

INTERNATIONAL STANDARD

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QC 840000

First edition
2001-12

Fibre optic filters – Generic specification

*Filtres à fibres optiques –
Spécification générique*



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CONTENTS

FOREWORD.....	3
INTRODUCTION.....	4
1 Scope.....	5
2 Normative references	5
3 Definitions	6
4 Requirements	8
4.1 Classification.....	8
4.2 Documentation	11
4.3 Standardisation system	14
4.4 Design and construction	16
4.5 Quality.....	16
4.6 Performance requirements	16
4.7 Identification and marking.....	16
4.8 Packaging	17
4.9 Storage conditions.....	17
4.10 Safety.....	18
5 Quality assessment procedures	18
5.1 Primary stage of manufacture.....	18
5.2 Structurally similar components	18
5.3 Qualification approval procedures	18
5.4 Quality conformance inspection.....	20
5.5 Certified record of released lots.....	21
5.6 Delayed deliveries	22
5.7 Delivery release before completion of group B tests	22
5.8 Alternative test methods	22
5.9 Unchecked parameters.....	22
Table 1 – The IEC specification structure.....	12
Table 2 – Standards interlink matrix.....	16
Table 3 – Quality assurance options	16

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC FILTERS –
Generic specification**
FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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International Standard IEC 61977 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

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

FDIS	Report on voting
86B/1603/FDIS	86B/1637/RVD

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 3.

The QC number that appears on the front cover of this publication is the specification number in the IEC Quality Assessment System for Electronic Components (IECQ).

The committee has decided that the contents of this publication will remain unchanged until 2008. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This standard is divided into three elements.

The first element, made up of clauses 1 to 3, contains general information which pertains to this standard.

The second element, consisting of clause 4, Requirements, contains all requirements which should be met by fibre optic filters covered by this standard. Requirements for classification, the IEC specification system, documentation, materials, workmanship, quality, performance, identification, and packaging are covered.

The third element, composed of clause 5, Quality assessment procedures, contains all of the procedures which must be followed for proper quality assessment of products covered by this standard.

FIBRE OPTIC FILTERS – Generic specification

1 Scope

IEC 61977 applies to the family of fibre optic filters. These components have all of the following general features:

- they are passive for the reason that they contain no optoelectronic or other transducing elements which can process the optical signal launched into the input port;
- they modify the spectral intensity distribution in order to select some wavelengths and inhibit others;
- they are fixed, i.e. the modification of the spectral intensity distribution is fixed and can not be tuned;
- they have a maximum of two ports for the transmission of optical power; the ports are optical fibre or optical fibre connectors;
- they differ according to their characteristics. They can be divided into the following categories:
 - short-wave pass (only wavelengths lower than or equal to a specified value are passed);
 - long-wave pass (only wavelengths greater than or equal to a specified value are passed);
 - band-pass (only an optical window is allowed);
 - notch (only an optical window is inhibited).

It is also possible to have a combination of the above categories.

This standard establishes uniform requirements for the following:

- optical, mechanical and environmental properties;
- measurement and test procedures for quality assessment.

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.

IECQ 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*

IECQ 001002 (all parts), *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure*

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

IEC 60050(731):1991, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60617 (all parts), *Graphical symbols for diagrams*

IEC 60695-2-2:1991, *Fire hazard testing – Part 2: Test methods – Section 2: Needle-flame test*

IEC 60825-1:1993, *Safety of laser products – Part 1: Equipment classification, requirements and user's guide*

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

ISO 129:1985, *Technical drawings – Dimensioning – General principles, definitions, methods of execution and special indications*

ISO 286-1:1988, *ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits*

ISO 1101:1983, *Technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indications on drawings*

ISO 8601:2000, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Definitions

For the purposes of this standard the definitions given in IEC 60050(731) and the following apply.

