

**DIAMOND**  
**Test & Calibration Laboratory STS 333 / SCS 101**

# Product Specification Qualification Test Report



**F-3000™ 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 F-3000™ PS APC 4° Titanium 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 reports no. 2710 and no. 2710a performed at the test & calibration laboratory STS 333 / SCS 101 ([www.sas.ch](http://www.sas.ch)).

The qualification test program of the F-3000™ PS APC 4° Titanium 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.

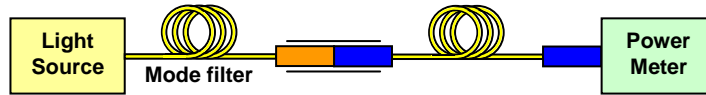
For requalification purposes the principle of similarity is applied, where the qualification data of similar products can be used if they meet the same technology platform and are manufactured using the same process.

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

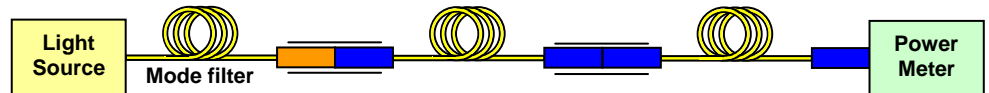
## Insertion loss

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

a) Reference measurement:



b) DUT measurement:



**Requirements:**  $IL_{Max} \leq 0.60$  dB

**Samples:**

- DUT: 42 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
- Reference connectors: 1 Diamond F-3000<sup>TM</sup> PS APC 4° connector of same lot
- Mating adapters: 1 Diamond F-3000<sup>IM</sup> SM simplex mating adapter

**Parameters:**

- Wavelengths: 1310 nm / 1550 nm
- No. of measurements: 42

**Results:**

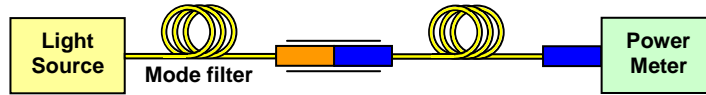
Statistics	Insertion loss IL against reference connector [dB]	
	at 1310 nm	at 1550 nm
Mean value	0.13	0.11
Standard deviation	0.07	0.05
Maximum value	0.33	0.26
Minimum value	0.02	0.05

## Insertion loss, random mated

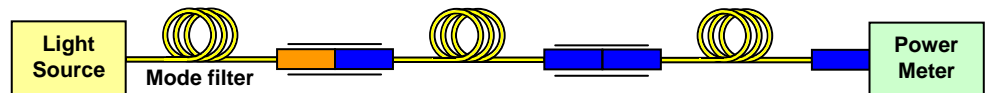
**Methods:**

- 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:**

- $IL_{\text{Mean}} \leq 0.30 \text{ dB}$
- $IL_{97\%} \leq 0.50 \text{ dB}$

**Samples:**

- DUT: 10 Diamond F-3000™ PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu\text{m}$ , Diamond art. no. 1005155
- Mating adapters: 1 Diamond F-3000™ SM simplex mating adapter

**Parameters:**

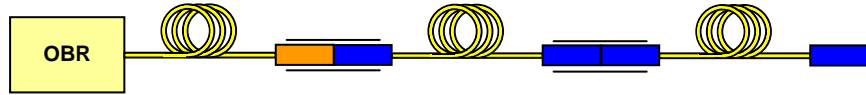
- Wavelengths: 1310 nm / 1550 nm
- No. of measurements: 90

**Results:**

Statistics	Insertion loss IL, random mated [dB]	
	at 1310 nm	at 1550 nm
Mean value	0.15	0.16
Standard deviation	0.05	0.04
97% value	0.23	0.25
Maximum value	0.26	0.26
Minimum value	0.03	0.06

## Return loss

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



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

**Samples:**

- DUT: 42 Diamond F-3000<sup>1M</sup> PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
- Reference connectors: 2 Diamond F-3000<sup>TM</sup> PS APC 4° connectors of same lot
- Mating adapters: 1 Diamond F-3000<sup>1M</sup> SM simplex mating adapter

