



**Technical Paper |**  
**opticalCON® QUAD LITE**

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**Technical Paper – opticalCON QUAD LITE**

Title: NTP02  
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Subject:

Mechanical and optical tests applied to the opticalCON QUAD LITE transmission system for Pro Audio / Video industry purposes with main focus on changes in attenuation.

Optical performance is being examined with regard to attenuation and its variation vs. environmental and mechanical conditions.

This documentation describes the results of the test series conducted at Neutrik AG and University of Applied Sciences of Technology Buchs NTB.

The tests were carried out in accordance with the IEC-Standard main groups IEC 60794 and IEC 61300 as well as to Neutrik internal specifications.

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## 1 Optical Attenuation

### Object:

Examination of the receptacle NO4FDW-A in combination with the opticalCON® QUAD LITE cable connector to determine the attenuation in a fiber optic system.

For the test of the cable connector a completely assembled opticalCON cable was used. See fig. 1.

### Test Set-Up:

Test specimens:	Single-mode NKO4S-L-0-1
Test procedure:	Occurred according to IEC 61300-3-4 (figure 4)
Test equipment:	OptoTest OP930 light source
	OptoTest OP710 power meter
Launching cables:	0.9 mm precision fibers
Measuring wave lengths:	1310 nm +1550 nm single-mode
Cable length:	1 m
Comment:	Short cable lengths do not affect attenuation remarkably and are therefore not considered.

