TIMES MICROWAVE SYSTEMS

# QTR2005

## Revision: B

## QUALIFICATION TEST REPORT
## FOR EADS / CASA / AIRBUS A400M
## PER TECHNICAL SPECIFICATIONS
## NT-A4-SAM-06003 AND NT-A4-SAM-06004

| APPROVALS QTR2005A.doc | DATE | SIGNATURES |
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**Table 1** – Revision Index

| Revision | Description | CDC Number | Date | Revised By |
|---|---|---|---|---|
| – | Initial Release | n/a | | DJF |
| A | Test Requirements Changed | N/A | 6/20/08 | DJF |
| B | Added test requirements | 28693 | | DJF |
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# 1.0 Executive Summary

This Qualification Test Report describes the testing and analysis used to demonstrate that the RF coaxial cable assemblies manufactured by Times Microwave Systems comply with Airbus' requirements for use on the A400M.

All tests have been satisfactorily completed. It is the position of Times Microwave Systems that this test report verifies the suitability of the cable assembly designs for Airbus' **NT-A4-SAM-06003** and **NT-A4-SAM-06004** specifications.

This design verification was performed on a representative set of RF coaxial cable assemblies representing the envelope of design parameters. Testing was performed on these test samples according to the test plans, QTP2005 and QTP2013.

# 2.0 Reference Documents

## *2.1 Airbus Documents*

**NT-A4-SAM-06003** V/UHF Low Loss Coaxial Cable Assemblies, Purchaser Technical Specification

**NT-A4-SAM-06004** TACAN-2/MIDS Low Loss Coaxial Cable Assemblies, Purchaser Technical Specification

## *2.2 Times Microwave Systems Documents*

| | |
|---|---|
| **ATP1047** | Acceptance Test Procedure |
| **QTP2005** | Qualification Test Plan for A400M |
| **QTP2013** | Qualification Test Plan for Additional Testing of A400 V/UHF and TACAN-2/MIDS Cable Assemblies. |
| **TP 02200C** | VSWR, Insertion Loss, and Phase Using an Agilent 87XX Based System |
| **TP 03003P** | Vapor Leakage per MIL-T-81490 |
| **TP 02001R** | Impedance using Techtronix 1502C TDR |
| **ETR 0116** | Power Handling Analysis for Miltech Cables |
| **ETR 0120** | Chemical Resistance Test for Miltech Cables |
| **T0873** | Vapor Leakage test |

## 2.3 Military Documents

| | |
|---|---|
| **MIL-STD-130** | Identification Marking |
| **MIL-STD-454** | Standard General Requirement for Electronic Equipment |
| **MIL-STD-810** | Test Method Standard; Environmental Test Specification |
| **MIL-STD-202** | Test Method Standard; Electronic and Electrical Component parts |
| **MIL-T-81490** | Transmission Lines, Transverse Electromagnetic Mode |

## 2.4 European Standards

| | |
|---|---|
| **RTCA/DO-160D** | Environmental Conditions and Test Procedure for Airborne Equipment. |
| **EN 3475-xxx** | Aerospace Series – Cables, electrical aircraft use – Test Methods |
| **ABD0031** | Fireworthiness requirements, pressurized section of fuselage |
| **ISO2669** | Environmental Tests for Aircraft Equipment, Steady State Acceleration |

## 2.5 Acronym Definitions

| | |
|---|---|
| APSD | Acceleration Power Spectral Density |
| ATP | Acceptance Test Procedure |
| QTP | Qualification Test Plan |
| QTR | Qualification Test Report |
| PTS | Purchaser Technical Specification |
| RF | Radio Frequency |
| VSWR | Voltage Standing Wave Ratio |

# 3.0 Qualification Method

Times Microwave Systems used the Qualification Methods outlined in **Table 2** to ensure the cable assemblies qualify Airbus specifications **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

Table 2 – Qualification Method

| **Qualification Methods** NA= Not Applicable, 1=Inspection, 2=Analysis, 3=Qual-By-Sim, 4=Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **NT-A4-SAM-06003/06004 PTS Reference** | | Verification Methods | | | | | Qualification | |
| **Para.** | **Description** | **NA** | **1** | **2** | **3** | **4** | **Section** | **Reference Doc.** |
| **2.1.5** | **ELECTRICAL CHARACTERISTICS** | | | | | | | |
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| 2.1.5.2 | Impedance | | | | | X | 7.2 | |
| 2.1.5.3 | Voltage Standing Wave Ratio (VSWR) | | | | | X | 7.3 | ATP1047 |
| 2.1.5.4 | RF Loss | | | | | X | 7.4 | ATP1047 |
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| **2.1.6** | **MECHANICAL CHARACTERISTICS** | | | | | | | |
| 2.1.6.1 | Mass | | X | | | | 7.7 | ATP1047 |
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| 2.1.6.5 | Pressure Seal | | | | | X | 7.11 | |
| 2.1.6.6 | Tensile Load | | | | | X | 7.12 | |
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| 2.1.6.8 | Torque | | | | | X | 7.14 | |
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| 2.1.6.10 | Chemical Resistance | | | X | | | 7.16 | |
| 2.1.6.11 | Flexure | | | | | X | 7.17 | |
| 2.1.6.12 | Hermetic Sealing | | | X | | | 7.18 | |
| 2.1.7 | Interface Characteristics | | | | | X | 7.19 | |
| 2.1.8 | Physical Requirements (Marking) | | X | | | | 7.20 | Mil-STD-130 |
| **2.2** | **ENVIRONMENTAL REQUIREMENTS** | | | | | | | |
| 2.2.3 | Temperature | | | | | X | 7.21 | EUR.ED14 Sec 4 |
| 2.2.4 | Atmospheric Pressure/Altitude | | | | | X | 7.22 | EUR.ED14 Sec 4 |
| 2.2.5 | Temperature Variation | | | | | X | 7.23 | EUR.ED14 Sec 5 |
| 2.2.6 | Humidity | | | | | X | 7.24 | EUR.ED14 Sec 6 |
| 2.2.7 | Shocks and Crash Safety | | | | | X | 7.25 | EUR.ED14 Sec 7 |
| 2.2.8.1 | Operational Vibration | | | | | X | 7.26 | MIL-STD-810F |
| 2.2.8.2 | Vibration - Tyre Burst | | | | | X | 7.27 | ABD0100.1.2 |
| 2.2.9 | Waterproofness | | | X | | | 7.28 | EUR.ED14 Sec 10 |
| 2.2.10 | Fluid Susceptibility | | | X | | | 7.29 | EUR.ED14 Sec 11 |
| 2.2.11 | Sand and Dust | | | | X | | 7.30 | MIL-STD-810F |
| 2.2.12 | Fungus Resistance | | | X | | | 7.31 | EUR.ED14 Sec 13 |
| 2.2.13 | Salt Spray | | | | | X | 7.32 | EUR.ED14 Sec 14 |
| 2.2.14 | Icing | | | X | | | 7.33 | EUR.ED14 Sec 24 |

**Qualification Methods (continued)**

NA= Not Applicable, 1=Inspection, 2=Analysis, 3=Qual-By-Sim, 4=Test

| NT-A4-SAM-06003/06004 PTS Reference | | Verification Methods | | | | | Qualification | |
|---|---|---|---|---|---|---|---|---|
| **Para.** | **Description** | **NA** | **1** | **2** | **3** | **4** | **Section** | **Reference Doc.** |
| **2.2** | **ENVIRONMENTAL REQUIREMENTS (continued)** | | | | | | | |
| 2.2.15 | Flammability/Toxicity/Smoke | | | | | X | 7.34 | ABD0031 |
| 2.2.16 | Constant Acceleration | | | | | X | 7.35 | ISO 2669 |
| 2.2.17 | Aircraft Attitude | | | X | | | 7.36 | |
| 2.3.3 | Connector Insertion Reliability | | | | | X | 7.37 | |
| **2.2** | **CABLE TESTS FOR FBT 600 FROM TABLE 2.2 of PTS** | | | | | | | |
| 2.2-1 | General | X | | | | | 8.1 | EN3475-100 |
| 2.2-1 | Visual Examination | | X | | | | 8.2 | EN3475-201 |
| 2.2-1 | Mass | | | | | X | 8.3 | EN3475-202 |
| 2.2-1 | Dimensions | | | X | | | 8.4 | EN3475-203 |
| 2.2-1 | Electrical Resistance per unit length | | | | | X | 8.5 | EN3475-301 |
| 2.2-1 | Voltage Proof Test | | | | | X | 8.6 | EN3475-302 |
| 2.2-1 | Insulation Resistance | | | | | X | 8.7 | EN3475-303 |
| 2.2-1 | Continuity of Conductors | | | | | X | 8.8 | EN3475-306 |
| 2.2-1 | Corona Extinction Volatage | | | | | X | 8.9 | EN3475-307 |
| 2.2-1 | Resitance to Fluids | | | X | | | 8.10 | EN3475-411 |
| 2.2-1 | Notch Propagation | | | | | X | 8.11 | EN3475-502 |
| 2.2-1 | Scrape Abrasion | | | | | X | 8.12 | EN3475-503 |
| 2.2-1 | Flexure Endurance | | | | | X | 8.13 | EN3475-512 |
| 2.2-1 | Deformation Resistance | | | | | X | 8.14 | EN3475-513 |
| 2.2-1 | Braid Screen Pushback Capability | | | | | X | 8.15 | EN3475-702 |
| 2.2-1 | Performance of Manufacturer's Marking | | | | | X | 8.16 | EN3475-703 |
| 2.2-1 | Flexibility | | | | | X | 8.17 | EN3475-704 |
| 2.2-1 | Capacitance per Unit Length | | | | | X | 8.18 | EN3475-801 |
| 2.2-1 | Velocity of Propagation | | | | | X | 8.19 | EN3475-804 |
| 2.2-1 | Characteristic Impedance | | | | | X | 8.20 | EN3475-805 |
| 2.2-1 | Attenuation | | | | | X | 8.21 | EN3475-806 |
| 2.2-1 | Fire Resistance | | | X | | | 8.22 | EN3475-408 |

# 4.0 Standard Test Conditions

The following conditions shall be used to establish normal functional performance characteristics.

| | |
|---|---|
| a. Ambient temperature | Room Ambient (23 +/-10 degrees C) |
| b. Surrounding Air Pressure | Prevailing Room Conditions |
| c. Humidity | Room Ambient up to 90% relative humidity |

The test method and/or test data will specifically indicate any testing that occurs outside these ranges.

# 5.0 Test Facilities

All tests were performed at Times Microwave Systems, Wallingford, Connecticut, or any other approved test facility.

# 6.0 Test Sample Definitions

The cable assemblies in **Table 3** and **Table 4** were used to satisfy the qualification requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.
Times Microwave Systems also utilized analysis and test data from similar products to satisfy qualification requirements.

The Test Samples utilized for the Qualification Testing are representative of samples used in this program. Configurations and lengths are not necessarily identical to part numbers being shipped as production cable assemblies.

**Table 3** – Test Sample Configurations

| Sample # | 1 | 2 | 3 | 4 (a,b,c) | 5(a,b) | 6(a,b) | 7(a,b,c) | 8(a,b,c) | 9(a,b) |
|---|---|---|---|---|---|---|---|---|---|
| Quantity | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 2 |
| Cable Type | FBT600 | FBT600 | FBT600 | FBT600 | FBT600 | FBT600 | FBT600 | FBT600 | FBT600 |
| Cable MI Number | 54173 | 54173 | 54173 | 54173 | 54173 | 54173 | 54173 | 54173 | 54173 |
| Length (ft) | 10’ | 10’ | 10’ | 15’ | 15’ | 15’ | 15’ | 15’ | 1.67’ |
| FWD Conn | N-M 90° | TNC-M 90° | HN-M | HN-M | N-M | N-M 90° | TNC-M | TNC-M 90° | N-M |
| FWD Conn pn | 48628-1 | 47573 | 48507 | 48507 | 48721 | 48628-1 | 48555 | 48573 | 48721 |
| FWD Int | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 |
| AFT Conn | N-M | TNC-F BH | TNC-F | TNC-F BH | N-M | N-M | N-M | TNC-F BH | N-M |
| AFT Conn pn | 48721 | 48590 | 48590 | 48590 | 48721 | 48721 | 48721 | 48590 | 48721 |
| AFT Int | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 | 47961 |
| Freq Rang (MHz) | 30-1220 | 30-1220 | 30-1220 | 30-1220 | 30-1220 | 30-1220 | 30-1220 | 30-1220 | 30-1220 |
| Max VSWR | 1.3:1 | 1.3:1 | 1.3:1 | 1.3:1 | 1.3:1 | 1.3:1 | 1.3:1 | 1.3:1 | N/A |
| Max Insertion Loss @ 400 MHz | 0.23 | 0.23 | 0.23 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | N/A |
| Max Insertion Loss @ 1220 MHz | 0.39 | 0.39 | 0.39 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | N/A |
| Mass (Lb) | 2.54 | 2.54 | 2.54 | 3.59 | 3.59 | 3.59 | 3.59 | 3.59 | 0.79 |
| Temp extreme Allowance | Insertion Loss 0.3% per degree allowable increase over 23°C | | | | | | | | |

**Table 4** – Test Sample Configurations (cont)

| Sample # | 10a | 10b | 11a | 11b | 12a | 12b |
|---|---|---|---|---|---|---|
| Quantity | 1 | 1 | 1 | 1 | 1 | 1 |
| Cable Type | FBT 600 | MT 340 | FBT 600 | MT 340 | FBT 600 | MT 340 |
| Cable MI Number | 54173 | 51678 | 54173 | 51678 | 54173 | 51678 |
| Length (ft) | 15 | 15 | 1 | 1 | 5 | 5 |
| FWD Conn | HN-M | N-M | HN-M | N-M | HN-M | N-M |
| FWD Conn pn | 48507 | 48721 | 48507 | 48721 | 48507 | 48721 |
| FWD Int | 47961 | 17944 | 47961 | 17944 | 47961 | 17944 |
| AFT Int | 47961 | 17921 | 47961 | 17921 | 47961 | 17921 |
| Pressure Seal | 3190-2198 | N/A | 3190-2198 | N/A | 3190-2198 | N/A |
| Adapter | HN-F to TNC-M | N-F to TNC-M | HN-F to TNC-M | N-F to TNC-M | HN-F to TNC-M | N-F to TNC-M |
| Adapter PN | 3190-2206 | 3191-220 | 3190-2206 | 3191-220 | 3190-2206 | 3191-220 |
| Freq Rang (MHz) | 30-1220 | | 30-1220 | | 30-1220 | |
| Max VSWR | 1.4:1 | | 1.4:1 | | 1.4:1 | |
| Max Insertion Loss @ 400 MHz | 0.94 | | 0.27 | | 0.48 | |
| Max Insertion Loss @ 1220 MHz | 1.57 | | 0.43 | | 0.76 | |
| Mass (Lb) | 5.69 | | 1.41 | | 2.63 | |
| Temp extreme Allowance | Insertion Loss 0.3% per degree allowable increase over 23°C | | | | | |

Table 4 Notes:

- The aft intermediates of assemblies a and b will be connected together and treated as one composite assembly.
- VSWR and Loss specs include entire assembly and added adapters.

