BS EN 60874-1:2012

BSI Standards Publication

Fibre optic interconnecting devices and passive components — Connectors for optical fibres and cables

Part 1: Generic specification

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National foreword

This British Standard is the UK implementation of EN 60874-1:2012. It is identical to IEC 60874-1:2011. It supersedes BS EN 60874-1:2007 which is withdrawn.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.

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(IEC 60874-1:2011)

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Foreword

The text of document 86B/3272/FDIS, future edition 6 of IEC 60874-1, 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 60874-1:2012.

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)	2012-09-29
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2012-12-29

This document supersedes EN 60874-1:2007.

The specific technical changes from EN 60874-1:2007 include removal of quality assessment procedure, to add the definition of plug-socket configuration, to reconsider a drawing showing the relationship between EN 60874, EN 61753, EN 61754 series of standards, and updating the normative references.

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 60874-1:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60874 series NOTE Harmonized in EN 60874 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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60027	Series	Letter symbols to be used in electrical technology	EN 60027	Series
IEC 60050-731	-	International Electrotechnical Vocabulary (IEV) - Chapter 731: Optical fibre communication	-	-
IEC 60617	Data-base	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 60825-1	-	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	-
IEC 61300	Series	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures	EN 61300	Series
IEC 61753	Series	Fibre optic interconnecting devices and passive components performance standard	EN 61753	Series
IEC 61753-1	-	Fibre optic interconnecting devices and passive components performance standard - Part 1: General and guidance for performance standards	EN 61753-1	-
IEC 61754	Series	Fibre optic connector interfaces	EN 61754	Series
IEC 61755	Series	Fibre optic connector optical interfaces	EN 61755	Series
IEC/TR 61930	-	Fibre optic graphical symbology	-	-
IEC/TR 61931	-	Fibre optic - Terminology	-	-
ISO 129	-	Technical drawings - Dimensioning - General principles, definitions, methods of execution and special indications	-	-
ISO 286-1	-	ISO system of limits and fits - Part 1: Bases 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

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – CONNECTORS FOR OPTICAL FIBRES AND CABLES –

Part 1: Generic specification

1 Scope

This part of IEC 60874 applies to fibre optic connector sets and individual components (i.e. adaptors, plugs, sockets) for all types, sizes and structures of fibres and cables. It includes:

– connector set requirements;

This part of IEC 60874 is divided into four clauses:

– Clauses 1 (Scope), 2 (Normative references) and 3 (Terms and definitions) contain general information pertaining to this generic specification;
– Clause 4 (Requirements) contains all the requirements to be met by connectors covered by this specification. This includes requirements for classification, the IEC specification system, documentation, materials, workmanship, quality, performance, identification, and packaging.

NOTE 1 Clauses 1 to 4 are applicable generally and refer to all connector standards

NOTE 2 This part of IEC 60874 applies also to the connectors covered by the IEC 61753, IEC 61754, and IEC 61755 series.

This standard does not cover test and measurement procedures, which are described in the IEC 61300 series.

2 Normative references

The following referenced documents are indispensable for the application 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 60027 (all parts), *Letter symbols to be used in electrical technology*

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

IEC 60617, *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*

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

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

IEC 61753 (all parts), *Performance standards*

IEC 61753-1: *Fibre optic interconnecting devices and passive components – Part 1: General and guidance for performance standards*

IEC 61754 (all parts), *Fibre optic connector interfaces*

IEC 61755 (all parts), *Fibre optic connector optical interfaces*

IEC/TR 61930, *Fibre optic graphical symbology*

IEC/TR 61931, *Fibre optic terminology*

ISO 129, *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: Bases 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 part of IEC 60874, the definitions contained in IEC 60050-731 and IEC 61931, as well as the following definitions, apply.

3.1
adaptor
a component in which two or more ferrules are aligned

3.2
alignment pins
cylindrical rods used for alignment in some types of connectors

NOTE Typically these are used in pairs and inserted into specific guide holes in the two plugs (usually for multifibre connectors) to provide the alignment.