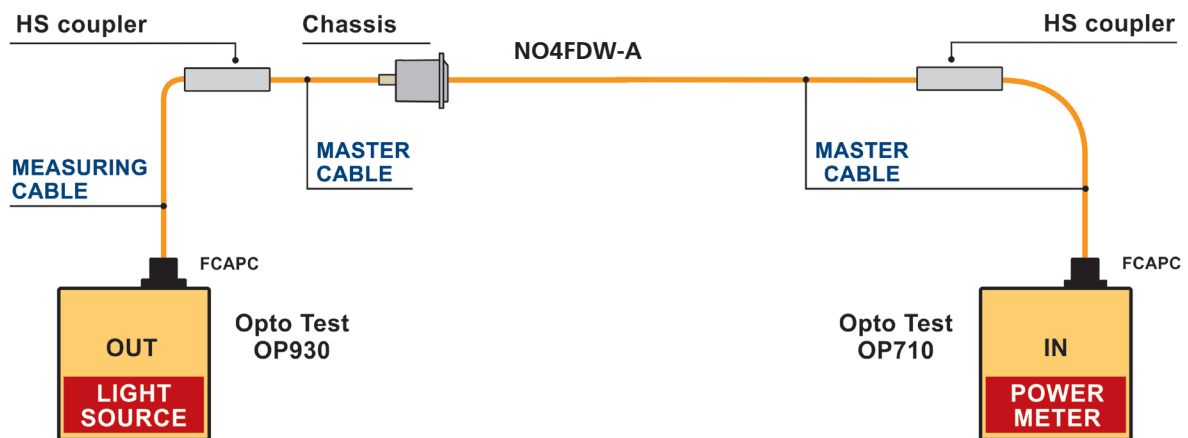


figure 1.a : reset to zero attenuation

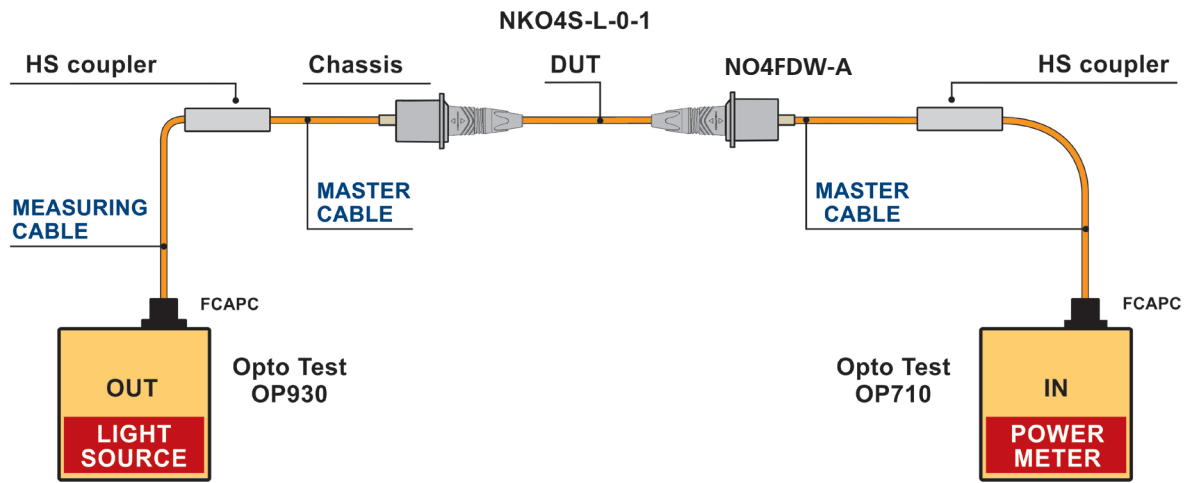


figure 1.b: Simplified measuring arrangement

### Limit Insertion Loss Values (per mating pair):

Single-mode: 0.90 dB (0.45 dB per connection)

### Results:

Basis of test series: 50 sets of cable assemblies

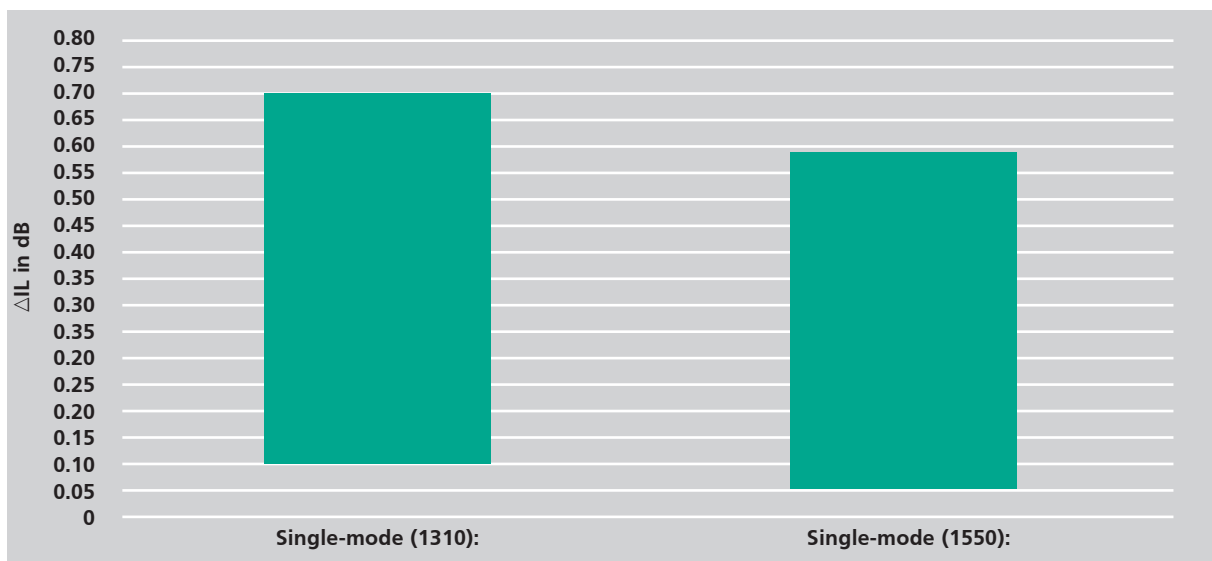


figure 1.c: Achieved values of the 50 sets test series

## 2 Vibration

### Object:

Examination of the two components, receptacle NO4FDW-A and the opticalCON cable connector. The intention of the test was to determine their attenuation in a fiber optic system before, during and after the vibration test.

In addition the function of the mechanical locking system and the wear were investigated.

The test was carried out by an independent laboratory: NTB, "Interstaatliche Hochschule für Technik Buchs" division "Labor Mess- und Simulationstechnik" located in Buchs/ Switzerland.

### Test Set-Up:

For the vibration test two receptacles NO4FDW-A per axis were mounted. The front side was mated with a NKO4S-L-0-2 opticalCON QUAD LITE cable. The rear end was connected with the test instrument via precision measuring cables (see fig. 2 a/b).

