CORNING

AFL

# Corning SMF-28® Ultra Optical Fiber
## Fusion Splice Verification Report

**AN0041**
Issued: March 2014

### OBJECTIVE

Corning asked AFL to independently test the splicing performance of Corning's new SMF-28® Ultra optical fiber. AFL is the North American subsidiary of Fujikura Ltd, who is a worldwide leader in splicing equipment. This report summarizes the test plan and results from the work conducted by AFL at its facility in Spartanburg, South Carolina.

### TEST PLAN AND PROCEDURE

The SMF-28® Ultra optical fiber splicing plan involved homogenous (same fiber type) and heterogeneous (different fiber types) splices. For each splicing combination, multiple fibers were used spanning a range of mode field diameters to simulate field conditions. The details of the fiber combinations and the number of splices can be found in Table 1. In addition to splicing different fiber types, a thorough understanding of splice loss was achieved through the use of core alignment and v-groove (cladding alignment) fusion splicers using standard splice equipment programs. A total of four different splicers were used, and the details can be found in Table 2.

Table 1. List of Fiber Combinations and Sample Size

| Fiber A | Fiber B | Quantity |
|---|---|---|
| Corning® SMF-28® Ultra optical fiber | Corning® SMF-28® Ultra optical fiber | 50 splices |
| Corning® SMF-28® Ultra optical fiber | Corning® SMF-28e+® optical fiber | 30 splices |
| Corning® SMF-28® Ultra optical fiber | Corning® ClearCurve® XB optical fiber | 30 splices |

Table 2. List of Splicers

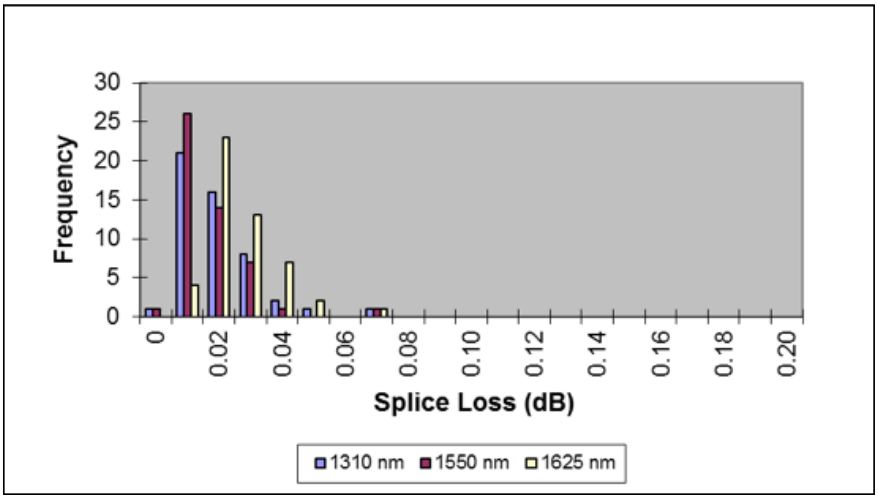
| Core Alignment Splicer | Fixed V-groove Splicer |
|---|---|
| Fujikura 70S | Fujikura 19S |
| 60S | 18S |

Splice loss was determined by averaging the measurements in both directions using an Optical Time Domain Reflectometer (OTDR) in accordance with ANSI/TIA/EIA-455-8-2000 and Telcordia GR-20-CORE, issue 4.

## RESULTS OF CORE ALIGNMENT SPLICERS:

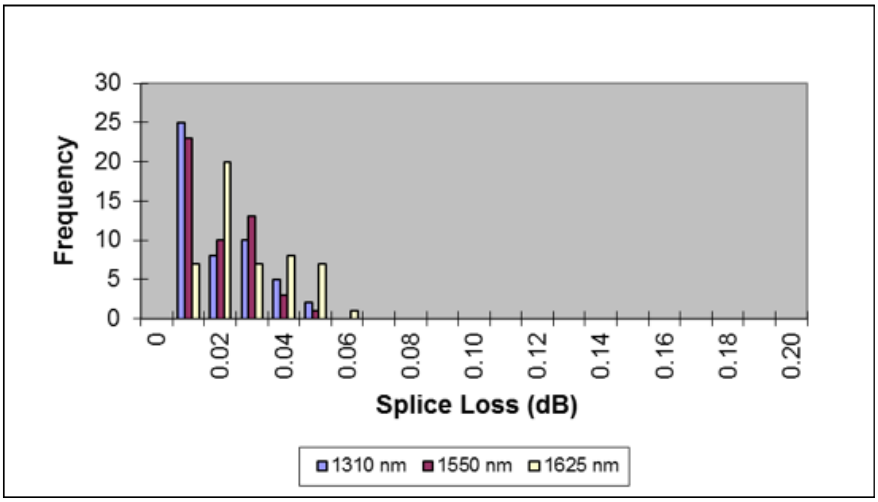
Splicing SMF-28® Ultra fiber to SMF-28® Ultra fiber