3.3
APC connector
connector with angled convex end-face ferrule capable of making an angled physical contact between the fibres

3.4
butting optical coupling
coupling in which the optical ports are in contact with each other

3.5
expanded beam optical coupling
coupling in which the optical ports use lens technology

3.6
ferrule
fibre holding component part of the plug, usually aligned in the sleeve of an adaptor. It confines the end(s) of a single or of multiple optical fibres

3.7
fully intermateable connector set
connector sets from different sources are considered fully intermateable when connector components from one source will mate with complementary components from other sources without mechanical damage and with optical properties maintained within specified limits

3.8
interchangeable connector set
connector sets are considered to be interchangeable when they share common installation geometry and have the same functional performance

3.9
mating face dimension
dimension of the features which determine the mating fit between components of an optical connector set

3.10
mechanically intermateable connector set
connector sets from different sources are considered mechanically intermateable when connector components from one source will mate with complementary components from other sources without mechanical damage but without regard to optical properties

3.11
mechanical reference plane (datum plane)
the plane of a plug or adaptor which is perpendicular to the fibre axis and is located on a physical feature of the component. It is the datum plane from which all features of the component are measured in the direction of the fibre axis

NOTE The mechanical reference planes of the plug and the adaptor should coincide when the two components are properly mated. Accordingly, each should be located on the feature that fixes or establishes the relative position of the two components when they are properly mated.

3.12
non-butting optical coupling
coupling in which the ports are not in contact with each other

3.13
optical datum target
theoretical datum point on a connector interface where the optical fibre core centre should be positioned by the plug or by the adaptor receptacle

3.14
optical fibre connector
component normally attached to an optical cable or piece of apparatus, for the purpose of providing frequent optical interconnection/disconnection of optical fibres or cables. This usually consists of two plugs mated together in an adaptor

3.15
optical fibre connector set
complete assembly of components required to provide demountable coupling between two or more optical fibre cables

3.16
optical fibre connector set kit
series of components necessary to make a complete connector set

3.17
optical fibre patchcord or jumper
length of optical fibre or cable, permanently terminated at both ends with two plugs

3.18
optical fibre pigtail
length of optical fibre or cable, permanently terminated at one end with a plug

3.19
PC connector
connector with convex end-face ferrule capable of making a physical contact between the fibres

3.20
plug
male-type part of a connector

3.21
plug-adaptor-plug configuration
configuration in which two plugs mate through an adaptor. The mechanical coupling takes place between the plugs and the adaptor

3.22
plug-receptacle configuration
configuration in which a plug mates in a receptacle

3.23
plug-socket configuration
configuration in which a plug mates in a socket. The mechanical coupling takes place between the plug and the socket

3.24
receptacle
structure for interfacing a plug with an active component. Typically it is formed by a semi-adaptor and a structure containing and aligning the active component

3.25
reference connector component
tighter toleranced or selected connector component (e.g. plug, adaptor, etc.) which is used for measuring purposes

NOTE Test and measurement methods may refer to this. The characteristics or the selection procedure are given in the relevant specification.

3.26
sleeve
precision part of the adaptor used to mechanically align two ferrules

3.27
small form factor connector (SFF)
an optical fibre connector with a ferrule with an outside diameter of less than 2.0 mm or a connector designed to accommodate two or more optical fibres with at least the same mounting density as the RJ-45 connector

NOTE SFF connectors have a smaller cross-sectional area, about one-half that of traditional connectors.

3.28
socket
the female part of a two part connector

4 Requirements

4.1 General

The requirements for connectors covered by this generic specification are specified in this clause and in the detail specification.

4.2 Classification

4.2.1 General

Fibre optic connector sets are classified, either totally or in part, according to the following categories:

– type;
– arrangement;
– style;
– interface standard;
– standardization system;
– variant;
– assessment level;
– normative reference extensions.

