Prüfung von konfektionierten und unkonfektionierten Kunststoff-Lichtwellenleitern (POF)

VDI/VDE-Richtlinie 5570

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VDI/VDE-Richtlinie 5570

- Einleitung
- VDI/VDE 5570 im Überblick
  - Teil 1
  - Teil 2
  - Teil 3
  - Teil 4
- Ausblick

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Characterisation and testing of POF at the beginning of the 21st century:

- National and international standards (e.g. IEC, EN and JIS)

IEC Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

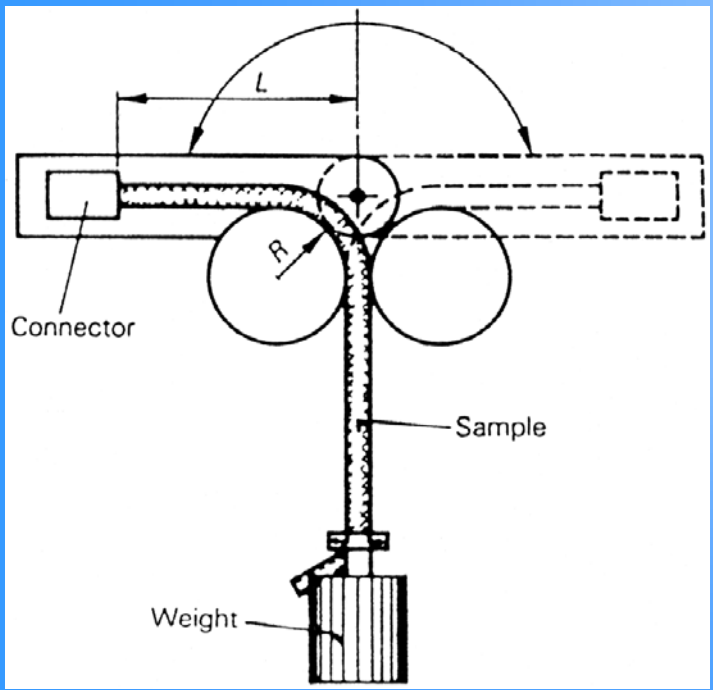
JISC Japanese Industrial Standards Committee

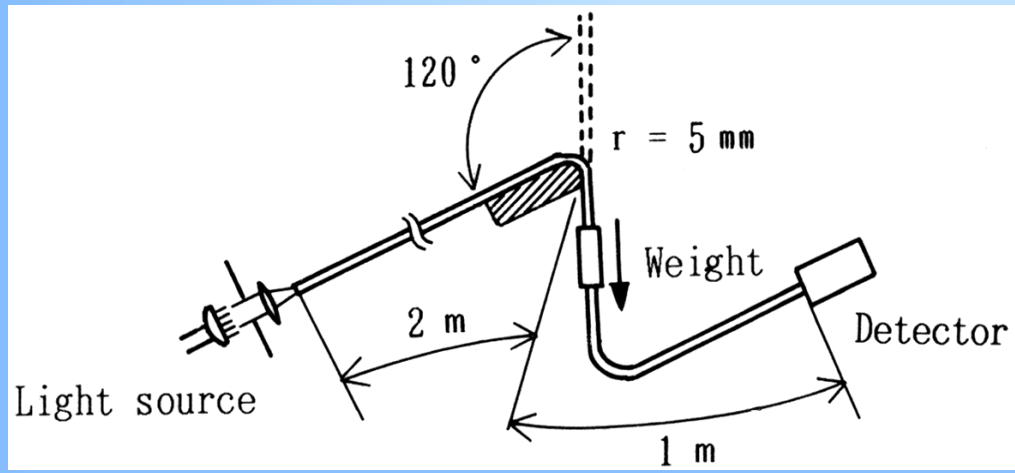
cen

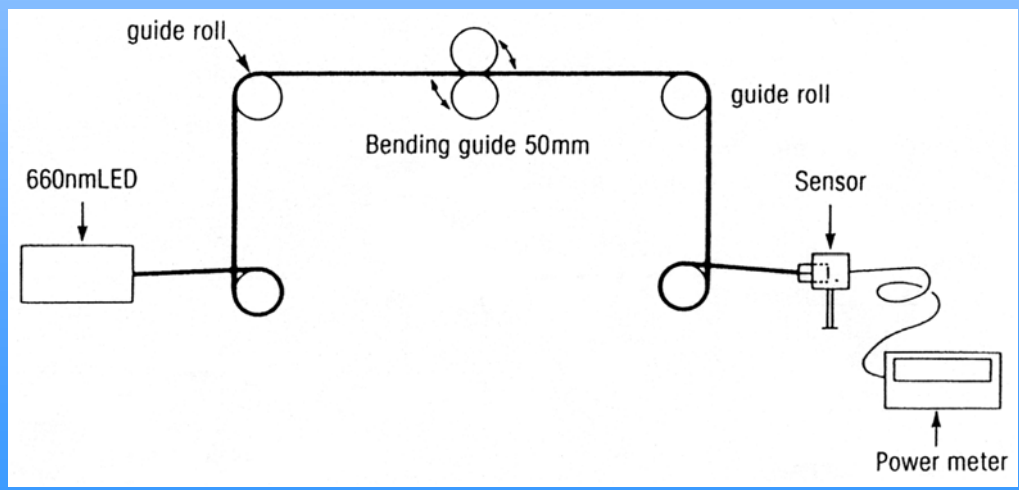
- Public available specifications (PAS) of manufacturers, test labs and users

All documents are not harmonised !!!

