

DIAMOND
Test & Calibration Laboratory STS 333 / SCS 101

Product Specification Qualification Test Report



E-2000 simplex PS APC 4° Titanium

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1) Edition: This column states the date of the Qualification;

2) Requalified: This column states the date of the Requalification.

The present Qualification Test Report (QTR) summarizes the qualification measurements and tests performed to verify the design and the optical, mechanical and environmental performance of the E-2000™ PS APC 4° simplex connector at the accredited test & calibration laboratory STS 333 / SCS 101 at Diamond SA, Losone. This current QTR is a summary of the internal qualification report no. 2770 performed at the test & calibration laboratory STS 333 / SCS 101 (www.sas.ch).

The qualification test program of the E-2000™ PS APC 4° simplex connector is determined under the guideline of IEC 61753-1, which defines the minimum requirements and severities which a single-mode connector must satisfy in order to be considered as meeting category U (uncontrolled environment).

The qualified product is subject to periodic requalification with the purpose of guaranteeing the product compliance to the specifications measured in the present report over the years.

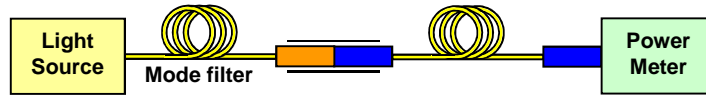
For requalification purposes the principle of similarity is applied, where the qualification data of similar products can be used if they meet the same technology platform and are manufactured using the same process.

For additional information, please contact Diamond or your Diamond Sales Representative.

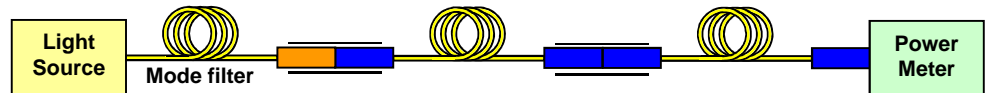
Insertion loss

Methods: Method B according to IEC 61300-3-4

a) Reference measurement:



b) DUT measurement:



Requirements: $IL_{Max} \leq 0.50$ dB

Samples:

- DUT: 16 SM fibre patch cords terminated with Diamond E-2000TM PS APC 4° connectors
- Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
- Reference connectors: 1 Diamond E-2000TM PS APC 4° connector of same lot
- Mating adapters: 1 Diamond E-2000^{IM} SM mating adapter

Parameters:

- Wavelengths: 1310 nm / 1550 nm
- No. of measurements: 16

Results:

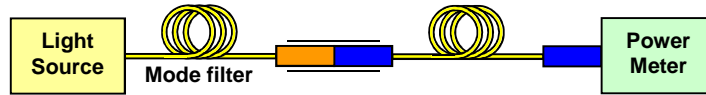
Statistics	Insertion loss IL against reference connector [dB]	
	at 1310 nm	at 1550 nm
Mean value	0.28	0.26
Standard deviation	0.06	0.06
Maximum value	0.40	0.37
Minimum value	0.17	0.16

Insertion loss, random mated

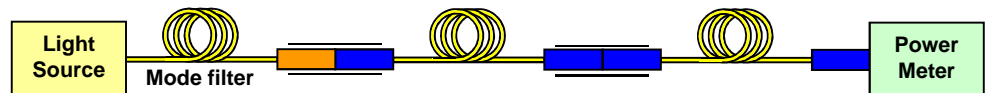
Methods:

- Insertion loss measurement method B according to IEC 61300-3-4
- Random mating method 1 according to IEC 61300-3-34

a) Reference measurement:



b) DUT measurement:



Requirements:

- $IL_{Mean} \leq 0.25 \text{ dB}$
- $IL_{97\%} \leq 0.40 \text{ dB}$

Samples:

- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μm, Diamond art. no. 1027276
- Mating adapters: 1 Diamond E-2000™ SM mating adapter

Parameters:

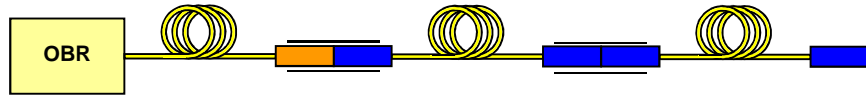
- Wavelengths: 1310 nm / 1550 nm
- No. of measurements: 180

