

LC Short Boots Singlemode Fiber Optic Cable Assemblies**1. INTRODUCTION****1.1. Purpose**

Testing was performed on Tyco Electronics LC Short Boots on singlemode, one-piece housing, fiber optic connectors to determine their conformance to the requirements stated in this document. The specific test and performance limits were selected from Telcordia GR-326-CORE, Issue 3.

1.2. Scope

This report covers the optical and mechanical performance of LC Short Boot cable assemblies, manufactured by Tyco Electronics, Fiber Optic Business Unit. Testing was performed between 19Dec06 and 09Jan07. The test file number for this testing is B060634-003.

1.3. Conclusion

The LC Short Boot singlemode fiber optic cable assemblies, listed in paragraph 1.5., meet the optical and mechanical performance requirements stated in this document.

1.4. Product Description

Tyco Electronics LC Short Boot connectors are used in telephone company central offices, CATV head-ends, inter-building backbones and customer premise applications. The reduced overall connector length is particularly suited for high-density applications where limited space is available.

1.5. Test Specimens

Test specimens were taken from current production. A specimen consisted of two cable assemblies, both LC to FC/APC, mated via duplex LC die-cast adapters.

Component Description	Manufacturing Location Waigaoqiao (WGQ)	
	Test Group	
	1	2
Fiber size (microns/microns)	9/125	9/125
Cable supplier	B	A
Cable PN	1918969-4	1918969-4
Cable assembly PN	1938086-3	1938086-3
LC short boot PN	1918403-1	1918403-1
Heat shrink assembly PN	1918918-2	1918918-2
Coupling receptacle PN	1754683-1	1754683-1
Test cable length	3 m [9.8 ft]	3 m [9.8 ft]
Test specimens required	10	10

Figure 1
Description of Sample Configuration

1.6. Qualification Test Sequence

Test or Examination	Test Group (a)	
	1	2
	Test Sequence (b)	
Visual and mechanical inspection	1	1
Attenuation (insertion loss)	2	2
Return loss	3	3
Flex	4	4
Twist	5	5
Proof - straight pull	6	6
Transmission with applied load	7	7

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 Test Groups

All samples submitted for testing were selected from normal, current production lots, and were inspected and accepted by the Product Assurance Department of the Fiber Optic Business Unit.

2.2. Optical Performance Requirements

Test Description	Maximum Loss	Mean Loss	Loss increase	Maximum Reflectance	Reflectance Increase
New Product	0.40	0.20	----	-55	----
During Test, Not Under Load	0.50	0.30	0.30	-55	5
During Test, Under Load	----	----	0.50	-55	5
End of Test	0.50	0.30	----	-55	5

NOTE All values in dB.

Figure 3

2.3. Initial Optical Performance - All Test Groups

All insertion loss and reflectance measurements met the specification requirements. Insertion loss and reflectance were measured at 1310 nm and 1550 nm for all test groups. See Appendix I, Figures 1 and 2.

2.4. Loss, Loss Increase, Reflectance, and Reflectance Increase - All Test Groups

All insertion loss, reflectance, loss increase and reflectance increase measurements met the specification requirements initially and for each test. All measurements were recorded at 1310 nm and 1550 nm wavelengths. Values shown in Figure 4 represent maximum Loss, Mean Loss, Loss Increase, Reflectance, and Reflectance Increase for each of the tests.