3.1

fibre optic filter

a passive component used in fibre optic transmission to modify the spectral intensity distribution of a signal in order to pass some wavelengths and block some others

3.2

port

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

3.3

unidirectional fibre optic filter

a fibre optic filter whose specified filtering action is in one direction only or requires designation of its input and output ports

3.4

bidirectional fibre optic filter

a fibre optic filter in which each port may be used either as an input or output port

3.5

transmitting type fibre optic filter

a fibre optic filter in which the input and output ports are different

3.6

reflecting type fibre optic filter

a fibre optic filter in which the input and output ports are coincident

3.7

operating wavelength

a nominal wavelength λ_h , at which a fibre optic filter operates with the specified performances

3.8**operating wavelength range, bandpass**

the specified range of wavelengths from λ_{hmin} to λ_{hmax} around the operating wavelength λ_h , within which a fibre optic filter operates with the specified performances

3.9**isolation wavelength**

a nominal wavelength λ_k (where $\lambda_h \neq \lambda_k$), that is nominally suppressed by a fibre optic filter

3.10**isolation wavelength range, stopband**

the specified range of wavelengths from λ_{kmin} to λ_{kmax} around the isolation wavelength λ_k , that are nominally suppressed by a fibre optic filter

3.11**attenuation**

the reduction of optical power, when transmitted between the ports of a two-port fibre optic filter expressed in decibels. It is defined as:

$$a = -10 \log (P_{out}/P_{in})$$

where

P_{in} is the optical power launched into one of the two ports;

P_{out} is the optical power received from the other port.

The attenuation is a function of wavelength

3.12**transmittance**

the percentage of optical power transmitted by the filter at the operating wavelength

3.13**return loss**

the fraction of input power that is returned from a port of a fibre optic filter expressed in decibels. It is defined as:

$$RL = -10 \log (P_{refl}/P_{in})$$

where

P_{in} is the optical power launched into the port;

P_{refl} is the optical power received back from the same port.

The return loss is a function of wavelength

3.14**reflectance**

the percentage of optical power reflected by the filter at the operating wavelength

3.15**X dB-bandwidth**

a) for transmitting-type fibre optic filters: defined through the spectral dependence of the attenuation as the minimum wavelength range about the operating wavelength λ_h within which the variation of the attenuation is less than "X" dB; the minimum wavelength range is determined considering the worst case shift due to temperature operating range and polarisation;

b) for reflecting-type fibre optic filters: defined through the spectral dependence of the return loss as the minimum wavelength range about the operating wavelength λ_h within which the variation of the return loss is less than "X" dB. The minimum wavelength range is determined considering the worst case shift due to temperature operating range and polarisation.

3.16

free spectral range

in the case of a periodic spectral response of a fibre optic filter, the difference between two adjacent operating wavelengths

3.17

spectral ripple (flatness)

the maximum peak-to-peak variation in attenuation (for transmitting-type fibre optic filter) or return loss (for reflecting-type fibre optic filter) over the bandpass

3.18

maximum slope of spectral ripple

the maximum value in module of the derivative of the attenuation (for transmitting-type fibre optic filter) or return loss (for reflecting-type fibre optic filter) as a function of wavelength over the bandpass

3.19

polarization dependent loss (PDL)

the maximum variation of attenuation over all the polarization states

3.20

polarization mode dispersion (PMD)

the maximum differential delay for all the polarization states of signals when they pass through a filter

4 Requirements

The requirements for filters covered by this section are intended to aid in classifying a filter in a detail specification.

4.1 Classification

Filters are classified either totally or in part by the following categories:

- type;
- style;
- variant;
- environmental category;
- assessment level;
- normative reference extensions.

An example of a typical filter classification is as follows:

Type	Fixed
Style	– Configuration C – Fibre type: IEC type A1a – SC connector
Variant	Means of mounting
Assessment level	A

4.1.1 Type

The optic filter type shall be defined by its intended function and optical performance. There are several types of filters, for instance:

- low pass filter (LPF);
- band pass filter (BPF);
- high pass filter (HPF);
- "notch".

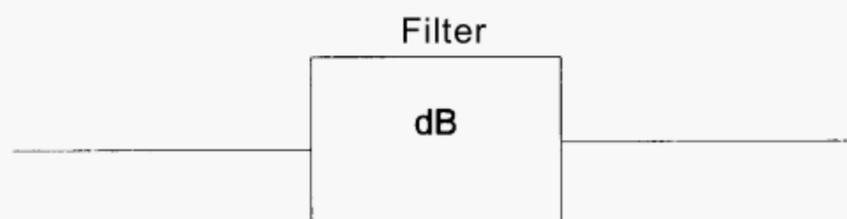
4.1.2 Style

The optic filter style shall be defined on the basis of the following elements:

