paragraph 4.2.1.1.1
  - 3.2 Dipping Device, in accordance with ANSI/J-STD-002, paragraph 4.2.1.1.2
  - 3.3 Microscope
- 4.0 PROCEDURE:**
- 4.1 Perform test in accordance with ANSI/J-STD-002, Test A on 1 foot per spool, minimum, with zero (0) rejects allowed for Qualification, with the following details and exceptions as required by MIL-STD-202, Method 208:
    - 4.1.1 The Contractual agreements statement in ANSI/J-STD-002 does not apply. The resistor specification requirements will be followed.
    - 4.1.2 Follow ANSI/J-STD-002, Test A with no steam aging required.
  - 4.2 Strip wire to a length that allows the exposed conductor to be immersed into the solder pot without touching the sides or bottom of the pot and attach the dipping fixture around the wire insulation to perform solderability testing.
  - 4.3 Verify flux is in accordance with ANSI/J-STD 002, paragraph 3.2.2 and immerse exposed conductor into flux approximately perpendicular to the surface of the flux and up to within 0.050 inches of the wire insulation. Let it remain in the flux for 5 seconds, then remove from flux and allow it to dry while suspended above the flux station for 5 – 20 seconds.
  - 4.4 Ensure solder is Sn63Pb37 per ANSI/J-STD-006 and measure the temperature of solder in the solder pot to ensure temperature is 245 +/- 5° C (473 +/- 9° F).
  - 4.5 Immerse fluxed exposed conductor into solder pot approximately perpendicular to the surface of the solder, up to within 0.050 inches of the wire insulation at a immerse and withdrawal rate of 0.984 +/-0.24 inches per second with a dwell time of 5 +/-0.5 seconds.
  - 4.6 After withdrawal allow solder to solidify by air cooling while wire is maintained in the same perpendicular attitude, then gently clean flux from exposed conductor.
  - 4.7 Visually examine the exposed conductor under 10X magnification, up to 30X referee magnification, to ensure there is good wetting over 95% of the area of the exposed conductor, per ANSI/J-STD-002, Appendices A and B.
  - 4.8 Repeat process until the entire length of the 1 foot test specimen has been tested.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# FLAMMABILITY

## INSULATED WIRE

**1.0 PURPOSE:** Verify the flammability and/or self extinguishing properties of the insulated wire are compatible with the environment in which the insulated wire will be operating. Testing is only required for insulation types that have unknown flammability properties as described in NASA-INST-002, Section W1, Page 1. The distance of upward flame travel and the time of flaming after removal of the test flame shall conform to the specification of the insulated wire under test. If not specified, any flame in the wire insulation shall be self extinguishing within 3 seconds, maximum, after test flame removal. Breaking of the test sample in cable sizes 24 AWG and smaller shall not be cause for failure as long as the other test parameters are within limits.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA-INST-002, Section W1, Page 1 and Table 3A

2.2 SAE AS22759 paragraph 3.6.15

**3.0 TEST EQUIPMENT:**

3.1 Flammability Test Chamber, in accordance with AS22759, paragraph 4.5.18.1

3.2 Bunsen type gas burner, in accordance with AS22759, paragraph 4.5.18.1

**4.0 PROCEDURE:** Perform testing in accordance with AS22759, paragraph 3.6.15 on a sample of 2 feet per lot, minimum, with zero (0) failures allowed for Qualification.

**NOTE:** Testing is only required for insulation types that have unknown flammability properties as described in NASA-INST-002, Section W1, Page 1.

4.1 Mark the wire test sample at 8" from one end to indicate point of test flame contact.

4.2 Clamp the test sample tautly, at a 60° angle from horizontal, into the sample holder with the marked end at the bottom.

4.3 Apply test flame for the period of time as follows, according to wire size:

4.3.1 Size 30 – 18: 15 seconds

4.3.2 Size 16 – 20: 30 seconds

4.3.3 Size 10 – 4: 1 minute

4.3.4 Larger sizes: 2 minutes

4.4 Withdraw the test flame, measure, and record the duration of the after flame and the burned length of the test sample.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION BLOCKING

## INSULATED WIRE

**1.0 PURPOSE:** Determine if the wire insulation material has been formulated and applied consistently enough to meet the maximum rated performance of the wire under test. As a result of winding and baking, the adjacent turns or layers of wire shall not stick to one another.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section W1 Tables 3A

2.2 SAE-AS22759, paragraph 3.6.3

2.3 MIL-STD-2223, Method 4007

**3.0 TEST EQUIPMENT:**

3.1 Air Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements

3.2 Metal Spool or metal mandrel; with a diameter 50X the diameter of the finished wire for size 30 through 14, 40X for size 12 and 10, and 30X for sizes 8 through 2

**4.0 PROCEDURE:**

4.1 Perform testing in accordance with SAE-AS22759, paragraph 3.6.3 on a sample of 2 feet per lot, minimum, of each lot with zero (0) failures allowed for Qualification.

4.2 Affix one end of the wire to the metal spool.

4.3 Wind wire helically on the spool for at least three turns, at a tension equal to the cold bend test load requirement of the wire specification for the wire under test, and with succeeding turns in close contact with one another.

4.4 Continue winding until there are at least three closely wound layers of such helical turns on the spool. See FIGURE 1.

4.5 Affix the loose wire end to the spool well enough to prevent unwinding or loosening of the turns or layers.

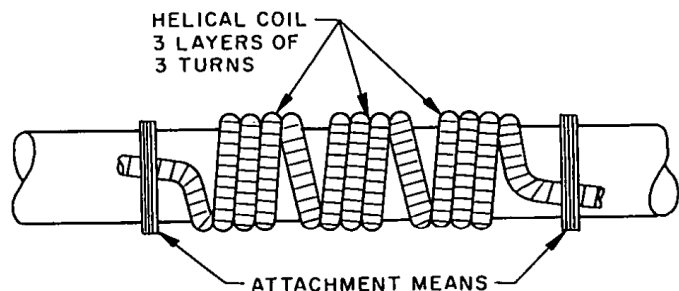
4.6 Place test sample on the spool into air chamber and bake for twenty four hours at the temperature required by the specification of the wire under test.

4.7 Remove test sample and spool from the chamber and allow them to cool to room temperature.

4.8 After cooling, manually unwind the wire from the spool while examining for evidence of adhesion (blocking) of adjacent turns or layers.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

**FIGURE 1**



# COLD BEND INSULATED WIRE

- 1.0 PURPOSE:** To evaluate the results of mechanically stressing the insulation of a wire in a cold environment. As a result of conditioning, there shall be no evidence of cracking of the wire insulation.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1 Tables 3A
  - 2.2 SAE-AS22759, paragraph 3.6.7
  - 2.3 MIL-STD-2223, Method 2004
- 3.0 TEST EQUIPMENT:**
- 3.1 Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements and is set up to allow for turning the Metal Spool from the outside of chamber.
  - 3.2 Metal Spool, at a diameter as required by the specification of the wire under test
  - 3.3 Calibrated Weights
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with SAE-AS22759, paragraph 3.6.7 on a sample of 2 feet, minimum, per lot with zero (0) failures allowed for Qualification with the following details:
    - 4.1.1 Secure one end of the wire to the Metal Spool with a diameter as required by the specification of the wire under test. Secure the other end of the wire to a calibrated weight with a value as required by the specification of the wire under test.
    - 4.1.2 Place the spool into the chamber so that the spool can be rotated from the outside of the chamber.
    - 4.1.3 Condition the wire and spool at the temperature required by the specification of the wire under test for 4 hours.
    - 4.1.4 After conditioning, but still at test temperature, slowly rotate the spool at a rate of 2 +/-1 RPM until the full length of the test sample is wrapped around the spool.
    - 4.1.5 Remove the spool and test sample from the chamber and allow both to warm to room temperature.
    - 4.1.6 Remove the test sample from the spool, without straightening, and examine the insulation of wire without magnification for evidence of cracking of the wire insulation.
    - 4.1.7 Do not perform post exposure dielectric test; NASA EEE-INST-002 does not require it.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CONCENTRICITY OF FINISHED WIRE

## INSULATED WIRE

**1.0 PURPOSE:** To verify the wall thickness of finished wire insulation is consistent. The ratio of concentricity shall be  $\geq 70\%$ .

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section W1, Table 3A

**3.0 TEST EQUIPMENT:**

**3.1** Mechanical measuring equipment; as required for type of measurement.

**4.0 PROCEDURE:**

**4.1** Perform testing on a sample of 1 foot, minimum, per lot with zero (0) failures allowed for Qualification.

**4.2** Cross section the wire sample; potted if necessary.

**4.3** Measure and record the maximum wall thickness and the minimum wall thickness of the sample.

**4.4** Calculate the % concentricity of concentric lay wires utilizing the following formula:

**4.4.1** % Concentricity (ratio) = (Maximum wall thickness – minimum wall thickness) X 100

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# ELONGATION AND TENSILE STRENGTH

## INSULATED WIRE

- 1.0 PURPOSE:** To determine the elongation and tensile strength of soft or annealed solid copper conductors of insulated wire, applicable to both coated and uncoated conductors. Tensile strength shall be in accordance with the specification for the conductor material (EX: ASTM B298 for silver coated copper).
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1, Table 3A
  - 2.2 FED-STD-228, Method 3211
  - 2.3 FED-STD-228, Method 1421
- 3.0 TEST EQUIPMENT:**
- 3.1 Pull test fixture that is power driven with a rate of travel of 10 +/- 2 inches per minute and a capacity rating that is 15 - 85% of the force required to break the specimen. Fixture shall have a dial indicator, indicator scale, or automatic recorder that remains at the maximum force after rupture without recoiling and is accurate within +/- 1%.
    - 3.1.1 The grips of the fixture shall be spool type for wire diameters less than 0.208", wedge type for wire diameters of 0.208" or larger
  - 3.2 Micrometer Caliper graduated to read in 0.0001" (0.1 mil) with flat jaw surfaces of approximately 1.25" diameter
  - 3.3 Calibrated ruler
- 4.0 PROCEDURE:**
- 4.1 Perform testing on a sample of 1 foot, minimum, per lot with zero (0) failures allowed for Qualification.
  - 4.2 Remove insulation from entire length of test sample, making sure not to disturb the strands of the conductor, and perform testing on the following:
    - 4.2.1 For 20 AWG or larger – individual strands of the conductor
    - 4.2.2 For 22 AWG or smaller – whole conductor, elongation measurement taken when the first strand breaks.
  - 4.3 Mark the sample with two parallel benchmarks 10 +/- 1/32" apart, without damage to strands.
  - 4.4 Measure the diameter of the sample using the micrometer caliper in accordance with FED-STD-228, Method 1421 at nine equally spaced places between the benchmarks; record the minimum measurement as "D".
  - 4.5 Place test sample in the pull tester as follows:
    - 4.5.1 Spool type grips – Ensure both benchmarks are between the spools but not in contact with the surface of the spools
    - 4.5.2 Wedge type grips – Ensure each benchmark is at least 1" away from the grips
  - 4.6 Initiate the pull test until there is a rupture of the first strand, read force from the indicator, and record measurement (rounded to the nearest pound) as "F".
    - 4.6.1 If rupture occurs outside of the benchmarks or within 1" of either benchmark, discard the test sample and repeat with additional samples until the rupture occurs within the limits.

4.7 Immediately remove the broken sample from the fixture, lay it on a smooth surface, fit the ruptured sections together as closely as possible, and measure the distance between the benchmarks; record measurement to the nearest 1/32 inch as “L”.

4.8 Calculate Tensile Strength using the following formula:

$$\text{Tensile Strength p.s.i.} = \frac{4F}{\pi (D)^2}$$

4.9 Calculate Elongation using the following formula:

$$\text{Elongation \%} = \frac{L - 10}{10} \times 100$$

5.0 **RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHRINKAGE INSULATED WIRE

- 1.0 PURPOSE:** To determine the amount of insulation shrinkage of an insulated wire when exposed to an elevated temperature for a set amount of time. As a result of exposure, shrinkage of the insulation shall conform to the specification of the wire under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1 Table 3A
- 3.0 TEST EQUIPMENT:**
- 3.1 Air Circulating Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 3.2 Calipers
- 4.0 PROCEDURE:**
- 4.1 Perform testing on a sample of 14 inches per spool, minimum, with zero (0) failures allowed for Qualification.
- 4.2 Strip 1 inch from each end of the test samples; ensure the end of the insulation is square and perpendicular.
- 4.3 Measure and record the length of the exposed conductor to the nearest 0.01 inch.
- 4.4 Place test samples into chamber and bake for 6 hours at the temperature required by the specification of the wire under test.
- 4.5 Remove test samples from the chamber and allow them to cool to room temperature.
- 4.6 Re-measure and record the length of the exposed conductor.
- 4.7 Calculate the shrinkage by subtracting the 2<sup>nd</sup> measurement from the 1<sup>st</sup> measurement.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MATERIAL OUTGASSING EVALUATION

## ALL EEE COMPONENTS

- 1.0 PURPOSE:** To verify all nonmetal materials outgassing properties do not exceed the limits of 1% TML or 0.1% CVCM. This evaluation shall be performed during the initial design review process. Outgassing can occur in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can also become more rigid or brittle.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002
  - 2.2** ASTM-E595
  - 2.3** NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
  - 3.1** N/A; verification by analysis
- 4.0 PROCEDURE:**
  - 4.1** Evaluate all nonmetal materials for outgassing properties during the initial design review process of an assembly that will incorporate said materials.
  - 4.2** Materials to be used in a design shall be selected from NASA Reference Publication 1124 at <http://outgassing.nasa.gov>
    - 4.2.1** Materials listed in NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.
      - 4.2.1.1** Materials listed that meet TML and CVCM limits may have been baked out prior to evaluation in order to reduce Outgassing, if so the Outgassing bake out may have to be performed to achieve acceptable levels of Outgassing; reference VACUUM OUTGAS BAKE-OUT Test Plan.
    - 4.2.2** Perform testing in accordance with ASTM-E595 for any material planned for use in a design that is not listed as acceptable.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VISUAL INSPECTION