The applied test set-up complies with IEC 61300-2-1 table 1.

Shaker:	TIRAVIB Model 5520, controlled by an external power amplifier and a PC with software SignalStar Vector (fig. 2 a/b).	
Test instruments:	Kingfisher KI 2824	light source
	Kingfisher KI 2600-Ge	power meter
Launching cables:	0.9 mm precision fibers	
Measuring wave lengths:	1310 nm	single-mode
DUT cable length:	2 m	
Comment:	Short cable lengths do not affect attenuation remarkably and therefore not considered.	

### Vibration Severity:

Frequency range:	10 – 55 Hz
Amplitude displacement:	0,75 mm (1,5 mm pp)
Sweep rate:	1 oct/min
Number of sweeps:	15
Axis:	Y, Z

After 15 cycles the receptacles were changed to the next axis without disconnecting the plugs to avoid any mismatching.

## Results:

Attenuation before, during and after vibration test:

a) Changes in attenuation:

Single-mode (1310nm):	- 0.03 dB
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Measurement during vibrations showed no variation in attenuation.

b) Mechanical

The locking mechanism withstands this extreme vibration without any functional impairment.



figure 2.a: : Vibration equipment and test cable arrangement

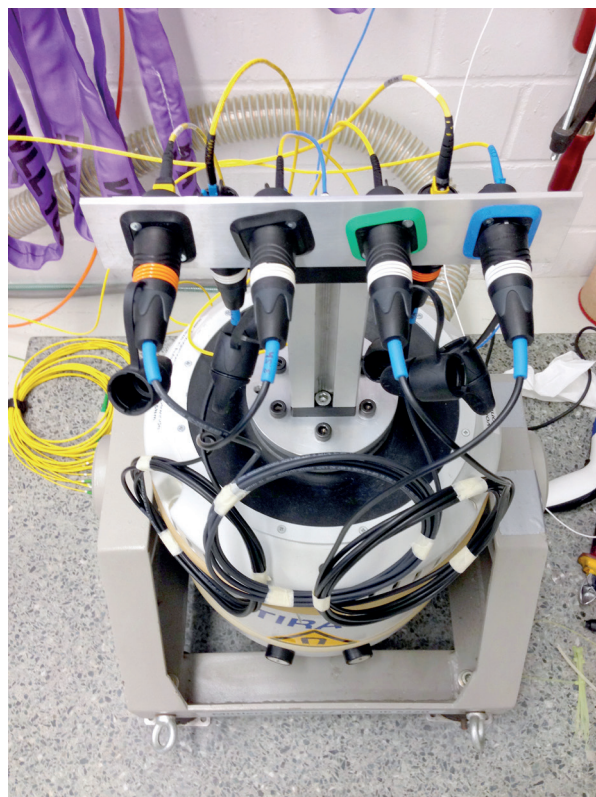


figure 2.b: : Vibration equipment and test cable arrangement

### 3 Cable Retention

#### Object:

Test of the cable retention efficiency. The opticalCON QUAD LITE cables were exposed to tractive forces until the cable started to move.

#### Test Set-Up:

The applied test procedure is referred to IEC 61300-2-4.

Tension-Tester:	Versa Test Mecmesin 0-1,000N (fig. 3)
Measuring Instruments:	AFG-R 1000N Mecmesin
Assembled cable types:	5 pieces of NKO4S-L-0-1 (single-mode 4 fibers)

#### Results:

NKO4S-L-0-1:	> 250 N
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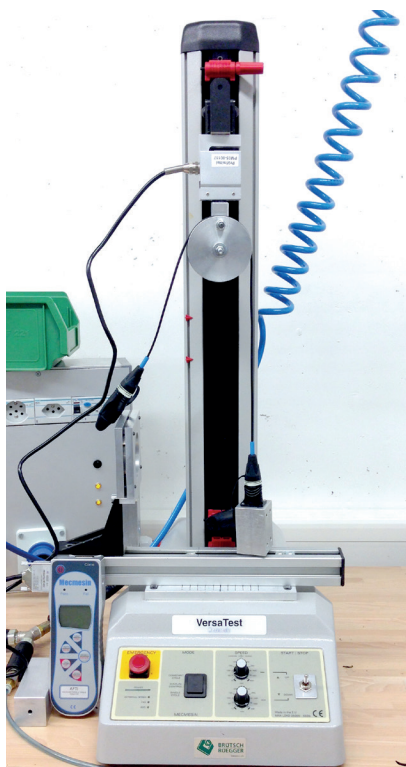


figure 3: Equipment for examination of cable retention

## 4 Locking Mechanism

### Object:

Tensile strength measurement of the locking mechanism.

