LC Duplex Adapter For LC Cutouts

1. INTRODUCTION

1.1. Purpose

| Testing was performed on Tyco Electronics LC Duplex Adapters for LC Cutouts, to determine their conformance to Tyco Electronics Product Specification 108-2358, which contains a subset of tests from the small form factor connector requirements specified in Telcordia Technologies Specification GR-326-CORE, Issue 3, General Requirements for Singlemode Optical Connectors and Jumper Assemblies.

1.2. Scope

This report covers the optical and mechanical performance of singlemode LC Duplex Adapter for LC Cutouts manufactured by Tyco Electronics, Fiber Optics Business Unit. Testing was performed between March 2008 and May 2008. The test file number for this testing is B090701-002

1.3. Conclusion

| The LC Duplex Sr-Jr Singlemode Adapters for LC Cutouts, listed in paragraph 1.5, meet the requirements of Tyco Electronics Product Specification 108-2358 and the optical and mechanical small form factor performance requirements at 1310 and 1550 nm wavelengths for the tests listed in Figure 2, which are a subset of Telcordia Technologies GR-326-CORE, Issue 3.

| LC Duplex Sr-Sr Adapters for LC Cutout are assumed to be qualified by similarity to LC Duplex Sr-Jr Adapters for LC Cutout.

| LC Duplex Multimode Adapters for LC Cutout are assumed to be qualified by similarity to LC Duplex Singlemode Adapters for LC Cutout.

1.4. Product Description

Tyco Electronics LC Duplex Adapters are used with panels with LC Cutouts to mount and connect LC fiber optic connectors used in data communication and telecommunication networks and equipment.

1.5. Test Specimens

Test specimens were manufactured using standard manufacturing processes and are representative of current production. A specimen consisted of one channel of a single Sr/Jr LC Duplex Adapter. Two reference quality test leads, LC to FC/APC, were connected to either channel A or channel B of the adapter. The transmit test leads were connected to the Jr.-side of the adapter and the receive test leads were connected to the Sr.-side of the adapter.

Component Description	Test Group 1
Adapter Type	LC Duplex Sr/Jr Singlemode
Adapter PN	1985150-1
Test Cable Assembly PN (see Note)	1695474-1
Test Cable Length (m)	10
Test Specimens Required	15
Test Cables Required	30
Control Cable Required	No

NOTE *Test cable assemblies were reference quality.*

Figure 1

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)
	1
	Test Sequence (b)
Visual and mechanical inspection	1
Loss (attenuation)	2,10
Reflectance	3,11
Vibration	4
Flex	5
Twist	6
Proof	7
Transmission with applied load	8
Durability	9

NOTE *(a) See paragraph 1.5.*
(b) Numbers indicate sequence in which tests are performed.

Figure 2

2. SUMMARY OF TESTING

2.1. Visual and Mechanical Inspection

All specimens submitted for testing were representative of normal, current production lots, and were inspected and accepted by the Product Assurance Department of the Fiber Optics Business Unit.

2.2. Initial Optical Performance

All initial loss and reflectance measurements were recorded and met the specification requirements for New Product. Loss and Reflectance were measured at both 1310 and 1550 nm. See Figure 3 for New Product Loss and Reflectance Measurements.

Maximum Loss, Mean Loss and Maximum Reflectance - Requirements and Actual for New Product (dB)

Wavelength (nm)	Requirement			Actual		
	Mean Loss	Maximum Loss	Maximum Reflectance	Mean Loss	Maximum Loss	Maximum Reflectance
1310	0.20	0.40	-40	0.07	0.17	-48
1550				0.06	0.12	-50

Figure 3

2.3. Loss, Loss Increase, Mean Loss, Reflectance, and Reflectance Increase - All Remaining Tests

All Loss, Loss Increase, Mean Loss, Reflectance, and Reflectance Increase measurements met the specification requirements for each test. All measurements were recorded at both 1310 and 1550 nm. Values shown in Figure 4 represent Maximum Loss, Maximum Loss Increase, Mean Loss, Maximum Reflectance, and Maximum Reflectance Increase.