See Table 1 for an example of a complete connector set classification.

4.2.2 Type

Connector set types shall be defined by four elements: the type name, the configuration, the coupling mechanism and the mating face dimensions.

Examples of type names:

– type SC;
– type LC.

Examples of configurations:

– plug-adaptor-plug configuration;
– plug-receptacle configuration.

Examples of coupling mechanisms:

– screw thread;
– bayonet;
– push-pull.

Table 1 – Example of a typical connector set classification

Type	– Name: type SC – Configuration: plug-adaptor-plug – Coupling: push -pull – Mating face dimensions: plug: see Figure 2[a] adaptor: see Figure 4 [a]
Arrangement	– Kit
Style	– Fibre retention: adhesive – Cable retention: crimp – Optical coupling: PC – Alignment: resilient bushing
Variants	– Twelve plug permutations of: • fibre diameters 0,125 mm • cable jacket diameters 2,4 mm 3,0 mm • coupling styles: push –pull plastic housing. – Two adaptor variants: • non-mountable (in-line) • four-hole flange mount
[a] Indicates figures in a hypothetical detail specification	

4.2.3 Arrangement

The connector set arrangement shall define the delivered connector set form.

Examples of connector set arrangements:

– kit arrangement for plug and adaptor;
– pigtail arrangement for plug;
– patch-cord arrangement for plugs.

4.2.4 Style

The connector set style shall be defined by four elements: the fibre retention technology, the cable retention technology, the optical coupling technology and the alignment technology.

Examples of fibre retention technologies:

– adhesive fibre retention;
– crimp fibre retention.

Examples of cable retention technologies:

– adhesive cable retention;
– crimp cable retention.

Examples of optical coupling technologies:

– non-butting;
– physical contact (PC)
– angled physical contact (APC);

– expanded beam.

Examples of alignment technologies:

– clearance fit alignment;
– resilient bushing alignment;
– resilient tip alignment;
– spherical alignment;
– solid bore alignment sleeve;
– resilient alignment sleeve;
– V-groove alignment;
– guide pin alignment.

4.2.5 Interface standard

The connector interface standard defines the dimensions and the physical features essential for mating and unmating a fibre optic connector with other connectors or components conforming to the same standard interface (see 4.4.1).

4.2.6 Variant

The connector set variant defines the variety of structurally similar components.

Examples of feature variables which create variants:

– fibre type (category, core and cladding diameter);
– cable type and size;
– mounting scheme;
– coupling nut design (hexagonal, knurled, etc.).

4.2.7 Assessment level

Assessment level defines the inspection levels and the acceptable quality level (AQL) of groups A and B, and the periodicity of inspection of groups C and D. Detail specifications shall specify one or more assessment levels, each of which shall be designated by a capital letter.

The following are preferred levels.

- Assessment level A
  - group A inspection: inspection level 11, AQL = 4 %
  - group B inspection: inspection level 11, AQL = 4 %
  - group C inspection: 24-month periods
  - group D inspection: 48-month periods
- Assessment level B
  - group A inspection: inspection level 11, AQL = 1 %
  - group B inspection: inspection level 11, AQL = 1 %
  - group C inspection: 18-month periods
  - group D inspection: 36-month periods
- Assessment level C
  - group A inspection: inspection level 11, AQL = 0,4 %

– group B inspection: inspection level 11, AQL = 0,4 %
– group C inspection: 12-month periods
– group D inspection: 24-month periods

4.2.8 Normative reference extensions

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

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

Published reference documents produced by ITU consistent with the scope statements of the relevant IEC specification series may be used as extensions. Published documents produced by other regional standardization bodies such as TIA, ETSI, JIS, etc, may be referenced in an informative annex attached to the generic specification.

Some optical fibre splice configurations require special qualification provisions which shall not be imposed universally. These accommodate individual component design configurations, specialised field tooling, or specific application processes and involve requirements necessary to assure repeatable performance or adequate safety. They also provide additional guidance for complete product specification. Such extensions are mandatory whenever used in the preparation, assembly or installation of an optical fibre 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 shall be given, in descending order, as follows: generic over mandatory extension, over blank detail, over detail, over application specific extension.

