

**Harmonized system of quality
assessment for electronic components**

Generic Specification — Connector sets for optical fibres and cables —

**Part 1: Requirements, test methods and
qualification approval procedures**

The European Standard EN 186000-1:1993 has the status of a
British Standard

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National foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Policy Committee and is the English language version of EN 186000-1:1993 *Generic Specification: Connector sets for optical fibres and cables — Part 1: Requirements, test methods and qualification approval procedures*, published by the Electronic Components Committee (CECC) of the European Committee for Electrotechnical Standardization (CENELEC). It is identical with CECC 86000:1992.

BS EN 186000-1 supersedes BS 9230:1986, which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 94, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Descriptors: Quality, electronic components, connector sets, optical fibres, optical cables

English version

Generic Specification:
Connector sets for optical fibres and câbles
Part 1: Requirements, test methods and qualification
approval procedures

Spécification Générique:
Jeux de connecteurs pour fibres et câbles
optiques
Partie 1: Exigences, méthodes d'essais et
procédures d'homologation

Fachgrundspezifikation:
Steckverbindersätze für Lichtwellenleiter und
Lichtwellenleiterkabel
Teil 1: Anforderungen, Prüfverfahren und
Bauartzulassungsverfahren

This European Standard was approved by the CENELEC Electronic Components Committee (CECC) on 26 March 1993. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. The membership of the CECC is identical, with the exception of the national electrotechnical committees of Greece, Iceland and Luxembourg.

CECC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The CENELEC Electronic Components Committee (CECC) is composed of those member countries of the European Committee for Electrotechnical Standardization (CENELEC) who wish to take part in a harmonized System for electronic components of assessed quality.

The object of the System is to facilitate international trade by the harmonization of the specifications and quality assessment procedures for electronic components, and by the grant of an internationally recognized Mark, or Certificate, of Conformity. The components produced under the System are thereby acceptable in all member countries without further testing.

This European Standard was prepared by CECC WG 26, Fibre Optic Connectors.

The text of the draft based on document CECC 86000-1 Issue 1:1992 was submitted to the formal vote for conversion to a European Standard; together with the voting report, circulated as document CECC (Secretariat) 3306 it was approved by CECC as EN 186000-1 on 26 March 1993.

The following dates were fixed:

- latest date of announcement of the EN at national level (doa) 1993-08-08
- latest date of publication of an identical national standard^a (dop) 1994-02-08
- latest date of withdrawal of conflicting national standards^a (dow) 1995-02-08

^a National standard (excluding national implementation of IECQ specifications).

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Foreword

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The object of the System is to facilitate international trade by the harmonization of the specifications and quality assessment procedures for electronic components, and by the grant of an internationally recognized Mark, or Certificate, of Conformity. The components produced under the System are thereby acceptable in all member countries without further testing.

This specification has been formally approved by the CECC, and has been prepared for those countries taking part in the System who wish to issue national harmonized specifications for CONNECTOR SETS FOR OPTICAL FIBRES AND CABLES. It should be read in conjunction with the current regulations for the CECC System.

At the date of printing of this specification, the member countries of the CECC are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom, and copies of it can be obtained from the addresses shown on the blue fly sheet.

