# LightCrimp* Plus Singlemode and Multimode LC Connector (Field Installable)

## 1. INTRODUCTION

### 1.1. Purpose

Testing was performed on Tyco Electronics LightCrimp* Plus LC, singlemode and multimode, fiber optic connectors to determine their conformance to the requirements of Tyco Electronics Product Specification 108-2189, Revision E, which meets the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3.

### 1.2. Scope

This report covers the optical, environmental, and mechanical performance of LightCrimp Plus LC, singlemode and multimode, fiber optic connectors, manufactured by Tyco Electronics, Fiber Optics Business Unit. Testing was performed between 17Jun04 and 09Oct07 on standard PC product terminated to 900 µm tight-buffered fiber, between 02Feb09 and 03Feb09 on APC digital product and between 20Sep06 and 14Nov06 for standard PC product terminated to 2.0 mm jacketed cable. The test file numbers for this testing are B049702-005, B072038-003, K414-008, and B108822-002.

### 1.3. Conclusion

LightCrimp Plus LC singlemode standard PC fiber optic connectors, terminated to 900 µm tight-buffered fiber, meet or exceed the optical, environmental, and mechanical performance requirements of Tyco Electronics Product Specification 108-2189, Revision E, and the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3.

LightCrimp Plus LC singlemode APC digital fiber optic connectors terminated to 900 µm tight-buffered fiber meet the optical performance requirements of Product Specification 108-2189, Revision E, and the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3. Environmental and mechanical performance are assumed to be qualified by similarity to the LightCrimp Plus LC singlemode standard PC connector.

LightCrimp Plus LC singlemode standard PC fiber optic connectors, terminated to 2.0 mm jacketed cable, meet or exceed the optical, environmental, and mechanical performance requirements of Tyco Electronics Product Specification 108-2189, Revision E, and the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3, when two simplex connectors are fastened together to form a duplex connector.

LightCrimp Plus LC multimode fiber optic connectors, listed in paragraph 1.5, meet the optical performance requirements of Product Specification 108-2189, Revision E, and the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3, when terminated to 900 µm tight-buffered fiber or 2.0 mm jacketed cable. Environmental and mechanical performance is assumed to be qualified by similarity to the singlemode LightCrimp Plus LC connector.

LightCrimp Plus LC XG fiber optic connectors, terminated to 900 µm tight-buffered fiber or 2.0 mm jacketed cable, are assumed to be qualified to Product Specification 108-2189, Revision E, and the Optical Fiber Cabling Components Standard ANSI/TIA-568-C.3 by similarity to LightCrimp Plus LC multimode 50/125 µm connectors.



* Trademark
| Indicates change

1.4. Product Description

Tyco Electronics LightCrimp Plus LC, singlemode and multimode, fiber optic connectors are field installable connectors that are used in data communication and telecommunications networks and equipment.

LightCrimp Plus LC APC digital fiber optic connectors can be used in digital applications where return loss requirements are less than 55 dB.

1.5. Test Specimens

Test specimens were manufactured using normal production means and randomly selected for test. Specimens terminated to 900 µm buffered fiber consisted of a simplex LightCrimp Plus LC connector mated to an epoxy-style LC connector and the following supplies outlined below. Specimens terminated to 2.0 mm jacketed cable utilized zipcord cable and consisted of two LightCrimp Plus LC connectors fastened together with a duplex clip to form a duplex specimen. LightCrimp Plus connectors mated to epoxy-style LC connectors to form a mated connector pair.

| Component Identification | Test Group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Fiber size (micron/micron) | 9/125 | | | | 50/125 | 62.5/125 | 9/125 | | | | |
| Termination cable type (launch) | 900 µm Tight Buffered Fiber, SM, LSZH | | | 900 µm Tight-Buffered Fiber, SM, SMF-28e | 900 µm Tight Buffered Fiber, Graded Index, MM 400/400 MHz-Km | 900 µm Tight Buffered Fiber, Graded Index, MM 160/500 MHz-Km | 2.0 mm OFNP Zipcord Cable, SM | | | | 900 µm Tight Buffered Fiber |
| Termination cable PN | 0-1594408-0 | | | 5599208-6 | 599204-2 | 599200-6 | 6457471-6 | | | | 6828209-6 |
| Connector type | LightCrimp Plus LC, Simplex, SM | | | | LightCrimp Plus LC, Simplex, MM | | LightCrimp Plus LC, Jacketed, Simplex, SM (see Note) | | | | LightCrimp Plus LC, APC Digital |
| Connector kit PN | 1754482-1 | | | 6754482-1 | 1754483-2 | 1754483-1 | 1918626-1 | | | | 2064181-1 |
| Coupling receptacle type | LC, Simplex | | | | | | LC, Duplex | | | | LC, Duplex |
| Coupling receptacle PN | 1457062-1 | | | | | | 6457567-4 | | | | 6457567-4 |
| Test lead connector type | LC, Simplex, SM | | | | LC, Simplex, MM | | LC, Duplex, SM, 1.6 to 2.0 mm | | | | LC/APC, SM Simplex, 2.0 mm |
| Mating connector kit PN (receive) | 1588710-1 | | | 1938086-3 | 1588706-1 | | 6588711-1 | | | | 1828588-1 |
| Test specimen quantity (see Note) | 8 | 8 | 8 | 10 | 24 | 24 | 8 | 8 | 8 | 8 | 30 |
| Control cable required | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

**NOTE** *Two simplex LightCrimp Plus LC connectors are fastened together with LightCrimp Plus LC duplex clip PN 1754371-1 to form a duplex specimen.*
*Refer to Product Specification 108-2189 for minimum specimen quantities required.*