**Parameters:**

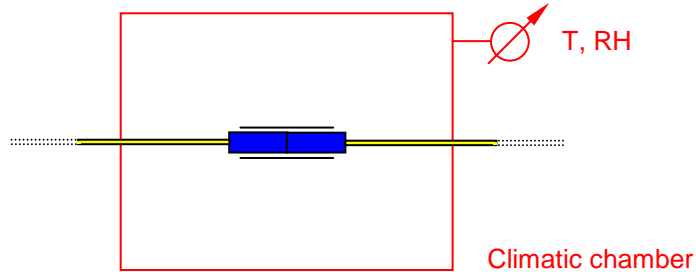
- Wavelengths: 1550 nm
- No. of measurements: 84

**Results:**

Statistics	Return loss RL against reference connector [dB]
	at 1550 nm
Mean value	83.0
Standard deviation	2.7
Maximum value	88.4
Minimum value	76.0

## 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



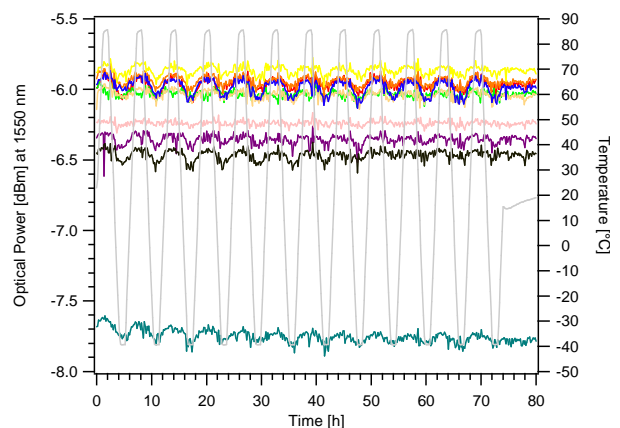
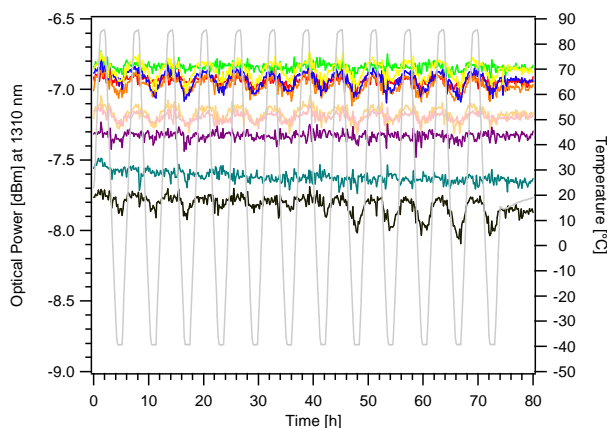
**Requirements:**  $\Delta IL_{Max} \leq 0.50$  dB during test

- Samples:**
- DUT: 20 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
  - Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Mating adapters: 10 Diamond F-3000<sup>TM</sup> SM simplex mating adapters

- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
  - Monitored channels: 10
  - 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

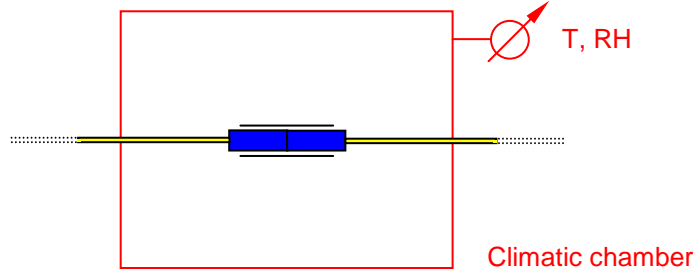
### Results:

Statistics	Variation of insertion loss $\Delta IL$ during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.40	0.35
Minimum value	0.19	0.14