Maximum Loss, Loss Increase, Mean Loss, Reflectance, and Reflectance Increase Results (dB)

Test	Condition	Requirement (dB)	Actual 1310 nm (dB)	Actual 1550 nm (dB)	Criteria Met?
Vibration	Mean Loss	0.3	0.07	0.04	Yes
	Maximum Loss	0.5	0.19	0.12	
	Loss Increase	0.3	0.06	0.03	
	Maximum Reflectance	-40	-48	-49	
	Reflectance Increase	5	1	1	
Flex	Mean Loss	0.3	0.03	0.03	Yes
	Maximum Loss	0.5	0.09	0.08	
	Loss Increase	0.3	0.04	0.03	
	Maximum Reflectance	-40	-52	-52	
	Reflectance Increase	5	1	1	
Twist	Mean Loss	0.3	0.03	0.03	Yes
	Maximum Loss	0.5	0.09	0.09	
	Loss Increase	0.3	0.04	0.01	
	Maximum Reflectance	-40	-52	-52	
	Reflectance Increase	5	0	0	
Proof, 0 degrees	Mean Loss	0.3	0.04	0.02	Yes
	Maximum Loss	0.5	0.09	0.09	
	Loss Increase	0.3	0.02	0.01	
	Maximum Reflectance	-40	-52	-52	
	Reflectance Increase	5	1	0	
Proof, 90 degrees	Mean Loss	0.3	0.04	0.04	Yes
	Maximum Loss	0.5	0.12	0.13	
	Loss Increase	0.3	0.09	0.06	
	Maximum Reflectance	-40	-51	-50	
	Reflectance Increase	5	3	4	
Transmission with Applied Load, 0 degrees See Note (b)	Loss Increase	0.5	0.04	0.04	Yes
	Maximum Reflectance	-40	-51	-52	
	Reflectance Increase	5	1	2	
Transmission with Applied Load, 90 degrees See Note (b)	Loss Increase	0.5	0.09	0.51 See Note (a)	Yes
	Maximum Reflectance	-40	-51	-52	
	Reflectance Increase	5	0	0	
Durability See Note (c)	Mean Loss	0.3	0.04	0.04	Yes 90%
	Maximum Loss	0.5	0.19	0.14	
	Loss Increase	0.3	0.15	0.11	
	Maximum Reflectance	-40	-42	-43	
	Reflectance Increase	5	5	5	

NOTE

(a) In the past Telcordia has applied a measurement error allowance of 2 dB for reflectance measurements and 0.05 dB for loss measurements. This was based on the observed repeatability of measurements on internal standards during testing.

(b) Optical performance requirements apply during the test, while the load is applied.

(c) After a cleaning interval, 90% must meet the requirements.

Figure 4

2.4. Vibration

There was no evidence of physical damage to the adapter or test cable. Maximum Loss, Loss Increase, Mean Loss, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 4, before and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.5. Flex

There was no evidence of physical damage to the adapter or test cable. Maximum Loss, Loss Increase, Mean Loss, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 4, before and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.6. Twist

There was no evidence of physical damage to the adapter or test connector or cable. Maximum Loss, Loss Increase, Mean Loss, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 4, before and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.7. Proof, 0 and 90 Degrees

There was no evidence of physical damage to the adapter or test cable during or after test. Maximum Loss, Loss Increase, Mean Loss, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 4, before and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.8. Transmission with Applied Load, 0 and 90 Degrees

There was no evidence of physical damage to the adapter or test cable assembly during or after test. Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 4, before, during, and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.9. Durability

There was no evidence of physical damage to the adapter or test cable assembly due to durability testing. Maximum Loss, Loss Increase, Mean Loss, Reflectance and Reflectance Increase measurements met the specified limits as stated in Figure 4, before, during, and after testing. Optical performance was measured at both 1310 and 1550 nm.

2.10. Final Optical Performance with Reference Quality Test Leads

At the completion of the test sequence, all final attenuation and reflectance measurements of the adapter (between reference quality test leads) met the specification requirements. No significant change was observed between initial adapter performance recorded before the first test and final adapter performance measured after the last test in the sequence. Attenuation and reflectance were measured at both 1310 nm and 1550 nm. See Figure 5.

Maximum Loss, Mean Loss and Maximum Reflectance - Requirements and Actual for End of Test (dB)

Wavelength (nm)	Requirement			Actual		
	Mean Loss	Maximum Loss	Maximum Reflectance	Mean Loss	Maximum Loss	Maximum Reflectance
1310	0.20	0.40	-40	0.04	0.10	-51
1550				0.03	0.08	

Figure 5

3. TEST METHODS

All optical measurements were performed with the utilization of a benchtop singlemode test system. This measurement facility is compliant with TIA/EIA-455-20A. Loss and Reflectance were measured at both 1310 and 1550 nm, unless otherwise specified. Following installation of the specimens, sequential testing was performed.

3.1. Visual and Mechanical Inspection

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

3.2. Loss (Attenuation)

All singlemode loss was measured in accordance with FOTP-171, Method D3 processes. The initial optical power through each of the launch connector fiber paths was measured. The receive connector assembly was then mated and optical power measured from the receive side fiber. Loss was calculated by taking the difference between these 2 measurements. The receive fiber was then connected to the optical test equipment. Optical power was recorded as a reference to calculate loss increase during/after subsequent tests. Optical power readings were compensated by changes in a source monitor cable.