### Test Set-Up:

Same test set-up as used in clause 3. Cable Retention.  
Instead of the cable a mechanical adapter was used to fix the plug.

### Results:

Tensile strength	> 300 N
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At a force of 300 N the test was stopped without any damages of the locking device.

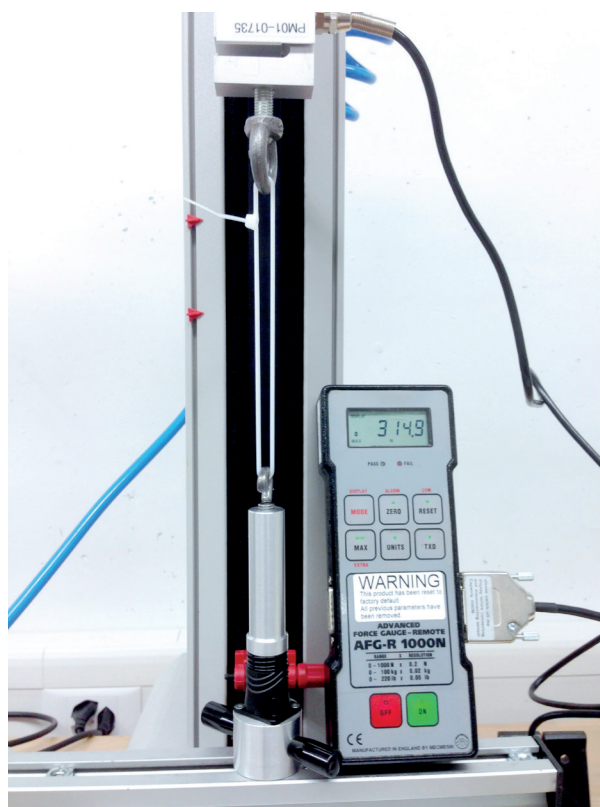


figure 4: Equipment for examination of locking mechanism



## 5 Impact

### Object:

The impact test is performed to show possible deformations or plug malfunction of the internal mechanism due to heavy mechanical exposure.

### Test Set-Up:

The applied test procedure is referred to the IEC 61300-2-12 Method A pendulum drop (fig. 5).

Test item:	opticalCON QUAD LITE cable connector
First part of test:	front side of connector protected by a protection cap of EPDM
Second part of test:	no connector protection

### Parameters of Test:

Distance from centre of rotation:	2.25 m
Number of drops:	5
Height of falling:	1.0 – 1.9 m
Ground:	steel plate, thickness 25 mm
Plug fixation:	small wire

### Results:

Tests 1 – 3:	No visible abrasions, no functional impairment
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figure 5.a: Test set-up "Impact"

TEST #	with cap	drop heigh [m]	drops	result
1	yes	1.0	5	no visible abrasion full function
2	yes	1.9	5	no visible abrasion full function
3	yes	1.0	5	no visible abrasion full function

figure 5.b: Impact test IEC 61300-2-12 method A

## 6 Mating Durability

### Object:

The mating durability test was carried out to show variations in attenuation (optical) after lifetime.

### Test parameter:

NKO4S-L-0-1 (single mode 4 fibers)

### Test Set-Up:

Test procedure occurred according to IEC 61300-2-2 figure 1!

The test was realized with the equipment shown in fig. 6.

