# 24 Position Fiber Optic Connector

## 1. SCOPE

### 1.1. Content

This specification covers performance, tests and quality requirements for the Tyco Electronics 24 Position Fiber Optic Connector used with LuxCis™ terminus. This specification is based on Boeing BPS-C-190, with the exception that this product is not sealed or moisture resistant.

### 1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 2 shall be used. All inspections shall be performed using the applicable inspection plan(s) and product drawing(s).

### 1.3. Qualification Test Results

Successful qualification testing on the subject product line was completed on 17Jan08. The Qualification Test Report number for this testing is 501-680. This documentation is on file at and available from Engineering Practices and Standards (EPS).

## 2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between requirements of this specification and referenced document(s), this specification shall take precedence.

### 2.1. Tyco Electronics Documents

- 102-8: Quality Specification (Product Testing, Procedure for)
- 102-952: Quality Specification (Qualification of Fiber Optic Connectors and Cable Assemblies)
- 118-28093: Process Specification (LuxCis Contact Assembly Instructions, excerpt, paragraphs 6.9 and 6.10)
- 501-680: Qualification Test Report (24 Position Fiber Optic Connector)

### 2.2. Commercial Documents

- AS13441: SAE International, Aerospace Standard
- BPS-C-190, Rev B, 4-Jun-2003: Boeing Part Specification for Fiber Optic Connectors
- TIA/EIA-455-B: Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components

## 3. REQUIREMENTS

### 3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing(s).

3.2. Optical Power Source

The optical power source wavelength shall be 1300 ± 30 nm for multimode product or as stated in the Test Report.

3.3. Launch Conditions

Launch conditions shall be compliant with requirements of Section 5.6.3.1 in BPS-C-190.

3.4. Ratings

| Performance | Value | Units |
|---|---|---|
| Attenuation, typical, see Note | 0.09 | dB |
| Return loss, typical, see Note | 30.1 | dB |
| Storage temperature (non-operational) | -55 to 85 | ˚C |
| Operational temperature | -15 to 70 | ˚C |

**NOTE** *Typical values represent the median of the sample data. See Figure 2 for maximum attenuation loss and minimum return loss values.*

Figure 1

3.5. Performance and Test Description

Product is designed to meet the mechanical, environmental and optical transmittance performance requirements specified in Figure 2. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

3.6. Test Requirements and Procedures Summary

| Test Description | Requirement | Procedure |
|---|---|---|
| Initial examination of product. | BPS-C-190, Sections 4.1.1, 4.1.5, 4.2 and 4.3.<br>Product shall meet the requirements of the applicable product drawing. Product drawings shall conform to requirements specified in applicable Boeing standards for individual parts, identification requirements, and material requirements. | BPS-C-190, Section 5.6.1 and FOTP-13.<br>Compare Tyco Electronics product drawings to Boeing requirements in Section 5.6.1 of BPS-C-190, for verification of conformance. Using applicable quality inspection plan(s), verify product meets visual, dimensional and functional requirements.<br>See Note. |
| Final examination of product. | After completion of the test sequence, product shall remain conforming to requirements of the applicable product drawing. | FOTP-13.<br>Visually inspect to verify that product meets visual, dimensional and functional requirements. |

Figure 2 (continued)