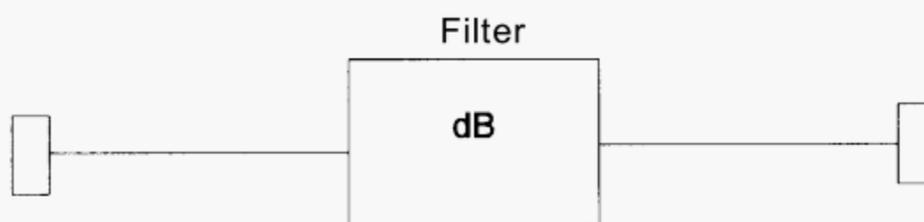
- the input and output port configuration;
- the connector set type(s), if any.

The four different input and output configurations can be scheduled as follows:

Configuration A – a device containing integral fibre optic pigtailed without connectors.



Configuration B – a device containing integral fibre optic pigtailed, with a connector on each pigtail.



Configuration C – a device containing fibre optic connectors as an integral part of the device housing.



Configuration D – a device containing some combination of the interfacing features of the preceding configurations.

4.1.3 Variant

The optic filter variant defines the feature that identifies the variety of structurally similar components. Examples of feature variables which create variants are:

- cable type;
- fibre type;
- housing;
- orientation of ports;
- means of mounting.

4.1.4 Environmental category

Various environmental categories are given in the blank detail specifications associated with this document, these define the test sequences needed for quality assurance.

Detail specification writers may add tests and/or groups of tests to a particular environmental category.

However, the detail specification writer shall not remove tests nor alter the sequence of an environmental category standard.

When a detail specification writer adds tests to a specified category, the environmental category shall be given a plus (+) designation.

Example:

- environmental category ii +
- environmental category v +

The blank detail specification for environmental category 99 is available for use where the category standards are not suitable.

4.1.5 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 II, QL = 4 %
- Group B inspection: inspection level II, AQL = 4 %
- Group C inspection: 24-month periods
- Group D inspection: 48-month periods

Assessment Level B:

- Group A inspection: inspection level II, AQL = 1 %
- Group B inspection: inspection level II, AQL = 1 %
- Group C inspection: 18-month periods
- Group D inspection: 36-month periods

Assessment level C:

- Group A inspection: inspection level II, AQL = 0,4 %
- Group B inspection: inspection level II, AQL = 0,4 %
- Group C inspection: 12-month periods
- Group D inspection: 24-month periods

One additional assessment level may be added in the detail specification. When this is done, the capital letter X shall be used.

4.1.6 Normative reference extensions

Normative reference extensions are used to identify independent standards specifications or other reference documents integrated 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 integrated functional application requirements that are dependent on technical expertise other than fibre optics.

Published reference documents produced by the International Telecommunication Union (ITU), consistent with the scope statements of the relevant IEC specification series may be used as an extension. Published documents produced by other regional standardisation bodies such as the Telecommunications Industry Association (TIA), the European Telecommunications Standards Institute (ETSI), Japanese Industrial Standards (JIS) etc, may be referenced in a bibliography attached to the generic.

Some optical fibre filter configurations require special qualification provisions which shall not be imposed universally. This accommodates individual component design configurations, specialised field tooling, or specific application processes. In this case requirements are necessary to guarantee 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 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, in descending order, shall be generic over mandatory extension, over blank detail, over detail, over application specific extension.

The following is an example of an optical connector extension:

- Using IEC 61754-4 and IEC 61754-2 to partially define a future IEC 60874-XX specification for a duplex type "SC/BFOC/2,5" hybrid connector adapter.

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.

4.2 Documentation

4.2.1 Symbols

Graphical and letter symbols shall, whenever possible, be taken from IEC 60027, IEC 60617 and IEC 61748 unless superseded by this specification.

4.2.2 Specification system

This specification is part of the 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 filters.

Table 1 – The IEC specification structure

Specification level	Examples of information to be included	Applicable to
Basic	Assessment system rules Inspection rules Optical measurement methods Sampling plans Identification rule Marking standards Dimensional standards Terminology Symbol 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

4.2.2.1 Blank detail specification

The blank detail specification lists all of the parameters and features applicable to a filter including the type, operating characteristics, housing configurations, test methods and performance requirements. The blank detail specification is applicable to any filter design and quality assessment requirement. The blank detail specification contains the preferred format for stating the required information in the detail specification.