| Splicer Type: Fujikura 70S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1310 | Mean ≤0.10 | 0.02 | 0.013 | 0.07 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1550 | Mean ≤0.10 | 0.02 | 0.012 | 0.07 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1625 | Mean ≤0.10 | 0.03 | 0.012 | 0.07 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

| Splicer Type: FSM-60S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |

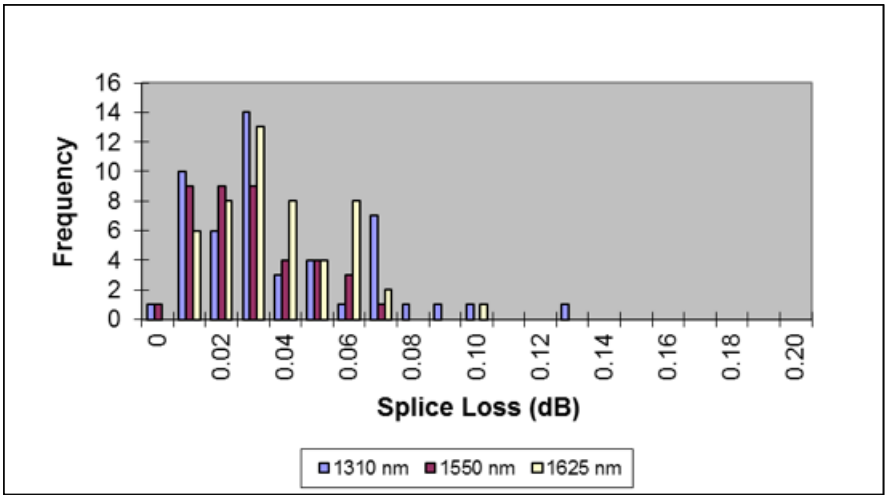



| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1310 | Mean ≤0.10 | 0.02 | 0.013 | 0.05 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1550 | Mean ≤0.10 | 0.02 | 0.012 | 0.05 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1625 | Mean ≤0.10 | 0.03 | 0.013 | 0.05 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

## RESULTS OF FIXED V-GROOVE SPLICERS:

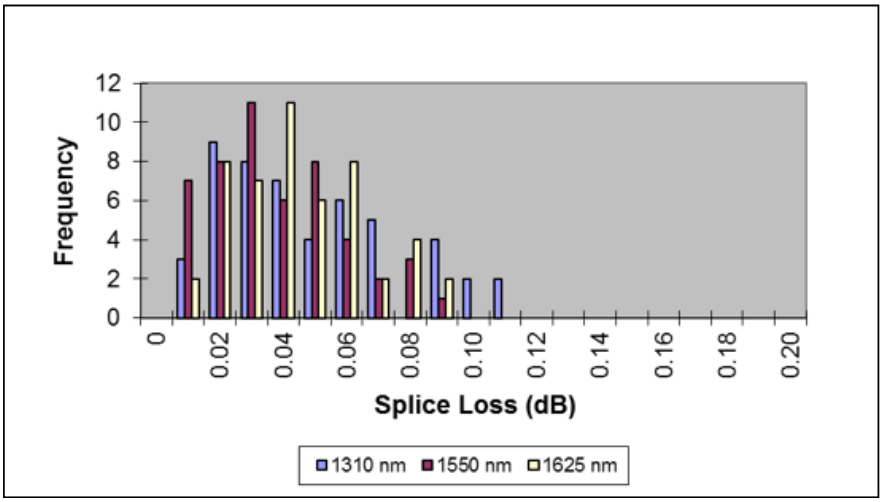
Splicing SMF-28® Ultra fiber to SMF-28® Ultra fiber