# 7.0 Test Requirements

Section **7.1** through Section **8.22** of this document are adopted from paragraph 2.1 through 2.3 of the **NT-A4-SAM-06003** and **NT-A4-SAM-06004** PTS specifications.

Requirements for both PTS documents have been consolidated herein. (i.e. mass, length)

## *7.1 Frequency Range*

**Requirement:**
The **NT-A4-SAM-06003** requirements for frequency range are 30-400 MHz.

The **NT-A4-SAM-06004** requirements for frequency range are 960-1220 MHz.

Since this qualification test plan covers both specifications, the qualification samples shall be examined over the frequency range of 30 to 1220 MHz.

**Method:**
VSWR and Insertion Loss were measured over the frequency range of 30 to 1220 MHz according to TMS procedure TP02200C.

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4** over the required frequency ranges are considered to have passed this test.

**Results:**
All of the cables tested met the VSWR and Insertion loss specifications over the required frequency ranges (see **Table 6** and **Table 7**). The test data is included in **APPENDIX B – INITIAL DATA**. In addition, all cable assemblies will be tested over the required frequency range for Loss and VSWR prior to delivery to the customer.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Frequency Range requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.2 Impedance*

**Requirement:**
The coaxial cable assemblies shall have a nominal impedance of 50 Ω.

**Method:**
Cable assemblies 1 – 3 were measured for impedance using a Time Domain Reflectometer per Times Microwave Systems procedure **02001R**.

**Accept / Reject Criteria:**
Cables that meet the impedance requirement of 50 Ω are considered to have passed this test.

**Results:**
All of the cables were tested for impedance and met the nominal requirement of 50 Ω as shown in **Table 5**. The test data for impedance is included in **APPENDIX B – IMPEDANCE DATA.**

**Table 5 – Impedance Test Results**

| Sample # | Impedance Ω | Result |
|---|---|---|
| 1 | 50.5 | **Pass** |
| 2 | 50.75 | **Pass** |
| 3 | 50.9 | **Pass** |
| 12B#1 | 50.6 | **Pass** |
| 12B#3 | 50.5 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Impedance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.3 Voltage Standing Wave Ratio (VSWR)*

**Requirement:**
VSWR shall not exceed 1.3:1 for the specified frequency range.

When TACAN connector adapters are fitted, VSWR for the cable assemblies shall not exceed 1.4:1.

**Method:**
VSWR was measured for each assembly over the required frequency range according to TMS procedure TP02200C. VSWR was measured on the cable assembly with adapters installed.

VSWR was measured over the frequency range of 30 to 1220 MHz according to TMS procedure TP02200C.

**Accept / Reject Criteria:**
Cables that meet the VSWR requirements according to **Table 3** and **Table 4** will be considered to have passed this test.

**Results:**
All of the cables tested met the VSWR requirements of 1.3:1 or better. (See **Table 6**) The test data is included in **APPENDIX B – INITIAL DATA**. In addition, all of the cable assemblies will be tested for VSWR prior to delivery to the customer. See also **APPENDIX D – ATP1047: Acceptance Test Procedure**.

**Table 6 – VSWR Initial Test Data**

| Sample # | VSWR | Spec | Result |
|---|---|---|---|
| 1 | 1.10:1 | 1.3:1 | **Pass** |
| 2 | 1.07:1 | 1.3:1 | **Pass** |
| 3 | 1.13:1 | 1.3:1 | **Pass** |
| 4a | 1.12:1 | 1.3:1 | **Pass** |
| 4b | 1.16:1 | 1.3:1 | **Pass** |
| 4c | 1.13:1 | 1.3:1 | **Pass** |
| 5a | 1.09:1 | 1.3:1 | **Pass** |
| 5b | 1.09:1 | 1.3:1 | **Pass** |
| 6a | 1.08:1 | 1.3:1 | **Pass** |
| 6b | 1.10:1 | 1.3:1 | **Pass** |
| 7a | 1.09:1 | 1.3:1 | **Pass** |
| 7b | 1.09:1 | 1.3:1 | **Pass** |
| 7c | 1.13:1 | 1.3:1 | **Pass** |
| 8a | 1.08:1 | 1.3:1 | **Pass** |
| 8b | 1.09:1 | 1.3:1 | **Pass** |
| 8c | 1.09:1 | 1.3:1 | **Pass** |
| 10 #1 | 1.19:1 | 1.4:1 | **Pass** |
| 10 #2 | 1.19:1 | 1.4:1 | **Pass** |
| 11 #1 | 1.17:1 | 1.4:1 | **Pass** |
| 11 #2 | 1.19:1 | 1.4:1 | **Pass** |
| 11 #3 | 1.22:1 | 1.4:1 | **Pass** |
| 12 #1 | 1.18:1 | 1.4:1 | **Pass** |
| 12 #2 | 1.18:1 | 1.4:1 | **Pass** |
| 12 #3 | 1.18:1 | 1.4:1 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the VSWR requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.4 Insertion Loss*

**Requirements:**

The cable assemblies shall meet the insertion loss requirements at 400MHz and 1220 MHz as listed in **Table 3** and **Table 4**. These specifications are not the same as the actual production assemblies, since the lengths of the qualification samples are optimized for testing. The Insertion Loss will however utilize the same cable and connector loss calculations to determine acceptable limits across the frequency range.

**Method:**

Insertion Loss was measured over the frequency ranges of 30 to 1220 MHz according to TMS procedure TP02200C. Loss data was recorded at 400MHz and 1220 MHz.

**Loss Calculation:**

The insertion loss of the cable assemblies was calculated according to the formula:
I.L. (dB) = R1 + R2 +C1+C2+C3 + A1 + A2

- R1 = loss of FBT 600 cable
- R2 = loss of MT 340 cable
- C1 = loss of connector 1
- C2 = loss of connector 2
- C3 = loss of splice between cables
- A1 and A2 are loss of added adapters.
- For FBT 600, 0.016862db/ft @ 400MHz and 0.030209db/ft @1220MHz was used.
- For Miltech 340, 0.028896db/ft @ 400MHz and 0.051189db/ft @ 1220MHz was used.
- At 400MHz, 0.05db was added for each connector, splice, or adapter.
- At 1220MHz, 0.07 db was added for each connector, splice, or adapter.

**Accept / Reject Criteria:**
Cables that meet the Insertion Loss requirements according to **Table 3** and **Table 4** will be considered to have passed this test.

**Results:**
All of the cables tested for insertion loss met the requirements**.** (See Table 7) The test data is included in **APPENDIX B – INITIAL DATA**. In addition, all of the cable assemblies will be tested for insertion loss prior to delivery to the customer. See also **APPENDIX D – ATP1047: Acceptance Test Procedure**.

**Table 7 – Insertion Loss Initial Test data**

| Sample # | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|
| 1 | 0.23 | 0.23 | 0.39 | 0.39 | **Pass** |
| 2 | 0.23 | 0.23 | 0.38 | 0.39 | **Pass** |
| 3 | 0.19 | 0.23 | 0.33 | 0.39 | **Pass** |
| 4a | 0.31 | 0.32 | 0.5 | 0.54 | **Pass** |
| 4b | 0.28 | 0.32 | 0.46 | 0.54 | **Pass** |
| 4c | 0.27 | 0.32 | 0.48 | 0.54 | **Pass** |
| 5a | 0.29 | 0.32 | 0.5 | 0.54 | **Pass** |
| 5b | 0.28 | 0.32 | 0.49 | 0.54 | **Pass** |
| 6a | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 6b | 0.29 | 0.32 | 0.52 | 0.54 | **Pass** |
| 7a | 0.31 | 0.32 | 0.53 | 0.54 | **Pass** |
| 7b | 0.3 | 0.32 | 0.51 | 0.54 | **Pass** |
| 7c | 0.29 | 0.32 | 0.51 | 0.54 | **Pass** |
| 8a | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 8b | 0.31 | 0.32 | 0.53 | 0.54 | **Pass** |
| 8c | 0.31 | 0.32 | 0.53 | 0.54 | **Pass** |
| 10 #1 | 0.72 | 0.94 | 1.3 | 1.57 | **Pass** |
| 10 #2 | 0.76 | 0.94 | 1.35 | 1.57 | **Pass** |
| 11 #1 | 0.12 | 0.27 | 0.23 | 0.43 | **Pass** |
| 11 #2 | 0.13 | 0.27 | 0.28 | 0.43 | **Pass** |
| 11 #3 | 0.13 | 0.27 | 0.33 | 0.43 | **Pass** |
| 12 #1 | 0.31 | 0.48 | 0.55 | 0.76 | **Pass** |
| 12 #2 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12 #3 | 0.28 | 0.48 | 0.52 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Insertion Loss requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.5 Power Handling*

**Requirement:**
The assembly power handling capability shall not be less than 200 W CW for V/UHF and not less than 2KW CW for Tacan.

**Analysis for FBT600:**
The following analysis demonstrates suitability of the FBT 600 cable for use in the Airbus A400 requirements.

**Table 8** – FBT 600 Power Handling – Cable Construction

| | |
|---|---|
| Center Conductor Diameter (in) | 0.150 |
| Dielectric Core Diameter (in) | 0.455 |
| Outer Conductor Diameter (in) | 0.490 |
| Jacket Diameter (in) | 0.565 |
| Dielectric Core Thermal Conductivity (W/in °C) | 0.00448 |
| Jacket Thermal Conductivity (W/in °C) | 0.00527 |

Analytical Assumptions

- The predominant means of transferring heat, dissipated within the cable, to its external environment is through radiation.
- Our analysis assumes some minimal amount of natural convective air-flow.
- No allowance is made for conductive heat transfer through the ends of the cable. This is treated as engineering safety margin.
- The limiting constraint for this analysis is a maximum temperature of +200°C at the center conductor which is the hottest part of the cable. The PTFE dielectric core starts to melt at +250°C. The 50 degree temperature buffer is to ensure suitable safety margin.

**Table 9** – FBT 600 Power Handling – Analysis

| | | |
|---|---|---|
| External Ambient Temperature (°C) | +25 | +85 |
| External Ambient Altitude (feet) | Sea Level | 50,000 |
| Frequency (MHz) | 1,220 | 1,220 |
| Center Conductor Temp (°C) | +200 | +200 |
| Outer Conductor Temp (°C) | +153 | +182 |
| Jacket Temp (°C) | +136 | +175 |
| Maximum Power Input (Watts) | 6,710 | 2,890 |

**Analysis for MilTech 340:**
The Miltech 340 cable was tested for power handling in the document **ETR-0116**. From the charts in this document, it can be determined that the maximum power handling for the Miltech 340 cable is as follows:

**Table 10** – Miltech 340 Power Handling – Analysis

| | | |
|---|---|---|
| External Ambient Temperature (°C) | +25 | +100 |
| External Ambient Altitude (feet) | Sea Level | 70,000 |
| Frequency (MHz) | 2000 | 2000 |
| Maximum Power Input (Watts) | 2400 | 700 |

Excerpts from the test report which contains the Power Handling test results for Miltech 340 is in **APPENDIX F – ETR-0116 Test** Report.

**Conclusion:**
For the Tacan, only the FBT 600 cable is used, which exceeds the power handling requirement of 2KW at both room ambient and at Temperature and altitude.

For the V/UHF requirement, The High Power Handling capability of both FBT 600 and Miltech 340 exceed the requirements of 200W CW.

Therefore Times Microwave Systems certifies that this cable meets the power handling requirement of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.6 Velocity of Propagation*

**Requirement:**
The velocity of propagation shall not be less than 70%.

**Method:**
Cables # 1, 2, 3 were tested to meet this requirement. Time delay of the cable was measured according to TMS procedure TP02200C.
To calculate the Velocity of Propagation, the following formula was used:

$$Vg = \frac{(100)\ (D)}{(C)\ (T)}$$

Where D = Accurate mechanical length in inches.
T = Time in nanoseconds.
C = Speed of light (11.80315 inches per nanoseconds).

Note that the mechanical length is the fully developed length. This includes the portion of the cable with the 90° connector bend.

**Accept / Reject Criteria:**
Cables that have a velocity of propagation equal to or greater than 70% will be considered to have passed this test.

**Results:**
All of the cables tested for Velocity of Propagation met the required specifications. Table 11 is a summary of the test results and the test data is included in **APPENDIX B – VELOCITY OF PROPAGATION DATA.**

**Table 11 – Velocity of Propagation Test Results**

| Sample # | Length (in) | Delay (ns) | Vg | Result |
|---|---|---|---|---|
| 1 | 122.75 | 13.707 | 75.87% | **Pass** |
| 2 | 122 | 13.697 | 75.46% | **Pass** |
| 3 | 123 | 13.689 | 76.13% | **Pass** |
| 11b#1 | 16 | 1.66 | 81.20% | **Pass** |
| 12b#1 | 64 | 6.74 | 80.40% | **Pass** |
| 12b#3 | 63.125 | 6.74 | 79.40% | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Velocity of Propagation requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.7 Mass*

**Requirement:**
**NT-A4-SAM-06003** states the total weight of the four assemblies shall not exceed 25 Kg and **NT-A4-SAM-06004** states the total weight of the four assemblies shall not exceed 16 Kg.

The mass of each cable assembly shall be measured.

**Calculation:**

The mass for each cable assembly was calculated as follows:

- Total Mass = M1 + M2 + C1 + C2 + C3 + PS + A1 + A2
- M1 = Mass of FBT 600 = 0.210 lb/ft
- M2 = Mass of MILTECH 340 = 0.096 lb/ft (**Table 4** samples only)
- C1, C2 = Mass of connector 1 and 2 = 0.2205 lb (100g) each
- C3 = Mass of splice = 0.2205 lb (100g) (**Table 4** samples only)
- PS = Mass of pressure seal = .2205 lb (100g) (**Table 4** samples only)
- A1, A2 = Mass of adapters 1 and 2 = 0.1102 (50g) each (**Table 4** samples only)

**Accept / Reject Criteria:**
Cables that meet the mass requirements according to **Table 3** and **Table 4** will be considered to have passed this test.

**Results:**
All of the cables tested for mass met the required specifications. **Table 12** is a summary of the test results.