Mating cycles:	250 (durability test) 2500 (lifetime test)	
Launching:	Kingfisher KI 2824 Kingfisher KI 2600-Ge	light source power meter
Microscope:	enlarged x 200	
Measuring cables:	0.9 mm precision fibers	
Measuring wave lengths:	1310 nm	single-mode
DUT cable length:	1 m	

### Results:

#### 250 cycles (durability test):

The microscopic assay shows a slight degree of contamination after 250 mating cycles due to the fact that the fibers are not protected by a separate shutter. The attenuation values still meet Neutrik's internal requirements of < 0.45 dB/connection.

Single-mode: 0.25 dB degradation without cleaning, 0.05 dB degradation after cleaning

#### 2500 cycles (lifetime test)

The visual inspection shows a slight degree of contamination of the fiber (soil remains) after 2500 mating cycles.

MEASURING	BEFOREE LIFETIME TEST [dB]	AFTER LIFETIME TEST [dB]	VARIATION [dB]
Return Loss	54.4	51.9	2.5
Insertion Loss	0.25	0.53	0.28

## 250 cycles - Durability test

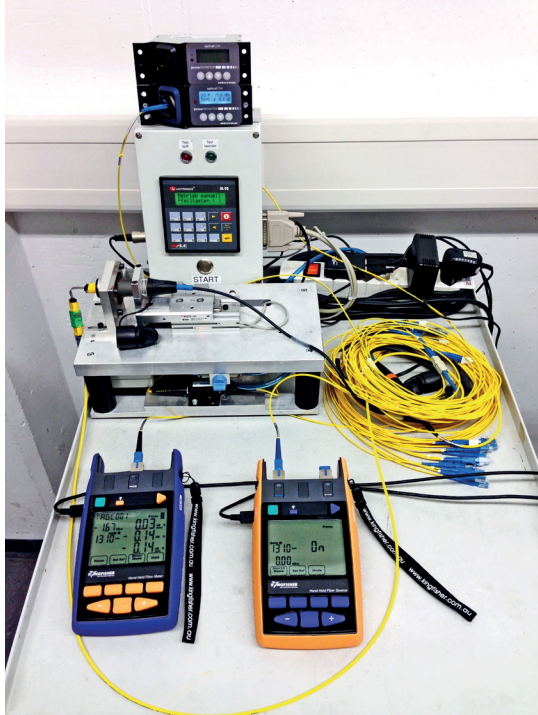


figure 6.a: measuring setup for durability and lifetime test

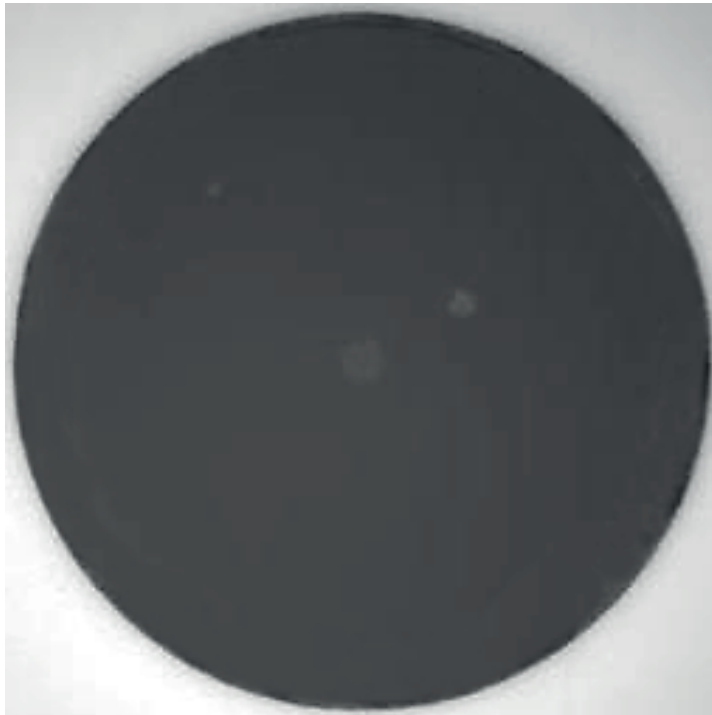


figure 6.b: Ch1 / sm: slight visual degradation (soil)