Results:

Statistics	Insertion loss IL, random mated [dB]	
	at 1310 nm	at 1550 nm
Mean value	0.25	0.24
Standard deviation	0.09	0.07
97% value	0.41	0.36
Maximum value	0.52	0.42
Minimum value	0.08	0.09

Return loss

Methods: OFDR/OTDR method according to IEC 61300-3-6



Requirements: $RL_{Min} \geq 75$ dB

Samples:

- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μm, Diamond art. no. 1027276
- Reference connectors: 1 Diamond E-2000™ PS APC 4° connector of same lot
- Mating adapters: 1 Diamond E-2000™ SM mating adapter

Parameters:

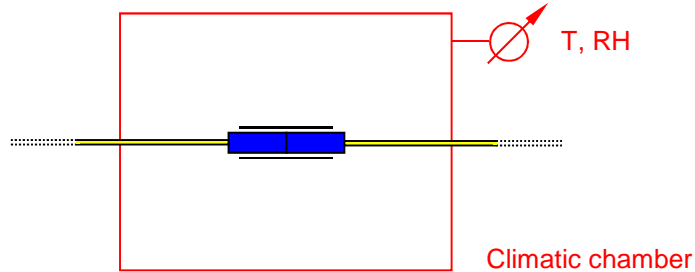
- Wavelengths: 1550 nm
- No. of measurements: 16

Results:

Statistics	Return loss RL against reference connector [dB]
	at 1550 nm
Mean value	81.4
Standard deviation	3.8
Maximum value	90.5
Minimum value	76.5

Change of temperature

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Change of temperature test according to IEC 61300-2-22



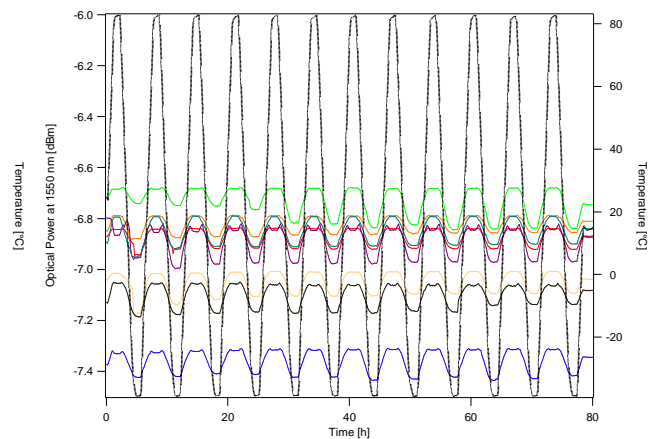
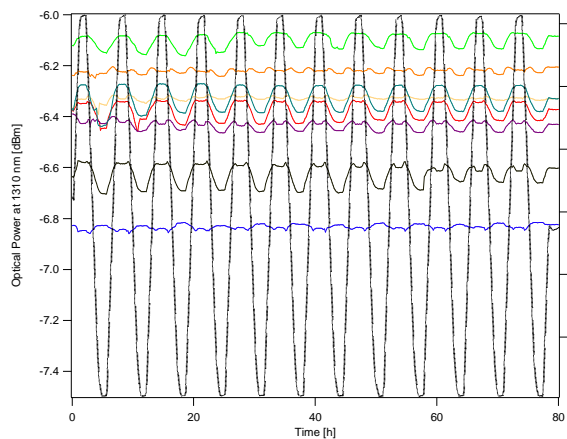
Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

- Samples:**
- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
 - Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
 - Mating adapters: 8 Diamond E-2000™ SM mating adapters

- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
 - Monitored channels: 8
 - Upper cycling temperature: +85°C
 - Lower cycling temperature: -40°C
 - Relative humidity: Not controlled
 - Dwell time at extreme temperatures: 1 h
 - Variation of temperature at slopes: 1°C/min
 - Number of cycles: 12
 - Duration: 74 h