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To verify the resistor meets specification through external visual inspection as specified in the resistor specification.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section R2, Table 2A and 3A

**2.2** Resistor specification

**3.0 TEST EQUIPMENT:** N/A

**4.0 PROCEDURE:**

**4.1** Perform inspection in accordance with the resistor specification of the resistor under test for materials, design, construction, marking, and workmanship on 100% of each lot with zero (0) failures allowed for Screening or a sample of forty five (45) of Group 1 minimum with zero (0) failures allowed for Qualification.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MECHANICAL

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To mechanically inspect the critical dimensions of the resistors to ensure they meet the resistor specification requirements.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section R2, Table 2A and 3A
- 3.0 TEST EQUIPMENT:**
- 3.1** Mechanical measuring equipment; as required for type of measurement
- 4.0 PROCEDURE:**
- 4.1** Perform mechanical inspection of all critical dimensions on a sample of three (3), minimum, per lot with zero (0) failures allowed for Screening or a sample of forty five (45), minimum, of Group 1 with zero (0) failures allowed for Qualification.
- 4.1.1** In the event of a failure, sample size changes to 100%, with rejects discarded.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DC RESISTANCE

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To verify the DC resistance of the resistors is within tolerance of the resistor specification.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section R2, Table 2A and 3A
  - 2.2** MIL-STD-202, Method 303
- 3.0 TEST EQUIPMENT:** Limit of error for all equipment shall not exceed 1/10 of the specified tolerance on the measured resistance.
- 3.1** Resistance Bridge
  - 3.2** Milliohm meter, or equivalent for 0-1 Ohm resistors
  - 3.3** Fluke Multi-meter, or equivalent for 1-1M Ohm resistors
  - 3.4** LCR, or equivalent for 1 M Ohm and above
- 4.0 PROCEDURE:**
- 4.1** Perform testing on 100% of each lot with zero (0) failures allowed for Screening or a sample of forty five (45), minimum, of Group 1 for Qualification.
  - 4.2** Perform test at 25° C. The temperature at which measurement is made affects the resistance values.
  - 4.3** Measure and record resistance across the resistor under test.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CONDITIONING

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To determine the effects on the electrical and mechanical characteristics resulting from exposure to an elevated ambient temperature for a specified length of time, while the resistor is performing its operational function. Upon completion of conditioning, resistor shall meet all electrical test requirements and there shall be no evidence of mechanical damage.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section R2 Table 2A and 3A

**2.2** MIL-STD-202, Method 108, Test Condition and Temperature to be determined by Military Specification of the resistor under test

**3.0 TEST EQUIPMENT:** Temperature Chamber and Voltage Generator

**4.0 PROCEDURE:**

**4.1** Perform conditioning on 100% of each lot for Screening or forty five (45), minimum, of Group 1 with zero (0) failures allowed for Qualification.

**4.2** Mount resistors by their normal mounting means and place into the chamber with enough spacing to avoid a resistor's operating heat affecting an adjacent resistor.

**4.3** Determine and apply the maximum derated DC voltage using values from the military specification of the resistor in the following formula:  $V = \sqrt{PR}$ .

**4.4** Apply the specified heat for the specified time per the military specification of the resistors under test.

**4.4.1** If time is  $\leq 24$  hours: Continuous

**4.4.2** If time is  $> 24$  hours: 1.5 hours on, 0.5 hours off

**4.5** Determine the electrical test requirements for before, during, or after conditioning by consulting the military specification of the resistor under test.

**4.5.1** Perform required electrical tests following the Test Plan for the required test type, attach test data.

**4.6** After completion of exposure, perform external visual examination to verify no evidence of mechanical damage.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RADIOGRAPHIC INSPECTION

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To detect internal physical defects which are not otherwise visible. Resistors shall exhibit no evidence of the defects detailed in MIL-PRF-39007, Appendix C.

**2.0 TEST SPECIFICATIONS:**

**2.1** MIL-PRF-39007, paragraph 3.27

**2.2** NASA EEE-INST-002, Section R2 Table 2A and 3A

**3.0 TEST EQUIPMENT:**

**3.1** Radiographic equipment

**4.0 PROCEDURE:**

**NOTE:** Resistors purchased to a military specification, and from a QPL manufacturer, with a failure rate of Tor S; do not require radiographic inspection.

**4.1** Record radiographic images in accordance with MIL-PRF-39007, paragraph 3.27 and Appendix C of two views, 90 degrees apart, or 360 degrees view by Vidicon on a sample of 100% of each lot for Screening or a sample of forty five (45), minimum, of Group 1 with zero (0) failures allowed for Qualification.

**4.1.1** Use of a "real time" X-ray system capable of viewing through 360 degrees of rotation is encouraged.

**4.1.2** Identify radiographic records with the part number, lot number, and specimen number.

**4.2** Examine the final images with suitable viewing equipment, which may include magnification, for any defects that may be present as detailed in MIL-PRF-39007, Appendix C, and Figure C-2.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SOLDERABILITY

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the solderability of all terminations which are normally joined by a soldering operation. Following the test, the preassembly lead finish of the resistor leads shall show evidence of good wetting with no evidence of pin holes, proving to provide a solderable surface of sufficient quality to enable satisfactory soldering.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section R2, Table 3A
  - 2.2 MIL-STD-202, Method 208
  - 2.3 ANSI/J-STD-002 and ANSI/J-STD-006
- 3.0 TEST EQUIPMENT:**
- 3.1 Steam Conditioning Apparatus, in accordance with ANSI/J-STD-002, paragraph 3.3.1
  - 3.2 Solder pot, maintained in accordance with ANSI/J-STD-002, paragraph 4.2.1.1.1
  - 3.3 Dipping Device, in accordance with ANSI/J-STD-002, paragraph 4.2.1.1.2
  - 3.4 Microscope
- 4.0 PROCEDURE:**
- 4.1 Perform test in accordance with ANSI/J-STD-002, Test A on both leads of a sample of three (3) resistors, minimum, of Group 2 with zero (0) failures allowed for Qualification with the following details and exceptions as required by MIL-STD-202, Method 208:
    - 4.1.1 The Contractual agreements statement in ANSI/J-STD-002 does not apply. The resistor specification requirements will be followed.
    - 4.1.2 Follow ANSI/J-STD-002, Test A and use category 3 for steam aging.
  - 4.2 Prepare test specimens with steam conditioning in accordance with ANSI/J-STD-002, paragraph 3.4.2, coating durability category 3 at 93 ° C (199.4 ° F) for 8 hours +/- 15 minutes.
  - 4.3 Within 72 hours of removal from the steam conditioning chamber, place test specimen(s) into the dipping fixture and perform solderability testing.
  - 4.4 Verify flux is in accordance with ANSI/J-STD 002, paragraph 3.2.2 and immerse resistor leads into flux approximately perpendicular to the surface of the flux and up to within 0.050 inches of the resistor body. Let it remain in the flux for 5 seconds, then remove from flux and allow leads to dry while suspended above the flux station for 5 – 20 seconds.
  - 4.5 Ensure solder is Sn63Pb37 per ANSI/J-STD-006 and measure the temperature of solder in the solder pot to ensure temperature is 245 +/- 5° C (473 +/- 9° F).
  - 4.6 Immerse fluxed resistor leads into solder pot approximately perpendicular to the surface of the solder, up to within 0.050 inches of the resistor body at a immerse and withdrawal rate of 0.984 +/-0.24 inches per second with a dwell time of 5 +0/-0.5 seconds.
  - 4.7 After withdrawal allow solder to solidify by air cooling while resistor is maintained in the same perpendicular attitude, then gently clean flux from resistor leads.
  - 4.8 Visually examine resistor leads under 10X magnification, up to 30X referee magnification, to ensure there is good wetting over 95% of the area of the lead, per ANSI/J-STD-002, Appendices A and B.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RESISTANCE TO SOLVENTS

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To verify the resistor markings will remain legible and the protective coating will remain intact when exposed to solvents and processes normally used during an assembly process utilizing the resistor. After exposure, the resistor marking shall remain legible and there shall also be no degradation of the protective coatings or encapsulation materials which affect the electrical or mechanical integrity of the resistor.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section R2, Table 3A
  - 2.2 MIL-STD-202, Method 215
- 3.0 TEST EQUIPMENT:**
- 3.1 Immersion vessel of non-reactive material and large enough to allow complete immersion
  - 3.2 Toothbrushes with handles of non reactive material and 3 to 4 long rows of hard bristles that are 1.0 - 1.12" long, each row will have 8-12 tufts with free ends all on the same plane. Use one for each solvent and discard when bristles show evidence of softening, bending, wear or loss.
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with MIL-STD-202, Method 215 on a sample of three (3) resistors, minimum, of Group 2 with zero (0) failures allowed for Qualification.
  - 4.2 Following exposure, visually examine the resistors for the following:
    - 4.2.1 Protective Coating at 10X magnification, maximum, for cracks, separations, crazing, swelling, softening and degradation of body material, end caps and seals, or any other damage which affects the electrical or mechanical integrity
    - 4.2.2 Marking remains legible at a distance of at least 6 inches, with normal room lighting and under zero to 3X magnification, maximum
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# THERMAL SHOCK

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the stability of a component when exposed to extremes of high and low temperature. Permanent changes in a component's operating characteristics and physical damage produced during thermal shock usually result from variations in dimensions and other physical properties such as mechanical displacement or rupture of conductors or insulating materials. After cycling is complete there shall be no evidence of mechanical damage.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** MIL-STD-202, Method 107, Test Condition to be determined by the resistor specification
  - 2.2** NASA EEE-INST-002, Section R2 Tables 2A and 3A
- 3.0 TEST EQUIPMENT:**
- 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 107 on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification with the following details:
- 4.1** For examination utilizing an environmental chamber, place resistors into the chamber so there is no obstruction to the flow of air across and around the specimen. Minimize direct heat conduction to the specimen.
  - 4.2** For examination utilizing a liquid bath, see the following:
    - 4.2.1** The liquid method is more severe and may damage some components that would not be damaged by the air method. It is not intended for non-hermetically sealed components.
    - 4.2.2** Do not use a liquid media without prior approval of the qualifying activity.
  - 4.3** Determine the MIL-STD-202, Method 107 Test Condition by selecting the test temperature extremes to match the minimum and maximum rated temperature of the resistor under test.
  - 4.4** Perform 25 cycles.
  - 4.5** After cycling, visually examine the resistor for evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RESISTANCE TEMPERATURE CHARACTERISTIC

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To determine the percentage change in DC resistance from the DC resistance at a reference temperature per unit temperature difference between the test temperature and the reference temperature. The calculated resistance temperature characteristic shall be as required in the resistor specification sheet of the resistor under test. After completion of cycling there shall be no evidence of mechanical damage.

**2.0 TEST SPECIFICATONS:**

- 2.1 NASA EEE-INST-002, Section R2, Table 3A
- 2.2 MIL-STD-202, Method 304 and Method 303

**3.0 TEST EQUIPMENT:**

- 3.1 Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 3.2 Resistance Bridge
- 3.3 Milliohm meter, or equivalent for 0-1 Ohm resistors
- 3.4 Fluke Multi-meter, or equivalent for 1-1M Ohm resistors
- 3.5 LCR, or equivalent for 1 M Ohm and above

**4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 304 and 303 on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification.

- 4.1 Subject resistors to temperatures as specified in MIL-STD-202, Method 304.
- 4.2 Measure and record DC resistance as stated and in accordance with Method 303 at each temperature.
- 4.3 Calculate the resistance temperature characteristic using the following formula:

$$PPM = \frac{R2 - R1}{R1 (t2 - t1)} \times 100$$

Where:

PPM = Resistance temperature characteristic in PPM

R1 = DCR at reference temperature

R2 = DCR at test temperature

t1 = Reference temperature in C°

t2 = Test temperature in C°

4.4 After completion of cycling, examine resistors for evidence of mechanical damage.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# LOW TEMPERATURE STORAGE

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the effects on the mechanical characteristics resulting from exposure to a lowered ambient temperature for a specified length of time. After exposure there shall be no evidence of mechanical damage. The change in resistance ( $\Delta R$ ) between the pre-exposure and post-exposure DCR shall meet the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
  - 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:**
  - 4.1** Perform testing on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification.
  - 4.2** Measure and record DC Resistance in accordance with MIL-STD-202, Method 303.
  - 4.3** Within one hour, place resistors into trays and place into the environment chamber.
    - 4.3.1** Trays must be of a design to present minimum obstruction to the airstream of the chamber and be capable of reaching the specified temperature within four minutes.
  - 4.4** Decrease temperature of chamber to  $-65^{\circ}\text{C}$ ; dwell at this temperature for 24 +/- 4 hours.
  - 4.5** Remove resistors from chamber and allow them to stabilize at  $+25^{\circ}\text{C}$  ambient; dwell for 2-8 hours.
  - 4.6** After dwell time, measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).
  - 4.7** Perform external visual examination to verify no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# LOW TEMPERATURE OPERATION