Examples of optical connector extensions include:

– using IEC 61754-2 and IEC 61754-4 to partially define a future specification within the IEC 60874 series for a duplex type “SC/BFOC/2,5” hybrid connector adaptor;
– using IEC 61754-13 to partially define a future specification within the IEC 60874 series for an integrated type “FC” preset attenuated optical connector;
– using IEC 61754-2 to partially define a specification within the IEC 60874 series for a duplex “BFOC/2,5” receptacle incorporating integral mechanical splices.

Other examples of requirements in normative extensions:

– some commercial or residential building applications may require direct reference to specific safety codes and regulations, or incorporate other specific material flammability or toxicity requirements for specialised locations;
– specialised field tooling may require an extension to implement specific ocular safety, electrical shock, or burn hazard avoidance requirements, or require isolation procedures to prevent potential ignition of combustible gases.

4.3 Documentation

4.3.1 Symbols

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

4.3.2 Specification system

4.3.2.1 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 2.

Table 2 – Three-level specification structure

Specification level	Examples of information to be included	Applicable to
Basic	– Assessment system rules – Inspection rules – Optical measurement methods – Environmental test methods – Sampling plans – Identification rule – Marking standards – Interface dimensions – Dimensional standards – Terminology – Symbol standards – Preferred number series – SI units	Two or more component families or subfamilies
Generic	– Specific terminology – Specific symbols – Specific units – Preferred values – Marking – Quality assessment procedures – Selection test – Qualification approval procedures – Capability approval procedure	Component family
Blank detail [a]	– Quality conformation 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
[a] Blank detail specifications do not, by themselves, constitute a specification level. They are associated to the generic specification		

4.3.2.2 Blank detail specifications

A blank detail specification shall contain:

– the 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 the case of hybrid components, including connectors, addition of appropriate entry fields to show the reference normative document, document title and issue date.

4.3.2.3 Detail specifications

Detail specifications shall specify the following as a minimum:

– type name (see 4.2.2);
– arrangement (see 4.2.3);
– connector set style (see 4.2.4);
– interface standards(4.2.5);
– variants (see 4.2.6);
– assessment level (see 4.2.7);
– qualification procedure method;
– part identification number for each variant (see 4.8.1);
– drawings, dimensions and performance criteria necessary to produce all required reference components (see 4.3.3);
– drawings and dimensions necessary to produce all required gauges (see 4.3.3);
– quality assessment test schedules;
– performance requirements (see 4.7).

4.3.3 Drawings

4.3.3.1 General

The drawings and dimensions given in documents covered by this specification shall not restrict the details of construction nor shall they be used as manufacturing drawings.

4.3.3.2 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.

4.3.3.3 Dimensional system

All dimensions shall be given in accordance with ISO 129, 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.

4.3.3.4 Intermateability

The requirements for mechanical intermateability are defined in the interface standards series IEC 61754.

The requirements for optical intermateability are defined in the optical interface standards series IEC 61755.

4.3.4 Performance

The performance requirements for fibre optic connectors are defined in the performance standard series IEC 61753 (all parts).

4.3.5 Measurements

4.3.5.1 Measurement method

The size measurement method to be used shall be specified in the specification for dimensions which are specified within a total tolerance zone of 0,01 mm (0,000 4 in) or less.

4.3.5.2 Reference components

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

4.3.5.3 Gauges

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

4.3.6 Test reports

Test reports shall be prepared for each test conducted. The reports shall be included in the qualification approval report and in the periodic inspection report.

Test reports shall contain the following information as a minimum:

– title of test and date;
– specimen description, including the type of fibre. The description shall also include the variant identification number (see 4.8.1);
– 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.

4.3.7 Instructions for use

Instructions for use shall be given by the manufacturer and shall consist of:

– assembly and termination instructions;
– cleaning method;
– additional information as necessary.

