



SLOVENSKI STANDARD

SIST EN 61280-4-2:2014

01-december-2014

Nadomešča:

SIST EN 61280-4-2:2001

**Postopki za preskušanje optičnih komunikacijskih podsistemov - 4-2. del:
Kabelska inštalacija - Meritve slabljenja v enorodnih vlaknih in optičnih povratnih
izgub (IEC 61280-4-2:2014)**

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

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

Ta slovenski standard je istoveten z: EN 61280-4-2:2014

ICS:

33.180.01	Sistemi z optičnimi vlakni na splošno	Fibre optic systems in general
-----------	---------------------------------------	--------------------------------

SIST EN 61280-4-2:2014

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61280-4-2:2014

<https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014>

EUROPEAN STANDARD

EN 61280-4-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2014

ICS 33.180.01

Supersedes EN 61280-4-2:1999

English Version

**Fibre-optic communication subsystem test procedures - Part 4-2:
Installed cable plant - Single-mode attenuation and optical return
loss measurement
(IEC 61280-4-2:2014)**

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
(CEI 61280-4-2:2014)

Prüfverfahren für Lichtwellenleiter-
Kommunikationsunterssysteme - Teil 4-2: Installierte
Kabelanlagen - Einmoden-Dämpfungs- und optische
Rückflussdämpfungsmessung
(IEC 61280-4-2:2014)

This European Standard was approved by CENELEC on 2014-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 86C/1238/FDIS, future edition 2 of IEC 61280-4-2, prepared by SC 86C, "Fibre optic systems and active devices", of IEC TC 86, "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61280-4-2:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-05-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-08-01

This document supersedes EN 61280-4-2:1999.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61280-4-2:2014 was approved by CENELEC as a European Standard without any modification. (standards.iteh.ai)

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

<https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014>

IEC 60793-1-40	NOTE	Harmonized as EN 60793-1-40.
IEC 60793-2	NOTE	Harmonized as EN 60793-2.
IEC 61280-1-3	NOTE	Harmonized as EN 61280-1-3.
IEC 61753-1	NOTE	Harmonized as EN 61753-1.
IEC 61755-2-1	NOTE	Harmonized as EN 61755-2-1.
IEC 61755-2-2	NOTE	Harmonized as EN 61755-2-2.
IEC 61755-2-4	NOTE	Harmonized as EN 61755-2-4 ¹⁾ .
IEC 61755-2-5	NOTE	Harmonized as EN 61755-2-5 ¹⁾ .

¹⁾ To be published.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60793-2-50	-	Optical fibres -- Part 2-50: Product specifications - Sectional specification for class B single-mode fibres	EN 60793-2-50	-
IEC 60825-2	-	Safety of laser products -- Part 2: Safety of optical fibre communication systems (OFCS)	EN 60825-2	-
IEC 60874-14-2	-	Connectors for optical fibres and cables - Part 14-2: Detail specification for fibre optic connector type SC-PC 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	EN 61300-3-6	-
IEC 61300-3-35	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 3-35: Examinations and measurements - Visual inspection of fibre optic connectors and fibre-stub transceivers	EN 61300-3-35	-
IEC 61315	-	Calibration of fibre-optic power meters	EN 61315	-
IEC 61746-1	2009	Calibration of Optical Time-Domain Reflectometers (OTDR) -- Part 1: OTDR for single-mode fibres	EN 61746-1	2011
IEC/TR 62627-01	-	Fibre optic interconnecting devices and passive components - Part 01: Fibre optic connector cleaning methods	-	-

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61280-4-2:2014

<https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014>



IEC 61280-4-2

Edition 2.0 2014-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XC**
CODE PRIX

ICS 33.180.01

ISBN 978-2-8322-1665-1

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms, definitions, graphical symbols and abbreviations.....	11
3.1 Terms and definitions.....	11
3.2 Graphical symbols	13
3.3 Abbreviations	14
4 Measurement methods	15
4.1 General.....	15
4.2 Cabling configurations and applicable test methods	16
4.2.1 Cabling configurations and applicable test methods for attenuation measurements.....	16
4.2.2 Cabling configurations and applicable test methods for optical return loss measurements.....	18
4.3 Overview of uncertainties.....	18
4.3.1 General	18
4.3.2 Test cords.....	18
4.3.3 Reflections from other interfaces.....	18
4.3.4 Optical source	18
4.3.5 Output power reference.....	19
4.3.6 Received power reference.....	19
4.3.7 Mode field diameter variation.....	19
4.3.8 Bi-directional measurements.....	19
5 Apparatus.....	19
5.1 General.....	19
5.2 Light source	19
5.2.1 Stability	19
5.2.2 Spectral characteristics	20
5.2.3 Launch cord.....	20
5.3 Receive or tail cord.....	20
5.4 Substitution cord.....	21
5.5 Power meter – LSPM methods only.....	21
5.6 OTDR apparatus.....	21
5.7 Return loss test set.....	22
5.8 Connector end-face cleaning and inspection equipment.....	22
5.9 Adapters	22
6 Procedures.....	22
6.1 General.....	22
6.2 Common procedures.....	23
6.2.1 Care of the test cords	23
6.2.2 Make reference measurements (LSPM and OCWR methods only).....	23
6.2.3 Inspect and clean the ends of the fibres in the cabling.....	23
6.2.4 Make the measurements.....	23
6.2.5 Make the calculations	23
6.3 Calibration	23

