BS EN 60875-1:2015

BSI Standards Publication

Fibre optic interconnecting devices and passive components — Non-wavelength-selective fibre optic branching devices

Part 1: Generic specification

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 60875-1:2015. It is identical to IEC 60875-1:2015. It supersedes BS EN 60875-1:2010, which is withdrawn.

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.

Published by BSI Standards Limited 2015

ISBN 978 0 580 85858 1
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 July 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60875-1

July 2015

ICS 33.180.20

Supersedes EN 60875-1:2010

English Version

Fibre optic interconnecting devices and passive components - Non-wavelength-selective fibre optic branching devices - Part 1: Generic specification (IEC 60875-1:2015)

Dispositifs d'interconnexion et composants passifs à fibres optiques - Dispositifs de couplage à fibres optiques ne dépendant pas de la longueur d'onde - Partie 1: Spécification générique (IEC 60875-1:2015)

Lichtwellenleiter - Verbindungselemente und passive Bauteile - wellenlängenunabhängige Lichtwellenleiter-Verzweiger - Teil 1: Fachgrundspezifikation (IEC 60875-1:2015)

This European Standard was approved by CENELEC on 2015-06-11. 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.

CENELEC

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

Ref. No. EN 60875-1:2015 E

European foreword

The text of document 86B/3806/CDV, future edition 6 of IEC 60875-1, 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 60875-1:2015.

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)	2016-03-11
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-06-11

This document supersedes EN 60875-1:2010.

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 60875-1:2015 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:

IEC 60068	NOTE	Harmonized in EN 60068 series.
IEC 60974	NOTE	Harmonized in EN 60974 series.
IEC 61300-1	NOTE	Harmonized as EN 61300-1.
IEC 61300-2	NOTE	Harmonized in EN 61300-2 series.
IEC 61300-3	NOTE	Harmonized in EN 61300-3 series.
IEC 61753	NOTE	Harmonized in EN 61753 series.
IEC 61754	NOTE	Harmonized in EN 61754 series.
IEC 62005	NOTE	Harmonized in EN 62005 series.

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.

Publication	Year	Title	EN/HD	Year
IEC 60027	series	Letter symbols to be used in electrical technology	EN 60027	-
IEC 60050	series	International electrotechnical vocabulary	-	-
IEC 60617	series	Graphical symbols for diagrams	-	-
IEC 60695-11-5	-	Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance	EN 60695-11-5	-
IEC 60825	series	Safety of laser products	EN 60825	series
IEC 61300	series	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures	EN 61300	series
IEC/TR 61930	-	Fibre optic graphical symbology	-	-
ISO 129-1	-	Technical drawings - Indication of dimensions and tolerances - Part 1: General principles	-	-
ISO 286-1	-	Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 1: Basis of tolerances, deviations and fits	EN ISO 286-1	-
ISO 1101	-	Geometrical product specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out	EN ISO 1101	-
ISO 8601	-	Data elements and interchange formats - Information interchange - Representation of dates and times	-	-

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – NON-WAVELENGTH-SELECTIVE FIBRE OPTIC BRANCHING DEVICES –

Part 1: Generic specification

FOREWORD

International Standard IEC 60875-1 has been prepared by subcommittee SC86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This sixth edition cancels and replaces the fifth edition published in 2010 and constitutes a technical revision.

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

a) removal of terms and definitions for splitter, coupler, symmetric non-wavelength-selective branching device, asymmetric non-wavelength-selective branching device;

b) addition of terms and definitions for bidirectional non-wavelength-selective branching device and non-bidirectional non-wavelength-selective branching device

c) removal of assessment level.

The text of this standard is based on the following documents:

CDV	Report on voting
86B/3806/CDV	86B/3872/RVC

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 60875 series, published under the general title *Fibre optic interconnecting devices and passive components – Non-wavelength-selective fibre optic branching devices*, 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 website 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.

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.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – NON-WAVELENGTH-SELECTIVE FIBRE OPTIC BRANCHING DEVICES –

Part 1: Generic specification

1 Scope

This part of IEC 60875 applies to non-wavelength-selective fibre optic branching devices, all exhibiting the following features:

– they are passive, in that they contain no optoelectronic or other transducing elements;
– they have three or more ports for the entry and/or exit of optical power, and share optical power among these ports in a predetermined fashion;
– the ports are optical fibres, or optical fibre connectors.

This standard establishes uniform requirements for the optical, mechanical and environmental properties.

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org/)

IEC 60617 (all parts), *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60825 (all parts), *Safety of laser products*

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC TR 61930, *Fibre optic graphical symbology*

ISO 129-1, *Technical drawings – Indication of dimensions and tolerances – Part 1: General principles*

ISO 286-1, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits*

ISO 1101, *Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-731, as well as the following, apply.