4.2.2.2 Detail specification

A specific fibre optic filter is described by a corresponding detail specification, which is prepared by filling in the blanks of the detail specification.

Detail specifications shall specify the following as applicable:

- type (see 4.1.1);
- optic filter style (see 4.1.2);
- variant(s) (see 4.1.3);
- variant identification number(s) (see 4.7.1);
- climatic category (see 4.1.4);
- all tests required (see 4.1.5 and 5.3);
- assessment level (see 4.1.5);
- qualification procedure method (see 5.3);
- performance requirements (see 4.6).

4.2.3 Drawings

The drawings and dimensions given in the detail specifications shall not restrict detail construction nor be used as manufacturing drawings.

4.2.3.1 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.

4.2.3.2 Dimensional system

All dimensions shall be given in accordance with ISO 129, ISO 286 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 detail specification.

4.2.4 Test and measurements

4.2.4.1 Test and measurement procedures

The test and measurement procedures for optical, mechanical, climatic and environmental characteristics of filters to be used shall be defined and selected preferentially from IEC 61300 series standards. The size measurement method to be used shall be specified in the detail specification for 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 detail specification.

4.2.4.3 Gauges

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

4.2.5 Test report

The test report shall be prepared for each test conducted as required by a detail specification. The data sheets shall be included in the qualification report (see 5.3.9) and in the periodic inspection report (see 5.4.2).

Data sheets shall contain the following information as a minimum:

- title and date of test;
- specimen description including the variant identification number (see 4.7.1);
- test equipment used;
- all applicable test details;
- all measurement values and observations;
- sufficiently detailed documentation to provide traceable information for failure analysis (see 5.3.7 and 5.4.2.5).

4.2.6 Instructions for use

Instructions for use, when required, shall be given by the manufacturer.

4.3 Standardisation system

4.3.1 Interface standards

Interface standards provide both manufacturers and users with all the information they require to make or use products conforming to the physical features of 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 adapters 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 plugs' 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 by mating products from different manufacturing specifications, although the level of performance can not be expected to be any better than that of lower specified performance.

4.3.2 Performance standard

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 "one-off" basis to prove the ability of any products to satisfy the "performance standards" requirement. Each performance standard has a different set of tests, and/or severities (and/or groupings) representing 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 a performance standard but should then be controlled by a quality assurance / quality conformance programme.

A key point of the test and measurements standards, for the application of these (particularly with regard to attenuation and return loss) in conjunction with the interface standards of inter-product compatibility, may be able to be defined. Certainly conformance on each individual product to this standard will be ensured.

4.3.3 Reliability standard

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 become standard):

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

These are all related to environmental and material aspects.

There is an initial "infant mortality phase" just after component manufacturing, 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 and humidity related. This is to induce known failure mechanisms in a controlled environmental situation to occur earlier than would normally be seen in the 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 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 some defined threshold. At this point the useful life ends and the "wear-out region" 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 specified maximum failure rate. These tests are usually done by utilising the performance testing, but increasing its duration and severity, in order 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 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.

4.3.4 Interlinking

A large number of the test and measurement standards are already in place; the quality assurance qualification approval standards which come under the banner of IECQ are already in place and have been for many years. As previously mentioned, alternative methods of quality assurance/quality conformance are being developed other than those of capability approval and technology approval, which are covered by IECQ 001001, IECQ 001002, and IEC guide 102.

With regard to interface, performance and reliability standards, once all these three standards are in place, the matrix given in table 2 demonstrates some of the other options available for product standardisation.

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

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

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

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

Obviously the matrix is more complex than shown since there will be a number of interface, performance and reliability standards which will be able to be cross-related. In addition, the products may all be subjected to a quality assurance programme that could be under IEC Qualification Approval, Capability Approval, Technology Approval (as table 3 attempts to demonstrate), or even under a national or company quality assurance system.

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 A			COMPANY A		
	QA	CA	TA	QA	CA	TA	QA	CA	TA
Product A	X			X					X
Product B	X				X				X
Product C	X				X				X
Product D	X					X			X

4.4 Design and construction

4.4.1 Materials

The devices shall be manufactured with materials which meet the requirements of the detail specification.