## 1.6. Qualification Test Sequence

| Test or Examination | Test Groups | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | Test Sequence (a) | | | | | | | | | | |
| Visual and mechanical inspection | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Attenuation (insertion loss) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Return loss | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Temperature life | 4 | | | | | | 4 | | | | |
| Low temperature | 5 | | | | | | 5 | | | | |
| Humidity, steady state | 6 | | | | | | 6 | | | | |
| Temperature cycling, Part 1 (b) | 7 | | | | | | 7 | | | | |
| Temperature cycling, Part 2 (b) | 8 | | | | | | | | | | |
| Cable retention, 0 degree | | 4 | | 5 | | | | | 4 | | |
| Cable retention, 90 degree | | 5 | | | | | | | 5 | | |
| Flex | | 6 | | | | | | | 6 | | |
| Twist | | 7 | | | | | | | 7 | | |
| Strength of coupling mechanism | | 8 | | 4 | | | | 4 | | | |
| Impact | | 9 | | | | | | | 8 | | |
| Mating durability | | | 4 | | | | | | | 4 | |

**NOTE**

*(a) The numbers indicate the sequence in which tests were performed.*
*(b) Test is not required by ANSI/TIA-568-C.3.*
*(c) Key FOCIS-10 dimensions were verified on a quantity of 32 specimens from Groups 1, 2, 3 and 7.*

## 2. SUMMARY OF TESTING

### 2.1. Visual and Mechanical Inspection - All 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. For specimens in Test Groups 1, 2, 3 and 7 (total quantity of 32), 6 dimensions were verified and met criteria per FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC, TIA-604-10-B.

### 2.2. Initial Optical Performance - All Groups

All attenuation and return loss measurements met the specification requirements. Attenuation and return loss were measured at 1310 and 1550 nm for singlemode and 850 and 1300 nm for multimode. Histograms for attenuation data are provided in the Appendix.

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

| Performance Requirements | Singlemode 1310 and 1550 nm | Multimode 850 and 1300 nm |
|---|---|---|
| Maximum allowed attenuation for any individual specimen | 0.75 | 0.75 |
| Minimum allowed return loss for any individual specimen | 26 | 20 |

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

| Test Groups | Maximum and Median Values for Attenuation | | Minimum and Median Values for Return Loss | |
|---|---|---|---|---|
| Singlemode | 1310 nm | 1550 nm | 1310 nm | 1550 nm |
| Groups 1, 2 and 3, Standard PC (900 µm tight buffered fiber) | 0.63 maximum 0.21 median | 0.42 maximum 0.19 median | 46 minimum 55 median | 45 minimum 57 median |
| Group 4, Standard PC (900 µm tight-buffered fiber) | 0.41 maximum 0.20 median | 0.34 maximum 0.22 median | 48 minimum 56 median | 51 minimum 58 median |
| Groups 7, 8, 9 and 10, Standard PC (2.0 mm jacketed cable) | 0.49 maximum 0.21 median | 0.51 maximum 0.19 median | 31 minimum 54 median | 31 minimum 55 median |
| Group 11, APC Digital (900 um tight-buffered fiber) | 0.61 maximum 0.32 median | 0.51 maximum 0.30 median | 50 minimum 56 median | 53 minimum 64 median |
| Multimode | 850 nm | 1300 nm | 850 nm | 1300 nm |
| Group 5 (50/125) (900 µm tight-buffered fiber) | 0.43 maximum 0.17 median | 0.34 maximum 0.13 median | 24 minimum 40 median | 24 minimum 41 median |
| Group 6 (62.5/125) (900 µm tight-buffered fiber) | 0.47 maximum 0.17 median | 0.52 maximum 0.13 median | 34 minimum 37 median | 34 minimum 38 median |

2.3. Attenuation, Attenuation Increase and Return Loss - Groups 1-4 and 7-10

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.

| Group | Condition | Requirements (1310 and 1550 nm) | | | Actual (1310 nm) | | | Actual (1550 nm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Before | During | After | Before | During | After | Before | During | After |
| | | IL | IL↑ | IL, RL, IL↑ | IL | IL↑ | IL, RL, IL↑ | IL | IL↑ | IL, RL, IL↑ |
| 1 | Temperature life | 0.75 | NA | 0.75(IL) 26(RL) | 0.37 | NA | 0.36(IL) 45(RL) | 0.31 | NA | 0.29(IL) 52(RL) |
| | Low temperature | | 0.3 | | 0.36 | 0.04 | 0.35(IL) 47(RL) | 0.29 | 0.05 | 0.29(IL) 45(RL) |
| | Humidity, steady state | | 0.4 | | 0.35 | 0.03 | 0.36(IL) 42(RL) | 0.29 | 0.02 | 0.29(IL) 44(RL) |
| | Temperature cycling, Part 1 (Note 2) | NA | NA | NA | 0.36 | NA | 0.36(IL) 41(RL) | 0.29 | NA | 0.29(IL) 45(RL) |
| | Temperature cycling, Part 2 (Note 2) | NA | NA | NA | 0.31 | NA | 0.29(IL) 41(RL) | 0.26 | NA | 0.26(IL) 45(RL) |
| 2 | Cable retention, 0 degree | 0.75 | NA | 0.75(IL) 0.5(IL↑) 26(RL) | 0.63 | NA | 0.61(IL) 0.01(IL↑) 48(RL) | 0.42 | NA | 0.43(IL) 0.01(IL↑) 50(RL) |
| | Cable retention, 90 degree | | | | 0.61 | | 0.57(IL) 0.00(IL↑) 48(RL) | 0.43 | | 0.38(IL) 0.00(IL↑) 50(RL) |
| | Flex | | | 0.75(IL) 26(RL) | 0.57 | | 0.68(IL) 34(RL) | 0.38 | | 0.47(IL) 37(RL) |
| | Twist | | | | 0.68 | | 0.67(IL) 34(RL) | 0.47 | | 0.46(IL) 37(RL) |
| | Strength of coupling mechanism | | | | 0.61 | | 0.61(IL) 43(RL) | 0.43 | | 0.43(IL) 46(RL) |
| | Impact | | | | 0.56 | | 0.60(IL) 48(RL) | 0.41 | | 0.44(IL) 50(RL) |
| 3 | Mating durability | 0.75 | NA | 0.75(IL) 26(RL) | 0.33 | NA | 0.30(IL) 48(RL) | 0.28 | NA | 0.30(IL) 45(RL) |
| 4 | Strength of coupling mechanism | 0.75 | NA | 0.75(IL) 26(RL) | 0.41 | NA | 0.41(IL) 49(RL) | 0.34 | NA | 0.35(IL) 52(RL) |
| | Cable retention, 0 degree | | | 0.75(IL) 0.5(IL↑) 26(RL) | 0.41 | | 0.59(IL) 0.27(IL↑) 53(RL) | 0.35 | | 0.51(IL) 0.22(IL↑) 53(RL) |
| 5<br>6 | Attenuation and Return loss | See paragraph 2.2. | | | | | | | | |