**Table 12 - Mass**

| Sample # | Mass (lb) | Spec | Result |
|---|---|---|---|
| 1 | 2.54 | 2.54 | **Pass** |
| 2 | 2.52 | 2.54 | **Pass** |
| 3 | 2.48 | 2.54 | **Pass** |
| 4a | 3.59 | 3.59 | **Pass** |
| 4b | 3.58 | 3.59 | **Pass** |
| 4c | 3.58 | 3.59 | **Pass** |
| 5a | 3.59 | 3.59 | **Pass** |
| 5b | 3.58 | 3.59 | **Pass** |
| 6a | 3.58 | 3.59 | **Pass** |
| 6b | 3.59 | 3.59 | **Pass** |
| 7a | 3.59 | 3.59 | **Pass** |
| 7b | 3.57 | 3.59 | **Pass** |
| 7c | 3.58 | 3.59 | **Pass** |
| 8a | 3.59 | 3.59 | **Pass** |
| 8b | 3.59 | 3.59 | **Pass** |
| 8c | 3.59 | 3.59 | **Pass** |
| 9a | 0.67 | 0.79 | **Pass** |
| 9b | 0.68 | 0.79 | **Pass** |
| 11 #1 | 1.11 | 1.41 | **Pass** |
| 11 #3 | 1.13 | 1.41 | **Pass** |
| 12 #1 | 2.38 | 2.63 | **Pass** |
| 12 #3 | 2.39 | 2.63 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Mass requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.8 Cable Length*

**Requirements:**
All cable assemblies shipped to the customer shall meet the requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

Unless otherwise specified, the length tolerance for production assemblies will be
+/- .25" (6.4mm) for Cable Assemblies less than 5 ft (1524mm)
+/- .5" (13mm) for Cable Assemblies between 5 ft (1524mm) and 10 ft (2540mm)
+/- .5% for Cable Assemblies Greater than 10 ft (2540mm)

The cable assembly length shall be measured in accordance with **Figure 1**, except when measuring the propagation velocity. See paragraph **7.6** for Vg measurements.

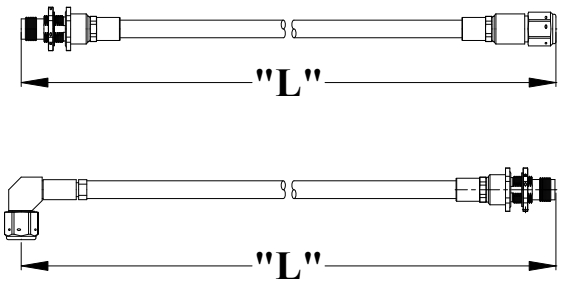


**Figure 1** – Cable Length Description

Notice the measurement is taken from the contact location. The only exception to this rule is when measuring propagation velocity, which uses the fully developed length.

**Results:**
The assembly length for the purpose of this qualification is indicated in **Table 3** and **Table 4**. These lengths are designed to cater to the test design. Since the qualification samples will not be installed in an aircraft, the exact length of the qualification samples is not critical.

The length shall be measured for each cable assembly shipped to the customer according to the **ATP1047**. See **APPENDIX D – ATP1047: Acceptance Test Procedure**.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies will meet the Length requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.9 Bend Radius*

**Requirement:**
The minimum bend radius shall not exceed 50 mm for the V/UHF-2 CCSUBASSY#1 and V/UHF-4 CCSUBASSY#1.

The minimum bend radius shall not exceed 80 mm for the rest of the cable assemblies.

**Method:**
Samples from **Table 3** and **Table 4** were used for this test. FBT 600 cable samples were wrapped 3 times (1080°) around a mandrel of 3.15 in (80 mm) diameter and Miltech 340 cable samples were wrapped 3 times around a mandrel of 2 in (50mm). While in this position, VSWR and Insertion Loss was measured and recorded. The test setup is shown in **Figure 2** below.

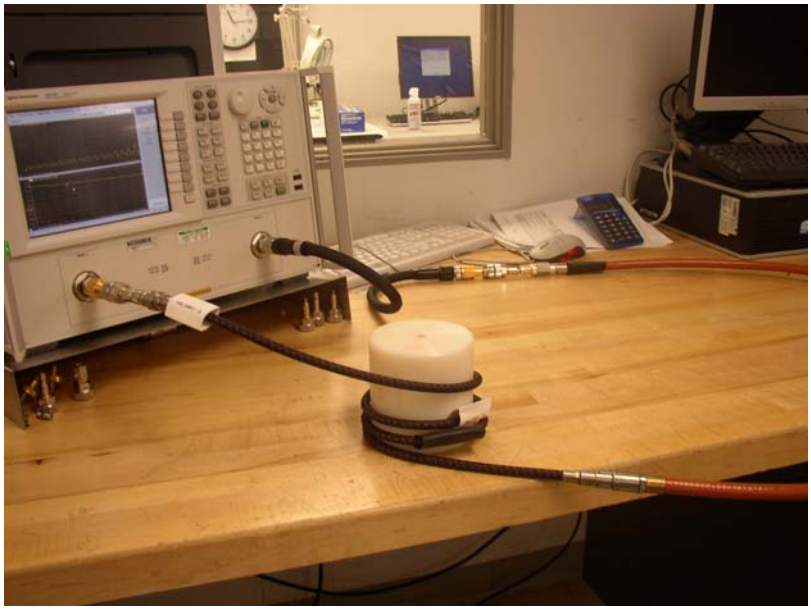

**Figure 2 – Minimum Bend Test**

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4** over the required frequency ranges are considered to have passed this test.

**Results:**
All of the cables tested for Minimum Bend Radius met the required specifications. **Table 13** is a summary of the test results. The test data is included in **APPENDIX B – BEND RADIUS DATA.**

**Table 13 –Minimum Bend Radius Test Results**

| Sample # | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|
| 1 | 1.09:1 | 1.3:1 | 0.22 | 0.23 | 0.38 | 0.39 | **Pass** |
| 2 | 1.08:1 | 1.3:1 | 0.23 | 0.23 | 0.38 | 0.39 | **Pass** |
| 3 | 1.13:1 | 1.3:1 | 0.2 | 0.23 | 0.32 | 0.39 | **Pass** |
| 12b#1 | 1.20:1 | 1.4:1 | 0.3 | 0.48 | 0.55 | 0.76 | **Pass** |
| 12b#3 | 1.21:1 | 1.4:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Bend Radius requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.10 Cable Diameter*

**Requirement:**
The cable diameter shall not exceed 9mm(.355in) for the V/UHF-2 CCSUBASSY#1.1 and V/UHF-4 CCSUBASSY#1.1. The cable diameter shall not exceed 15mm(.59in) for the rest of the assemblies.

**Method:**
The cable diameter for FBT 600 is nominally 0.565 in (14.35 mm) by design. The cable diameter for Miltech 340 is 0.34 in (8.636mm) by design. Verification of the cable diameter is part of the in-process inspection and Times Microwave Systems certifies compliance.

The diameters of several cable assemblies were measured to verify compliance.

**Accept / Reject Criteria:**
Cables that meet diameter specifications are considered to have passed this test.

**Results:**
All of the cables measured for cable diameter met the requirements. The test results are listed in **Table 14** below.

**Table 14 – Cable Diameter**

| Sample # | Cable | Diameter | Spec(max) | Result |
|---|---|---|---|---|
| 11a#1 | FBT600 | 0.56 | 0.59 | **Pass** |
| 11b#1 | MT340 | 0.333 | 0.355 | **Pass** |
| 11a#3 | FBT600 | 0.562 | 0.59 | **Pass** |
| 11b#3 | MT340 | 0.34 | 0.355 | **Pass** |
| 12a#1 | FBT600 | 0.56 | 0.59 | **Pass** |
| 12b#1 | MT340 | 0.33 | 0.355 | **Pass** |
| 12a#3 | FBT600 | 0.56 | 0.59 | **Pass** |
| 12b#3 | MT340 | 0.332 | 0.355 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Cable Diameter requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.11 Pressure Seal*

**Requirement:**
The cable type is expected to be compatible with Airbus standard pressure seal ref ABS1378-1B.

**Method:**
TMS specifies the use of pressure seal p/n 3190-2198 for this application

- The pressure seal was installed on the test samples as described in **Table 4**.
- The pressure seals were tested for vapor leakage using TMS test procedure TP03003P and the Helium Leak Tester (see **Figure 3**). This test was performed before and after environmental testing of the pressure seal and the leak rate was recorded.
- After all testing was performed on each sample, the pressure seal was visually inspected for any external or structural damage.

**Figure 3 – Pressure Seal Test on Helium Leak Tester**

**Accept / Reject Criteria:**
Cable assemblies, which show no signs of external or structural damage on the pressure seal after testing, will be considered to have passed this test. The pressure seal must also have minimal change in the leakage rate after all testing is performed.

**Results:**
All of the cables measured for Pressure Seal met the requirements. No physical damage and only minimal amount of change in leak rate was observed. The test results are listed in **Table 15** below.

**Table 15 – Pressure Seal**

| Sample | He Leak Rate Before Testing | He Leak Rate After Testing | Result |
|---|---|---|---|
| 11A#2 | $2.3x10^{-7}$ | $1.5x10^{-7}$ | **PASS** |
| 12A#2 | $1.8x10^{-7}$ | $5.1x10^{-7}$ | **PASS** |
| 10A#1 | $2.8x10^{-7}$ | $7.4x10^{-7}$ | **PASS** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Pressure Seal requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.12 Tensile Load*

**Requirement:**
The assemblies shall be capable of withstanding a Tensile load of 40 pounds minimum. The Tensile Load shall be verified as specified per MIL-T-81490A paragraph 4.7.17.

**Method:**

- Two composite cable assemblies, both ends, were tested for Tensile Load.
- The Tensile Load test was performed per MIL-T-81490A paragraph 4.7.17.
- The test setup shown in **Figure 4** was used to test a sample of each cable at 40 lbs minimum.
- The cable was tested for VSWR and Insertion loss before, during, and after the tensile test.

**Figure 4**: Tensile Load Test Fixture

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges, before, during and after the Tensile Load test are considered to have passed this test.

**Results:**
All of the cables tested for Tensile load passed the test. The test results are summarized in **Table 16** below and the test data is contained in **APPENDIX B – TENSILE LOAD DATA.**

**Table 16 – Tensile Load test results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a#1 | pre | 1.17:1 | 1.40:1 | 0.31 | 0.48 | 0.58 | 0.76 | **Pass** |
| 12a#1 | during | 1.17:1 | 1.40:1 | 0.31 | 0.48 | 0.58 | 0.76 | **Pass** |
| 12a#1 | post | 1.17:1 | 1.40:1 | 0.31 | 0.48 | 0.58 | 0.76 | **Pass** |
| 12a#3 | pre | 1.22:1 | 1.40:1 | 0.3 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12a#3 | during | 1.22:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12a#3 | post | 1.22:1 | 1.40:1 | 0.3 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12b#1 | pre | 1.19:1 | 1.40:1 | 0.31 | 0.48 | 0.56 | 0.76 | **Pass** |
| 12b#1 | during | 1.18:1 | 1.40:1 | 0.31 | 0.48 | 0.55 | 0.76 | **Pass** |
| 12b#1 | post | 1.18:1 | 1.40:1 | 0.31 | 0.48 | 0.56 | 0.76 | **Pass** |
| 12b#3 | pre | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12b#3 | during | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12b#3 | post | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Tensile Load requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.13 Concentrated Load*

**Requirement:**
The assemblies shall be capable of withstanding a concentrated load of 100 pounds minimum. The Concentrated Load shall be verified as specified per MIL-T-81490A paragraph 4.7.18.

**Method:**

- Both types of cable on 2 composite cable assemblies were tested for Concentrated Load.
- The Concentrated Load test was performed per MIL-T-81490A paragraph 4.7.18.
- The test setup as shown in **Figure 5** was used to test a sample of each cable at 100 lbs minimum.
- The cable was tested for VSWR and Insertion loss before and after concentrated load.

**Figure 5** – Concentrated Load Test Fixture

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges, before and after the Concentrated Load test are considered to have passed this test.

**Results:**
All of the cables tested for Concentrated load passed the test. The test results are summarized in **Table 17** below and the test data is contained in **APPENDIX B – CONCENTRATED LOAD DATA.**

**Table 17 – Concentrated Load Test Results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a#1 | pre | 1.16:1 | 1.40:1 | 0.31 | 0.48 | 0.55 | 0.76 | **Pass** |
| 12a#1 | post | 1.16:1 | 1.40:1 | 0.31 | 0.48 | 0.55 | 0.76 | **Pass** |
| 12a#3 | pre | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12a#3 | post | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12b#1 | pre | 1.20:1 | 1.40:1 | 0.31 | 0.48 | 0.56 | 0.76 | **Pass** |
| 12b#1 | post | 1.20:1 | 1.40:1 | 0.31 | 0.48 | 0.56 | 0.76 | **Pass** |
| 12b#3 | pre | 1.22:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12b#3 | post | 1.21:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Concentrated Load requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.14 Torque*

**Requirement:**
The assemblies shall be capable of withstanding a Torque of 50 inch-pounds minimum. The Torque shall be verified as specified per MIL-T-81490A paragraph 4.7.16.

**Method:**

- One of each cable/intermediate combination were tested for Torque.
- The Torque test was performed per MIL-T-81490A paragraph 4.7.16.
- The apparatus shown in **Figure 6** was used to test a sample of each cable at 30 inch-lbs.
- Torque was applied in the clockwise and counter clockwise direction for 10 seconds. 5 cycles were performed
- The cable was tested before, during (cw and ccw, 5$^{th}$ cycle), and after the test for VSWR and Insertion loss.
- Due to the supple nature of high performance coaxial cable assemblies, the maximum torque limits were not developed in some cases. Instead, torque was applied to the cable until 90° in either direction was achieved.

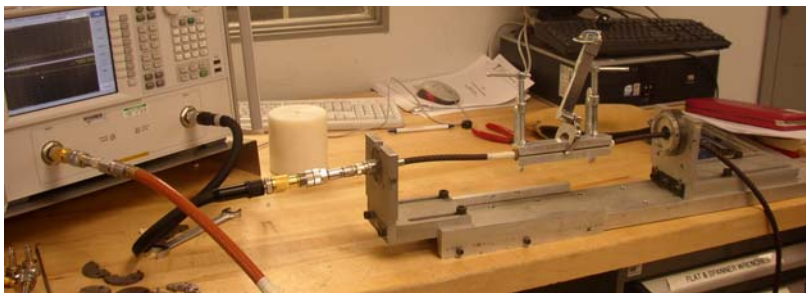

**Figure 6** – Torque Test Fixture

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges, before, during, and after the torque test are considered to have passed this test.