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the effects on the mechanical characteristics resulting from exposure to a lowered ambient temperature for a specified length of time while resistor is performing its operational function. After exposure there shall be no evidence of mechanical damage. The change in resistance ( $\Delta R$ ) between the pre-exposure and post-exposure DCR shall meet the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
  - 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
  - 3.2** Voltage Generator
- 4.0 PROCEDURE:**
  - 4.1** Perform testing on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification.
  - 4.2** Measure and record DC Resistance in accordance with MIL-STD-202, Method 303.
  - 4.3** Within one hour, mount the resistors in a manner other than soldering and place them into the environmental chamber.
  - 4.4** Connect the voltage generator to the resistor leads.
  - 4.5** Decrease temperature of chamber to  $-65^{\circ}\text{C}$ ; dwell at temperature for 1 hour.
  - 4.6** Apply the full rated voltage of the resistor under test for 45 minutes.
  - 4.7** Turn off voltage, remove resistors from chamber and allow them to stabilize at  $+25^{\circ}\text{C}$  ambient; dwell for 24 +/- 4 hours.
  - 4.8** After dwell time, measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).
  - 4.9** Perform external visual examination to verify no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHORT TIME OVERLOAD

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the effects on the mechanical characteristics resulting from a short time of voltage overload. As a result of voltage application there shall be no evidence of arcing, burning, or charring. The change in resistance ( $\Delta R$ ) between the pre-exposure and post-exposure DCR shall meet the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
- 3.1** Voltage Generator
  - 3.2** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:**
- 4.1** Perform testing on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification.
  - 4.2** Measure and record DC Resistance in accordance with MIL-STD-202, Method 303
  - 4.3** Mount resistors by means other than soldering and apply the voltage (watts) for a period of time and at a temperature as specified by the resistor specification of the resistor under test.
    - 4.3.1** If test temperature is other than room temperature, place resistors into chamber within one hour of the first DC Resistance test and allow stabilizing at test temperature prior to applying voltage.
  - 4.4** Turn off voltage and allow resistors to stabilize at room temperature.
  - 4.5** Measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).
  - 4.6** Perform external visual examination to verify no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# TERMINAL STRENGTH

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To determine whether the design of the terminals and their method of attachment can withstand twist or torsion mechanical stresses to which they will be subjected during installation into an assembly. As a result of tests, there shall be no evidence of breaking or loosening of terminals from the resistor body; chipping of the coating of the lead is permissible as long as the end caps are not exposed. The change in resistance ( $\Delta R$ ) between the pre-test and post-test DCR shall meet the specification of the resistor under test.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section R2, Table 3A

2.2 MIL-STD-202, Method 211, Test condition A and C

2.3 MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)

**3.0 TEST EQUIPMENT:**

3.1 Pull test fixture

3.2 Calibrated weights

**4.0 PROCEDURE:**

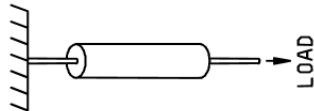
4.1 Perform testing on a sample of ten (10), minimum, of Group 3 with zero (0) failures allowed for Qualification.

4.2 Measure and record DC Resistance in accordance with MIL-STD-202, Method 303.

4.3 Perform pull test in accordance with MIL-STD-202, Method 211, Test Condition A

4.3.1 Hold or clamp the resistor at a point as directed by the resistor specification.

4.3.2 Apply force gradually and maintain for 5-10 seconds, at an amount specified by the resistor specification, in the direction of the axes of termination, per below diagram.



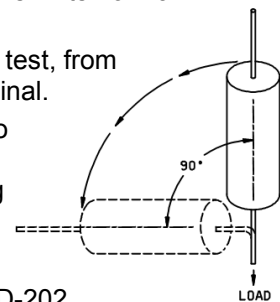
4.4 Perform bend test in accordance with MIL-STD-202, Method 211, Test Condition C

4.4.1 Clamp resistor body into a mounting fixture so that the terminal is in its normal position with respect to the resistor body.

4.4.2 Suspend a load that is closest to  $\frac{1}{2}$  the force applied in the pull test, from the resistor terminal within  $\frac{1}{4}$  inch from the free end of the terminal.

4.4.3 Slowly incline the body at a rate of approximately 3 seconds, so as to bend the terminal through  $90^\circ$  in one vertical plane and then return it to normal position. Restrict the load while bending so that the bend starts at  $\frac{3}{32} \pm \frac{1}{32}$  inches from the body.

4.4.4 Repeat the bend three times, always in the same direction.



4.5 Measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).

4.6 Perform external visual examination to verify no evidence of breaking or loosening of terminals from the resistor body.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DIELECTRIC WITHSTANDING VOLTAGE

## RESISTORS- WIREWOUND

**1.0 PURPOSE:** To ensure the resistor can operate safely at its rated voltage and withstand momentary over potentials due to switching, surges, and other similar phenomena. While voltage is applied, there shall be no flashover, arcing or breakdown between terminal points and the leakage rate shall not exceed the requirements of the resistor specification of the resistor under test. As a result of voltage application there shall be no evidence of flashover or arcing, mechanical damage, or insulation breakdown. The change in resistance ( $\Delta R$ ) between the pre and post DCR shall meet the specification of the resistor under test.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section R2, Table 3A

2.2 MIL-STD-202, Method 301

2.3 MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)

**3.0 TEST EQUIPMENT:** Biddle AC High Pot Tester; Model #230315 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH COPPER FOIL OR RESISTOR LEADS DURING TEST.**

**4.0 PROCEDURE;** Perform testing at sea level on a sample of nine (9), minimum, of Group 4 with zero (0) failures allowed for Qualification.

4.1 Measure and record DC Resistance in accordance with MIL-STD-202, Method 303.

4.2 Connect one lead of the Hypot to a piece of copper foil wrapped around the resistor body, and center. Connect the other lead to both resistor leads tied together.

4.3 Apply the specified voltage of the resistor specification uniformly at a rate of 500 volts per second, unless otherwise specified, and maintain for 60 seconds; then return to zero.

4.3.1 Monitor leakage current during voltage application.

4.4 After test, measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).

4.5 Perform external visual examination to verify no evidence of electrical or mechanical damage.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION RESISTANCE

## RESISTORS - WIREWOUND

**1.0 PURPOSE:** To measure the resistance offered between each mutually insulated members of the component. Resistance minimum shall be as specified in the specification of the resistor under test.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section R2, Table 3A

**2.2** MIL-STD-202, Method 302, Test Condition to be determined by the specification of the resistor under test

**3.0 TEST EQUIPMENT:** Megohm-meter; Beckman L-8 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT COPPER FOIL OR RESISTOR TERMINALS DURING TEST.**

**4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 302 on a sample of nine (9), minimum, of Group 4 with zero (0) failures allowed for Qualification.

**4.1** Connect one lead of the Megohm-meter to a length of copper foil wrapped around the resistor body and centered. Connect the other Megohm-meter lead to both resistor leads tied together.

**4.2** Apply the voltage value of the specification of the resistor under test and measure resistance.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MOISTURE RESISTANCE

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To evaluate, in an accelerated manner, the resistance to the absorption of moisture and deteriorative effects of high humidity and heat moisture vapor resulting in degraded performance from 10 years of exposure to a pressurized habitat environment. Resistors shall pass all tests and there shall be no evidence of moisture absorption or damage that may result in degradation of performance.
  
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 106
  
- 3.0 TEST EQUIPMENT:**
  - 3.1** Environmental Chamber of sufficient thermal and humidity capacity to meet temperature and test condition requirements. Materials used within the chamber shall be nonreactive in high humidity and shall not be wood or plywood, nor shall it contain formaldehyde or phenol. Provisions shall be made to prevent condensate from the chamber ceiling dripping onto the specimens.
  - 3.2** Steam, distilled and demineralized water, or deionized water, having a pH level between 6.0 and 7.2 at 23° C (77° F) shall be used; no rust or corrosive contaminants shall be imposed on the specimens.
  
- 4.0 PROCEDURE:**
  - 4.1** Perform testing in accordance with MIL-STD-202, Method 106 on sample of nine (9), minimum, with zero (0) failures allowed with the following details:
  - 4.2** Mount resistors in their normal manner but positioned so that they do not contact each other to ensure they all get essentially the same amount of humidity.
  - 4.3** Initial measurements: Prior to beginning the moisture resistance cycling; perform DC Resistance, Dielectric Withstanding Voltage and Insulation Resistance testing per their Test Plans.
  - 4.4** After drying period: Following step 6 of the 10<sup>th</sup> cycle, repeat the same tests.
  - 4.5** After completion of all cycles: Repeat the same tests and inspect the resistors for moisture absorption and damage caused by cycling.
  
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHOCK

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the ability of the component to withstand applied mechanical shocks to simulate operating environments. As a result of shock pulses, there shall be no evidence of mechanical damage and the change in resistance ( $\Delta R$ ) shall be as required in the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 213, Test Condition to be determined by the specification of the resistor under test
  - 2.3** MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
- 3.1** Shock Machine
  - 3.2** Transducers; one for each connector
- 4.0 PROCEDURE:**
- 4.1** Perform testing in accordance with MIL-STD-202, Method 213 on a test sample of nine (9), minimum, of Group 5 with zero (0) failures allowed for Qualification with the following details:
    - 4.1.1** Prior to application of shock, measure and record DC Resistance in accordance with MIL-STD-202, Method 303.
    - 4.1.2** Mount resistors rigidly on appropriate jig fixtures with their leads supported at a distance of .375 +/- .062 inches from the resistor body in a manner to ensure that the points of the resistor mounting supports will have the same motion as the shock table. Cut resistor leads as short as possible.
    - 4.1.3** Apply shock utilizing the Test Condition and all other required details as required by the specification of the resistor under test.
    - 4.1.4** After test, measure and record DC Resistance in accordance with MIL-STD-202, Method 303 a second time and determine the change in resistance ( $\Delta R$ ).
    - 4.1.5** Perform external visual examination to verify no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VIBRATION – HIGH FREQUENCY

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To assess the ability of the component to withstand specified severities of vibration that may be encountered during the life of the component. As a result of vibration there shall be no evidence of mechanical damage and the change in resistance ( $\Delta R$ ) shall be as required by the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 204, Test Condition to be determined by the specification of the resistor under test.
  - 2.3** MIL-STD-202, Method 303 (DC RESITANCE RESISTORS-WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
  - 3.1** Vibration System
  - 3.2** Mounting Jig(s)
- 4.0 PROCEDURE:**
  - 4.1** Perform Vibration testing in accordance with MIL-STD-202, Method 204, using the Test Condition specified in the resistor specification of the resistor under test, on a sample of nine (9), minimum, of Group 5 with zero (0) failures allowed for Qualification.
    - 4.1.1** Prior to application of vibration, measure and record DC Resistance in accordance with MIL-STD-202, Method 303, as detailed in the DC Resistance-Resistors-Wirewound Test Plan.
    - 4.1.2** Mount resistors rigidly on appropriate jig fixtures with their leads supported at a distance of .375 +/- .062 inches from the resistor body in a manner to ensure that the points of the resistor mounting supports will have the same motion as the vibration test table. Cut resistor leads as short as possible.
      - 4.1.2.1** Monitor the fixture throughout application of vibration to ensure the construction of the fixture precludes any resonance in the fixture when subjected to vibration within the test frequency.
    - 4.1.3** Apply vibration utilizing the Test Condition and all other required details as required by the specification of the resistor under test.
    - 4.1.4** After test, measure and record DC Resistance a second time, in accordance with MIL-STD-202, Method 303 as detailed in the DC Resistance-Resistors-Wirewound Test Plan to determine the change in resistance ( $\Delta R$ ).
    - 4.1.5** Perform external visual examination to verify there is no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# LIFE

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the effects on the electrical and mechanical characteristics resulting from exposure to an elevated ambient temperature for a specified length of time, while the resistor is performing its operational function. The change in resistance ( $\Delta R$ ) shall be as required by the specification of the resistor under test and there shall be no evidence of mechanical damage following the life cycling.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section R2 Table 3A
  - 2.2 MIL-STD-202, Method 108, Test Condition F at temperatures and operational conditions as required by the Specification of the resistor under test
  - 2.3 MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS-WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:** Temperature Chamber and Voltage Generator
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with MIL-STD-202, Method 108 on a sample of twelve (12), minimum, of Group 6 with zero (0) failures allowed for Qualification.
  - 4.2 Mount resistors by their normal mounting means, as required by the specification of the resistor under test, and place into the chamber with enough spacing to avoid a resistor's operating heat affecting an adjacent resistor.
  - 4.3 Prior to cycling, measure and record DC Resistance in accordance with MIL-STD-202, Method 303, as detailed in the DC Resistance-Resistors-Wirewound Test Plan.
  - 4.4 Determine and apply operational conditions as required by the specification of the resistor under test.
  - 4.5 Apply the required heat for the required time of the specification of the resistor under test.
  - 4.6 Determine the electrical test requirements for before, during, or after cycling by consulting the specification of the resistor under test.
  - 4.7 After completion of exposure, perform external visual examination to verify there is no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# HIGH TEMPERATURE EXPOSURE

## RESISTORS - WIREWOUND

- 1.0 PURPOSE:** To determine the effects on the electrical and mechanical characteristics resulting from exposure to a high ambient temperature for a specified length of time. After exposure there shall be no evidence of mechanical damage. The change in resistance ( $\Delta R$ ) between the pre-exposure and post-exposure DCR, Insulation Resistance and Dielectric Withstanding Voltage shall meet the specification of the resistor under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section R2, Table 3A
  - 2.2** MIL-STD-202, Method 301 (DWV RESISTORS–WIREWOUND Test Plan)
  - 2.3** MIL-STD-202, Method 302 (IR RESISTORS-WIREWOUND Test Plan)
  - 2.4** MIL-STD-202, Method 303 (DC RESISTANCE RESISTORS – WIREWOUND Test Plan)
- 3.0 TEST EQUIPMENT:**
- 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:**
- 4.1** Perform testing in accordance with the specification of the resistor under test, on a sample of five (5), minimum, of Group 9 with zero (0) failures allowed for Qualification.
  - 4.2** Measure and record DC Resistance in accordance with MIL-STD-202, Method 303.
  - 4.3** Within one hour, place resistors into trays and place into the environment chamber.
    - 4.3.1** Trays must be of a design to present minimum obstruction to the airstream of the chamber and be capable of reaching the specified temperature within four minutes.
  - 4.4** Apply temperature to the chamber and allow resistor to dwell with no load applied as required by the specification of the resistor under test.
  - 4.5** Perform any measurements during the test required by the specification of the resistor under test.
  - 4.6** After high temperature exposure, measure and record DC Resistance in accordance with MIL-STD-202, Method 303, as detailed in the DC Resistance-Resistors-Wirewound Test Plan, and determine the change in resistance ( $\Delta R$ ).
  - 4.7** Perform and record Dielectric Withstanding Voltage and Insulation Resistance in accordance with their respective test plans; attach test data.
  - 4.8** Perform external visual examination to verify no evidence of mechanical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VISUAL/MECHANICAL

## RF COAXIAL CABLE

**1.0 PURPOSE:** To visually inspect cable and its components for material and workmanship criteria. There shall be no evidence of defects as defined in the procedure.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section W1, Table 2C

**3.0 TEST EQUIPMENT:**

3.1 Microscope

**4.0 PROCEDURE:**

4.1 Perform the following inspections at 3X magnification, minimum; use progressively higher magnification as necessary to examine anomalies and adequate lighting level on a sample of 1 foot per spool, minimum, of each lot with zero (0) failures allowed for Screening.