3.1 Basic terms and definitions

3.1.1
port
optical fibre or optical connector attached to a passive component for the entry (input port) and/or exit (output port) of the optical power

3.1.2
optical pigtail
short length of jumper or cable forming an optical port for an optic component

3.1.3
transfer matrix
optical properties of a non-wavelength-selective optic branching device can be defined in terms of an $n \times n$ matrix of coefficients, n being the number of ports, with the coefficients representing the fractional optical power transferred between designated ports

Note 1 to entry: In general, the transfer matrix T is as follows:

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdot & \cdot & \cdot & t_{1n} \\ t_{21} & & & & & \\ \cdot & & & & & \\ \cdot & & & t_{ij} & & \\ \cdot & & & & & \\ t_{n1} & & & & & t_{nn} \end{bmatrix}$$

where

t_{ij} is the ratio of the optical power P_{ij} transferred out of port j with respect to input power P_i into port i, that is:

$$t_{ij} = P_{ij}/P_i$$

The transfer matrix is used to classify the different types of non-wavelength-selective branching devices which are specified in this generic specification.

Note 2 to entry: In a non-wavelength-selective branching device, the coefficients t_{ij} may be a function of the input wavelength, input polarization or modal power distribution. The values of these parameters are provided in the detail specification, when necessary.

Note 3 to entry: Single-mode, non-wavelength-selective branching devices may operate in a coherent fashion with respect to multiple inputs. Consequently, the transfer coefficients may be affected by the relative phase and intensity of simultaneous coherent optical power inputs at two or more ports.

3.1.4
transfer coefficient
element t_{ij} of the transfer matrix

3.1.5
conducting port pair
two ports i and j between which t_{ij} is nominally greater than zero

3.1.6
isolated port pair
two ports i and j between which t_{ij} is nominally zero, and a_{ij} is nominally infinite

3.2 Component definitions

3.2.1
non-wavelength-selective branching device
(optical) coupler
(optical) splitter
bidirectional passive component possessing three or more ports which operates non-selectively over a specified range of wavelengths, divides or combines optical power coming into one or more input port(s) among its one or more output port(s) in a predetermined fashion, without any amplification, switching, or other active modulation

3.2.2
bidirectional non-wavelength-selective branching device
device whose transfer matrix element of t_{ij} is equal to t_{ji} for all i and j

3.2.3
non bidirectional non-wavelength-selective branching device
device which at least one transfer matrix element of t_{ij} is not equal to t_{ji}

3.2.4
balanced coupler
non-wavelength-selective branching device which is designed and intended to produce that each output port power from the same input port is equal

3.2.5
unbalanced coupler
non-wavelength-selective branching device which is designed and intended to produce that at least one output port power from the same input port is not equal

3.2.6
tap-coupler
unbalanced coupler, typically the coupling ratio is from 1 % to 20 %

3.3 Performance parameter definitions

3.3.1
insertion loss
reduction in optical power between an input and output port of a passive component expressed in decibels and defined as

$$a = -10 \log_{10} (P_1/P_0)$$

where

P_0 is the optical power launched into the input port;

P_1 is the optical power received from the output port.

3.3.2
return loss
fraction of input power that is returned from a port of a passive component expressed in decibelsand defined as

$$RL = -10 \log_{10} (P_r/P_0)$$

where

P_0 is the optical power launched into a port;

P_r is the optical power received back from the same port.

3.3.3
directivity
optical attenuation expressed in decibels between ports which have conducting connections at any state within isolated port pairs

Note 1 to entry: It is a positive value expressed in dB. Generally, directivity for a passive device is defined as the minimum value of directivities of all ports.

Note 2 to entry: Directivity is the optical loss between ports which has no conducting connections within all operating wavelength ranges.

Note 3 to entry: Directivity is defined for port pairs which are expected to be isolated but not expressly intended to be isolated. That means it is expected to isolate leak light and/or stray light.

3.3.4
excess loss
total power lost in a non-wavelength-selective branching device when an optical signal is launched into port i, defined as

$$EL_{\text{i}} = -10 \log_{10} \sum\nolimits_{\text{j}} t_{\text{ij}}$$

where the summation is performed only over those values j for which i and j are conducting ports

Note 1 to entry: For a non-wavelength-selective branching device with n input ports, there is an array of n values of excess loss, one for each input port i.

3.3.5
uniformity
difference between the maximum and minimum attenuation measured for all output ports for one input port

Note 1 to entry: For each input port, it is the maximum value over the operating wavelength range or ranges. The uniformity for a device with more than one input port is defined as the maximum value of uniformities of all input ports.

Note 2 to entry: Uniformity is expressed as the difference of maximum and minimum value of each insertion loss from a common input port. It is expressed in decibels.

Note 3 to entry: Generally, uniformity for a passive device is defined as maximum value of uniformities of all ports.

3.3.6
coupling ratio
splitting ratio
for a given input port i, the ratio of light at a given output port k to the total light from all output ports and defined as

$$CR_{\text{ik}} = t_{i\text{k}} \Big/ \sum\nolimits_{\text{j}} t_{\text{ij}}$$

where j represents the operational output ports.

3.3.7
operating wavelength
nominal wavelength λ, at which a passive component is designed to operate with the specified performance

3.3.8
operating wavelength range
specified range of wavelengths from $\lambda_{i\ min}$ to $\lambda_{i\ max}$ about a nominal operating wavelength λ_i, within which a passive component is designed to operate with the specified performance

Note 1 to entry: For a non-wavelength-selective branching device with more than one operating wavelength, the corresponding wavelength ranges are not necessarily equal.