| Test Description | Requirement | Procedure |
|---|---|---|
| Initial attenuation, new product. | BPS-C-190 Section 4.4.2.1.<br>0.5 dB maximum attenuation for new product.<br>0.3 dB maximum average attenuation per connector for new product. | BPS-C-190 Section 5.6.3.1 and TIA/EIA-455-171A, Methods B1 and D1.<br>Launch conditions shall meet requirements of BPS-C-190 Section 5.6.3.1. Record all attenuation data at 1300 nm wavelength. Attach test leads to optical measurement equipment, mate and record optical power. Unmate test leads, insert sample between leads and record optical power. Difference between the two readings is the attenuation of the specimen. |
| Attenuation, after any test. | BPS-C-190 Section 4.4.2.1.<br>0.6 dB maximum attenuation per channel after conditioning.<br>0.4 dB maximum average attenuation per connector after conditioning. | BPS-C-190 Section 5.6.3.1 and TIA/EIA-455-171A, Methods B1 and D1.<br>Launch conditions shall meet requirements of BPS-C-190 Section 5.6.3.1. Record all attenuation data at 1300 nm wavelength. |
| Return loss. | BPS-C-190, Section 4.4.2.2.<br>20 dB minimum return loss per channel. | BPS-C-190 Section 5.6.3.2 and TIA/EIA-455-107.<br>Record all return loss data at 1300 nm wavelength. |
| Connector coupling (mating and unmating) forces and connector mating durability. | BPS-C190, Sections 4.4.3.2 and 4.4.3.1.<br>45 pounds maximum connector coupling force.<br>30 pounds maximum connector uncoupling force.<br>0.6 dB maximum attenuation per channel after test.<br>0.4 dB maximum average attenuation per connector after test.<br>No defect detrimental to the operation of the connector. | BPS-C-190, Sections 5.6.4.2 and 5.6.4.1, and SAE AS13441, Methods 2013.1 and 2016.<br>Install connectors in test fixture per Figure 5. Record initial attenuation and return loss. Measure initial unmating and mating forces. Perform 500 cycles of connector separation and engagement at a maximum rate of 5 cycles per minute. Plug and receptacle shall be completely separated during each cycle. Full mating requires closing the fixture to the dimension shown in Figure 6. Record final attenuation and return loss after test. Record final unmating and mating forces. Clean the terminus after 100 cycles. Visually inspect after test. |

Figure 2 (continued)

| Test Description | Requirement | Procedure |
|---|---|---|
| Terminus retention force. | BPS-C-190, Section 4.4.4.3.<br>Each terminus in an unmated MTC connector must withstand a 12 pound axial load with no more than 0.015 inch maximum axial displacement of the terminus. | BPS-C-190, Section 5.6.5.3 and SAE AS13441, Method 2009.1.<br>Two plugs and two receptacles (one half from each connector pair) shall be randomly selected from the official specimens for test, along with one half of the spare connector. Once chosen for the initial test, the same ones shall be retested at the end of the test sequence. Connector is unmated for test (no optical measurements). Test all terminus in each selected connector half. Inspect fiber endfaces prior to test. Mount connector shell. Approximately 4 to 5 ounces may be applied as a pre-load to remove slack. Record initial position of the terminus (Reading #1). Apply 12 pound axial load and record position of the terminus (Reading #2). After holding the load for 1 hour, record position of the terminus (Reading #3). Remove load. Record final position of the terminus (Reading #4). Difference between Reading #2 and Reading #3 must meet displacement requirement. Inspect fiber endfaces immediately after test to verify that no damage occurred due to test. Repeat test for the next selected plug or receptacle. Six termini in randomly selected cavities of either the backplane or module half of five connectors shall be tested, resulting in 30 displacement values. Identify each terminus tested so that the same termini can be tested at the start and end of the test sequence. |
| Terminus insertion and removal forces. | BPS-C-190, Section 4.4.4.4.<br>8 pound maximum insertion force.<br>8 pound maximum removal force. | BPS-C-190, Section 5.6.5.4 and SAE AS13441, Method 2012.1.<br>Measure force to remove terminus from the insert. Measure force to re-insert terminus back into the insert. Six termini in randomly selected cavities of either the backplane or module half of five connectors shall be tested, resulting in 30 insertion & removal force values. |

Figure 2 (continued)