**Results:**
All of the cables tested for Torque passed the test. The test results are summarized in **Table 18** below and the test data is contained in **APPENDIX B – TORQUE DATA.**

**Table 18 - Torque Test Results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a#3 | pre | 1.19:1 | 1.40:1 | 0.29 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12a#3 | CW | 1.19:1 | 1.40:1 | 0.29 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12a#3 | CCW | 1.19:1 | 1.40:1 | 0.29 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12a#3 | post | 1.19:1 | 1.40:1 | 0.29 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12b#3 | pre | 1.23:1 | 1.40:1 | 0.29 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12b#3 | CW | 1.20:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12b#3 | CCW | 1.20:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12b#3 | post | 1.20:1 | 1.40:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Torque requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.15 Abrasion Resistance*

**Requirement:**
The assemblies shall be subjected to the Abrasion resistance test as specified in MIL-T-81490 paragraph 4.7.19.

**Method:**
Procedure I, Sand and Dust was conducted as follows:

- One cable assembly was exposed to the Sand and Dust test in accordance with the requirements of MIL-STD-202G, method 110.
- VSWR and loss was measured before and after exposure.

Procedure II, Chafing, was conducted as follows:

- One of each cable type was tested for Abrasion, Chafing.
- The test samples were placed over the squirrel cage abrasion tester. See **Figure 7**. One end was securely mounted and a three-pound weight attached to the other end of the cable.
- The round bars are tool steel fitted with a groove on the abrading surface to accommodate a 0.032-inch diameter hardened drill rod affixed in the groove.
- The test sample underwent 500 oscillations at 20 ±2 oscillations per minute.

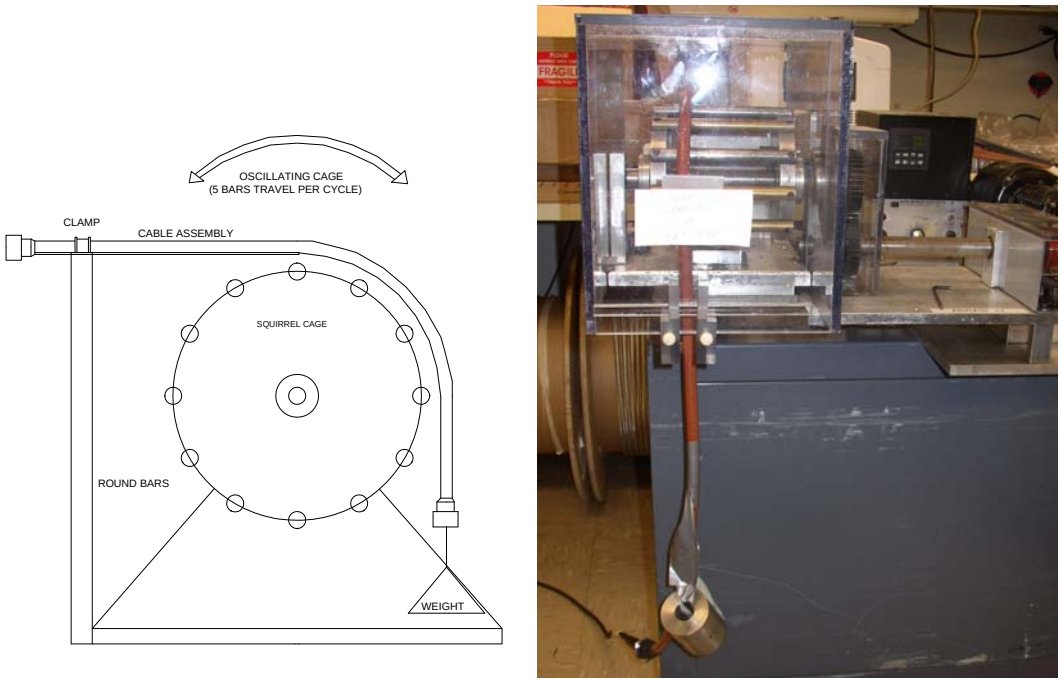


**Figure 7** – Chafing Fixture

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges, before and after the Abrasion test are considered to have passed this test.

**Results:**
All of the cables tested for Abrasion passed the test. As shown in **Figure 8**, there was some minor jacket damage, but there was no penetration through the jacket. The test results are summarized in **Table 19** and **Table 20** below. The test data is contained in **APPENDIX B – ABRASION DATA.** The Stamford test report and pictures for Procedure I, Sand and Dust is contained in **APPENDIX C – ADDITIONAL TEST REPORTS**.

**Table 19 – Abrasion Chafing Test Results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a#2 | pre | 1.17:1 | 1.40:1 | 0.29 | 0.48 | 0.51 | 0.76 | **Pass** |
| 12a#2 | post | 1.17:1 | 1.40:1 | 0.25 | 0.48 | 0.48 | 0.76 | **Pass** |
| 12b#2 | pre | 1.17:1 | 1.40:1 | 0.31 | 0.48 | 0.56 | 0.76 | **Pass** |
| 12b#2 | post | 1.17:1 | 1.40:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |

**Table 20 – Abrasion Sand and Dust Test Results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 10a/b #2 | pre | 1.19:1 | 1.40:1 | 0.76 | 0.94 | 1.35 | 1.57 | **Pass** |
| 10a/b #2 | post | 1.19:1 | 1.40:1 | 0.74 | 0.94 | 1.26 | 1.57 | **Pass** |

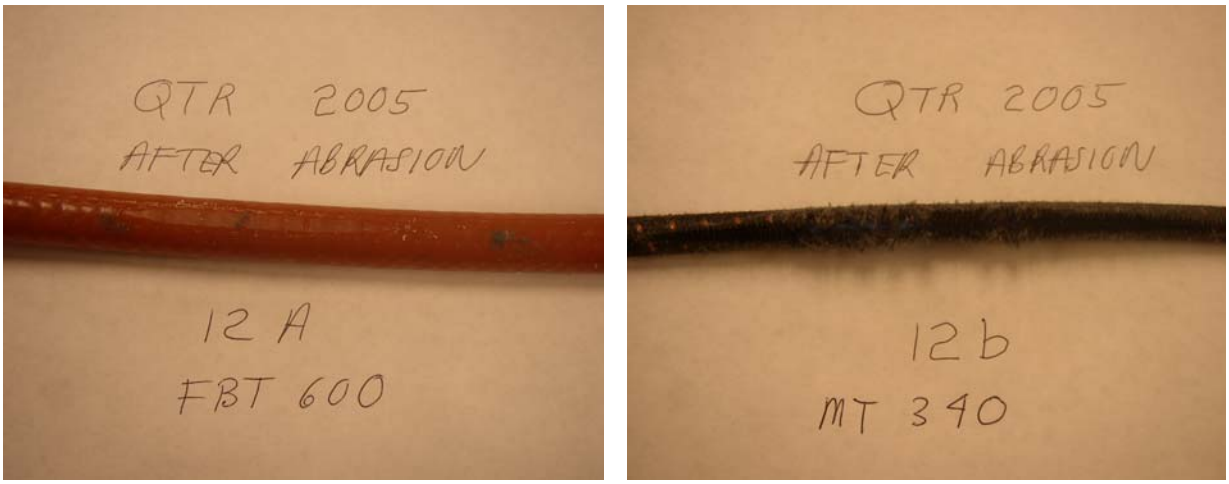


**Figure 8 – Post Abrasion Chafing Pictures**

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Abrasion requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.16 Chemical Resistance*

**Requirement:**
The assemblies shall not be damaged when exposed to fluids and solutions specified in MIL-T-81490 paragraph 4.7.20.

**Analysis:**

- The ability of a cable assembly to resist fluids is directly related to the integrity of the seal of the cable and the outer materials resistance to chemicals.
- The successful completion of the Humidity and Salt Spray tests in sections **7.24** and **7.32** demonstrate that the cable assembly seal will prevent any chemical from penetrating the outer materials of the cable.
- Both types of cables used in this program have an FEP outer jacket as a sealing mechanism and Stainless Steel connectors. According to the manufacturer of the FEP material used for the cable jacket, "*DuPont FEP film is chemically inert and solvent-resistant to virtually all chemicals, except molten alkali metals, gaseous fluorine, and certain complex halogenated compounds such as chlorine trifluoride at elevated temperatures and pressures.*"
- Miltech 340, 265, and 230 cable assemblies were tested for chemical resistance in the document ETR-0120 (**APPENDIX K – ETR-0120 Test Report**).
    - The cable assemblies were exposed to Aviation Fluids AVTAG FSII (JP4), AVTUR FSII (JP5), Hydraulic Fluid, various aircraft cleaning fluids, de-icing fluids, lubricants, coolants, and sealant compound as listed in the test report.
    - The cables were not adversely affected by exposure to these chemicals.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Chemical Resistance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.17 Flexure*

**Requirement:**
The assemblies shall meet the Flexure requirements as specified in MIL-T-81490 paragraph 4.7.15.

**Method:**

- One of each cable type was tested for Flexure.
- Procedure I (large angle) and Procedure II (small angle) of MIL-T-81490 paragraph 4.7.15 were performed.
- The cable assembly was installed in the fixture as shown in **Figure 9**.
- A weight was attached to the end of the cable (for tension).
- For procedure I, the cables were flexed +/- 75° for 400 cycles.
- For procedure II, the cables were flexed +/- 25° for 100,000 cycles.
- VSWR and loss was measured for the cable assemblies before and after this test was performed.

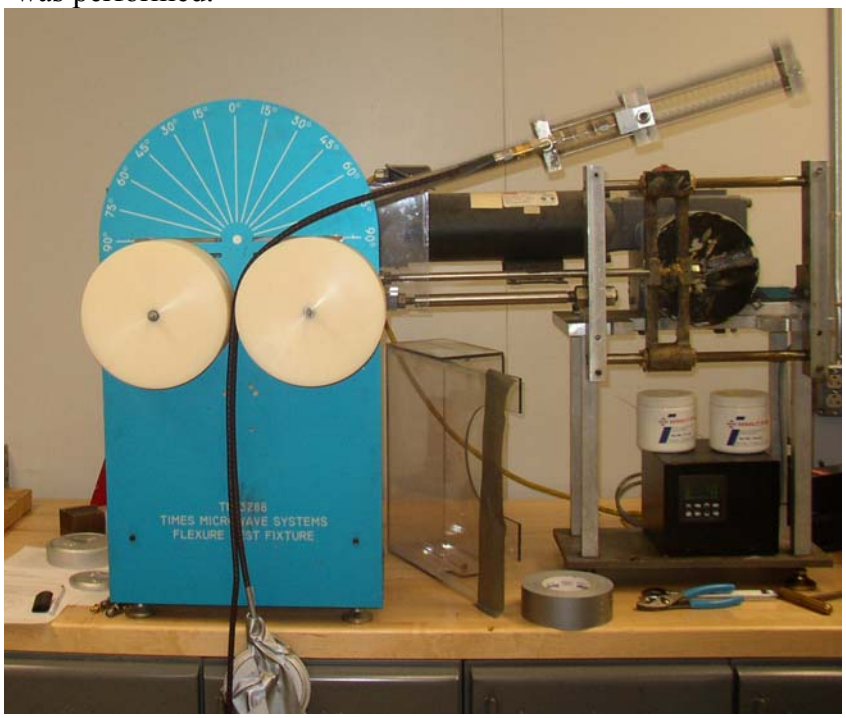

**Figure 9** – Flexure Fixture

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges, before and after the Flexure tests are considered to have passed this test.

**Results:**
There was some cable degradation in loss for both assemblies after the 100,000 cycle +/- 25° test. Since this test represents a lifetime use of the cable, some degradation can be expected. All of the cables, however, met the required specifications before and after Flexure and passed the test. The test results are summarized in **Table 21** below and the test data is contained in **APPENDIX B – FLEXURE DATA.**

**Table 21 – Flexure Test Results**

| Sample # | Test | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a#1 | pre 75° | 1.17:1 | 1.40:1 | 0.27 | 0.48 | 0.46 | 0.76 | **Pass** |
| 12a#1 | post 75° | 1.17:1 | 1.40:1 | 0.24 | 0.48 | 0.49 | 0.76 | **Pass** |
| 12a#1 | pre 25° | 1.17:1 | 1.40:1 | 0.24 | 0.48 | 0.49 | 0.76 | **Pass** |
| 12a#1 | post 25° | 1.17:1 | 1.40:1 | 0.37 | 0.48 | 0.67 | 0.76 | **Pass** |
| 12b#3 | pre 75° | 1.22:1 | 1.40:1 | 0.3 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12b#3 | post 75° | 1.22:1 | 1.40:1 | 0.3 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12b#3 | pre 25° | 1.22:1 | 1.40:1 | 0.3 | 0.48 | 0.54 | 0.76 | **Pass** |
| 12b#3 | post 25° | 1.18:1 | 1.40:1 | 0.37 | 0.48 | 0.62 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Flexure requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.18 Hermetic Sealing*

**Requirement:**
The cable assemblies shall be hermetically sealed.

**Analysis:**

- The successful completion of the Humidity and Salt Spray tests in sections **7.24** and **7.32** demonstrate that the cable assembly is hermetically sealed (air tight). Had any moisture or salt spray penetrated the cable jacket, a noticeable degradation in electrical performance would have resulted.
- In addition, MilTech 230, 265, 340 were tested for vapor leakage in **T0873** section 1.12.3.
- The MT 340 cable has an FEP outer jacket and the same connector sealing mechanism as the MT 340 cable assembly in this report.
- The MT 230 and MT265 cable assemblies tested in T0873 have tape jackets.
- The FBT 600 cable assembly has an FEP outer jacket and uses capton tape and Viton Primer, wrapped over the stainless steel connectors as a sealing mechanism. **T0873** demonstrates that the capton tape and FEP jackets make effective hermetic seals to pass vapor leakage.
- See also **APPENDIX L – T0873 Test Report (excerpt).**

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Hermetic Sealing requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.19 Interface Characteristics*

**Requirements:**
The connector types shall be as per table 2.1.7 in **NT-A4-SAM-06003** and **NT-A4-SAM-06004** PTS**.**
Both connectors of each assembly shall be a replaceable end connector.
Suitable protection shall be provided for electrical connectors against fluids and products.

As an option, a connector adapter for TACAN-2/MIDS CCASSY#1 and #2 shall be supplied.

**Method:**
Both connector adapters (N-F to TNC-M and HN-F to TNC-M) were tested with the cable assemblies in **Table 4**.
The adapters underwent all tests in this document, as part of the cable assemblies tested, unless otherwise noted.

**Accept / Reject Criteria:**
Cables assemblies that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** over the required frequency ranges after all testing are considered to have passed this test.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Connector Interface requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.20 Physical Requirements (Marking)*

The identification of each item shall comply with MIL-STD-130 and shall be fully visible when installed.

No special tools shall be required to install the equipment or to remove it from the aircraft.

**Analysis:**
Identification on each assembly shipped to the customer will comply with MIL-STD-130.

All cable assemblies use standard interface connectors as requested by the customer and do not require special tools to remove or install from the aircraft.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Physical (marking) requirements of **NT-A4-SAM-06003** and **NT-A4-SAM-06004**.