3.3.9
polarization dependent loss
PDL
maximum variation of insertion loss due to a variation of the state of polarization (SOP) over all the SOPs

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: This note applies to the French language only.

4 Requirement

4.1 Classification

4.1.1 General

Non-wavelength-selective branching devices shall be classified as follows:

– type;
– style;
– variant;
– performance standard grade;
– assessment level;
– normative reference extensions.

4.1.2 Types

The main characteristics of each type are as follows:

– transmissive or reflective;
– bidirectional or unidirectional;
– tree or star;
– any combination of the above.

4.1.3 Style

4.1.3.1 General

Non-wavelength-selective branching devices may be classified into styles based on the fibre type(s), the connector type(s), the cable type(s), the housing shape, and the configuration. The configuration of branching device ports are classified as follows:

4.1.3.2 Configuration A

Device containing integral fibre optic pigtails, without connectors (see Figure 1).

EXAMPLE

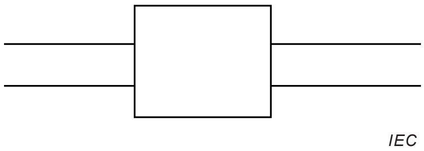


Figure 1 – Non-wavelength-selective branching device

4.1.3.3 Configuration B

Device containing integral fibre optic pigtails, with a connector on each pigtail (see Figure 2).

EXAMPLE

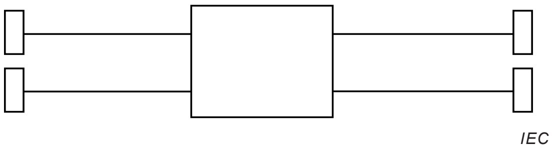


Figure 2 – Non-wavelength-selective branching device

4.1.3.4 Configuration C

Device containing fibre optic connectors as an integral part of the device housing (see Figure 3).

EXAMPLE

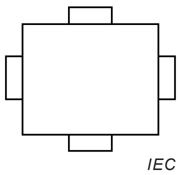


Figure 3 – Non-wavelength-selective branching device

4.1.3.5 Configuration D

Device containing some combination of the interfacing features of the preceding configurations (see Figure 4).

EXAMPLE

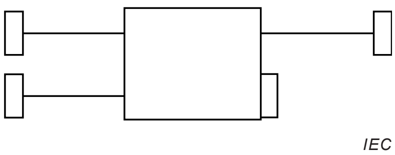


Figure 4 – Non-wavelength-selective branching device

4.1.4 Variant

The branching device variant identifies those common features which encompass structurally similar components.

Examples of features which define a variant include, but are not limited to the following:

– orientation of ports;
– means of mounting.

4.1.5 Normative reference extensions

Normative reference extensions are used to identify the integration of independent standards specifications or other reference documents into blank detail specifications.

Unless otherwise specified, additional requirements imposed by an extension are mandatory. Usage is primarily intended to merge associated components to form hybrid devices or integrated functional application requirements that are dependent on technical expertise used for other than fibre optics.

Published reference documents produced by ITU, consistent with the scope of the relevant IEC specification series may be used as extension.

Some optical splice configurations require special qualification provisions which shall not be imposed universally. This accommodates individual component design configurations, specialized field tooling or specific application processes. In this case, requirements necessary to assure repeatable performance or adequate safety, and provide additional guidance for complete product specification. These extensions are mandatory whenever used to prepare, assemble or install an optical splice either for field application usage or preparation of qualification test specimens. The relevant specification shall clarify all stipulations. However, design and style dependent extensions shall not be imposed universally.

In the event of conflicting requirements, precedence, in descending order, shall be generic over mandatory extension, over blank detail, over detail, over application specific extension.

4.2 Documentation

4.2.1 Symbols

Graphical and letter symbols shall, whenever possible, be taken from IEC 60027, IEC 60617 and IEC 61930.

4.2.2 Specification system

4.2.2.1 General

This specification is part of a three-level IEC specification system. Subsidiary specifications shall consist of blank detail specifications and detail specifications. This system is shown in Table 1. There are no sectional specifications for non-wavelength-selective branching devices.

Table 1 – Three-level IEC specification structure

Specification level	Examples of information to be included	Applicable to
Basic	Assessment system rules Inspection rules Optical measuring methods Environmental test methods Sampling plans Identification rule Marking standards Dimensional standards Terminology standards Symbol standards Preferred number series SI units	Two or more component families or sub-families
Generic	Specific terminology Specific symbols Specific units Preferred values Marking Quality assessment procedures Selection of tests Qualification approval and/or capability approval procedures	Component family
Blank detail	Quality conformance test schedule Inspection requirements Information common to a number of types	Groups of types having a common test schedule
Detail	Individual values Specific information Completed quality conformance test schedules	Individual type

4.2.2.2 Blank detail specifications

Blank detail specifications are not, by themselves, a specification level. They are associated with the generic specification.

Each blank detail specification shall be limited to one environmental category.

Each blank detail specification shall contain:

– minimum mandatory test schedules and performance requirements;
– one or more assessment levels;
– the preferred format for stating the required information in the detail specification;
– in case of hybrid components, including connectors, addition of appropriate entry fields to show the reference normative document, document title and issue date.