4.1.1 Require a certificate of compliance from the wire manufacturer that certifies the proper conductor material and finish were used in manufacturing; verify they meet the specification of the wire under test.

4.1.2 Inspect cable samples for the following:

4.1.2.1 Cable insulation – Marking and/or color coding, and workmanship for cracks or splits

4.1.2.2 Verify dimensions – Conform to the specification of the cable under test

4.1.2.3 Inner conductor & shield – Number of strands and AWG of strands conform to the specification of the cable under test, and workmanship for no discoloration, corrosion of the strands, or plating that flakes off with normal flexing

4.1.2.4 Weight of cable, as applicable – Conforms to the specification of the cable under test

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# JACKET FLAWS

## RF COAXIAL CABLE

**1.0 PURPOSE:** To detect the presence of jacket flaws and remove any cable length with those flaws.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section W1, Tables 2C

**2.2** MIL-STD-2223, Method 3002 or 3008

**3.0 TEST EQUIPMENT:**

**3.1** AC voltage Generator

**3.2** Bead Chain Electrode

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-2223, either Method referenced, on 100 % of each lot with zero (0) failures allowed for Screening.

**4.1.1** This test is normally performed by the cable manufacturer on 100% of each lot during final winding of the wire on spools. A certificate of compliance from the manufacturer certifying that all wire shipped was subjected to and passed this test is sufficient to meet this requirement.

**4.1.2** If the wire is procured from a QPL manufacturer to military specification, re-screening using one of the above referenced test specifications is not required, but may be performed at the user's discretion.

**4.2** Apply voltage at the required value of the specification of the cable under test at a frequency of 60 Hz or 3K Hz, between the electrode and the shield.

**4.3** Remove all cable lengths where the jacket failed.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CONTINUITY

## RF COAXIAL CABLE

**1.0 PURPOSE:** To measure the continuity of the center conductor and shield of the cable. Both the center conductor and shield shall be continuous.

**2.0 TEST SPECIFICATONS:**

2.1 NASA-EEE-INST-002, Section W1, Table 2C

**3.0 TEST EQUIPMENT:**

3.1 Fluke 77 Multi-Meter; or equivalent

**4.0 PROCEDURE:**

4.1 Connect multi-meter leads between the ends of the center conductor and measure to ensure continuity.

4.2 Connect multi-meter leads between the ends of the shield and measure to ensure continuity.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VOLTAGE WITHSTANDING

## RF COAXIAL CABLE

**1.0 PURPOSE:** To determine whether the insulation over the center conductor will withstand a specified voltage without rupture. During voltage application there shall be no evidence of breakdown, flashover, or sparkover.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section W1, Tables 2C

**2.2** FED-STD-228, Method 6111

**3.0 TEST EQUIPMENT:** Biddle AC Hypot Tester, Model #230315, or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with FED-STD-228, Method 6111 on each spool of cable of each lot for Screening with the following details:

**4.1.1** This test is normally performed by the cable manufacturer on 100% of each lot during final winding of the wire on spools. A certificate of compliance from the manufacturer certifying that all wire shipped was subjected to and passed this test is sufficient to meet this requirement.

**4.1.2** Do not immerse cable in water, test dry.

**4.1.3** Connect one lead of the Hypot to the center conductor and the other to the shield, with the shield grounded.

**4.2** Apply the specified voltage of the specification for the cable under test at 60 Hz, slowly and at a uniform rate of 10-60 seconds, and maintain for 60 seconds; then return to zero.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CHARACTERISTIC IMPEDANCE

## RF COAXIAL CABLE

**1.0 PURPOSE:** To determine if the Characteristic Impedance of the cable conforms to the cable specification of the cable under test. The Characteristic Impedance of the test sample shall conform to the cable specification of the cable under test.

**2.0 TEST SPECIFICATONS:**

2.1 NASA EEE-INST-002, Section W1, Table 3C

2.2 MIL-DTL-17, paragraph 3.7.6

**3.0 TEST EQUIPMENT:**

3.1 Time Domain Reflectometer (TDR), with a rise time of 150 picoseconds or less, and the vertical sensitivity that provides minimum resolution of one major scale division

3.2 Precision Air-line of the same nominal characteristic as the test sample

3.3 Connectors for mating test cable to the TDR

**4.0 PROCEDURE:**

4.1 Perform testing in accordance with MIL-DTL-17 on a sample of ten (10) feet, minimum, per lot with zero (0) failures allowed for Qualification.

4.2 Assemble appropriate connectors onto test sample.

4.3 Connect the Precision Air-line to the TDR and then to the test sample.

4.4 Measure the characteristic impedance of the test sample compared to the Precision Air-line, and record.

4.5 Turn the test sample end-to-end, repeat measurement, and record.

4.6 For cables other than 50 and 75 ohms, where Precision Air-lines, loads, or proper impedance

$$Z_0 = \frac{101,670}{\text{Velocity of Propagation (\%)} \times \text{Capacitance (pF/ft)}}$$

measuring equipment is not available, calculate the characteristic impedance using the following formula:

4.7 Measure Capacitance per the associated Test Plan for insertion into the formula.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# ATTENUATION & VSWR

## RF COAXIAL CABLE

- 1.0 PURPOSE:** To analyze the electrical characteristics of RF coaxial cable. Attenuation (transmission loss) and Voltage Standing Wave Ratio (VSWR) shall conform to the specification of the cable under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA-EEE-INST-002, Section W1, Table 3C
  - 2.2 MIL-DTL-17, paragraph 3.7.7 and 3.7.8
  - 2.3 15025; Phoenix Logistics RF Acceptance Test Procedures
  - 2.4 15028; Phoenix Logistics Network Analyzer Calibration Procedures
  - 2.5 HP8510B Network Analyzer Operating and Programming Manual
- 3.0 TEST EQUIPMENT:**
- 3.1 HP8510B Network Analyzer, or equivalent
  - 3.2 HP8515 S-Parameter Tester Set, or equivalent
  - 3.3 HP8340 B Synthesized Sweeper, or equivalent
  - 3.4 HP7470A Plotter, or equivalent
  - 3.5 AVNA-8510B Computerized Graphing Program, or equivalent
  - 3.6 Various precision test adapters, as required
- 4.0 PROCEDURE:**
- 4.1 Perform testing as prescribed in MIL-DTL-17, paragraph 3.7.7, utilizing the HP8510B Network Analyzer in accordance with internal RF Acceptance Test Procedure 15025, section 7.0 and the HP8510B Operating and Programming Manual on a sample of one (1) length per lot, minimum, long enough to exhibit 1 dB loss, minimum, at low frequency with zero (0) failures allowed for Qualification.
  - 4.2 Assemble connectors onto each end of the cable test sample to facilitate testing.
    - 4.2.1 The prescribed test included in the RF Acceptance Test Procedure 15025 details the following:
      - 4.2.1.1 Calibration procedure in accordance with HP8510B Operating and Programming Manual to characterize the test fixture such that when the test fixture plus the test specimen measurement is made, the characteristics of the test specimen alone can be accurately determined.
      - 4.2.1.2 Connector interface preparation and torque requirements for the test adapter and the test specimen connectors to ensure there is no introduction of false dynamics during the measurement.
      - 4.2.1.3 Specific test procedures detailing the test fixture programming, connections necessary, and analysis of measurement results for each type of test.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CAPACITANCE

## RF COAXIAL / TWINAXIAL CABLE

**1.0 PURPOSE:** To determine if the capacitance of the cable conforms to the cable specification of the cable under test. The maximum capacitance of the test sample shall conform to the cable specification of the cable under test.

**2.0 TEST SPECIFICATONS:**

**2.1** NASA EEE-INST-002, Section W1, Table 3C

**2.2** MIL-DTL-17, paragraph 3.7.9

**3.0 TEST EQUIPMENT:**

**3.1** Capacitance Bridge, or equivalent

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-DTL-17, paragraph 3.7.9 on a sample of 5 feet, minimum, but less than 1/40 wavelength, per lot with zero (0) failures allowed for Qualification.

**4.2 Coaxial Cable:** Measure and record the capacitance of the test sample, in Pico farads per foot, at 1 KHz between the center conductor and shield with the shield grounded.

**4.3 Twinax Cables:** Calculate the capacitance of the test sample using one of the following methods:

**4.3.1** Two-terminal method

**4.3.1.1** Measure the capacitance between center conductors with conductor (1) tied to the shield (outer conductor), record measurement as (Ca).

**4.3.1.2** Measure the capacitance between center conductors with conductor (2) tied to the shield (outer conductor), record measurement as (Cb).

**4.3.1.3** Measure the capacitance between both center conductors tied together and the shield (outer conductor), record measurement as (Cc).

**4.3.1.4** Perform calculation: 
$$\text{Capacitance} = \frac{2(Ca + Cb) - Cc}{4}$$

**4.4** Three-terminal method

**4.4.1.1** Measure the capacitance between center conductors with the shield (outer conductor) connected to the ground terminal of the Capacitance Bridge, record measurement as (Cd).

**4.4.1.2** Measure the capacitance between conductor (1) and shield (outer conductor) with conductor (2) connected to the ground terminal of the Capacitance Bridge; record measurement as (Ce).

**4.4.1.3** Measure the capacitance between conductor (2) and shield (outer conductor) with conductor (1) connected to the ground terminal of the Capacitance Bridge; record measurement as (Cf).

**4.4.1.4** Perform calculation: 
$$\text{Capacitance} = Cd + \frac{Ce + Cf}{4}$$

**5.0 RECORD DATA:** Document test results on the following data sheets or within an attached test report.

# STRESS CRACK RESISTANCE

## RF COAXIAL CABLE

- 1.0 PURPOSE:** To determine the cable's resistance to cracking under heat stress. As a result of winding and baking, there shall be no evidence of cracking or other flaws.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section W1 Table 3C
- 3.0 TEST EQUIPMENT:**
- 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 3.2** Mandrel; with a diameter measuring 3X the jacket diameter of the cable under test
- 4.0 PROCEDURE:**
- 4.1** Perform testing on four 3 foot samples per lot, minimum, with zero (0) failures allowed for Qualification.
- 4.2** Affix one end of the cable to the mandrel.
- 4.3** Wind each sample cable around the mandrel for ten (10) turns and affix the loose end well enough to prevent unwinding.
- 4.4** Place test samples, on the mandrel, into the chamber and bake for ninety six (96) hours at 230° C (446° F).
- 4.5** Remove test samples on mandrel from the chamber and allow them to cool to room temperature for four (4) hours.
- 4.6** After cooling, unwind the cable from the mandrel and examining for cracks and other flaws.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# BENDABILITY

## RF COAXIAL CABLE - SEMI-RIGID, ONLY

- 1.0 PURPOSE:** To determine the cable's resistance to cracking under mechanical stress. As a result of coiling, there shall be no evidence of cracks, splits, or wrinkles.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section W1 Table 3C
- 3.0 TEST EQUIPMENT:**
- 3.1** Mandrel; with a diameter as required by the specification of the cable under test
- 4.0 PROCEDURE:**
- 4.1** Perform testing on four 3 foot samples per lot, minimum, with zero (0) failures allowed for Qualification.
- 4.2** Form each cable sample around the mandrel for two turns.
- 4.3** Remove the coiled specimen from the mandrel and examine the cable surface for cracks, splits, or wrinkles.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DIMENSIONAL STABILITY