Various test methods for repeated bending







Introduction

History

March 2001	Establishment of a working group within the VDI competence field 'Optical Technologies'
September 2001	First draft of VDI/VDE 5570 is announced at 10th Int. POF Conf.
April 2002	VDI/VDE 5570 Part 1 to Part 4 Committee draft
January 2003	VDI/VDE 5570 Part 1 to Part 4 Publication of guideline draft

Introduction

Main objectives of VDI/VDE 5570

- to define suitable and sounded test and measurement procedures,
- to harmonise test and measurement procedures,
- to improve the quality of tests and measurements,
- to improve the comparability, reproducibility and traceability of test and measuring results,
- to stimulate technical developments,
- to promote the exchange of experience and transfer of POF technology.

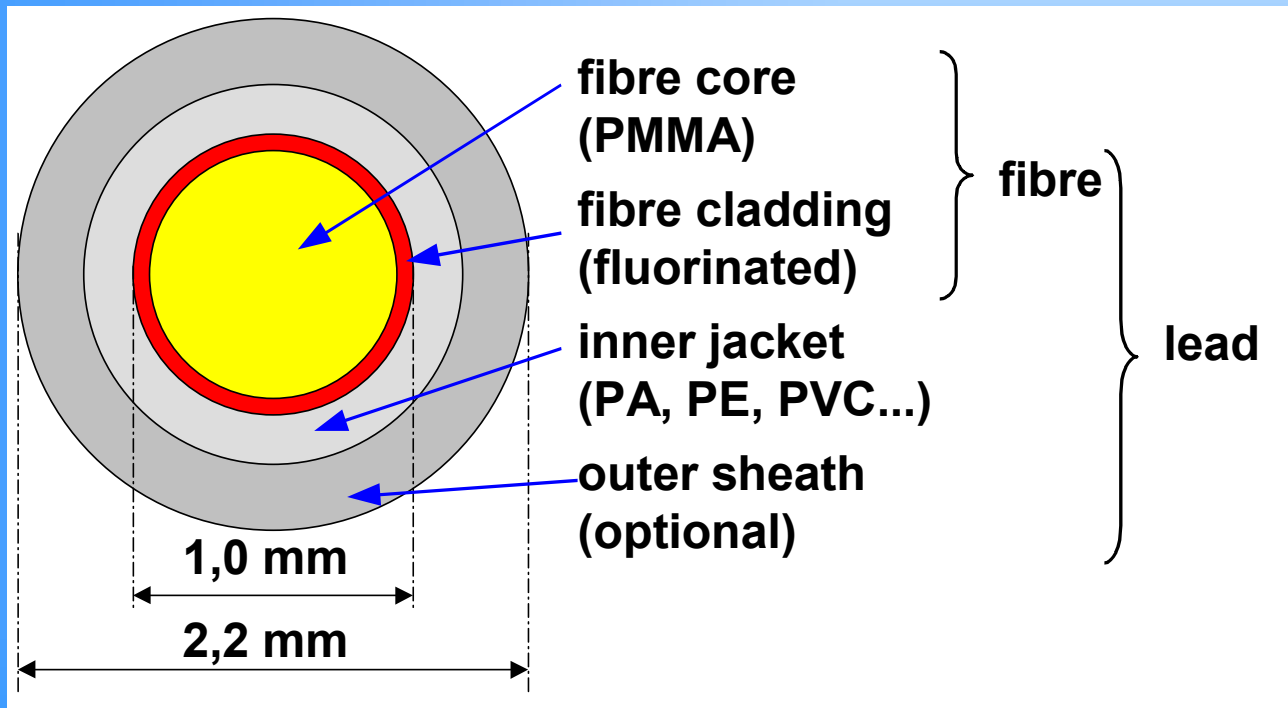
Introduction

VDI/VDE 5570 is divided into

- **Part one:** Terms and definitions
- **Part two:** Measuring and test methods for optical characteristics
- **Part three:** Test methods for mechanical and environmental characteristics
- **Part four:** Power budget

Terms and definitions

VDI/VDE 5570 is focusing on step-index POF, up to now the most used fibre type in automotive and industrial fields of application.



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Measuring and test methods for optical characteristics

Selected parameter	VDI/VDE 5570	IEC 60793-1 60794-1	JIS C 6863	EN 187000 188000	Asahi Chemical Ind. Co.	BAM	Mitsubishi Rayon Co.	Toray Indust. Inc.
Attenuation	•		•	•	•	•	•	•
Refractive index profile		•		•				
Bandwidth	under pre-paration	•		•	•			
Numerical aperture	•	•		•				