Preface

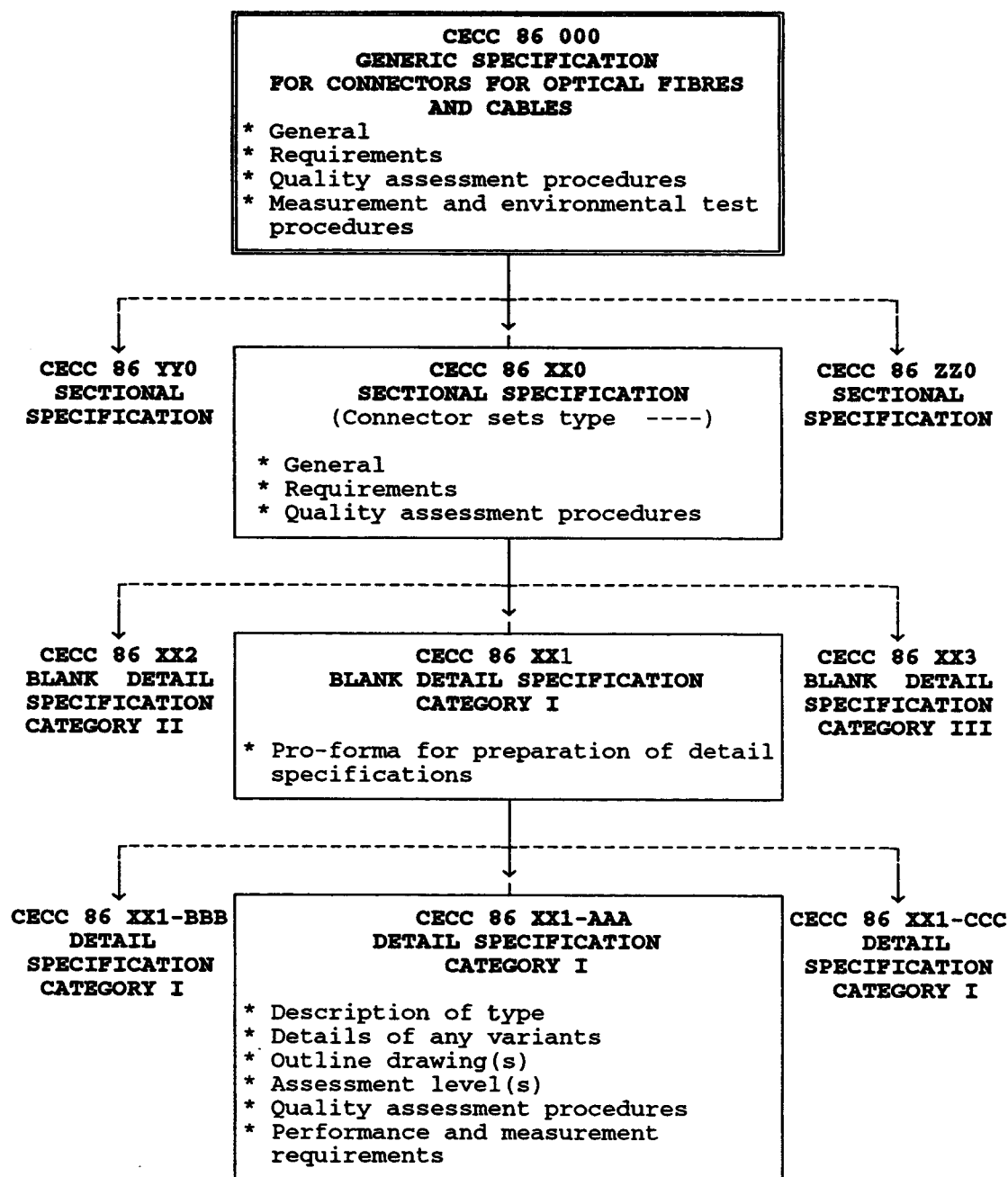
This specification was prepared by CECC WG 26.

It is based, wherever possible, on the Publications of the International Electrotechnical Commission, and in particular on IEC 874-1.

The text of this specification was circulated to the CECC for voting in the document listed below and was ratified by the President of the CECC for printing as a CECC Specification.

<u>Document</u>	<u>Date of Voting</u>	<u>Report on the Voting</u>
CECC (Secretariat) 2518	May 1990	CECC (Secretariat) 2663

CECC SPECIFICATION SYSTEM



NOTE A detail specification is a "completed" blank detail specification.

Section 1. General

1 General

1.1 Scope

This specification applies to fibre optic connector sets for optical fibres and cables. It includes

- connector set requirements
- measurement and test procedures for quality assessment of both connector sets and their individual components, such as adaptors, plugs and sockets.

1.2 Related documents

The following standards contain provisions which, through reference in this text, constitute provisions of this specification. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this specification are encouraged to apply the most recent editions of the referenced standards. Members of CECC, IEC and ISO maintain registers of currently valid international standards.

References made to a specific clause or sub-clause of a standard include all sub-clauses to the reference unless otherwise specified.

