

NXTCore ARINC801 Fiber Optic Terminus Qualification Test Plan

1. Scope

To define the test samples, test sequence and test methods used to validate the optical performance of XiOptics ARINC 801 fiber optic terminus. It is understood that the standard optical channel performance is governed by the optical terminus in conjunction with the connector and cable options. Optical performance has been generally governed by the performance criteria outlined in the ARINC Specification 801-2; Fiber Optic Connectors. XiOptics has utilized outside testing facilities certified by to ISO/IEC-17025:2005, Mil-STD-790 and ITL FOC to ensure the independent and quality nature of all data presented. Termini were installed onto cables and into connectors by a ISO9001/2008 supplier prior to submittal to the testing organization.

2. Order of Precedence

In case of a conflict between the text of this document and the applicable referenced documents, the text of this document shall take precedence.

3. Description of Test Articles

Item	Part Number	Qty	Description
1	TA-1260-S-P	98	Optical terminus, loose structure
2	N/A	12	Cable assembly, Item 1 to Item 1, 62.5/125 multi-mode fiber, 1.8mm to 2.0mm diameter, 4 meters in length, -55°C to 125°C minimum rating, loose structure (Fiber: Carlisle P/N NFO(EP)-125-1) supplied pre-conditioned
3	N/A	25	Cable assembly, Item 1 to Item 1, 62.5/125 multi-mode fiber, 1.8mm to 2.0mm diameter, 4 meters in length, standard temperature rating, loose structure with Aramid strength member (Fiber: OFS)
4	N/A	1	Cable assembly, Item 9 to Item 9, 62.5/125 multi-mode fiber, 1.8mm to 2.0mm diameter, 4 meters in length, standard temperature rating, loose structure with Aramid strength member (Fiber: OFS)
5	N/A	4	Cable assembly, Item 1 to Item 1, 9/125 single-mode fiber, 1.8mm to 2.0mm diameter, bend insensitive, 4 meters in length, -55°C to 125°C minimum rating, semi-loose structure (Fiber: Carlisle P/N NFO(EP)-125-5B) supplied pre-conditioned
6	N/A	8	Cable assembly, Item 1 to Item 1, 9/125 single-mode fiber, 1.8mm to 2.0mm diameter, 4 meters in length, standard temperature rating, loose structure with Aramid strength member (Fiber: TBD by cable assembly supplier)
7	N/A	36	Patch cord, 900 µm, FC UPC to FC UPC, 62.5/125 multimode fiber, 4 meters in length
8	N/A	12	Patch cord, 900 µm, FC APC to FC APC, 9/125 single-mode fiber, 4 meters in length
9	N/A	2	Optical terminus, 801-conforming, Radial P/N F725 003 419

Termini intended for multimode cables with loose structure and termini intended for single-mode cables with loose structure, shall be installed in ARINC801 capable connectors. The termini and connectors are

intended for continuous operation at any temperature between -55°C and 125°C. Fiber optic termini supplied are certified to be of production source and quality.

Cable/Terminus assembly and crimping of the crimp sleeve shall be performed by an outside source cable assembly supplier using standard termination methods per the applicable ARINC documents. Fiber optic cable, supplied to the cable assembly supplier will be pre-conditioned for 5 cycles, -55°C to 135°C with a 5 minute ramp time between temperature extremes and each temperature plateau stabilized for at least 30 minutes. The cable assembly supplier will affix a unique label to each cable assembly to ensure performance and end face traceability throughout the entire test regimen. The cable assembly supplier will complete and record end face geometry per Telcordia Core GR-326 and per TIA/EIA-568-C.3. These measurements shall be made using a calibrated interferometer. The cable assembly supplier shall perform and record initial attenuation and return loss testing on all cable assemblies. All necessary test fixtures will be supplied by the selected independent testing laboratory.

The test connectors shall be populated according to the following table:

Connector Variant	Multimode position	Single-mode position
Connector 1	A1, A3	---
Connector 2	A1, A2, A4, A5	---
Connector 3	A1, A5	A2, A4
Connector 4	A1, A2, A6, A7	A3, A5

Note: Item 4 containing the Radial terminus shall be populated into connector according to the above table and considered part of Group D. This will be considered for intermate performance.

