

# **3M** Technical Report

## 3M™ No Polish Multimode Connector

## **1.0 Product Description & Requirements**

The 3M™ No Polish Connector, (NPC), enables fast on-site installation of 250µm and 900µm multimode connections utilizing a one piece pre-assembled design. The SC compatible connector incorporates a factory-polished ferrule and a mechanical splice that makes the connector easily terminated with a simple field tool. Systems integrators and installers will find this connector to be one of the easiest ways to make field terminations for business and home network installations.

<b>Product Number</b>	<b>Product Description</b>	<b>Stock Number</b>
6800-50	NO POLISH CONNECTOR SC MM 50UM 250/ 900	80611323967
6800-50/LOMMF	NO POLISH CONNECTOR SC MM 50UM LOMMF 250/ 900	80611323975
6800-62.5	NO POLISH CONNECTOR SC MM 62.5UM PLUG 250/ 900	80611323983

## **2.0 Test Program**

The purpose of the test program is to assess the long-term performance of the 3M multimode NPC fiber optic connector product. Connectors were assembled on three types of 900um buffered fiber: 50/125µm laser optimized multimode fiber, (LOMMF), 50/125µm standard fiber, and 62.5/125µm standard fiber. A series of optical, environmental and mechanical tests were conducted which exposed them to conditions more severe than those anticipated in actual use. All tests are performed in accordance with TIA/EIA-568-B.3. A list of tests performed is presented below.

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

## **2.1 New Product**

Sample Size: 24 NPC connector pairs assembled on standard 50/125µm fiber  
24 NPC connector pairs assembled on LOMMF 50/125µm fiber  
24 NPC connector pairs assembled on standard 62.5/125µm fiber

### **Procedure:**

The plugs and couplings for pretest measurements were cleaned as described in section 1.7.4 of TIA-568A. Measurements of insertion loss and reflection at wavelengths of 850nm and 1300nm were performed at ambient conditions before any environmental testing.

### Results: NPC Connector 50um Standard Fiber

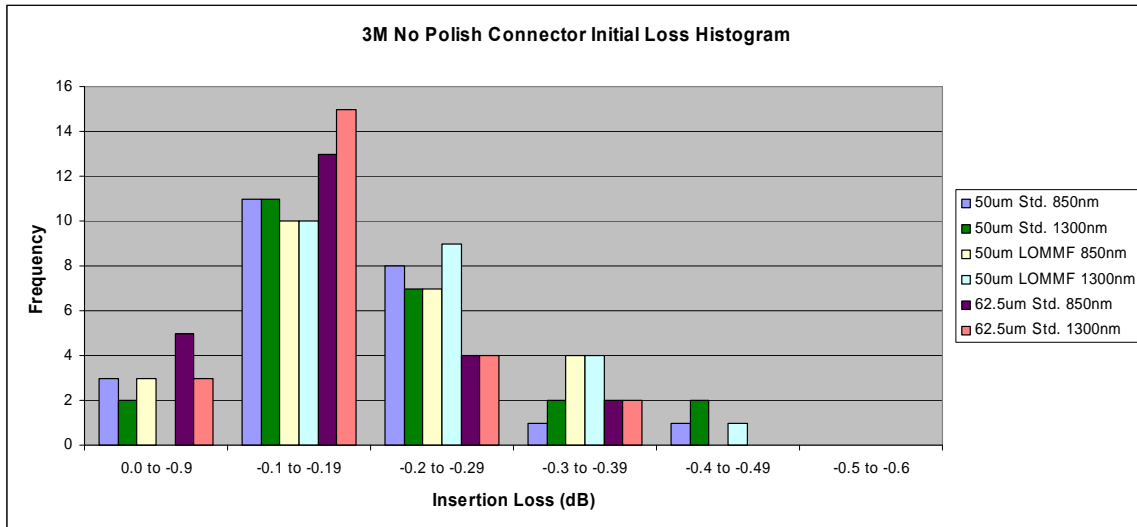
$\lambda$ (nm)	Insertion Loss (dB)			Reflection (dB)		
	Initial Mean	Initial Standard Dev.	Max Insertion Loss	Initial Mean	Initial Standard Dev.	Max Reflection
1300	-0.19	0.09	-0.40	-31.19	2.74	-22.56
850	-0.21	0.10	-0.45	-30.42	2.63	-21.90