VDE/VDE 5570 Part 2

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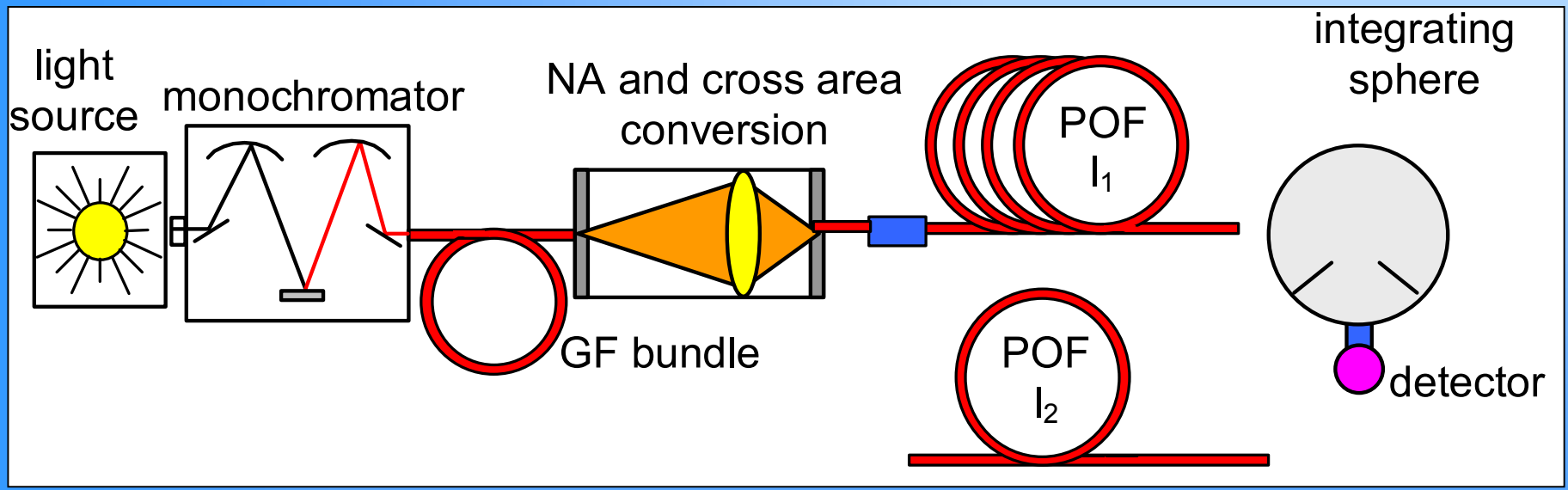
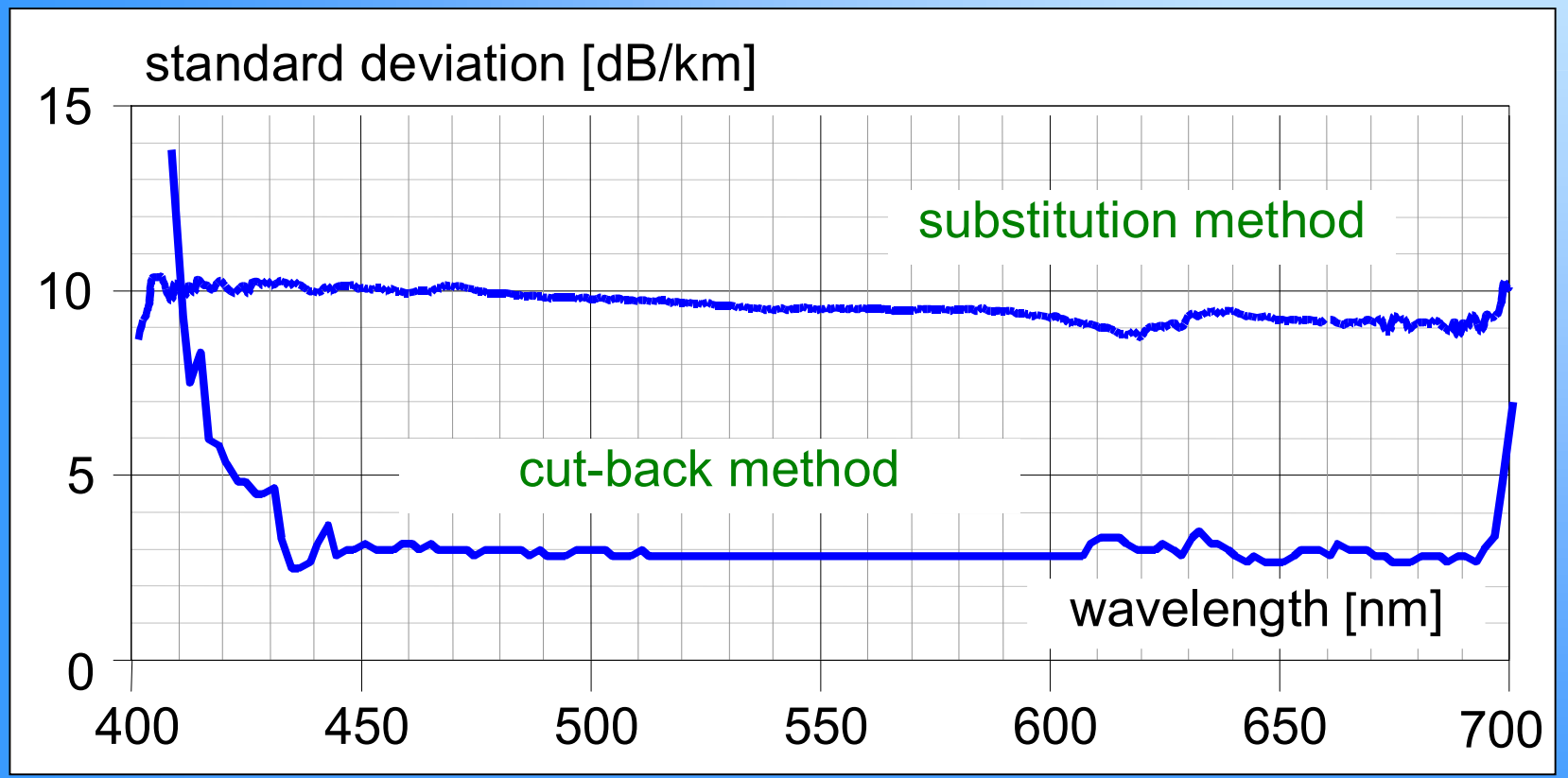
Three methods for attenuation measurements:

- attenuation measurement under laboratory conditions with small measurement uncertainty,
- on-site attenuation measurement with extended measurement uncertainty during cable or cable harness manufacturing,
- on-site attenuation measurement of installed POF systems (e.g. in cars or at industrial production plants).