4.2.2.3 Detail specifications

A specific non-wavelength-selective branching device is described by a corresponding detail specification, which is prepared by filling in the blanks of the blank detail specification. Within the constraints imposed by this generic specification, the blank detail specification may be filled in by any national committee of the IEC, thereby defining a particular non-wavelength-selective branching device design as an IEC standard.

Detail specifications shall specify the following, as applicable:

– type (see 4.1.2);
– style (see 4.1.3);
– variant(s) (see 4.1.4);
– part identification number for each variant (see 4.7.2);
– drawings, dimensions required (see 4.2.3);
– performance requirements (see 4.6).

4.2.3 Drawings

4.2.3.1 General

The drawings and dimensions given in detail specifications shall not restrict themselves to details of construction, nor shall they be used as manufacturing drawings.

4.2.3.2 Projection system

Either first angle or third angle projection shall be used for the drawings in documents covered by this specification. All drawings within a document shall use the same projection system and the drawings shall state which system is used.

4.2.3.3 Dimensional system

All dimensions shall be given in accordance with ISO 129-1, ISO 286-1 and ISO 1101.

The metric system shall be used in all specifications.

Dimensions shall not contain more than five significant digits.

When units are converted, a note shall be added in each relevant specification and the conversion between systems of units shall use a factor of 25,4 mm to 1 inch.

4.2.4 Measurements

4.2.4.1 Measurement method

The measurement method for optical, mechanical, climatic, and environmental characteristics of branching devices to be used shall be defined and selected preferentially from the IEC 61300 series.

The size measurement method to be used shall be specified in the detail specification for any dimensions which are specified within a total tolerance zone of 0,01 mm or less.

4.2.4.2 Reference components

Reference components for measurement purposes, if required, shall be specified in the relevant specification.

4.2.4.3 Gauges

Gauges, if required, shall be specified in the relevant specification.

4.2.5 Test data sheets

Test data sheets shall be prepared for each test conducted as required by a relevant specification. The data sheets shall be included in the qualification report and in the periodic inspection report.

Data sheets shall contain the following information as a minimum:

– title of test and date;
– specimen description including the type of fibre and the variant identification number (see 4.7.2);
– test equipment used and date of latest calibration;
– all applicable test details;
– all measurement values and observations;
– sufficiently detailed documentation to provide traceable information for failure analysis.

4.2.6 Instructions for use

Instructions for use, when required, shall be given by the manufacturer and shall include:

– assembly and connection instructions;
– cleaning method;
– safety aspects;
– additional information, as necessary.

4.3 Standardization system

4.3.1 Interface standards

The interface standards provide both manufacturer and user with all the information they require to make or use a product conforming to the physical features of that standard interface. Interface standards fully define and provide dimensions for the features essential for the mating and unmating of optical connectors and other components. They also serve to position the optical datum target, where defined, relative to other reference datum.

Interface standards ensure that connectors and adaptors that comply with the standard will fit together. The standards may also contain tolerance grades for ferrules and alignment devices. Tolerance grades are used to provide different levels of alignment precision.

The interface dimensions may also be used to design other components that will mate with the connectors. For example, an active device mount can be designed using the adapter interface dimensions. The use of these dimensions combined with those of a standard plug, provides the designer with assurance that the standard plugs will fit into the optical device mount. They also provide the location of the plug's optical datum target.

Standard interface dimensions do not, by themselves, guarantee optical performance. They guarantee connector mating at a specified fit. Optical performance is currently guaranteed via the manufacturing specification. Products from the same or different manufacturing specifications using the same standard interface will always fit together. Guaranteed performance can be given by any single manufacturer only for products delivered to the same manufacturing specification. However, it can be reasonably expected that some level of performance will be obtained from products having different manufacturing specifications, although the level of performance cannot be expected to be any better than that of the lowest specified performance.

4.3.2 Performance standards

Performance standards contain a series of tests and measurements (which may or may not be grouped into a specified schedule depending on the requirements of that standard) with clearly defined conditions, severities and pass/fail criteria. The tests are intended to be run on a "once-off" basis to prove any product's ability to satisfy the "performance standards" requirements of a market sector, user group or system location. A product that has been shown to meet all the requirements of a performance standard can be declared as complying with a performance standard, but should then be controlled by a quality assurance/quality conformance programme.

A key point of the test and measurement standards for their application (particularly with regard to insertion loss and return loss) in conjunction with the interface standards of interproduct compatibility can be defined. Conformity of each individual product to this standard will be ensured.

4.3.3 Reliability standards

Reliability standards are intended to ensure that a component can meet performance specifications under stated conditions for a stated time period.

For each type of component, the following shall be identified (and shall appear in the standard):

– failure modes (observable, general mechanical or optical effects of failure);
– failure mechanisms (general causes of failure common to several components);
– failure effects (detailed cause of failure, specific to component).

These are all related to environmental and material aspects.

Initially, just after component manufacture, there is an "infant mortality phase" during which many components would fail if deployed in the field. To avoid early field failure, all components can be subjected to a screening process in the factory, involving environmental stress that may be mechanical, thermal or humidity related. This is to induce known failure mechanisms in a controlled environmental situation to occur earlier than would normally be seen in an unscreened population. For those components that survive (and are then sold), there is a reduced failure rate since these mechanisms have been eliminated.