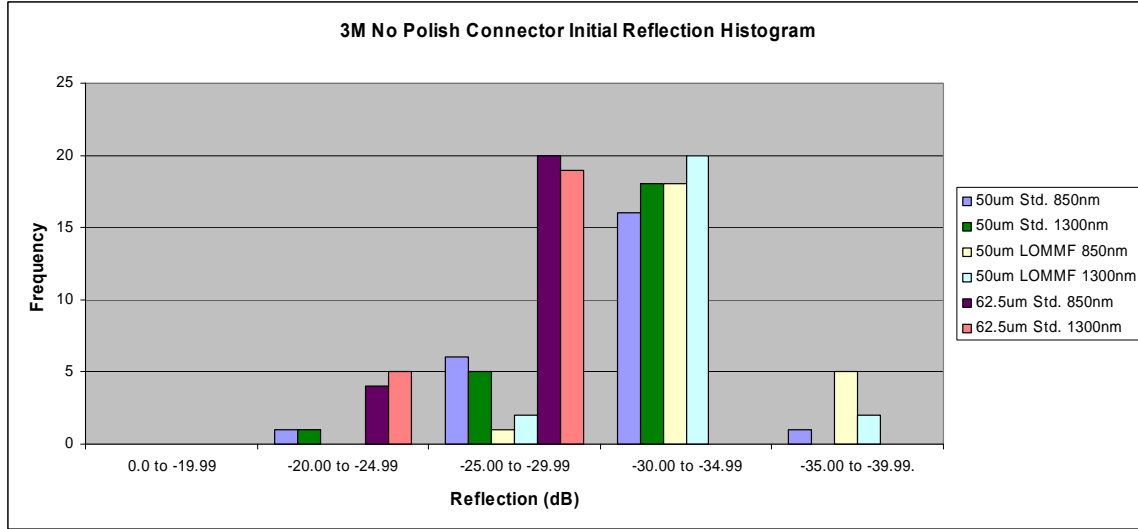
### Results: NPC Connector 50um LOMMF Fiber

$\lambda$ (nm)	Insertion Loss (dB)			Reflection (dB)		
	Initial Mean	Initial Standard Dev.	Max Insertion Loss	Initial Mean	Initial Standard Dev.	Max Reflection
1300	-0.20	0.08	-0.38	-33.45	1.76	-29.29
850	-0.22	0.08	-0.40	-32.64	1.95	-28.36

### Results: NPC Connector 62.5um Standard Fiber

$\lambda$ (nm)	Insertion Loss (dB)			Reflection (dB)		
	Initial Mean	Initial Standard Dev.	Max Insertion Loss	Initial Mean	Initial Standard Dev.	Max Reflection
1300	-0.16	0.07	-0.33	-26.37	1.39	-22.87
850	-0.17	0.07	-0.33	-25.91	1.59	-21.45





## 2.2 Cold (Group 0)

Sample Size: 8 NPC connector pairs assembled on standard 50/125µm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125µm fiber  
 8 NPC connector pairs assembled on standard 62.5/125µm fiber

### Procedure:

Measurements of insertion loss and reflection at 850nm and 1300nm 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 0°C. Additional measurements are made every 30 min. at 0°C during test to monitor performance.