CECC 00 114-I, RP14-I:1990, *Approval of manufacturers and other organizations.*

CECC 00 114-II, RP14-II:1991, *Qualification approval of electronic components.*

IEC 27:1971, *Letter symbols to be used in electrical technology.*

IEC 68-1:1982, *Basic environmental testing procedures — Part 1: General and guidance.*

IEC 68-2-1:1974, *Tests A: Cold.*

IEC 68-2-2:1974, *Tests B: Dry heat.*

IEC 68-2-3:1969, *Test Ca: Damp heat, steady state.*

IEC 68-2-5:1975, *Test Sa: Simulated solar radiation at ground level.*

IEC 68-2-6:1982, *Test Fc and guidance: Vibration (sinusoidal).*

IEC 68-2-7:1983, *Test Ga and guidance: Acceleration, steady state.*

IEC 68-2-9:1975, *Guidance for solar radiation testing.*

IEC 68-2-10:1984, *Test J: Mould growth.*

IEC 68-2-11:1981, *Test Ka: Salt mist.*

IEC 68-2-13:1983, *Test M: Low air pressure.*

IEC 68-2-14:1984, *Test N: Change of temperature.*

IEC 68-2-17:1978, *Test Q: Sealing.*

IEC 68-2-27:1972, *Test Ea: Shock.*

IEC 68-2-29:1968, *Test Eb: Bump.*

IEC 68-2-30:1980, *Test Db and guidance: Damp heat, cyclic (12 + 12 hours).*

IEC 410:1973, *Sampling plans and procedures for inspection by attributes.*

IEC 617, *Graphical symbols for diagrams.*

IEC 695-2-2:1980, *Fire hazard tests — Part 2: Test methods — needle-flame test.*

IEC 793-1:1987, *Optical fibres — Part 1: Generic specification.*

IEC 875-1:1986, *Fibre optic branching devices — Part 1: Generic specification.*

IEV 50 (731):1987, *International Electrotechnical Vocabulary, chapter 731: Optical Fibre Communication.*

ISO Standard 129, *Technical drawings — dimensioning — general principles, definitions, methods of execution and special indications.*

ISO/R 286, *ISO system of limits and fits — Part 1: General, tolerances and deviations.*

ISO Standard 1101, *Technical drawings — geometrical tolerancing — tolerancing of form, orientation, location and run-out — generalities, definitions, symbols, indications on drawings.*

ISO Standard 2015:1976, *Numbering of weeks.*

1.3 Definitions

The definitions given in IEC 73, with the following definitions, apply to this specification. They also apply to all sectional and detail specifications written to this specification. See also Annex B.

fully intermateable connector set

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

mechanically intermateable connector set

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

fibre optic connector set

all the connector components required to provide for coupling and uncoupling between two or more optical fibre cables

connector set component

that part of a connector set which can be individually specified and qualified. Examples are, plug connector, adaptor connector, socket connector and socket receptacle

counterpart component

a qualified connector set component required to complete a connector set for qualification testing of a connector set component

reference connector set

a precisely made or selected connector set of a particular type used for measurement purposes. Such a connector set may be in the form of a precision jig incorporated in the test equipment. The performance or selection criterion shall be given in the relevant specification

reference connector set component

a precisely made or selected connector set component which is used for measuring purposes (e.g. plug, adaptor, etc.). The component may be in the form of a precision jig incorporated in the test equipment

plug-adaptor-plug configuration

two plug connectors which mate through an adapter. The mechanical coupling takes place between plug connectors and the adapter. A connector set consists of two plugs and one adapter

plug-socket configuration

a connector set consisting of one plug and one socket. The mechanical coupling mechanism and optical alignment mechanism are self-contained in the two connector halves

mating face dimensions

the dimensions of the features which determine the mating fit between components of an optical connector set

connector set kit (fibre optics)

a connector set which is unterminated

connector kit (fibre optics)

an unterminated component of a connector set (a plug or an adaptor)

pigtailed connector (fibre optics)

an assembly with a plug or socket connector terminated to a length of optical fibre or cable

pigtailed connector set (fibre optics)

two pigtailed connectors with the means of coupling them together

patchcord (fibre optics)

an assembly where the cable or fibre is terminated at each end with either a plug or socket connector

patchcord connector set (fibre optics)

a patch cord and any additional connector set component necessary for measurement purposes

variant

a variation of details for a particular connector set component. Different cable entry sizes or different mounting dimensions are examples of variant

Section 2. Requirements

2 Requirements

The requirements for connector sets covered by this specification are specified herein and in the relevant specification.

2.1 Classification

Fibre optic connector sets shall be classified by the following categories:

- type
- arrangement
- style
- variant
- climatic category
- environmental category
- assessment level.