Attenuation measurement under laboratory conditions with small measurement uncertainty



Attenuation measurement under laboratory conditions with small measurement uncertainty



After: D. Peitscher, Georg Schulte, H. Mühlen, O. Ziemann, J. Krauser: "Correct Definition and Measurement of Spectral Attenuation for Step Index Polymer Optical Fibers", 9th International POF Conference, Boston, September 5-8, 2000

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Test methods for mechanical characteristics

Selected parameter	VDI/VDE 5570	IEC 60793-1 60794-1	JIS C 6861	EN 187000 188000	Asahi Chemical Ind. Co.	BAM	Mitsubishi Rayon Co.	Toray Indust. Inc.
Tensile strength	•	•	•	•	•	•	•	•
Crushing strength	•	•	•	•	•	•	•	•
Impact	•	•	•	•	•	•	•	•
Torsion	•	•	•	•	•	•	•	•
Repeated bending	•	•	•	•	•	•	•	•
Static bending	•	•	•	•	•	•	•	•
Flexing	•	•		•		•		
Tight fit	•							
Kink		•		•			•	
Abrasion				•				

VDE/VDE 5570 Part 3

Test methods for environmental characteristics

Selected parameter	VDI/VDE 5570	IEC 60793-1 60794-1	JIS C 6861	EN 187000 188000	Asahi Chemical Ind. Co.	BAM	Mitsubishi Rayon Co.	Toray Indust. Inc.
Temperature cycling	•	•		•	•	•	•	•
High Temperature (dry, wet)	•				•	•	•	•
Low Temperature	•					•		•
Ageing	•					•	•	
Chemicals	•					•	•	•
Industrial atmosphere						•	•	
Flammability		•		•				
Pistoning	•							
Radiation	• Crosstalk of external light	• Nuclear		• Nuclear		• UV		

Principle outline of test method description

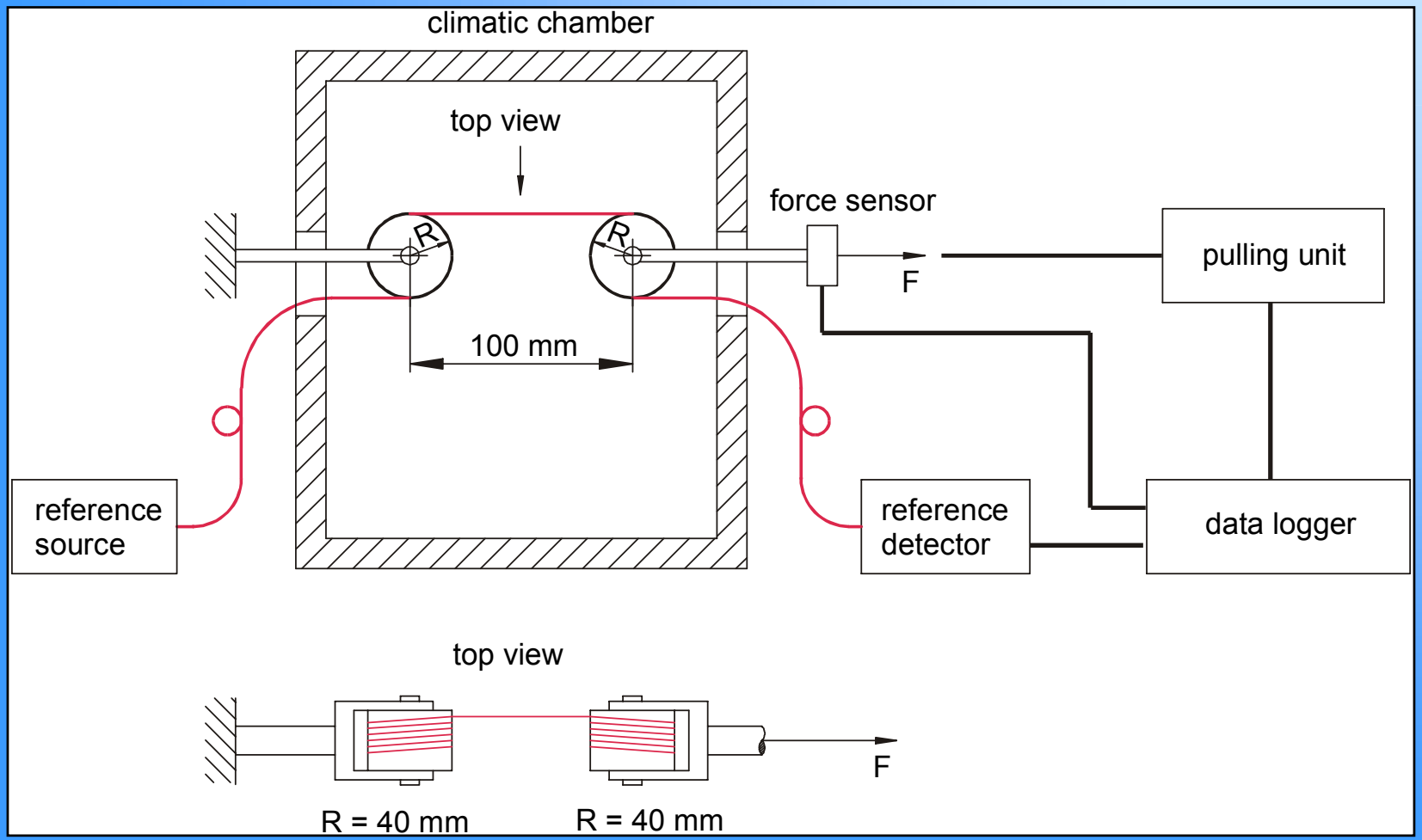
1. Purpose
2. Reference to fundamental procedure
3. Apparatus
4. Procedure
5. Result documentation