### Results: NPC Connector 50µm Standard Fiber

#### Insertion Loss - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.21	0.13	-0.26	0.01	-0.21	0.13	-0.51
850	-0.26	0.14	-0.31	0.01	-0.27	0.14	-0.57

#### Reflection - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-30.51	4.11	-30.73	0.07	-30.29	4.06	-22.47
850	-30.13	4.05	-30.62	0.11	-29.91	3.94	-21.90

**Results: NPC Connector 50um LOMMF Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.22	0.11	-0.24	0.01	-0.22	0.10	-0.44
850	-0.25	0.09	-0.27	0.01	-0.26	0.09	-0.46

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-34.50	1.43	-34.45	0.07	-34.49	1.42	-31.53
850	-33.73	1.56	-34.44	0.13	-33.69	1.58	-30.72

**Results: NPC Connector 62.5um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.15	0.08	-0.18	0.01	-0.16	0.09	-0.39
850	-0.17	0.07	-0.20	0.01	-0.18	0.10	-0.38

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-26.23	1.72	-26.34	0.05	-26.31	1.71	-22.87
850	-25.59	2.16	-25.89	0.06	-25.66	2.14	-21.45

**2.3 Temperature Life (Group 0)**

Sample Size: 8 NPC connector pairs assembled on standard 50/125 $\mu$ m fiber  
 8 NPC connector pairs assembled on LOMMF 50/125 $\mu$ m fiber  
 8 NPC connector pairs assembled on standard 62.5/125 $\mu$ m fiber

**Procedure:**

Testing is performed on samples after exposure to the Cold test. Measurements of insertion loss and reflection at 850nm and 1300nm 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 60°C. Additional measurements are made every hour at 60°C during test to monitor performance.

**Results: NPC Connector 50um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.21	0.12	-0.21	0.01	-0.24	0.11	-0.41
850	-0.26	0.14	-0.27	0.01	-0.29	0.13	-0.48

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-30.54	4.14	-29.11	0.25	-29.84	3.99	-21.54
850	-29.91	3.91	-28.44	0.25	-29.25	3.85	-20.50

**Results: NPC Connector 50um LOMMF Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.22	0.10	-0.22	0.00	-0.23	0.11	-0.39
850	-0.25	0.09	-0.25	0.01	-0.26	0.09	-0.41

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-34.48	1.44	-33.98	0.28	-34.21	1.31	-32.08
850	-33.70	1.62	-31.84	0.42	-33.48	0.98	-26.30

**Results: NPC Connector 62.5um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.16	0.09	-0.16	0.00	-0.18	0.09	-0.36
850	-0.18	0.09	-0.19	0.00	-0.20	0.10	-0.36

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-26.34	1.75	-25.45	0.23	-26.11	1.65	-22.46
850	-25.79	2.08	-24.03	0.28	-25.22	2.07	-20.01

## 2.4 Humidity (Group 0)

Sample Size: 8 NPC connector pairs assembled on standard 50/125 $\mu$ m fiber  
 8 NPC connector pairs assembled on LOMMF 50/125 $\mu$ m fiber  
 8 NPC connector pairs assembled on standard 62.5/125 $\mu$ m fiber

### Procedure:

Testing is performed on samples after exposure to the Temperature Life test. Measurements of insertion loss and reflection at 850nm and 1300nm wavelengths are performed at the start and the finish of the test at 22°C and every 30 min. during the test. The test samples are subjected to 96 hours (4 days) at 40°C, 90-95%RH.

### Results: NPC Connector 50 $\mu$ m Standard Fiber

#### Insertion Loss - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.24	0.11	-0.25	0.01	-0.25	0.11	-0.42
850	-0.29	0.13	-0.30	0.00	-0.30	0.13	-0.49

#### Reflection - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-29.87	4.08	-29.43	0.09	-29.89	3.98	-21.36
850	-29.59	3.66	-29.47	0.07	-29.64	3.60	-21.94

### Results: NPC Connector 50 $\mu$ m LOMMF Fiber

#### Insertion Loss - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.23	0.11	-0.23	0.00	-0.24	0.10	-0.42
850	-0.25	0.09	-0.25	0.00	-0.26	0.08	-0.41