## *7.21 Temperature*

**Requirement:**
The equipment shall meet the requirements of Eurocae ED14/RTCA DO160 section 4 Cat D2. The operating Temperature range is –65°C to 200°C.

**Method:**
Times Microwave Systems combined the Temperature test with the Temperature Variation (7.23) test. Sample #12 a/b #2 composite cable assembly was used for this test.

- Two temperature chambers were used, with one set at the high temperature (+200°C) and the other set at the low temperature (-65°C).


**Figure 10 – Temperature Chamber Test Setups**

- The cables were manually moved from one chamber to the other and the time of transition was recorded.
- SiO2 test lead cables were used to connect the test samples inside the chamber to the network analyzer.
- The cable assemblies were cycled through the temperatures in **Table 22** two times.
- The cables were tested electrically on the second cycle.

**Table 22 – Temperature Testing**

| Condition | Duration | Action (cycle 2) |
|---|---|---|
| Ambient (+23°C) | | VSWR and Insertion Loss |
| -65°C, | Stabilize for 2 hours | VSWR and Insertion Loss |
| +200°C | Stabilize for 2 hour | VSWR and Insertion Loss |
| -65°C, | Stabilize for 2 hours | VSWR and Insertion Loss |
| Ambient (+23°C) | Stabilize for 2 hours | VSWR and Insertion Loss |

TMS used a performance allowance of 0.3% per degree increase over 23°C for Insertion Loss. The insertion loss at the high temperature will increase as the physical properties of the materials change, increasing the overall loss of the cable. Therefore, at 200°C, the loss for sample 12 will be 0.73 instead of 0.48 at 400MHz and 1.16 instead of 0.76 at 1220MHz.

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4**, adjusted for temperature, are considered to have passed this test.

**Results:**
The cable assembly was tested as described in **Table 22**. Test data was taken on the second cycle and recorded. The time of transition between temperatures was much less than the required 5°/min and the transition times are recorded in **APPENDIX B – TEMPERATURE DATA.**
The cables tested for Temperature, and Temperature Variation met the required specifications. **Table 23** is a summary of the test results and the test data is included in **APPENDIX B – TEMPERATURE DATA.**

## Table 23 – Temperature Testing Results

| Sample # | Temperature (°C) | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a/b #2 | ambient (pre temp test) | 1.18:1 | 1.4:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12a/b #2 | ambient (post cycle 1) | 1.21:1 | 1.4:1 | 0.29 | 0.48 | 0.53 | 0.76 | **Pass** |
| 12a/b #2 | -65 | 1.20:1 | 1.4:1 | 0.27 | 0.48 | 0.48 | 0.76 | **Pass** |
| 12a/b #2 | +200 | 1.11:1 | 1.4:1 | 0.44 | 0.73 | 0.72 | 1.16 | **Pass** |
| 12a/b #2 | -65 | 1.20:1 | 1.4:1 | 0.27 | 0.48 | 0.46 | 0.76 | **Pass** |
| 12a/b #2 | ambient (post cycle 2) | 1.23:1 | 1.4:1 | 0.3 | 0.48 | 0.54 | 0.76 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Temperature requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.22 Atmospheric Pressure/Altitude Requirements*

**Requirement:**
The cable shall be tested for Altitude, Decompression, and Overpressure according to the specifications in EUROCAE ED14 RTCA/DO-160D Section 4 Category D2 and A2. The maximum operating altitude is 50,000 ft.

**Method:**

- One complete cable assembly was tested for Altitude.
- All tests were conducted at room temperature.
- Place the cable assembly into the Altitude chamber and perform the tests as described in **Table 24**.
- Record the time required to reduce the pressure when required.
- The test setups are shown in **Figure 11** and **Figure 12**.
- Note that due to limitations in the pressure chamber setup, additional test leads and adapters were required for the test.

**Table 24 – Atmospheric Pressure / Altitude Tests**

| Condition | Duration | Action |
|---|---|---|
| Sea Level | | VSWR and Insertion Loss |
| 8,000 feet (75.26 kPa, 564 Torr) | Stabilize for 30 minutes | VSWR and Insertion Loss |
| Rapidly increase to 50,000 feet (11.6 kPa, 87 Torr) | 15 sec to achieve reduced pressure, maintain for 30 minutes | VSWR and Insertion Loss |
| 8,000 feet #2 (75.26 kPa, 564 Torr) | Stabilize for 30 minutes | VSWR and Insertion Loss |
| 50,000 ft, #2 (11.6 kPa, 87 Torr) | 15 sec to achieve reduced pressure, maintain for 30 minutes | VSWR and Insertion Loss |
| 8,000 feet #3 (75.26 kPa, 564 Torr) | Stabilize for 30 minutes | VSWR and Insertion Loss |
| 50,000 ft , #3(11.6 kPa, 87 Torr) | 15 sec to achieve reduced pressure, maintain for 30 minutes | VSWR and Insertion Loss |
| 50,000 ft , (11.6 kPa, 87 Torr) | Stabilize for 2 hours | VSWR and Insertion Loss |
| Sea Level | Stabilize for 30 minutes | VSWR and Insertion Loss |
| (190 kPa) | Stabilize for 2 hours | VSWR and Insertion Loss |
| Sea Level | Stabilize for 30 minutes | VSWR and Insertion Loss |

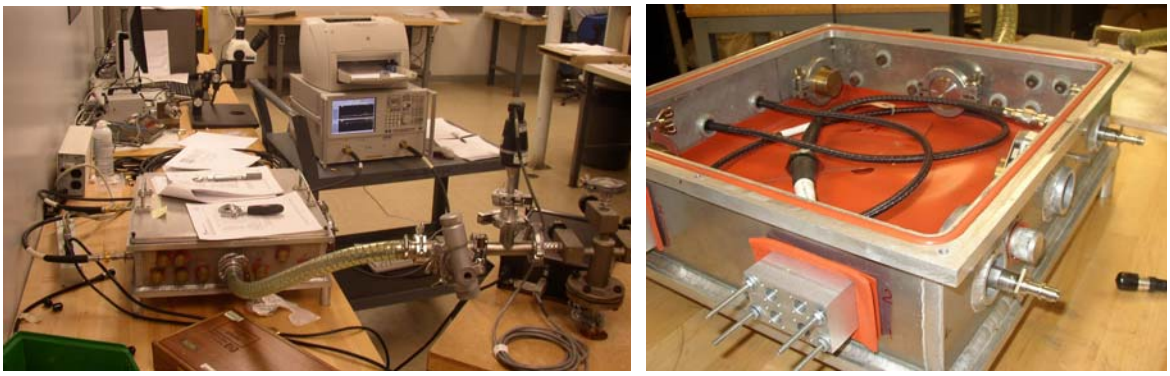

**Figure 11 – Altitude Test Setup**


**Figure 12 – Pressure setup and Cable with Test Leads**

## Accept / Reject Criteria:

Cables that meet the VSWR and Insertion Loss specifications of **Table 3** and **Table 4** during the Atmospheric Pressure / Altitude test are considered to have passed this test.

**Results:**
All of the cables tested for Atmospheric Pressure / Altitude, Decompression, and Overpressure met the required specifications. **Table 25** is a summary of the test results, and the test data is included in **APPENDIX B – ATMOSPHERIC PRESSURE/ ALTITUDE /DECOMPRESSION / OVERPRESSURE DATA**.

**Table 25 – Atmospheric Pressure / Altitude, Decompression and Overpressure Results**

| Sample # | Condition | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Trans. Time | Result |
|---|---|---|---|---|---|---|---|---|---|
| 11a/b#2 | Sea Level | 1.23:1 | 1.40:1 | 0.12 | 0.27 | 0.19 | 0.43 | N/A | **Pass** |
| 11a/b#2 | 8000 ft (1st) | 1.21:1 | 1.40:1 | 0.1 | 0.27 | 0.18 | 0.43 | N/A | **Pass** |
| 11a/b#2 | 50000 ft (1st) | 1.21:1 | 1.40:1 | 0.23 | 0.27 | 0.41 | 0.43 | 9 sec | **Pass** |
| 11a/b#2 | 8000 ft (2nd) | 1.21:1 | 1.40:1 | 0.21 | 0.27 | 0.39 | 0.43 | N/A | **Pass** |
| 11a/b#2 | 50000 ft (2nd) | 1.25:1 | 1.40:1 | 0.22 | 0.27 | 0.38 | 0.43 | 7 sec | **Pass** |
| 11a/b#2 | 8000 ft (3rd) | 1.25:1 | 1.40:1 | 0.22 | 0.27 | 0.38 | 0.43 | N/A | **Pass** |
| 11a/b#2 | 50000 ft (3rd) | 1.25:1 | 1.40:1 | 0.22 | 0.27 | 0.38 | 0.43 | 12 sec | **Pass** |
| 11a/b#2 | 50000 ft (4rth) | 1.25:1 | 1.40:1 | 0.21 | 0.27 | 0.37 | 0.43 | N/A | **Pass** |
| 11a/b#2 | Sea Level | 1.25:1 | 1.40:1 | 0.22 | 0.27 | 0.38 | 0.43 | N/A | **Pass** |
| 11a/b#2 | Sea Level | 1.21:1 | * | 0.36 | * | 0.65 | * | N/A | **Pass** |
| 11a/b#2 | -15000 ft (190kpa) | 1.21:1 | * | 0.36 | * | 0.64 | * | N/A | **Pass** |
| 11a/b#2 | Sea Level | 1.21:1 | * | 0.36 | * | 0.64 | * | N/A | **Pass** |

*Note: Due to additional test leads and adapters required for the pressure chamber, the assemblies do not necessarily meet the specifications for VSWR and Loss. We are instead looking for changes in cable performance due to exposure to pressure.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Atmospheric Pressure/Altitude requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.23 Temperature Variation*

**Requirement:**
The cable shall be tested according to the specifications for Temperature Variation in EUROCAE ED14 RTCA/DO-160D Section 5 category B.

- The temperature change rate requirement for RTCA/DO-160 Section 5, category B is 5° per minute.

**Method:**

- This test shall be combined with the Temperature test, section **7.21**.

**Accept / Reject Criteria:**
Cables that meet the VSWR and Insertion Loss specifications of **Table 3** and **Table 4** after the Temperature Variation test are considered to have passed this test. The time of transition between temperatures shall be less than 5 degrees per minute, or less than 53 minutes.

## *7.24 Humidity*

**Requirement:**
The equipment shall meet the requirements of **EUROCAE ED14/ RTCA DO160** Section **6**, Category **A**.

**Method:**
Test sample #12a/b was tested using the following procedure:

1. Install the mating connector plugs to the cable assembly for test and place in the humidity chamber.
2. Over a two-hour period, plus or minus 10 minutes, raise the chamber temperature to 50°C and increase the relative humidity to at least 95%.
3. Maintain the chamber temperature at 50°C with the relative humidity at least 95% for six hours minimum.
4. During the next 16-hour period, plus or minus 15 minutes, gradually decrease the temperature to 38°C or lower. During this period, keep the relative humidity above 85%.
5. Repeat Steps 1, 2, and 3 one time. (total of 48-hours)
6. Remove the cable assembly from the chamber. If VSWR and Insertion Loss testing cannot begin within 15 minutes after humidity cycling, place the cable assembly in a sealed plastic bag while still wet for later testing.
7. Drain off any condensed moisture and test for VSWR and Insertion Loss.

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4**, after humidity testing are considered to have passed this test.

**Results:**
All of the cables tested for Humidity met the required specifications. **Figure 13** shows the physical affects on the cable from humidity and salt fog. **Table 26** is a summary of the test results and the test data is included in **APPENDIX B – HUMIDITY AND SALT SPRAY DATA.** The Humidity test report from Stanford Technologies is included in **APPENDIX C – ADDITIONAL TEST REPORTS.**

**Table 26 – Humidity Test Results**

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a/b #2 | Pre | 1.18:1 | 1.4:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12a/b #2 | Post | 1.17:1 | 1.4:1 | 0.24 | 0.48 | 0.44 | 0.76 | **Pass** |


**Figure 13 – Humidity Test Results**

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Humidity requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.25 Shocks and Crash Safety – Operational Shock*

**Requirement:**
The equipment shall meet the requirements of **EUROCAE ED14 / RTCA DO160**, section **7,** Cat D.

**Method:**
One cable assembly described in **Table 4**, underwent Operational Low Frequency Shock as expressed herein.

| Test | Acceleration Peak Value (g) | Nominal Duration (ms) |
|---|---|---|
| Operational Low Frequency Shock | 6 | 20 |

Three shocks were applied in each orientation having a terminal saw-tooth wave shape with an acceleration peak value of six (6) g's. The nominal pulse duration is 20 ms for this low frequency shock testing.

Measurements were taken before and after Shock testing using the same fixture setup as the Vibration Test. These measurements may not conform to the VSWR and Loss requirements of **Table 3** and **Table 4**, because they include extra cables and adapters, which cannot be calibrated out of the system due to limitations in the test setup. The measurements instead indicate changes in performance due to shock. However, all cables were tested for VSWR and Loss individually, before and after the Vibration and Shock tests.

Pictures of the test setups are contained in the Stamford Technologies Test Reports in **APPENDIX C – ADDITIONAL TEST REPORTS**.

**Accept / Reject Criteria:**
Cables that meet the VSWR and Insertion Loss specifications in **Table 3** and **Table 4**, after Shock and Crash Safety testing, are considered to have passed this test.

**Results:**
All of the cables tested for Operational Shock met the required specifications. **Table 27** is a summary of the test results and the test data is included in **APPENDIX B – SHOCK AND VIBRATION DATA.** Note that these measurements were taken after both shock and Vibration were performed.

In addition, performance test data (included in **Appendix B**) shows that there were no changes in electrical performance due to Shock.

The Operational Shock test report from Stanford Technologies is included in **APPENDIX C – ADDITIONAL TEST REPORTS.**

**Table 27 – Vibration and Shock Test Results**

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 10a#2 | Pre | 1.19:1 | 1.4:1 | 0.76 | 0.94 | 1.35 | 1.57 | **Pass** |
| 10a#2 | Post | 1.21:1 | 1.4:1 | 0.75 | 0.94 | 1.29 | 1.57 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Shocks and Crash Safety requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.26 Vibration – Operational*

**Requirement:**
The equipment shall meet the requirements of MIL STD 810F Method 514 Category 13 with the levels shown in **Table 28**.

**Method:**

- Several Cable assemblies described in **Table 3** and **Table 4** were tested for VSWR and Insertion Loss before and after exposure to these vibration levels.
- Measurements were also be taken during the vibration testing for performance.
- MIL-STD-810F, Method 514, Procedure 1, Category 13 – Fixed Wing Propeller Aircraft, was used as a guide for Operational Vibration.
- The test duration consisted of 1-hour in each of 3 mutually perpendicular axis, for a total of 3 hours.
- A resonance search with low-level sine excitation was also performed. **Table 28** and **Figure 14** depict actual test levels.

