3M™ 6900 Multimode SC Crimplok Connector

Technical Report

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1.0 Product Description & Requirements

The 3M™ SC Crimplok™ Connector is designed to provide the customer with an easily installed, high performance, low-cost, epoxy-free, pull-proof multimode connector for use in indoor applications, such as local area networks. The main advantage of this connector is it's ability to give the customer a lower installed cost due to time saved at installation with a minimal initial investment in tooling.

Some mechanical connectors grip the fiber buffer coating which results in poor performance characteristics in initial insertion loss measurements, as well as during temperature cycling. Reliability of this method is also questionable due to differences in buffer coating materials encountered with different manufacturers and the tolerances involved. Other mechanical connectors grip the glass portion of the fiber with soft compliant materials, such as plastics, which have demonstrated poor performance characteristics at initial insertion loss and during temperature cycle testing. Reliability is again questionable due to the nature of the materials involved, which provide the grip onto the glass fiber.

The 3M SC Crimplok Connector grips the glass fiber with a small Fiberlok™-style element that is integrated inside the backbone of the SC connector version. Activation of the element is achieved by depressing an element cap located in the SC backbone. The 6955-T Crimplok Activation Tool, which is part of the new 6955 kit, activates the element cap and secures the fiber. The tool also sets the amount of fiber protrusion within strict tolerance limits for faster polishing times. The connector is removed, and a simple one step polish is performed on a fine grit lapping film that requires less than 30 seconds to complete. The connector is then ready for use.

2.0 Test Program

The purpose of the test program is to assess the long-term performance of the 3M SC Crimplok fiber optic connector product. A series of optical, environmental and mechanical tests were conducted, which expose them to conditions more severe than those anticipated in actual use. All tests are performed in accordance with TIA-568A. Field mount Crimplok connectors in the evaluation were obtained directly from 3M factory stock, assembled on cable, and spliced into the test system. A list of tests performed is presented below.

New Product	Environmental Group 0	Mechanical Group 1	Mechanical Group 2
New Product	Cold	Impact	Vibration
	Temperature Life	Flex	Connector Durability
	Humidity	Twist	Connector Intermatability
		Cable Retention	

Sample Preparation:

The SC Crimplok Connectors were cleaved using the Model 6955-T Crimplok Activation Tool, and were processed according to the Crimplok Instruction Manual P/N 78-8073-7660-9, Issue 2, July 1997. The fiber protrusion specification after cleaving is 105 ± 25 µm (using the 6955-T activation tool), and the final fiber protrusion specification after polishing is 10-50 µm (typical values range from 15-40 µm).

The SC Crimplok Connectors tested in this report had a fiber protrusion range of 95-122 µm after cleaving, and the final fiber protrusions after polishing were:

Mean ..... 28.6 (µm)
Sigma 4.6
Minimum 22.0
Maximum 40.0

2.1 New Product

Procedure:

The plugs and couplings for pretest measurements were cleaned as described in section 1.7.4 of the TIA-568A. Measurements of loss and return loss at wavelengths of 850 nm and 1310 nm were performed at ambient conditions before any environmental testing.

Sample Size: 30

Results:

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**
850	0.11	0.07	-27.8	3.1
1310	0.13	0.06	-28.9	1.6

2.2 Cold (Group 0)

Procedure:

Measurements of loss and return loss at 850 nm and 1310 nm wavelengths are performed at the start and the finish of the test at 22°C. The test samples are subjected to 96 hours (4 days) at -10°C. Additional measurements are made every 15 min. at -10°C during test to monitor performance.

Sample Size: 10

Results:

LOSS (dB)

Wavelength	Initial Mean	Initial Std. dev.	Mean During	Std. Dev. During	Mean Final	Std. Dev. Final
850	0.11	0.07	0.16	0.06	0.16	0.06
1310	0.13	0.06	0.10	0.05	0.11	0.06

RETURN LOSS (dB)

Wavelength	Initial Mean	Initial Std. dev.	Mean During	Std. Dev. During	Mean Final	Std. Dev. Final
850	-27.8	3.1	-31.40	1.64	-31.32	1.73
1310	-28.9	1.6	-31.32	0.67	-28.32	0.70

2.3 Temperature Life (Group 0)

Procedure:

Testing is performed on samples after exposure to the Cold Test. Measurements of loss and return loss at 850 nm and 1310 nm wavelengths are performed at the start and finish of test at 22°C. The test samples are subjected to 336 hours (14 days) at 60°C. Additional measurements are made every hour at 60°C during test to monitor performance.

Sample Size: 10

Results:

LOSS (dB)

Wavelength	Initial Mean	Initial Std. Dev.	Mean During	Std. dev. During	Mean Final	Std. Dev. Final
850	0.16	0.06	0.17	0.06	0.17	0.06
1310	0.10	0.05	0.12	0.05	0.13	0.06

RETURN LOSS (dB)

Wavelength	Initial Mean	Initial Std. Dev.	Mean During	Std. Dev. During	Mean Final	Std. Dev. Final
850	-31.25	1.72	-31.76	1.77	-30.72	1.88
1310	-28.10	0.68	-27.70	1.00	-27.64	1.08

2.4 Humidity (Group 0)

Procedure:

Testing is performed on samples after exposure to the Temperature Life Test. Measurements of loss and return loss at 850 nm and 1310 nm wavelengths are performed at the start and finish of the test at 22°C, and every 15 min. during the test at 40°C with 90%-95% Relative Humidity.