| Test Description | Requirement | Procedure |
|---|---|---|
| Terminus walk-out. | BPS-C190, Section 4.4.4.5.<br>Terminus shall not become dislodged from normal position. | BPS-C-190, Section 5.6.5.5.<br>Randomly select 2 terminus from each plug and receptacle for testing. Mount connector to a 360 degree rotating fixture. Apply a 3 pound load to the fiber optic cable at a 45 degree angle from the connector. Rotate the fixture 360 degrees for 1 cycle. Perform 100 cycles at a rate of 10 to 20 cycles per minute. If load application to the fiber optic cable assembly is unsuccessful, replacement specimens with steel cable crimped to the termini may be used instead. |
| Mechanical shock. | BPS-C-190, Section 4.4.5.3.<br>0.25 dB maximum change in optical transmittance per channel after test.<br>No optical discontinuities > 1 microsecond during test.<br>Attenuation increase > 3 dB is considered discontinuity.<br>No disengagement of mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking or loosening of parts. | BPS-C-190, Section 5.6.6.3 and TIA/EIA-455-14, Condition A.<br>50 G, 11 millisecond, half-sine.<br>Record optical transmittance and return loss before test. Perform 3 shocks per axis in 6 directions (18 total shocks). Six terminus in each connector shall randomly be selected for optical discontinuity monitoring during test. Record optical transmittance before and after testing in each axis. At the completion of testing, record final optical transmittance and return loss. Visually inspect after test. |
| Random vibration. | BPS-C-190, Section 4.4.5.4.<br>0.25 dB maximum change in optical transmittance per channel after test.<br>No optical discontinuities > 1 microsecond during test.<br>Attenuation increase > 3 dB is considered discontinuity.<br>No evidence of cracks, breaks, or loosening of parts due to vibration exposure. | BPS-C-190, Section 6.4 and TIA/EIA-455-11, except per Condition VI-B, 0.04 PSD, 7.3 RMS G's. Record optical transmittance and return loss before test. Subject specimens to 1.5 hours exposure per plane in 3 mutually perpendicular planes (4.5 hours total exposure). Six terminus in each connector shall randomly be selected for optical discontinuity monitoring during test. Record optical transmittance before and after testing in each plane. At the completion of testing, record final optical transmittance and return loss. Visually inspect after test. |

Figure 2 (continued)

| Test Description | Requirement | Procedure |
|---|---|---|
| Thermal cycling. | BPS-C-190, Section 4.4.6.1.<br>0.25 dB maximum change in optical transmittance (change from initial) during and after test.<br>0.6 dB maximum attenuation per channel after test.<br>0.4 dB maximum average attenuation per connector after test.<br>No observable changes in dimension, color or marking legibility.<br>Ability to mate and unmate shall not be impaired after test. | BPS-C-190, Section 5.6.7.1 and SAE AS13441, Method 1003.1, Test Condition A.<br>With specimens in place in the test chamber, record initial optical transmittance and return loss at ambient. Expose specimens to 5 cycles between -55 and 85˚C with 1 hour dwells at temperature extremes. At a minimum, record optical transmittance at the end of the dwell at each temperature extreme, during all 5 cycles. For information purposes, record return loss at the end of each dwell for at least the first and last cycles, and record optical transmittance readings as often as possible during test. After test, allow specimens to stabilize at ambient conditions prior to recording attenuation and return loss. Unmate and remate connectors and record final attenuation and return loss. Visually examine for any observable changes. |
| Temperature life. | BPS-C-190 Section 4.4.6.2.<br>0.25 dB maximum change in optical transmittance (change from initial) during and after test.<br>0.6 dB maximum attenuation per channel after test.<br>0.4 dB maximum average attenuation per connector after test.<br>No observable changes in dimension, color, or marking legibility.<br>Ability to mate and unmate shall not be impaired after test. | BPS-C-190, Section 5.6.7.2 and TIA/EIA-455-4, except 100˚C for 500 hours. |
| Humidity/temperature cycling. | BPS-C-190, Section 4.4.7.1.<br>0.25 dB maximum change in optical transmittance during test (calculate change from initial).<br>0.6 dB maximum attenuation per channel after test.<br>0.4 dB maximum average attenuation per connector after test.<br>20 dB minimum return loss after test. | BPS-C-190, Section 5.6.8.1 and TIA/EIA-455-5, Method B (with cold shock).<br>Precondition specimens per FOTP-5. Run test for 10 cycles with each cycle being 24 hours duration and consisting of 2 high temperature dwells at 65˚C with 90 to 98% RH and a low temperature dwell at -10˚C with uncontrolled humidity (cold shock applicable to 5 cycles only). |

