Assessment of cables and connecting elements under operational conditions

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Current technology and its drawbacks

Cable properties according to the manufacturer's technical data sheet – compared with reality

Data sheets with values according to IEC/ DIN EN standards-give the customer the impression of high cable quality under operational conditions. But according to the standards, the most important cable properties under installation, assembly and ageing (temperature) conditions should be explicitly agreed upon between customer and supplier.

Our solutions for the future

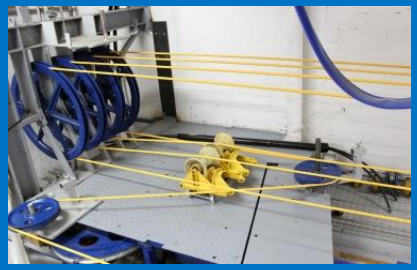
We are a neutral cable-testing lab with extensive know-how

- 50 years' experience in the telecom-munication and signalling-cable sector
- 30 years practical experience in testing and assessing the quality of cables, cable designs and connecting elements under real-life conditions
- Expert assessment of transmission property changes during and after the guarantee period
- Praxis-based seminars held on the themes of measurement technology, construction supervision and cable-quality assessment

Our plus:

- We have our own testing facility e.g. for tensile strength tests (static and dynamic) on lengths up to 110 m
- Temperature cycling tests can be carried out on cable lengths up to approx. 1000 m
- Measurement of fibre-optic routes up to lengths of 1000 km

Our testing facility: sample layout for cable bending under tensile stress acc. to DIN-EN/ IEC 60794-1-2/ E18 60794-1-21/ E18A



We welcome the opportunity of passing on our know-how

Participants in our seminars and clients have the opportunity of discussing with us the results of cable tests carried out under real-life conditions.

We can give you expert advice on the relevant criteria for evaluating fibre-optic property changes within the guarantee period of at least 20 years.

On request you can receive our newsletter (News 00/xx) containing extracts from cable test results.

- Requirements of IEC-/ DIN EN standards
- Manufacturers' technical data sheets in comparison with actual test results obtained under real-life conditions

The most important test criteria in the operational area of a fibre optic cable

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Testing and evaluating the most common faults: properties connected with design, manufacture, installation, assembly, and ageing

Quality characteristic "excess length of cabled fibres"

Knowing the (excess) length of all the fibres in an optical cable is an indispensable criterion for all the relevant optical fibre properties during the service life of a cable. Every fibre in an optical cable occupies a particular position within the (stranding) bundle in a neutral state, i.e. when the cable is free of outer/inner forces or tensions, at an ambient temperature of approx. 20°C.

In relation to this neutral fibre position there are special "work area limits" for either cable elongation or cable shrinkage, depending on the cable design. Within these "work area limits", which are affected by ageing, but especially by environmental influences such as tension/ pressure or temperature, the mechanical and transmission properties of the optical fibres do not show any special irregularities.

However, if the limit range is exceeded, the optical fibre may develop changes in transmission behaviour or may, in the worst case, break down completely.

Pre-calculated, necessary excess fibre length …

- **… in an unstranded core (depending on the cable design)**
  Layer-stranded cable Lg: ~0.37 % = 3.7 mm/m
  Central loose tube: ~0.20 % = 2.0 mm/m
  Slotted core: ~0.32 % = 3.2 mm/m
  Ribbon fibres: ~0.20 % = 2.0 mm/m

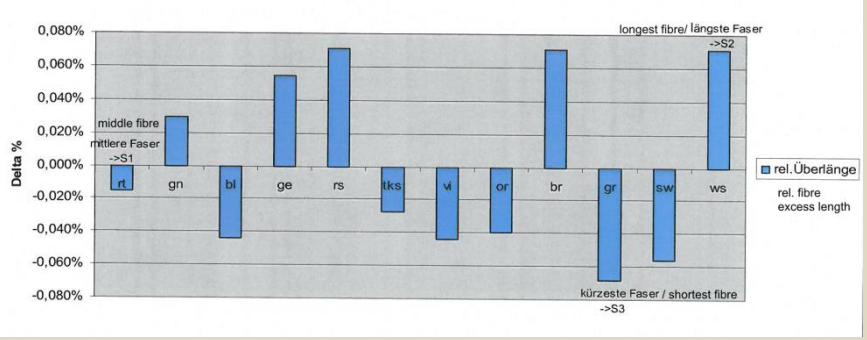
- **.. in the whole cable**
  The difference in length between all the fibres in the cable 0.1% = 1 mm/m
  for the operational area of the cable (guideline values)

If the excess length of a cabled fibre is known, then its available margin of manoeuvre, the result of the cable design, can be calculated, and also checked by testing if necessary. The manufacturer and user of a particular cable type can only reach a reasonable agreement as to its relevant properties and limit values after this has been done.