Attenuation, Change in Attenuation, Attenuation Increase and Return Loss (continued)

| Group | Condition | Requirements (1310 and 1550 nm) | | | Actual (1310 nm) | | | Actual (1550 nm) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Before | During | After | Before | During | After | Before | During | After |
| | | IL | IL↑ | IL, RL, IL↑ | IL | IL↑ | IL, RL, IL↑ | IL | IL↑ | IL, RL, IL↑ |
| 7 | Temperature life | 0.75 | NA | 0.75(IL) 26(RL) | 0.50 | NA | 0.53(IL)43(RL) | 0.37 | NA | 0.43(IL) 41(RL) |
| | Low temperature | | 0.3 | | 0.53 | 0.02 | 0.54(IL) 38(RL) | 0.43 | 0.07 | 0.42 (IL) 37 (RL) |
| | Humidity, steady state | | 0.4 | | 0.52 | 0.02 | 0.53(IL) 38(RL) | 0.41 | 0.02 | 0.40(IL) 37(RL) |
| | Temperature cycling Part 1 (see Note) | NA | NA | NA | 0.52 | NA | 0.54(IL) 38(RL) | 0.40 | NA | 0.43(IL) 36(RL) |
| 8 | Strength of coupling mechanism | 0.75 | NA | 0.75(IL) 26(RL) | 0.32 | NA | 0.35(IL) 39(RL) | 0.36 | NA | 0.35(IL) 33(RL) |
| 9 | Cable retention, 0 degree | 0.75 | NA | 0.75(IL) 0.5(IL↑) 26(RL) | 0.41 | NA | 0.46(IL) 0.05(IL↑) 42(RL) | 0.55 | N/A | 0.58(IL) 0.04 (IL↑) 35(RL) |
| | Cable retention, 90 degree | | | | 0.46 | | 0.63(IL) 0.27(IL↑) 42(RL) | 0.58 | | 0.60(IL) 0.26(IL↑) 35(RL) |
| | Flex | | | 0.75(IL) 26(RL) | 0.63 | | 0.71(IL) 42(RL) | 0.60 | | 0.60(IL) 35(RL) |
| | Twist | | | | 0.71 | | 0.67(IL) 42(RL) | 0.60 | | 0.58(IL) 35(RL) |
| | Impact | | | | 0.40 | | 0.49(IL) 41(RL) | 0.52 | | 0.45(IL) 36(RL) |
| 10 | Mating durability | 0.75 | NA | 0.75(IL) 26(RL) | 0.50 | NA | 0.51(IL) 32(RL) | 0.55 | NA | 0.52(IL) 31(RL) |
| 11 | Attenuation and Return Loss | See paragraph 2.2. | | | | | | | | |

**NOTE** *Test is not required by ANSI/TIA-568-C.3 or 108-2189.*

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

Attenuation, Attenuation Increase and Return Loss (end)

2.4. Temperature Life - Groups 1 and 7

There was no evidence of physical damage to the connector or terminated fiber after temperature life. All attenuation and return loss measurements met specified limits before and after test.

2.5. Low Temperature - Groups 1 and 7

There was no evidence of physical damage to the connector or terminated fiber and no increase in attenuation beyond the specified limit during low temperature exposure. All attenuation and return loss measurements met requirements before and after test.

2.6. Humidity, Steady State - Groups 1 and 7

There was no evidence of physical damage to the connector or terminated fiber and no increase in attenuation beyond the specified limits during steady state humidity. All attenuation and return loss measurements met requirements before and after test.

2.7. Temperature Cycling, Part 1 - Groups 1 and 7

There was no evidence of physical damage to the connector or terminated fiber due to temperature cycling exposure. Although this test is not required by ANSI/TIA-568-C.3, all attenuation and return loss measurements recorded before and after temperature cycling still met the optical performance limits stated in ANSI/TIA-568-C.3.

2.8. Temperature Cycling, Part 2 - Group 1

There was no evidence of physical damage to the connector or terminated fiber due to temperature cycling exposure. Although this test is not required by ANSI/TIA-568-C.3, all attenuation and return loss measurements recorded before and after temperature cycling still met the optical performance limits stated in ANSI/TIA-568-C.3.

2.9. Cable Retention, 0 Degree - Groups 2, 4 and 9

There was no evidence of fiber pullout, or other damage to the connector or attached fiber and no increase in attenuation beyond the specified limits after cable retention. Attenuation and return loss measurements met the specified limits before and after the 0 degree cable retention test.

