LC SECURE Fiber Optic Connector and Adapter

1. INTRODUCTION

1.1. Purpose

Testing was performed on Tyco Electronics LC SECURE, multimode, fiber optic connectors and adapters to confirm that the addition of keying geometries have not affected the connector or adapter's ability to conform 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 LC SECURE, multimode, fiber optic connectors terminated to 1.8 mm jacketed 50/125 µm cable, and LC SECURE adapters. Cable assemblies and adapters were manufactured by Tyco Electronics, Fiber Optics Business Unit. Testing | was performed between 23Jan06 and 28Aug06. The test file numbers for this testing are B071178-002 | and B071178-005.

1.3. Conclusion

The LC SECURE, multimode, fiber optic connectors terminated to 1.8 mm jacketed cable and LC SECURE adapters (described 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. Product was subjected to a subset of mechanical tests as specified in paragraph 1.6. Environmental performance and remaining mechanical tests are assumed to be qualified by similarity to the standard multimode LC connector and duplex LC adapter. Refer to Tyco Electronics Qualification Test Report 501-628, containing full TIA/EIA-568-B.3 test results.

The following additional keying configurations/colors are assumed to be qualified by similarity to the | parts tested, since they are comprised of the same keying geometries in a different orientation.

LC SECURE Connectors	LC SECURE Adapters
• 1828078-2 (yellow)	• 1828074-2 (yellow)
• 1828078-3 (green)	• 1828074-3 (green)
• 1828078-4 (blue)	• 1828074-4 (blue)
• 1828078-6 (aqua)	• 1828074-6 (aqua)
• 1828078-7 (brown)	• 1828074-7 (brown)
• 1828078-8 (violet)	• 1828074-8 (violet)
• 1-1828078-0 (slate)	• 1-1828074-0 (slate)

LC SECURE connectors terminated to cable with 62.5/125 µm fiber size are assumed to be qualified by similarity to performance of LC SECURE connectors terminated to cable with 50/125 µm fiber size.

1.4. Product Description

The Tyco Electronics LC SECURE fiber optic cable assemblies consist of two LC SECURE simplex connectors (fastened with a clip to form a duplex connector) on one end of 1.8 mm jacketed, 50/125 µm, OFNP zipcord cable, and dual FC connectors on the other end for attachment to optical measurement equipment. LC SECURE fiber optic connectors and cable assemblies are used in data communication and telecommunications networks and equipment.

* Trademark
| Indicates change

LC SECURE connectors are available in ten keys and ten colors - four standard colors and six additional colors. The LC SECURE product provides assured safety and protection against unwanted intrusion. The chance of improper interconnections between networks can be minimized when multiple networks in a common area are segregated by colors.

LC SECURE connectors and adapters will not mate with non-matching colors or with standard LC connectors and adapters.

1.5. Test Specimens

Test specimens were manufactured using normal production means. Specimens consisted of a duplex LC SECURE cable assembly mated to a universal LC duplex cable assembly using a duplex LC SECURE adapter to form a duplex connector pair. Part numbers are shown in the table below.

Component Description	Test Group	
	1	2
Fiber size: (microns/microns)	50/125	
Cable Type	1.8 mm OFNP Zipcord	
Cable Assembly PN, see Note (a)	1918192-5 (red) 1918193-5 (rose) 1918194-5 (orange)	
Connector Type, see Note (b)	Simplex LC SECURE	
Coupling Receptacle PN	1828074-1 (red) 1828074-5 (rose) 1828074-9 (orange)	
Adapter Type	Duplex LC SECURE	
Test Lead Cable Assembly PN	1918195-5 (black/universal)	
Test Specimens Required, see Note (c)	12 (duplex)	12 (duplex)
Control Cable Required	No	No

NOTE

(a) A cable assembly consists of two simplex LC SECURE connectors, PN 1828078-1 (red), 1828078-5 (rose), or PN 1828078-9 (orange), terminated to cable PN 1-1828844-2.

(b) Two LC SECURE simplex connectors are fastened together with LC duplex clip PN 1754371-1 to form a duplex specimen.

(c) Two duplex cable assemblies (LC SECURE and universal LC) and one duplex LC SECURE adapter were used to form one mated connector pair (test specimen). A quantity of 4 specimens, from each of three different secure keying configurations, were subjected to the test sequence in each group.