Figure 2 (continued)

| Test Description | Requirement | Procedure |
|---|---|---|
| Altitude immersion. | BPS-C-190, Section 4.4.7.4.<br>0.25 dB maximum change in optical transmittance per channel after test.<br>No breakage of any component due to altitude immersion exposure. | BPS-C-190, Section 5.6.8.4 and FOTP-15.<br>Record initial optical transmittance and return loss at ambient with specimens in place in the test chamber. Reduce pressure to the equivalent of 50,000 feet altitude, within 5 minutes transition time from room ambient. Maintain for 30 minutes. Record optical transmittance and return loss at least once at high altitude/low pressure (readings more often if possible, for information purposes). Increase pressure back to room ambient within 1 minute transition time, and maintain for 30 minutes. Record optical transmittance and return loss at ambient. This completes 1 cycle. Repeat test 2 more times for a total of 3 cycles. Initial and final optical measurements shall be recorded while specimens are undisturbed and immersed in distilled water in the test chamber. Allow specimens to dry at ambient for 20 to 24 hours or in a circulating air oven at 48.9 ± 2.8˚C for 2 to 3 hours. Visually examine specimens after test. |

**NOTE** *Dimensions and criteria not verified on actual test specimens are covered by First Article approval, which includes comparison of product drawings per requirements specified in BPS-C-190.*

Figure 2 (end)

3.7. Product Qualification Test Sequence

| Test or Examination | Test Group (a) | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| | Test Sequence (b) | | |
| Initial examination of product | 1 | 1 | 1 |
| Initial attenuation, new product | 2,6,8,10,12 | 2,5,8,11 | 2,6 |
| Attenuation, after any test | | | |
| Return loss | | | |
| Connector coupling forces and connector mating durability | 3 | | |
| Terminus retention force (c) | 4,11 | 3,10 | |
| Terminus insertion and removal forces | 5 | 4 | |
| Terminus walk-out (d) | | | 5 |
| Mechanical shock | | 7 | |
| Random vibration | | 6 | |
| Thermal cycling | 7 | | 3 |
| Temperature life | | | 4 |
| Humidity/temperature cycling | | 9 | |
| Altitude immersion | 9 | | |
| Final examination of product | 13 | 12 | 7 |

**NOTE**

*(a) See paragraph 4.1.A.*

*(b) Numbers indicate sequence in which tests are performed.*

*(c) Termini retention force is performed at the start and near the end of Group 1 test sequence for verification of adequate retention force.*

*(d) If steel cable is needed to perform the test, new specimens may be introduced for terminus walk-out test.*

Figure 3

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1. Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable Instruction Sheets and shall be selected at random from current production. Each test group shall consist of a minimum of 5 specimens. A specimen shall consist of a mated pair of 24 position connectors (module and backplane halves) installed with LuxCis terminus per Figure 4.

| Component Description | Test Group | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Backplane connector PN | Tyco 1738965-1 | | |
| Module connector PN | Tyco 1738960-1 | | |
| Cable type and PNs | Tensolite flight cable, 1.8 mm, simplex, fiber optic<br>Tyco 1828395-1<br>Boeing BMS13-71TOCOIGA | | |
| Terminus type and PNs | LuxCis ML<br>Tyco 1828199-1<br>Boeing BACT64A1 | | |
| Test specimens required | 5 | 5 | 5 |

Figure 4

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Figure 3.

### 4.2. Requalification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

### 4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Figure 2. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

### 4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

## 5. SPECIAL INSTRUCTIONS

### 5.1. Cleaning

When a connector specimen is uncoupled during qualification testing, the optical interfaces shall be visually inspected and, if necessary, cleaned per TE recommended cleaning instructions (reference Specification 118-28093) prior to any subsequent optical measurements. If, after cleaning the connectors as prescribed, loss performance exceeds the specified limit, or if the operator suspects the presence of debris at the optical interface, perform the cleaning procedure a second time. If the resultant optical reading still exceeds the specification, clean the interface a third time and accept that reading.

### 5.2. Control Cables

Control cables shall be subjected to climatic environmental tests. Transmittance shall be recorded each time a specimen transmittance is made. Changes in control cable power of less than 0.05 dB may be neglected in the test specimen power and loss calculations. If control cable power changes by more than 0.05 dB during the duration of the test or sequence of tests, change in control cable power should be included in the power and loss calculations per TIA/EIA-455-20A.