Example of test method description

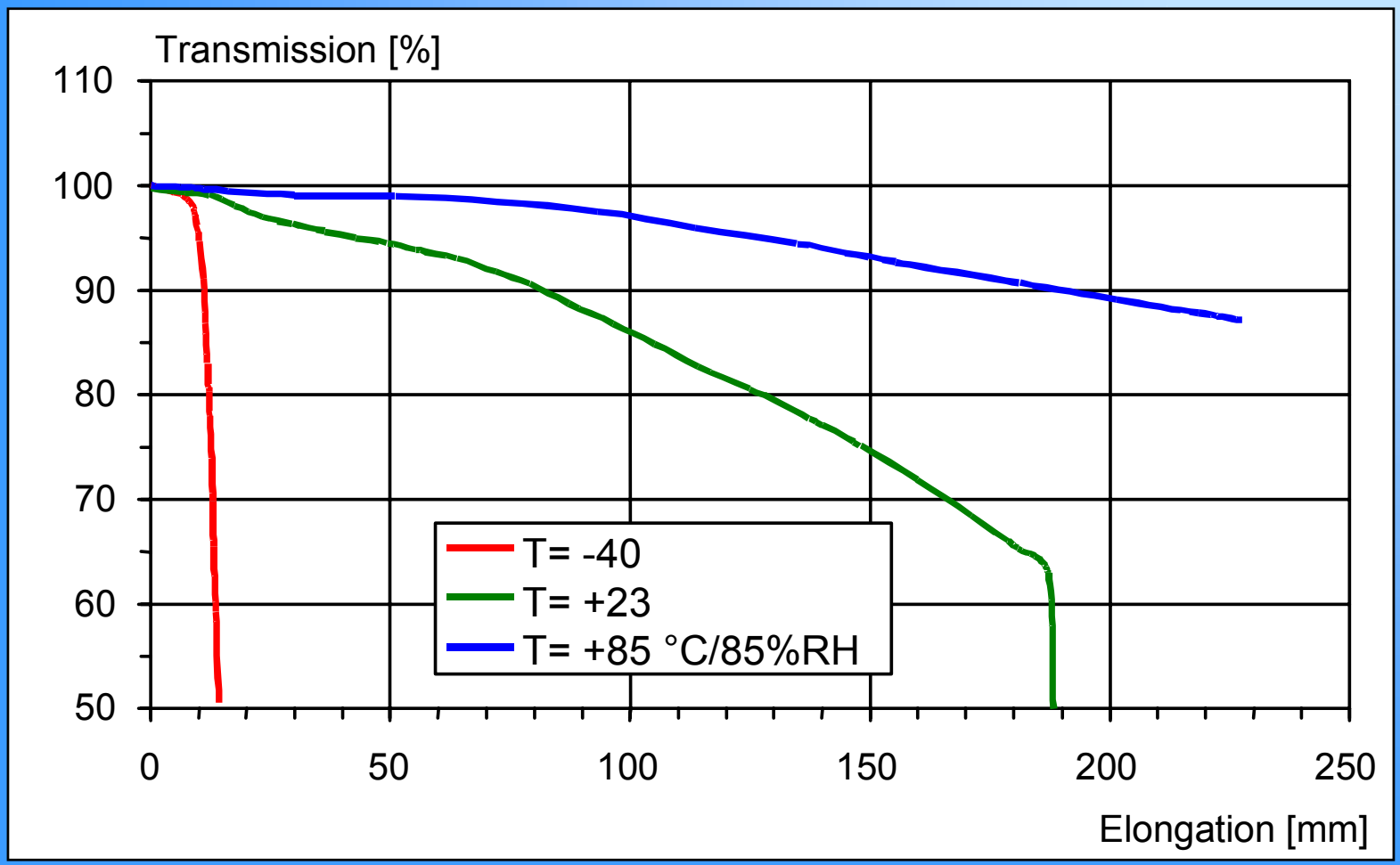
Description of the test equipment

- mechanical or hydraulic pulling unit (e.g. tensile materials testing machine) to generate the tensile force
- force sensor for measuring the tensile force
- extensometer for measuring the fibre elongation
- optical reference source and detector
- data logger for measuring force, elongation and optical power in parallel
- a clamping device: drum with a radius of 40 mm and rough surface in order to increase the friction force

