BRITISH STANDARD

BS EN 60793-1-44: 2002

Optical fibres —

Part 1-44: Measurement methods and test procedures — Cut-off wavelength

The European Standard EN 60793-1-44:2002 has the status of a British Standard

ICS 33.180.10

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National foreword

This British Standard is the official English language version of EN 60793-1-44:2002. It is identical with IEC 60793-1-44:2001. It partly supersedes BS EN 188000:1994 which will be withdrawn upon publication of the full BS EN 60793-1 series.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/1, Optical fibres and cables, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 6 June 2002

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EUROPEAN STANDARD **EN 60793-1-44**

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ICS 33.180.10 Partly supersedes EN 188000:1992

English version

Optical fibres
Part 1-44: Measurement methods and test procedures – Cut-off wavelength
(IEC 60793-1-44:2001)

Fibres optiques
Partie 1-44: Méthodes de mesure et procédures d'essai – Longueur d'onde de coupure
(CEI 60793-1-44:2001)

Lichtwellenleiter
Teil 1-44: Messmethoden und Prüfverfahren – Grenzwellenlänge
(IEC 60793-1-44:2001)

This European Standard was approved by CENELEC on 2001-10-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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

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Foreword

The text of document 86A/673/FDIS, future edition 1 of IEC 60793-1-44, prepared by SC 86A, Fibres and cables, of IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60793-1-44 on 2001-10-01.

This European Standard supersedes subclause 4.21 (test method 312) and subclause 4.22 (test method 313) of EN 188000:1992.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2002-09-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-10-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A, B, C and D are normative.

Compared to IEC 60793-1:1989 and IEC 60793-2:1992, IEC/SC 86A has adopted a revised structure of the new IEC 60793 series: The individual measurement methods and test procedures for optical fibres are published as "Part 1-XX"; the product standards are published as "Part 2-XX".

The general relationship between the new series of EN 60793 and the superseded European Standards of the EN 188000 series is as follows:

EN	Title	supersedes
EN 60793-1-XX	Optical fibres -- Part 1-XX: Measurement methods and test procedures	Individual subclauses of EN 188000:1992
EN 60793-2-XX	Optical fibres -- Part 2-XX: Product specifications	EN 188100:1995 EN 188101:1995 EN 188102:1995 EN 188200:1995 EN 188201:1995 EN 188202:1995

EN 60793-1-4X consists of the following parts, under the general title: Optical fibres:

- Part 1-40: Measurement methods and test procedures – Attenuation
- Part 1-41: Measurement methods and test procedures – Bandwidth
- Part 1-42: Measurement methods and test procedures – Chromatic dispersion
- Part 1-43: Measurement methods and test procedures – Numerical aperture
- Part 1-44: Measurement methods and test procedures – Cut-off wavelength
- Part 1-45: Measurement methods and test procedures – Mode field diameter
- Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance
- Part 1-47: Measurement methods and test procedures – Macrobending loss
- Part 1-48: Measurement methods and test procedures – Under consideration
- Part 1-49: Measurement methods and test procedures – Under consideration

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Endorsement notice

The text of the International Standard IEC 60793-1-44:2001 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

Publications in the IEC 60793-1 series concern measurement methods and test procedures as they apply to optical fibres.

Within the same series several different areas are grouped, as follows:

– parts 1-10 to 1-19: General
– parts 1-20 to 1-29: Measurement methods and test procedures for dimensions
– parts 1-30 to 1-39: Measurement methods and test procedures for mechanical characteristics
– parts 1-40 to 1-49: Measurement methods and test procedures for transmission and optical characteristics
– parts 1-50 to 1-59: Measurement methods and test procedures for environmental characteristics.

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OPTICAL FIBRES –

Part 1-44: Measurement methods and test procedures – Cut-off wavelength

1 Scope

This part of IEC 60793 establishes uniform requirements for measuring the cut-off wavelength of single-mode optical fibre, thereby assisting in the inspection of fibres and cables for commercial purposes.

