# CONNECTOR, FSD™, MULTIMODE POLYMER FERRULE, FIBER OPTIC

## 1. Introduction

### 1.1 Purpose

Testing was performed on AMP® FSD, Multimode Polymer Ferrule, Fiber Optic Connector to determine its conformance to the requirements of AMP® Product Specification 108-1507 Rev. A.

### 1.2 Scope

This report covers the optical, mechanical, and environmental performance of the FSD, Multimode Polymer Ferrule, Fiber Optic Connector manufactured by the Optical Connectors & Assemblies Division. The testing was performed between February 14, 1994 and December 13, 1994.

### 1.3 Conclusion

The FSD, Multimode Polymer Ferrule, Fiber Optic Connector, listed in paragraph 1.5, meet the optical, mechanical, and environmental performance requirements of AMP® Product Specification 108-1507 Rev A.

### 1.4 Product Description

The FSD Multimode Polymer Ferrule Fiber Optic Connector is a multimode connector used in communication networks and equipment.

### 1.5 Test Samples

The test samples were taken from current production. The fiber used in the following tests was multimode graded index optical fiber. The following sample quantities were used for each test group.

| Test Group | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Fiber size (microns/microns) | 62.5/125 | 62.5/125 | 62.5/125 | 50/125 | 100/140 |
| Cable type | LDD(a) | LDD(a) | Dualan(b) | LDD(a) | LDD(a) |
| Cable part number | 502086-1 | 502086-1 | 501749-1 | 502085-1 | 502087-1 |
| Connector kit part number | 503347-5 | 503347-5 | 503347-1 | 503347-5 | 503347-6 |
| Coupling bushing part number | 501926-1 | 501926-1 | 501926-1 | 501926-1 | 501926-1 |
| Test cable length (m) | 10 | 10 | 10 | 5 | 5 |
| Test samples required | 5 | 5 | 5 | 5 | 5 |
| Control cables required | 1 | 0 | 0 | 0 | 0 |

(a) Light Duty Dual, Zipcord Style, 3.0mm diameter
(b) Dualan, 4.75mm diameter


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1.6 Qualification Test Sequence

| Test or Examination | Test Groups | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Examination of product | 1 | 1 | 1 | 1 | 1 |
| Insertion loss | 2 | 2 | 2 | 2 | 2 |
| Temperature cycling | 3 | | | | |
| Humidity, steady state | 4 | | | | |
| Coupling mechanism strength | | 3 | | | |
| Cable retention | | 4 | 3 | | |
| Cable flexing | | 5 | 4 | | |
| Twist | | 6 | 5 | | |
| Durability | | 7 | | | |
| # Change in optical transmittance | 5 | 8 | 6 | | |

The numbers indicate sequence in which tests were performed.

# Change in Transmittance measured before, during and after Temperature Cycling, Humidity, Coupling Mechanism Strength, Cable Flexing, and Durability. Change in Transmittance measured before, and after Cable Retention, and Twist.

2. Summary of Testing

2.1 Examination of Product - All Groups

All samples submitted for testing were selected from normal current production lots. They were inspected and accepted by the Product Assurance Department of the Optical Connectors and Assemblies Division.

2.2 Insertion Loss - All Groups

The insertion loss of the test samples measured met the maximum allowed specification requirements. Insertion loss was measured at 1300nm for all test groups.

Insertion Loss - Requirements (dB)

| Fiber size (microns/microns) | 50/125 | 62.5/125 | 100/140 |
|---|---|---|---|
| Maximum allowed average of all values per test group | 0.7 | 0.5 | 0.5 |
| Maximum allowed individual value for any single sample | 1.5 | 0.9 | 0.9 |

Insertion Loss - Actual (dB)

| Group | Fiber size (microns/microns) | Group average | Single sample |
|---|---|---|---|
| 1 | 62.5/125 | 0.3 | 0.8 |
| 2 | 62.5/125 | 0.3 | 0.8 |
| 3 | 62.5/125 | 0.3 | 0.5 |
| 4 | 50/125 | 0.6 | 1.1 |
| 5 | 100/140 | 0.3 | 0.5 |

2.3 <u>Change in Optical Transmittance - Groups 1, 2 & 3</u>

**All change in optical transmittance measurements met the maximum allowed specification** requirements. Change in optical transmittance was measured at 1300nm for groups 1, 2 & 3.