#### Reflection - dB

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-34.19	1.20	-33.13	0.14	-34.03	1.16	-31.44
850	-33.56	0.87	-32.86	0.10	-33.45	0.84	-31.47

**Results: NPC Connector 62.5um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Insertion Loss
1300	-0.18	0.09	-0.19	0.01	-0.18	0.08	-0.38
850	-0.20	0.10	-0.22	0.01	-0.20	0.09	-0.40

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Mean During	Standard Dev. During	Final Mean	Final Standard Dev.	Max Reflection
1300	-26.13	1.62	-25.79	0.08	-26.03	1.60	-22.85
850	-25.36	2.05	-25.03	0.08	-25.25	2.04	-21.22



### **3.0 Mechanical Tests (Group 1)**

#### **3.1 Flex**

Sample Size: 8 NPC connector pairs assembled on standard 50/125µm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125µm fiber  
 8 NPC connector pairs assembled on standard 62.5/125µm fiber

##### **Procedure:**

The connector - coupling is mounted onto the swing arm of the 3M Flex Tester. A 0.5 lb. load is attached to the cable 25cm 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 reflection.

#### **Results: NPC Connector 50um Standard Fiber**

##### **Initial**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.17	0.06	-0.28	-0.19	0.08	-0.30

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-31.27	2.18	-28.74	-30.01	2.02	-26.35

#### **Results: NPC Connector 50um LOMMF Fiber**

##### **Flex**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.21	0.08	-0.33	-0.22	0.07	-0.31

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-33.83	1.24	-31.62	-32.77	2.07	-29.46

#### **Results: NPC Connector 62.5um Standard Fiber**

##### **Flex**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.16	0.05	-0.21	-0.16	0.05	-0.24

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-26.58	1.38	-23.56	-26.09	1.47	-22.88

## 3.2 Twist

Sample Size: 8 NPC connector pairs assembled on standard 50/125µm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125µm fiber  
 8 NPC connector pairs assembled on standard 62.5/125µm fiber

### Procedure:

Testing was performed on samples subjected to the Flex test. The connector - coupling is mounted onto the swing arm of the 3M Flex Tester and the swing arm is locked in the 0° position. A 2.2 N (0.5 lbs.) load is attached to the cable 25cm 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 reflection.

### Results: NPC Connector 50µm Standard Fiber

#### Twist

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.19	0.07	-0.33	-0.21	0.07	-0.35

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-31.23	2.22	-28.64	-29.96	2.02	-26.31

### Results: NPC Connector 50µm LOMMF Fiber

#### Twist

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.21	0.08	-0.36	-0.22	0.08	-0.36

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-33.65	1.69	-30.04	-32.37	2.44	-28.18

### Results: NPC Connector 62.5µm Standard Fiber

#### Twist

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.16	0.06	-0.24	-0.16	0.05	-0.24

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-26.41	1.33	-23.55	-26.03	1.46	-22.79

### 3.3 Cable Retention

Sample Size: 8 NPC connector pairs assembled on standard 50/125μm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125μm fiber  
 8 NPC connector pairs assembled on standard 62.5/125μm fiber

#### Procedure:

Testing was performed on samples subjected to the Twist test. A coupling was secured to the traversing stage of an Instron tensile tester. At 0.3m from the socket - connector, the cable was secured to the stationary base by wrapping the cable 3 times around a 3" mandrel. A load of 0.5 lbs. @ 0° is applied to the connector for 5 seconds, and then released. Additional testing was performed after the first cable Retention Test in the same manner, but with 0.5 lbs. @ 90°. Values for insertion loss and reflection are measured 10 seconds after releasing the load.