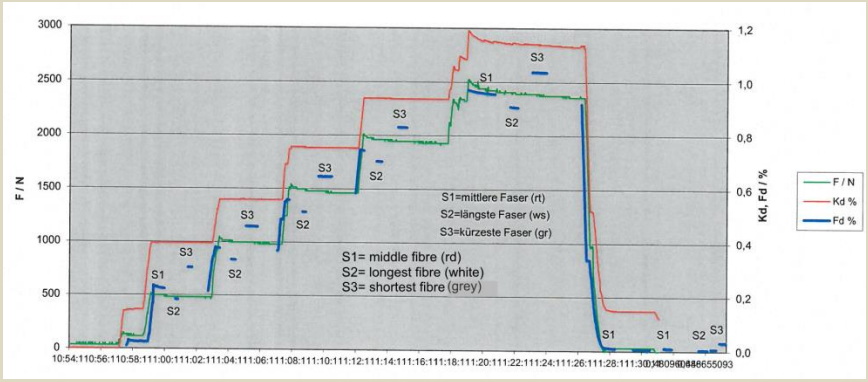
The diagram shows an example of the excess cabled fibre length of two central tubes and how the fibres stretch under tension.

Cable with a central tube and 12 single-mode fibres

Relative excess length of fibres in a cable with single-mode fibres, in relation to the average value for all 12 fibres

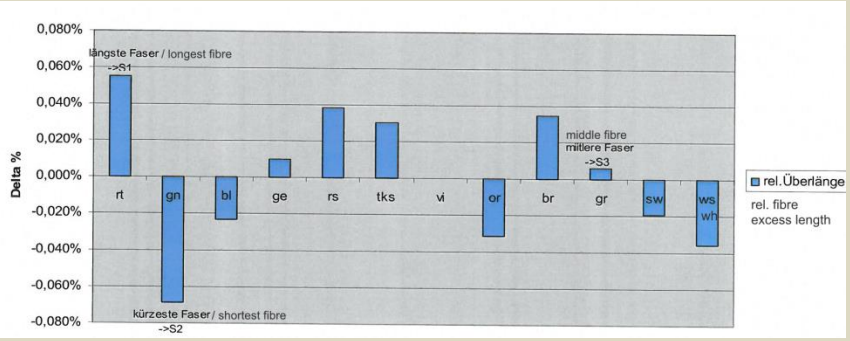


Cable with single-mode fibres – tensile test with fibre stretching Static measurement up to F=2500 N

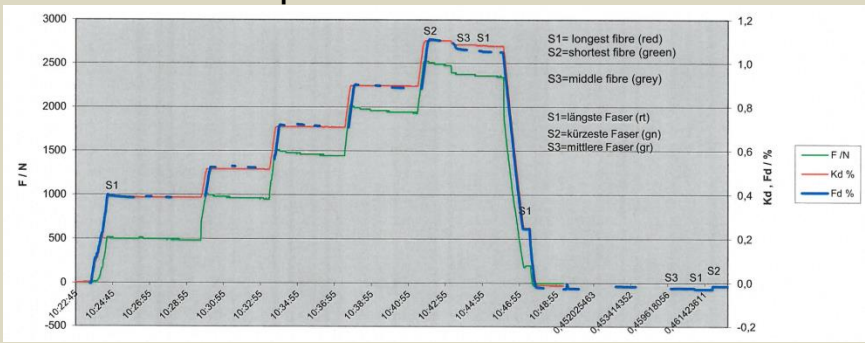


Cable with a central tube and 12 multimode fibres

Relative excess length of fibres in a cable with multimode fibres, in relation to the average value for all 12 fibres