Sample Size: 10

Results:

LOSS (dB)

Wavelength	Initial Mean	Initial Std. Dev.	Mean During	Std. Dev. During	Mean Final	Std. Dev. Final
850	0.17	0.06	0.17	0.06	0.18	0.06
1310	0.12	0.06	0.11	0.06	0.13	0.06

RETURN LOSS (dB)

Wavelength	Initial Mean	Initial Std. Dev.	Mean During	Std. Dev. During	Mean Final	Std. Dev. Final
850	-31.12	1.72	-30.72	1.68	-31.00	1.76
1310	-28.19	0.82	-27.71	0.80	-27.97	0.87

3.0 Mechanical Tests (Group 1)

3.1 Impact

Procedure:

The connector is placed in the impact test fixture. The connector is raised to the horizontal position and released in a manner so that it strikes a concrete block. This is repeated 8 times, then cleaned and measured for loss and return loss. The connector is also inspected for any physical damage.

Sample Size: 10

Results:

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.17	0.08	-27.29	0.70
1310	0.31	0.09	-30.86	1.98

3.2 Flex

Procedure:

Testing was performed on samples subjected to the Impact Test. The connector - coupling is mounted onto the swingarm of the 3M Flex Tester. A 0.5kg load is attached to the cable 25 cm from the pivot point. The connector is then cycled through 0°, +90°, 0°, -90°, 0°, about the center axis of the connector for 100 cycles. At the completion of the test, the connector is measured for Insertion Loss and Return Loss.

Sample Size: 10

Results:

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.14	0.09	-26.68	1.98
1310	0.26	0.10	-30.81	0.70

3.3 Twist

Procedure:

Testing was performed on samples subjected to the Flex Test. The connector - coupling is mounted onto the swingarm of the 3M Flex Tester and the swingarm is locked in the 0° position. A 15 N (3.3 lbs.) load is attached to the cable 25 cm from the pivot point. The weight is rotated about the cable axis 2.5 revolutions in one direction, reversed for 5 revolutions, and reversed for 5 more revolutions for a total of 10 cycles. At the completion of the test, the connector is measured for Insertion Loss and Return Loss.

Sample Size: 10

Results:

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.15	0.06	-26.91	0.95
1310	0.22	0.09	-30.57	0.69

3.4 Cable Retention

Procedure:

Testing was performed on samples subjected to Twist Test. A coupling was secured to the traversing stage of an Instron tensile tester. At 0.3 m from the coupling/connector, the cable was secured to the stationary base by wrapping the cable 3 times around a 3" mandrel. A load of 15 lbs. @ 0° is applied to the connector for 5 seconds, then released. Additional testing was performed after the first cable Retention Test in the same manner, but with 4.5 lbs. @ 90°. Values for Insertion Loss and Return Loss are measured 10 seconds after releasing the load.

Sample Size: 10

Results:

(Cable Retention 15 lbs. @ 0°)

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.12	0.08	-26.76	0.84
1310	0.25	0.10	-30.49	0.82

(Cable Retention 4.5 lbs. @ 90°)

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.14	0.09	-26.81	0.80
1310	0.26	0.07	-30.52	0.80

4.0 Mechanical Tests (Group 2)

4.1 Vibration

Procedure:

Ten samples from group 2 were subjected to a Vibration Test from 10 to 55 Hz, 1.5 mm p-p amplitude. The samples were attached to the vibration table via a 10 port patch panel. The connectorized samples were tested in 3 axis (X, Y, Z) for 2 hours in each axis, at a sweep rate of 45 Hz per minute.

Sample Size: 10

Results:

LOSS (dB)

	Initial		After Vibration	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.06	0.03	0.04	0.04
1310	0.13	0.06	0.13	0.08

RETURN LOSS (dB)

	Initial		After Vibration	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	-24.38	1.19	-24.35	1.33
1310	-27.52	0.88	-27.42	0.96

4.2 Connector Durability

Procedure:

After the completion of the Vibration Test the 10 samples from group 2 were subjected to a Connector Durability Test to 500 insertions. One side of each of the connectorized samples was removed and inserted 500 times. Cleaning and measurements were performed every 25th insertion.

Sample Size: 10

Results:

LOSS (dB)

	Initial		After Connector Durability	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.04	0.04	0.06	0.04
1310	0.13	0.08	0.15	0.07

RETURN LOSS (dB)

	Initial		After Connector Durability	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	-24.35	1.33	-23.93	0.93
1310	-27.42	0.96	-27.50	0.89

4.3 Connector Intermatibility

Procedure:

This test is not a requirement of TIA-568A and is performed to demonstrate compatibility of the Crimplok™ connector to standard epoxy connectors. After completion of the Connector Durability Test, the 10 samples from group 2 were subjected to a connector intermatability. One side of each conectorized samples was removed and mated to a 3M Epoxy factory mount SC connector, then removed and inserted 10 times. Cleaning and measurements were performed after every insertion.

Sample Size: 10

Results:

	Loss (dB)		Return Loss (dB)	
Wavelength	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
850	0.06	0.04	-24.0	1.06
1310	0.15	0.07	-27.6	1.07

5.0 Conclusion

Throughout this test program the 3M™ SC Crimplok™ Fiber Optic Connector meets or exceeds all targeted performance requirements. The excellent test results demonstrate the low insertion loss, environmental stability and physical robustness of this optical fiber termination method, helping ensure a reliable voice and/or data transmission circuit.

For information concerning specific agency approvals please contact your 3M Telecom representative.

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