| Splicer Type: Fujikura 19S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1310 | Mean ≤0.10 | 0.04 | 0.027 | 0.13 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1550 | Mean ≤0.10 | 0.03 | 0.020 | 0.10 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1625 | Mean ≤0.10 | 0.04 | 0.020 | 0.10 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

| Splicer Type: FSM-18S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |

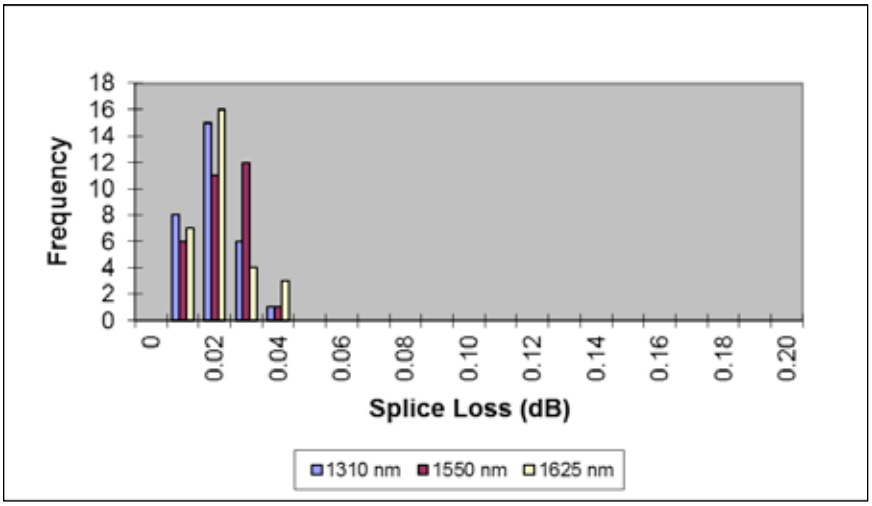



| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1310 | Mean ≤0.10 | 0.05 | 0.028 | 0.11 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1550 | Mean ≤0.10 | 0.04 | 0.021 | 0.09 |
| SMF-28 Ultra fiber | SMF-28 Ultra fiber | 1625 | Mean ≤0.10 | 0.04 | 0.020 | 0.09 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

## RESULTS OF CORE ALIGNMENT SPLICERS:

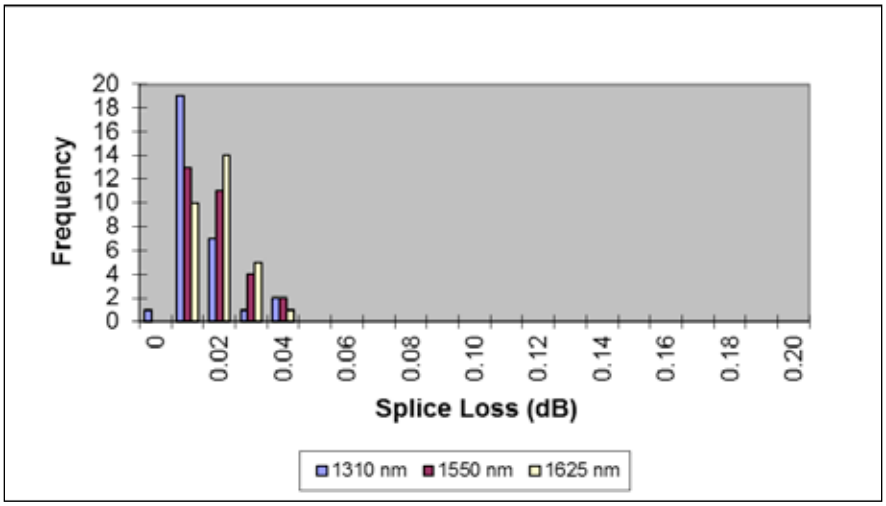
Splicing SMF-28® Ultra fiber to SMF-28e+® fiber

| Splicer Type: Fujikura 70S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1310 | Mean ≤0.10 | 0.02 | 0.008 | 0.04 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1550 | Mean ≤0.10 | 0.02 | 0.007 | 0.04 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1625 | Mean ≤0.10 | 0.02 | 0.008 | 0.04 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