4. Guide Pins

When using XiOptics optical termini within ARINC801 connector systems all mating conditions are to be tested with standard ARINC801 specification guidance features installed into connectors.

5. Test Sequence

The test plan is divided into four (4) groups of test sequences. Groups A, B and C shall each be comprised of four mated, fully populated connector pairs and each group will consist of 16 optical channels or 32 total termini. Group D shall be comprised of one mated, fully populated connector pair and will consist of 2 optical channels or 4 total termini. Each pair of connectors shall go through the listed tests in the order specified. The test sequence is given in the table on the following page.

Test Procedure	Group A Environmental	Group B Mechanical Environment	Group C Mechanical Usage	Group D Intermate
Attenuation and splicing	X	X	X	X
Return loss	X	X	X	
Thermal cycling	X			
Humidity	X			
Temperature life	X			
Salt spray	X			
Thermal shock	X			
Vibration		X		
Mechanical shock		X		
Maintenance aging			X	
Mating durability			X	
Cable Pull-out			X	
Termini retention force			X	

Return loss	X	X	X	X
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6. Test Procedures

All electrical configuration specifications, tests or electrical failure criteria associated with the following referenced test specifications are not applicable for the following tests.

6.1 Optical

All the following optical performance tests shall be performed at a nominal wavelength of 1300 nm for multimode and 1550 nm for single-mode. Multimode tests shall use overfill launch conditions as defined in TIA-455-54B (FOTP-54) or IEC 60793-1-40 (TIA-455-78B (FOTP-78)), paragraph A.1.3.

6.1.1 Attenuation

Requirements:

Test in accordance with TIA-455-171A (FOTP-171), Method D1 (multimode) and D3 (single-mode).

Criteria:

Fiber optic connector assemblies shall have a maximum attenuation of 0.3 dB for multimode connections. For all single-mode connections, measure and record only. No failure criterion exists for single-mode connections.

6.1.2 Return Loss

Requirements:

Test as specified in paragraph 2.4.3.2 of ARINC Specification 801-2 and in accordance with TIA/EIA-455-107A (FOTP-107). Return loss should be a minimum of 20 dB for multimode PC polish termini and 30 dB for single-mode PC polish termini.

Criteria: Measure and record return loss measurements.

6.1.3 Change in Transmittance (CIT)

Requirements:

Where tests specify a CIT measurement, CIT should be measured in accordance with TIA-455-20B (FOTP-20), Method A. Launch conditions for CIT measurements should be an Equilibrium Modal Distribution profile. Measurements shall be recorded before, during, and after the test, unless otherwise specified. The measurement made during a test need not be continuous, unless otherwise specified, but should be made at the extremities of the test conditions.

Criteria:

Unless otherwise specified in this test plan, the CIT for any test should not exceed 0.5 dB for multimode connections. For all single-mode connections, measure and record only. No failure criterion exists for single-mode connections.

6.2 Environmental Category

6.2.1 Thermal Cycling

Requirements:

Test as specified in ANSI/TIA-455-3B (FOTP-3) with the following procedure and criteria, which is based from paragraph 2.4.4.1 of ARINC Specification 801-2 with exceptions.

Procedure:

Connectors shall be tested using Test Condition D, 10 cycles, with Step 1 set at $-55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and Step 2 set at $125^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Both of these temperature plateau intervals shall not be less than 30 minutes. The rate of the environmental chamber air temperature change, between the minimum and maximum temperature extremes, shall be between 50 and 70 minutes. No stabilization is necessary for Step 3 as it is the indicator of the start/end of each cycle. At the completion of the last cycle, the connector assemblies shall be returned to $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and there shall be no damage detrimental to operation of the assembly after being subjected to the temperature extremes. The CIT measurements shall be taken continuously throughout and at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ at the end of the test. The frequency of CIT measurements taken throughout the test will be up to the discretion of the testing laboratory, although an absolute minimum frequency of CIT measurements taken every 5 minutes will be herein required. Stabilization shall be considered achieved at least 30 minutes after the start of each plateau interval.