3.3. Loss Increase (Attenuation Increase)

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

3.4. Reflectance

Reflectance was measured in accordance with EIA/TIA-455-107A, Method A. A single measurement was recorded for reflectance. Reflectance was measured initially and during/after each test evaluation as required by the specification.

3.5. Reflectance Increase

Increase in reflectance was calculated by taking the difference between the initial measurement and the measurement during or after each test. Reflectance increase is a change in reflectance that represents degraded performance.

3.6. Vibration

Specimens were subjected to sinusoidal vibration, having a simple harmonic motion with amplitude of 1.5 mm [0.06 in] peak-to-peak. The vibration frequency was varied uniformly between the limits of 10 and 55 Hz for 2 hours in each of the 3 mutually perpendicular directions, at a rate of 45 Hz per minute. Optical performance was recorded before and after exposure in each plane with the specimens in place on the vibration machine.

3.7. Flex

Specimens were subjected to 100 cycles of cable flexing. Specimens were tested at a rate of 25 cycles per minute. A 7.5 cm [3 in] mandrel was used to apply a tensile load of 0.6 kg [1.3 lbf] to jacketed cable on the Sr end of the adapter at an approximate distance of 25 cm [10 in] from the connector boot. 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

Specimens were subjected to 10 cycles of twist. Specimens were manually 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 1.35 kgf [3.0 lbf] to jacketed cable on the Sr end of the adapter at an approximate distance of 25 cm [10 in] from the connector boot. The twist motion for each cycle was ± 2.5 revolutions about the axis of optical transmittance. Optical performance was measured before and after test with the load removed.

3.9. Proof

Axial and 90 degree side loads were manually applied by wrapping the test lead cable around a 7.5 cm [3 in] diameter mandrel at an approximate distance of 25 cm [10 in] from the connector boot. Specimens were subjected to a 4.5 kg (10 lb) axial load on the Sr end of the adapter for a 5 second duration for Small Form Factor Connectors. The load was removed and optical measurements taken after 20 seconds to allow the specimens to normalize. Subsequently, the specimens were subjected to the 90 degree applied side load requirement of 1.5 kg (3.3 lb) for Small Form Factor Connectors. The load was removed and optical measurements taken after 20 seconds to allow the specimens to normalize.

3.10. Transmission with Applied Tensile Load

Attenuation and reflectance were measured before the start of the test. An adapter was secured to the test fixture. The first load of 0.25 kg [0.55 lb] was manually applied on the Sr end of the adapter at 0 degrees by wrapping the cable around a 7.5 cm [3 in] diameter mandrel at an approximate distance of 25 cm [10 in] from the connector boot. Attenuation and reflectance were recorded after holding the load for a minimum of 20 seconds, or until stability was reached. The load was removed and the test was repeated with the next load and angle. During test measurements were recorded for each of the 8 load and angle combinations shown in Figure 4. Final attenuation and reflectance were recorded a minimum of 20 seconds after the last load was removed. The test criteria shown in the table below follows Telcordia GR-326-CORE Table 4-10 requirements for small form factor, media type I, except for the 135 degree load application.

Small Form Factor Required Tensile Loads for Transmission with Applied Load

Test Order	Required Load		Angle
	Kilogram	Pound	
1	0.25	0.55	0
2	0.17	0.37	90
3	0.7	1.54	0
4	0.47	1.0	90
5	1.5	3.3	0
6	1.0	2.2	90
7	2.0	4.4	0
8	1.3	2.9	90

GR-326 Table 4-10

3.11. Durability, 200 Cycles

The plug on the receive end (Sr.-side of the adapter) was subjected to 200 cycles of durability. Half of the test specimens' test leads were connected to channel A. The remaining test specimens' test leads were connected to channel B. The simplex plug on the receive end (Sr.-side of the adapter) was mated and unmated for all specimens during durability cycling. Specimens were mounted at 1.8 m [6 ft], 1.4 m [4.5 ft] and 0.9 m [3 ft] above the floor per GR-326-CORE procedure. Specimens were manually cycled at a rate not in excess of 300 cycles per hour. Attenuation and reflectance were recorded after one sided cleaning at 25, 75, 125 and 175 cycles. Attenuation and reflectance were recorded after two sided cleaning at 50, 100, 150 and 200 cycles. If specimens did not meet optical criteria after any of the cleaning intervals, additional cleanings of the reference quality test leads were permitted.