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

Example of a typical connector set classification
Type — name: type F-SMA — configuration: plug-adaptor-plug — coupling: screw thread — mating face dimensions: — plug: see Figure 2* — adapter: see Figure 4*
Arrangement — kit
Style — fibre category: IEC category A1 — fibre retention: adhesive — cable retention: crimp — optical coupling: non-butting ferrules — alignment: resilient busing
Variants — twelve plug permutations of: — fibre core sizes — 50 μm — 62,5 μm — 85 μm — cable types and sizes — tight structure, 3 mm O.D. — loose structure, 3,8 mm O.D. — coupling nut styles: — knurl — hex — two adaptor variants: — non-mountable (free hanging) — four hole flange mount
Climatic category — 55/125/21
Environmental category — II +
Assessment level: A, B, C & X

Note: *indicates figures in a hypothetical detail specification.

Figure 1 — Example of a typical connector set classification

2.1.1 *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 F-SMA
- type BAM.

Examples of configurations:

- plug-adaptor-plug configuration
- plug-socket configuration.

Examples of coupling mechanisms:

- screw thread
- bayonet
- push-pull.

2.1.2 *Arrangement*

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

Examples of connector set arrangements:

- kit arrangement
- pigtail arrangement
- patch-cord arrangement.

2.1.3 *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 ferrules
- butting ferrules
- expanded beam techniques.

Examples of alignment technologies :

- clearance fit alignment
- resilient bushing alignment
- resilient tip alignment
- spherical alignment.

2.1.4 *Variant*

The connector set variant defines the variety of structurally similar components (see 3.2).

Examples of feature variables which create variants :

- fibre type (core, cladding)
- cable types and sizes
- mounting schemes
- coupling nut designs (hex, knurl, etc.).

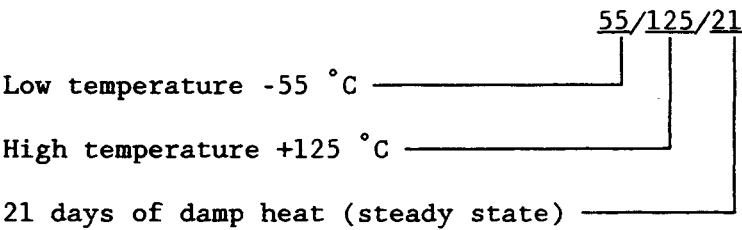
2.1.5 Climatic category

Connector sets shall be classified by climatic category. This category defines, in a generalized way, the climatic conditions of cold temperatures, hot temperatures and damp heat for which a component is suited. The components shall be subjected to, as a minimum, the environmental tests of Cold (see 4.5.17), Dry heat (see 4.5.18) and Damp heat steady state (see 4.5.19).

Climatic category shall be expressed by a series of three numbers separated by oblique strokes corresponding respectively to the temperatures, low and high, and the number of days of exposure to damp heat (steady state) to which the connector set components are assessed.

- First number: two digits denoting the minimum ambient temperature (– °C)
- Second number: three digits denoting the maximum ambient temperature (+ °C). Two digit values shall be prefixed by the digit “0”
- Third number: two digits denoting the number of days of damp heat (steady state). One (1) digit values shall be prefixed by the digit “0”

Example:



The following are preferred values which may be specified.

Low temperature (°C)	High temperature (°C)	Damp heat duration (days)
– 5	+ 30	4
– 10	+ 40	10
– 25	+ 55	21
– 40	+ 70	56
– 55	+ 85	
– 65	+ 100	
	+ 125	
	+ 155	
	+ 175	
	+ 200	

2.1.6 Environmental category

The connector set environmental category defines the test sequences used for quality assessment. Sectional specifications shall specify one or more categories.

Three preferred categories appear in Table 1, Table 2 and Table 3 as examples.

Table 1 — Test sequences for environmental category I

FIXED SAMPLE QUALIFICATION	LOT-BY-LOT INSPECTION
<u>Group 0</u> — (initialize all specimens) — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group 1</u> — (initial optical performance) — Insertion loss (see 4.4.7) <u>Group 2</u> — (climatic category) — Cold (see 4.5.17) — Dry heat (see 4.5.18) — Damp heat (steady state) (see 4.5.19)	<u>Group A</u> — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group B</u> No tests specified
<u>Group 3</u> — (evaluate construction) — Cable pulling (see 4.5.4) — Axial compression (see 4.5.11) — Cable torsion (see 4.5.5) <u>Group 4</u> — (evaluate coupling mechanism) — Strength of coupling mechanism (fastening mechanism only, see 4.5.6) — Mechanical endurance (see 4.5.32)	PERIODIC INSPECTION
	<u>Group C0</u> Same as “Group 0” of the fixed sample sequence
	<u>Group C1</u> Same as “Group 1” of the fixed sample sequence
	<u>Group C2</u> Same as “Group 2” of the fixed sample sequence <u>Group D</u> Repeat all of the fixed sample sequences

Environmental category I is the mildest category. It suggests a protected environment consisting of controlled temperature and humidity conditions and complete protection from the elements. Examples of such environments are offices and buildings with climatically controlled conditions.