Criteria:

Fiber optic connector assemblies shall pass the CIT test as stated in 6.1.3 of this test plan and a visual inspection in accordance with the requirements of TIA-455-13A (FOTP-13).

6.2.2 Humidity**Requirements:**

Test as specified in paragraph 4.5.15 of MIL-DTL-24308G and in accordance with EIA-364-31B, Method IV (-10°C to $+65^{\circ}\text{C}$, 10 cycles, 240 hours). Optional cold shock required. Connectors are to remain in a mated condition throughout the test using the provided jackscrew hardware system. Panel mounting not required.

Procedure:

The CIT measurements shall be taken upon stabilization at every temperature plateau and at 25°C at the end of the test. Stabilization shall be considered achieved at least 30 minutes after the start of each plateau interval.

Criteria:

Fiber optic connector assemblies shall pass a CIT test.

6.2.3 Temperature Life:**Requirements:**

Test as specified in TIA/EIA-455-4C (FOTP-4) with the following procedure and criteria, which is based from paragraph 2.4.4.2 of ARINC Specification 801-2 with exceptions.

Procedure:

The temperature exposure shall be $125^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for the duration of 1,000 hours. CIT measurements shall initially be recorded at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, once every hour for the duration of the test and at the conclusion of testing upon return to $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Cleaning of the termini is permitted prior to and post testing, but not during the test.

Criteria:

Fiber optic connector assemblies shall pass a CIT test and a visual examination using the failure criteria referenced in paragraph 5.9 of TIA/EIA-455-4C (FOTP-4).

6.2.4 Salt Spray:**Requirements:**

Test as specified in paragraph 2.4.4.5 of ARINC Specification 801-2 the testing requirements of TIA-455-16A (FOTP-16), test condition C.

Procedure:

After exposure, a CIT test shall be performed. The connector assemblies shall then be thoroughly washed with tap water to remove all salt deposits and then shall be dried in a circulating air oven at a temperature of $38^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for a period of 12 hours. They shall then be visually examined for evidence of corrosion.

Criteria:

Fiber optic connector assemblies shall pass a CIT test and visual inspection. Mating and un-mating force testing is not required during final inspection of the connector assemblies.

6.2.5 Thermal Shock

Requirements:

Test as specified in paragraph 4.5.13.1 of MIL-DTL-24308G and in accordance with EIA-364-32F with the exception that no plateau interval shall be less than 30 minutes.

Procedure:

Connectors shall be tested using Method A, Test Condition I, 5 cycles, unless otherwise specified. At the completion of the last cycle, the connector assemblies shall be returned to 25°C and there shall be no damage detrimental to operation of the assembly after being subjected to the temperature extremes. The CIT measurements shall be taken continuously throughout and at 25°C at the end of the test. The frequency of CIT measurements taken throughout the test will be up to the discretion of the testing laboratory, although an absolute minimum frequency of CIT measurements taken every 5 minutes will be herein required. Stabilization shall be considered achieved at least 30 minutes after the start of each plateau interval.

Criteria:

No CIT failure criterion exists for this test; measure and record only. Visual inspection, using the failure criteria outlined in paragraph 4.6 of EIA-364-32F, is required.

6.3 Mechanical Environment

6.3.1 Mechanical Vibration

Requirements:

Test as specified in paragraph 4.5.13.1 of MIL-DTL-24308G and in accordance with EIA-364-32F with the exception that no plateau interval shall be less than 30 minutes.

Procedure:

Connectors shall be tested using Method A, Test Condition I, 5 cycles, unless otherwise specified. At the completion of the last cycle, the connector assemblies shall be returned to 25°C and there shall be no damage detrimental to operation of the assembly after being subjected to the temperature extremes. The CIT measurements shall be taken continuously throughout and at 25°C at the end of the test. The frequency of CIT measurements taken throughout the test will be up to the discretion of the testing laboratory, although an absolute minimum frequency of CIT measurements taken every 5 minutes will be herein required. Stabilization shall be considered achieved at least 30 minutes after the start of each plateau interval.

Criteria:

No CIT failure criterion exists for this test; measure and record only. Visual inspection, using the failure criteria outlined in paragraph 4.6 of EIA-364-32F, is required.