Change in Optical Transmittance

| Gr# | Condition | Limits (during) | Limits (after) | Change (during) | Change (after) |
|---|---|---|---|---|---|
| 1 | Temperature cycling | -0.3 dB group average<br>-0.5 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | -0.1 group average<br>-0.3 single sample | -0.1 group average<br>-0.3 single sample |
| 1 | Humidity | -0.3 dB group average<br>-0.5 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | -0.1 group average<br>-0.3 single sample | -0.1 group average<br>-0.3 single sample |
| 1 | Change in optical transmittance (completion of sequence) | Not required | -0.3 dB group average<br>-0.5 dB single sample | Not required | 0.0 group average<br>-0.3 single sample |
| 2 | Coupling mechanism strength | -0.3 dB group average<br>-0.5 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | 0.0 group average<br>-0.1 single sample | 0.0 group average<br>0.0 single sample |
| 2 | Cable retention | Not required | -0.2 dB group average<br>-0.4 dB single sample | Not required | 0.0 group average<br>-0.2 single sample |
| 2 | Cable flex | -0.2 dB group average<br>-0.4 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | 0.0 group average<br>-0.1 single sample | 0.0 group average<br>-0.1 single sample |
| 2 | Twist | Not required | -0.2 dB group average<br>-0.4 dB single sample | Not required | 0.0 group average<br>0.0 single sample |
| 2 | Durability | -0.2 dB group average<br>-0.4 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | 0.0 group average<br>-0.2 single sample | 0.0 group average<br>-0.2 single sample |
| 2 | Change in optical transmittance (completion of sequence) | Not required | -0.3 dB group average<br>-0.5 dB single sample | Not required | -0.0 group average<br>-0.1 single sample |
| 3 | Cable retention | Not required | -0.2 dB group average<br>-0.4 dB single sample | Not required | 0.0 group average<br>-0.1 single sample |
| 3 | Cable flex | -0.2 dB group average<br>-0.4 dB single sample | -0.2 dB group average<br>-0.4 dB single sample | 0.0 group average<br>-0.1 single sample | 0.0 group average<br>-0.1 single sample |
| 3 | Twist | Not required | -0.2 dB group average<br>-0.4 dB single sample | Not required | 0.0 group average<br>0.0 single sample |
| 3 | Change in optical transmittance (completion of sequence) | Not required | -0.3 dB group average<br>-0.5 dB single sample | Not required | -0.0 group average<br>-0.1 single sample |

2.4 Temperature Cycling - Group 1

There was no evidence of physical damage to the connector or attached cable and no change in optical performance beyond the specified limits after temperature cycling. Change in optical transmittance was measured at 1300nm.

2.5 Humidity, Steady State - Group 1

There was no evidence of physical damage to the connector or attached cable and no change in optical performance beyond the specified limits after humidity. Change in optical transmittance was measured at 1300nm.

2.6 Coupling Mechanism Strength - Group 2

There was no evidence of physical damage to the connector and no change in optical performance beyond the specified limits after coupling mechanism strength. Change in optical transmittance was measured at 1300nm.

2.7 Cable Retention - Group 2 & 3

There was no evidence of physical damage to the connector and no change in optical performance beyond the specified limits after coupling mechanism strength. Change in optical transmittance was measured at 1300nm.

2.8 Cable Flexing - Group 2 & 3

There was no evidence of cable clamp or strain relief failure, pullout, or other damage to the connector or attached cable and no change in optical performance beyond the specified limits after cable flexing. Change in optical transmittance was measured at 1300nm.

2.9 Twist - Group 2 & 3

There was no evidence of cable clamp or strain relief failure, pullout, or other damage to the connector or attached cable and no change in optical performance beyond the specified limits after twist. Change in optical transmittance was measured at 1300nm.