Test Description	Test Criteria	Requirement (dB)	Actual - 1310 nm		Actual - 1550 nm		Test Result
			Cable A	Cable B	Cable A	Cable B	
New Product Performance	Maximum Loss	0.40	0.18	0.13	0.09	0.15	Pass
	Mean Loss	0.20	0.05	0.04	0.05	0.04	Pass
	Maximum Reflectance	-55.0	-56.7	-55.9	-56.7	-57.1	Pass
Twist	Maximum Loss	0.50	0.12	0.15	0.11	0.13	Pass
	Mean Loss	0.30	0.02	0.05	0.05	0.04	Pass
	Loss Increase	0.30	0.02	0.13	0.01	0.03	Pass
	Maximum Reflectance	-55.0	-57.0	-56.0	-57.0	-57.0	Pass
	Reflectance Increase	5.0	0.2	1.0	0.1	0.7	Pass
Flex	Maximum Loss	0.50	0.14	0.14	0.1	0.14	Pass
	Mean Loss	0.30	0.05	0.05	0.05	0.04	Pass
	Loss Increase	0.30	0.03	0.05	0.01	0.02	Pass
	Maximum Reflectance	-55.0	-57.0	-55.9	-56.9	-57.0	Pass
	Reflectance Increase	5.0	0.4	0.6	1.1	0.1	Pass
Proof	Maximum Loss	0.50	0.08	0.14	0.11	0.14	Pass
	Mean Loss	0.30	0.03	0.04	0.05	0.04	Pass
	Loss Increase	0.30	0.04	0.03	0.03	0.03	Pass
	Maximum Reflectance	-55.0	-56.3	-55.8	-56.8	-57.2	Pass
	Reflectance Increase	5.0	3.8	0.9	0.3	0.6	Pass
Transmission With Applied Load	Loss Increase	0.50	0.06	0.09	0.47	0.42	Pass
	Maximum Reflectance	-55.0	-56.34	-56.0	-55.7	-56.1	Pass
	Reflectance Increase	5.0	0.5	1.3	2.0	3.2	Pass

Figure 4
Loss, Loss Increase, Reflectance, and Reflectance Increase Summary Results

2.5. Flex

There was no evidence of physical damage to the connector or cable. Loss, Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 3, before and after flex testing. Optical performance was measured at 1310 and 1550 nm. See Appendix, Figures 3 and 4 for Loss Increase Results.

2.6. Twist

There was no evidence of physical damage to the connector or cable. Loss, Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 3, before and after the twist test. Optical performance was measured at 1310 and 1550 nm. See Appendix, Figures 3 and 4 for Loss Increase Results.

2.7. Proof - Straight Pull and Side Pull

There was no evidence of physical damage to the connector or cable assembly during or after test. Loss, Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 3, before and after test. Optical performance was measured at 1310 and 1550 nm. See Appendix, Figure 5 and 6 for Loss Increase Results.

2.8. Transmission with Applied Load - Axial Load

There was no evidence of physical damage to the connector or cable assembly during or after test. Loss, Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 3, before, during, and after test. Optical performance was measured at 1310 and 1550 nm. See Appendix, Figures 7 and 8 for Loss Increase Results.

2.9. Transmission with Applied Load - Side Load

There was no evidence of physical damage to the connector or cable assembly during or after test. Loss, Loss Increase, Reflectance and Reflectance Increase measurements met the specified limits, as stated in Figure 3, before, during, and after test. Optical performance was measured at 1310 and 1550 nm. See figure 9 and 10 for results.

3. TEST METHODS

All optical measurements were performed with the utilization of a singlemode test system. This measurement facility is compliant with Telcordia GR-326-CORE, Issue 3. Loss and reflectance were measured at 1310 nm and 1550 nm wavelengths. Following installation of the samples, 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. Flex

Specimens were subjected to 100 cycles of cable flexing at a rate of 15 cycles per minute. A 7.62 cm [3 in] mandrel was used to apply a tensile load of 0.6 kg [1.3 lbf] to jacketed cable at a point 50 cm [19.7 in] from the plug housing. The flex arc was ± 90 degrees from a vertical position. Optical performance was measured before and after test with the load removed.

3.3. Twist

Specimens were subjected to 10 manual cycles of twist at a rate less than 30 cycles per minute. A 7.62 cm [3 in] diameter mandrel was used to apply a tensile load of 15 N [3.4 lbf] to jacketed cable at a point 28 cm [11 in] from the plug housing. 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.

3.4. Proof

Specimens were subjected to a 4.5 kgf (10 lbf) axial load for a 5 second duration. The load was removed and optical measurements taken after a 20 seconds to allow the specimens to normalize. Subsequently, the specimens were subjected to a 1.5 kgf (3.3 lbf) side load and a 2.3 kgf (5.0 lbf) side load respectively, for Small Form Factor Connectors. The loads were removed and optical measurements taken after 20 seconds to allow the specimens to normalize.