Screening is an optional part of the manufacturing process rather than a test method. It does not affect the "useful life" of a component, defined as the period during which it performs according to specifications. Eventually, other failure mechanisms appear and the failure rate increases beyond the defined threshold. At this point, the useful life ends and the "wear-out period" begins and the component must be replaced.

At the beginning of useful life, performance testing on a sampled population of components may be applied by the supplier, by the manufacturer or by a third party. This is to ensure that the component meets performance specifications over the range of intended environments at this initial time. Reliability testing, on the other hand, is applied to ensure that the component meets performance specifications for at least a specified minimum useful lifetime or for a specified maximum failure rate. These tests are usually carried out by utilizing the performance testing but increasing duration and severity in order to accelerate the failure mechanism.

A reliability theory relates component reliability testing to component parameters and to lifetime or failure rate under testing. The theory then extrapolates these to life or failure rate under less stressful service conditions. The reliability specifications include values of the component parameters needed to ensure the specified minimum lifetime or maximum failure rate in service.

4.3.4 Interlinking

Standards currently under preparation are given in Figure 5. A large number of the test and measurement standards exist already and the quality assurance qualification approval standards have existed for many years.

When interface, performance and reliability standards are in place, the matrix given in Table 2 demonstrates some of the options available for product standardization.

Product A is a product that is fully IEC standardized, having a standard interface and meeting defined performance standards and reliability standards.

Product B is a product with a proprietary interface, but which meets a defined IEC performance standard and reliability standard.

Product C is a product which complies with an IEC standard interface but does not meet the requirement of either an IEC performance standard or reliability standard.

Product D is a product which complies with an IEC interface standard and with a performance standard, but does not meet a reliability requirement.

Obviously, the matrix is more complex than shown since there will be a number of interface, performance and reliability standards that can be cross-related. In addition, all the products may be subject to a recognized quality assurance programme or even a national or company quality assurance system. Table 3 shows options of qualification approval, capability approval and technology approval within a quality assurance programme.

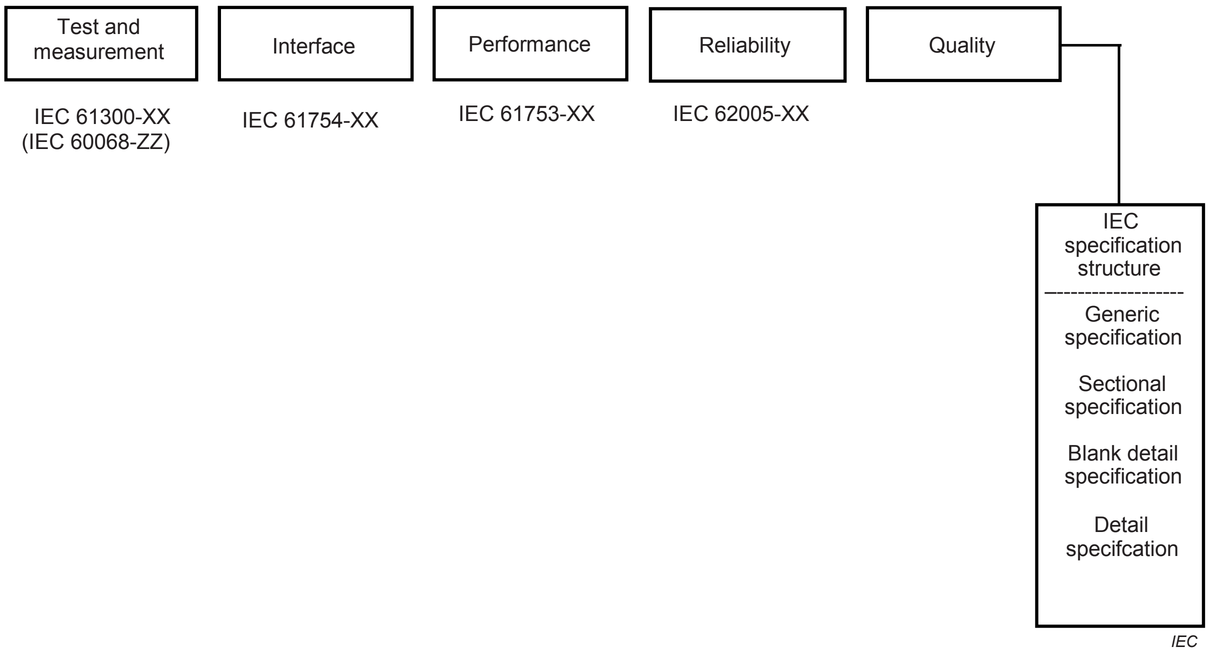


Figure 5 – Standards

Table 2 – Standards interlink matrix

	Interface standard	Performance standard	Reliability standard
Product A	Yes	Yes	Yes
Product B	No	Yes	Yes
Product C	Yes	No	No
Product D	Yes	Yes	No

Table 3 – Quality assurance options

	Company A			Company B			Company C		
	QA[a]	CA[b]	TA[c]	QA[a]	CA[b]	TA[c]	QA[a]	CA[b]	TA[c]
Product A	x			x					x
Product B	x				x				x
Product C	x				x				x
Product D	x					x			x

[a] Qualification approval

[b] Capability approval

[c] Technology approval

4.4 Design and construction

4.4.1 Materials

4.4.1.1 Corrosion resistance

All materials used in the construction shall be corrosion resistant or suitably finished to meet the requirements of the relevant specification.