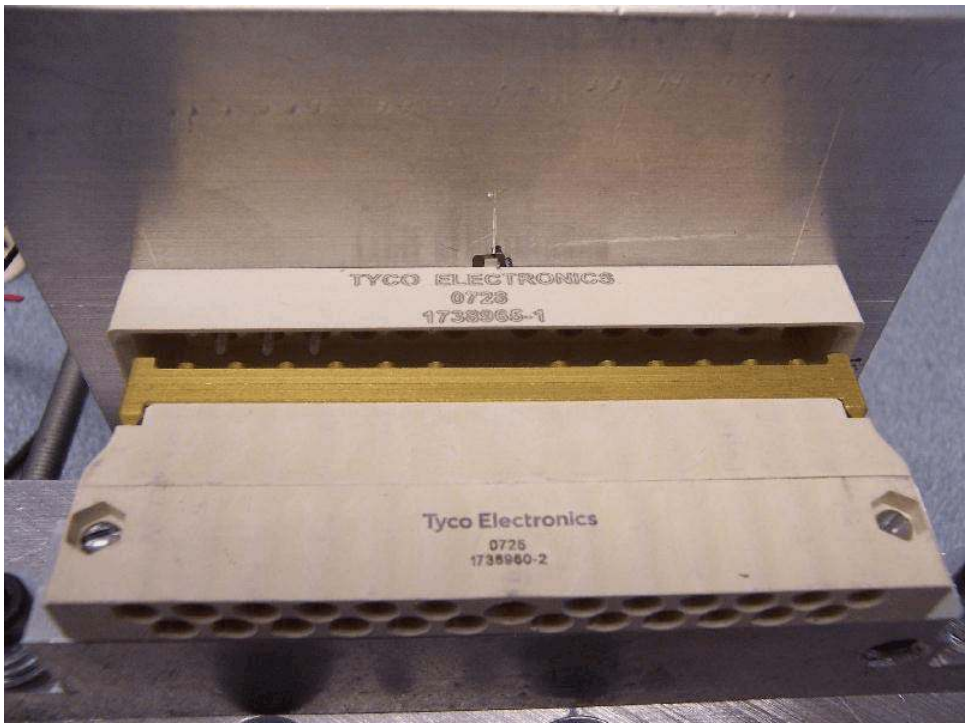


Figure 5
Connector Coupling Fixture

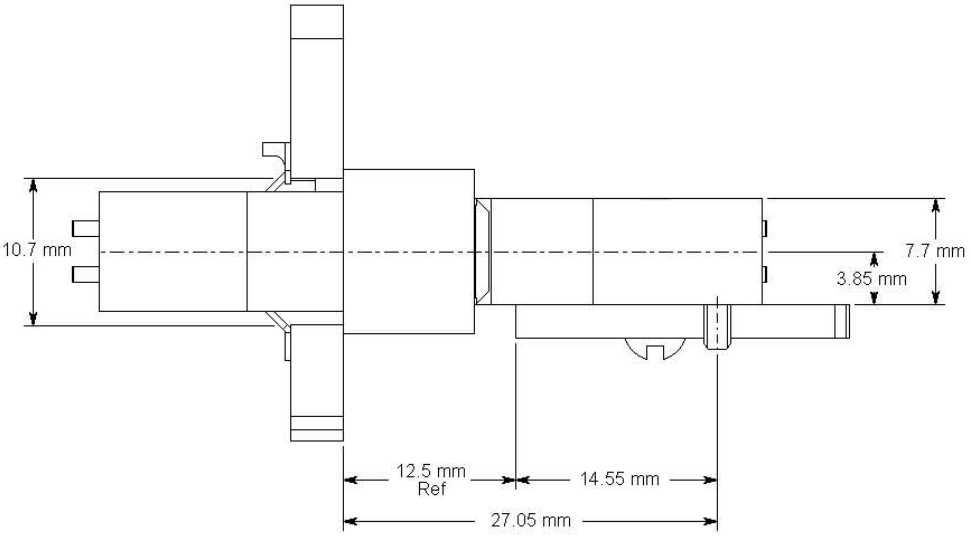


Figure 6
Fully Mated Connectors