## RF COAXIAL CABLE

- 1.0 PURPOSE:** To determine the effects on the dimensional characteristics resulting from exposure to a high ambient temperature for a specified length of time. After exposure, the measurements shall conform to the specification of the cable under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section W1, Table 3C
  - 2.2 MIL-DTL-17, paragraph 3.7.19
- 3.0 TEST EQUIPMENT:**
- 3.1 Air Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
  - 3.2 Brass test fixtures and caps with a center diameter equal to the cable outer diameter, as specified in Figure 11 of MIL-DTL-17; for semi-rigid cable only
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance MIL-DTL-17, on a sample of one 5 foot section, minimum, per lot of flexible RF coaxial cable or one 4 foot sample, minimum, per lot of semi-rigid RF coaxial cable with zero (0) failures allowed for Qualification.
  - 4.2 Flexible cables:
    - 4.2.1 Cut both ends of sample squarely and carefully deburr them.
    - 4.2.2 Place sample into the heat chamber, coiled or straight, and bake for six hours, minimum, at 200° C or as required by the specification of the cable under test.
    - 4.2.3 Remove the sample from the chamber and dwell at room temperature for four (4) hours, minimum.
    - 4.2.4 Measure and record both ends for protrusion or contraction of the center conductor.
  - 4.3 Semi-rigid cables:
    - 4.3.1 Cut sample into six inch lengths; cut both ends squarely and carefully deburr them.
    - 4.3.2 Place each sample into a brass fixture and cap both ends; caps shall be tightened to 8 in/lbs +/- 1 in/lb of torque.
    - 4.3.3 Place the fixtures containing the samples into the heat chamber and bake at 125° C for one hour, minimum.
    - 4.3.4 Remove the fixtures from the chamber, with the samples in the fixtures, and dwell at room temperature for one (1) hour, minimum.
    - 4.3.5 One at a time, remove a sample from the fixture; measure and record both ends for protrusion or contraction of the insulation within the outer conductor. NOTE: Do not remove a sample from the test fixture until ready to measure.
      - 4.3.5.1 Make three measurements at each end, for six measurements total, one in each of the three different axes spaced approximately 120° apart.
    - 4.3.6 Continue until all samples have been measured.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# FLAMMABILITY

## RF COAXIAL CABLE – FLEXIBLE ONLY

**1.0 PURPOSE:** Verify the flammability and/or self extinguishing properties of the cable insulation are compatible with the environment in which the insulated wire will be operating. Testing is only required for insulation types that have unknown flammability properties as described in NASA-INST-002, Section W1, Page 1. The rate of the travel of flame shall not exceed 1 inch per minute and the cable surface shall not flame for more than 1 minute after removal of the test flame. Breaking of the test sample in cable sizes 24 AWG and smaller shall not be cause for failure as long as the other test parameters are within limits. There shall be no flaming of the facial tissue on the bottom of the test chamber as a result of incendiary drippings from the test sample. Charred holes or spots in the tissue can be ignored in the absence of actual flame.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA-INST-002, Section W1, Page 1 and Table 3C

2.2 MIL-DTL-17, paragraph 3.7.22

**3.0 TEST EQUIPMENT:**

3.1 Flammability Test Chamber, in accordance with MIL-DTL-17, paragraph 4.8.23.1

3.2 Bunsen type gas burner, in accordance with MIL-DTL-17, paragraph 4.8.23.1

**4.0 PROCEDURE:** Perform testing in accordance with MIL-DTL-17, paragraph 3.7.22 on a sample of 2 feet per lot, minimum, with zero (0) failures allowed for Qualification.

**NOTE:** Testing is only required for insulation types that have unknown flammability properties as described in NASA-INST-002, Section W1, Page 1.

4.1 Mark the wire test sample at 8” from one end to indicate point of test flame contact.

4.2 Clamp the lower end of the test sample, at a 60° angle from horizontal, into the sample holder, pass the upper end over the pulley of the sample holder and hold taut.

4.3 Hold the Bunsen burner perpendicular the test sample and at an angle of 30° from the vertical plane of the test sample, apply the hottest portion of the test flame to the lower side of the cable at the test mark for 30 seconds no matter the size of the cable.

4.4 Withdraw the test flame, measure, and record the duration of the after flame and the burned length of the test sample.

4.5 Record the presence or absence of flame of the facial tissue on the bottom of the chamber caused by incendiary dripping from the test sample.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MATERIAL OUTGASSING EVALUATION

## ALL EEE COMPONENTS

- 1.0 PURPOSE:** To verify all nonmetal materials outgassing properties do not exceed the limits of 1% TML or 0.1% CVCM. This evaluation shall be performed during the initial design review process. Outgassing can occur in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can also become more rigid or brittle.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002
  - 2.2 ASTM-E595
  - 2.3 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
- 3.1 N/A; verification by analysis
- 4.0 PROCEDURE:**
- 4.1 Evaluate all nonmetal materials for outgassing properties during the initial design review process of an assembly that will incorporate said materials.
  - 4.2 Materials to be used in a design shall be selected from NASA Reference Publication 1124 at <http://outgassing.nasa.gov>
    - 4.2.1 Materials listed in NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.
      - 4.2.1.1 Materials listed that meet TML and CVCM limits may have been baked out prior to evaluation in order to reduce Outgassing, if so the Outgassing bake out may have to be performed to achieve acceptable levels of Outgassing; reference VACUUM OUTGAS BAKE-OUT Test Plan.
    - 4.2.2 Perform testing in accordance with ASTM-E595 for any material planned for use in a design that is not listed as acceptable.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VISUAL

## RF CONNECTORS

**1.0 PURPOSE:** To visually inspect connectors for workmanship criteria. There shall be no evidence of defects as defined in the below procedure.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section C2, Table 2E, 3E and 4A

**3.0 TEST EQUIPMENT:**

3.1 Microscope

**4.0 PROCEDURE:**

4.1 Perform the following inspections at 3X magnification, minimum, progressively higher magnification as necessary to examine anomalies, on 100% of each lot for Screening and four (4) of Group A and two (2) of Group B, minimum, with zero (0) failures allowed for Qualification

4.1.1 Insert/Insulator Body – Insert to shell positioning and orientation, cracks, chips, blisters, pinholes and marking.

4.1.2 Hermetically Sealed Connectors – Negative meniscus (glass to contacts & glass to shell), solder cup misalignment at rear of connector.

4.1.3 Contact positioning (molded inserts with soldertails or soldercup contacts) – Consistent centering between contacts, soldercup misalignment at rear of connector.

4.1.4 Grommet (as applicable) – Nicks, gouges, tears, folds, discoloration and marking (as applicable).

4.1.5 Shell/Body – Cracks, dents, burrs, sharp edges, finish for peeled or blistered/ scratches/ exposed base metal/ corrosion or discoloration, marking completeness and legibility.

4.1.6 Threads (when applicable) – Coupling for nicks/ dents/ voids or burrs and that hardware is attached.

4.1.7 Adhesives/Molding Material – Excess bonding material(overflow) and voids

4.1.8 Leads (when applicable) – Bent, nicked, cracked/broken leads, burrs and finish for peeling, corrosion or exposed base metal.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MECHANICAL

## RF CONNECTORS

**1.0 PURPOSE:** To mechanically inspect dimensions of the connector to ensure they meet the Military Specification Sheet of the connector type or Commercial Source Control Drawing of the connector under test, as applicable.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 2E and 3E

**3.0 TEST EQUIPMENT:**

**3.1** Mechanical measuring equipment as required for type of measurement

**4.0 PROCEDURE:**

**4.1** Perform mechanical inspection of all dimensions on a sample of two (2), minimum, per lot with zero (0) failures allowed for Screening or a sample of six (6) of Groups A and B, minimum, with zero (0) failures allowed for Qualification.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DIELECTRIC WITHSTANDING VOLTAGE

## RF CONNECTORS

**1.0 PURPOSE:** To ensure the connector can operate safely at its rated voltage and withstand momentary over potentials due to switching, surges, and other similar phenomena. While voltage is applied there shall be no arcing or breakdown between terminal points and leakage current shall not exceed 2.0 mA.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 2E and 3E

**2.2** MIL-STD-202, Method 301

**3.0 TEST EQUIPMENT:** Biddle AC Hypot Tester; Model #230315 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE;** Perform testing at sea level on a sample of two (2) per lot, minimum, with zero (0) failures allowed for Screening or a sample of six (6), minimum, of Groups A and B with zero (0) failures allowed for Qualification.

**4.1** Assemble connector onto cable prior to testing.

**4.2** Set relative humidity at 50% during testing.

**4.3** Connect one Hypot lead to the center contact. Connect the other lead to the connector body.

**4.4** Apply the specified voltage in accordance with the connector specification sheet for the connector type of the connector under test, except for an SMA connector.

**4.4.1** The specified voltage for an SMA connector is dependant on which cable it is installed on:

Cable Part Number	Outer Diameter	Voltage
M17/93-RG178	0.075	500 VRMS
M17/113-RG316	1.102	750 VRMS
M17/60-RG142	0.200	1000 VRMS
M17/111-RG303	0.175	1000 VRMS
M17/128-RG400	0.200	1000 VRMS

**4.5** Apply voltage slowly (500 volts per second) and at a uniform rate and maintain for 60 seconds, then return to zero.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION RESISTANCE

## RF CONNECTORS

**1.0 PURPOSE:** To measure the resistance offered by the insulating members of the connector under test. Resistance shall be equal to or greater than 5000 M Ohms.

**2.0 TEST SPECIFICATIONS:**

**2.1** MIL-STD-202, Method 302, Test Condition B

**2.2** NASA EEE-INST-002, Section C2, Tables 2E and 3E

**3.0 TEST EQUIPMENT:** Megohm-meter; Beckman L-8 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST**

**4.0 PROCEDURE:** Perform testing on a sample of two (2) per lot, minimum, with zero (0) failures allowed for Screening or a sample of six (6) minimum of Group A and Group B with zero (0) failures allowed for Qualification.

**4.1** Connect one lead of the Megohm-meter to the center contact. Connect the other lead to the connector body.

**4.2** Set meter to the 500 Volts. Depress the meter "TEST" button.

**4.3** The Megohm-meter will indicate an initial low reading; then go up and indicate a steady reading.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# FORCE TO ENGAGE AND DISENGAGE

## RF CONNECTORS - BAYONET AND THREADED

- 1.0 PURPOSE:** To assess the Engagement and Separation Force of the connector. During the entire coupling/decoupling cycle, the forces or torques shall not exceed the MIL-PRF-39012 specification sheet for the connector under test; SMA types shall not exceed 2 in/lbs.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 MIL-PRF-39012, paragraph 3.5.1
  - 2.2 NASA EEE-INST-002, Section C2, Table 2E & 3E
- 3.0 TEST EQUIPMENT:**
- 3.1 Mating Standard Part – Steel jig containing the critical interface dimensions finished to the tolerances specified in MIL-STD-348. Spring members, when applicable, shall be heat treated BeCu. The surface finish or mating surfaces shall be 16 micro inches maximum
  - 3.2 Force Gage/Torque Gage with uncertainty of 5% maximum of reading
- 4.0 PROCEDURE:**
- 4.1 Perform testing in accordance with MIL-PRF-39012, paragraph 3.5.1 and the MIL-PRF-39012 specification sheet for the connector under test on a sample of two (2), minimum, per lot with zero (0) failures allowed for Screening or a sample of six (6) of Groups A and B with zero (0) failures allowed for Qualification.
  - 4.2 Secure one connector in a holding fixture and the mating standard part into an axial aligned fixture with a force gage attached.
  - 4.3 Mate the connectors until fully engaged and then disengaged with the force or torque under constant monitoring during the entire coupling/uncoupling cycle.
    - 4.3.1 A bayonet connector is fully engaged when the bayonet studs have passed the detent and their reference planes coincide. No additional tightening torque shall be applied.
    - 4.3.2 A threaded connector is fully engaged when their reference planes coincide.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# COUPLING PROOF TORQUE

## RF CONNECTORS - THREADED PLUGS, ONLY

- 1.0 PURPOSE:** To ensure the connector will meet dimensional and force to engage/disengage requirements after the connector is engaged to the specified torque value of the MIL-PRF-39012 specification sheet of the connector under test.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** MIL-PRF-39012, paragraph 4.6.3
  - 2.2** NASA EEE-INST-002, Section C2, Table 2E
- 3.0 TEST EQUIPMENT:**
  - 3.1** Mating Standard Part – Steel jig containing the critical interface dimensions finished to the tolerances specified in MIL-STD-348. Spring members when applicable shall be heat treated BeCu. The surface finish or mating surfaces shall be 16 micro inches maximum
  - 3.2** Force Gage/Torque Gage with uncertainty of 5% maximum of reading
- 4.0 PROCEDURE:**
  - 4.1** Perform testing in accordance with MIL-PRF-39012, paragraph 4.6.3 and the MIL-PRF-39012 specification sheet for the connector under test; on a sample of two (2) minimum per lot with zero (0) failures allowed for Screening or a sample of six (6) of Groups A & B with zero (0) failures allowed for Qualification.
  - 4.2** Engage the connector under test with the Mating Standard Part and tighten the coupling nut to the torque value of the MIL-PRF-39012 specification sheet for the connector under test.
    - 4.2.1** Exception: SMA types shall be 15 in/lbs min.
  - 4.3** Let the connector stand mated for one minute, then disengage it.
  - 4.4** Post test: Perform Force to Engage/Disengage testing per its Test Plan, record and attach data.
  - 4.5** Post test: Inspect interface dimensions per the MIL-PRF-39012 specification sheet for the connector under test.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# HERMETIC SEAL TEST

## RF CONNECTORS – COMMERCIAL PRESSURIZED, ONLY

- 1.0 PURPOSE:** To determine the effectiveness of and detect leaks in the seal of a component part which has an internal cavity which is either evacuated or contains air or gas. Leak rate shall be equal to or less than  $10^{-8}$  ATM CM<sup>3</sup> per second or as otherwise specified.
- 1.1 NOTE:** Connectors procured to Military or NASA specifications normally have this test performed by the manufacturer, if so, this test does not need to be performed a second time.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section C2, Table 2E and 3E
- 2.2** MIL-STD-202, Method 112, Test Condition C, Procedure 1
- 3.0 TEST EQUIPMENT:**
- 3.1** Mass-spectrometer-type leak detector
- 3.2** Pressure or Vacuum Chamber
- 4.0 PROCEDURE:**
- 4.1** Test connectors in accordance with MIL-STD-202, Method 112, Condition C, Procedure I on 100% of each lot for Screening or a sample of six (6) of Groups A and B, minimum, with zero (0) failures allowed for Qualification.
- 4.2** As part of this Test Plan, determine and communicate which “Follow on Procedures” and “Conditions” within Procedure 1 are to be performed according to the type of seal employed in the connector under test.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CENTER CONTACT RETENTION