2.10. Cable Retention, 90 Degree - Groups 2 and 9

There was no evidence of fiber pullout, or other damage to the connector or attached fiber and no increase in attenuation beyond the specified limits after 90 degree cable retention. Attenuation and return loss measurements met the specified limits before and after the 90 degree cable retention test.

2.11. Flex - Groups 2 and 9

There was no evidence of physical damage to the connector or attached fiber. Attenuation and return loss measurements met the specified limits before and after flex testing.

2.12. Twist - Groups 2 and 9

There was no evidence of physical damage to the connector or attached fiber. Attenuation and return loss measurements met the specified limits before and after the twist test.

2.13. Strength of Coupling Mechanism - Groups 2, 4 and 8

There was no evidence of physical damage to the connector or attached fiber. Attenuation and return loss measurements met the specified limits before and after strength of coupling mechanism test.

2.14. Impact - Groups 2 and 9

There was no evidence of physical damage to the connector due to impact testing. Attenuation and return loss measurements met the specified limits before and after test.

2.15. Durability - Groups 3 and 10

There was no evidence of physical damage to the connector or attached fiber. Attenuation and return loss measurements met the specified limits before and after durability.

## 3. TEST METHODS

The singlemode environmental facility is an automated, TIA-455-20B compliant test system. Following the installation of the specimens, the sequential testing was performed.

Multimode optical tests and some singlemode mechanical tests were obtained using manually operated TIA-455-20B compliant test equipment. Initial specimen installation was performed according to TIA/EIA-455-171A 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.

Thirty-two specimens were measured to verify conformance to Dimensions B, D, G, H1, H2 and S in the FOCIS 10 Fiber Optic Connector Intermateability Standard - Type LC, TIA-604-10-B. Other dimensions not measured on actual test specimens are assumed to be compliant with FOCIS 10 dimensions from Tyco Electronics First Article approval, which included verification of product drawings per the dimensions specified in TIA-604-10-B.

### 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 fiber was measured. The LightCrimp Plus LC connector was terminated to the fiber and optical power was measured from the connector end. The LightCrimp Plus connector was then mated to an epoxy-style LC connector and optical power was measured from the receive fiber. Attenuation was calculated by taking the difference between the first and third measurements. The receive fiber was then spliced to a test lead attached to the optical measurement equipment. Optical power readings were compensated by changes in a source monitor cable. In cases where a control cable was also used and exceeded limits stated in the specification, the change in the control cable was also factored into the loss

All multimode attenuation was measured in accordance with TIA/EIA-455-171A, 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 fiber was measured. The LightCrimp Plus LC connector was terminated to the fiber and optical power was measured from the connector end. The LightCrimp Plus connector was then mated to an epoxy-style LC connector and optical power was measured from the receive fiber. Attenuation was calculated by taking the difference between the first and third measurements. Optical power readings were compensated by changes in a source monitor cable.

### 3.3. Return Loss

Return loss was measured in accordance with TIA/EIA-455-107A or TIA/EIA-455-8. A single measurement was recorded for return loss. Return loss was measured initially and after each test evaluation.

### 3.4. Attenuation Increase

Increase in attenuation was calculated by taking the difference between the initial measurement before test and the during/after measurements for each test as applicable. Attenuation increase represents the maximum change in attenuation that results from a decrease in optical power (degraded performance).

3.5. Temperature Life

Mated specimens were subjected to 60˚C for a period of 96 hours (4 days). Optical performance for each sample was recorded before and after exposure with the specimens in place in the test chamber. Final optical performance was recorded 2 hours after the chamber's return to ambient conditions.

3.6. Low Temperature

Mated specimens were subjected to -10˚C for a period of 96 hours (4 days). Optical performance for each sample was recorded before and after exposure with the samples in place in the test chamber and at 10 minute intervals throughout the exposure. Final optical performance was recorded 2 hours after the chamber's return to ambient conditions.

3.7. Humidity, Steady State

Mated specimens were preconditioned at 50 ± 5˚C and low humidity for 24 hours then brought to ambient for at least 1 hour before starting humidity exposure of 40 ± 2˚C at 90 to 95% RH for a period of 96 hours (4 days). Optical performance for each specimen was recorded before and after humidity exposure with the specimens in place in the test chamber and at 10 minute intervals throughout the exposure. Final optical performance was recorded 2 hours after the chamber's return to ambient conditions.

3.8. Temperature Cycling, Part 1

Mated specimens were subjected to 5 cycles between -10 and 60˚C with 1 hour dwells at each temperature extreme. Ramp rate was 1˚C per minute. Each cycle started with a cold ramp/dwell of -10˚C then followed by a hot ramp/dwell to 60˚C. Optical performance was recorded at ambient before and after exposure with the specimens in place in the test chamber and at 10 minute intervals throughout the exposure.

3.9. Temperature Cycling, Part 2

Mated specimens were subjected to 5 cycles between -40 and 70˚C with 1 hour dwells at each temperature extreme. Ramp rate was 1˚C per minute. Each cycle started with a cold ramp/dwell of -40˚C then followed by a hot ramp/dwell to 70˚C. Optical performance was recorded at ambient before and after exposure with the specimens in place in the test chamber and at 10 minute intervals throughout the exposure. Temperature exposure is more harsh than the range specified in ANSI/TIA-568-C.3.

3.10. Cable Retention, 0 Degree

A. Group 2

Specimens terminated to 900 µm buffered fiber were subjected to a sustained load of 2.2 N [0.5 lbf] for a minimum of 5 seconds (load meets TIA/EIA-568-B.3; see Group 4 for ANSI/TIA-568-C.3 performance). An adapter was secured to the test fixture. The tensile load was manually applied by wrapping the buffered fiber around a mandrel at a point approximately 23 cm [9 in] from the connector boot of a mated specimen. Optical performance was measured before and after test with the load removed.