This standard provides methods for measuring the cut-off wavelength of cable, fibre, and jumper cable.

Two methods exist for measuring cable cut-off wavelength, λ_{cc}:

– method A: using uncabled fibre;
– method B: using cabled fibre.

There is only one method for measuring fibre cut-off wavelength, λ_c.

There is only one method for measuring jumper cable fibre cut-off wavelength, λ_{cj}.

The test method in this standard describes procedures for determining the cut-off wavelength of a sample fibre in either an uncabled condition (λ_c) or in a cable (λ_{cc}) or as a jumper cable (λ_{cj}). Three default configurations are given here: any different configuration will be given in a detail specification. This method applies to all B fibre types.

All methods require a reference measurement. There are two reference-scan techniques, either or both of which may be used with all methods:

– bend-reference technique;
– multimode-reference technique.

2 Normative references

None.

3 Background

Theoretical cut-off wavelength is the shortest wavelength at which only the fundamental mode can propagate in a single-mode fibre, as computed from the refractive index profile of the fibre.

In optical fibres, the change from multimode to single-mode behaviour does not occur at an isolated wavelength, but rather it occurs smoothly over a range of wavelengths. For purposes of determining fibre performance in a telecommunications network, theoretical cut-off wavelength is less useful than the lower value actually measured when the fibre is deployed.

Measured cut-off wavelength is defined as the wavelength greater than which the ratio between the total power, including launched higher-order modes, and the fundamental mode power has decreased to less than 0,1 dB. According to this definition, the second-order (LP_{11}) mode undergoes 19,3 dB more attenuation than the fundamental (LP_{01}) mode.

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Because measured cut-off wavelength depends on the length and bends of the fibre, the resulting value of cut-off wavelength depends on whether the measured fibre is configured in a deployed, cabled condition, or it is short and uncabled. Consequently, there are three overall types of cut-off wavelength:

a) cable cut-off wavelength, measured in an uncabled fibre deployment condition (method A), or in a cabled condition (method B);

b) fibre cut-off wavelength, measured on a short length of uncabled, primary-coated fibre;

c) jumper cable cut-off wavelength, λ_{cj}, measured on short length of jumper cable deployed with a single loop.

Cable cut-off wavelength is the preferred attribute to be specified and measured.

4 Overview of methods

All of the methods shall use the transmitted power technique, which measures the variation with wavelength of the transmitted power of a fibre under test compared to a reference transmitted power wavelength scan. The reference scan normalizes wavelength-dependent fluctuations in the measurement equipment so that the attenuation of the LP_{11} mode in the specimen can be properly characterized and the cut-off wavelength precisely determined.

The reference scan uses one of the following two techniques:

– the specimen with an additional, smaller-radius fibre bend;

– a (separate) multimode fibre.

This procedure can determine the cut-off wavelength of a fibre specimen in either a cabled or uncabled condition. Each method has its own default configurations; the detail specification will give any different configuration required.

The fibre cut-off wavelength, (λ_c), measured under the standard length and bend conditions described in this standard, will generally exhibit a value larger than λ_{cc}. For normal installed cable spans, it is common for the measured λ_c value to exceed the system transmission wavelength. Thus cable cut-off wavelength is the more useful description of system performance and capability. For short cables, e.g. pigtail with a length shorter (and possibly a bending radius larger) than described in this method, the cable may become multimode at wavelengths larger than λ_{cc}.

Where the cable length is even shorter than described in the fibre cut-off wavelength measurement, the cable can become multimode at wavelengths larger than λ_c.

Jumper cable cut-off will generally produce a value between cable cut-off wavelength and fibre cut-off wavelength. The value is affected by the jumper cable construction to a greater degree than it is affected by regular transmission cable. The choice of bend radius will also affect the result. The bend radius should be specified to be similar to the field deployment condition. Jumper cable cut-off wavelength can be specified for a particular construction, for applications using lengths between the specified measurement length and 20 m, and for application bend radii greater than the specified measurement bend radius.

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