#### Results: NPC Connector 50um Standard Fiber

Cable ret. @ 0°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.18	0.06	-0.29	-0.20	0.07	-0.30

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-31.24	2.23	-28.65	-29.96	2.02	-26.33

#### Results: NPC Connector 50um LOMMF Fiber

Cable ret. @ 0°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.22	0.07	-0.32	-0.22	0.07	-0.31

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-33.84	1.25	-31.57	-32.64	1.99	-29.41

#### Results: NPC Connector 62.5um Standard Fiber

Cable ret. @ 0°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.15	0.05	-0.22	-0.15	0.05	-0.24

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-26.50	1.37	-23.51	-26.01	1.38	-22.89

**Results: NPC Connector 50um Standard Fiber**

Cable ret. @ 90°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.18	0.06	-0.30	-0.20	0.07	-0.32

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-31.21	2.24	-28.65	-29.94	2.03	-26.30

**Results: NPC Connector 50um LOMMF Fiber**

Cable ret. @ 90°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.21	0.07	-0.33	-0.22	0.07	-0.31

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-33.83	1.25	-31.56	-32.64	1.99	-29.41

**Results: NPC Connector 62.5um Standard Fiber**

Cable ret. @ 90°

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.15	0.06	-0.21	-0.16	0.06	-0.25

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-26.45	1.32	-23.57	-25.96	1.33	-22.91

**3.4 Impact**

Sample Size: 8 NPC connector pairs assembled on standard 50/125µm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125µm fiber  
 8 NPC connector pairs assembled on standard 62.5/125µm fiber

**Procedure:**

Testing was performed on samples subjected to the cable retention tests. 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 struck a concrete block. This was repeated 8 times, then cleaned and measured for insertion loss and reflection. The connector is also inspected for any physical damage.

**Results: NPC Connector 50um Standard Fiber****Impact**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.11	0.17	-0.21	-0.12	0.18	-0.24

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-22.95	22.67	32.91	-22.39	21.31	30.12

**Results: NPC Connector 50um LOMMF Fiber****Impact**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.23	0.07	-0.34	-0.24	0.07	-0.32

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-33.75	1.12	-31.56	-32.34	1.92	-28.82

**Results: NPC Connector 62.5um Standard Fiber****Impact**

Insertion Loss (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-0.16	0.05	-0.23	-0.17	0.05	-0.26

Reflection (dB)					
1300nm			850nm		
Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
-26.35	1.41	-23.49	-25.80	1.43	-22.96

**4.0 Mechanical Tests (Group 2)****4.1 Connector Durability**

Sample Size: 8 NPC connector pairs assembled on standard 50/125µm fiber  
 8 NPC connector pairs assembled on LOMMF 50/125µm fiber  
 8 NPC connector pairs assembled on standard 62.5/125µm fiber

**Procedure:**

24 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. Insertion loss and reflection were recorded before after the first and after the 500<sup>th</sup> insertion.

**Results: NPC Connector 50um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-0.18	0.05	-0.23	0.05
850	-0.19	0.05	-0.25	0.07

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-31.80	1.44	-30.67	1.12
850	-31.11	1.18	-29.89	1.37

**Results: NPC Connector 50um LOMMF Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-0.19	0.07	-0.23	0.06
850	-0.21	0.07	-0.24	0.08

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-32.01	1.74	-31.40	2.14
850	-31.56	1.83	-31.37	2.07

**Results: NPC Connector 62.5um Standard Fiber****Insertion Loss - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-0.17	0.09	-0.21	0.08
850	-0.18	0.09	-0.23	0.08

**Reflection - dB**

$\lambda$ (nm)	Initial Mean	Initial Standard Dev.	Final Mean	Final Standard Dev.
1300	-26.37	1.02	-25.54	1.47
850	-26.10	1.04	-25.27	1.55

## **5.0 Conclusion**

Throughout this test program the 3M No Polish Multimode Fiber Optic Connector met or exceeded targeted performance requirements. The excellent test results demonstrate the low insertion loss, environmental stability and physical robustness of this optical fiber termination method. This connector will ensure a reliable voice and/or data transmission circuit.

For information concerning specific agency approvals please contact your 3M Communication Markets sales representative or call 800-426-8688.

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