## 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:**  $\Delta IL_{Max} \leq 0.50$  dB during test

**Samples:**

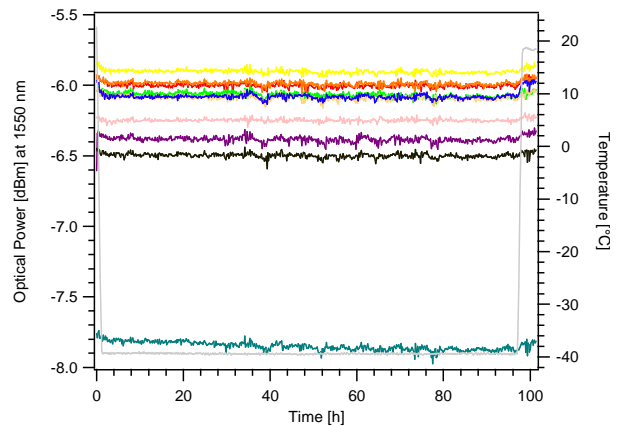
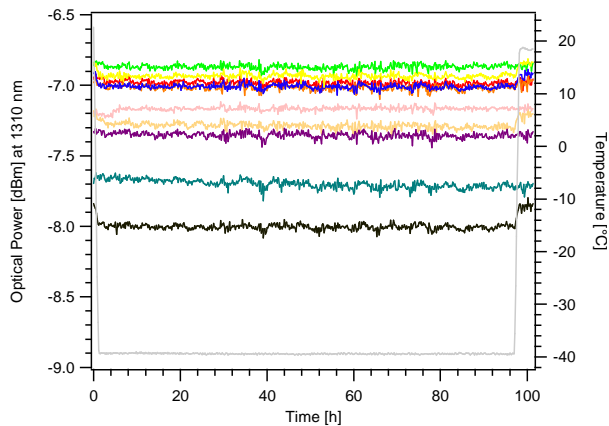
- DUT: 20 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu\text{m}$ , Diamond art. no. 1005155
- Mating adapters: 10 Diamond F-3000<sup>TM</sup> SM simplex mating adapters

**Parameters:**

- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 10
- Constant temperature: -40°C
- Relative humidity: Not controlled
- Duration: 96 h

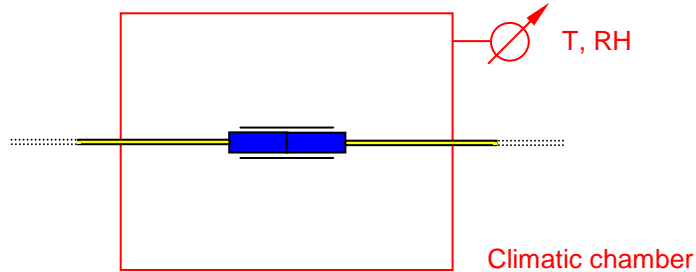
### Results:

Statistics	Variation of insertion loss $\Delta IL$ during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.28	0.30
Minimum value	0.12	0.10



## 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:**  $\Delta IL_{Max} \leq 0.50$  dB during test

**Samples:**

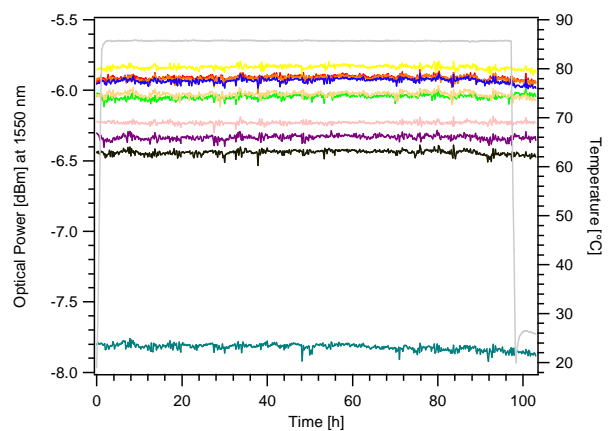
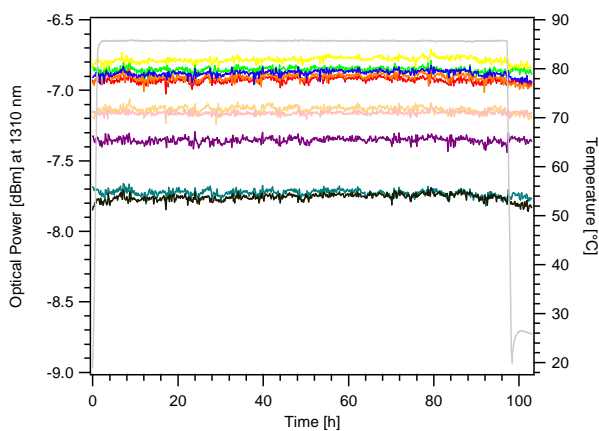
- DUT: 20 Diamond F-3000™ PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
- Mating adapters: 10 Diamond F-3000™ SM simplex mating adapters

