Use of fibre optics International Standards for calibration laboratory accreditation
A continuous chain of International Standards

IEC Technical Committee 86 prepares International Standards for fibre optic systems, modules, devices and components intended for use with communications equipment. In particular, publications cover the area of tests, measurements and calibration.

ISO/IEC 17025 is a guide published by ISO (International Organization for Standardization) and the IEC, containing all of the requirements that testing and calibration laboratories have to meet if they wish to demonstrate that they operate a quality system, are technically competent and are able to generate technically valid results.

Calibration documents issued by Working Group 4 of IEC TC 86 provide calibration procedures that can be used to comply fully with the technical requirements of ISO/IEC 17025. They are directly related to more than 15 IEC International Standards concerned with fibre optic tests and measurements.

**TC 86 Working Group 4**

About 30 experts from 15 countries make up WG 4. They represent calibration labs such as NIST (National Institute of Standards and Technology, US), NPL (National Physical Laboratory, UK), METAS (Federal Institute of Metrology, Switzerland) and AIST (National Institute of Advanced Industrial Science and Technology, Japan), optical fibre manufacturers, measurement device manufacturers and telecom carriers.

WG 4 has published calibration Standards for various types of equipment:
- Fibre optic power meters
- Optical time-domain reflectometers (OTDRs)
- Optical spectrum analyzers (OSAs) and other wavelength/optical frequency meters
- Chromatic dispersion measuring systems
- Fibre geometry measuring systems
- Tuneable laser sources
Set of tests and measurements

Set of calibration standards

Field equipment area

ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories

Calibration lab area
IEC 61315: Calibration of fibre optic power meters

Fibre optic power meters are designed to measure accurately optical power from fibre optic sources. IEC 61315 defines all the steps involved in the calibration process:

- Establishing calibration conditions
- Carrying out calibration
- Evaluating, calculating and reporting uncertainty and traceability issues

The calibration processes cover:
- Absolute power calibration
- Nonlinearity calibration

Calibrated fibre optic power meters are required for the following International Standards:

For output optical power:
- IEC 61280-1-1, Fibre optic communication subsystem basic test procedures – Part 1-1: Test procedures for general communication subsystems – Transmitter output optical power measurement for single-mode optical fibre cable

Additionally:

For optical fibre attenuation – Cut back or insertion method:

For change in optical transmittance:

For attenuation measurements:
- IEC 61280-4-1, Fibre-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement
- IEC 61280-4-2, Fibre-optic communication subsystem test procedures – Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement
- IEC 61300-3-4, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation
IEC 61746: Calibration of optical time-domain reflectometers (OTDR)

OTDRs are designed to measure backscattering from optical fibres as accurately as possible. IEC 61746, Part 1: OTDR for single mode fibres, and Part 2: OTDR for multimode fibres, define all the steps involved in the calibration process:

- Establishing calibration conditions
- Carrying out calibration
- Calculating and reporting uncertainty and traceability issues

For both single mode and multimode OTDR the calibration processes cover:

- Calibration of horizontal and vertical axis
- Calibration of reflectance measurements
- Calibration of horizontal and vertical axis

Calibrated OTDRs are required for the following International Standards:

- IEC 61280-4-1, Fibre-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement
- IEC 61280-4-2, Fibre-optic communication subsystem test procedures – Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement
- IEC 61300-4-4, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation
- IEC TS 62033, Attenuation uniformity in optical fibres
- IEC TR 62316, Guidance for the interpretation of OTDR backscattering traces
IEC 62129: Calibration of wavelength/optical frequency measurement instruments

Optical spectrum analyzers or wavelength meters analyze the power distribution of an optical spectrum. IEC 62129 series includes:

- IEC 62129-1, Calibration of wavelength/optical frequency measurement instruments – Part 1: Optical spectrum analyzers
- IEC 62129-2, Calibration of wavelength/optical frequency measurement instruments – Part 2: Michelson interferometer single wavelength meters
- IEC TS 62129-3, Calibration of wavelength/optical frequency measurement instruments – Part 3: Optical frequency meters using optical frequency combs

It defines all the steps involved in calibration process of a wavelength/optical frequency measurement instrument to ensure that:

- Wavelengths are calibrated
- Power level is calibrated (IEC 62129-1)

This series is required mainly for the following International Standards:

- IEC 61280-1-3, Fibre optic communication subsystem test procedures – Part 1-3: General communication subsystems – Central wavelength and spectral width measurement
- IEC 61300-3-7, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components
IEC 61744: Calibration of fibre optic chromatic dispersion test sets

Chromatic dispersion is the variation with optical light wavelength of the light propagation delay time in a length of fibre. IEC 61744 defines all the steps involved in the calibration process of chromatic dispersion test sets to ensure that:

- The programmed wavelengths are calibrated
- The measured delays are calibrated

Calibrated chromatic dispersion test sets are required for the following International Standards:

- IEC 61300-3-38, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-38: Examinations and measurements – Group delay, chromatic dispersion and phase ripple
Geometry of optical fibre can be measured with test sets which perform end-face image analysis, also known as near-field or grey-scale analysis. IEC 61745 defines a standard procedure for calibrating test sets for measuring the glass geometry of optical fibres.