B. Group 4

Specimens were tested similarly to Group 2 except the load was 5 N [1.1 lbf] (meets ANSI/TIA-568-C.3 requirement). Load was applied at a rate of 0.5 N per second and held for a minimum of 5 seconds.

C. Group 9

For connectors terminated to jacketed cable with strength members, a load of 50 N [11.24 lbf] was applied to a duplex specimen for a minimum of 5 seconds (meets ANSI/TIA-568-C.3 requirement). A duplex adapter was secured to the test fixture. The tensile load was manually applied by wrapping the jacketed cable around a 7.6 cm [3 in] mandrel at a point approximately 23 cm [9 in] from the connector. Optical performance was measured before and after test with the load removed.

3.11. Cable Retention, 90 Degree

Specimens terminated to 900 µm buffered fiber were subjected to a sustained load of 2.2 N [0.5 lbf] for a minimum of 5 seconds (load is slightly greater than ANSI/TIA-568-C.3 requirement). 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 mandrel at a point approximately 23 cm [9 in] from the connector boot of a mated specimen. Optical performance was measured before and after test with the load removed.

For connectors terminated to jacketed cable with strength members terminated to the connector, a load of 19.4 N [4.4 lbf] was applied to a duplex specimen for a minimum of 5 seconds. A duplex 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 7.6 cm [3 in] mandrel at a point approximately 23 cm [9 in] from the connector. Optical performance was measured before and after test with the load removed.

3.12. Flex

Specimens were subjected to 100 cycles of fiber flexing. The flex arc was ± 90 degree from a vertical position. Specimens were tested at a rate of approximately 15 cycles per minute. A mandrel was used to apply a tensile load to the buffered fiber or cable at a point approximately 23 cm [9 in] from the boot of a mated connector. Optical performance was measured before and after test with the load removed.

For 900 µm buffered fiber, the load used was 2.2 N [0.5 lbf] (slightly greater load than required by ANSI/TIA-568-C.3). For jacketed cable (with strength members terminated to the connector), a load of 4.9 N [1.1 lbf] (meets ANSI/TIA-568-C.3 requirement) was applied to a mated, duplex specimen.

3.13. Twist

Specimens were manually subjected to 10 cycles of twist. A mandrel was used to apply a tensile load to the buffered fiber or cable at a point approximately 23 cm [9 in] from the ferrule endface of a mated specimen. 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.

For 900 µm buffered fiber, the load used was 2.2 N [0.5 lbf] (slightly greater load than required by ANSI/TIA-568-C.3). For jacketed cable (with strength members terminated to the connector), a load of 15 N [3.4 lbf] (meets ANSI/TIA-568-C.3 requirement) was applied to a mated, duplex specimen.

3.14. Strength of Coupling Mechanism

A. Groups 2 and 8

A 33 N [7.4 lbf] tensile load (meets TIA/EIA-568-B.3; see Group 4 for ANSI/TIA-568-C.3 performance) was applied between the connector plug and adapter at a rate of 25.4 mm [1 in] per minute. The load was sustained for a minimum of 5 seconds. Optical performance was measured before and after test with the load removed.

B. Group 4

Specimens were tested similarly to Groups 2 and 8 except the load was 40 N [9.0 lbf] and was applied at a rate of 2 N [0.45 lbf] per second (meets ANSI/TIA-568-C.3 requirements).

3.15. Impact

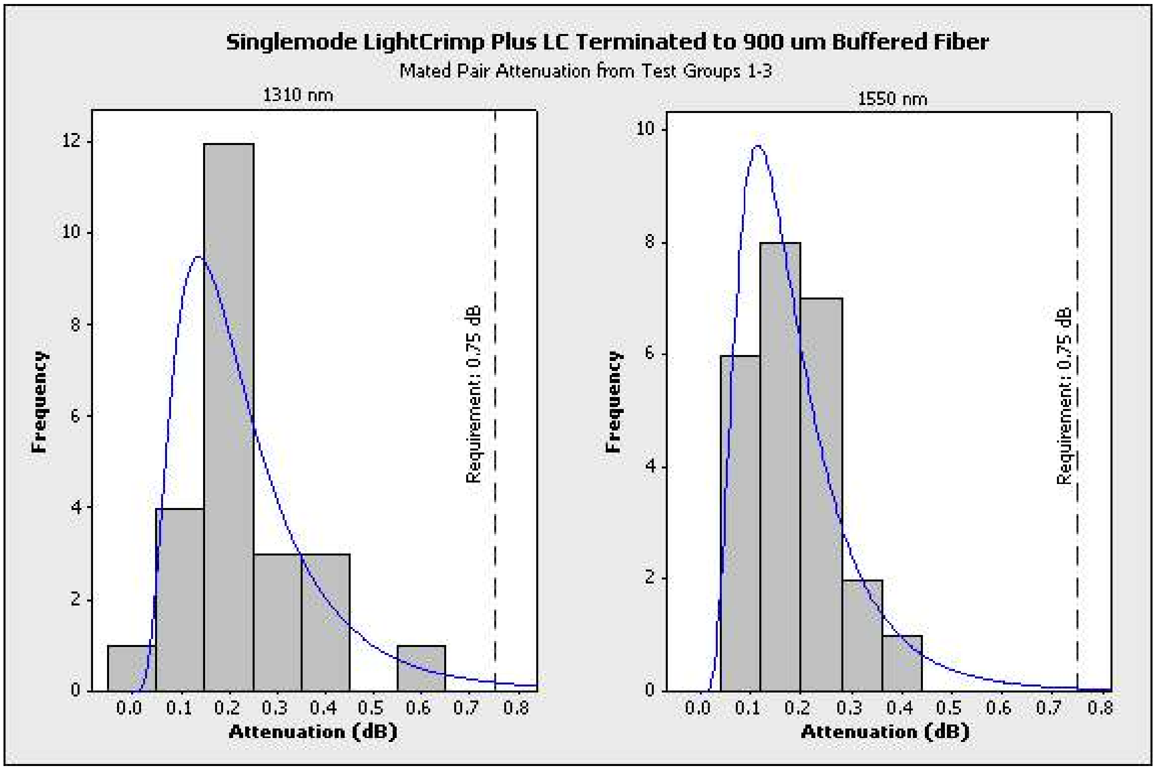
An unmated connector was dropped from a height of 1.8 m [70.9 in] onto a concrete slab (exception to ANSI/TIA-568-C.3) while the fixed end was mounted at a height of 0.60 m [2 ft] with cable length of 2 m [79 in]. A ferrule cap was used to protect the fiber endface. The impact exposure was performed 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. Test drop height and duration were harsher criteria than ANSI/TIA-568-C.3 requirements.