1.6. Qualification Test Sequence

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

NOTE

(a) See paragraph 1.5.
(b) Numbers indicate sequence in which tests are performed.
(c) A subset of mechanical tests were chosen to validate the secure features of the connector. Remaining tests from TIA/EIA-568-B.3 are assumed to be qualified by similarity to standard product. Refer to paragraph 1.3.

2. SUMMARY OF TESTING

2.1. Visual and Mechanical Inspection - All Test Groups

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. Areas not impacted by keying geometries are assumed to be compliant with FOCIS dimensions from Tyco Electronics First Article approval, which included verification of product drawings per the dimensions specified in TIA/EIA-604-10A.

2.2. Initial Optical Performance - All Test Groups

All attenuation and return loss measurements met the specification requirements. Attenuation and return loss were measured at 850 and 1300 nm wavelengths for all test groups.

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

Performance Requirements	Test Groups (1-2)	
	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	Maximum and Median Attenuation Values		Minimum and Median Return Loss Values	
	850 nm	1300 nm	850 nm	1300 nm
1	0.08 Max 0.02 Med	0.06 Max 0.01 Med	28 Min 30 Med	30 Min 31 Med
2	0.23 Max 0.04 Med	0.18 Max 0.02 Med	28 Min 30 Med	30 Min 31 Med

2.3. Attenuation, Attenuation Increase and Return Loss - All Test Groups

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	Strength of coupling mechanism	0.75	0.75 (IL) 20 (RL)	0.09	0.07 (IL) 29 (RL)	0.06	0.05 (IL) 30 (RL)
	Cable retention, 90 degrees		0.75 (IL) 0.5 (IL↑) 20 (RL)	0.13	0.14 (IL) 0.02 (IL↑) 28 (RL)	0.10	0.12 (IL) 0.02 (IL↑) 29 (RL)
	Cable flexing		0.75 (IL) 20 (RL)	0.14	0.14 (IL) 28 (RL)	0.13	0.13 (IL) 30 (RL)
2	Impact	0.75	0.75 (IL) 20 (RL)	018	0.18 (IL) 29 (RL)	0.19	0.21 (IL) 30 (RL)
	Durability			0.17	0.19 (IL) 29 (RL)	0.23	0.27 (IL) 31 (RL)

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

2.4. Strength of Coupling Mechanism - Test Group 1

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

2.5. Cable Retention, 90 Degrees - Test Group 1

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 - Test Group 1

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. Impact - Test Group 2

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

2.8. Durability - Test Group 2

There was no evidence of physical damage to the connectors or adapter. 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

Initial optical measurements were obtained using manually operated FOTP-20 compliant test equipment.

For mechanical tests, an automated, FOTP-20 compliant test system with initial specimen installation performed according to FOTP-171 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 multimode attenuation was measured in accordance with FOTP-171A, 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 connected to the optical test equipment. Optical power was recorded as a reference to calculate change in attenuation during/after subsequent tests. 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. Strength of Coupling Mechanism

A duplex LC SECURE connector was mated to a duplex LC SECURE adapter which was attached to the test fixture. A 33 N [7.4 lbf] tensile load was applied at a rate of approximately 25.4 mm [1 in] per minute to the coupling mechanism by using a cord wrapped around the duplex connector clip. The load was sustained for a minimum of 5 seconds. Optical performance was measured before and after test with the load removed.

3.6. Cable Retention, 90 degrees

Duplex LC SECURE specimens were subjected to a sustained load of 19.4 N [4.4 lbf] for a minimum of 5 seconds. A duplex LC SECURE adapter was mounted 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 approximately 25.4 cm [10 in] from the connector. Optical performance was measured before and after test with the load removed.

3.7. Cable Flexing

Duplex LC SECURE specimens were subjected to 100 cycles of fiber flexing. Specimens were tested at a rate of 15 cycles per minute. A mandrel was used to apply a tensile load of 0.5 Kg [1.1 lbf] to jacketed cable at a point approximately 25.4 cm [10 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. Impact

An unmated, duplex, LC SECURE connector assembly (with protective cap over the ferrule) 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.

3.9. Durability

A duplex LC SECURE connector was removed from and reinserted into a duplex LC SECURE adapter to complete one cycle. Each 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.