**Table 28 – Vibration Levels**

| Broadband Background | Narrow Band Spikes ($g^2$/Hz) | | | |
|---|---|---|---|---|
| | $F_0$: 78Hz – 118Hz | 2 $F_0$: 159Hz – 236Hz | 3 $F_0$: 239Hz – 354Hz | 4 $F_0$: 369Hz – 472 Hz |
| 0.01 $g^2$/Hz | 1.2 | 0.3 | 0.133 | $7.5 \times 10^{-2}$ |

Pictures of the test setups are contained in the Stamford Technologies Test Reports in **APPENDIX C – ADDITIONAL TEST REPORTS**.

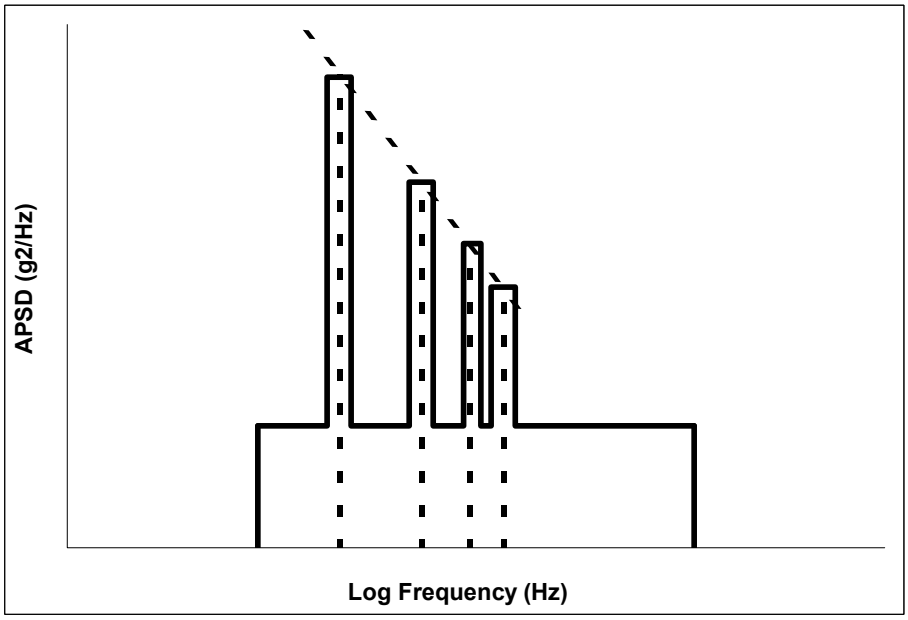


**Figure 14** – APSD / Vibration Level Diagram

Measurements taken during vibration may not conform to the VSWR and Loss requirements of **Table 3** and **Table 4**, but indicate changes in performance due to vibration. These measurements include extra fixtures due to the limitations of testing during vibration. VSWR and Loss measurements were taken before, during and after vibration with the same setup to indicate changes in performance due to vibration.

**Accept / Reject Criteria:**
Cables that meet the VSWR and Insertion Loss specifications of **Table 3** and **Table 4**, before and after Vibration testing are considered to have passed this test.

**Results:**
All of the cables tested for Vibration met the required specifications**. Table 29** is a summary of the test results before and after Vibration testing and the test data is included in **APPENDIX B –SHOCK AND VIBRATION DATA.**

In addition, performance test data (included in **Appendix B**) shows that there were no changes in electrical performance due to Vibration.

The Vibration test report from Stanford Technologies is included in **APPENDIX C – ADDITIONAL TEST REPORTS.**

## Table 29 – Vibration Test Results

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 4a | Pre | 1.12:1 | 1.3:1 | 0.31 | 0.32 | 0.5 | 0.54 | **Pass** |
| 4a | Post | 1.12:1 | 1.3:1 | 0.3 | 0.32 | 0.49 | 0.54 | **Pass** |
| 4b | Pre | 1.16:1 | 1.3:1 | 0.28 | 0.32 | 0.46 | 0.54 | **Pass** |
| 4b | Post | 1.16:1 | 1.3:1 | 0.27 | 0.32 | 0.45 | 0.54 | **Pass** |
| 4c | Pre | 1.13:1 | 1.3:1 | 0.27 | 0.32 | 0.48 | 0.54 | **Pass** |
| 4c | Post | 1.13:1 | 1.3:1 | 0.27 | 0.32 | 0.46 | 0.54 | **Pass** |
| 5a | Pre | 1.09:1 | 1.3:1 | 0.29 | 0.32 | 0.5 | 0.54 | **Pass** |
| 5a | Post | 1.09:1 | 1.3:1 | 0.29 | 0.32 | 0.49 | 0.54 | **Pass** |
| 6a | Pre | 1.08:1 | 1.3:1 | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 6a | Post | 1.08:1 | 1.3:1 | 0.31 | 0.32 | 0.54 | 0.54 | **Pass** |
| 7a | Pre | 1.09:1 | 1.3:1 | 0.31 | 0.32 | 0.53 | 0.54 | **Pass** |
| 7a | Post | 1.09:1 | 1.3:1 | 0.3 | 0.32 | 0.52 | 0.54 | **Pass** |
| 7b | Pre | 1.09:1 | 1.3:1 | 0.3 | 0.32 | 0.51 | 0.54 | **Pass** |
| 7b | Post | 1.10:1 | 1.3:1 | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 8a | Pre | 1.08:1 | 1.3:1 | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 8a | Post | 1.08:1 | 1.3:1 | 0.31 | 0.32 | 0.54 | 0.54 | **Pass** |
| 10a#2 | Pre | 1.19:1 | 1.4:1 | 0.76 | 0.94 | 1.35 | 1.57 | **Pass** |
| 10a#2 | Post | 1.21:1 | 1.4:1 | 0.75 | 0.94 | 1.29 | 1.57 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Operation Vibration requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.27 Vibration – Landing Gear Tire Burst*

**Requirement:**
The requirements for Landing Gear Tire Burst shall be in accordance with ABD0100.1.2 paragraph 1.6.3.

**Method:**
Several cable assemblies described in **Table 3** and **Table 4** were tested for VSWR and Insertion Loss before and after exposure to the landing gear tire burst vibration levels shown in **Figure 15**.
Pictures of the test setups are contained in the Dayton T. Brown Test Reports in **APPENDIX C – ADDITIONAL TEST REPORTS**.

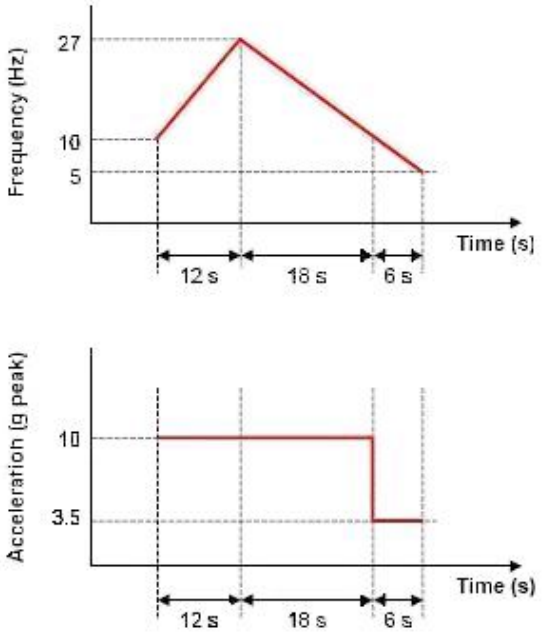


**Figure 15 –** Nose Landing Gear Tire Burst Vibration

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4**, after this test, are considered to have passed this test.

**Results:**
All of the cables tested for Vibration – Tire Burst met the required specifications. **Table 30** is a summary of the test results before and after Tire Burst testing and the test data is included in **APPENDIX B –LANDING GEAR TIRE BURST DATA.** The Tire Burst test reports from Dayton T. Brown are included in **APPENDIX C – ADDITIONAL TEST REPORTS.**

**Table 30 – Tire Burst Test Results**

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 4a | Pre | 1.12:1 | 1.3:1 | 0.3 | 0.32 | 0.49 | 0.54 | **Pass** |
| 4a | Post | 1.14:1 | 1.3:1 | 0.31 | 0.32 | 0.49 | 0.54 | **Pass** |
| 5b | Pre | 1.09:1 | 1.3:1 | 0.28 | 0.32 | 0.49 | 0.54 | **Pass** |
| 5b | Post | 1.09:1 | 1.3:1 | 0.27 | 0.32 | 0.49 | 0.54 | **Pass** |
| 6a | Pre | 1.08:1 | 1.3:1 | 0.31 | 0.32 | 0.54 | 0.54 | **Pass** |
| 6a | Post | 1.08:1 | 1.3:1 | 0.31 | 0.32 | 0.54 | 0.54 | **Pass** |
| 8a | Pre | 1.08:1 | 1.3:1 | 0.3 | 0.32 | 0.53 | 0.54 | **Pass** |
| 8a | Post | 1.09:1 | 1.3:1 | 0.31 | 0.32 | 0.54 | 0.54 | **Pass** |
| 11a/b#2 | Pre | 1.16:1 | 1.4:1 | 0.11 | 0.27 | 0.21 | 0.43 | **Pass** |
| 11a/b#2 | Post | 1.15:1 | 1.4:1 | 0.09 | 0.27 | 0.2 | 0.43 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Tire Burst requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.28 Waterproofness*

**Requirement:**
The equipment shall meet the requirements of EUORCAE ED14/ RTCA DO160 Section 10, Cat. S for Waterproofness.

**Analysis:**
From the RTCA DO160 Waterproofness specification:
*"These tests determine whether the equipment can withstand the effects of liquid water being sprayed or falling on the equipment.*
*These tests are not intended to verify performance of hermetically sealed equipment. Therefore, hermetically sealed equipment may be considered to have met all the waterproofness requirements without further testing. Equipment shall be considered hermetically sealed when the seal is permanent and airtight."*

All of the cable assemblies manufactured by Times Microwave Systems for the NT-A4-SAM-06003 and NT-A4-SAM-06004 programs are hermetically sealed. In addition, the test results from sections 7.24 and 7.32 demonstrate that these cable assemblies can withstand exposure to moisture and salt fog for extended periods of time.

Based on this analysis, it can be determined that the cable assemblies will not be adversely affected by the tests in the Waterproofness specification.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Waterproofness requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.29 Fluid Susceptibility*

**Requirement:**
The equipment shall meet the requirements of **EUROCAE ED14/ RTCA DO160** Section **11**, Category **F**, Spray test procedure.
The fluid types to be considered are:

- Fuels
- Hydraulic Fluids
- Oils
- Greases
- Cleaning agents
- Extinguishing agents

**Analysis:**
See section **7.16** for analysis.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Fluids Susceptibility requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.30 Sand and Dust*

**Requirement:**
The equipment shall meet the requirements of MIL-STD-810 Method 510.4, Procedures III.

**Analysis:**

- Mil Std 810 Method 510.4 Procedure III is the settling dust test.
- The potential effect of settling dust on the cable assemblies is dust penetration in the cable seals and decreased heat dissipation.
- As described in section **7.15** of this document, there is no degradation in cable performance due to sand and dust exposure.
- The power handling analysis in section **7.5** of this document show that both cable types can handle significantly more power than required, even at elevated temperatures and altitudes.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Sand and Dust requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.31 Fungus Resistance*

**Requirement:**
The cable assembly shall meet the requirements of **EUROCAE ED14 – RTCA DO160** section **13**, category **F**.

**Analysis:**

- Times Microwave Systems certifies that the materials used within the cable construction and associated connector types are free from fungi nutrients.
- In lieu of testing, a review of the materials used in the manufacture of the cable assemblies has been performed, and that review has shown that those materials are inert and/or resistant to the types of fungi required as listed in MIL-STD-454 Requirement 4.
- The following table identifies those materials that have been reviewed. In addition, the data sheet for the cable is included in **APPENDIX A – PRODUCT DATA SHEETS**.

**Table 31 – Fungal Resistance Evaluation by Composition**

| Component | Material | Generic Name | Document of Fungal Resistance |
|---|---|---|---|
| Center Conductor | Copper Clad Aluminum, Solid Silver | Copper Clad Aluminum, Silver | MIL-STD-454, Req. 4 |
| Dielectric | Low Density Teflon PTFE, Taped PTFE | Polytetrafluoroethylene | MIL-STD-454, Req. 4 |
| Composite Tape | Kapton Tape | Polyimide | MIL-STD-454, Req. 4 |
| Shield | Tinned Copper Braid, Silver Plated Copper | Tinned Copper Braid, Silver Plated Copper | MIL-STD-454, Req. 4 |
| Jacket | Teflon FEP | Fluorinated Ethylenepropylene Copolymer | MIL-STD-454, Req. 4 |
| O-Ring / Gasket | Viton | Fluoroelastomer | MIL-STD-454, Req. 4 |
| Connector Body | Stainless Steel | Stainless Steel | MIL-STD-454, Req. 4 |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Fungus Resistance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.32 Salt Spray*

**Requirement:**
The cable assembly shall meet requirements of EUROCAE ED14 RTCA/DO-160 section 14, category S.

**Method:**

- One composite test sample was tested for VSWR and Insertion Loss before and after exposure to Salt Spray.
- Mating connector plugs were installed on the cable assembly.
- The cable assembly was placed in the salt fog chamber for a period of 48 hours. The chamber was set at 35°C, relative humidity of 85% or greater, with pH of 6.5-7.2. See **EUROCAE ED14**, section **14**, category **S** for additional detail.
- The cable assembly was then allowed to dry at ambient conditions for 48 hours. At the end of the drying period, the cable assembly was tested for VSWR and Insertion Loss.
- The cable assembly was rinsed and inspected for corrosion. Superficial corrosion and aesthetic degradation shall not constitute product failure.

**Accept / Reject Criteria:**
Cables that meet the VSWR and Insertion Loss specifications in **Table 3** and **Table 4**, after this test, are considered to have passed this test.