When non-flammable materials are required, the requirement shall be specified in the detail specification, and IEC 60695-2-2 shall be referenced.

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 would affect life, serviceability or appearance. Particular attention shall be given to neatness and thoroughness of marking, plating, soldering, bonding, etc.

4.5 Quality

Filters shall be controlled by the quality assessment procedures of clause 5. The measurement and test procedures of clause 5 shall be used, as applicable, for quality assessment.

4.6 Performance requirements

Filters shall meet the performance requirements specified in the detail specification.

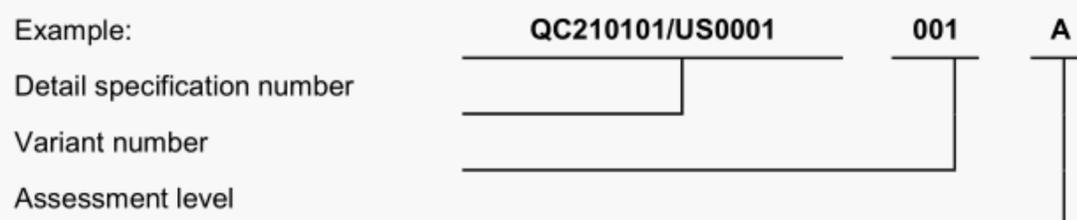
4.7 Identification and marking

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

4.7.1 Variant identification number

Each variant in a detail specification shall be assigned a variant identification number; this number shall be set out as follows:

Example:



4.7.2 Component marking

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

- 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.

4.7.3 Package marking

Several devices may be packaged together for shipment.

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

- 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 4.7.1);
- e) the assessment level;
- f) the type designations (see 4.1.1);
- g) environmental category;
- h) 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 Packaging

Packages shall include instructions for use when required by the specification (see 4.2.6).

4.9 Storage conditions

Where short-term degradable materials, such as adhesives, are supplied with the package, 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.

4.10 Safety

Optical filters, 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 optical filter manufacturers shall provide 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 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, the relevant document on safety.

5 Quality assessment procedures

Procedures for quality assessment and release of components consist of:

- qualification approval procedures (see 5.3);
- quality conformance inspection (see 5.4).

5.1 Primary stage of manufacture

The primary stage of manufacture of a passive fibre optic component is the earliest point in the manufacturing process at which the component is completely defined by the detail specification. Subcontracting of the primary stage and subsequent stages is permitted under the terms of IECQ 001002.

5.2 Structurally similar components

Structurally similar components are those components that may be grouped together within a common detail specification for the purpose of qualification approval and quality conformance inspection. Passive components are considered structurally similar for the purpose of sampling inspection if they are:

- produced by one manufacturer with essentially the same design, materials, process and method;
- constructed such that the results of any required test carried out on one of these components can be regarded as valid for the other components.

The specific grouping of structurally similar components for the purpose of qualification approval and quality conformance testing shall be approved by the national supervising inspectorate (refer to IECQ 001002).

5.3 Qualification approval procedures

Qualification approval procedures are specified herein, and in the detail specification.

Manufacturers shall:

- comply with the general requirements of clause 11 of IECQ 001002;
- produce test evidence showing successful completion of the qualification test procedures.

5.3.8 Maintenance of qualification approval

Qualification approval shall be maintained for components by continuously submitting them to the quality conformance requirements as specified in 5.4.

Qualification approval shall be verified if any of the following conditions exist:

- the production programme is such that the periodic tests cannot be carried out at the specified frequency;
- the conformity of the components to the initial qualification approval is doubtful. For example, technical modifications may potentially change the performance of the component;
- a change has been made to the specification.

Qualification approval shall be verified by the procedures defined in 11.5.3 and 11.5.4 of IECQ 001002.

5.3.9 Qualification report

Qualification testing results shall be recorded in a qualification approval report in accordance with 11.3 of IECQ 001002.

5.4 Quality conformance inspection

Quality conformance inspection consists of the lot-by-lot and periodic inspections specified herein and in the detail specification. Manufacturers shall comply with the general requirements of the rules and procedures governing quality conformance inspection of components in accordance with 12.3 of IECQ 001002. Lot-by-lot and periodic inspection schedules shall specify the groupings and be established in accordance with 12.3 of IECQ 001002.