| Splicer Type: FSM-60S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |

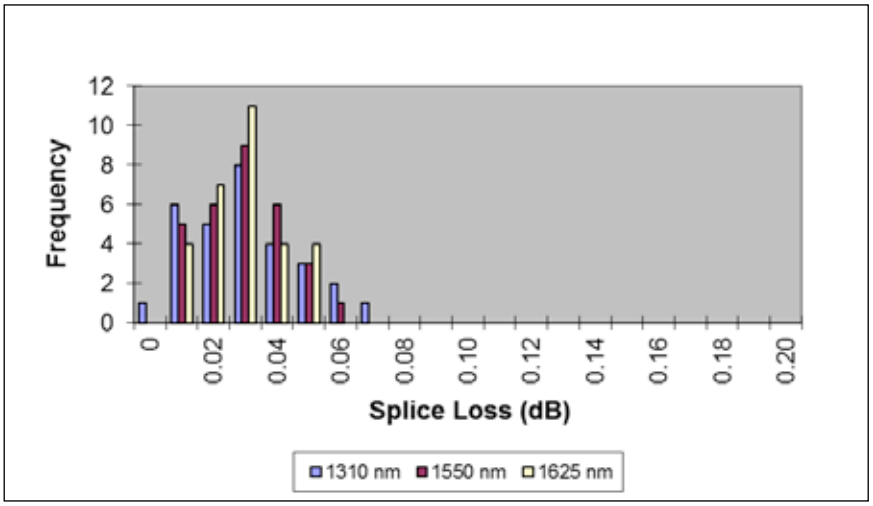



| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1310 | Mean ≤0.10 | 0.01 | 0.009 | 0.04 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1550 | Mean ≤0.10 | 0.02 | 0.008 | 0.04 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1625 | Mean ≤0.10 | 0.02 | 0.008 | 0.04 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

## RESULTS OF FIXED V-GROOVE SPLICERS:

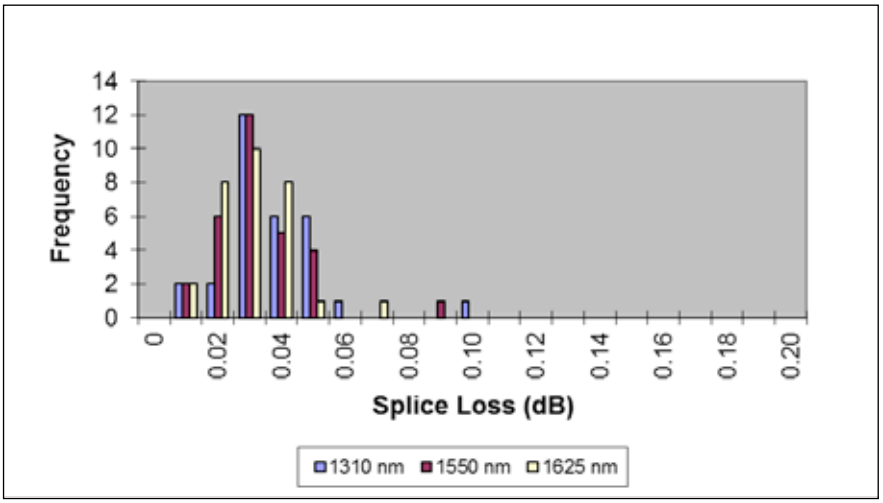
Splicing SMF-28® Ultra fiber to SMF-28e+® fiber

| Splicer Type: Fujikura 19S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1310 | Mean ≤0.10 | 0.03 | 0.017 | 0.07 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1550 | Mean ≤0.10 | 0.03 | 0.013 | 0.06 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1625 | Mean ≤0.10 | 0.03 | 0.012 | 0.05 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