4.4 Standardization system

4.4.1 Interface standards

Interface standards provide both manufacturer and user with all the information required to manufacture or use the product in conformity with the physical features foreseen by that standard interface. Interface standards fully define and dimension the features essential for the mating and unmating of optical fibre connectors and other components. They also serve to position the optical datum target, where defined, relative to other reference data.

Interface standards ensure that connectors and adaptors complying with the standard 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 adaptor interface dimensions. The use of these dimensions combined with those of a standard plug provides the designer with assurance that standard plugs will fit into the optical device mount. They also provide the location of the plug optical datum target.

Standardised interface dimensions do not, by themselves, guarantee optical performance. They guarantee connector mating at a specified fit. Optical performance is ensured by compliance with the requirements of the optical interface standard series. Products from the same or different manufacturing specifications using the same standard interface will always fit together. A guarantee of performance can be given by any individual manufacturer only for products delivered according to the same manufacturing specification. However, it can be reasonably expected that a certain level of performance will be obtained by mating products from different manufacturing specifications, although this level of performance cannot be expected to be any better than that of the lowest specified performance.

4.4.2 Performance standards

Performance standards contain a series of test and measurements sets (which, depending on the requirements of the standard, may or may not be grouped into a specified schedule) with clearly defined conditions, severities and pass/fail criteria. The tests are intended to be run on a “one-off” basis to prove the ability of a given product to satisfy the “performance standards” requirement. Each performance standard has a different set of tests, and/or severities (and/or groupings) and represents the 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 that standard, but should then be controlled by a quality assurance/ quality conformance programme.

A key point of the performance standards is the selection of tests and severities from the tests and measurements standards, for application in conjunction with interface standards on inter-product compatibility (this particularly relates to attenuation and return loss). The certain conformance of each individual product to this standard will be ensured.

4.4.3 Optical interface standards

An optical interface standard is a multi-part collection of the physical and mechanical requirements necessary in order to comply with the optical functionality specifications for a defined interface between two optical fibres. It consists of those essential features that are functionally critical to the optical attenuation and return loss performance of an optical interface in the mated condition. The standard defines the location of the fibre core in relation to the datum target and the following key parameters: lateral offset, end face separation, end face angle, end face high index layer condition. It also defines standardised test methods where appropriate.

Each interface contains the essential information to ensure that products conforming to the standard will work together repeatedly to a known level of optical performance without the need for compatibility testing or cross checking.

The two basic performance parameters that characterise the optical interface are attenuation and return loss. Each parameter places different physical constraints on the optical interface. Environmental conditions also affect the performance of the optical interface and it may require definition of physical and mechanical requirements to ensure that the performance specified is maintained over the environmental extremes defined in a particular performance standard.

Manufacturing materials and processes also affect the optical interface and therefore the standard has been designed to allow manufacturers to demonstrate compliance with the standard while still permitting the maximum of manufacturing differentiation. The relationship between and suitability of materials specified in Part 3 documents of IEC 61755 series, for different performance categories as specified in IEC 61753-1 shall be defined, e.g. zirconia ferrule material can be applied in all environmental categories, while the polymer material specified for some rectangular ferrules may only be applicable for category C.

Optical interface standards define sets of prescribed conditions, which must be maintained in order to satisfy the requirements for the attenuation and return loss performance in a randomly mated pair of fibres of the same type.

4.4.4 Reliability documentation

Reliability documentation is 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 should be identified (and appear in the reliability documentation):

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

These are all related to environmental and material aspects.

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

Screening is an optional part of the manufacturing process, rather than a test method. It will 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 a specifically defined threshold. At this point the useful life of the component ends and the “wear-out region” begins: the component has to be replaced.

At the beginning of the 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 a 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 at a specified maximum failure rate. These tests are usually carried out by applying performance testing, but increasing duration and severity to accelerate the failure mechanisms.