4.4.1.2 Non-flammable materials

When non-flammable materials are required, the requirement shall be specified in the specification and reference shall be made to IEC 60695-11-5.

4.4.2 Workmanship

Components and associated hardware shall be manufactured to a uniform quality and shall be free of sharp edges, burrs or other defects that will affect service life, serviceability, or appearance. Particular attention shall be given to neatness and thoroughness of marking, plating, soldering, bonding, etc.

4.5 Quality

Non-wavelength-selective branching devices shall be controlled by the quality assessment procedures. The measurement and test procedures from the IEC 61300 series shall be used, as applicable.

4.6 Performance requirements

Branching devices shall meet the performance requirements specified in the relevant IEC performance standard.

4.7 Identification and marking

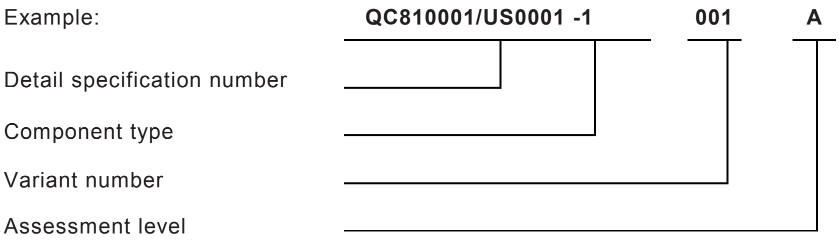
4.7.1 General

Components, associated hardware, and packages shall be permanently and legibly identified and marked when this is required by the detail specification.

4.7.2 Variant identification number

Each variant in a detail specification shall be assigned a variant identification number. The number shall consist of the number assigned to the detail specification followed by a four-digit number preceded by a dash and a letter designating the assessment level. The first digit of the four-digit number shall be sequentially assigned to each component type covered by the detail specification. The last three digits shall be sequentially assigned to each variant of the component.

Example:



4.7.3 Component marking

Component marking, if required, shall be specified in the detail specification. The preferred order of marking is as follows:

a) port identification;
b) manufacturer's part number (including serial number, if applicable);
c) manufacturer's identification mark or logo;
d) manufacturing date;
e) variant identification number;
f) any additional marking required by the detail specification.

If space does not allow for all the required marking on the component, each unit shall be individually packaged with a data sheet containing all of the required information which is not marked.

4.7.4 Package marking

Several non-wavelength-selective branching devices may be packed together for shipment.

Package marking, if required, shall be specified in the detail specification. The preferred order of marking is as follows:

a) manufacturer's identification mark or logo;
b) manufacturer's part number;
c) manufacturing date code (year/week, see ISO 8601);
d) variant identification number(s) (see 4.7.2);
e) type designation (see 4.1.2);
f) any additional marking required by the detail specification.

When applicable, individual unit packages (within the sealed package) shall be marked with the reference number of the certified record of released lots, the manufacturer's factory identity code, and the component identification.

4.8 Safety

Non-wavelength-selective branching devices, when used on an optical transmission system and/or equipment, may emit potentially hazardous radiation from an uncapped or unterminated output port or end.

The non-wavelength-selective branching device manufacturers shall make available sufficient information to alert system designers and users about the potential hazard and shall indicate the required precautions and working practices.

In addition, each detail specification shall include the following:

WARNING NOTE

Care should be taken when handling small diameter fibre optics to prevent puncturing the skin, especially near the eyes. Direct viewing of the end of an optical fibre or an optical connector when it is propagating energy is not recommended unless prior assurance has been obtained as to the safety of the energy output level.

Reference shall be made to the IEC 60825 series, the relevant standard on safety.

Annex A
(informative)

Examples of technology of fibre optic branching devices

Non-wavelength-selective branching devices are typically based on the following two optical technologies. One is the fused biconic taper (FBT) technology (see Figure A.1), which is mainly used for 1(2) × 2, 1(3) × 3 and 1(4) × 4 couplers (splitters). FBT-type optical branching devices are manufactured by coming close between two or more optical fibres, and fused using a burner or heater system. It functions by evanescent effects. Fused fibres are typically fixed on a glass half-tube by adhesive. And a half-tube is packed by a hard pipe.

The other is the planar lightwave circuit (PLC) technology shown in Figure A.2, which is mainly used for 1(2) × n (n = 4 to 128) couplers (splitters). A PLC-type fibre optic branching device consists a PLC chip and optical fibres which are connected to the facets of the PLC chip by adhesive as shown in Figure A.2. The typical fabrication methods of PLC chips are shown in Annex B.