5.4.1 Lot-by-lot inspection

Lot-by-lot inspection consists of subjecting a sample of specimens to the group A and B tests specified in the detail specification. Specimens shall be drawn from each inspection lot in accordance with the specified sampling plan. They shall be drawn in a random fashion from current production.

5.4.1.1 Formation of inspection lots

An inspection lot may consist of one production lot or of several lots which have been aggregated under the following safeguards:

- inspection lots shall consist of structurally similar production lots (see 5.2);
- the period over which the production lots were aggregated shall not exceed one month.

The plan for the aggregation of production lots into inspection lots shall be approved by the national supervising inspectorate.

5.4.1.2 Rejected lots

Specimens found to be defective during lot-by-lot testing shall be treated in accordance with 12.4.1 of IECQ 001002. Rejected lots may be reworked to correct the defects or to screen them out. The reworked lot shall then be submitted for re-inspection using tightened inspection. They shall be separated from new lots and shall be clearly identified as re-inspected lots.

5.4.2 Periodic inspection

Periodic inspection consists of subjecting a sample of specimens to the group C and D tests specified in the detail specification. Each group shall be conducted at the period specified for the relevant assessment level (see 4.1.5). The periods shall be maintained relative to each other so that the group D inspection replaces the group C inspection at the group D period. Periodic inspection specimens shall meet the performance requirements given in the detail specification.

5.4.2.1 Periodic inspection specimen

The periodic inspection specimen shall be a complete filter. The specimens shall be the same variants which were used for qualification. The specimens being inspected shall be units produced with equipment and procedures used in current production.

5.4.2.2 Sample size

The sample size for periodic inspection shall be specified in the detail specification. The specimens shall be representative of the range of devices to be inspected. The specimens shall be selected from inspection lots which satisfied the lot-by-lot inspections of 5.4.1 during the time since the previous periodic inspection. Following completion of the group "C0" or "D0" tests, the specimens for the other groups shall be randomly selected from the group "C0" or "D0" specimens.

5.4.2.3 Preparation of specimens

The preparation of specimens is the same as that specified in 5.3.5.

5.4.2.4 Periodic inspection

Periodic inspection specimens shall meet the performance requirements given in the detail specification.

5.4.2.5 Periodic inspection failures

Failures shall be treated according to the procedures of 5.3.7. If a specimen fails to satisfy the requirements of a periodic test, the manufacturer's chief inspector shall immediately initiate the requirements of 12.6 of IECQ 001002. One or more unresolved failures shall be cause to withdraw qualification approval.

5.4.2.6 Periodic inspection report

Periodic testing results shall be maintained in accordance with the requirements of 12.4.2 of IECQ 001002.

5.5 Certified record of released lots

The detail specifications shall specify if a certified record of released lots is required. When required, the record shall be prepared in accordance with clause 14 of IECQ 001002 and contain the following information as a minimum:

- attribute information (i.e. number of components tested and number of defective components) for tests in the subgroups covered by periodic inspection, without reference to the parameter for which rejection was made;
- variable information for the change of any optical performance parameter after any environmental test.

5.6 Delayed deliveries

Released components which have been in storage for a period longer than two years following the release of the lot shall be re-examined before delivery. The re-examination procedure shall be recommended by the manufacturer and be approved by the national supervising inspectorate. Re-inspected products may be placed back into stores for another specified period.

5.7 Delivery release before completion of group B tests

When the conditions of IEC 60410 for changing to reduced inspection have been satisfied for all group B tests, the manufacturer is permitted to release components before completion of these tests.

5.8 Alternative test methods

Alternative test methods to those specified in the detail specification may be used. However, the manufacturer shall satisfy the national supervising inspectorate that the alternative method will give results equivalent to those obtained by the methods specified. In case of dispute, only the test method specified in the detail specification shall be used.

5.9 Unchecked parameters

Only those component parameters which have been specified in a detail specification and which were tested can be assumed to be within the specified limits. It should not be assumed that unspecified parameters will be uniform and unchanged from one component to another. If it should be necessary to control parameters other than those specified, a new, more extensive detail specification shall be written and used. The additional test method(s) shall be described, and appropriate performance limits and assessment levels specified.



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