A reliability theory relates component reliability testing to component parameters and to lifetime or failure rate under testing. The theory then extrapolates these parameters to lifetime 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.

4.4.5 Interlinking

The standards relevant to fibre optic connectors are given in Figure 1. A large number of test and measurements standards are already in place. The quality assurance/qualification approval standards produced under the banner of the IECQ have already been in place for many years.

With regard to interface, performance optical interface and reliability standards, the matrix given in Figure 2 demonstrates some of the options available for product standardization once all the standards are in place.

Product A is fully IEC standardized, having a standard interface and meeting defined optical interface performance and reliability requirements.

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

Product C is a product with a proprietary interface, which meets defined IEC optical interface and performance standards but does not comply with reliability requirements.

Product D is a product which complies with an IEC standard interface which complies with the IEC optical interface standard but does not meet the requirements of either an IEC performance standard or reliability documentation.

Product E is a product which complies with both an IEC standard interface and a performance standard, but does not meet the optical interface or reliability requirements.

Obviously the matrix is more complex than that shown in Table 3, since a number of interface, performance and reliability documents will be able to be cross-related. In addition, the products may all be subject to a quality assurance programme that could be conducted under IEC approval, or even under a national or company quality assurance system.

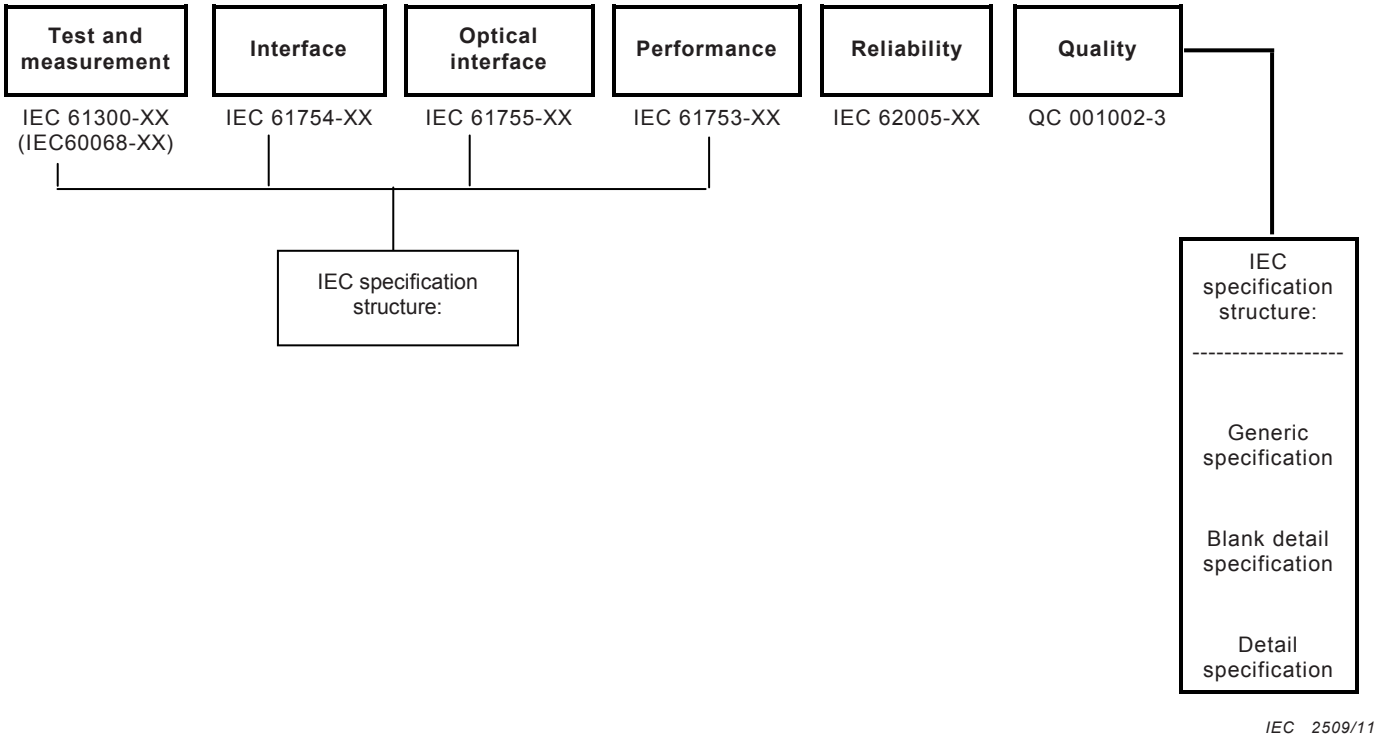


Figure 1 – Standardization structure

Table 3 – Standards interlink matrix

	Interface standard	Optical interface Standard	Performance standard	Reliability documentation
Product A	YES	YES	YES	YES
Product B	NO	YES	YES	YES
Product C	NO	YES	YES	NO
Product D	YES	YES	NO	NO
Product E	YES	NO	YES	NO

4.5 Design and construction

4.5.1 Materials

4.5.1.1 Corrosion resistance

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

4.5.1.2 Non-flammable materials

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

4.5.2 Workmanship

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

4.6 Quality