Calibrated test sets for measuring the glass geometry are required for the following International Standards and Technical Requirements (TR):

- IEC 60793-1-20, Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry
- IEC 61280-1-4, Fibre optic communication subsystem test procedures – Part 1-4: General communication subsystems – Light source encircled flux measurement method
- IEC TR 62614-2, Fibre optics - Multimode launch conditions - Part 2: Determination of launch condition requirements for measuring multimode attenuation

And indirectly

- IEC 62614, Fibre optics – Launch condition requirements for measuring multimode attenuation
A tuneable laser source is used in many wavelength dependent measurement processes. Most of the time, the tuneable source needs to be associated with a calibrated wavelength meter.

When the source is properly calibrated using IEC 62522, the use of an extra wavelength meter that is an expensive instrument can be avoided.

IEC 62522 defines all the steps involved in the calibration process to ensure that:

- Wavelengths are calibrated
- Optical power is calibrated
About the IEC

The IEC, headquartered in Geneva, Switzerland, is the world’s leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies – collectively known as “electrotechnology”. IEC Standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fibre optics, batteries, flat panel displays and solar energy, to mention just a few. Wherever you find electricity and electronics, you find the IEC supporting safety and performance, the environment, Electrical Energy Efficiency and Renewable Energies. The IEC also administers International Conformity Assessment Systems in the areas of electrotechnical equipment testing and certification (IECEE), quality of electronic components, materials and processes (IECQ), certification of equipment operated in explosive atmospheres (IECEx), as well as renewable energy systems (IECRE).

The IEC has served the world’s electrical industry since 1906, developing International Standards to promote quality, safety, performance, reproducibility and environmental compatibility of materials, products and systems.

The IEC family, which now comprises 170 countries, includes all the world’s major trading nations. This membership collectively represents about 99.1% of the world’s population and 99.2% of the world’s electrical generating capacity.
Further information

Please visit the IEC website at www.iec.ch for further information. In the “About the IEC” section, you can contact your local IEC National Committee directly. Alternatively, please contact the IEC Central Office in Geneva, Switzerland or the nearest IEC Regional Centre.

Global

IEC – International Electrotechnical Commission
Central Office
3 rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

T +41 22 919 0211
Fax +41 22 919 0300
info@iec.ch
www.iec.ch

Asia Pacific

IEC-APRC – Asia-Pacific Regional Centre
2 Bukit Merah Central #15-04/05
Singapore 159835

T +65 6377 5173
Fax +65 6278 7573
dch@iec.ch

Latin America

IEC-LARC – Latin America Regional Centre
Av. Paulista, 2300 – Pilotis Floor – Cерq.
César
São Paulo - SP - CEP 01310-300
Brazil

T +55 11 2847 4672
as@iec.ch

North America

IEC-ReCNA – Regional Centre for North America
446 Main Street, 16th Floor
Worcester, MA 01608
USA

T +1 508 755 5663
Fax +1 508 755 5669
tro@iec.ch

IEC Conformity Assessment Systems

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IECEE / IECRE
c/o IEC – International Electrotechnical Commission
3 rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

T +41 22 919 0211
secretariat@iecee.org
secretariat@iecre.org
www.iecee.org
www.iecre.org

IECEx / IECQ

The Executive Centre
Australia Square, Level 33
264 George Street
Sydney NSW 2000
Australia

T +61 2 4628 4690
Fax +61 2 4627 5285
chris.agius@iecex.com
chris.agius@iecq.org
www.iecex.com
www.iecq.org

IEC Regional Offices

—

Africa

IEC-AFRC – Africa Regional Centre
7th Floor, Block One, Eden Square
Chiromo Road, Westlands
PO Box 856
00606 Nairobi
Kenya

T +254 20 367 3000 / +254 20 375 2244
M +254 73 389 7000 / +254 70 493 7806
Fax +254 20 374 0913
eod@iec.ch
fya@iec.ch