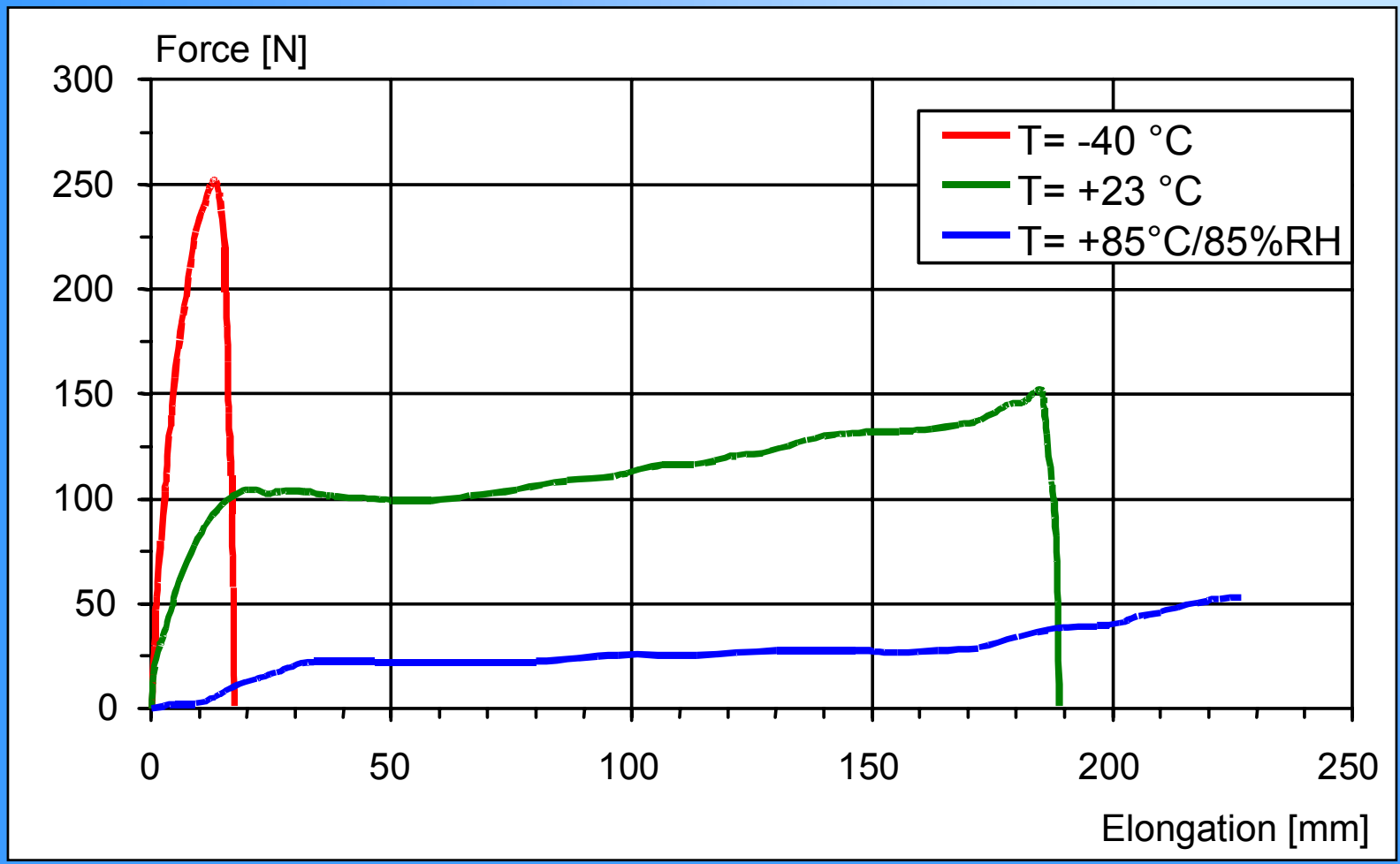
Description of the principle test set-up



Documentation of the test results



Documentation of the test results



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Power budget

Selected parameter	VDI/VDE 5570	IEC 60793-1 60794-1	JIS C 6863	EN 187000 188000	Asahi Chemical Ind. Co.	BAM	Mitsubishi Rayon Co.	Toray Indust. Inc.
Power budget	•							