3.5. Transmission with Applied Load

Specimens were subjected to Small Form Factor Connector Tensile Loads for Type 1 Media. Specimens from both test groups were subjected to axial loads of 0.25 kgf (0.55 lbf), 0.7 kgf (1.54 lbf), 1.5 kgf (3.3 lbf), and 2.0 kgf (4.4 lbf) and side loads of 0.17 kgf (0.37 lbf), 0.47 kgf (1.0 lbf), 1.0 kgf (2.2 lbf), and 1.3 kgf (2.9 lbf). Loss and Reflectance were measured at both 1310 nm and 1550nm wavelengths before application of the load and again when each combination of load and angle. Loads were applied until stability or equilibrium was reached before measurements were made. The end of test measurements were not made until at least 20 seconds after the load had been removed to allow the specimens to normalize.

APPENDIX

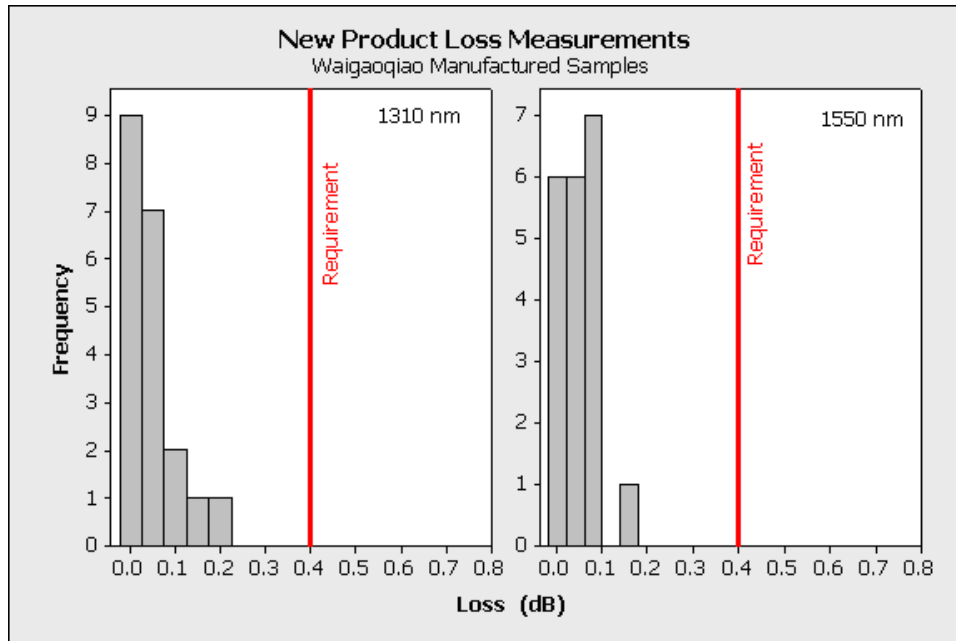


Figure 1
New Product Loss Measurements

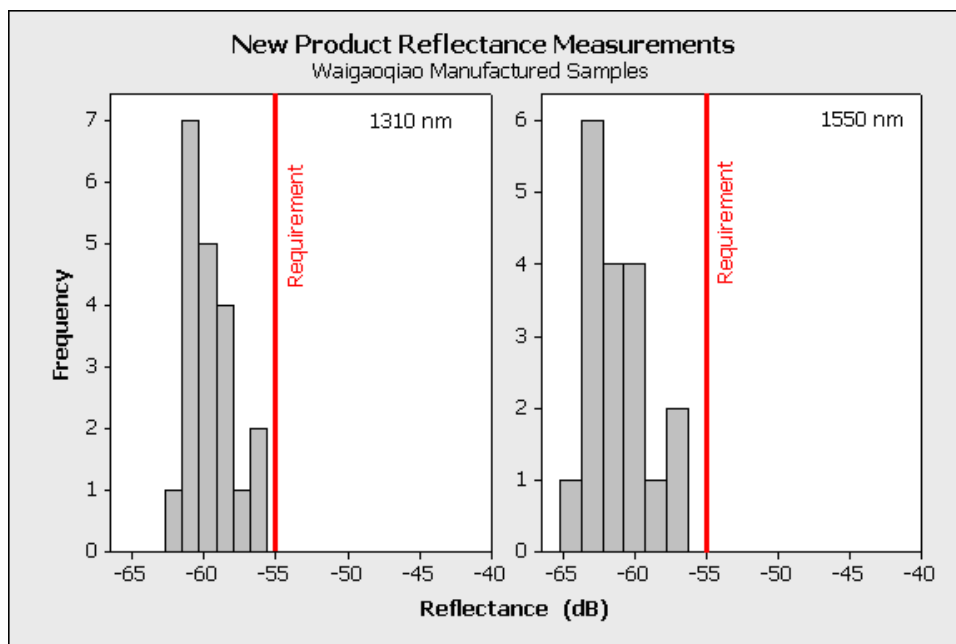


Figure 2
New Product Reflectance Measurements

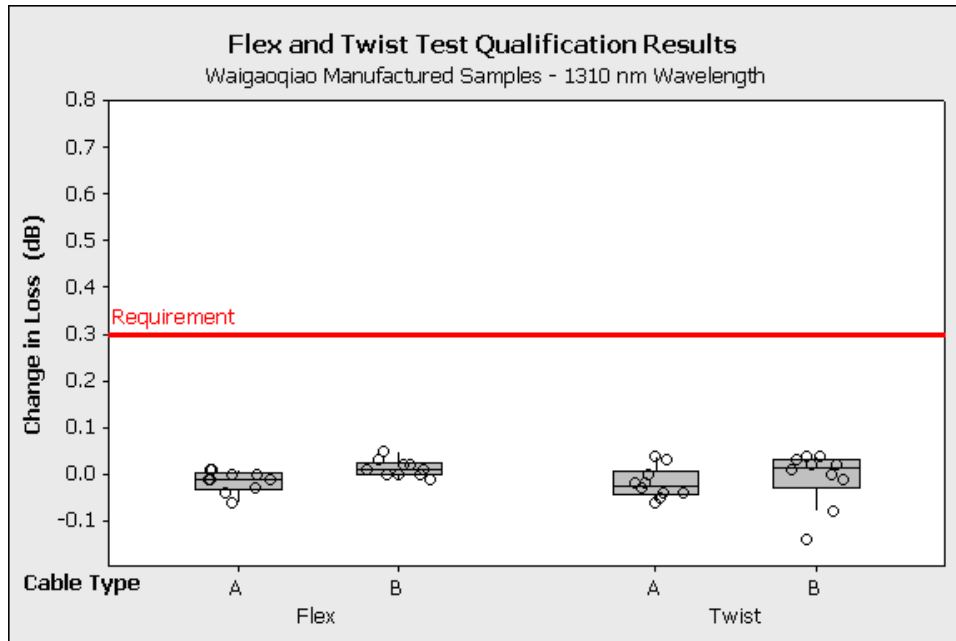


Figure 3
Flex and Twist Results at 1310 nm Wavelength

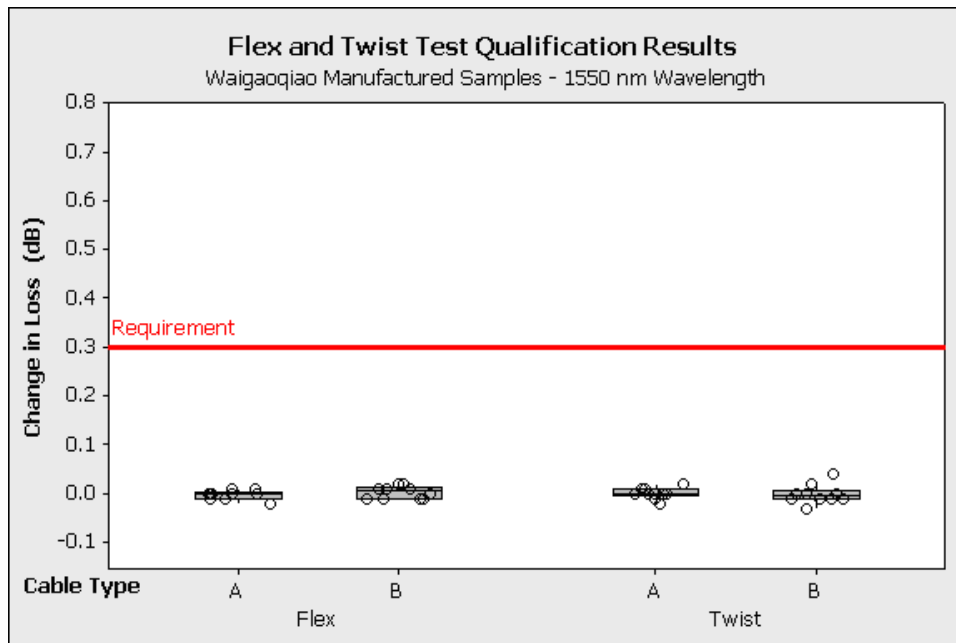