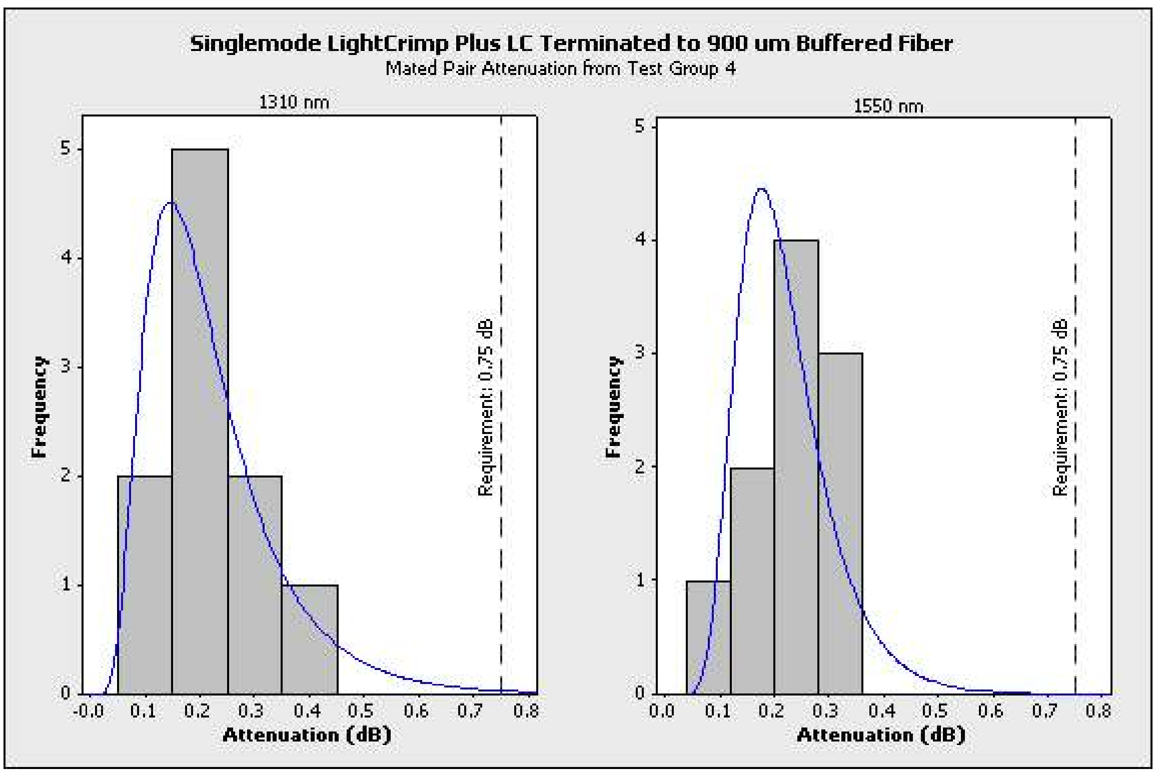
3.16. Durability

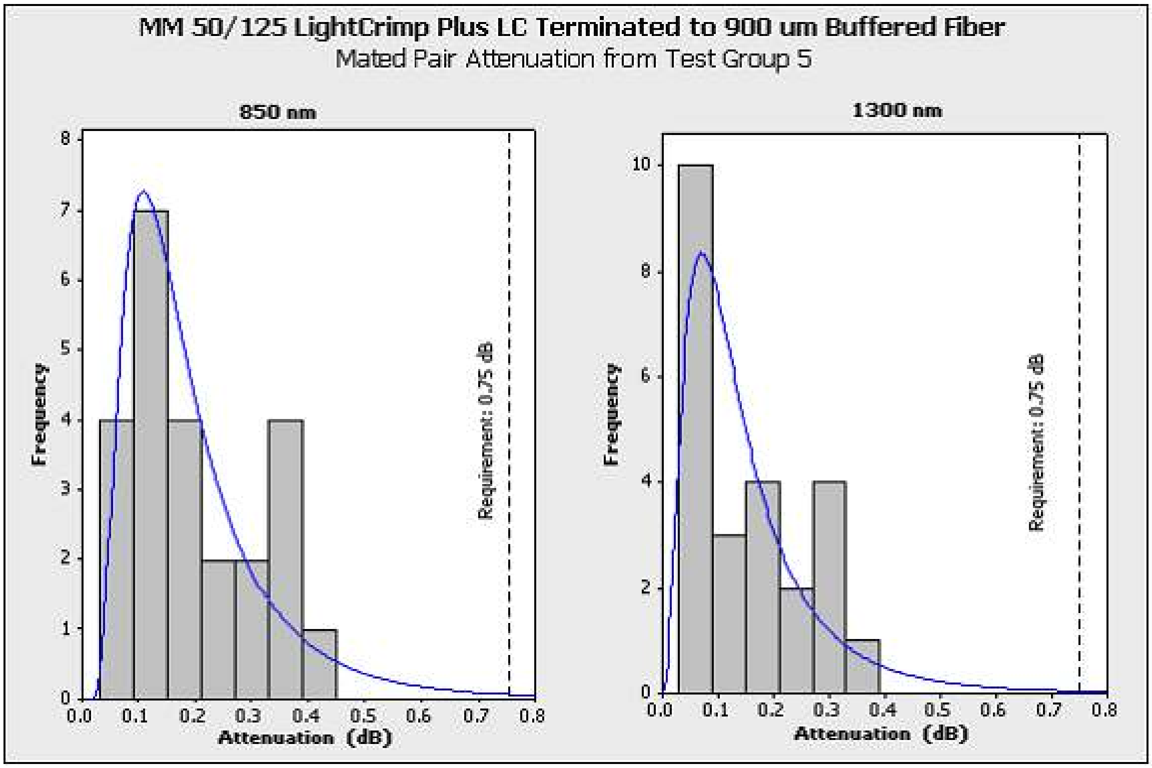
The launch connector of each mated specimen was subjected to 500 cycles of durability. Specimens were manually cycled at a rate not in excess of 300 cycles per hour. The connector and adapter were cleaned as necessary per manufacturer's instructions. Attenuation and return loss were measured before and after test. Specimens were unmated, cleaned, inspected, and re-mated before final optical measurements.

