

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

1. SCOPE

1.1. Content

This specification covers the performance, tests and quality requirements for the TE Connectivity Optical Expanded Beam Termini, Size 16 (EB16), spring-less and crimp-less single channel single mode fiber. The termini are to be evaluated when mounted into a MIL-DTL-38999 series III style circular connector.

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).

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 the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Documents

408-163020: Instruction Sheet (Termination of Optical Expanded Beam Termini, Size 16, SM)
501-163005: Qualification Test Report (Optical Expanded Beam Termini, Size 16, SM)

2.2. Industry Documents

TIA/EIA-455-B: Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components

2.3. Product drawings

2313255-1: EB16-SM Pin kit
2313256-1: EB16-SM Socket kit

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing. The cable used for thermal testing and cable pull is a 1.8-2.1 mm High Temperature Flight Grade jacketed cable with internal strength members. The cable used for mechanical testing is a 1.8-2.1 mm MIL-Tactical jacketed cable with internal strength members.

3.2. Optical Power Source

The optical power source wavelengths shall be $1310 \pm 30\text{nm}$ and $1550 \pm 30\text{ nm}$ for single mode operation with the exception that all Optical Discontinuity Monitoring (ODM) shall be conducted at $1310 \pm 30\text{ nm}$.

3.3. Ratings

| Performance | Value at 1310 nm | Value at 1550 nm | Units |
|---|------------------|------------------|--------|
| Max. Initial Insertion Loss, Objective (Required) | 1.50 (1.75) | 1.50 (1.75) | dB |
| Min. Return Loss, mated: Objective (Required) | 30 (28) | 30 (28) | dB |
| Storage Temperature | -50 to 100 | | °C |
| Operating Temperature | -65 to 165 | | °C |
| Terminus Durability | 500 | | Cycles |

NOTE 1: See Figure 2 for maximum attenuation and minimum return loss requirements during test.

Figure 1

3.4. 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. All measurements shall be recorded at the two optical wavelengths specified in section 3.2 with the exception noted in section 3. 2.

3.5. Test Requirements and Procedures Summary

| Test Description | Requirement | Procedure |
|--|--|--|
| TEST GROUP 1 | | |
| Visual and Mechanical Inspection | Termini shall meet the requirements of product drawings. | TIA/EIA-455-13. Visual, dimensional and functional per applicable quality inspection plan. |
| Insertion Loss and Return Loss for New Product | Each specimen of the test sample shall meet the optical performance criteria: Max. IL (Required) ≤ 1.75dB Max. IL (Objective) ≤ 1.50dB Min. RL ≥ 28 dB (mated) | TIA/EIA-455-171 and TIA/EIA-455-107. If needed, clean prior to initial measurement and as subsequently permitted per paragraph 5.1. |
| Vibration, Sinusoidal. | Each fiber channel of the test sample shall meet the following optical performance criteria after testing each plane: <u>After any test:</u> Max. IL (Required) ≤ 1.75dB Max. IL (Objective) ≤ 1.50dB Max. Attn. Increase ≤ 0.50dB Min. RL ≥ 28 dB (mated) No optical discontinuities exceeding 0.5dB for more than 1µsec. | TIA/EIA-455-11, Test Condition IV. 10 to 2000 Hz sine motion, except velocity of 10 inch/sec from 10 to 50Hz, 0.06-inch double amplitude from 50 to 140 Hz, and 60g from 140 to 2000 Hz. Conduct 36 sweeps of 20 minutes each, applied in 3 mutually perpendicular axes, for a total test time of approximately 12 hrs (4 hrs for each axis) at ambient temperature. Record optical transmittances before test and after specimens have been tested in each axis. Monitor 6 channels for discontinuities during the test (see Note 1, section 3.7). |