2.10 Durability - Group 2

There was no evidence of physical damage to the connector and no change in optical performance beyond the specified limits after durability. Change in optical transmittance was measured at 1300nm.

## 3. Test Methods

### 3.1 Examination of Product

Product drawings and inspection plans were used to examine the samples. They were examined visually and functionally.

3.2 Insertion Loss

A restricted launch condition was created by wrapping the test cables around a mandrel of prescribed size for the fiber used. The initial optical power through the cable was measured and recorded. The cable was then cut in the middle and the test sample terminated in accordance with AMP® Instruction Sheet 408-9972. The sample was mated and unmated a total of ten times, cleaning each time, and the optical power was measured after each cycle. Optical power readings were compensated by the changes in source monitor cables. In cases where a control cable was also used, these changes were also factored into the loss calculations.

3.3 Change in Optical Transmittance

The initial optical power (dBm) through the fiber was recorded before the test. Relative optical power (dB) through the fiber was measured during and after each test. Change in optical transmittance was calculated by taking the difference between the initial measurement and the during/after measurements. Source output power variations were compensated by subtracting any changes in the control or source monitor cable. Optical power was measured during and/or after the following tests: temperature cycling, humidity, coupling mechanism strength, cable retention, cable flex, twist, and durability.

3.4 Temperature Cycling

Samples were subjected to 5 cycles of temperature extremes, each cycle consisting of 8 hours, for a total of 40 hours exposure to temperature cycling. One cycle consisted of a 1.5 hour ramp down to and a 0.5 hour dwell at -40°C, then a 1.5 hour ramp up to and a 0.5 hour dwell at 25°C, then a 1.5 hour ramp up to and a 0.5 hour dwell at 85°C, and finally, a 1.5 hour ramp back down to and 0.5 hour dwell at 25°C. The maximum transition time between temperatures was 40°C per hour. Optical transmittance was recorded before and after exposure with the samples in place in the test chamber and 5 minutes before the end of each dwell during exposure. Final optical transmittance was recorded at least two hours after temperature cycling exposure, after the samples were unmated, inspected, cleaned and remated.

3.5 Humidity, Steady State

Samples were preconditioned at 50°C for a period of 24 hours, then subjected to 60°C at 95% RH for a period of 96 hours. Initial optical transmittance was recorded 1 hour after preconditioning and once every 24 hours during exposure. Final optical transmittance was recorded at least two hours after humidity exposure after samples were unmated, inspected, cleaned and remated.

3.6 Coupling Mechanism Strength

The connector on the detector side of the samples was mated to the coupling bushing in a fixed position, then subjected to a sustained load of 150N (33.7 lbf) for 1 minute. Loading was applied at a rate of 2.54mm/min and released at a rate of 25.4mm/min. Final optical transmittance was recorded after samples were inspected, cleaned and remated.

3.7 Cable Retention

The connector on the detector side of the samples was supported from behind the connector housing nut in a fixed position and subjected to a sustained load of 267N (60 lbf) for 1 minute. Loading was applied and released at a rate of 25.4mm/min. Final optical transmittance was recorded after the samples were inspected, cleaned, and remated.

### 3.8 Cable Flexing

Samples were subjected to 500 cycles of cable flexing. Samples were tested at a rate of 15 cycles per minute. A tensile load of 0.5kg (1.10 lbs) was applied to the cable on the detector side of the mated samples. The flex arc was ±90° from a vertical position. Optical transmittance was measured before testing and after every 50 cycles with load removed.

### 3.9 Twist

Samples were subjected to 10 cycles of twist. Samples were tested at a rate of 15 cycles per minute. A tensile load of 4.0kg (8.82 lbs) was applied to the cable on the detector side of the mated samples. The twist direction was ±90° about the axis of the cable. Optical transmittance was measured before and after test with load removed.

### 3.10 Durability

The connector on the detector side of the mated samples was subjected to 250 cycles of durability. Samples were manually cycled at a rate not in excess of 300 cycles per hour. Optical transmittance was measured before test and after every 50 cycles. Samples were unmated, cleaned, inspected, and remated before each measurement.

4. Validation

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