**Results:**
All of the cables tested for Salt Spray passed the test. **Figure 16** shows there is minimal corrosion on the cable from salt spray. **Table 32** is a summary of the test results and the test data is included in **APPENDIX B – HUMIDITY AND SALT SPRAY DATA.** The Salt Spray test report from Stanford Technologies is included in **APPENDIX C – ADDITIONAL TEST REPORTS.**

**Table 32 – Salt Spray Test Results**

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 12a/b #2 | Pre | 1.18:1 | 1.4:1 | 0.29 | 0.48 | 0.52 | 0.76 | **Pass** |
| 12a/b #2 | Post | 1.17:1 | 1.4:1 | 0.24 | 0.48 | 0.44 | 0.76 | **Pass** |


**Figure 16 – Humidity Test Results**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Salt Spray requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *7.33 Icing*

**Requirement:**
The equipment shall meet the requirements of EUROCAE ED14/RTCA DO160 Section 24, Category A.

**Analysis:**

- The purpose of the Icing test is to determine the performance characteristics of equipment that must operate while exposed to icing conditions that would be encountered under conditions of rapid changes in temperature and altitude.
- The primary mechanism of failure of a cable assembly under these conditions would be the vapor seal and it's ability to operate in extremely cold temperatures.
- The integrity of the vapor seal for the cable assemblies used in these programs has been demonstrated by passing the Humidity and Salt Spray tests as described in sections 7.24 and 7.32 of this document.
- The ability of the cable assemblies to withstand cold temperatures has been demonstrated in section 7.21 of this document.
- Therefore, the cable assemblies used in these programs will not be adversely affected by Icing conditions as described in EUROCAE ED14/RTCA DO160 Section 24, Category A.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Icing requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.34 Flammability / Toxicity / Smoke / Gas Emission*

**Requirement:**
The flammability, toxicity and smoke density tests as defined in ABD0031 shall be performed. The heat release test of ABD0031 will not be performed.

**Analysis:**
These tests are being performed at QuinetiQ and the results will be reported in a separate report.

## *7.35 Constant Acceleration*

**Requirement:**
The equipment shall meet the constant acceleration requirements of ISO 2669 Category B functional test only with the levels at 9g.

**Method:**

- The cable was tested according to the requirements of ISO 2669 Category B functional test only with the levels at 9g.
- One cable assembly from **Table 4** was tested for VSWR and Insertion Loss before and after exposure to the constant acceleration.
- The cable was mounted on an aluminum test fixture and secured to the beam of a radial accelerator.
- The cable was accelerated in six different directions. Ramp to 9g in 15 sec. Hold at 9g for 60 sec. Ramp to 0 in 15 sec.
- Pictures of the test setups are contained in the Stamford Test report for constant acceleration found in **APPENDIX C – ADDITIONAL TEST REPORTS.**

**Accept / Reject Criteria:** Cables that meet VSWR and Insertion Loss specifications of **Table 3** and **Table 4** after this test, are considered to have passed this test.

**Results:**
All of the cables tested for constant acceleration met the requirements. **Table 33** is a summary of the test results and the Stamford Test report is contained in **APPENDIX C – ADDITIONAL TEST REPORTS**.

**Table 33 - Acceleration Test Data**

| Sample # | Pre/Post | VSWR | Spec | Loss @ 400 MHz(dB) | Spec | Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 11a#2 | Pre | 1.19:1 | 1.4:1 | 0.13 | 0.27 | 0.28 | 0.43 | **Pass** |
| 11a#2 | Post | 1.16:1 | 1.4:1 | 0.11 | 0.27 | 0.21 | 0.43 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Constant Acceleration requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.36 Aircraft Attitude*

**Requirement:**
Equipment operation shall remain within specification limits if it is subjected to any of the operating attitudes specified in the following table:

| Mode | Aircraft Attitude Transisent | Aircraft Attitude Stabilized |
|---|---|---|
| Roll | 60° Max right and left | 15° max right and left |
| Normal Descent | 30° nose down | 6° nose down |
| Emergency Descent | 40° nose down | 20° nose down |
| Normal Climb | 30° nose up | 23° nose up |
| Maximum Climb | 40° nose up | |

**Analysis:**

- The cable assemblies manufactured by Times Microwave Systems will perform the same in any attitude orientation as described in the requirements.
- The vibration testing in section **Error! Reference source not found.** of this document demonstrates that the cable will operate the same when it is mounted on a fixed plane in specified orientations (x,y,z).
- Under normal operating test conditions at Times Microwave Systems, the cables are coiled and therefore operating in virtually all attitude orientations at the same time.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Aircraft Attitude requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *7.37 Connector Insertion Reliability*

**Requirement:**
The electrical and mechanical reliability and performance of the connector shall be insured for at least 500 insertions.

**Method:**

- Two cable samples were tested with one of each type of front end interface: TNC-M (48555), TNC-F(48590), NM(48721), and HN-M (48507).
- VSWR and Insertion Loss were measured on each cable assemblies.
- The connectors were mated and de-mated to an appropriate connector for 500 insertions.
- VSWR and Insertion Loss were measured on the cable assemblies after the mate de-mate cycles.

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and **Table 4** over the required frequency ranges are considered to have passed this test.

**Results:**
All of the connectors, which were tested for Connector Insertion Reliability passed the test. Table 34 is a summary of the test results and the test data is included in **APPENDIX B – CONNECTOR INSERTION RELIABILITY.**

**Table 34 – Connector Insertion Reliability Test Results**

| Connector | Pre/Post | VSWR | Max Loss(dB) | Result |
|---|---|---|---|---|
| TNCM - TNCF | Pre | 1.09:1 | 0.45 | **Pass** |
| TNCM - TNCF | Post | 1.09:1 | 0.45 | **Pass** |
| HNM | Pre | 1.16:1 | 0.44 | **Pass** |
| HNM | Post | 1.17:1 | 0.46 | **Pass** |
| NM | Pre | 1.16:1 | 0.44 | **Pass** |
| NM | Post | 1.15:1 | 0.45 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Connector Insertion Reliability requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

# 8.0 Cable Tests For FBT 600

The tests in this section pertain only to the FBT 600 cable.

## *8.1 General Requirement*

The general requirement of **EN 3475-100** is a reference that provides terms and definitions. Whenever possible, TMS will use similar terminology in its documentation.

## *8.2 Visual Examination*

**Requirement:**
A visual examination shall be performed in accordance with **EN 3475-201** on all cable assemblies for workmanship. The outer covering of the cable assembly shall be free of cuts, nicks, dents, and burned or frayed areas. Connector interfaces shall be free of sharp edges, burrs, damaged mating surfaces, and foreign objects or debris.

**Accept / Reject Criteria:**
Cables that meet the requirements of Visual Examination are considered to have passed this test.

**Results:**
All cable assemblies for this qualification test passed the visual examination inspection. All cable assemblies shipped from TMS for the A400 will meet the visual examination requirements per **ATP 1047**.

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Visual Examination requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## 8.3 Mass

**Requirement:**
The cables shall meet the mass requirements according to EN-3475-202.

**Accept / Reject Criteria:**
See section **7.7**.

## 8.4 Dimensions

**Requirement:**
The Cable assembly shall meet the dimension requirements of EN3475-203.

**Accept / Reject Criteria:**
See sections **7.8** and **7.10**.

## 8.5 Electrical Resistance per Unit Length

**Requirement:**
Electrical Resistance per Unit Length will be tested in accordance with **EN 3475-301**.

**Method:**
A Wheatstone Bridge was used to measure Electrical Resistance per unit length on a 10ft sample.

**Accept / Reject Criteria:**
The resistance of the cables samples shall be measured and recorded.

**Results:**
The cable was measured as follows:

- Center Conductor = 21.3 ohms/KM
- Shield = 21.7 ohm/Km

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Electrical Resistance per Unit Length requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.6 Voltage Proof Test*

**Requirement**:
Cables shall be tested in accordance to **EN3475-302** by the Jacket immersion test and by analysis for Dry Spark test.

**Method:**
***Dry Spark Test:***
Times Microwave Systems examines the coaxial cable 100% via the dry spark test indicated in **EN 3475-302**.

The entire length of cable is inspected with electrodes consisting of small bead chains as part of the manufacturing process. If a defect is found, the imperfection shall be discarded and the remaining cable re-inspected.

***Dry Test***
Prior to the immersion test, a dry voltage test was performed on the cable. 1750VAC was applied to the cable between the center conductor and the shield.

***Immersion Test***
The immersion test was conducted on a 50ft cable sample (approx 15M) in accordance with **EN 3475-302.** The cable sample was immersed in the salt water liquid solution as specified in EN 3475-302, and allowed to soak for 1 hour. 1750 VAC was applied between the shield and an electrode in contact with the liquid for 5 minutes.

**Accept / Reject Criteria:**
Cables that have no perforation between the insulation and jacket after the Voltage Proof test will be considered to have passed this test.

**Results:**
The cables passed the dry test, **Figure 17**, and the immersion test, **Figure 18,** and **Figure 19**. No perforation of the jacket was observed.

**Figure 17 – Voltage Proof Dry Setup**


**Figure 18 – Voltage Proof Immersion Test Setup**


**Figure 19 – Voltage Proof Immersion Test**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Voltage Proof Test requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.7 Insulation Resistance*

**Requirement:**
Cables shall be tested in accordance with **EN3475-303** for Insulation Resistance.

**Method**

***Dry Test:***
A 50ft (15M) cable sample was tested for Insulation Resistance via the dry method of **EN 3475-303.** A high resistance meter was connected to the dry cable sample between the center conductor and the shield at ambient temperature. It was set to measure using a voltage of 500Vdc. After 1 minute, the resistance measurement was recorded.

***Immersion Test:***
The immersion test was conducted on a 50ft cable sample (approx 15M) in accordance with **EN 3475-303.** The cable sample was immersed in the salt water liquid solution as specified in EN 3475-303, and allowed to soak for 1 hour. After 1 hour, the high resistance meter was connected to the cable sample between the shield and an electrode in contact with the liquid. It was set to measure using a voltage of 500Vdc. After 1 minute, the resistance measurement was recorded.

**Accept / Reject Criteria:**
Cables that have an insulation resistance greater than 1000Mohm / KM will be considered to have passed this test.

**Results:**
The cables passed both the dry test and the immersion test for Insulation Resistance. The resistance between the center conductor and the outer braid for the dry insulation resistance test was measured as 1.8TΩ ($1.8x10^{12}$) for the 50 ft sample, which calculates to 27432 MΩ/KM. For the immersion test, the resistance was measured between the outer braid and an electrode in the salt solution at 1.58TΩ for the 50ft sample, which calculates out to 24079.2 MΩ/KM. **Figure 20** shows the test setup for the Insulation Resistance immersion test.

**Figure 20 – Immersion Test Setup**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Insulation Resistance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.8 Continuity of Conductors*

**Requirement:**
Continuity of Conductors shall be measured in accordance with **EN 3475-306**.

**Method:**
The continuity of the center and outer conductors was measured using a digital multi-meter. In addition, the continuity of the center conductors and the outer conductors were indirectly verified by observing VSWR and Insertion Loss measurements.

**Accept / Reject Criteria:**
Cables with no discontinuity of the inner or outer conductors are considered to have passed this test.

**Results:**
Continuity was measured on the conductors for all cables using a digital multi-meter and all cables passed this test, as indicated in **Table 35**.

**Table 35 – Continuity of Conductors Test Results**

| Sample # | Result |
|---|---|
| 1 | **Pass** |
| 2 | **Pass** |
| 3 | **Pass** |
| 4a | **Pass** |
| 4b | **Pass** |
| 4c | **Pass** |
| 5a | **Pass** |
| 5b | **Pass** |
| 6a | **Pass** |
| 6b | **Pass** |
| 7a | **Pass** |
| 7b | **Pass** |
| 7c | **Pass** |
| 8a | **Pass** |
| 8b | **Pass** |
| 8c | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Continuity of Conductors requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.9 Corona Extinction Voltage*

**Requirement:**
The Corona Extinction voltage shall be measured in accordance with EN-3475-307.

**Method:**
One cable sample was tested for Corona Extinction according to EN-3475-307. The test setup is shown below.


**Figure 21 – Corona Extinction Test Setup**

**Accept / Reject Criteria:**
The Corona Extinction measurements shall be measured and reported.

**Results:**
The corona ignition voltage was measured at 8.5kV.
The corona extinction voltage was measured at 8.0kV.

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Corona Extinction requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.10 Resistance to Fluids*

**Requirement:**
The cable assembly shall be resistant to Fluids in accordance with EN 3475-411**.**

**Accept / Reject Criteria:**
See section **7.16**.

## *8.11 Notch Propagation*

**Requirement:**
Notch propagation shall be conducted in accordance with EN-3475-502.

**Method:**

- Cable sample 1 was tested for notch propagation.
- A notch was created of 0.0125 in (0.318 mm) depth to the cable jacket, 90° to the axis of the cable. The depth of notch employed is approximately 1/3 the jacket thickness.
- The cable was then wound 360° around a mandrel with a diameter of six times the diameter of cable (3.39 in), with the cut facing the outside.
- Next a High Potential Withstanding voltage of 316 volts, 60 Hz was applied for 1 minute.

**Accept / Reject Criteria:**
Cables that pass the High Potential Withstanding voltage test after cutting the notch are considered to have passed this test.

**Results:**
The cable passed the High Potential Withstanding voltage test after a notch was cut.
See **Figure 22.**

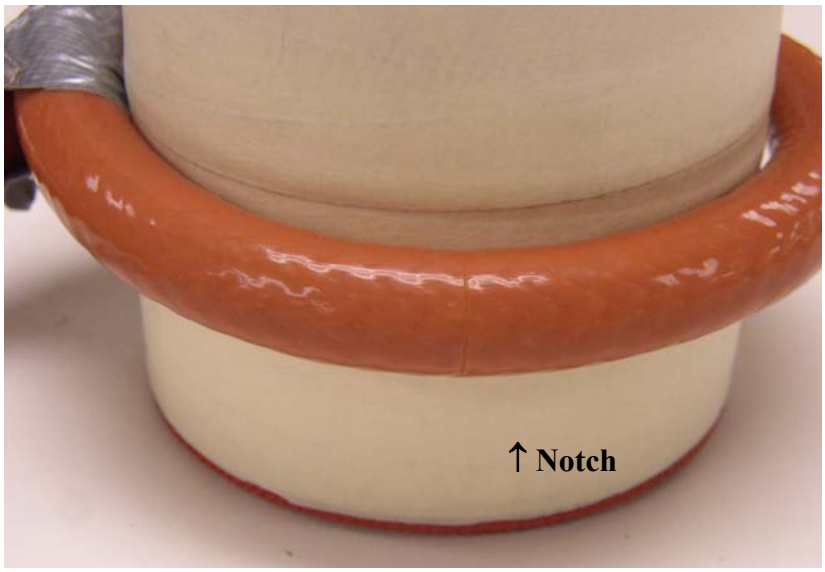


**Figure 22 – Notch Propagation Test**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Notch Propagation requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.12 Scrape Abrasion*

**Requirement:**
Scrape Abrasion will be conducted in accordance with **EN 3475-503**.

**Method:**
- Test sample #3 was used for the abrasion test.
- The apparatus shown in **Figure 23** was used to abrade the jacket surface. Note that a Squirrel cage abrasion fixture as described in **MIL-T-81490** and **MIL-C-5756** was substituted for the abrasion apparatus described in **EN-3475-503**.
- A radius edge of 0.02 inch (0.5 mm) was used.
- A 2 lb weight was hung on the cable (9 N).
- The fixture was adjusted to have a travel of 2 inches.
- The cable was chafed for 50 cycles at a rate of 50 cycles/min.
- The outer jacket was inspected and VSWR and Insertion Loss measurements were taken before and after.