**Parameters:**

- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 10
- Constant temperature: +85°C
- Relative humidity: Not controlled
- Duration: 96 h

### Results:

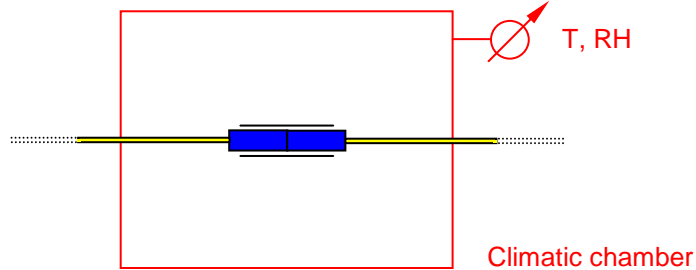
Statistics	Variation of insertion loss $\Delta IL$ during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.18	0.16
Minimum value	0.10	0.10





## 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



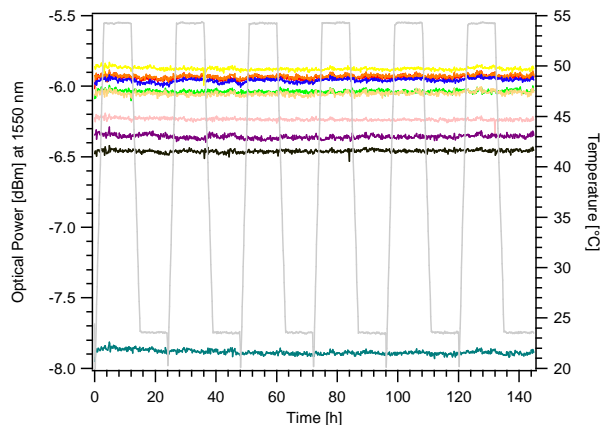
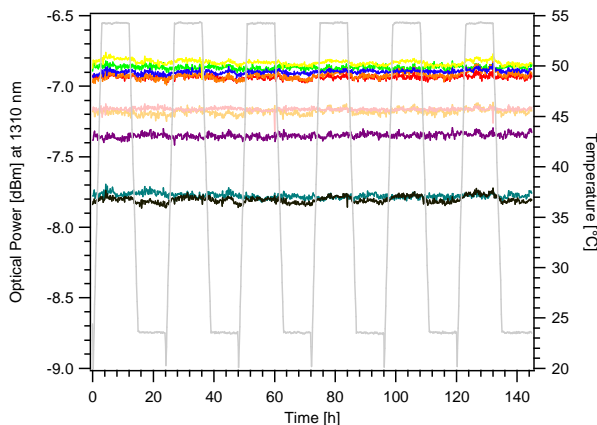
**Requirements:**  $\Delta IL_{Max} \leq 0.50$  dB during test

- Samples:**
- DUT: 20 Diamond F-3000™ PS APC 4° Titanium connectors on fibre patch cords
  - Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Mating adapters: 10 Diamond F-3000™ SM simplex mating adapters

- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
  - Monitored channels: 10
  - 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

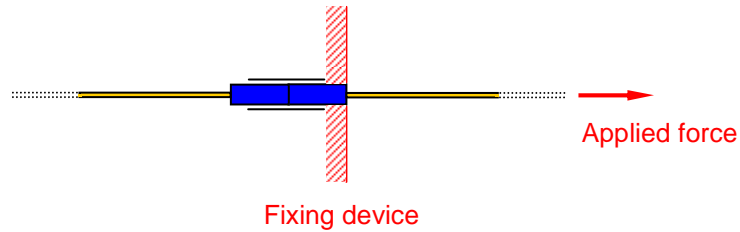
### Results:

Statistics	Variation of insertion loss $\Delta IL$ during test [dB]	
	at 1310 nm	at 1550 nm
Maximum value	0.19	0.16
Minimum value	0.09	0.06



## 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 Diamond F-3000™ PS APC 4° Titanium connectors on fibre patch cords
  - Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Mating adapters: 1 Diamond F-3000™ SM simplex mating adapter

