

INTERNATIONAL STANDARD

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**Fibre-optic communication subsystem test procedures –
Part 4-2: Installed cable plant – Single-mode attenuation and optical return
loss measurement**

**Procédures d'essai des sous-systèmes de télécommunication à
fibres optiques –
Partie 4-2: Installations câblées – Mesure de l'affaiblissement de réflexion
optique et de l'affaiblissement des fibres unimodales**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE-OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –**Part 4-2: Installed cable plant –
Single-mode attenuation and optical return loss measurement**

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International Standard IEC 61280-4-2 has been prepared by subcommittee SC86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition, published in 1999, and constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- revision of optical time-domain reflectometer (OTDR) measurements;
- addition of optical return loss (ORL) measurements;
- addition of informative annexes on measurement uncertainties, OTDR configuration, test cord attenuation verification and spectral attenuation measurement.

The text of this standard is based on the following documents:

FDIS	Report on voting
86C/1238/FDIS	86C/1261/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61280 series, published under the general title *Fibre-optic communication subsystem test procedures*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This second edition of IEC 61280-4-2 for testing single-mode cable plant follows on from the second edition of IEC 61280-4-1, dealing with multimode cable plants.

Cabling design standards such as ISO/IEC 11801 for commercial premises, ISO/IEC 24702 for industrial premises, ISO/IEC 24764 for data centres and ISO/IEC 15018 for residential cabling contain specifications for this type of cabling. These standards support cabling lengths of up to 2 km for commercial premises and data centres and up to 10 km for industrial premises. ISO/IEC 14763-3, which supports these design standards, makes reference to the test methods of this standard.

Various recommendations from ITU-T have requirements for longer distance applications including short haul (40 km), long haul (80 km) and ultra long haul (160 km). The testing of cable plant for these is covered in ITU-T Recommendation G.650.3, which makes reference to the test methods of this standard.

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FIBRE-OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement

1 Scope

This part of IEC 61280 is applicable to the measurement of attenuation and optical return loss of installed optical fibre cable plant using single-mode fibre. This cable plant can include single-mode optical fibres, connectors, adapters, splices and other passive devices. The cabling may be installed in a variety of environments including residential, commercial, industrial and data centre premises, as well as outside plant environments.

This standard may be applied to all single-mode fibre types including those designated by IEC 60793-2-50 as Class B fibres.

The principles of this standard may be applied to cable plants containing branching devices (splitters) and at specific wavelength ranges in situations where passive wavelength selective components are deployed, such as WDMs, CWDM and DWDM devices.

This standard is not intended to apply to cable plant that includes active devices such as fibre amplifiers or dynamic channel equalizers.

2 Normative references

[IEC 61280-4-2:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/e3d18347-d42c-42ea-ab6e->

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC 60874-14-2, *Connectors for optical fibres and cables – Part 14-2: Detail specification for fibre optic connector type SC-PC tuned terminated to single-mode fibre type B1*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61300-3-35, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-35: Examinations and measurements – Fibre optic cylindrical connector endface visual inspection*

IEC 61315, *Calibration of fibre-optic power meters*

IEC 61746-1:2009, *Calibration of optical time-domain reflectometers (OTDR) – Part 1: OTDR for single-mode fibres*

IEC TR 62627-01, *Fibre optic interconnecting devices and passive components – Fibre optic connector cleaning methods*

3 Terms, definitions, graphical symbols and abbreviations

For the purposes of this document, the following terms, definitions, graphical symbols and acronyms apply.

3.1 Terms and definitions

3.1.1

adapter

female part of a connector in which one or two plugs are inserted and aligned

[SOURCE: IEC TR 61931:1998, 2.6.4]

3.1.2

attenuation

measure of the reduction of optical power transmitted through the cabling under test

Note 1 to entry: Attenuation (L) is determined as the ratio of the input power (P_{in}) to output power (P_{out}) of the cabling under test, given as

$$L = 10 \times \log_{10} \times (P_{in}/P_{out})$$

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Alternatively attenuation may be expressed as $L = -10 \times \log_{10} \times (P_{out}/P_{in})$. Both equations are mathematically equivalent, resulting in positive decibel values.

Note 2 to entry: Loss and attenuation are equivalent.