6.4	Safety	24
7	Calculations.....	24
8	Documentation	24
8.1	Information for each test	24
8.2	Information to be made available	24
Annex A	(normative) One-cord reference method.....	25
A.1	Applicability of test method	25
A.2	Apparatus	25
A.3	Procedure	25
A.4	Calculation.....	26
A.5	Components of reported attenuation	26
Annex B	(normative) Three-cord reference method	27
B.1	Applicability of test method	27
B.2	Apparatus	27
B.3	Procedure	27
B.4	Calculations	28
B.5	Components of reported attenuation	28
Annex C	(normative) Two-cord reference method	29
C.1	Applicability of test method	29
C.2	Apparatus	29
C.3	Procedure	29
C.4	Calculations	31
C.5	Components of reported attenuation	31
Annex D	(normative) Optical time domain reflectometer	32
D.1	Applicability of test method	32
D.2	Apparatus	32
D.2.1	General	32
D.2.2	OTDR	32
D.2.3	Test cords	32
D.3	Procedure (test method)	33
D.4	Calculation of attenuation	34
D.4.1	General	34
D.4.2	Connection location	34
D.4.3	Definition of the power levels F_1 and F_2	35
D.4.4	Alternative calculation.....	36
D.5	Calculation of optical return loss	37
D.6	Calculation of reflectance for discrete components	39
D.7	OTDR uncertainties	40
Annex E	(normative) Continuous wave optical return loss measurement – Method A	41
E.1	Applicability of test method	41
E.2	Apparatus	41
E.2.1	General	41
E.2.2	Light source.....	41
E.2.3	Branching device or coupler	41
E.2.4	Power meters	42
E.2.5	Connector interface	42
E.2.6	Low reflection termination.....	42
E.3	Procedure	42

E.3.1	Test set characterization.....	42
E.3.2	Measurement procedure.....	44
E.3.3	Calculations.....	44
E.3.4	Measurement uncertainty.....	45
Annex F (normative) Continuous wave optical return loss measurement – Method B.....		46
F.1	Applicability of test method.....	46
F.2	Apparatus.....	46
F.2.1	General requirements.....	46
F.2.2	Known reflectance termination.....	46
F.3	Procedure.....	46
F.3.1	Set-up characterization.....	46
F.3.2	Measurement procedure.....	47
F.3.3	Calculation.....	48
F.3.4	Measurement uncertainty.....	48
Annex G (informative) Measurement uncertainty examples.....		49
G.1	Reduction of uncertainty by using reference grade terminations and related issues.....	49
G.1.1	Motivations for using reference grade terminations on test cords.....	49
G.1.2	Adjusting acceptance limits to allow for different expected losses when using reference grade and standard grade connectors.....	49
G.2	Estimation of the measurement uncertainties.....	51
G.2.1	Measurement uncertainty.....	51
G.2.2	Uncertainty due to the instrument.....	51
G.2.3	Uncertainty due to the source.....	51
G.2.4	Uncertainty due to the device under test.....	52
G.2.5	Example of uncertainty accumulation using a single power meter.....	53
G.2.6	Example of uncertainty accumulation using two power meters.....	54
Annex H (informative) OTDR configuration information.....		55
H.1	Introductory remarks.....	55
H.2	Fundamental parameters that define the operational capability of an OTDR.....	56
H.2.1	Dynamic range.....	56
H.2.2	Pulse width.....	56
H.2.3	Averaging time.....	56
H.2.4	Dead zone.....	56
H.3	Other parameters.....	56
H.3.1	Index of refraction.....	56
H.3.2	Measurement range.....	57
H.3.3	Distance sampling.....	57
H.4	Other measurement configurations.....	57
H.4.1	General.....	57
H.4.2	Macro bend attenuation measurement.....	57
H.4.3	Splice attenuation measurement.....	58
H.4.4	Measurement with high reflection connectors or short length cabling.....	58
H.4.5	Ghost.....	60
H.5	More on the measurement method.....	61
H.6	Bidirectional measurement.....	62
H.7	OTDR bi-directional trace analysis.....	63
H.8	Non recommended practices.....	64
H.8.1	Measurement without tail cord.....	64