Table 2 — Test sequences for environmental category II

FIXED SAMPLE QUALIFICATION	LOT-BY-LOT INSPECTION
<u>Group 0</u> — (initialize all specimens) — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group 1</u> — (initial optical performance) — Insertion loss (see 4.4.7) <u>Group 2</u> — (climatic category) — Cold (see 4.5.17) — Dry heat (see 4.5.18) — Damp heat (steady state) (see 4.5.19) <u>Group 3</u> — (evaluate construction) — Change in temperature (test Na) (see 4.5.22) — Cable pulling (see 4.5.4) — Axial compression (see 4.5.11) — Cable torsion (see 4.5.5) — Cold (see 4.5.17) <u>Group 4</u> — (evaluate coupling mechanism) — Change in temperature (test Na) (see 4.5.22) — Strength of coupling mechanism (fastening mechanism only, see 4.5.6) — Mechanical endurance (see 4.5.32) — Cold (see 4.5.17)	<u>Group A</u> — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group B</u> No tests specified PERIODIC INSPECTION <u>Group C0</u> Same as “Group 0” of the fixed sample sequence <u>Group C1</u> Same as “Group 1” of the fixed sample sequence <u>Group C2</u> Same as “Group 2” of the fixed sample sequence <u>Group D</u> Repeat all of the fixed sample sequences

Environmental category II suggests an environment without climatic control but with protection from the elements. Examples of such environments are outdoor enclosures and storage facilities.

Table 3 — Test sequences for environmental category III

FIXED SAMPLE QUALIFICATION	LOT-BY-LOT INSPECTION
<u>Group 0</u> — (initialize all specimens) — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group 1</u> — (initial optical performance) — Insertion loss (see 4.4.7) <u>Group 2</u> — (climatic category) — Cold (see 4.5.17) — Dry heat (see 4.5.18) — Damp heat (steady state) (see 4.5.19) <u>Group 3</u> — (evaluate construction) — Change in temperature (test Na) (see 4.5.22) — Vibration (see 4.5.1) — Cable pulling (see 4.5.4) — Axial compression (see 4.5.11) — Cable torsion (see 4.5.5) — Cold (see 4.5.17) <u>Group 4</u> — (evaluate coupling mechanism) — Change in temperature (test Na) (see 4.5.22) — Vibration (see 4.5.1) — Strength of coupling mechanism (fastening mechanism only, see 4.5.6) — Mechanical endurance (see 4.5.32) — Cold (see 4.5.17) <u>Group 5</u> — Corrosive atmosphere (salt mist) (see 4.5.26) — Dust (see 4.5.27)	<u>Group A</u> — Visual inspection (see 4.4.1) — Dimensions (see 4.4.2) <u>Group B</u> No tests specified PERIODIC INSPECTION <u>Group C0</u> Same as “Group 0” of the fixed sample sequence <u>Group C1</u> Same as “Group 1” of the fixed sample sequence <u>Group C2</u> Same as “Group 2” of the fixed sample sequence <u>Group D</u> Repeat all of the fixed sample sequences

Environmental category III represents the most severe environment. It suggests an environment without climatic control or protection from the elements. Examples of such environments are those found in land vehicles, ships and aircraft.

Detail specification writers may add tests and/or groups of tests to a particular environmental category as specified in the sectional specification. However, tests may not be removed nor the sequence altered. When tests are added to a specified category, the environmental category shall be given a plus (+) designation.

Example: Environmental category I +
 Environmental category II +
 Environmental category III +

Additional environmental categories shall only be introduced by the CECC WG26 at the sectional specification level.