Connector set components shall be controlled by an appropriate quality assessment procedure. The measurement and test procedures of the IEC 61300 standards shall be used, as applicable, for quality assessment.

4.7 Performance

Connector sets shall meet the performance requirements specified in the relevant specification.

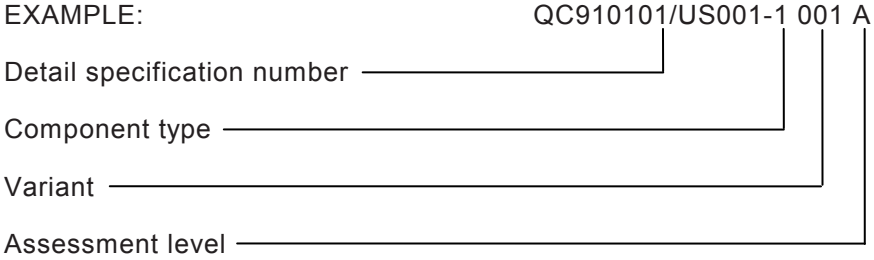
4.8 Identification and marking

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

4.8.1 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 dash number and a letter designating the assessment level. The first digit of the dash 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: QC910101/US001-1 001 A



4.8.2 Component marking

Components, associated hardware and packages shall be permanently and legibly identified and marked when required by the relevant specification. The preferred order of marking is as follows:

a) manufacturer’s identification mark;

b) manufacturing date code;

c) manufacturer’s part number;

d) variant identification number.

4.8.3 Package marking

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

a) manufacturer’s identification mark;

b) manufacturer’s part number;

c) manufacturing date code (year/week, see ISO 8601);

d) variant identification number(s) (see 4.8.1);

e) type name (see 4.2.2);

f) assessment level;

g) any additional marking required by the relevant 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.

4.9 Packaging

Packages shall include instructions for use when required by the specification (see 4.3.7).

4.10 Storage conditions

Where short-term degradable materials, such as adhesives, are supplied with the package of connector parts, the manufacturer shall mark these with the expiry date (year and week numbers, see ISO 8601) together with any requirements or precautions concerning safety hazards or environmental conditions for storage.

4.11 Safety

Optical fibre connectors, when used on an optical fibre transmission system and/or equipment, may emit potentially hazardous radiation from an uncapped or unterminated output port or fibre end.

The connector manufacturers shall make available sufficient information to alert system designers and connector users about the potential hazard and shall indicate the required precautions and working practices.

In addition, each relevant specification shall include the following:

WARNING NOTE

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

Reference shall be made to IEC 60825-1, the relevant document on safety.

Bibliography

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

IEC 60874, (all parts), *Connectors for optical fibres and cables*

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