## RF CONNECTORS - CAPTIVATED CONTACT TYPES, ONLY

- 1.0 PURPOSE:** To verify contact displacement caused by the force applied does not exceed acceptable limits. As a result of applied forces the center contact shall not be displaced from the specified interface dimensions of the MIL-PRF-39012 Specification Sheet of the connector under test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 MIL-PRF-39012, paragraph 3.12
  - 2.2 NASA EEE-INST-002, Section C2, Table 2E and 3E
- 3.0 TEST EQUIPMENT:**
- 3.1 Force Gage of suitable range for contact under test as determined by the MIL-PRF-39012 Specification Sheet of the connector under test so that the readings shall lie in the middle 50% of the scale, full scale accuracy shall be +/-2% of reading
  - 3.2 Dial Indicator Gage of suitable range for contact under test as determined by the MIL-PRF-39012 Specification Sheet of the connector under test so that the readings shall lie in the middle 50% of the scale; full scale accuracy shall be +/-2% of reading
- 4.0 PROCEDURE:**
- 4.1 Perform testing on assembled but non-cabled connectors, on a sample of two (2) per lot, minimum, with zero (0) failures allowed for Screening or a sample of two (2) of Group B with zero (0) failures allowed for Qualification.
  - 4.2 Apply an axial force of 6 lbs, minimum, to the center contact in one direction along the mating axis.
  - 4.3 Inspect the center contact to determine if contact has been displaced from the specified interface dimensions of the MIL-PRF-39012 Specification Sheet of the connector under test.
  - 4.4 Apply an axial force of 6 lbs, minimum, to the center contact in the opposite direction along the mating axis as required by the MIL-PRF-39012 Specification Sheet of the connector under test.
    - 4.4.1 If the MIL-PRF-39012 Spec Sheet required axial force is torque, apply the torque for a minimum of 10 seconds.
  - 4.5 Inspect the center contact again to determine whether the contact has been displaced from the specified interface dimensions of the MIL-PRF-39012 Specification Sheet of the connector under test.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MATERIAL OUTGASSING EVALUATION

## ALL EEE COMPONENTS

- 1.0 PURPOSE:** To verify all nonmetal materials outgassing properties do not exceed the limits of 1% TML or 0.1% CVCM. This evaluation shall be performed during the initial design review process. Outgassing can occur in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can also become more rigid or brittle.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002
  - 2.2 ASTM-E595
  - 2.3 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
- 3.1 N/A; verification by analysis
- 4.0 PROCEDURE:**
- 4.1 Evaluate all nonmetal materials for outgassing properties during the initial design review process of an assembly that will incorporate said materials.
  - 4.2 Materials to be used in a design shall be selected from NASA Reference Publication 1124 at <http://outgassing.nasa.gov>
    - 4.2.1 Materials listed in NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.
      - 4.2.1.1 Materials listed that meet TML and CVCM limits may have been baked out prior to evaluation in order to reduce Outgassing, if so the Outgassing bake out may have to be performed to achieve acceptable levels of Outgassing; reference VACUUM OUTGAS BAKE-OUT Test Plan.
    - 4.2.2 Perform testing in accordance with ASTM-E595 for any material planned for use in a design that is not listed as acceptable.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VACUUM OUTGAS BAKE-OUT

## ALL NONMETAL MATERIALS

- 1.0 PURPOSE:** To control outgassing of all nonmetal materials utilized in a finished part assembly or finish part component. This test is required at the component level per NASA EEE-INST-002. After vacuum outgas bake-out, materials shall not exceed 1% (TML) or 0.1% (CVCM).
- 2.0 TEST SPECIFICATIONS:**
  - 2.1 NASA EEE-INST-002
  - 2.2 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
  - 3.1 Vacuum evacuation oven chamber
  - 3.2 Torr Indicator Gauge
- 4.0 PROCEDURE:**
  - 4.1 Perform vacuum outgassing bake-out on all finished part assemblies and finished part components that utilize any nonmetal material following completion of all manufacturing processes and prior to final test for shipment.
    - 4.1.1 Expose test specimens to 125 ° C at 10 to the -6 Torr vacuum for 24 hours.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MAGNETIC PERMEABILITY

## 1553 DATA BUS CONNECTORS / RF CONNECTORS

**1.0 PURPOSE:** To determine whether the magnetic permeability of the specimen is below a specified value. The indicator magnet shall not pull out of the indicator during application to the surfaces of the connector.

**2.0 TEST SPECIFICATIONS:**

2.1 ANSI/EIA-364, Test Procedure 54

**3.0 TEST EQUIPMENT:**

3.1 Permeability Indicator, Low-Mu: Severn Engineering Co., Permeability Indicator #3904, or equivalent

**4.0 PROCEDURE:**

4.1 Perform testing on a fully assembled connector, connector components, or contacts; as specified.

4.2 Use a 2.0 Mu pellet (Indicator insert) unless otherwise specified by the customer.

4.3 Apply the magnet of the indicator to and delicately remove from all areas of the connector.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# THERMAL SHOCK

## 1553 DATA BUS CONNECTORS / RF CONNECTORS

- 1.0 PURPOSE:** To determine the stability of a component when exposed to extremes of high and low temperature. Permanent changes in a component's operating characteristics and physical damage produced during thermal shock usually result from variations in dimensions and other physical properties such as mechanical displacement or rupture of conductors or insulating materials. After cycling is complete there shall be no evidence of damage detrimental to connector operation.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 MIL-STD-202, Method 107, Test Condition B
  - 2.2 NASA EEE-INST-002, Section C2 Tables 3I and 3E
- 3.0 TEST EQUIPMENT:**
- 3.1 Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
- 4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 107, Test Condition B on a sample of three (3), minimum, with zero (0) failures allowed for Data Bus Connector Qualification and a sample of four (4) minimum of Group A with zero (0) failures allowed for RF Connector Qualification with the following details:
- 4.1 For examination utilizing an environmental chamber, place connectors into the chamber so there is no obstruction to the flow of air across and around the specimen. Minimize direct heat conduction to the specimen.
  - 4.2 For examination utilizing a liquid bath, see the following:
    - 4.2.1 The liquid method is more severe and may damage some components that would not be damaged by the air method. It is not intended for non-hermetically sealed components.
    - 4.2.2 Do not use a liquid media without prior approval of the qualifying activity.
  - 4.3 Test temperature extremes are -55° C and +125° C.
  - 4.4 Visually examine the connector for damage that is detrimental to the connector operation.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VIBRATION – HIGH FREQUENCY

## RF CONNECTORS

**1.0 PURPOSE:** To assess the ability of the connector components to withstand specified severities of vibration that may be encountered during the life of the connector. As a result of vibration, there shall be no damage or loosening of connector parts and no discontinuities greater than one microsecond.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 3E

**2.2** MIL-STD-202, Method 204, Test Condition D

**2.2.1** Or ANSI/EIA-364-28, Test Plan 28, Test Condition IV

**3.0 TEST EQUIPMENT:**

**3.1** Vibration System

**3.2** Voltage Generator

**3.3** Oscilloscope

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-202, Method 204, Test Condition D or ANSI/EIA-364-28, Test Condition IV on a sample of four (4) connectors, minimum, with zero (0) failures allowed, with the following details:

**4.1.1** Assemble connectors onto cable and mate

**4.1.2** Wire the inner and outer conductors in a series circuit with 100 mA of current flow applied.

**4.1.3** Monitor connectors for discontinuities throughout testing.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHOCK

## RF CONNECTORS

**1.0 PURPOSE:** To determine the ability of the component to withstand applied mechanical shocks to simulate operating environments. Throughout testing there shall be no discontinuities greater than one microsecond. As a result of shock pulses there shall be no damage or loosening of the connector parts.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section C2, Table 3E

**2.2** MIL-STD-202, Method 213, Test Condition I (100 Gs)

**3.0 TEST EQUIPMENT:**

**3.1** Shock Machine

**3.2** Transducers; one for each connector

**3.3** Oscilloscope, or equivalent

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-202, Method 213, Test Condition I (100G Sawtooth) on a test sample of four (4) of Group A, minimum, with zero (0) failures allowed for Qualification, with the following details:

**4.1.1** Assemble connectors onto cable and mate.

**4.1.2** Wire the inner and outer conductors in a series circuit with 100 mA of current flow applied.

**4.1.3** Apply one shock to each direction of three mutually perpendicular axes of specimen.

**4.1.4** Connectors shall be monitored for discontinuities throughout testing.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# CABLE RETENTION FORCE

## RF CONNECTORS

**1.0 PURPOSE:** To verify cable and connector termination will withstand a force and that continuity through connections will be maintained.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section C2, Table 3E

**3.0 TEST EQUIPMENT:**

3.1 Push/Pull Fixture

3.2 Force Gage with uncertainty of 5% maximum of reading

**4.0 PROCEDURE:**

4.1 Perform testing on a sample of four (4) of Group A, minimum, with zero (0) failures allowed for Qualification.

4.2 Terminate connectors to cable per Table 1.

**Table 1**

CABLE TYPE	CABLE OUTER DIAMETER	TEST FORCE	APPLICABLE CABLE
Flexible	.036	10	RG 178, RG316
	.067	20	M17/152-00001
	.110	30	RG142, RG180, RG302
	.122 and up	40	RG 303, RG393, RG400
Semi-Rigid	.085	30	RG405
	.140	60	RG402

4.3 Secure the connector in the Push/Pull Fixture clamp. Secure the cable into the clamp on the other end of the Push/Pull Fixture clamp attached to the force gage.

4.4 Pull longitudinally on the cable away from the back of the connector to the force indicated in Table 1.

4.5 Hold pull force for 30 seconds, minimum.

4.6 After test, inspect connector for mechanical failures or loosening of parts and test for continuity.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VISUAL AND DIMENSIONAL INSPECTION

## TRANSFORMERS

- 1.0 **PURPOSE:** To verify the transformer meets specification through external visual and dimensional inspection as specified in the transformer specification.
- 2.0 **TEST SPECIFICATIONS:**
  - 2.1 NASA EEE-INST-002, Section M1, Table 2 and 3
  - 2.2 Transformer specification
- 3.0 **TEST EQUIPMENT:**
  - 3.1 Mechanical measuring equipment; as required for type of measurement
  - 3.2 Microscope
- 4.0 **PROCEDURE:**
  - 4.1 Perform inspection in accordance with the transformer specification of all dimensions, material, configuration, weight, marking and workmanship on a sample of two (2), minimum, per lot with zero (0) failures allowed for Screening or a sample of six (6) minimum with zero (0) failures allowed for Qualification.
    - 4.1.1 Perform visual inspection using at a minimum of 10X magnification.
- 5.0 **RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INSULATION RESISTANCE

## TRANSFORMERS

**1.0 PURPOSE:** To measure the resistance offered between each mutually insulated portions of the component. Resistance shall be equal to or greater than 1000 M Ohms.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section M1, Tables 2 and 3

**2.2** MIL-STD-202, Method 302

**3.0 TEST EQUIPMENT:** Megohm-meter; Beckman L-8 or equivalent

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT COPPER FOIL OR TRANSFORMER TERMINALS DURING TEST.**

**4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 302 on a sample of three (3) per lot, minimum, with zero (0) failures allowed for Screening and Qualification.

**4.1** Connect one lead of the Megohm-meter to a length of copper foil wrapped around the component's outer potted surface to act as the case. Connect the other Megohm-meter lead to transformer terminal 1.

**4.2** Apply 500 VDC for a period of 2 min, 30 sec. as required by NASA EEE-INST-002.

**4.3** Repeat test connected between foil and terminal 4.

**4.4** Adjust voltage to 250 VDC and repeat test between terminal 1 and terminal 4.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DC RESISTANCE

## TRANSFORMERS

- 1.0 PURPOSE:** To measure the DC Resistance across the Bus side and the Stub side of transformers to verify resistance is within limits, indicating there are no open conditions in circuit. Resistance across terminals 1 and 2 shall be 117 Ohms, maximum. Resistance across terminals 3 and 4 shall be 117 Ohms, maximum.
- 2.0 TEST SPECIFICATONS:**
  - 2.1** NASA-EEE-INST-002, Section M1, Table 2, Test 2 and Table 3
  - 2.2** MIL-STD-202, Method 303
- 3.0 TEST EQUIPMENT:**
  - 3.1** Fluke 77 Multi-Meter; or equivalent
- 4.0 PROCEDURE:**
  - 4.1** Connect multi-meter leads across Terminals 1 and 2 and measure the resistance.
  - 4.2** Repeat across Terminals 3 and 4 and measure the resistance.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# WINDING INDUCTANCE

## TRANSFORMERS

- 1.0 PURPOSE:** To determine the effect of thermal shock on transformer winding inductance. From the baseline measurement to the post thermal shock measurement, the change in inductance ( $\Delta L$ ) shall be less than 3%.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section M1, Table 2 and 3
- 3.0 TEST EQUIPMENT:**
  - 3.1** Signal Generator
  - 3.2** Impedance Meter 252, or equivalent
  - 3.3** Test Box # 3 Input Impedance, or equivalent
- 4.0 PROCEDURE:**
  - 4.1** From the screening test data sheet, collect the baseline winding inductance and record it.
    - 4.1.1** Winding inductance is measured and recorded as part of Open Circuit Impedance testing for transformer screening, as a baseline.
  - 4.2** Following thermal shock testing, measure and record inductance a second time in accordance with the Open Circuit Impedance test plan.
  - 4.3** Calculate and record the change in inductance ( $\Delta L$ ) by subtracting the lower of the two measurements from the higher of the two measurements.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# URNS RATIO & POLARITY