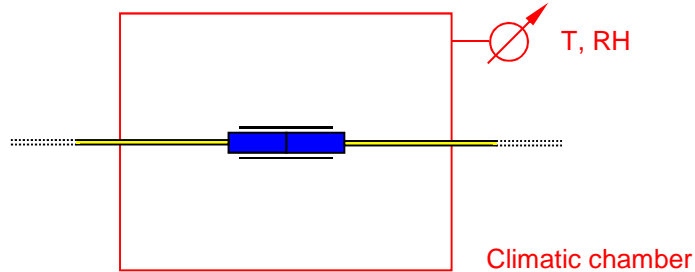
Results:

Statistics	Variation of insertion loss ΔIL during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.20	0.17
Minimum value	0.11	0.04



Cold

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Cold test according to IEC 61300-2-17



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

Samples:

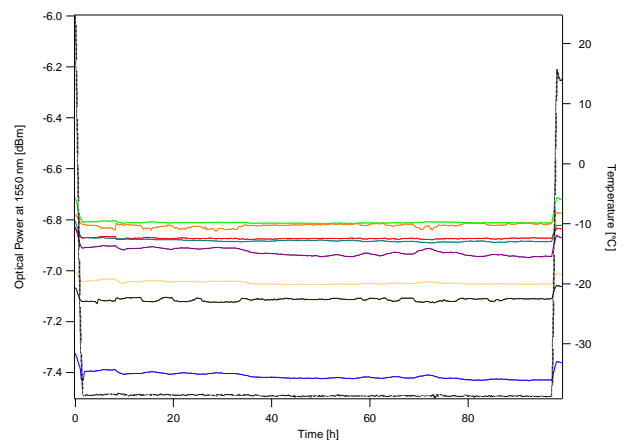
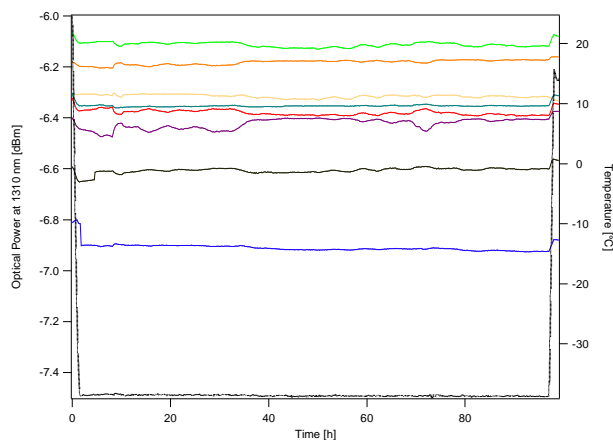
- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
- Mating adapters: 8 Diamond E-2000™ SM mating adapters

Parameters:

- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 8
- Constant temperature: -40°C
- Relative humidity: Not controlled
- Duration: 96 h

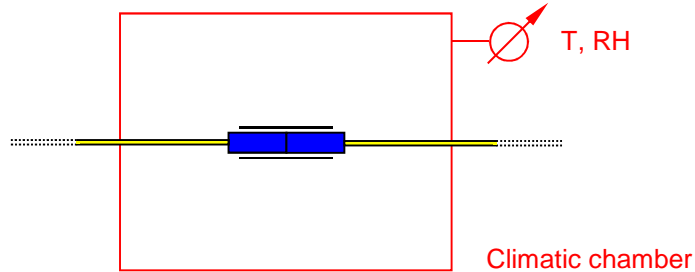
Results:

Statistics	Variation of insertion loss ΔIL during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.13	0.12
Minimum value	0.03	0.05



Dry heat

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Dry heat test according to IEC 61300-2-18



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

Samples:

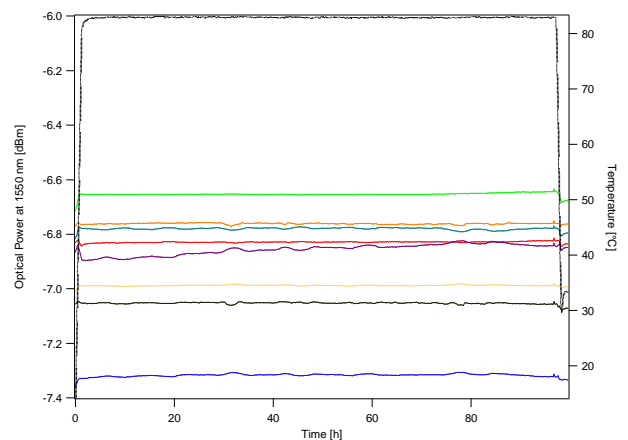
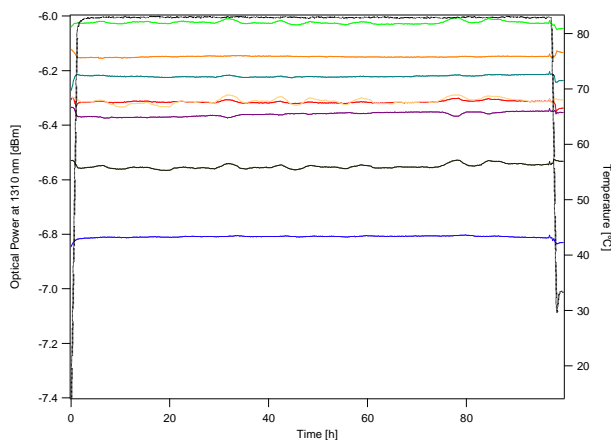
- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μm , Diamond art. no. 1027276
- Mating adapters: 8 Diamond E-2000™ SM mating adapters

Parameters:

- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 8
- Constant temperature: +85°C
- Relative humidity: Not controlled
- Duration: 96 h

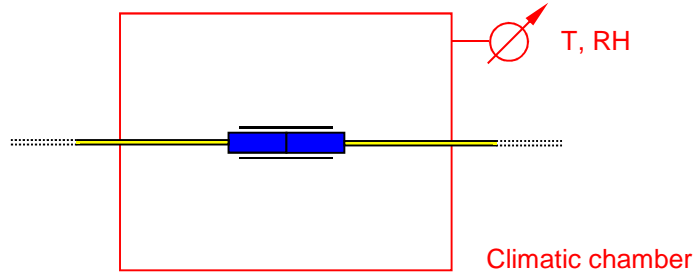
Results:

Statistics	Variation of insertion loss ΔIL during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.07	0.08
Minimum value	0.03	0.02



Damp heat, cyclic

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Damp heat, cyclic, test according to IEC 61300-2-46



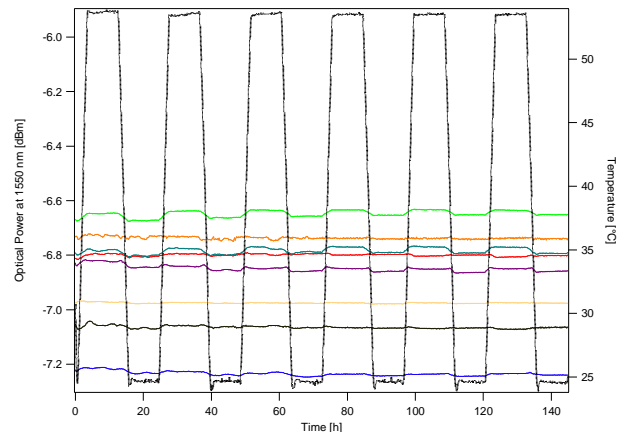
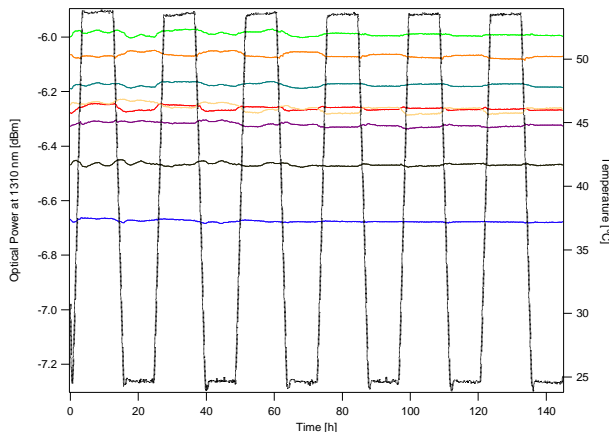
Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