[IEC 61280-4-2:2014](#)

3.1.3

bidirectional measurement

two measurements of the same optical fibre made by launching light into opposite ends of that fibre

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3.1.4

configuration

form or arrangement of parts or elements such as terminations, connections and splices

3.1.5

connector

component normally attached to an optical cable or piece of apparatus, for the purpose of providing frequent optical interconnection/disconnection of optical fibres or cables

[SOURCE: IEC TR 61931:1998, 2.6.1]

3.1.6

light source power meter

LSPM

test system consisting of a light source (LS), power meter (PM) and associated test cords used to measure the attenuation of installed cable plant

3.1.7

optical return loss

ORL

ratio of the input power (P_{in}) of the cabling under test to the backward power (P_r), reflected by the cabling under test, expressed in decibels:

$$ORL = 10 \times \log_{10}(P_{in}/P_r)$$

Note 1 to entry: Optical return loss is a positive number.

3.1.8 optical time domain reflectometer OTDR

test system consisting of an optical time-domain reflectometer and associated test cords used to characterize and measure the attenuation and optical return loss of installed cable plant and specific elements within that cable plant

3.1.9 plug free connector male part of a connector

[SOURCE: IEC TR 61931:1998, 2.6.2]

3.1.10 reference grade termination

connector plug with tightened tolerances terminated onto a single-mode optical fibre with tightened tolerances such that the expected loss of a connection formed by mating two such assemblies is less than or equal to 0,2 dB

Note 1 to entry: An adapter, required to assure this performance, may be considered to be part of the reference grade termination where required by the test configuration.

Note 2 to entry: This definition is consistent with the reference grade 2 connections defined in IEC 61755-2-4 for non-angled (PC) and IEC 61755-2-5 for angled (APC) cylindrical ferrule connectors. These standards may be referenced for further information.

3.1.11 reference test method

RTM <https://standards.iteh.ai/catalog/standards/sist/e3d18347-d42c-42ea-ab6e-3366d391e612/iec-61280-4-2-2014>
test method used in the resolution of a dispute

3.1.12 reflectance

for a discrete component in the cabling, the ratio of the backward power (P_r) reflected by the component to the input power (P_{in}) into the component, expressed in decibels:

$$\text{Reflectance} = 10 \times \log_{10}(P_r / P_{in})$$

Note 1 to entry: Reflectance is a negative number.

Note 2 to entry: Alternatively, this is referred to (e.g. by IEC 61300-3-6) as the return loss of individual components and is expressed as $RL = -10 \times \log_{10}(P_r / P_{in})$, which is a positive number.

3.1.13 return loss test set RLTS

test system consisting of a light source (LS) and internal power meter (PM), directional coupler and additional external power meter and associated test cords used to measure the optical return loss of an installed cabling plant

3.1.14 socket-style connector

fixed connector, socket
connector for which the adapter, including any alignment device, is integrated with and permanently attached to the connector plug on one side of the connection

Note 1 to entry: Examples include the SG (IEC 61754-19) and many harsh environment connectors.

3.1.15 test cord

terminated optical fibre cord used to connect the optical source or detector to the cabling or to provide suitable interfaces to the cabling under test

Note 1 to entry: There are five types of test cords:

- launch cord: used to connect the light source to the cabling;
- receive cord: used to connect the cabling to the power meter (LSPM only);
- tail cord: attached to the far end of the cabling when an OTDR is used at the near end. This provides a means of evaluating attenuation and optical return loss of the whole of the cabling including the far end connection;
- adapter cord: used to transition between sockets or other incompatible connectors in a required test configuration;
- substitution cord: a test cord used within a reference measurement which is replaced during the measurement of the loss of the cabling under test.

3.2 Graphical symbols

The following graphical symbols, as shown in Figure 1, for different connection options have been adapted from IEC 61930.



Figure 1a – Socket and plug assembly

Figure 1b – Connector set
(plug, adapter, plug)

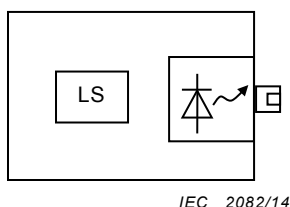


Figure 1c – Light source

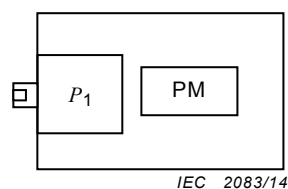


Figure 1d – Power meter

Key

a	socket
b	plug
c	plug-adapter assembly
d	plug inserted into plug-adapter assembly
LS	light source
PM	power meter

NOTE 1 In Figure 1b and elsewhere in this standard, the plugs are shown with different sizes to indicate directionality where the cabling has adapters pre-attached and the test cord does not, or vice versa. In Figure 1b, the plug on the left has the adapter pre-attached.

NOTE 2 Reference grade terminations are shown shaded with grey.

Figure 1 – Connector symbols