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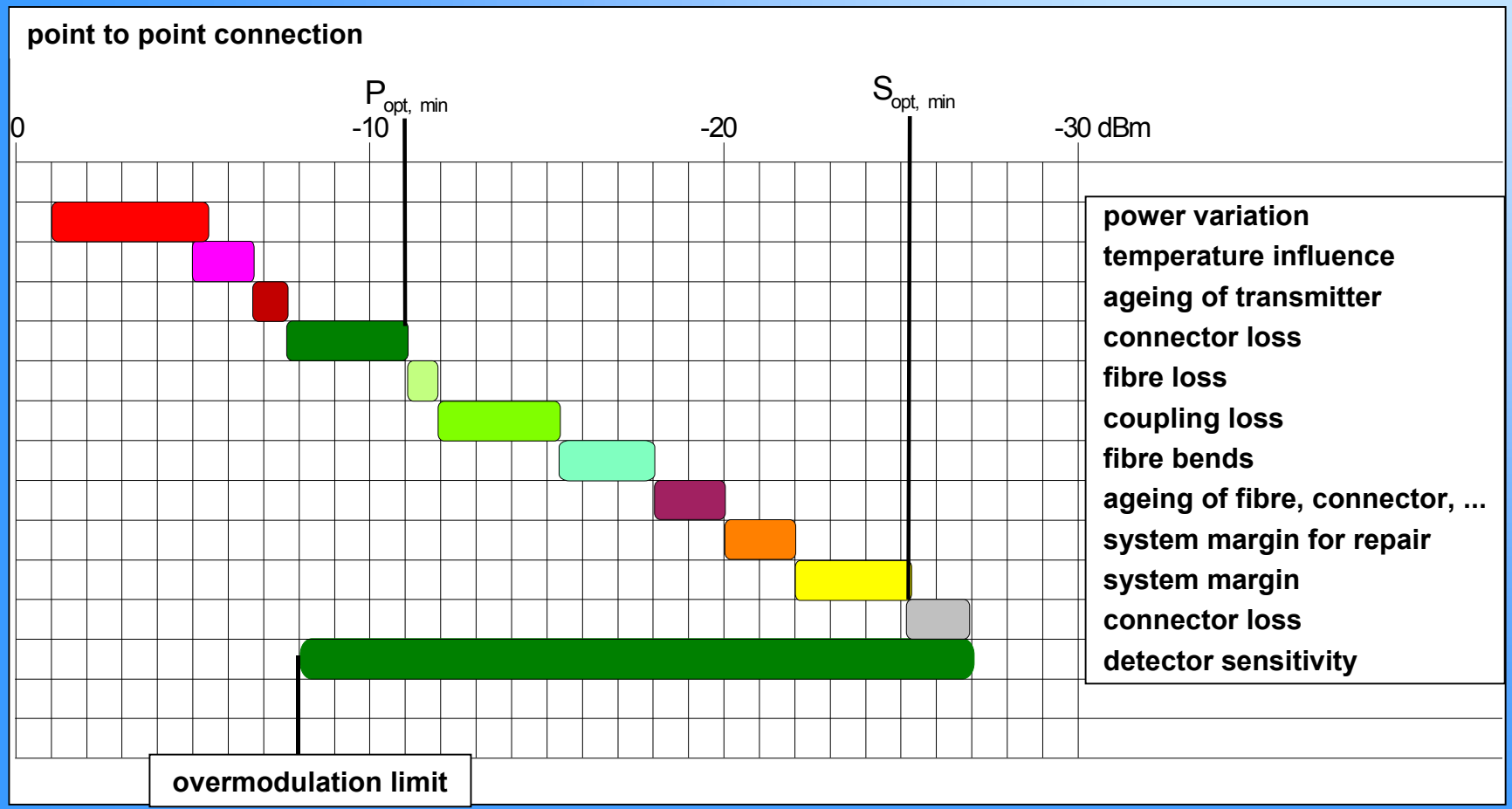
System power budget

- concerns the overall system,
- considers the power level of the transmitter,
- considers the power loss of the POF link,
- considers performance changes due to environmental influences.

From this, individual limiting values for each functional unit are derived.