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

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|-----------------------------|---|---|
| Vibration, Random | <p>Each fiber channel of the test sample shall meet the following optical performance criteria after testing each plane:</p> <p><u>After any test:</u></p> <p>Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) No optical discontinuities exceeding 0.5dB for more than 1μsec.</p> | <p>TIA/EIA-455-11, Test Condition VI-J. Test shall be applied for 8 hours in the longitudinal direction and 8 hours in a perpendicular direction for a total of 16 hours.</p> <p>Test temperature shall be ambient, record optical transmittance before test and following the test in each plane. Monitor 6 channels for discontinuities during the test (see Note 1, section 3.7).</p> |
| Mechanical shock | <p>Each fiber channel of the test sample shall meet the following optical performance criteria after testing each plane:</p> <p><u>After any test:</u></p> <p>Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) No optical discontinuities exceeding 0.5dB for more than 1μsec.</p> | <p>TIA/EIA-455-14, Test Condition D 300G, 3 ms half-sine pulse. Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test sample (18 shocks) Record optical transmittance before and after test. Monitor 6 channels for discontinuities during the test (see Note 1, section 3.7).</p> |
| Durability | <p>Each fiber channel of the test sample (1 connector) shall meet the following optical performance criteria:</p> <p><u>After/during test:</u></p> <p>Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated)</p> | <p>TIA/EIA-455-21. Mate and unmate the connectors 500 times at a maximum rate of 250 cycles per hour. Measure insertion loss every 50 cycles. Cleaning is permitted to meet the optical requirements. Cleaning schedule described in paragraph 5-1. Record attenuation immediately before and immediately after cleaning (if cleaning is applied). At the completion of the test, make final IL measurements after cleaning and inspecting (501st cycle)</p> |
| Terminus mate/unmate forces | <p>20 randomly selected samples from the test group shall be tested and meet the following optical performance criteria: Mating force & unmating force $\leq 2.0\text{ lbf}$</p> | <p>Pre-align the pin and socket, measure the insertion force while inserting the pin into the socket with a speed of 6.25 mm/s and stop approx. 0.5mm before solid contact. Pull out the pin from the socket while measuring the force. Each pair shall be measured 3 times and the average force shall be calculated</p> |

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

| TEST GROUP 2 | | |
|--|--|--|
| Visual and Mechanical Inspection | Termini shall meet the requirements of product drawings. | TIA/EIA-455-13. Visual, dimensional and functional per applicable quality inspection plan. |
| Insertion Loss and Return Loss for New Product | Each specimen of the test group shall meet the optical performance criteria: Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-171 and TIA/EIA-455-107. If needed, clean prior to initial measurement and as subsequently permitted per paragraph 5.1. |
| Thermal Cycling - 1 | Each fiber channel of the test group shall meet the following optical performance criteria: <u>After/during test:</u> Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-3, Test Condition C-2. Temp gradient $3^{\circ}\text{C}/\text{min}$. Subject mated specimens to 25 cycles from -55°C to $+125^{\circ}\text{C}$. Dwell 1 hour at every 23°C crossing and at each temperature extreme. Measure IL and RL at least 30 minutes into each dwell. After completion of the final cycle, measure IL and RL within 1 to 2 hours after the chamber returns to ambient conditions, with specimens undisturbed in the test chamber. |
| Thermal Cycling - 2 | Each fiber channel of the test group shall meet the following optical performance criteria: <u>After/during test:</u> Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.75\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-3, Test Condition C-2. Temp gradient $3^{\circ}\text{C}/\text{min}$. Subject mated specimens to 25 cycles from -65°C to $+165^{\circ}\text{C}$. Dwell 1 hour at every 23°C crossing and at each temperature extreme. Measure IL and RL at least 30 minutes into each dwell. After completion of the final cycle, measure IL and RL within 1 to 2 hours after the chamber returns to ambient conditions, with specimens undisturbed in the test chamber. |
| Thermal Shock | Each fiber channel of the test group shall meet the following optical performance criteria: <u>After/during test:</u> Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-71, Schedule C-0 (5 cycles). The high and low soak temperatures shall be $125^{\circ}\text{C} +5^{\circ}\text{C}/-0^{\circ}\text{C}$ and $-55^{\circ}\text{C} +0^{\circ}\text{C}/-5^{\circ}\text{C}$. At the completion of testing, measure final IL and RL and the change 1 to 2 hours after the chamber returns to ambient conditions, with specimens undisturbed in the test chamber. If the transfer is manual, record 3 dry runs prior to actual test. |

