Fibre optic interconnecting devices and passive components — Basic test and measurement procedures

Part 3-53: Examinations and Measurements — Encircled angular flux (EAF) measurement method based on two-dimensional far field data from step index multimode waveguide (including fibre)
This British Standard is the UK implementation of EN 61300-3-53:2015. It is identical to IEC 61300-3-53:2015.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/2, Fibre optic interconnecting devices and passive components.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2015.
Published by BSI Standards Limited 2015

ISBN 978 0 580 82206 3
ICS 33.180.20

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 2015.

Amendments/corrigenda issued since publication

<table>
<thead>
<tr>
<th>Date</th>
<th>Text affected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-53: Examinations and measurements - Encircled angular flux (EAF) measurement method based on two-dimensional far field data from step index multimode waveguide (including fibre) (IEC 61300-3-53:2015)

This European Standard was approved by CENELEC on 2015-03-12. 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.
The text of document 86B/3850/FDIS, future edition 1 of IEC 61300-3-53, prepared by SC 86B "Fibre optic interconnecting devices and passive components" of IEC/TC 86 "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61300-3-53:2015.

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) 2015-12-12
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-03-12

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 61300-3-53:2015 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 standards indicated:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Note</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60793-2-30</td>
<td>NOTE</td>
<td>Harmonized as EN 60793-2-30.</td>
</tr>
<tr>
<td>IEC 60793-2-40</td>
<td>NOTE</td>
<td>Harmonized as EN 60793-2-40.</td>
</tr>
<tr>
<td>IEC 60793-1-43</td>
<td>NOTE</td>
<td>Harmonized as EN 60793-1-43.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Publication</th>
<th>Year</th>
<th>Title</th>
<th>EN/HD</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60825-1</td>
<td>-</td>
<td>Safety of laser products -- Part 1:EN 60825-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equipment classification and requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEC 61300-1</td>
<td>-</td>
<td>Fibre optic interconnecting devices and EN 61300-1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>passive components -- Basic test and measurement procedures -- Part 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>General and guidance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B.2 Requirements .................................................................................................................................................. 19
Bibliography .......................................................................................................................................................... 20

Figure 1 – Apparatus configuration: Measurement method 1: fθ lens imaging ........................................... 8
Figure 2 – Far field optical system diagram ........................................................................................................... 8
Figure 3 – Apparatus configuration: measurement method 2 – Direct imaging using an integrating sphere .......................................................................................................................................................... 10
Figure 4 – Apparatus configuration: measurement method 2 – Direct imaging using a single-mode fibre .......................................................................................................................................................... 10
Figure 5 – Apparatus configuration: measurement method 2 – Direct imaging using an imaging device .......................................................................................................................................................... 11
Figure 6 – Calibration apparatus example ........................................................................................................... 12
Figure 7 – Acquired far field image ...................................................................................................................... 13
Figure 8 – Acquired far field image with false colour .......................................................................................... 13
Figure 9 – Optical centre determination ............................................................................................................ 14
Figure 10 – Coordinate conversion to polar coordinate on the image sensor plane .................................. 15
Figure 11 – Standard encircled angular flux chart .............................................................................................. 16
Figure A.1 – An example of an optical system using an fθ lens ....................................................................... 18
1 Scope

This part of IEC 61300 is intended to characterize the encircled angular flux of measurement step index multimode waveguide light sources, in which most of the transverse modes are excited. The term waveguide is understood to include both channel waveguides and optical fibres but not slab waveguides in this standard.

Encircled angular flux (EAF) is the fraction of the total optical power radiating from a step index multimode waveguide’s core within a certain solid angle. The EAF is measured as a function of the numerical aperture full angle. The basic approach is to collect, for every measurement, two dimensional far field data using a calibrated camera and to convert them mathematically into encircled angular flux.

2 Normative references

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

IEC 61300-1, Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance

3 Terms and definitions

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

3.1 encircled angular flux

EAF

fraction of the total optical power radiating from a step index multimode waveguide’s core within a certain solid angle

3.2 \( f\theta \) lens

lens converting the angle of incidence of the input beam, \( \theta \), into the output beam height, \( h \)

Note 1 to entry: The relationship between them is \( h = f\theta \), where \( f \) is the focal length of the lens.