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INTERNATIONAL STANDARD

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Fibre optic communication subsystem test procedures – Part 1-4: General communication subsystems – Light source encircled flux measurement method

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

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

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61280-1-4:2009. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

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INTRODUCTION

0.1 General

This part of IEC 61280 is used specifies how to measure the encircled flux of a multimode light source. Encircled flux is a measure, as a function of radius, of the fraction of the cumulative output power to the total output power radiating from 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. Intensity has dimension optical power per area; incremental flux has dimension power per differential of radius; and encircled flux has dimension total optical power, all three being functions of radius. 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.

0.2 Changes from previous edition

This edition of the standard differs from its predecessor in both scope and content. Many of the content changes improve the measurement precision. Several changes have been made to the computation procedure:

- the integration methodology of the radial functions was simple summation, and is now specified to use trapezoidal integration or other higher-order techniques (see 9.3);
- a baseline subtraction step is specified to improve immunity to DC drifts (see 9.2.2 and 9.2.3);
- the ring width parameter is explicitly specified (see 9.2.1);
- the integration limit is specified (see 9.3).

The geometric calibration of the apparatus microscope now specifies either (depending on the application) the methodology of IEC 61745 or the original technique using the micropositioning stage (see Clause 7). Pixel sensitivity uniformity correction is now optional.

0.3 Assumptions applicable to the characterization of data sources

The 50-µm or 62,5-µm core near-parabolic graded-index multimode fibre used as the "test jumper assembly" is treated as if it possessed perfect circular symmetry about its optical centre, as asymmetries in the launched optical flux distributions will dominate any lopsidedness of the test jumper assembly. It is further assumed that all cladding modes will be stripped by passage through the specified ten metres or more of fibre. The modes of a mode group need not carry equal flux. (In fact, with such short fibres, one thousand metres or less, unequal distribution of flux in the modes of a group is the norm, not the exception.)

0.4 Assumptions applicable to the characterization of measurement sources

Measurement sources are assumed to be sufficiently broadband and incoherent that speckle is not a problem, and to have a sufficiently symmetrical nearfield distribution that the truncated centroid of that nearfield indicates the location of the optical centre of the fibre with sufficient accuracy for the purposes of this standard.

FIBRE OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

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

1 Scope

~~This part of IEC 61280 is intended to characterize the encircled flux of two types of light sources: transmission light sources, which are usually coherent and substantially under-excite the mode volume of a multimode fibre, and measurement light sources, which are incoherent and excite most of the mode volume of a multimode fibre.~~

This part of IEC 61280 establishes the characterization process of the encircled flux measurement method of light sources intended to be used with multimode fibre.

This document sets forth a ~~standard~~ procedure for the collection of two-dimensional fibre optic nearfield greyscale data and subsequent reduction to one-dimensional data expressed as a set of three sampled parametric functions of radius from the fibre's optical centre. ~~This revision of IEC 61280-1-4 continues to fulfil its original purpose, characterization of transmission light sources, which enables the accurate mathematical prediction of minimum guaranteed link length in 1 gigabit per second or greater fibre optic data communication systems. New to this revision is support for improved measurement precision of insertion loss in multimode fibre optic links through the characterization of measurement light sources.~~

Estimation of the fibre core diameter is not an objective of this document.

2 Normative references

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.

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

~~IEC 61745:1988, *End-face image analysis procedure for the calibration of optical fibre geometry test sets*~~

IEC 61280-1-4

Edition 3.0 2023-01

INTERNATIONAL STANDARD

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Fibre optic communication subsystem test procedures – Part 1-4: General communication subsystems – Light source encircled flux measurement method

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 61280-1-4:2023-01(en-fr)

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FIBRE OPTIC COMMUNICATION SUBSYSTEM TEST PROCEDURES –

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

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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

AVANT-PROPOS

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L'IEC 61280-1-4 a été établie par le sous-comité 86C: Systèmes et dispositifs actifs à fibres optiques, du comité d'études 86 de l'IEC: Fibres optiques. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2009. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) amélioration de la procédure et de la traçabilité de l'étalonnage;
b) amélioration de la description et des exigences relatives à l'agitateur de fibre;
c) ajout des sources optiques pulsées;

d) suppression d'un processus d'étalonnage utilisant un micropositionneur, en raison de sa faible traçabilité.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
86C/1806/CDV	86C/1828/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

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INTRODUCTION

La présente partie de l'IEC 61280 spécifie comment mesurer le flux inscrit d'une source optique multimodale. Le flux inscrit est une fraction de la puissance de sortie cumulée sur la puissance de sortie totale, en fonction de la distance radiale depuis le centre du cœur de la fibre optique multimodale.

L'approche de base consiste à rassembler des données de champ proche bidimensionnelles (2D) en utilisant une caméra étalonnée, et à convertir mathématiquement ces données en 2D en trois fonctions normalisées de la distance radiale par rapport au centre optique de la fibre. Les trois fonctions sont l'intensité, le flux incrémental et le flux inscrit. L'intensité représente la puissance optique par zone (exprimée en watts par mètre carré). Le flux incrémental représente la puissance optique par différentiel de rayon (exprimée en watts par mètre), et le flux inscrit représente une fraction de la puissance de sortie cumulée sur la puissance de sortie totale.

Ces trois fonctions radiales sont destinées à caractériser des sources laser fibroniques utilisées dans des modèles mathématiques prévoyant la longueur garantie minimale d'une liaison de communication, ou pour qualifier une source optique afin de mesurer la perte d'insertion dans des liaisons multimodales.

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

1 Domaine d'application

La présente partie de l'IEC 61280 stipule le processus de caractérisation de la méthode de mesure du flux inscrit de sources optiques destinées à être utilisées avec des fibres multimodales.

Le présent document définit une procédure consistant à collecter des données fibroniques de champ proche, bidimensionnelles et en niveaux de gris, puis à les réduire en données unidimensionnelles exprimées sous la forme d'un ensemble de trois fonctions paramétriques échantillonnées du rayon par rapport au centre optique de la fibre.

L'évaluation du diamètre du cœur des fibres ne constitue pas un objectif du présent document.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60793-2-10, *Fibres optiques – Partie 2-10: Spécifications de produits – Spécification intermédiaire pour les fibres multimodales de catégorie A1*

IEC 60825-1, *Sécurité des appareils à laser – Partie 1: Classification des matériels et exigences*