| Splicer Type: FSM-18S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |

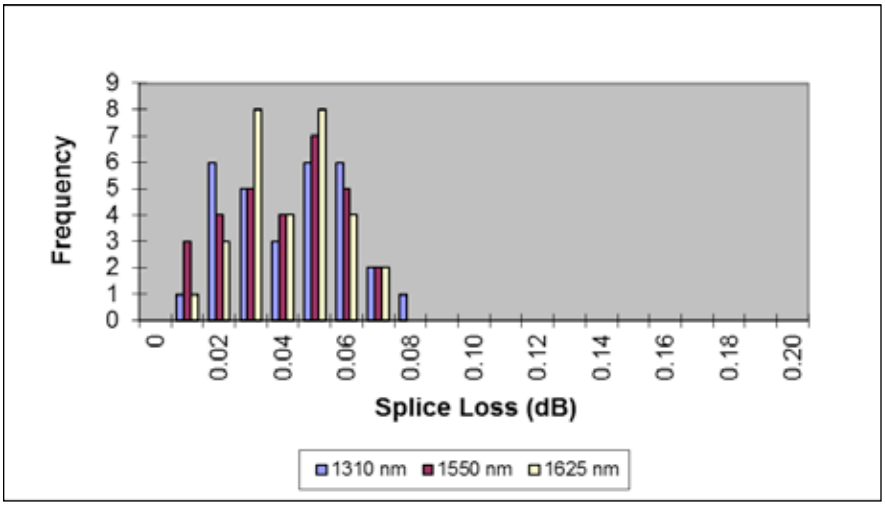



| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1310 | Mean ≤0.10 | 0.04 | 0.016 | 0.10 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1550 | Mean ≤0.10 | 0.03 | 0.014 | 0.09 |
| SMF-28 Ultra fiber | SMF-28e+ fiber | 1625 | Mean ≤0.10 | 0.03 | 0.011 | 0.07 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.10 dB | | | | | | |

## RESULTS OF CORE ALIGNMENT SPLICERS:

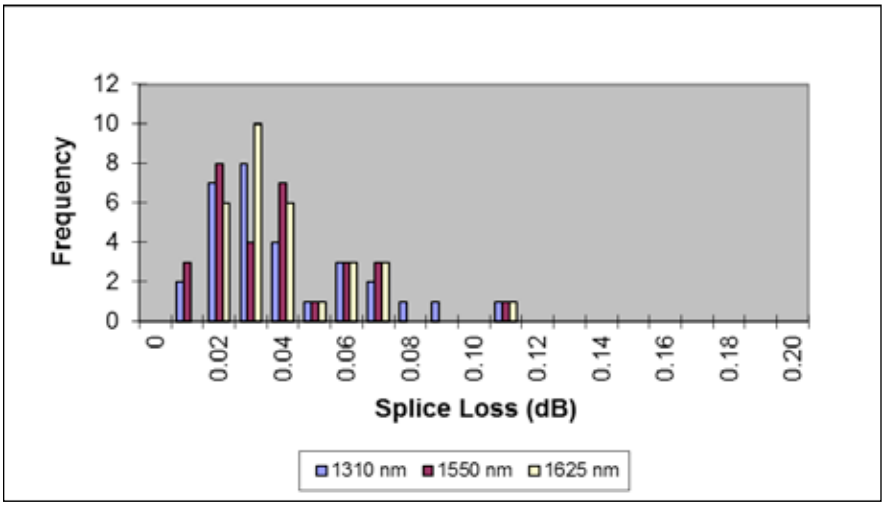
Splicing SMF-28® Ultra fiber to ClearCurve® XB fiber

| Splicer Type: Fujikura 70S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1310 | Mean ≤0.15 | 0.04 | 0.018 | 0.08 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1550 | Mean ≤0.15 | 0.04 | 0.017 | 0.07 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1625 | Mean ≤0.15 | 0.04 | 0.016 | 0.07 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.15 dB | | | | | | |

| Splicer Type: FSM-60S (core alignment splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM-SM Mode 10 |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 2000 ms |
| Cleaning Arc | 180 ms |