## 2500 cycles - Lifetime test

### Fiber condition

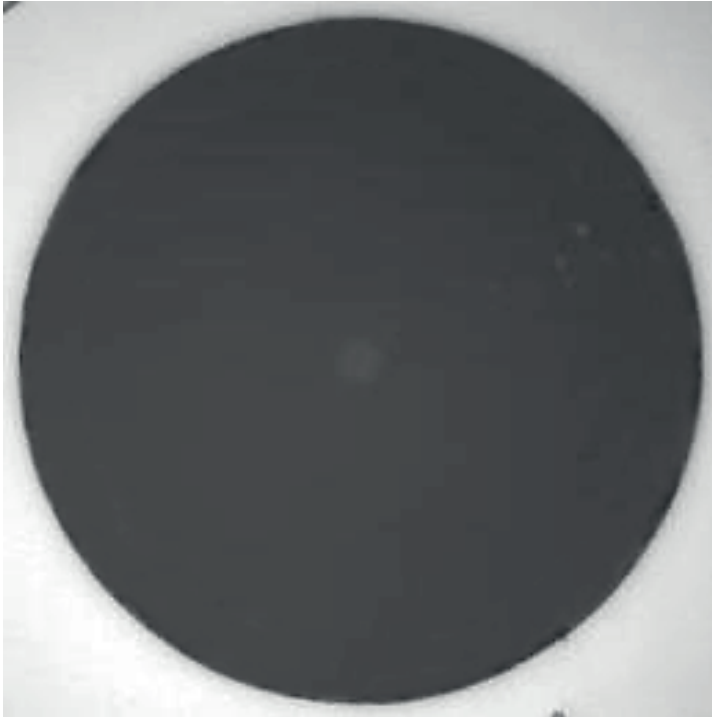


figure 6.c: Ch1/ sm: slight visual degradation

Due to the results, Neutrik AG definitely recommends changing to the opticalCON ADVANCED product range, when higher mating cycles are required.

## 7 Change of Temperature

### Object:

Variations in attenuation due to temperature changes.

The test was arranged with a single-mode cable which is more critical than multimode.

### Test Set-Up:

Test procedure according to IEC 61300-2-22 in combination with IEC 61300-3-4 (Fig 7.a)  
The test was realized in a temperature testing chamber type WEISS WK11-180/40.

Test cycles:	16 (96 h)	
Profile of temperature:	-25°C to +75°C (fig. 7a)	
Test instruments:	Kingfisher KI 2824	light source
	Kingfisher KI 2600-Ge	power meter
Launching cables:	0.9 mm precision fibers, constantly connected with the DUT (device under test) in the test chamber.	
Measuring wave lengths:	1310 nm	single-mode
Cable length:	5 m	
Test specimen:	NKO4S-L-0-10	

### Results:

Maximum increase in attenuation 0.13 dB over the temperature range between +23°C and +75°C.  
In the temperature range from -25°C to 75°C the insertion loss meets Neutrik's requirement. (fig. 7b)