Figure 4
Flex and Twist Results at 1550 nm Wavelength

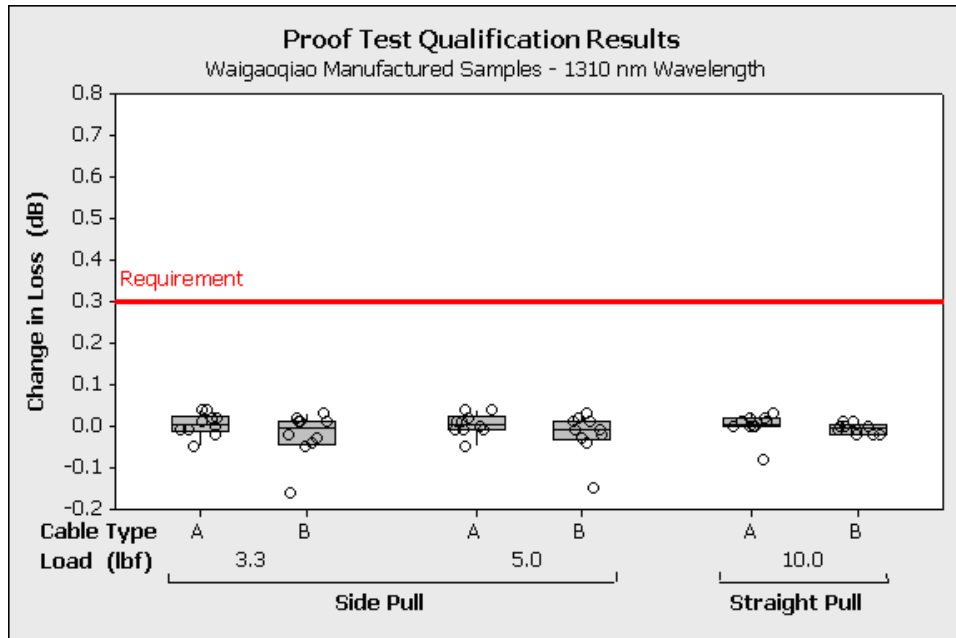


Figure 5
Proof Results at 1310 nm Wavelength

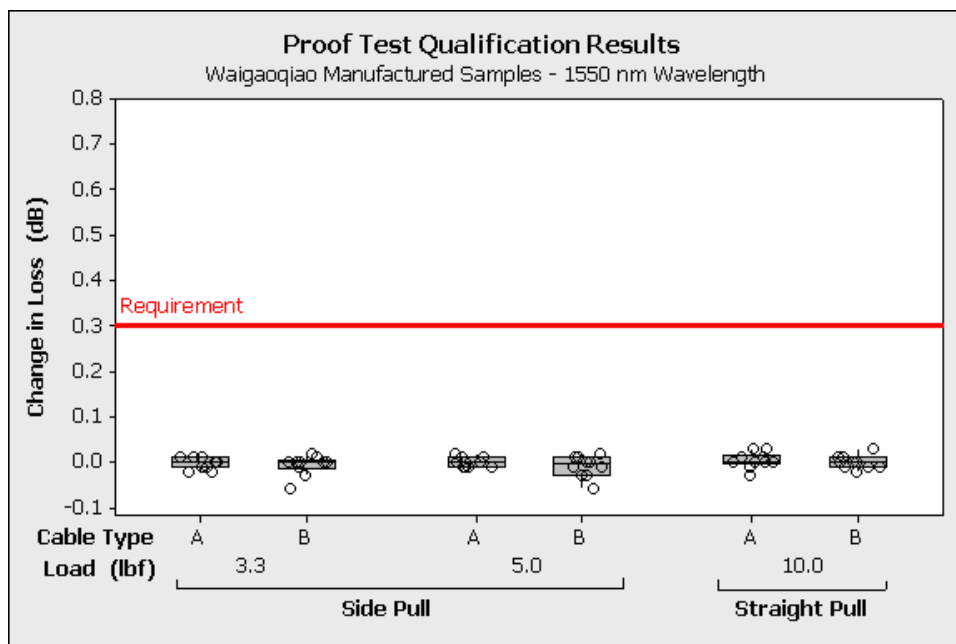


Figure 6
Proof Results at 1550 nm Wavelength

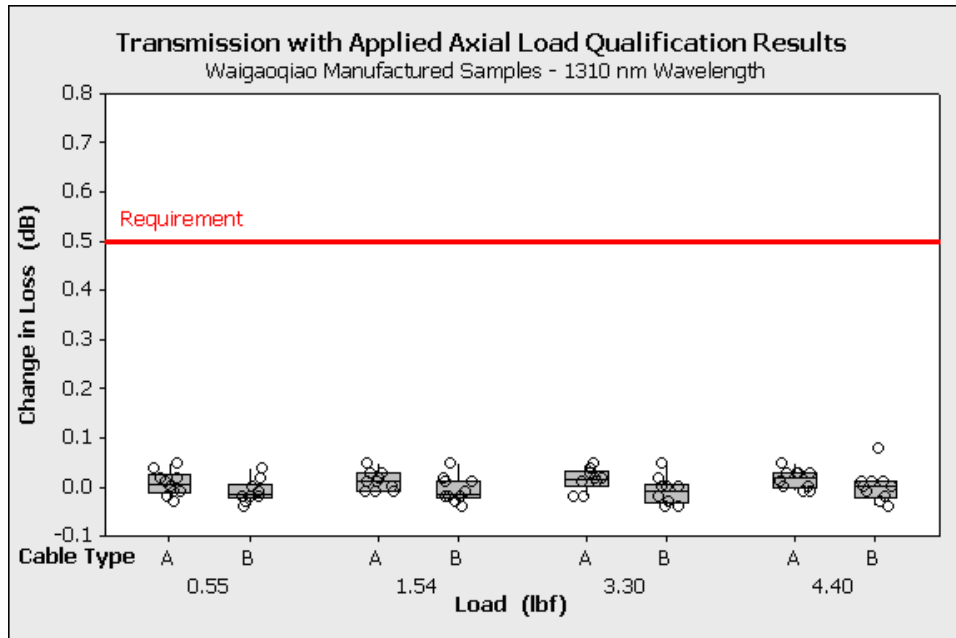


Figure 7
 0 Degree Transmission with Applied Load Results at 1310 nm Wavelength