- Samples:**
- DUT: 16 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
 - Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
 - Mating adapters: 8 Diamond E-2000™ SM mating adapters

- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
 - Monitored channels: 8
 - Upper cycling temperature: +55°C
 - Lower cycling temperature: +25°C
 - Relative humidity: 95% r.h.
 - Dwell time at extreme temperatures: 9 h
 - Variation of temperature at slopes: 10°C/h
 - Number of cycles: 6
 - Duration: 144 h

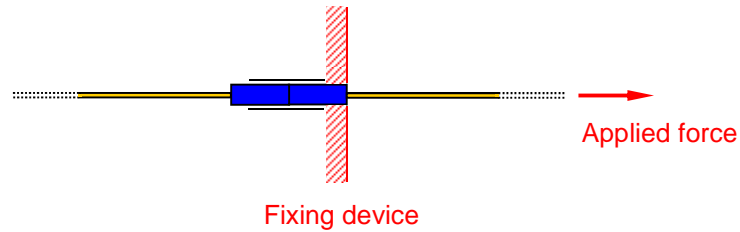
Results:

Statistics	Variation of insertion loss ΔIL during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.06	0.05
Minimum value	0.02	0.01



Fibre retention

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Fibre retention test according to IEC 61300-2-4



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

- Samples:**
- DUT: 10 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
 - Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
 - Mating adapters: 1 Diamond E-2000™ SM mating adapter

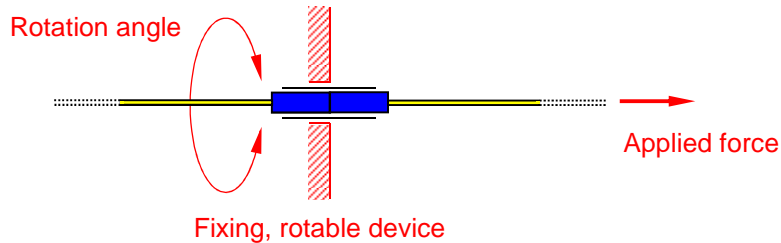
- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
 - Monitored channels: 10
 - Applied force: 5 N
 - Force direction: Longitudinal connector axis
 - Duration of applied force: 1 min
 - Force application distance: 30 cm

Results:

Sample no.	Insertion loss IL [dB]						Variation of insertion loss ΔIL [dB]	
	before test		during test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.14	0.16	0.14	0.16	0.14	0.16	0.00	0.00
2	0.27	0.26	0.27	0.26	0.27	0.22	0.00	0.04
3	0.23	0.24	0.23	0.24	0.22	0.24	0.01	0.00
4	0.22	0.22	0.22	0.22	0.22	0.22	0.00	0.00
5	0.17	0.20	0.17	0.20	0.17	0.20	0.00	0.00
6	0.27	0.31	0.28	0.31	0.28	0.31	0.01	0.00
7	0.14	0.15	0.14	0.15	0.14	0.15	0.00	0.00
8	0.11	0.12	0.11	0.12	0.11	0.12	0.00	0.00
9	0.25	0.29	0.25	0.30	0.25	0.29	0.00	0.01
10	0.07	0.13	0.06	0.12	0.12	0.06	0.06	0.07
Maximum value							0.06	0.07
Minimum value							0.00	0.00

Fibre torsion

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Fibre torsion test according to IEC 61300-2-5



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

Samples:

- DUT: 10 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
- Mating adapters: 1 Diamond E-2000™ SM mating adapter

Parameters:

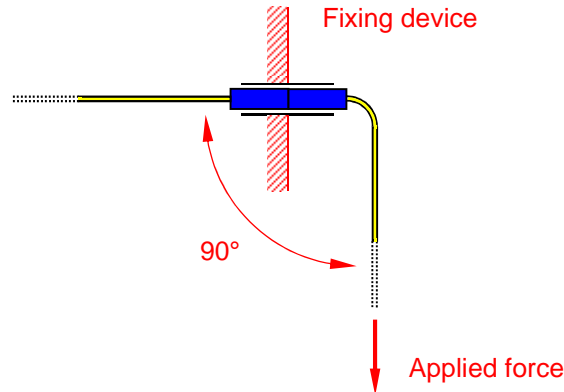
- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 10
- Applied force: 0.2 N
- Force direction: Longitudinal connector axis
- Rotation angle: +180° to -180° and back
- Number of cycles: 25
- Force application distance: 30 cm

Results:

Sample no.	Insertion loss IL [dB]						Variation of insertion loss ΔIL [dB]	
	before test		during test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.15	0.15	0.14	0.15	0.15	0.16	0.01	0.01
2	0.27	0.26	0.29	0.29	0.27	0.25	0.04	0.03
3	0.24	0.23	0.27	0.27	0.25	0.25	0.03	0.04
4	0.25	0.24	0.27	0.26	0.25	0.23	0.04	0.02
5	0.19	0.20	0.15	0.16	0.14	0.15	0.04	0.06
6	0.32	0.31	0.33	0.33	0.30	0.30	0.03	0.03
7	0.22	0.20	0.21	0.19	0.21	0.19	0.03	0.02
8	0.15	0.17	0.17	0.19	0.16	0.17	0.02	0.03
9	0.30	0.27	0.25	0.25	0.30	0.27	0.05	0.05
10	0.11	0.13	0.09	0.11	0.10	0.13	0.04	0.03
Maximum value							0.05	0.06
Minimum value							0.01	0.01

Static side load

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Static side load test according to IEC 61300-2-42



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

Samples:

- DUT: 10 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
- Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
- Mating adapters: 1 Diamond E-2000™ SM mating adapter

Parameters:

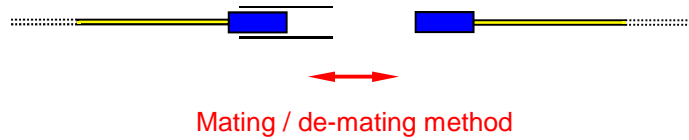
- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 10
- Applied force: 0.2 N
- Force direction: 90° respect to the longitudinal connector axis
- Duration of applied force: 5 min
- Force application distance: 30 cm

Results:

Sample no.	Insertion loss IL [dB]						Variation of insertion loss ΔIL [dB]	
	before test		during test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.14	0.16	0.14	0.16	0.14	0.16	0.00	0.00
2	0.25	0.29	0.25	0.29	0.25	0.29	0.00	0.00
3	0.25	0.25	0.24	0.25	0.24	0.26	0.01	0.01
4	0.27	0.25	0.27	0.26	0.27	0.26	0.00	0.01
5	0.16	0.21	0.16	0.22	0.16	0.22	0.00	0.01
6	0.31	0.34	0.30	0.35	0.30	0.35	0.01	0.01
7	0.19	0.20	0.19	0.20	0.19	0.20	0.00	0.00
8	0.18	0.18	0.18	0.18	0.18	0.18	0.00	0.00
9	0.26	0.32	0.26	0.33	0.26	0.33	0.00	0.01
10	0.11	0.13	0.11	0.14	0.11	0.11	0.00	0.03
Maximum value							0.01	0.03
Minimum value							0.00	0.00

Mating durability

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Mating durability test according to IEC 61300-2-2



Requirements: $\Delta IL_{Max} \leq 0.20$ dB during test

- Samples:**
- DUT: 2 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
 - Fibre type: 9/125/900 μ m, Diamond art. no. 1027276
 - Mating adapters: 1 Diamond E-2000™ SM mating adapter