H.8.2	Cursor measurement	64
Annex I (informative)	Test cord attenuation verification	65
I.1	Introductory remarks	65
I.2	Apparatus	65
I.3	Procedure	65
I.3.1	General	65
I.3.2	Test cord verification for the one-cord and two-cord reference test methods when using non-pinned/unpinned and non-plug/socket style connectors	66
I.3.3	Test cord verification for the one-cord and two-cord reference test methods using pinned/unpinned or plug/socket style connectors	67
I.3.4	Test cord verification for the three-cord reference test method using non-pinned/unpinned and non-plug/socket style connectors	68
I.3.5	Test cord verification for the three-cord reference test method using pinned/unpinned or plug/socket style connectors	70
Annex J (informative)	Spectral attenuation measurement	72
J.1	Applicability of test method	72
J.2	Apparatus	72
J.2.1	Broadband light source	72
J.2.2	Optical spectrum analyser	72
J.3	Procedure	72
J.3.1	Reference scan	72
J.3.2	Measurement scan	73
J.4	Calculations	73
Bibliography	.....	74
	https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014	
Figure 1 – Connector symbols	.....	13
Figure 2 – Symbol for cabling under test	.....	14
Figure 3 – Configuration A – Start and end of measured losses in reference test method	.....	16
Figure 4 – Configuration B – Start and end of measured losses in reference test method	.....	17
Figure 5 – Configuration C – Start and end of measured losses in reference test method	.....	17
Figure 6 – Typical OTDR schematic	.....	21
Figure 7 – Return loss test set illustration	.....	22
Figure A.1 – One-cord reference measurement	.....	26
Figure A.2 – One-cord test measurement	.....	26
Figure B.1 – Three-cord reference measurement	.....	27
Figure B.2 – Three-cord test measurement	.....	28
Figure C.1 – Two-cord reference measurement	.....	30
Figure C.2 – Two-cord test measurement	.....	30
Figure C.3 – Two-cord test measurement for plug-socket style connectors	.....	30
Figure D.1 – Test measurement for method D	.....	34
Figure D.2 – Location of the cabling under test ports	.....	35
Figure D.3 – Graphic construction of F_1 and F_2	.....	36
Figure D.4 – Graphic construction of F_1 , F_{11} , F_{21} and F_2	.....	37

Figure D.5 – Graphic representation of OTDR ORL measurement.....	38
Figure D.6 – Graphic representation of reflectance measurement	39
Figure E.1 – Return loss test set illustration.....	41
Figure E.2 – Measurement of the system internal attenuation P_{ref2}	43
Figure E.3 – Measurement of the system internal attenuation P_{ref1}	43
Figure E.4 – Measurement of the system reflected power P_{rs}	43
Figure E.5 – Measurement of the input power P_{in}	44
Figure E.6 – Measurement of the reflected power	44
Figure F.1 – Return loss test set illustration	46
Figure F.2 – Measurement of P_{rs} with reflections suppressed	47
Figure F.3 – Measurement of P_{ref} with reference reflector	47
Figure F.4 – Measurement of the system reflected power P_{rs}	47
Figure F.5 – Measurement of the reflected power	48
Figure H.1 – Splice and macro bend attenuation measurement.....	58
Figure H.2 – Attenuation measurement with high reflection connectors	59
Figure H.3 – Attenuation measurement of a short length cabling.....	60
Figure H.4 – OTDR trace with ghost.....	61
Figure H.5 – Cursor positioning.....	62
Figure H.6 – Bidirectional OTDR trace display	63
Figure H.7 – Bi-directional OTDR trace loss analysis	63
Figure I.1 – Obtaining reference power level P_0	66
Figure I.2 – Obtaining power level P_1	67
Figure I.3 – Obtaining reference power level P_0	67
Figure I.4 – Obtaining power level P_1	67
Figure I.5 – Obtaining reference power level P_0	68
Figure I.6 – Obtaining power level.....	68
Figure I.7 – Obtaining reference power level P_0	69
Figure I.8 – Obtaining power level P_1	69
Figure I.9 – Obtaining power level P_6	70
Figure I.10 – Obtaining reference power level P_0	70
Figure I.11 – Obtaining power level P_1	71
Figure J.1 – Result of spectral attenuation measurement	73
Table 1 – Cabling configurations.....	16
Table 2 – Test methods and configurations.....	17
Table D.1 – Typical launch and tail cord lengths	33
Table G.1 – Expected loss for examples (see NOTE 1).....	49
Table G.2 – Example of uncertainty accumulation using a single power meter	53
Table G.3 – Example of uncertainty accumulation using two power meters	54
Table H.1 – Example of effective group index of refraction values.....	57

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

iTeh STANDARD PREVIEW

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

<https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014>

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.

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[SIST EN 61280-4-2:2014](https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014)

<https://standards.iteh.ai/catalog/standards/sist/1bf31785-a5a6-4d09-941b-4d72f8c68a20/sist-en-61280-4-2-2014>