Example of a system power budget

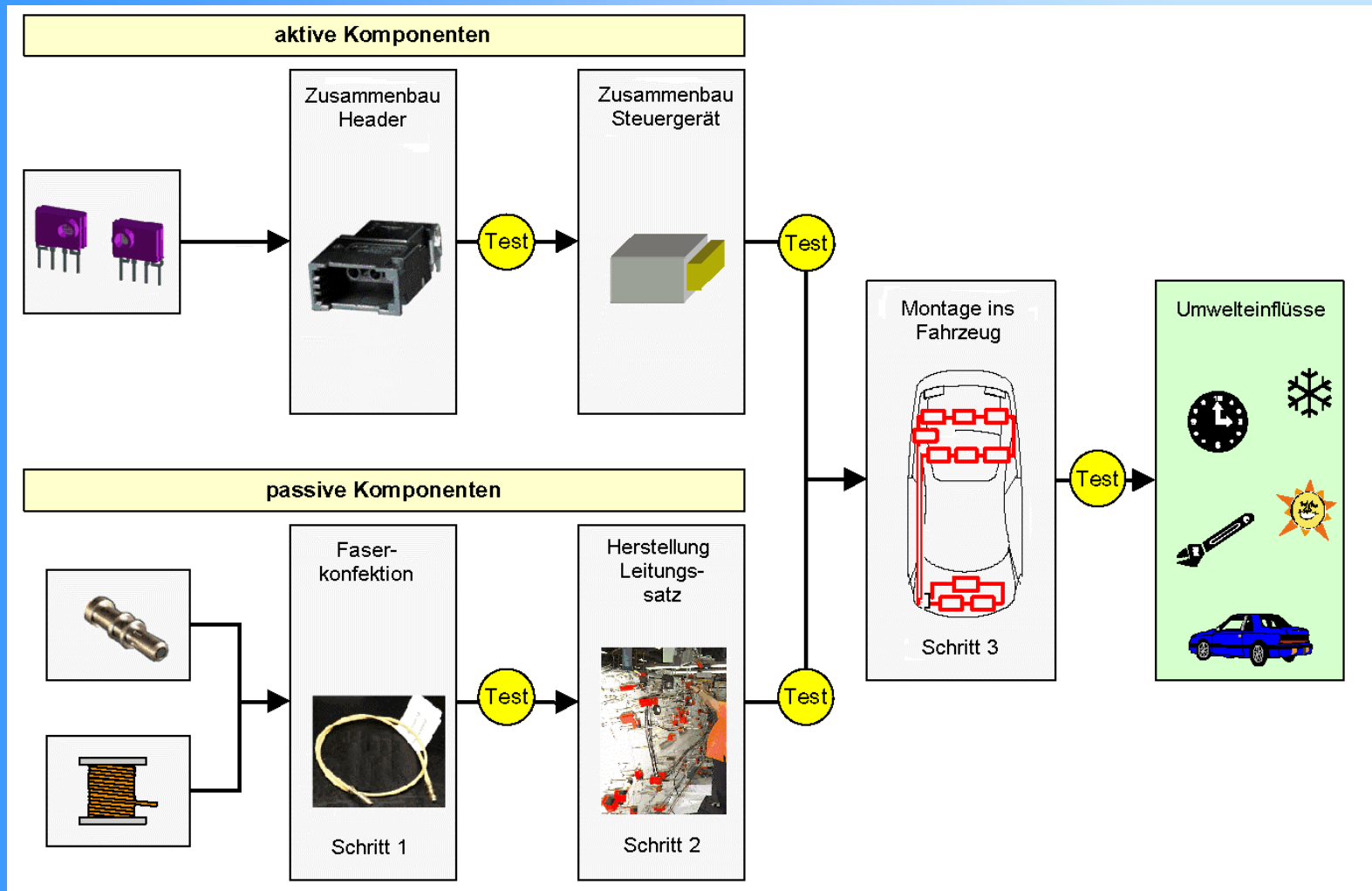


Measuring power budget

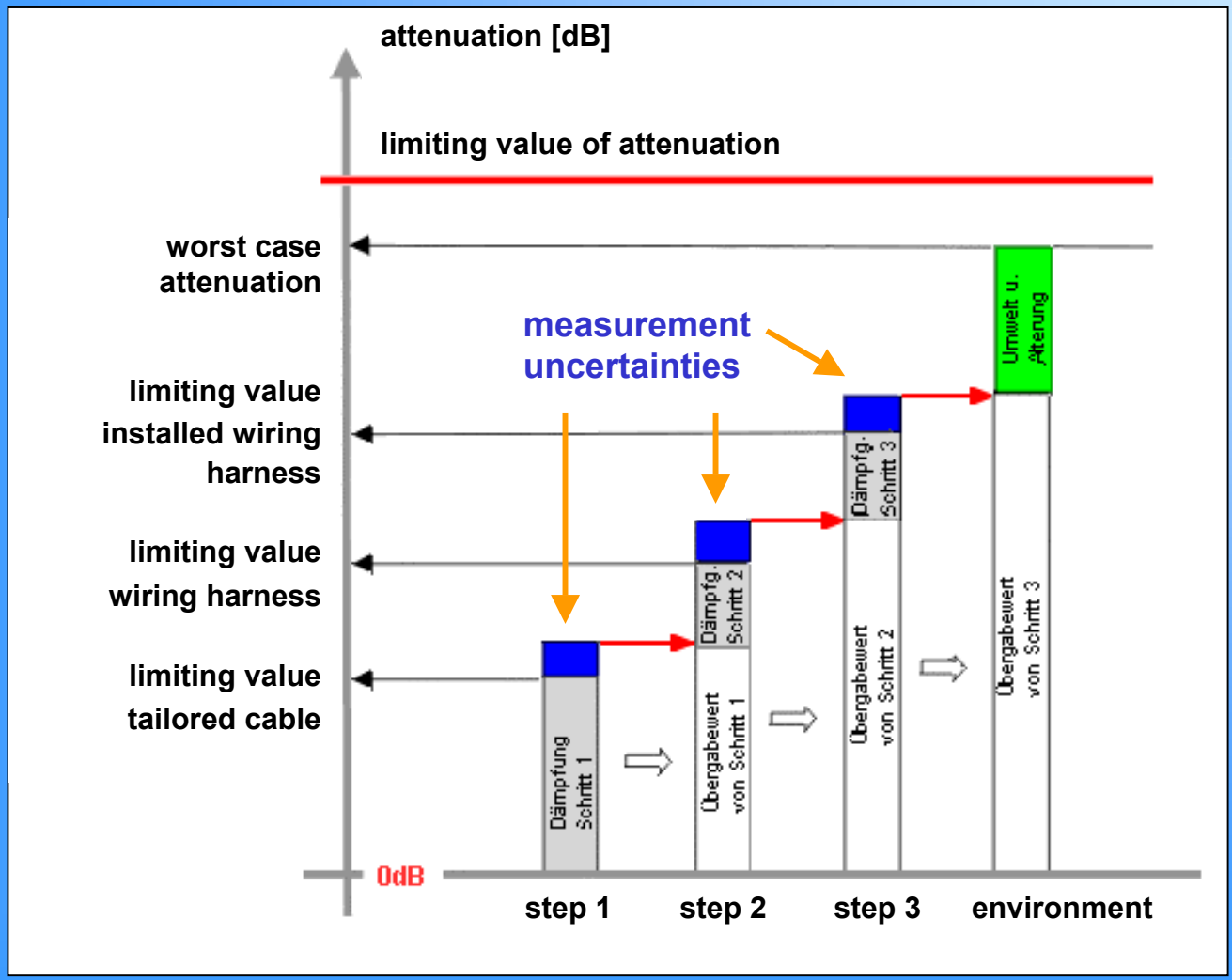
- concerns an interim budget from the viewpoint of a manufacturing sequence of intermediates.
- considers measurement uncertainties.
- is based on limiting values, which can be guaranteed during production.
- the influence of environmental conditions are still to be added.

It is very important for quality control during the manufacturing process when strong quality requirements have to be fulfilled and several parties are involved in the manufacturing process.

Illustration of the problem



Example of a measuring power budget



Concluding remarks

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VDI/VDE guideline 5570

- is an up-to-date and comprehensive standard on characterisation and testing of POF.
- is a result of technical and scientific collective work of qualified European experts.
- contains perspective test and measuring methods.
- can be a basis for a national or European perspective in establishing international standards in harmonisation with international organisations like IEC or ICPOF.

Acknowledgement

The authors would like to express their appreciation for the unique engagement of all the members of the working group, and for the support by M. Scholl (VDI, The Association of Engineers).