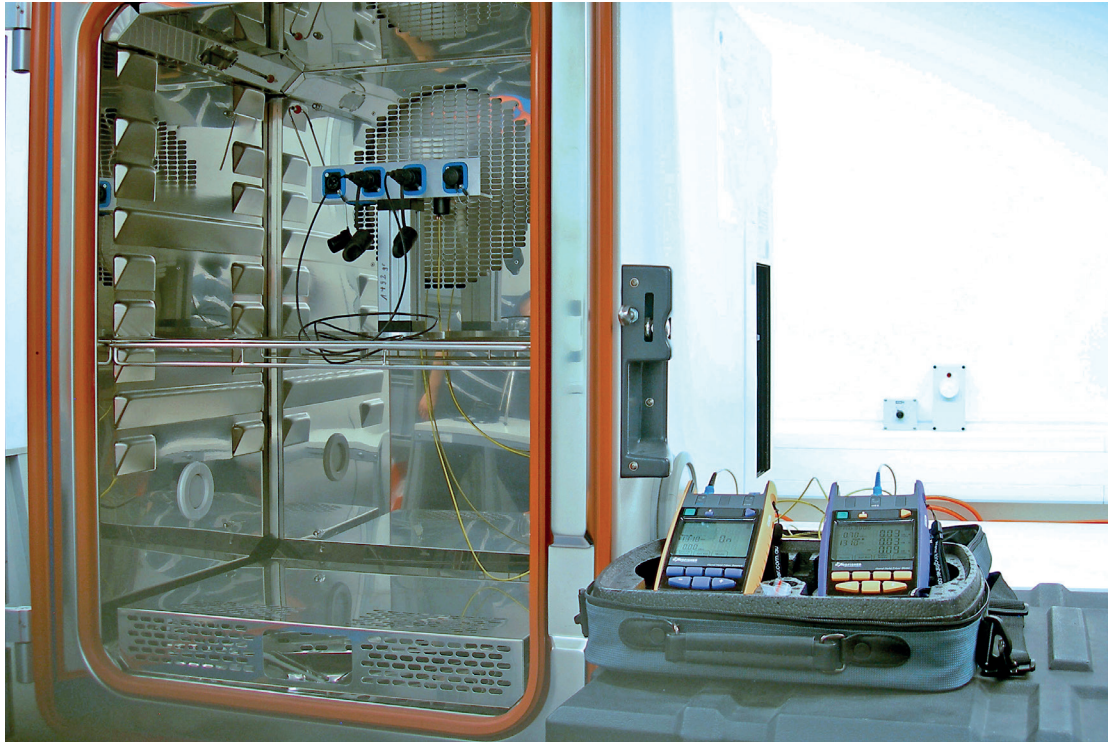


figure 7.a: Test setup of temperature influence

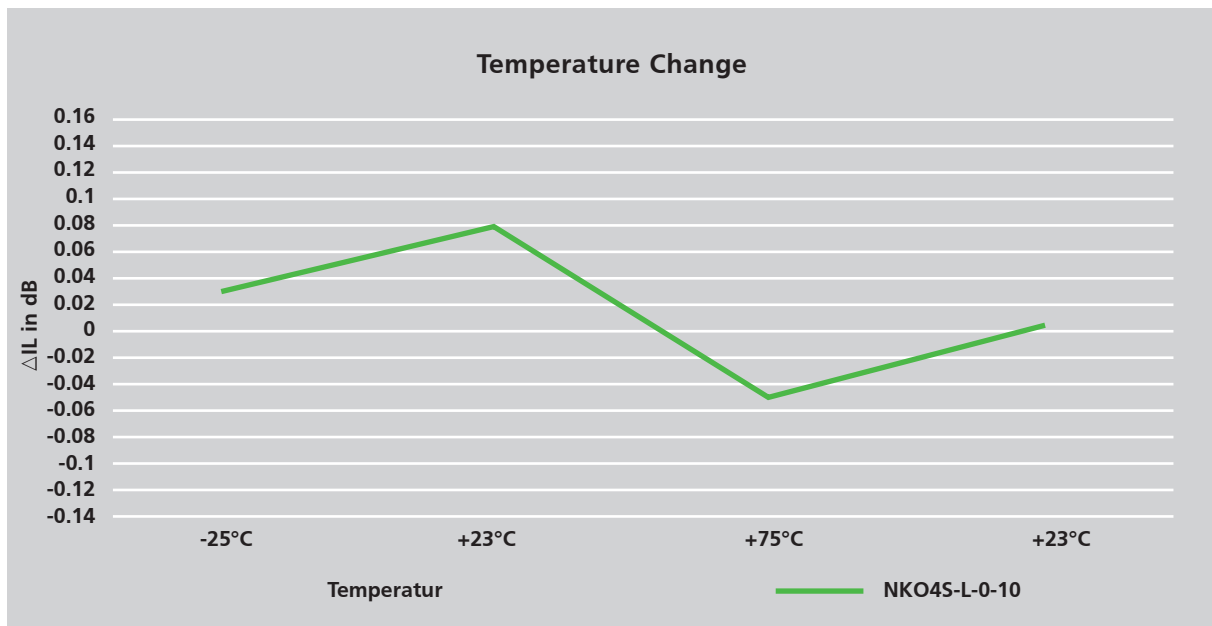


figure 7.b: Increase of the IL due to temperature change



## 8 Flexing

### Object:

Variations of attenuation and mechanical damage of fiber optic cable due to a defined flexing procedure.

