Multimode SC Duplex Fiber Optic Connectors

1. INTRODUCTION

1.1. Purpose

Testing was performed on Tyco Electronics multimode SC duplex fiber optic connectors to determine their conformance to the requirements of the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3.

1.2. Scope

This report covers the optical and mechanical performance of multimode SC duplex fiber optic connectors terminated to 3.0 mm jacketed cable. Cable assemblies were manufactured by Tyco Electronics, Fiber Optics Business Unit. Testing was performed between 19Jan05 and 13Nov06. The test file numbers for this testing are B044363-006 and 7260-001.

1.3. Conclusion

The multimode SC duplex fiber optic connectors, listed in paragraph 1.5, meet the optical and mechanical performance requirements of the Optical Fiber Cabling Components Standard, ANSI/TIA-568-C.3. Environmental performance is assumed to be qualified by similarity to the multimode SC connector terminated to 1.6 mm jacketed cable (reference Tyco Electronics Qualification Test Report 501-603, containing ANSI/TIA-568-C.3. test results).

1.4. Product Description

The Tyco Electronics SC fiber optic cable assemblies consist of duplex SC connectors on each end of 3.0 mm jacketed, riser-rated cable. These cable assemblies are used in data communication and telecommunications networks and equipment.

1.5. Test Specimens

Test specimens were manufactured using normal production means. Specimens consisted of two cable assemblies mated to form a connector pair, and the following supplies outlined below.

Test Group	1
Fiber size: (microns/microns)	50/125
Cable Type	3.0 mm Riser
Cable Assembly PN (See Note)	1754974-1
Connector Type	Duplex SC
Coupling Receptacle PN	1278049-4
Test Specimens Required	8 (Duplex)
Control Cable Required	No

NOTE *Two duplex SC cable assemblies and one duplex SC adapter were used to form one mated connector pair (test specimen).*

* Trademark
| Indicates change

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)
	1
	Test Sequence (b)
Visual and mechanical inspection	1
Attenuation (insertion loss)	2
Return loss	3
Cable retention, 0 degrees	4
Cable retention, 90 degrees	5
Flex	6
Twist	7
Impact	8
Durability	9
Strength of coupling mechanism	(c)

NOTE

(a) See paragraph 1.5.

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

(c) Strength of coupling mechanism test was not performed since this test was satisfactorily completed in Tyco Electronics test numbers B044363-001 and 7260-001. Therefore, SC adapters and multimode connectors terminated to 3.0 mm cable are 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 Tyco 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 from Tyco 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 850 and 1300 nm wavelengths.

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

Performance Requirements	Multimode Product	
	850 nm	1300 nm
Maximum allowed attenuation for any individual specimen	0.75	0.75
Minimum allowed return loss for any individual specimen	20	20

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	
		850 nm	1300 nm	850 nm	1300 nm
1	Multimode	0.14 Max 0.09 Med	0.09 Max 0.05 Med	29.3 Min 31.5 Med	31.5 Min 33.6 Med

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 850 and 1300 nm for 50/125 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 (850 and 1300 nm)		Actual (850 nm)		Actual (1300 nm)	
		Before	After	Before	After	Before	After
		IL	IL,IL↑,RL	IL	IL,IL↑,RL	IL	IL,IL↑,RL
1	Cable retention, 0 degrees	0.75	0.75 (IL) 0.5 (IL↑) 20 (RL)	0.21	0.23 (IL) 0.02 (IL↑) 29.3 (RL)	0.17	0.19 (IL) 0.02 (IL↑) 31.4 (RL)
	Cable retention, 90 degrees			0.23	0.24 (IL) 0.01 (IL↑) 29.3 (RL)	0.19	0.20 (IL) 0.01 (IL↑) 31.2 (RL)
	Cable flexing		0.75 (IL) 20 (RL)	0.24	0.24 (IL) 29.3 (RL)	0.20	0.20 (IL) 31.2 (RL)
	Twist			0.24	0.24 (IL) 29.3 (RL)	0.20	0.20 (IL) 31.2 (RL)
	Impact			0.19	0.31 (IL) 29.3 (RL)	0.15	0.14 (IL) 31.4 (RL)
	Durability			0.20	0.32 (IL) 30.2 (RL)	0.16	0.12 (IL) 32.4 (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 jacket pullout, or other damage to the connector or cable and no change in optical performance beyond the specified limits after cable retention test. Optical performance was measured at 850 and 1300 nm.

2.5. Cable Retention, 90 Degrees

There was no evidence of jacket pullout, or other damage to the connector or cable and no change in optical performance beyond the specified limits after side pull test. Optical performance was measured at 850 and 1300 nm.

2.6. Flex

There was no evidence of physical damage to the connector or cable. Attenuation and return loss measurements met the specified limits before and after flex test. Optical performance was measured at 850 and 1300 nm.

2.7. Twist

There was no evidence of physical damage to the connector or cable. Attenuation and return loss measurements met the specified limits before and after twist test. Optical performance was measured at 850 and 1300 nm.

2.8. Impact

There was no physical damage to the connector that affected optical performance. Attenuation and return loss measurements met the specified limits before and after impact test. Optical performance was measured at 850 and 1300 nm.

2.9. Durability

There was no physical damage to the connectors that affected optical performance. Attenuation and return loss measurements met the specified limits before and after durability test. Optical performance was measured at 850 and 1300 nm.

3. TEST METHODS

The multimode environmental facility is an automated, FOTP-20 compliant test system with initial specimen installation performed according to FOTP-171 processes. 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 multimode attenuation was measured in accordance with FOTP-171, method D1 processes, except that the launch was part of the specimen under test and was not reference quality. The initial optical power through each launch connector fiber path was measured. The connector assembly was then mated and optical power measured from the receive side cable assembly. Attenuation was calculated by taking the difference between these two measurements. The receive side cable assembly was then mated to a test lead which 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 FOTP-107A. 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 50 N [11.24 lbf] for a minimum of 5 seconds. An adapter was secured to the test fixture. The tensile load was manually applied by wrapping the jacketed cable around a 7.5 cm [3 in] diameter mandrel at a point 23 cm [9 in] from the connector. 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 19.4 N [4.4 lbf] for a minimum of 5 seconds. An adapter was secured to the test fixture. The load was manually applied at a 90 degree pull angle by wrapping the jacketed cable around a 7.5 cm [3 in] diameter mandrel at a point 23 cm [9 in] from the connector. Optical performance was measured before and after test with the load removed.

3.7. 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 0.5 Kg [1.1 lbf] to jacketed cable at a point approximately 23 cm [9 in] from the connector. The flex arc was ± 90 degrees from a vertical position. Optical performance was measured before and after test with the load removed.

3.8. Twist

Duplex specimens were subjected to 10 cycles of twist. Specimens were tested at a rate less than 30 cycles per minute. A 7.5 cm [3 in] diameter mandrel was used to apply a tensile load of 15 N [3.4 lbf] to jacketed cable at a point approximately 23 cm [9 in] from the connector. 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.

3.9. Impact

An unmated duplex connector assembly was dropped in random orientations from a height of 1.8 m [70.9 in] onto a concrete slab. 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.

3.10. 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 as specified every 25 cycles during test. Optical performance was measured before and after test. Specimens were unmated, cleaned, inspected, and re-mated before final optical measurements.