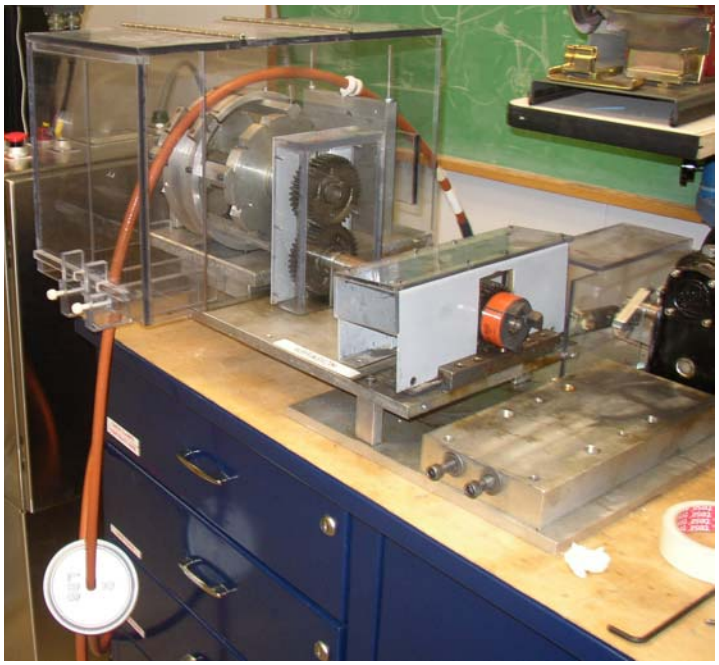

**Figure 23 – Scrape abrasion setup**

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** and resist scrape abrasion (jacket completely worn through) are considered to have passed this test.

**Results:**
The cable tested for Scrape Abrasion met the required specifications. **Table 36** is a summary of the test results and the test data is included in **APPENDIX B – SCRAPE ABRASION DATA**. **Figure 24** shows the results of abrasion on the cable.

**Table 36 – Scrape Abrasion Test Results**

| Sample # | Pre/Post | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 3 | Pre | 1.13:1 | 1.3:1 | 0.2 | 0.23 | 0.33 | 0.39 | **Pass** |
| 3 | Post | 1.13:1 | 1.3:1 | 0.19 | 0.23 | 0.33 | 0.39 | **Pass** |

**Figure 24 – Scrape Abrasion Results**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Scrape Abrasion requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.13 Flexure Endurance*

**Requirement:**
The Flexure Endurance test shall be conducted in accordance with **EN 3575-512**.

**Method:**

- Test Sample #3 was flexed at a rate of 18 ±2 cycles per minute, +/- 90°, with a Mandrel diameter of 8.6 in (220 mm), 1 lb (4.4N) tensile force, for 500 cycles.
- VSWR and Insertion Loss measurements were taken before and after. **Figure 25** shows the apparatus used in this test.

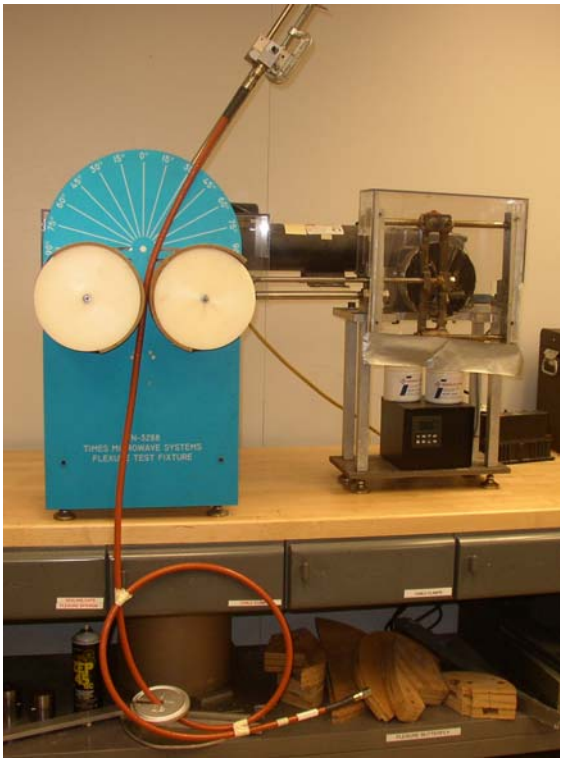

**Figure 25** – Flexure Endurance Setup

**Accept / Reject Criteria:**
Cables that meet VSWR and Insertion Loss specifications in **Table 3** after Flexure are considered to have passed this test.

**Results:**
Cable Sample #3 met the required specifications for Flexure Endurance. **Table 37** is a summary of the test results and the test data is included in **APPENDIX B – FLEXURE ENDURANCE DATA.**

**Table 37 – Flexure Test Results**

| Sample # | Pre/Post | VSWR | Spec | Insertion Loss @ 400 MHz(dB) | Spec | Insertion Loss @ 1220 MHz(dB) | Spec | Result |
|---|---|---|---|---|---|---|---|---|
| 3 | Pre | 1.13:1 | 1.3:1 | 0.19 | 0.23 | 0.33 | 0.39 | **Pass** |
| 3 | Post | 1.14:1 | 1.3:1 | 0.21 | 0.23 | 0.37 | 0.39 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Flexure Endurance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.14 Deformation Resistance*

**Requirement:**
Deformation Resistance shall be tested in accordance with **EN 3475-513**.

**Method:**

- Test samples #9a and 9b were used for the Deformation Resistance test.
- The 2 cables were secured with 3 cable ties spaced 4 inches (101mm) apart.
- The tightening force applied to each tie was 10 lb, typical of over-tightening conditions that may occur during installation.
- The impedance of the cable pair was measured before and after the tightening of the cable ties at room ambient temperature.
- The cable ties were then removed and the cables were heated 130 ± 5 ° C for 8 hours and then cooled 4-6 hours at room temperature.
- Impedance measurements were taken before and after tightening cable ties.

**Accept / Reject Criteria:**
The impedance shall not deviate more than 5% from the originally recorded values. (approx ± 2.5Ω)

**Results:**
Cable samples 9a and 9b met the required specifications for Deformation Resistance. **Table 38** is a summary of the test results and the test data is included in **APPENDIX B – DEFORMATION RESISTANCE DATA**.

**Table 38 – Deformation Resistance Test Results**

| Sample # | Test | Cable ties | Impedance Ω | Result |
|---|---|---|---|---|
| 9a | Pretest | no | 51 | **Pass** |
| 9a | before heat | yes | 51 | **Pass** |
| 9a | after heat | no | 50.5 | **Pass** |
| 9a | after heat | yes | 50.6 | **Pass** |
| 9b | Pretest | no | 50.9 | **Pass** |
| 9b | before heat | yes | 50.9 | **Pass** |
| 9b | after heat | no | 50.5 | **Pass** |
| 9b | after heat | yes | 50.6 | **Pass** |

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Deformation Resistance requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.15 Braid Screen Pushback Capability*

**Requirement:**
The Braid Screen Pushback capability test shall be performed in accordance with EN 3475-702.

**Analysis:**
TMS verifies that the installation of the intermediate section and connector complies with the Braid Screen Pushback Capability of **EN 3475-702.**

The outer conductor of the cable assembly (Braid Screen) is trimmed and pushed back for the installation of the intermediate sections. All of the assemblies provided under these specifications utilize the same intermediate section (47961). Installation of the intermediate sections on the cable proves that the cable meets the Braid Screen Pushback Capability requirement.

**Conclusion:**
Times Microwave Systems certifies that the cable assemblies meet the Braid Screen Pushback Capability requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004.

## *8.16 Performance of Manufacturer's Marking*

**Requirement:**
The marking shall be tested for abrasion resistance according to **EN 3475-703**.

**Method:**

- The Performance on Manufacturers Marking test was performed on sample 9b.
- The apparatus used in section **8.12** was also used for this test.
- The abrading needle had a diameter of 0.02 in (0.5 mm) while applying 2.2 N (0.5lb) to the intended area.
- The test sample was subjected to 50 cycles, with each cycle consisting of 1 inch travel in the positive and negative directions, at a rate of 50 cycles per minute.
- A visual examination was performed to verify compliance.

Additionally, Times Microwave Systems certifies that the identification markings meet the Permanency and Legibility requirements of **MIL-STD-130**.

**Accept / Reject Criteria:**
Cables which meet the requirements of EN 3475-703 are considered to have passed this test.

**Results:**
**Figure 26** shows that the marking complies with the requirements of EN 3475-703 after the Performance of Manufacturers marking test.


**Figure 26 – Performance of Manufacturers Marking**

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Performance of Manufacturer's Marking requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## *8.17 Flexibility*

**Requirement:**
The cable will be tested for flexibility in accordance with **EN 3475-704.**

**Method:**
A cable was assembled according to **EN 3475-704**. A cable was cut to 6.285 feet and the ends were spliced together to form a 24 inch loop. The force required to bend the loop 25% (to 18 inches) was measured and recorded.

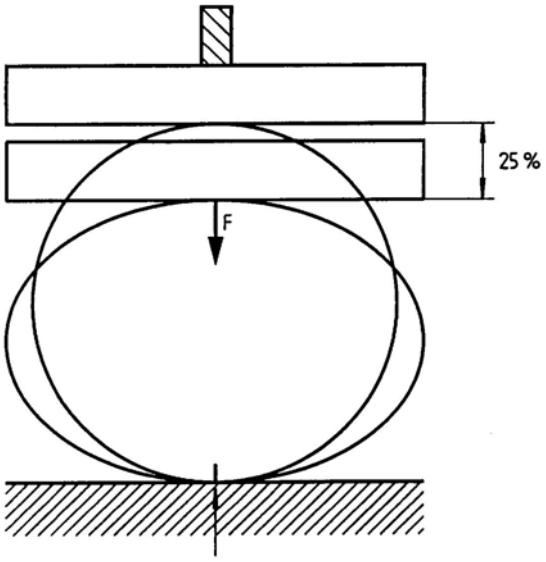


**Figure 27 - Flexibility**

**Accept / Reject Criteria:**
The maximum force required to deform a cable loop 25% shall be 15N (3.37lb).

**Results:**
It required 5.8 Lb or 25.8 N to deform the cable loop 25% instead of the 15N as specified. However, the flexibility of the cable is very close to the required specification. The Flexure test results prove that the cable is capable of withstanding significant flexing with minimal effect on the electrical performance. Even though the cable does not meet the specific requirements of flexibility, Times Microwave Systems certifies that it is suitable for this application.

## 8.18 Capacitance per Unit Length

**Requirement:**
Capacitance per unit length shall be measured in accordance with EN 3475-801.

**Method:**
Capacitance for the cable was measured on a 10ft cable using an LCR meter.

**Accept / Reject Criteria:**
**NT-A4-SAM-06003** and **NT-A4-SAM-06004** do not specifically indicate the effective capacitance requirement required for this application. TMS suggests that a maximum capacitance of 40 pF/ft (131.2 pF/meter) until a specific requirement can be determined.

**Results:**
The capacitance per unit length of the cable was measured to be 8.27 pF/meter.

**Conclusion:**
Times Microwave Systems certifies that the cables assemblies meet the Capacitance per Unit Length requirements of NT-A4-SAM-06003 and NT-A4-SAM-06004**.**

## 8.19 Velocity of Propagation

**Requirement:**
The velocity of propagation shall not be less than 70%.

**Method:**
See Section **7.6**.

**Accept / Reject Criteria:**
Cables that have a velocity of propagation equal to or greater than 70% will be considered to have passed this test.

## *8.20 Characteristic Impedance*

**Requirement:**
The coaxial cable assemblies shall have a nominal impedance of 50 Ω.

**Method:**
See section **7.2**.

**Accept / Reject Criteria:**
Cables that meet the impedance requirement of 50 Ω are considered to have passed this test.

## *8.21 Attenuation*

**Requirement:**
The cable shall meet the attenuation requirements of **EN 3475-806**.

**Method:**
See section 7.4.

## *8.22 Fire Resistance*

**Requirement:**
Fire resistance shall be performed according to **EN3475-408**.

**Method:**
See Section 7.34.

# 9.0 Conclusion

The qualification for RF cable assemblies manufactured by Times Microwave Systems for EADS / CASA / Airbus A400 is complete. The cable assemblies meet all of the requirements of the Airbus NT-A4-SAM-06003 and NT-A4-SAM-06004 specifications through testing and/or analysis. It is the position of Times Microwave Systems that the cable assemblies used in this program are suitable for this application.

# 10.0 APPENDIX A – PRODUCT DATA SHEETS

FBT 600 – AA8959
MT 340 – AA9244

# 11.0 APPENDIX B – TEST DATA

## *11.1 APPENDIX B – INITIAL DATA*

## *11.2 APPENDIX B – IMPEDANCE DATA*

## *11.3 APPENDIX B – VELOCITY OF PROPAGATION DATA*

## *11.4 APPENDIX B – BEND RADIUS DATA*

## *11.5 APPENDIX B – TENSILE LOAD DATA*

## *11.6 APPENDIX B – CONCENTRATED LOAD DATA*

## *11.7 APPENDIX B – TORQUE DATA*

## *11.8 APPENDIX B – ABRASION DATA*

## *11.9 APPENDIX B – FLEXURE DATA*

## *11.10 APPENDIX B – TEMPERATURE DATA*

## *11.11 APPENDIX B – ATMOSPHERIC PRESSURE/ ALTITUDE /DECOMPRESSION / OVERPRESSURE DATA*

## *11.12 APPENDIX B – HUMIDITY AND SALT SPRAY DATA*

## *11.13 APPENDIX B –SHOCK AND VIBRATION DATA*

## *11.14 APPENDIX B –LANDING GEAR TIRE BURST DATA*

## *11.15 APPENDIX B – CONSTANT ACCELERATION DATA*

## *11.16 APPENDIX B – CONNECTOR INSERTION RELIABILITY*

## *11.17 APPENDIX B – SCRAPE ABRASION DATA*

## *11.18 APPENDIX B – FLEXURE ENDURANCE DATA*

## *11.19 APPENDIX B – DEFORMATION RESISTANCE DATA*

# 12.0 APPENDIX C – ADDITIONAL TEST REPORTS

Stamford Technologies Test Reports
Dayton T Brown Test Report

# 13.0 APPENDIX D – ATP1047: Acceptance Test Procedure

# 14.0 APPENDIX F – ETR-0116 Test Report

# 15.0 APPENDIX K – ETR-0120 Test Report

# 16.0 APPENDIX L – T0873 Test Report (excerpt)