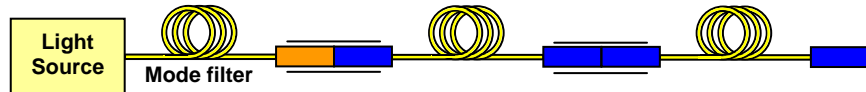
- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
  - Monitored channels: 10
  - Applied force: 5 N
  - Force direction: Longitudinal connector axis
  - Duration of applied force: 1 min
  - Force application distance: 30 cm

**Results:**

Sample no.	Insertion loss IL [dB]						Variation of insertion loss $\Delta IL$ [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	0.13	0.11	0.14	0.11	0.13	0.11	0.01	0.00
2	0.19	0.17	0.20	0.19	0.19	0.17	0.01	0.02
3	0.17	0.16	0.20	0.18	0.18	0.17	0.03	0.02
4	0.23	0.19	0.24	0.19	0.24	0.19	0.01	0.00
5	0.25	0.26	0.27	0.26	0.26	0.25	0.02	0.01
6	0.18	0.18	0.17	0.19	0.18	0.18	0.01	0.01
7	0.23	0.22	0.22	0.22	0.24	0.21	0.02	0.01
8	0.16	0.17	0.16	0.19	0.16	0.17	0.00	0.02
9	0.15	0.13	0.19	0.15	0.16	0.14	0.04	0.02
10	0.15	0.15	0.16	0.17	0.15	0.15	0.01	0.02
<b>Maximum value</b>							<b>0.04</b>	<b>0.02</b>
<b>Minimum value</b>							<b>0.00</b>	<b>0.00</b>

## Optical power handling

- 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



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

- Samples:**
- DUT: 4 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
  - Fibre: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Reference connectors: 2 Diamond F-3000<sup>TM</sup> PS APC 4° connectors of same lot
  - Mating adapters: 1 Diamond F-3000<sup>TM</sup> SM simplex mating adapter

- Parameters:**
- Wavelength: 1550 nm
  - Monitored channels: 2
  - 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: 10 min.

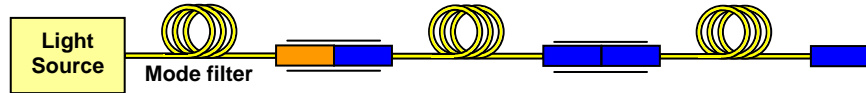
### Results:

Sample no.	Insertion loss IL [dB]				Variation of insertion loss $\Delta$ IL [dB]	
	before test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.24	0.24	0.21	0.18	0.03	0.06
2	0.19	0.18	0.24	0.25	0.05	0.07

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, extended duration

- 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



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

- Samples:**
- DUT: 2 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
  - Fibre: 8.2/125/245/900  $\mu\text{m}$ , Diamond art. no. 1005155
  - Reference connectors: 1 Diamond F-3000<sup>TM</sup> PS APC 4° connector of same lot
  - Mating adapters: 1 Diamond F-3000<sup>TM</sup> SM simplex mating adapter

- Parameters:**
- Wavelength: 1550 nm
  - Monitored channels: 1
  - Applied power level: 10 W
  - Exposure time: 1 h

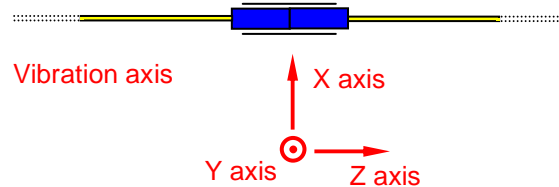
**Results:**

Sample no.	Insertion loss IL [dB]				Variation of insertion loss $\Delta IL$ [dB]	
	before test		after test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.30	0.20	0.35	0.22	0.05	0.02

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

## Vibration, sinusoidal

- Methods:**
- Insertion loss measurement method B according to IEC 61300-3-4
  - Active monitoring of attenuation according to IEC 61300-3-3
  - Sinusoidal vibration test according to IEC 61300-2-1



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

- Samples:**
- DUT: 8 Diamond F-3000™ PS APC 4° Titanium connectors on fibre patch cords
  - Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Mating adapters: 4 Diamond E-2000™ SM simplex mating adapters