6.3.2 Mechanical Shock

Requirements:

Phase 1: Test as specified in paragraph 4.5.16 of MIL-DTL-24308G and in accordance with EIA-364-28F, test condition IV.

Phase 2: Test as specified in paragraph 4.5.16 of MIL-DTL-24308G and in accordance with EIA-364-28F, test condition IV with the following exception:

The 20-minute cycle shall be performed two times in each of the three mutually perpendicular directions (total of six times), so that the motion shall be applied for a total period of approximately 2 hours.

Procedure:

Phase 1 & 2: Two separate tests consisting of Phase 1 & 2 are to be performed. The first test will consist of a test fixture with two mated pair test sample mounted. The second test will consist of a test fixture with a secondary mated pair test sample mounted. Connector pairs shall be held together by their locking mechanism.

Phase 1: CIT shall be measured before and after the vibrations, and shall not be monitored during the vibration application when the discontinuity detector is in use.

Phase 2: The test laboratory is restricted to two simultaneous channels when monitoring for a 1μsec discontinuity. For this reason, it is necessary to only use two multi-mode channels, one from each connector test sample.

Criteria:

During phase 1 of the test, there shall be no optical discontinuities in excess of 50 microseconds and a change in power >0.5 dB. At the conclusion of phase 1, fiber optic connector assemblies shall pass a CIT test. In addition, the mated connectors shall not be damaged and there shall be no loosening of parts due to vibration.

During phase 2 of the test, there shall be no optical discontinuities in excess of 1 microsecond and a change in power >1.0 dB. Failure of this phase of the test will not constitute a failure of the test samples. A CIT test and visual inspection are not required after phase 2.

6.4 Mechanical Use

6.4.1 Maintenance Aging

Requirements:

Test as specified in paragraph 2.4.5.7 of ARINC Specification 801-2 and in accordance with EIA-364-24B.

Procedure:

All termini shall be removed and reinstalled ten times using the appropriate insertion and removal tools.

Criteria:

The termini insertion force should be measured during the first and last cycles and should not exceed 36 N (8 pounds).

6.4.2 Mating Durability

Requirements:

Test as specified in paragraph 4.5.18 of MIL-DTL-24308G and in accordance with EIA-364-09C, which meets or exceeds the testing requirements of TIA-455-21A (FOTP-21). The following detail applies:

- a. Manual mating and un-mating of test samples, 500 cycles at a rate between 100 and 300 cycles per hour.
- b. (Salt spray requirement removed here due to its absence in ARINC 801-2 and 2008 test plan)

Procedure:

500 cycles of engagement and separation shall be performed. A cycle shall be defined as the point at which optical termini are fully disengaged to a point at which the connectors are fully mated and termini are fully engaged. Connector shells are not required to be fully unmated.

A CIT test shall be performed after every 100 cycles. Termini may be cleaned prior to each measurement.

Criteria:

Fiber optic connector assemblies shall pass CIT tests and at the conclusion of the test, the connectors, adapters and termini shall be inspected for visual damage using the failure criteria outlined in paragraph 4.6 of TIA-455-21A (FOTP-21).

6.4.3 Cable Pull-out Force

Requirements:

Test as specified in TIA-455-6B (FOTP-6) Method 1.

Procedure:

This test applies only to cables with 1.8mm to 2.1mm outer jacket diameter and reinforced with an Aramid strength member. Mount the test sample in a test fixture such that adequate support is provided. The test load shall be applied as follows with a rate of pull being 89N/min $\pm$ 4N:
Load 1: Apply 12 lb force at 0° for at least 5 seconds but no more than 10 seconds.

Criteria:

For the procedure above, remove the load and after at least 10 seconds, measure and record the CIT.

6.4.4 Terminus Retention Force

Requirements:

Test as specified in paragraph 2.4.5.3 of ARINC Specification 801-2 and in accordance with EIA-364-38C, either Method A or B.

Procedure:

The test load shall be 12 lb force. *Note: This test is intended to prove the integrity of the connector terminus retention feature and not to prove the attachment of the cable terminus.*

Criteria:

All termini shall be retained with no damage to the termini, the connector inserts or to the retention mechanisms.