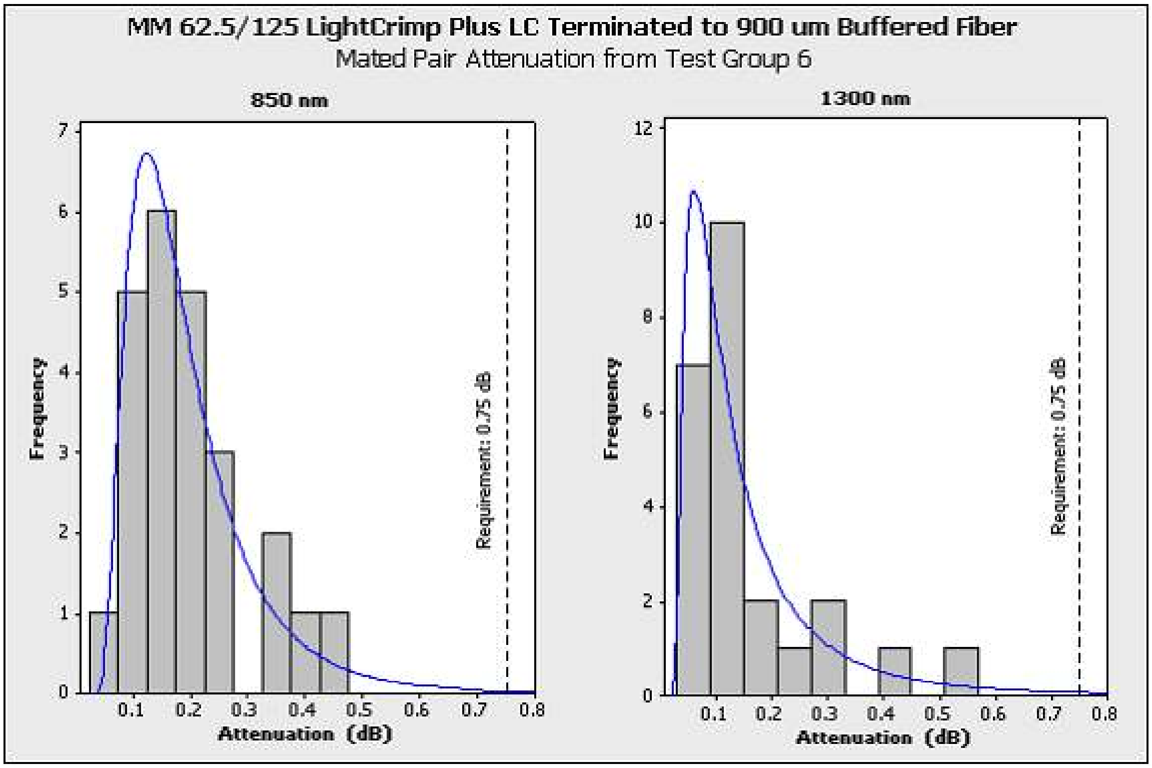
# APPENDIX

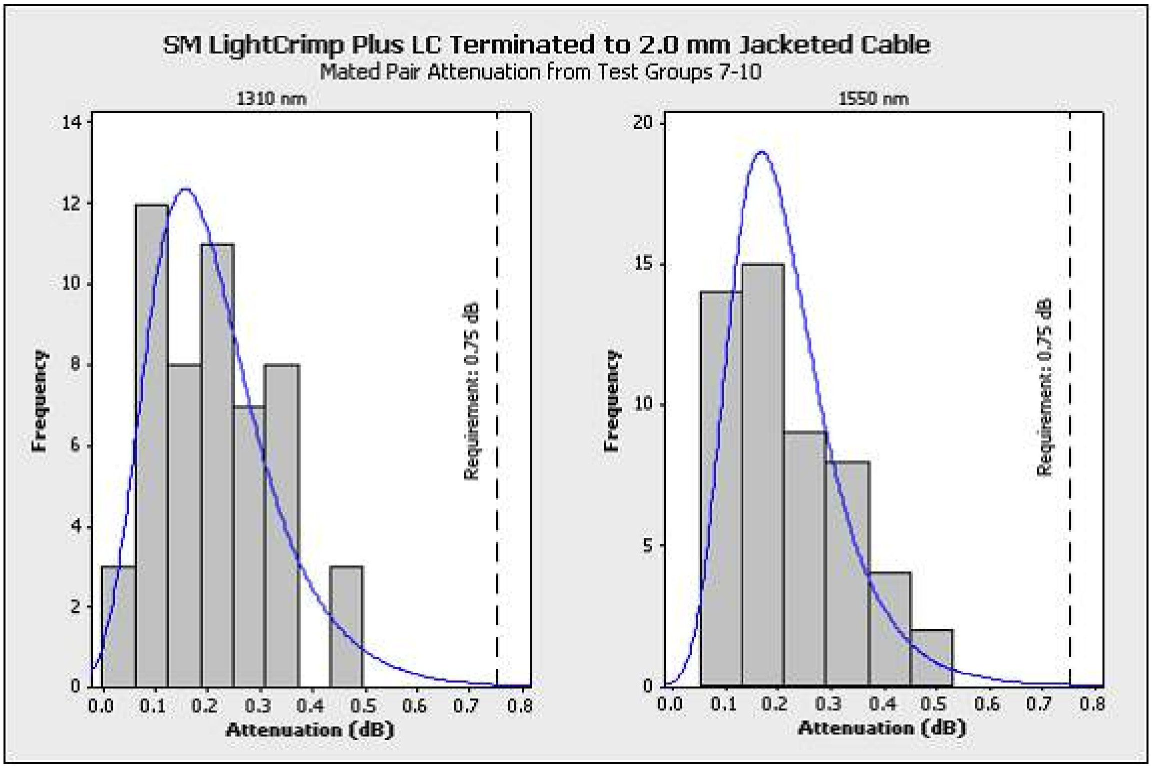
Histograms of Mated Pair Attenuation
for LightCrimp Plus LC Connector

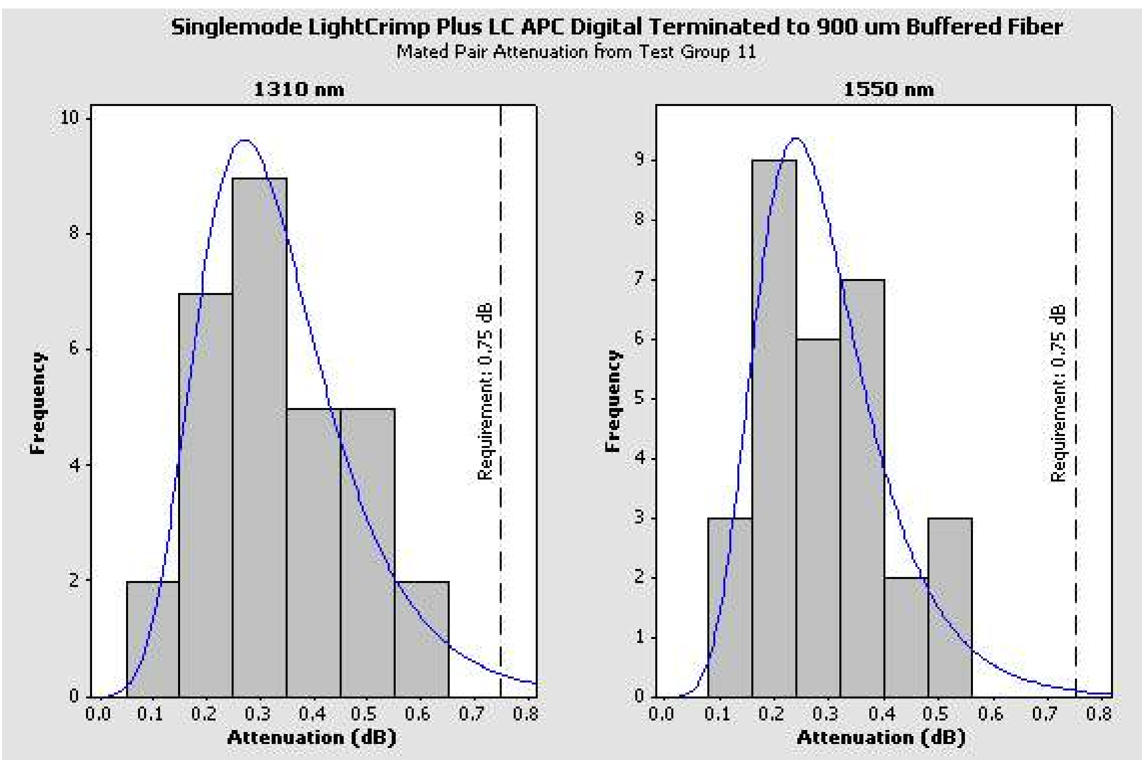

Singlemode LightCrimp Plus LC Terminated to 900 um Buffered Fiber
Mated Pair Attenuation from Test Groups 1-3
1310 nm
1550 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB


Singlemode LightCrimp Plus LC Terminated to 900 um Buffered Fiber
Mated Pair Attenuation from Test Group 4
1310 nm
1550 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB


MM 50/125 LightCrimp Plus LC Terminated to 900 um Buffered Fiber
Mated Pair Attenuation from Test Group 5
850 nm
1300 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB


MM 62.5/125 LightCrimp Plus LC Terminated to 900 um Buffered Fiber
Mated Pair Attenuation from Test Group 6
850 nm
1300 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB


SM LightCrimp Plus LC Terminated to 2.0 mm Jacketed Cable
Mated Pair Attenuation from Test Groups 7-10
1310 nm
1550 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB


Singlemode LightCrimp Plus LC APC Digital Terminated to 900 um Buffered Fiber
Mated Pair Attenuation from Test Group 11
1310 nm
1550 nm
Frequency
Attenuation (dB)
Requirement: 0.75 dB