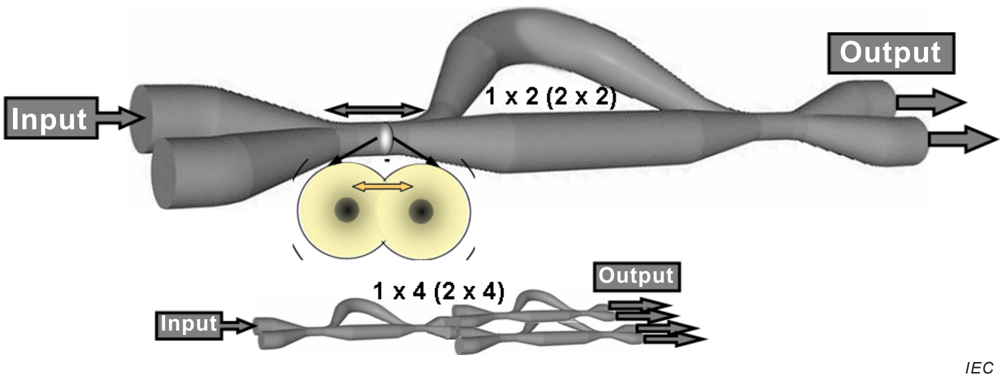


Figure A.1 – FBT-type optical branching device technology

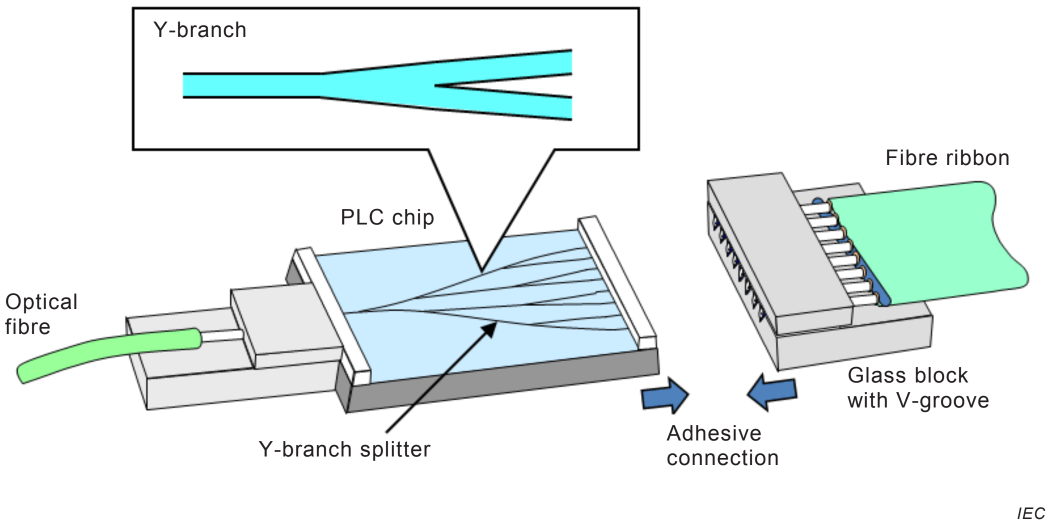


Figure A.2 – PLC-type optical branching device technology

Annex B
(informative)

Examples of fabrication technology of PLC chips

The typical fabrication methods of PLCs are shown in Annex B. In the flame hydrolysis deposition (FHD) method, PLC is manufactured by depositing those particles of SiO2 and GeO2 on a substrate by reacting reactant gas in oxyhydrogen flame and light waveguide is molded by etching (see Figure B.1). In the chemical vapour deposition (CVD) method, light waveguide is molded by etching the cores fabricated by reacting reactant gas (see Figure B.2). In the ion-exchange method, light waveguide is molded by enhancing the refractive index of the place where Na+ ion in glass is exchanged for Ag+ in molten salt by soaking glass including Na+ in molten salt including Ag+ (see Figure B.3).