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

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|--|--|---|
| Humidity-Temperature cycling | Each fiber channel of the test group shall meet the following optical performance criteria: After/during test: Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-5. Condition the samples in a dry oven for 24 hrs at $50\pm 5^\circ\text{C}$ prior to the test. Perform 10 continuous temp-hum cycles following the profile of Fig.1 of the specification. Record IL and RL before, during and after test. |
| Altitude Immersion | Each fiber channel on three (3) connector samples shall be tested and meet the following optical performance criteria: After/during test: Max. Attn. Increase $\leq 0.50\text{dB}$ | TIA/EIA-455-15 Samples shall be tested in accordance with TIA-455-15. Termini shall be installed in new connectors and tested at a minimum pressure equivalent to an altitude of 15,200 m (50,000 ft.). Record IL and RL changes during and after test. |
| TEST GROUP 3 | | |
| Visual and Mechanical Inspection | Termini shall meet the requirements of product drawings. | TIA/EIA-455-13. Visual, dimensional and functional per applicable quality inspection plan. |
| Insertion Loss and Return Loss for New Product | Each specimen of the test group shall meet the optical performance criteria: Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) | TIA/EIA-455-171 and TIA/EIA-455-107. If needed, clean prior to initial measurement and as subsequently permitted per paragraph 5.1. |
| Cable Pull Force | 16 samples (pin and sockets) mounted in mated connectors using the Flight Grade cable shall meet the following optical performance criteria: <u>After test:</u> Max. IL (Required) $\leq 1.75\text{dB}$ Max. IL (Objective) $\leq 1.50\text{dB}$ Max. Attn. Increase $\leq 0.50\text{dB}$ Min. RL $\geq 28\text{ dB}$ (mated) No physical damage | Guidance from TIA-455-6-B, SAE AS13441 and MIL-PRF-29504 Wrap cable of one specimen around a 3-inch mandrel weight hanger at a point 12 inches from the rear of the connector. Apply a load to the contact of 53.4N [12 lbf] gradually without sudden impulses for a period of 1 minutes and monitor the before/after loss change after load removal. Repeat the test with a 66.7N [15 lbf] load. After completion, do a physical and visual examination of the termini in accordance with TIA/EIA-455-13. |

Figure 2 (end)

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

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3.7. Product Qualification Test Sequence

| Test | Test Group 1 | Test Group 2 | Test Group 3 |
|---|--------------|--------------|--------------|
| Examination of Product | 1 | 1 | 1 |
| IL & RL | 2, 6 | 2, 7 | 2, 4 |
| Vibration, Sinusoidal <small>(see note 1)</small> | 3 | | |
| Vibration, Rand <small>(see note 1)</small> | 4 | | |
| Mechanical Shock <small>(see note 1)</small> | 5 | | |
| Mating Durability <small>(see note 2)</small> | 7 | | |
| Terminus Mate/Unmate <small>(see note 3)</small> | 8 | | |
| Thermal Cycling - 1 | | 3 | |
| Thermal Cycling - 2 | | 4 | |
| Thermal Shock | | 5 | |
| Humidity - Temperature Cycling | | 6 | |
| Altitude Immersion | | 8 | |
| Cable Pull Out Force | | | 3 |

Figure 3

All testing is performed at both 1310nm and 1550nm where possible.

Note 1: The Group 1 (GR1) paths signal continuity is monitored throughout the Vibration and Mechanical Shock testing. For test of individual connectors, 6 random channels per connector shall be monitored for discontinuities. Only wavelength $1310 \pm 30\text{nm}$ is applicable during this test.

Note 2: Perform testing on one connector sample.

Note 3: The force to mate/unmate of the termini are measured on individual samples external to the connectors

3.8 Cable assemblies in each Group

(Lay-out is shown in Figure 6)

| SINGLE MODE | Group # | Qty | Connector | Terminus - Connector | Paths Qty |
|----------------|---------------|-----|----------------|----------------------|-----------|
| Cable Assembly | #1 | 5 | D38999/26WE8AN | EB16-SM Pin to LC | 40 |
| | Environmental | 5 | D38999/24WE8BN | EB16-SM Sock to LC | |
| Cable Assembly | #2 | 5 | D38999/26WE8AN | EB16-SM Pin to LC | 40 |
| | Mechanical | 5 | D38999/24WE8BN | EB16-SM Sock to LC | |
| Cable Assembly | #3 | 2 | D38999/26WE8AN | EB16-SM Pin to LC | 16 |
| | Mechanical | 2 | D38999/24WE8BN | EB16-SM Sock to LC | |
| Control Cable | #1 Environm. | 1 | NA | SC/APC to SC/APC | 1 |

