



BSI Standards Publication

Fibre optic communication subsystem test procedures

Part 1-4: General communication subsystems — Light
source encircled flux measurement method

National foreword

This British Standard is the UK implementation of EN IEC 61280-1-4:2023. It is identical to IEC 61280-1-4:2023. It supersedes BS EN 61280-1-4:2010, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/86/3, Fibre optic systems and active devices.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 17938 5

ICS 33.180.01

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2023.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English Version

Fibre optic communication subsystem test procedures - Part 1-4:
General communication subsystems - Light source encircled flux
measurement method
(IEC 61280-1-4:2023)

Procédures d'essai des sous-systèmes de
télécommunication fibroniques - Partie 1-4: Sous-systèmes
généraux de télécommunication - Méthode de mesure du
flux inscrit de la source optique
(IEC 61280-1-4:2023)

Lichtwellenleiter-Kommunikationsuntersysteme -
Grundlegende Prüfverfahren - Teil 1-4: Allgemeine
Kommunikationsuntersysteme - Verfahren zur Messung des
begrenzten Lichtstroms einer Strahlungsquelle
(IEC 61280-1-4:2023)

This European Standard was approved by CENELEC on 2023-02-23. 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 86C/1806/CDV, future edition 3 of IEC 61280-1-4, 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 IEC 61280-1-4:2023.

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) 2023-08-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-02-23

This document supersedes EN 61280-1-4:2010 and all of its amendments and corrigenda (if any).

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

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 61280-1-4:2023 was approved by CENELEC as a European Standard without any modification.

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

IEC 60793-1-20 NOTE Approved as EN 60793-1-20

IEC 60793-1-41 NOTE Approved as EN 60793-1-41

IEC 61745:2017 NOTE Approved as EN 61745:2017 (not modified)

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where 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 60793-2-10	-	Optical fibres - Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres	EN IEC 60793-2-10 -	
IEC 60825-1	-	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	-

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Symbols	8
5 Assumptions.....	10
5.1 Assumptions applicable to the characterization of data sources	10
5.2 Assumptions applicable to the characterization of measurement sources	10
6 Apparatus.....	10
6.1 Common apparatus.....	10
6.1.1 General	10
6.1.2 Computer.....	10
6.1.3 Image digitizer.....	11
6.1.4 Detector	11
6.1.5 Magnifying optics.....	11
6.1.6 Attenuator.....	12
6.1.7 Micro positioner (optional)	12
6.1.8 Input port.....	12
6.1.9 Calibration light source	12
6.2 Transmission source apparatus	13
6.2.1 General	13
6.2.2 Test jumper assembly.....	13
6.2.3 Fibre shaker	13
6.3 Measurement source apparatus	15
7 Sampling and specimens	15
8 Geometric calibration.....	15
9 Measurement procedure	15
9.1 Safety	15
9.2 Image acquisition.....	15
9.2.1 Raw image acquisition.....	15
9.2.2 Dark image acquisition	16
9.2.3 Corrected image.....	16
9.3 Optical centre determination	16
9.3.1 General	16
9.3.2 Centroid image	17
9.3.3 Centroid computation.....	17
9.4 Test source image acquisition.....	18
10 Computation of encircled flux	18
10.1 Computation of radial data functions	18
10.2 Integration limit and baseline determination	20
10.2.1 Integration limit.....	20
10.2.2 Baseline determination	20
10.2.3 Baseline subtraction	20
10.3 Computation of encircled flux.....	21
11 Results	21

11.1	Information available with each measurement	21
11.2	Information available upon request	21
12	Specification information	22
Annex A (informative)	Measurement sensitivity considerations	23
A.1	Baseline averaging considerations	23
A.2	Pixel sensitivity variation calibration	25
A.3	Correlated double sampling	25
A.4	Imperfections of practical detectors and optics	26
Bibliography		28
Figure 1	– Apparatus block diagram	10
Figure 2	– Typical set-up for transmission source measurement	13
Figure 3	– Fibre shaker example	14
Figure 4	– Pixel and ring illustration	18
Figure A.1	– Core images from instrument A and instrument B	23
Figure A.2	– Compressed core images from instrument A and instrument B	24
Figure A.3	– Intensity versus radius for instruments A and B	24

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC COMMUNICATION SUBSYSTEM
TEST PROCEDURES –****Part 1-4: General communication subsystems –
Light source encircled flux measurement method**

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.

IEC 61280-1-4 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) improvement of calibration procedure and calibration traceability;
- b) improvement of fibre shaker description and requirements;
- c) addition of pulsed light sources;
- d) removal of a poorly traceable calibration process using a micro positioner.

The text of this International Standard is based on the following documents:

Draft	Report on voting
86C/1806/CDV	86C/1828/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

INTRODUCTION

This part of IEC 61280 specifies how to measure the encircled flux of a multimode light source. Encircled flux is a fraction of the cumulative output power to the total output power as a function of radial distance from the centre of the multimode optical fibre's core.

The basic approach is to collect two-dimensional (2D) nearfield data, using a calibrated camera, and to mathematically convert the 2D data into three normalized functions of radial distance from the fibre's optical centre. The three functions are intensity, incremental flux, and encircled flux. The intensity represents optical power per surface area (in watts per square meter). The incremental flux represents optical power per radius differential (in watts per meter), and the encircled flux represents a fraction of the cumulative output power to the total output power.

These three radial functions are intended to characterize fibre optic laser sources either for use in mathematical models predicting the minimum guaranteed length of a communications link, or to qualify a light source to measure insertion loss in multimode links.