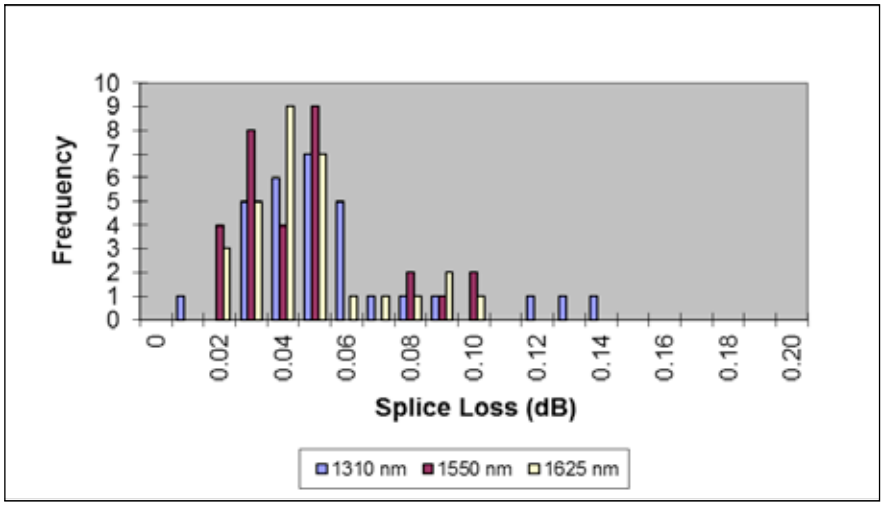



| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1310 | Mean ≤0.15 | 0.04 | 0.025 | 0.11 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1550 | Mean ≤0.15 | 0.04 | 0.023 | 0.11 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1625 | Mean ≤0.15 | 0.04 | 0.021 | 0.11 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.15 dB | | | | | | |

## RESULTS OF FIXED V-GROOVE SPLICERS:

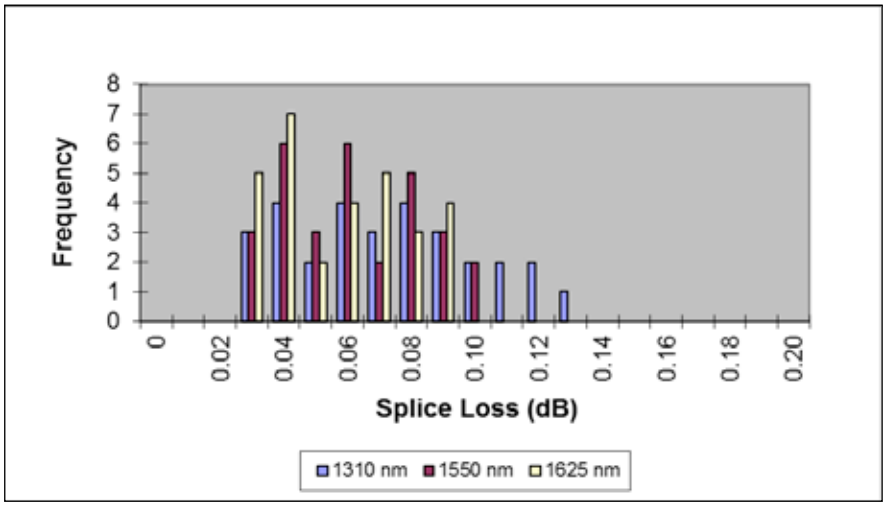
Splicing SMF-28® Ultra fiber to ClearCurve® XB fiber

| Splicer Type: Fujikura 19S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1310 | Mean ≤0.15 | 0.03 | 0.017 | 0.07 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1550 | Mean ≤0.15 | 0.03 | 0.013 | 0.06 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1625 | Mean ≤0.15 | 0.03 | 0.012 | 0.05 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.15 dB | | | | | | |

| Splicer Type: FSM-18S (v-groove splicer) | |
|---|---|
| Splicer Settings | |
| Program | SM Setting |
| Cleave Limit | 1.5° |
| Loss Limit | 0.20 dB |
| Arc Power | STANDARD |
| Arc Time | 6000 ms |
| Cleaning Arc | 200 ms |




| Fiber A | Fiber B | Wavelength (nm) | Spec (dB)* | Mean (dB) | Standard Deviation | Maximum (dB) |
|---|---|---|---|---|---|---|
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1310 | Mean ≤0.15 | 0.07 | 0.029 | 0.10 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1550 | Mean ≤0.15 | 0.06 | 0.020 | 0.09 |
| SMF-28 Ultra fiber | ClearCurve XB fiber | 1625 | Mean ≤0.15 | 0.06 | 0.021 | 0.07 |
| *Summarized results meet Telcordia GR-20 requirements; mean splice loss of a group required to be ≤0.15 dB | | | | | | |

## CONCLUSIONS

AFL has successfully completed the splicing test plan for SMF-28® Ultra optical fiber using both core alignment and fixed v-groove (non-active alignment) fusion splicing equipment. The results of this independent study confirm that SMF-28® Ultra optical fiber has the same excellent splice loss performance (both homogeneous and heterogeneous) using standard fusion splicer equipment. These results were as expected given that SMF-28® Ultra fiber's Mode Field Diameter (MFD) is the same as SMF-28e+® fiber across the full wavelength spectrum.

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