Figure 4

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

Specimen Selection

| | | |
|--|-----------|----------------|
| EB16-SM Pin to LC, SM Flight Cable, 1.8mm | 3 meters | 2348128-1 |
| EB16-SM Socket to LC, SM Flight Cable, 1.8mm | 3 meters | 2348129-1 |
| SC/APC to LC jumper, SM Mil-Tactical Cable, 1.8mm | 3 meters | 2348221-1 |
| EB16-SM Pin to SC/APC, SM Mil-Tactical Cable, 1.8mm | 7 meters | 2348131-1 |
| EB16-SM Socket to SC/APC, SM Mil-Tactical Cable, 1.8mm | 7 meters | 2348132-1 |
| SC/APC to SC/APC, SM Flight Cable, 1.8mm | 12 meters | 2348226-1 |
| D38999 Plug, Size 17, 8 pos Pin insert | NA | D38999/26WE8AN |
| D38999 Rcpt, Size 17, 8 pos Socket insert | NA | D38999/24WE8BN |

Figure 5

4.2. Requalification Testing

If changes significantly affecting form, fit or functions 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. When product failure occurs, corrective action shall be taken, and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmitted.

4.4. Quality Conformance Inspection

The applicable quality inspection plan will 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

Cleaning shall be performed prior to initial attenuation measurements and any time a connector specimen is uncoupled during qualification testing. The lenses and mating face are to be cleaned per the procedures of TE Instruction Sheet specification 408-163020. If, after cleaning the connector as prescribed, loss performance exceeds the specified limit, or, if the operator suspects the presence of debris at the optical or mechanical 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.

Cleaning is permitted between any two tests.

Optical Expanded Beam Termini, Size 16, spring-less and crimp-less, SM Fiber for MIL-DTL-38999 series III Style Connector

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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 shall be included in power and loss calculations per TIA/EIA-455-20.

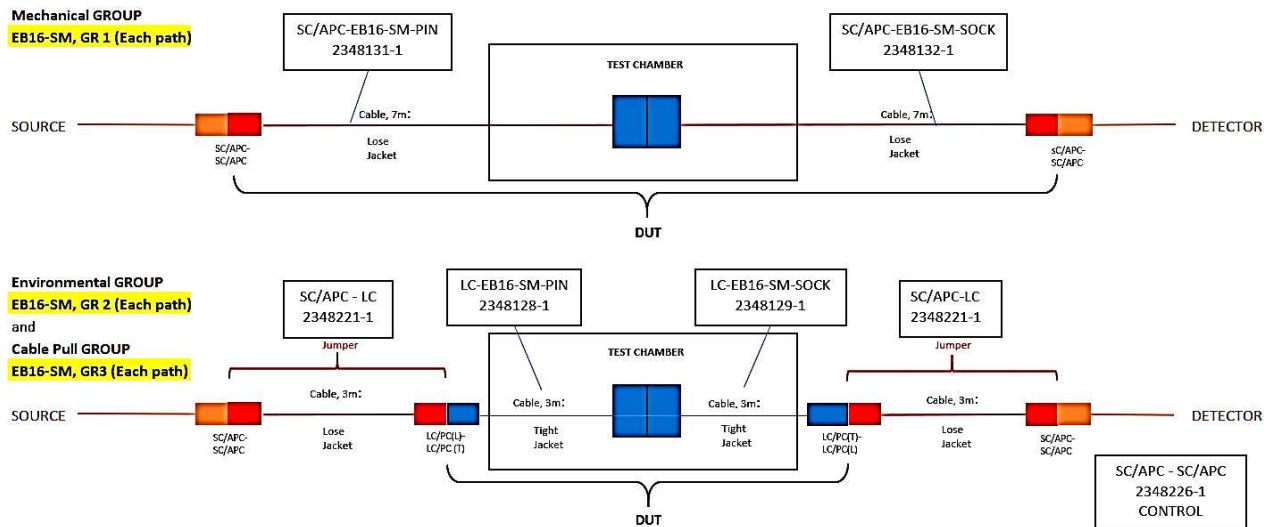


Figure 6