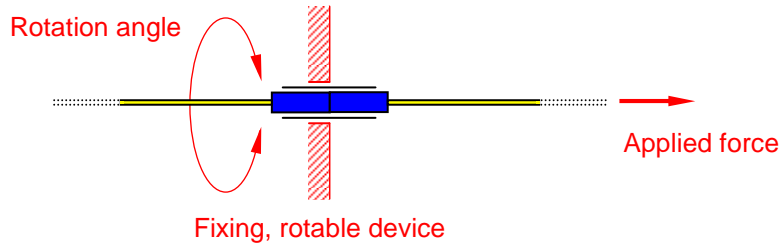
- Parameters:**
- Wavelengths: 1310 nm / 1550 nm
  - Monitored channels: 4
  - Upper vibration frequency: 55 Hz
  - Lower vibration frequency: 10 Hz
  - Vibration amplitude: 0.75 mm (peak-to-peak)
  - Sweep rate: 1 Oct/min
  - Sweep cycles: 15
  - Duration per axis: 1.5 h

### Results:

Sample no.		Insertion loss IL [dB]				Maximum variation of insertion loss during test $\Delta IL$ [dB]	
		before test		after test		at 1310 nm	at 1550 nm
		at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	Axis X	0.21	0.20	0.20	0.20	0.01	0.01
	Axis Z	0.20	0.19	0.18	0.19	0.02	0.01
2	Axis X	0.16	0.19	0.16	0.19	0.00	0.00
	Axis Z	0.17	0.18	0.16	0.17	0.01	0.01
3	Axis X	0.12	0.10	0.11	0.08	0.01	0.02
	Axis Z	0.11	0.11	0.11	0.11	0.00	0.00
4	Axis X	0.16	0.15	0.16	0.15	0.01	0.01
	Axis Z	0.14	0.14	0.13	0.14	0.01	0.00
<b>Maximum value</b>						<b>0.02</b>	<b>0.02</b>
<b>Minimum value</b>						<b>0.00</b>	<b>0.00</b>

## Torsion

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



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

**Samples:**

- DUT: 10 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
- Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
- Mating adapters: 1 Diamond E-2000<sup>TM</sup> SM simplex mating adapter

**Parameters:**

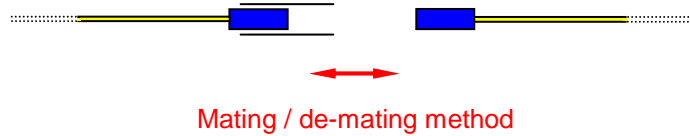
- Wavelengths: 1310 nm / 1550 nm
- Monitored channels: 10
- Applied force: 2 N
- Force direction: Longitudinal connector axis
- Rotation angle: +180° to -180° and back
- Number of cycles: 25
- Force application distance: 40 cm

### Results:

Sample no.	Insertion loss IL [dB]				Maximum variation of insertion loss during test $\Delta IL$ [dB]	
	maximum, during test		minimum, during test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.07	0.08	0.05	0.06	0.02	0.02
2	0.17	0.15	0.15	0.12	0.02	0.03
3	0.11	0.07	0.09	0.06	0.02	0.01
4	0.18	0.14	0.15	0.13	0.03	0.01
5	0.24	0.24	0.21	0.21	0.03	0.03
6	0.12	0.15	0.08	0.15	0.04	0.00
7	0.25	0.23	0.22	0.21	0.03	0.02
8	0.11	0.12	0.08	0.10	0.03	0.02
9	0.08	0.10	0.06	0.08	0.02	0.02
10	0.07	0.07	0.04	0.05	0.03	0.02
<b>Maximum value</b>					<b>0.04</b>	<b>0.02</b>
<b>Minimum value</b>					<b>0.03</b>	<b>0.00</b>

## 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 Diamond F-3000<sup>TM</sup> PS APC 4° Titanium connectors on fibre patch cords
  - Fibre type: 8.2/125/245/900  $\mu$ m, Diamond art. no. 1005155
  - Mating adapters: 1 Diamond F-3000<sup>TM</sup> SM simplex mating adapter

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

**Results:**

Sample no.	Insertion loss IL [dB]				Maximum variation of insertion loss during test $\Delta IL$ [dB]	
	maximum, during test		minimum, during test		at 1310 nm	at 1550 nm
	at 1310 nm	at 1550 nm	at 1310 nm	at 1550 nm		
1	0.15	0.13	0.10	0.09	0.05	0.04