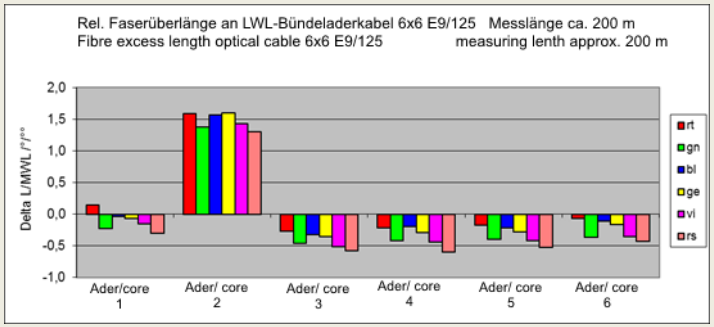
Cable with multimode fibres – tensile test with fibre stretching Static measurement up to F=2500 N



Cable with 6 S/Z-stranded loose tubes

Excess length of cabled fibre (no existing standard)

on cable lengths of up to 200 m



This should make it clear why there is basically no point in carrying out a tensile test with measurement of fibre stretching without measuring the excess length beforehand and identifying the longest, shortest and middle fibre.

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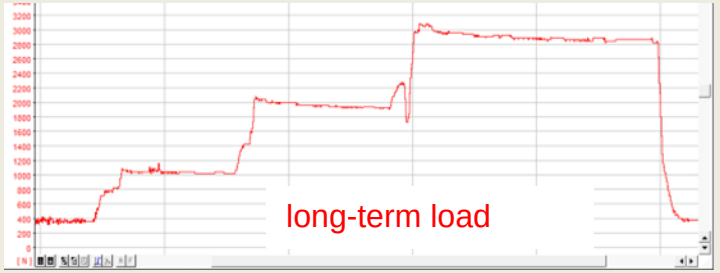
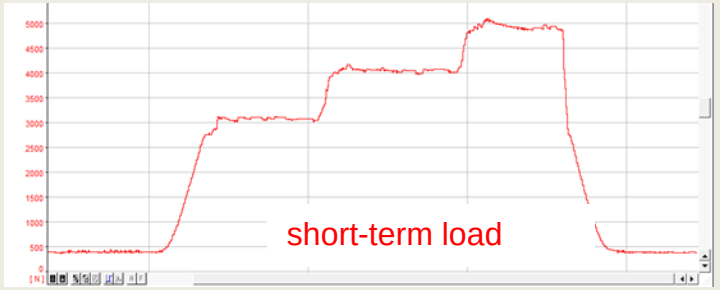
Tensile strength IEC DIN EN 60794-1-21 (May 2011) E1A and E1B

Attenuation change and fibre elongation of the shortest, middle and longest fibres of cable lengths from 30 m to 200 m. Load: 100 N to 15000 N

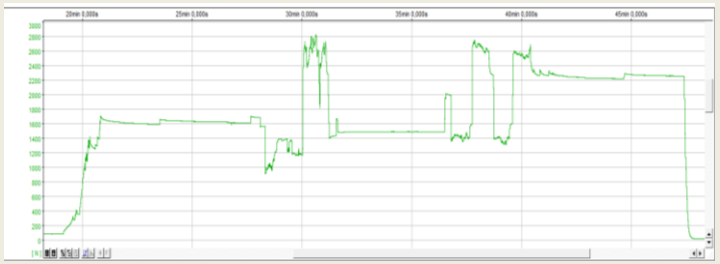


Attenuation Δα [dB]		Fibre stretching [%] in cabled fibres		Cable elong-ation
1550 nm	1625 nm	shortest	longest	[%]
1.47	3.72	0.42	0.24	0.7
0.8	1.53	0.23	0.07	0.4
0.07	0.19	0.06	0	0.02
0.03	0.08	0.01	0.04	0.15

Nominal value exceeded



Attenuation Δα [dB]		Fibre stretching [%] in cabled fibres		Cable elong-ation
1550 nm	1625 nm	shortest	longest	[%]
2.1	4.02	0.839	0.651	2.6
1.79	3.34	0.652	0.478	1.5
1.36	2.56	0.445	0.28	0.6
0.22	0.04			1.7



Cable bending under load

IEC DIN EN 60794-1.21/ E18A

Attenuation changes in cable lengths of 30 m to 130 m.
Load 100 N to 15000 N.