Singlemode SC Fiber Optic Connector

1. INTRODUCTION

1.1. Purpose

Testing was performed on CS Electronics singlemode SC fiber optic connectors to determine their conformance to the requirements of the Optical Fiber Cabling Components Standard TIA/EIA-568-B.3.

1.2. Scope

This report covers the optical and mechanical performance of singlemode SC fiber optic connectors terminated to 900 µm buffered fiber. Cable assemblies were manufactured by CS Electronics, Fiber Optics Business Unit. Testing was performed between 28Sep04 and 01Nov04. The test file number for this testing is B044363-002.

1.3. Conclusion

Singlemode SC fiber optic connectors, listed in paragraph 1.5, meet the optical and mechanical performance requirements of the Optical Fiber Cabling Components Standard, TIA/EIA-568-B.3, when two simplex connectors are fastened together to form a duplex connector. Strength of Coupling Mechanism is assumed to be qualified by similarity to the multimode SC connector terminated to 1.6 mm jacketed cable (reference CS Electronics test number B044363-001, containing TIA/EIA-568-B.3 test results). Environmental performance is assumed to be qualified by similarity to the singlemode SC connector terminated to 1.6 mm jacketed cable (reference CS Electronics Qualification Test Report 501-584, containing GR-326-CORE test results).

1.4. Product Description

CS Electronics SC fiber optic cable assemblies consist of a simplex SC connector on each end of singlemode 900 µm buffered fiber. Two simplex cable assemblies are joined by fastening the connectors with a clip to form a duplex connector pair. These cable assemblies are used in data communication and telecommunications networks and equipment.

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1.5. Test Specimens

Test specimens were manufactured using normal production means. Each cable assembly was cut in the center of the length of cable and fiber ends attached to the measurement equipment. Connectors from two simplex pigtails were fastened together to form a duplex connector. Two duplex connectors were mated to form a specimen.

Test Group	1	2
Fiber size: (microns/microns)	9/125	
Cable Type	900 μm buffered fiber	
Cable Assembly PN	1754705-1 (see Note (b))	
Connector Type (see Note (a))	Simplex SC	
Coupling Receptacle PN	1374223-1	
Test Specimens Required (see Note)	8 (Duplex)	
Control Cable Required	No	

NOTE

(a) A quantity of 16 SM Simplex SC cable assemblies were used to form 8 duplex test specimens.

(b) Test Group 1 specimens had boot PN 1457493-5, and Test Group 2 specimens contained boot PN 1278309-1.

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)	
	1	2(b)
	Test Sequence ©)	
Visual and mechanical inspection	1	1
Attenuation (insertion loss)	2	2
Return loss	3	3
Cable retention, 0 degrees	4	
Cable retention, 90 degrees	5	
Twist	6	
Impact	7	
Durability	8	
Flex		4

NOTE

(a) See paragraph 1.5.
(b) Group 2 specimens were reused from Group 1, and therefore had already been exposed to Group 1 tests.
(c) Numbers indicate sequence in which tests are performed.
(d) Strength of coupling mechanism test was not performed since this test was satisfactorily performed on multimode SC connectors terminated to 1.6 mm jacketed cable in CS Electronics test number B044363-001. Therefore, singlemode product is assumed to also meet requirements of the strength of coupling mechanism test.

2. SUMMARY OF TESTING

2.1. Visual and Mechanical Inspection

All specimens submitted for testing were manufactured by CS Electronics, and were inspected and accepted by the Product Assurance Department of the Fiber Optics Business Unit. Specimens are assumed to be compliant with FOCIS dimensions per CS Electronics First Article approval, which includes verification of product drawings per the dimensions specified in TIA/EIA-604-3A.

2.2. Initial Optical Performance

All attenuation and return loss measurements met the specification requirements. Attenuation and return loss were measured at both 1310 and 1550 nm wavelengths for all tests.

Attenuation (Insertion Loss) and Return Loss - Requirements for New Product (dB)

Performance Requirements	1310 nm	1550 nm
Maximum allowed attenuation for any individual specimen	0.75	0.75
Minimum allowed return loss for any individual specimen	26	26

Attenuation (Insertion Loss) and Return Loss - Actual for New Product (dB)

Test Group	Fiber Type	Maximum and Median Attenuation Values		Minimum and Median Return Loss Values	
		1310 nm	1550 nm	1310 nm	1550 nm
1	Singlemode	0.35 Max 0.13 Med	0.25 Max 0.11 Med	53 Min 56 Med	54 Min 57 Med
2	Singlemode	0.63 Max 0.13 Med	0.49 Max 0.11 Med	53 Max 56 Med	54 Max 56 Med

NOTE

Group 2 specimens were sourced from Group 1, therefore Group 2 data are not from unique specimens.

2.3. Attenuation, Attenuation Increase and Return Loss

All attenuation, attenuation increase and return loss measurements met the specification requirements. All measurements were recorded at 1310 and 1550 nm for 9/125 μm fiber size. Values shown in the table below represent maximum attenuation, maximum attenuation increase and minimum return loss.