## TRANSFORMERS

- 1.0 PURPOSE:** To verify the transformer turns ratio of 1:1.41 +/- 3% and the polarity of the transformer. During testing the output shall be between 0.6880 and 0.7300, with 0.7090 being nominal and the output voltage shall have the same instantaneous polarity as the input voltage, be in phase.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** SSQ 21676, paragraph 3.3.3.1.1
  - 2.2** NASA EEE-INST-002, Section M1, Table 2, Test 2
- 3.0 TEST EQUIPMENT:**
  - 3.1** Sine Wave Generator
  - 3.2** Oscilloscope
- 4.0 PROCEDURE:**
  - 4.1** Apply a 1 VRMS, 10.0 kHz signal to terminals 3 and 4.
  - 4.2** Measure output at terminals 1 and 2
  - 4.3** Polarity is tested at the same time in the same set up by monitoring the output voltage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# THERMAL SHOCK

## TRANSFORMERS

- 1.0 PURPOSE:** To determine the stability of a component when exposed to extremes of high and low temperature. Permanent changes in a component's operating characteristics and physical damage produced during thermal shock usually result from variations in dimensions and other physical properties such as mechanical displacement or rupture of conductors or insulating materials. During monitoring there shall be no arcing or breakdown between test points and leakage current shall not exceed 2.0 mA.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section M1, Table 2, Test 3
  - 2.2** MIL-STD-202, Method 107, Test Condition B, Cycle quantity determined by reliability level of application
- 3.0 TEST EQUIPMENT:**
  - 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
  - 3.2** Oscilloscope, or equivalent
- 4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Condition B with the following details:
  - 4.1** Place transformers into the chamber so there is no obstruction to the flow of air across and around the specimen. Minimize direct heat conduction to the transformers under test.
    - 4.1.1** Liquid Baths shall not be used without prior written approval from Phoenix Logistics, Inc and shall only be used on hermetically sealed components.
  - 4.2** Set test temperature extremes at -55° C and +125° C.
  - 4.3** Cycle transformers between the temperature extremes twenty five times for reliability level 1 and level 2, or ten times for reliability level 3.
  - 4.4** Continually monitor during last cycle to verify there are no intermittent conditions.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# VIBRATION – HIGH FREQUENCY

## TRANSFORMERS

- 1.0 PURPOSE:** To assess the ability of the component to withstand specified severities of vibration that may be encountered during the life of the component. As a result of vibration, transformer shall pass all acceptance tests and there shall be no leakage of filling materials or evidence of other physical damage affecting mechanical or electrical operation.
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section M1, Table 2 and 3
  - 2.2** MIL-STD-202, Method 204, Test Condition B
- 3.0 TEST EQUIPMENT:**
  - 3.1** Vibration System
- 4.0 PROCEDURE:**
  - 4.1** Perform testing in accordance with MIL-STD-202, Method 204, Test Condition D with the transformers rigidly mounted in their normal manner.
  - 4.2** After vibration testing, perform normal acceptance testing as listed on the transformer specification, record data and attach.
  - 4.3** After vibration testing, examine transformer for leakage of filling material or evidence of other physical damage that could affect the mechanical or electrical operation.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# POWER BURN-IN

## TRANSFORMERS

- 1.0 PURPOSE:** To determine the stability of a component when exposed to extremes of high temperature for a set period of time, while operating. This test is applicable for transformers with an output greater than 0.8 watts. After exposure there shall be no evidence of physical damage to the case such as cracks, bursting, bulging or visible potting material, and no evidence of corrosion affecting mechanical or electrical operation.
  
- 2.0 TEST SPECIFICATIONS:**
  - 2.1** NASA EEE-INST-002, Section M1, Table 2
  - 2.2** MIL-STD-981, Appendix B, paragraph 30.1.2.1.1
  
- 3.0 TEST EQUIPMENT:**
  - 3.1** Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
  - 3.2** Function Generator
  
- 4.0 PROCEDURE:** Perform testing on 100% of each lot for Screening of any transformer with an output greater than 0.8 watts.
  - 4.1** Place transformers into the chamber so there is no obstruction to the flow of air across and around the specimens. Minimize direct heat conduction to specimens.
  - 4.2** Expose transformers to the specified maximum rated temperature level for 96 hours, minimum.
  - 4.3** During exposure, apply test voltage and current at the transformer rated level, at the minimum rated frequency, and at the maximum rated load.
  - 4.4** After exposure, examine transformers for physical damage and leakage of potting material.
  
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# DIELECTRIC WITHSTANDING VOLTAGE: HIGH ALTITUDE TRANSFORMERS

**1.0 PURPOSE:** To ensure there is no arcing or breakdown and that minimal current leakage through the dielectric occurs when the derated value of the specified voltage rating of the component under test is applied between each mutually insulated portions of the component and/or insulated portions and ground. The test is repeated at high altitude to investigate the influence on component part's operating characteristics. While voltage is applied, there shall be no arcing or breakdown between test points and leakage current shall not exceed 2.0 mA.

**2.0 TEST SPECIFICATIONS:**

- 2.1 MIL-STD-202, Method 301 and 105, at sea level and high altitude
- 2.2 NASA EEE-INST-002, Section M2, Table 2, Test 7 and Table 3

**3.0 TEST EQUIPMENT:**

- 3.1 AC High Pot Tester
- 3.2 Vacuum Sealed Barometric Chamber
- 3.3 Torr Indicator Gauge

**WARNING: HIGH VOLTAGE EXISTS DURING PROCEDURE THAT CAN CAUSE SHOCK.  
DO NOT COME INTO CONTACT WITH SHIELD OR CONDUCTORS DURING TEST.**

**4.0 PROCEDURE:**

- 4.1 Perform testing in accordance with MIL-STD-202, Method 105.
  - 4.1.1 Place transformers in a nonmetallic tray for testing.
  - 4.1.2 Test Condition shall be B
  - 4.1.3 Measure DWV in accordance with MIL-STD-202, Method 301, as detailed below, prior to placement into the chamber, again at 50,000 ft, and again after removal from chamber.
    - 4.1.3.1 Take measurement at 50,000 ft after test specimens are maintained at the specified pressure and sufficient time has been allowed for all entrapped air in the chamber to escape.
- 4.2 Details to measure DWV in accordance with MIL-STD-202, Method 301:
  - 4.2.1 Connect one lead of the Hypot to a piece of copper foil wrapped around the component's outer insulation to act as the case. Connect the other lead to terminal 1.
  - 4.2.2 Rotate "Voltage Control" clockwise to the below specified derated voltage, slowly and at a uniform rate, and maintain for 60 seconds, then return to zero.
  - 4.2.3 Repeat test connected to terminal 4.
  - 4.2.4 Repeat test between terminal 1 (primary) and terminal 4 (secondary).
  - 4.2.5 Derated Test Voltage Values:
    - 4.2.5.1 250 Vrms between terminal 1 (Stub) and case
    - 4.2.5.2 250 Vrms between terminal 4 (Bus) and case
    - 4.2.5.3 50 Vrms between primary and secondary terminals

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# INDUCED VOLTAGE

## TRANSFORMERS

- 1.0 PURPOSE:** To verify the transformer can withstand an induced voltage with no breakdown or arcing. While voltage is applied there shall be no evidence of continuous arcing or breakdown of insulation.
- 2.0 TEST SPECIFICATIONS:**
- 2.1** NASA EEE-INST-002, Section M1, Tables 2 and 3
  - 2.2** MIL-PRF-27, paragraph 3.12
  - 2.3** Transformer Specification
- 3.0 TEST EQUIPMENT:**
- 3.1** Function Generator
  - 3.2** Oscilloscope
- 4.0 PROCEDURE:**
- 4.1** Apply a 54 peak-to-peak squarewave, 500 kHz to terminals 4 and 3 for one minute, minimum.
  - 4.2** Attach oscilloscope between terminals 1 and 2.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RADIOGRAPHIC INSPECTION

## TRANSFORMERS

**1.0 PURPOSE:** To detect internal physical defects which are not otherwise visible. These defects include but are not limited to improper positioning of elements, damaged or broken elements, poor workmanship, voids in potting compounds, and presence of foreign or extraneous materials.

**2.0 TEST SPECIFICATIONS:**

2.1 MIL-STD-981, Appendix C

2.2 MIL-STD-202, Method 209

**3.0 TEST EQUIPMENT:**

3.1 Radiographic Equipment

**4.0 PROCEDURE:**

4.1 Make and record radiographic images in accordance with MIL-STD-981, Appendix C in each of the three axes; X, Y and Z on a sample of two (2), minimum, per lot for Screening or a sample of two (2) of Groups 1, 2, and 3 for Qualification.

4.1.1 Identify radiographic records by part number, lot number and serial number of specimen.

4.2 Examine the final image with suitable viewing equipment, which may include magnification, for any defects that may be present; such as but not limited to:

4.2.1 Improper positioning of elements that may allow inadequate internal electrical and mechanical clearances.

4.2.2 Damaged or broken elements

4.2.3 Foreign or extraneous materials that can cause damage to insulation or electrical short circuit between elements.

4.2.4 Poor workmanship such as incomplete solder connections, excess lengths of unsupported wires or raveled, frayed or broken wires or terminals.

4.2.5 Voids in potting compound that would allow movement of elements that may cause shorts or damage by vibration or thermal expansion.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# TEMPERATURE RISE

## TRANSFORMERS

**1.0 PURPOSE:** To verify the transformer can withstand a temperature rise across of any winding without effect to the operation or cause any physical damage. This test is only performed on transformers rated at more than 0.8-watt average output. The computed temperature rise of any winding shall not exceed the transformer specification for the transformer under test maximum ambient temperature and there shall be no evidence of physical damage.

**2.0 TEST SPECIFICATONS:**

- 2.1 NASA EEE-INST-002, Section M1, Table 3
- 2.2 MIL-PRF-27, paragraph 3.15, Method 1

**3.0 TEST EQUIPMENT:**

- 3.1 Voltage Generator
- 3.2 Test cabinet
- 3.3 Fluke 77 Multi-meter, or equivalent

**4.0 PROCEDURE:**

- 4.1 Perform testing in accordance with MIL-PRF-27 on a sample of six (6) with zero (0) failures allowed for Qualification.
- 4.2 Compute the temperature rise of each winding based on the change in resistance method using the following formula:

$$\Delta T = \frac{R - r}{r} \left( T + 234.5 \right) - \left( T - t \right)$$

Where:

$\Delta T$  = Temperature rise (in C°) above the specified maximum ambient temperature per the transformer specification

R = Resistance of winding (in Ohms) at temperature (T +  $\Delta T$ )

r = Resistance of winding (in Ohms) at temperature (t)

t = Specified ambient temperature per the transformer specification

T = Maximum ambient temperature at time of power shut off (in C°), (T) shall not differ from (t) by more than 5° C

- 4.3 Condition transformers for at least eight hours at temperature (t) in a location free of drafts before resistance (r) is measured.
- 4.4 Apply 28 Volts peak to peak across terminals 3 and 4 for 30 minutes.
- 4.5 Remove power and immediately read resistance across terminals 1 and 2.
- 4.6 Repeat these two steps until two consecutive readings are the same.
- 4.7 Examine transformer for physical damage.

**NOTE:** Perform OVERLOAD testing following its Test Plan prior to breaking down this test set up.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# OVERLOAD

## TRANSFORMERS

- 1.0 PURPOSE:** To verify the transformer can withstand a temperature rise up to a specified overload across any winding without effect to the operation or cause any physical damage. Following testing per the below procedure, there shall no evidence of physical damage such as cracks, bursting, or bulging of the case.
- 2.0 TEST SPECIFICATONS:**
- 2.1 NASA EEE-INST-002, Section M1, Table 3
  - 2.2 MIL-PRF-27, paragraph 3.23
- 3.0 TEST EQUIPMENT:**
- 3.1 Function Generator
  - 3.2 Test cabinet
  - 3.3 Fluke 77 Multi-meter, or equivalent
- 4.0 PROCEDURE:**
- 4.1 Directly following Temperature Rise – Transformer testing and using the same test set up, perform Overload testing in accordance with MIL-PRF-27 on a sample of six (6) with zero (0) failures allowed, or as specified, for Qualification.
  - 4.2 Increase the ambient temperature above the transformer specification limits until the operating temperature reaches the maximum specified operating temperature for the transformer under test.
  - 4.3 Overload transformer by applying the rated voltage, at the minimum frequency, at the rated duty cycle of the transformer specification to the primary winding, and with the rated load connected to the secondary to set the load impedance.
  - 4.4 Increase input voltage to a value of 112% of the transformer specification rated voltage and maintain this overload for a period of 48 hours -0 / +2 hours.
  - 4.5 Allow transformer to cool for 8 hours, minimum.
  - 4.6 Examine transformer for physical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RESISTANCE TO SOLDERING HEAT