Assembled cable types:  
NKO4S-L-0-1 (single mode 4 fibers)

### Test Set-Up:

Measurement of attenuation before, during and after flexing cycles.

The applied test procedure is referred to IEC 61300-2-44 in combination with IEC 61300-3-4 Fig. 9.a.

Test equipment:	fig. 8.b	
Test cycles:	1,000 / 5,000	
Mass of weight:	10 N or 20 N depending on cable type	
Flexing angle:	$\pm 90^\circ$	
Flexing speed:	ca. 12 cycles/min	
Test Instruments:	Kingfisher KI 2824	light source
	Kingfisher KI 2600-Ge	power meter
Launching cables:	0.9 mm precision fibers	
Measuring wave lengths:	1310 nm	single-mode
DUT cable length:	1 m	single-mode

### Results:

a) Change in attenuation:

Single-mode:	0.05 dB to 0.27 dB
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b) Mechanical cable damage:

1,000 cycles:	no damage
5,000 cycles:	no significant damage



NO4FDW-A  
NKO4S-L-0-1

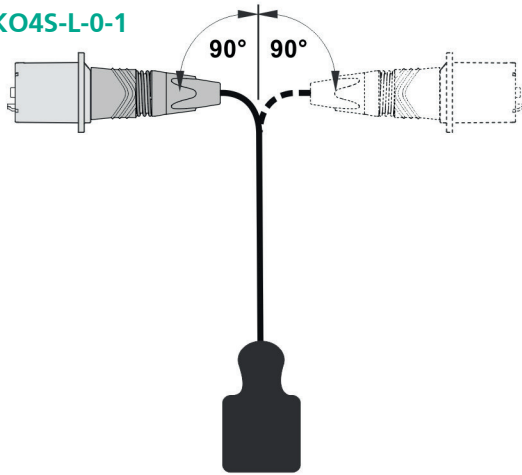


figure 8.a: Principle of Test according to IEC 61300-2-44 (IEC 61300-3-4)

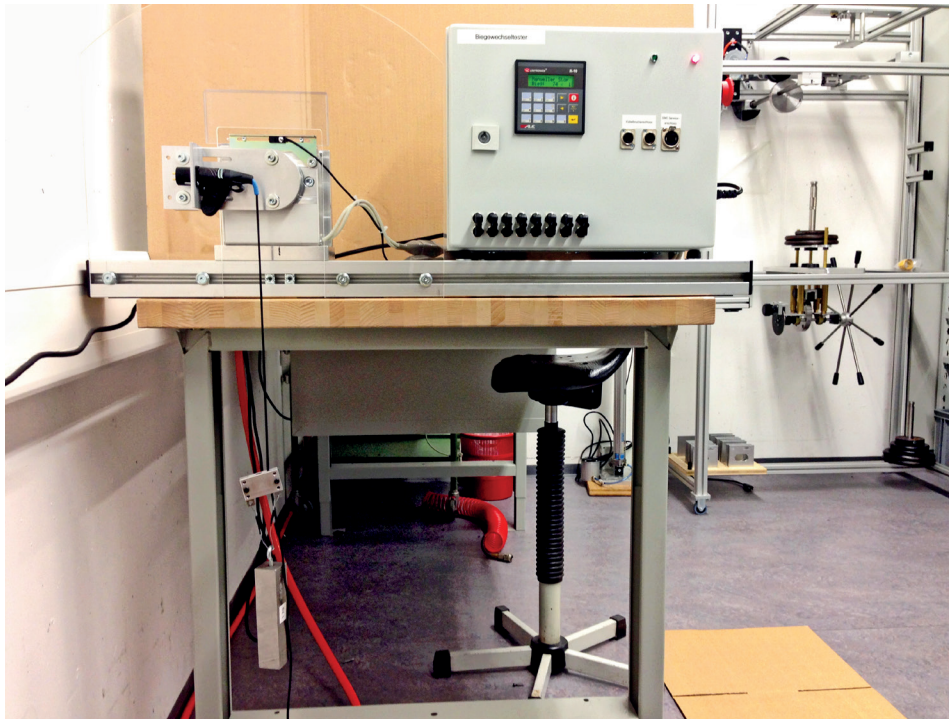


figure 8.b: Test Equipment and Fixture for flexing test