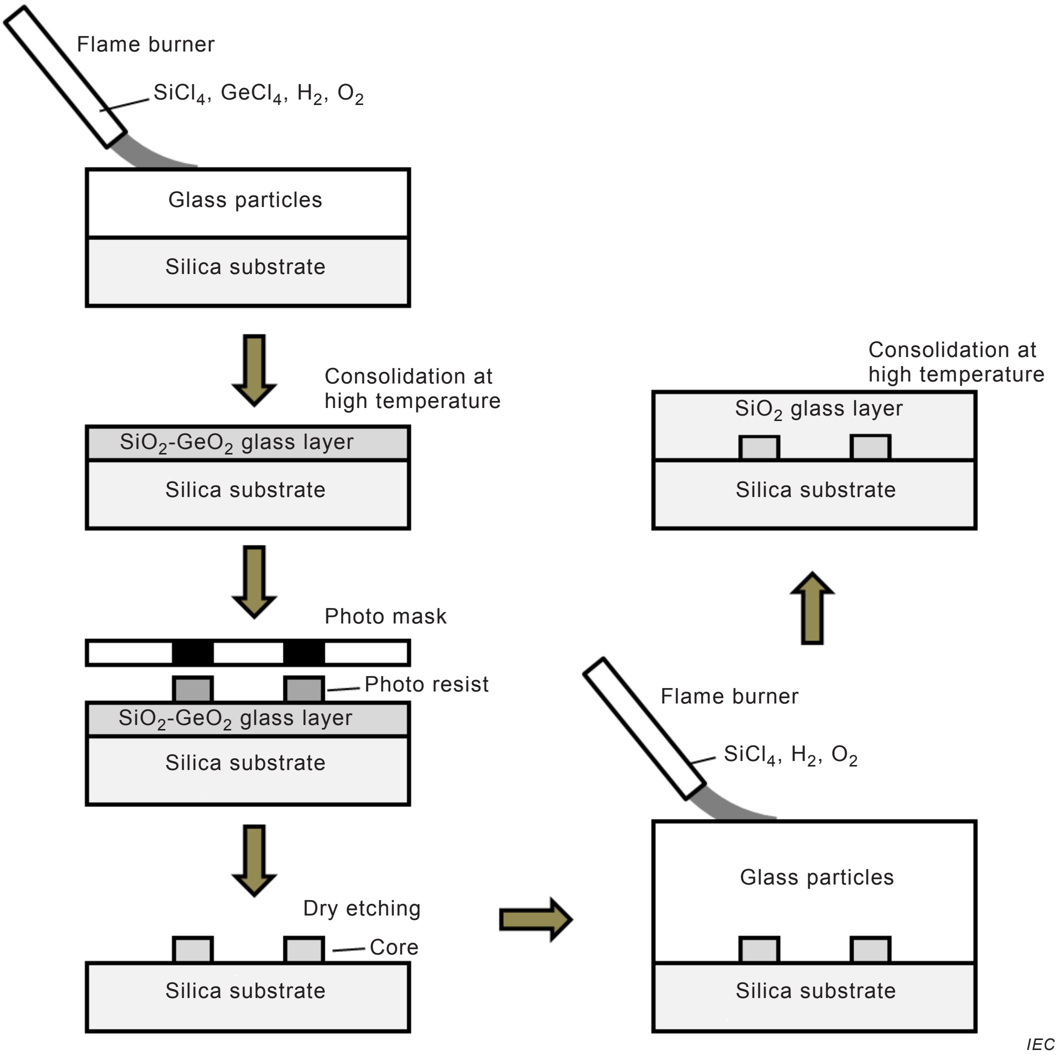


Figure B.1 – Fabrication by FHD method

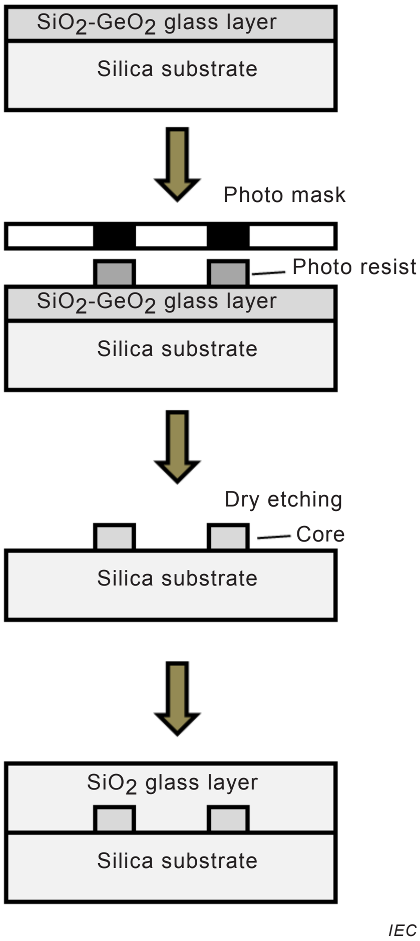


Figure B.2 – Fabrication by CVD method

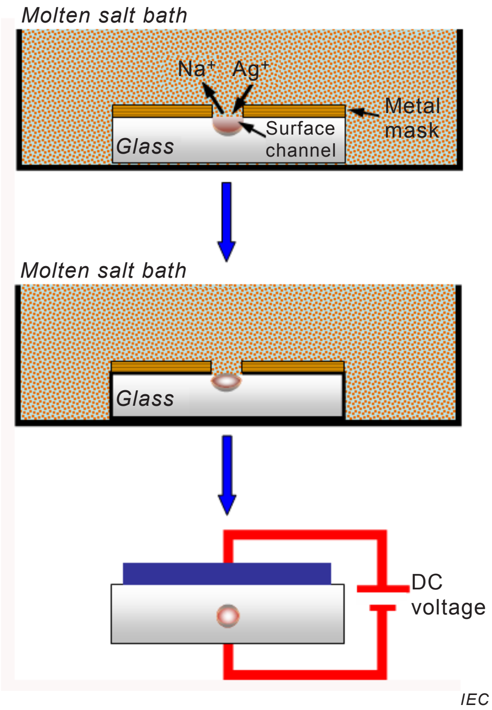


Figure B.3 – Fabrication by ion-exchange method

Bibliography

IEC 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 60068 (all parts), *Environmental testing*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

IEC 60974 (all parts), *Arc welding equipment*

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

IEC 61300-2 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2: Tests*

IEC 61300-3 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3: Examinations and measurements*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components performance standard*

IEC 61754 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces*

IEC TR 61931, *Fibre optic – Terminology*

IEC 62005 (all parts), *Reliability of fibre optic interconnecting devices and passive optical components*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ITU-T Recommendation G.671, *Transmission characteristics of optical components and subsystems*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

...making excellence a habit.™