## TRANSFORMERS

- 1.0 PURPOSE:** To ensure transformers can withstand soldering heat application. Following testing there shall be evidence of free flowing solder with proper wetting, no softening of the insulation, loosening of the windings or terminals, or other damage and the windings shall pass continuity test.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 MIL-PRF-27, paragraph 3.8
  - 2.2 MIL-STD-202, Method 210, Test Condition A
  - 2.3 ANSI/J-STD-004
  - 2.4 ANSI/J-STD-006
- 3.0 TEST EQUIPMENT:**
- 3.1 Fluke 77 Multi-meter
- 4.0 PROCEDURE:**
- 4.1 Transformer specimens are not to be previously soldered for any previous test.
  - 4.2 Solder Bath Method (For printed circuit terminals):
    - 4.2.1 Perform test in accordance with MIL-STD-202, method 210, test condition A (350° +/- 10° C; immersion, 4-5 seconds)
    - 4.2.2 Immerse in molten solder to a depth of ¼” from the nearest insulating material or to ½ the exposed length of the terminal; whichever point is closest to the insulating material.
  - 4.3 Solder Iron Method (For all other terminal types):
    - 4.3.1 Ensure solder conforms to J-STD-004, composition Sn60Pb40A or Sn60Pb37A.
    - 4.3.2 Ensure flux conforms to J-STD-006, form W, flux symbol A, and flux percentage of 6% or 7%.
    - 4.3.3 Apply soldering iron ¼” from the nearest insulating material or to ½ the exposed length of the terminal, whichever point is closest to the insulating material.
  - 4.4 Allow transformer 15 minutes recovery time at standard atmospheric conditions.
  - 4.5 Inspect transformer terminals tinning for evidence of free flowing of solder, with proper wetting.
  - 4.6 Visually examine transformer to ensure there has been no seepage of the impregnant, loosening of terminals, or other mechanical damage.
  - 4.7 Test the continuity of the windings.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# TERMINAL STRENGTH

## TRANSFORMERS

**1.0 PURPOSE:** To determine whether the design of the terminals and their method of attachment can withstand twist or torsion mechanical stresses to which they will be subjected during installation into an data bus coupler assembly. During the force application there shall be no open circuits of 100 microseconds or longer.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section M1, Table 3

**2.2** MIL-STD-202, Method 211, Test condition D

**3.0 TEST EQUIPMENT:**

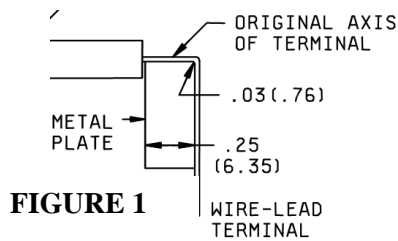
**3.1** Tooling: Padded clamp, ¼” wide machined metal plate with corner radius of approximately .03”, holding fixture, and a chuck on shaft capable of 360° rotation

**3.2** Oscilloscope, or equivalent

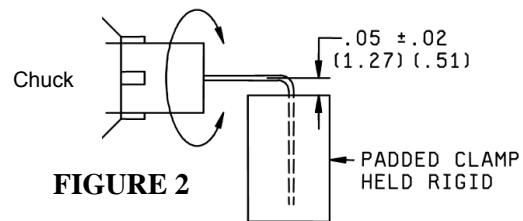
**4.0 PROCEDURE:**

**4.1** Perform testing on every terminal of a sample of six (6) transformers, minimum, with zero (0) failures allowed for Qualification.

**4.2** Bend terminal to 90° at .25” from it’s juncture with the transformer body by folding with fingers over the rounded edge of the ¼” wide metal plate (see Figure 1).



**FIGURE 1**



**FIGURE 2**

**4.3** Apply a clamp at the free end of the terminal starting at .05” +/- .02 from bend (see Figure 2).

**4.4** Hold either the transformer or the clamp on the terminal in a rigid holding fixture (see Figure 2).

**4.4.1** Place the opposite member, either the transformer or the clamp on the terminal, into the chuck (see figure 2).

**4.5** Connect oscilloscope between the terminal under test and the terminal at the other end of the winding for open circuit monitoring throughout the force application.

**4.6** Rotate chuck part through 360° at a rate of approximately 5 seconds per rotation while monitoring for open circuits.

**4.6.1** Ensure rotation axis is fixed with respect to the rigidly held member, do not allow any appreciable end play during rotation.

**4.7** Repeat rotation and monitoring two more times, each in alternating directions, for a total of three rotations (right, left, right / left, right, left).

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# SHOCK

## TRANSFORMERS

**1.0 PURPOSE:** To determine the ability of the component to withstand applied mechanical shocks to simulate field environments. As a result of shock pulses, there shall be no winding discontinuity or evidence of physical or mechanical damage.

**2.0 TEST SPECIFICATIONS:**

**2.1** NASA EEE-INST-002, Section M1, Table 3

**2.2** MIL-STD-202, Method 213, Test Condition I (100 Gs)

**3.0 TEST EQUIPMENT:**

**3.1** Shock Machine

**3.2** Transducers; one for each transformer

**4.0 PROCEDURE:**

**4.1** Perform testing in accordance with MIL-STD-202, Method 213, Test Condition I (100G Sawtooth) on a test sample of four (4) minimum with zero (0) failures allowed for Qualification with the following details:

4.1.1 Mount transformers rigidly in the normal manner.

4.1.2 Apply one shock to each direction of three mutually perpendicular axes of the test specimen.

4.1.3 Post- test: Test transformers for winding continuity and examine for evidence of physical or mechanical damage

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# LIFE

## TRANSFORMERS

- 1.0 PURPOSE:** To determine the effects on the electrical and mechanical characteristics of the transformer resulting from exposure to an elevated temperature for a specified length of time while the part is performing its operational function. Throughout cycling there shall be no evidence of open or short circuits. As a result of cycling there shall be no electrical degradation or evidence of mechanical damage.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002, Section M1, Table 3
  - 2.2 MIL-STD-202, Method 108
  - 2.3 MIL-PRF-15305, paragraph 3.17
- 3.0 TEST EQUIPMENT:**
- 3.1 Environmental Chamber of sufficient thermal capacity to meet temperature and test condition requirements
  - 3.2 Test circuit devised to detect open or short circuits and record time of occurrence during Life cycling
- 4.0 PROCEDURE:** Perform testing in accordance with MIL-STD-202, Method 108 on a sample of six (6) with zero (0) failures allowed of Subgroup II for Qualification with the following details:
- 4.1 Initial measurements: Prior to exposure perform DC RESISTANCE – TRANSFORMER and INDUCTANCE-TRANSFORMER at room temperature according to their Test Plans (to be used as a baseline for comparison after life cycling in determining electrical degradation limits after exposure).
  - 4.2 Mount test specimens by their normal mounting means and place into the chamber so there is no obstruction to the flow of air across and around the specimen. Minimize direct heat conduction to the test specimen, including spacing between specimens, to avoid temperature from one specimen influencing the temperature of another specimen.
  - 4.3 Subject test specimens to 5 life cycles a week for a minimum of 12 weeks; a total of 2,016 hours, while connected to the devised test circuit.
    - 4.3.1 4 cycles: 20 hours at 85° C with electrical conditions, then 4 hours at room ambient temperature without excitation
    - 4.3.2 1 cycle: 68 hours at 85° C, then 4 hours at room ambient temperature with excitation
  - 4.4 Post test, perform the following tests according to their Test Plans in order to ensure electrical degradation is within limits:
    - 4.4.1 INSULATION RESISTANCE -TRANSFORMER
    - 4.4.2 DIELECTRIC WITHSTANDING VOLTAGE; HIGH ALTITUDE-TRANSFORMERS; per paragraph 4.2 only
    - 4.4.3 DC RESISTANCE – TRANSFORMER
    - 4.4.4 INDUCTANCE -TRANSFORMER
    - 4.4.5 Examine the test specimen for physical damage.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# MATERIAL OUTGASSING EVALUATION

## ALL EEE COMPONENTS

- 1.0 PURPOSE:** To verify all nonmetal materials outgassing properties do not exceed the limits of 1% TML or 0.1% CVCM. This evaluation shall be performed during the initial design review process. Outgassing can occur in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can also become more rigid or brittle.
- 2.0 TEST SPECIFICATIONS:**
- 2.1 NASA EEE-INST-002
  - 2.2 ASTM-E595
  - 2.3 NASA Reference Publication 1124, <http://outgassing.nasa.gov>
- 3.0 TEST EQUIPMENT:**
- 3.1 N/A; verification by analysis
- 4.0 PROCEDURE:**
- 4.1 Evaluate all nonmetal materials for outgassing properties during the initial design review process of an assembly that will incorporate said materials.
  - 4.2 Materials to be used in a design shall be selected from NASA Reference Publication 1124 at <http://outgassing.nasa.gov>
    - 4.2.1 Materials listed in NASA Reference Publication 1124 that meet TML and CVCM limits are acceptable for use without further testing.
      - 4.2.1.1 Materials listed that meet TML and CVCM limits may have been baked out prior to evaluation in order to reduce Outgassing, if so the Outgassing bake out may have to be performed to achieve acceptable levels of Outgassing; reference VACUUM OUTGAS BAKE-OUT Test Plan.
    - 4.2.2 Perform testing in accordance with ASTM-E595 for any material planned for use in a design that is not listed as acceptable.
- 5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

# RESIDUAL MAGNETISM

## CONNECTOR: D-SUBMINIATURE

**1.0 PURPOSE:** To determine if the component's residual magnetism is low enough to be classified as nonmagnetic. The connector shall have residual magnetism per the Industry Acceptance Level as dictated by the customer's specification, only Levels B and C are used: Level A = 20,00 Gamma / Level B = 200 Gamma / Level C = 20 Gamma.

**2.0 TEST SPECIFICATIONS:**

- 2.1 NASA EEE-INST-002, Section C2, Tables 2B & 3B
- 2.2 NASA S-311-P-4; paragraph 3.4 for D-Subminiature
- 2.3 NASA S-311-P-10; paragraph 3.4.5 for D-Miniature

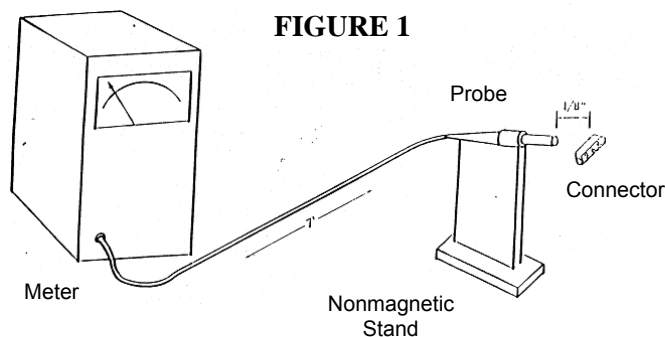
**3.0 TEST EQUIPMENT:**

- 3.1 HP Model 428 B Milliammeter, or equivalent
- 3.2 HP Model 3529A Magnetometer Probe
- 3.3 Electromagnet, field strength of 5000 gauss
- 3.4 Nonmagnetic stand and probe holder

**4.0 PROCEDURE:**

- 4.1 Perform testing on a fully assembled connector in a magnetically quiet area on a sample of (3) minimum with (0) failures allowed for Qualification.
- 4.2 Warm up Milliammeter for 15 minutes, minimum.
- 4.3 Mount the Magnetometer Probe in the nonmagnetic stand in a horizontal position at full cable length from the Milliammeter, (7 feet). See FIGURE 1.
- 4.4 With the meter preset to the appropriate scale, align the probe to obtain a zero reading on the meter.
- 4.5 Pass the connector test specimen between the poles of the magnet 3 times.
  - 4.5.1 Do not allow the connector to contact the pole pieces.
- 4.6 IMMEDIATELY place the connector to within 1/8 inch of the Probe tip and orient and orient it for a maximum magnetism reading.
- 4.7 Measurement is in Gamma where 1 Gamma=  $1 \times 10^{-5}$  Gauss.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.



# RESIDUAL MAGNETISM

## CONTACTS

**1.0 PURPOSE:** To determine if the component's residual magnetism is low enough to be classified as nonmagnetic. This test is performed only when contacts are procured separate from the connector they are to be used in. The measured value of the group shall be  $\leq 0.1$  multiplied by the number of contacts in the group. During the GO-NO-GO test, any contact that is attracted to the magnet shall be considered a failure.

**2.0 TEST SPECIFICATIONS:**

2.1 NASA EEE-INST-002, Section C2, Tables 2H & 3H

2.2 NASA S-311-P-4; paragraph 3.4

2.3 NASA S-311-P-4/08; paragraph 3.3.1 for Size 22 Contacts

2.4 NASA-S-311-P4/10; paragraph 3.3.1 for Size 20 Contacts

**3.0 TEST EQUIPMENT:**

3.1 HP Model 428 B Milliammeter, or equivalent

3.2 HP Model 3529A Magnetometer Probe

3.3 Electromagnet, field strength of 5000 gauss

3.4 Nonmagnetic stand and probe holder

**4.0 PROCEDURE:**

4.1 Perform testing with contacts grouped into quantities  $\leq 500$  in a magnetically quiet area on a sample quantity dependent upon Residual Magnetism Acceptance Level and contact type; see NASA EEE-INST-002 Section C2, Table 2H and Table Note 3 for Screening. Perform testing on a sample quantity of eight (8), minimum, of Groups A or B with zero (0) failures allowed for Qualification.

4.1.1 Military and NASA qualified contacts may use a go-no-go test at receiving inspection as defined in NASA EEE-INST-002, Section C2, Note 3.2 (found after Table 2K), rather than this test procedure.

4.1.1.1 If this test is performed, include Pass/Fail results in the GO-NO-GO column of following data sheet.

4.2 Warm up Milliammeter for 15 minutes, minimum.

4.3 Mount the Magnetometer Probe in the nonmagnetic stand in a horizontal position at full cable length from the Milliammeter, 7 feet. See FIGURE 1.

4.4 With the meter preset to the appropriate scale, align the probe to obtain a zero reading on the meter.

4.5 Pass the group of contacts between the poles of the magnet 3 times.

4.5.1 Do not allow the group of contacts to contact the pole pieces.

4.6 IMMEDIATELY place the group of contacts to within 1/8 inch of the Magnetometer Probe and orient the group for a maximum magnetism reading.

4.7 Measurement is in Gamma where 1 Gamma =  $1 \times 10^{-5}$  Gauss.

**5.0 RECORD DATA:** Document test results on the following data sheet or within an attached test report.