Attenuation, Attenuation Increase and Return Loss Results (dB)

Test Group	Condition	Requirements		Actual (1310 nm)		Actual (1550 nm)	
		Before	After	Before	After	Before	After
		IL	IL, IL↑, RL	IL	IL, IL↑, RL	IL	IL, IL↑, RL
	Cable retention, 0 degrees			0.36	0.33 (IL) 0.03 (IL↑) 53 (RL)	0.27	0.23 (IL) 0.04 (IL↑) 53 (RL)
	Cable retention, 90 degrees		0.75 (IL) 0.5 (IL↑) 26 (RL)	0.33	0.33 (IL) 0.01(IL↑) 53 (RL)	0.23	0.23 (IL) 0.01 (IL↑) 53 (RL)
	Twist			0.33	0.33 (IL) 53 (RL)	0.23	0.23 (IL) 53 (RL)
	Impact			0.27	0.27 (IL) 52 (RL)	0.20	0.20 (IL) 53 (RL)
1	Durability			0.32	0.37 (IL) 51 (RL)	0.22	0.22 (IL) 50 (RL)
2	Cable flexing	0.75	0.75 (IL) 26 (RL)	0.68	0.66 (IL) 53 (RL)	0.51	0.59 (IL) 55(RL)

NOTE

(IL) - Insertion Loss (Attenuation)
(IL↑) - Insertion Loss (Attenuation) Increase
(RL) - Return Loss

2.4. Cable Retention, 0 Degrees

There was no evidence of fiber pullout, or other damage to the connector or fiber and no change in optical performance beyond the specified limits after cable retention test. Optical performance was measured at 1310 and 1550 nm.

2.5. Cable Retention, 90 Degrees

There was no evidence of fiber pullout, or other damage to the connector or fiber and no change in optical performance beyond the specified limits after side pull test. Optical performance was measured at 1310 and 1550 nm.

2.6. Twist

There was no evidence of physical damage to the connector or fiber. Attenuation and return loss measurements met the specified limits before and after twist test. Optical performance was measured at 1310 and 1550 nm.

2.7. Impact

There was no evidence of physical damage to the connector. Attenuation and return loss measurements met the specified limits before and after impact test. Optical performance was measured at 1310 and 1550 nm.

2.8. Durability

There was no evidence of physical damage to the connectors. Attenuation and return loss measurements met the specified limits before and after durability test. Optical performance was measured at 1310 and 1550 nm.

2.9. Flex

There was no evidence of physical damage to the connector or fiber. Attenuation and return loss measurements met the specified limits before and after flex test. Optical performance was measured at 1310 and 1550 nm.

3. TEST METHODS

The singlemode measurement system consisted of FOTP-20 compliant test equipment. Initial specimen installation was performed according to FOTP-171, Method D3 procedures. Following the installation of the specimens, the sequential testing was performed.

3.1. Visual and Mechanical Inspection

Product drawings and inspection plans were used to examine the specimens. They were examined visually and functionally.

3.2. Attenuation (Insertion Loss)

All singlemode attenuation was measured in accordance with TIA/EIA-455-171A, Method D3 processes, except that the launch was part of the specimen under test and was not reference quality. The initial optical power through each launch (plug) connector fiber path was measured. The connector assembly was then mated and optical power measured from the receive side fiber. Attenuation was calculated by taking the difference between these two measurements. The receive fiber was then spliced to a test lead attached to the optical test equipment. Optical power readings were compensated by changes in a source monitor cable.

3.3. Attenuation Increase

Increase in attenuation was calculated by taking the difference between the initial measurement and the measurement after each test. Attenuation increase represents a change in attenuation that results from a decrease in optical power (degraded performance). Optical power readings were compensated by changes in the source monitor cable.

3.4. Return Loss

Return loss was measured in accordance with TIA/EIA-455-107A, Method A. A single measurement was recorded for return loss. Return loss was measured initially and after each test evaluation.

3.5. Cable Retention, 0 Degrees

Duplex specimens were subjected to a sustained load of 2.2 N [.5 lbf] for 5 seconds. An adapter was secured to the test fixture. The tensile load was manually applied by wrapping the buffered fiber around a 7.5 cm [3 in] diameter mandrel at a point 25 cm [10 in] from the boot. Optical performance was measured before and after test with the load removed.

3.6. Cable Retention, 90 Degrees

Duplex specimens were subjected to a sustained load of 2.2 N [.5 lbf] for 5 seconds. An adapter was secured to the test fixture. The load was manually applied at a 90 degree pull angle by wrapping the buffered fiber around a 7.5 cm [3 in] diameter mandrel at a point 25 cm [10 in] from the boot. Optical performance was measured before and after test with the load removed.

3.7. Twist

Duplex specimens were subjected to 10 cycles of twist. Specimens were tested at a rate of approximately 3 cycles per minute. A 7.5 cm [3 in] diameter mandrel was used to apply a tensile load of 2.2 N [.5 lbf] to buffered fiber at a point 25 cm [10 in] from the boot. The twist motion for each cycle was ± 2.5 revolutions about the axis of the fiber. Optical performance was measured before and after test with the load removed.

3.8. Impact

An unmated duplex connector was dropped from a height of 1.8 m [70.9 in] onto a concrete slab. A ferrule cap was used to protect the fiber endface. The impact exposure was repeated 8 times. Initial optical performance was recorded before the specimen was unmated and exposed to testing. After completion of the 8 impacts, each connector was inspected, cleaned and re-mated before recording final optical measurements.

3.9. Durability

The duplex connector on one end of each mated specimen was subjected to 500 cycles of durability. Specimens were manually cycled at a rate not in excess of 300 cycles per hour. The connector and adapter were cleaned every 25 cycles during test. Attenuation and return loss were measured before and after test. Specimens were unmated, cleaned, inspected, and re-mated before final optical measurements.

3.10. Cable Flexing

Duplex specimens were subjected to 100 cycles of fiber flexing. Specimens were tested at a rate of 15 cycles per minute. A 7.5 cm [3 in] mandrel was used to apply a tensile load of 224 g [.5 lbf] to buffered fiber at a point 25 cm [10 in] from the boot. The flex arc was ± 90 degrees from a vertical position. Optical performance was measured before and after test with the load removed. Final measurements were recorded after specimens were cleaned and re-mated.