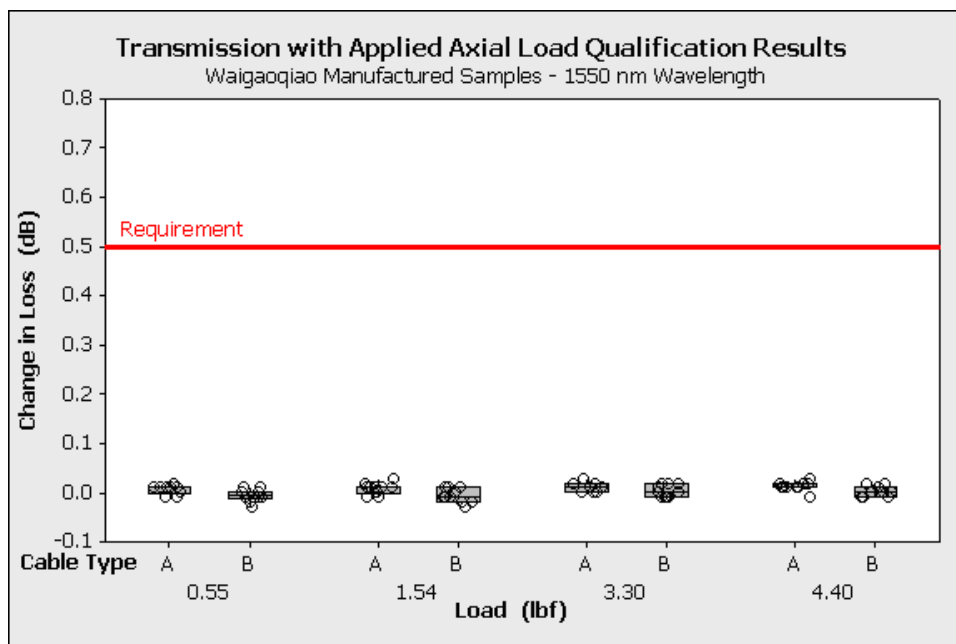


Figure 8
 0 Degree Transmission with Applied Load Results at 1550 nm Wavelength

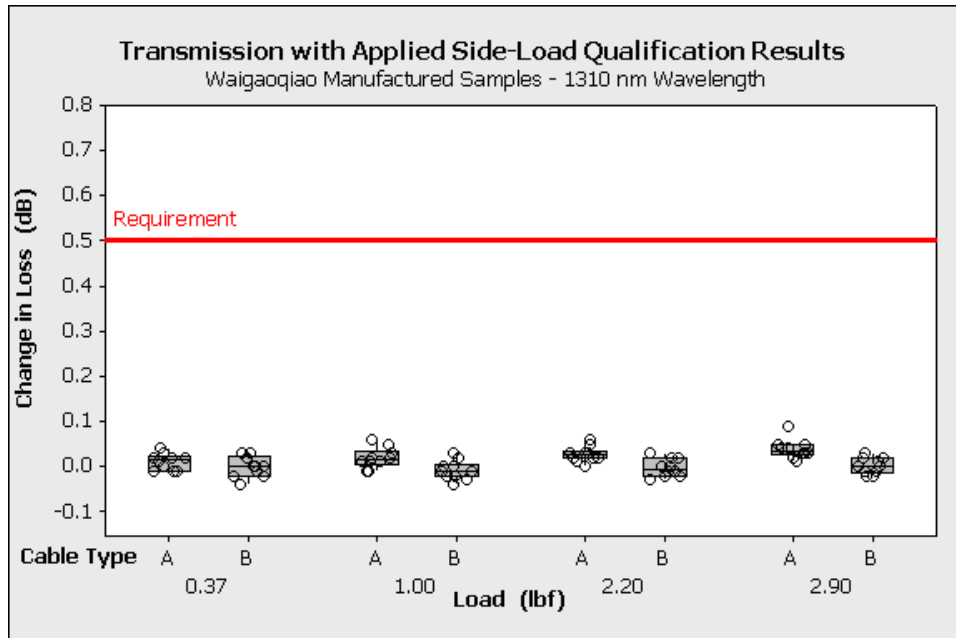


Figure 9
 90 Degree Transmission with Applied Load Results at 1310 nm Wavelength

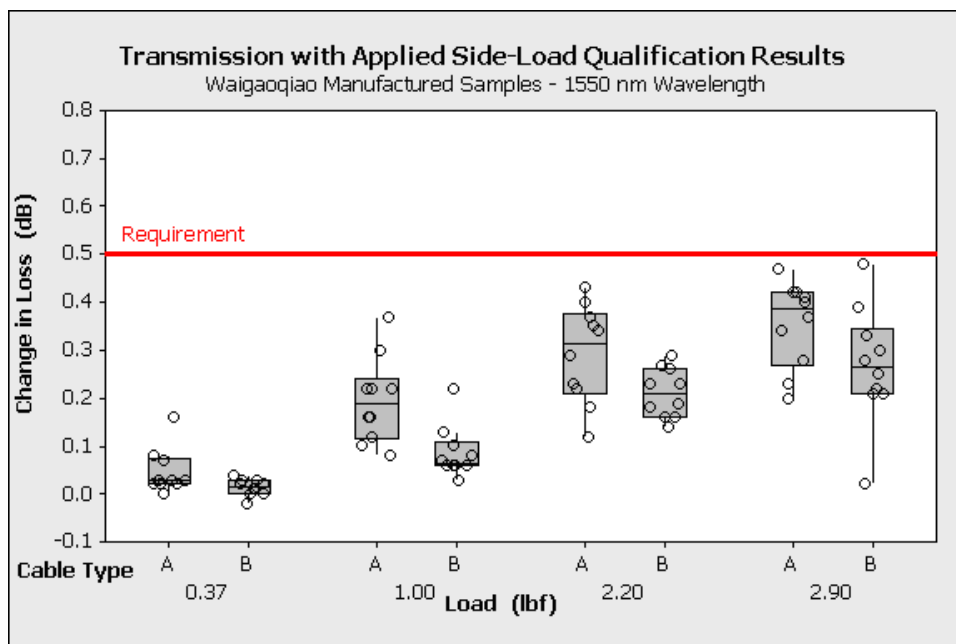


Figure 10
 90 Degree Transmission with Applied Load Results at 1550 nm Wavelength