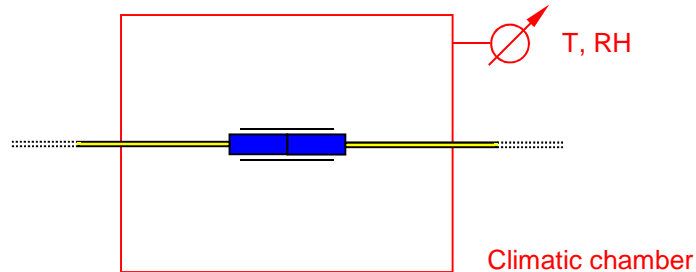
- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
 - Monitored channels: 1
 - Mating / de-mating cycles: 500

Results:

Sample no.	Insertion loss IL [dB]				Variation of insertion loss ΔIL [dB]	
	maximum value		minimum value		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1-2	0.14	0.14	0.08	0.09	0.06	0.05

Optical power handling at high temperature

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of attenuation according to IEC 61300-3-3
 - Optical power handling test according to IEC 61300-2-14
 - Dry heat test according to IEC 61300-2-18



Requirements: No damage of the fibre and of other connector parts

- Samples:**
- DUT: 2 SM fibre patch cords terminated with Diamond E-2000™ PS APC 4° connectors
 - Fibre type: 9/125/900 μm, Diamond art. no. 1027276
 - Mating adapters: 1 Diamond E-2000™ SM mating adapter

- Parameters:**
- Wavelength: 1550 nm
 - Monitored channels: 1
 - Minimum applied power level: 5 W
 - Maximum applied power level: 10 W
 - Power level increase at each step: 1 W
 - Exposure time at each power level: 30 minutes
 - Constant temperature: +85°C
 - Dwell time at high temperature: 1 h (30 minutes before each power level + 30 minutes during each power level)
 - Relative humidity: Not controlled

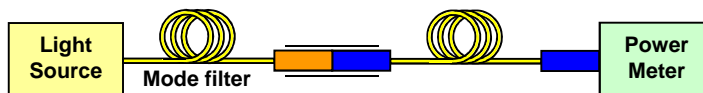
Results:

Sample no.	Insertion loss IL [dB]				Variation of insertion loss ΔIL [dB]	
	before test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1 - 2	0.09	0.10	0.43	0.35	0.34	0.33

Sample no.	Remarks
1	No damage of the fibre and of other connector parts observed
2	No damage of the fibre and of other connector parts observed

Optical power handling with extended duration

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
 - Active monitoring of changes in attenuation according to IEC 61300-3-3
 - Optical power handling test according to IEC 61300-2-14



- Requirements:**
- $\Delta IL_{Max} \leq 0.20$ dB before/after test
 - No damage of the fibre and of other connector parts

- Samples:**
- DUT: 6 SM fibre patch cords terminated with Diamond E-2000™ PS connectors
 - Fibre type: 9/125/900 μm , Diamond art. no. 1027276
 - Mating adapters: 5 Diamond E-2000™ SM mating adapters

- Parameters:**
- Wavelength: 1550 nm
 - Monitored channels: 1
 - Nominal power level: 6 W
 - Exposure time at given power level: 2'000 h

Remarks: Test performed with 6 concatenated patch cords (5 mated pairs of connectors)

Results:

Sample no.	Insertion loss IL at 1550 nm [dB]		Variation of insertion loss ΔIL at 1550 nm [dB]
	before test	after test	
1A - 1B	0.13	0.11	0.02
2A - 2B	0.11	0.11	0.00
3A - 3B	0.12	0.14	0.02
4A - 4B	0.17	0.16	0.01
5A - 5B	0.32	0.31	0.01
Maximum value	0.32	0.31	0.02
Minimum value	0.11	0.11	0.00

Sample no.	Remarks
1A	No damage of the fibre and of other connector parts observed
1B	No damage of the fibre and of other connector parts observed
2A	No damage of the fibre and of other connector parts observed
2B	No damage of the fibre and of other connector parts observed
3A	No damage of the fibre and of other connector parts observed
3B	No damage of the fibre and of other connector parts observed
4A	No damage of the fibre and of other connector parts observed
4B	No damage of the fibre and of other connector parts observed
5A	No damage of the fibre and of other connector parts observed
5B	No damage of the fibre and of other connector parts observed