Table 4 — Four level CECC specification structure

Specification level	Examples of information to be included	Applicable to
Basic	Assessment system rules Inspection rules Environmental test methods Sampling plans Identification rules 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 Test and measurement methods	Component family
Sectional	Additional terms Additional test methods Selection of tests Preferred values for: — characteristics — ratings — test severities — dimensions Qualification approval and/or Capability approval procedures	Component sub-family (type)
Blank Detail	Quality conformance test schedule Inspection requirements Information common to a number of types	A group of components having a common test schedule
Detail	Individual values Specific information Completed quality conformance test schedules	Individual type

2.1.7 Assessment level

Sectional 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, AQL = 4,0 %
- Group B inspection : inspection level II, AQL = 4,0 %
- Group C inspection : 24 month periods
- Group D inspection : 48 month periods.

Assessment level B

- Group A inspection : inspection level II, AQL = 1,0 %
- Group B inspection : inspection level II, AQL = 1,0 %
- Group C inspection : 18 month periods
- Group D inspection : 36 month periods.

Assessment level C

- Group A inspection : inspection level II, AQL = 0,40 %
- Group B inspection : inspection level II, AQL = 0,40 %
- Group C inspection : 12 month periods
- Group D inspection : 24 month periods.

One additional assessment level (other than those specified in the sectional specification) may be added in the detail specification. When this is done, capital letter X shall be used.

2.2 Documentation**2.2.1 Symbols**

Graphical and letter symbols shall, whenever possible, be taken from IEC 27 and 617.

2.2.2 Specification system

This specification is part of a four-level CECC specification system. Subsidiary specifications shall consist of sectional specifications, including blank detail specifications, and detail specifications. This system is shown in Table 4.

Sectional specifications

Sectional specifications shall define connector set types (see 2.1.1). They shall specify the following as a minimum:

- the type (see 2.1.1)
 - the type name
 - the coupling mechanism
 - the configuration(s)
 - the mating face mechanical intermateability dimensions
- the quality assessment procedures (see 2.4)
- one or more blank detail specifications — one for each environmental category specified (see 2.1.6).

Blank detail specifications

Blank detail specifications are not, by themselves, a specification level. They are part of a sectional specification. Sectional specifications may contain more than one blank detail specification to specify different usage applications.

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

Each blank detail specification shall contain:

- the minimum mandatory test schedules (environmental category) and performance requirements
- one or more assessment levels
- the preferred format for stating the required information in the detail specification.

Detail specifications

The detail specification is a completed blank detail specification, which is drafted under the authority of a national organisation or of the relevant CECC working group. Additional tests may be added to the blank detail specification.

The detail specification shall specify the following as a minimum:

- the type name (see 2.1.1)
- the arrangement (see 2.1.2)
- the variants (see 2.1.4)
- the connector set style (see 2.1.3)
- the climatic category (see 2.1.5)
- the environmental category (see 2.1.6)
- the assessment level (see 2.1.7)
- the dimensions for full intermateability and intermountability
- the qualification procedure method (see 3.3)
- the part identification number for each variant (see 2.6.1)
- the drawings, dimensions and performance criteria necessary to produce all required reference components (see 2.2.4)
- the drawings and dimensions necessary to produce all required gauges (see 2.2.4)
- the quality assessment test schedules (see 2.1.6)
- the performance requirements (see 2.5).

2.2.3 Drawings

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

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.

Dimensional system

All dimensions shall be given in accordance with ISO Standard 129, ISO Recommendation 286 and ISO Standard 1101.

The metric system shall be used in sectional specifications and detail specifications.

Dimensions shall not contain more than 5 significant digits.

2.2.4 Measurements

Measurement method

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

Reference components

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

Gauges

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

2.2.5 Test data sheets

Test data sheets shall be prepared for each test conducted to a detail specification. The data sheets shall be included in the qualification report (see 3.3.8) and in the periodic inspection report (see 4.4.2).

Data sheets 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 2.6.1)
- 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. (see 3.3.6 and 3.4.2).

2.2.6 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.

2.3 Design and construction

2.3.1 Materials

Corrosion resistance

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

Non-flammable materials

When non-flammable materials are required, the requirement shall be specified in the relevant specification and IEC 695-2-2 shall be referenced.

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

2.4 Quality

Connector set components shall be controlled by the quality assessment procedures of Section 3. The measurement and test procedures of Section 4 shall be used, as applicable, for quality assessment.

2.5 Performance

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

2.6 Identification and marking

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

2.6.1 Variant identification number

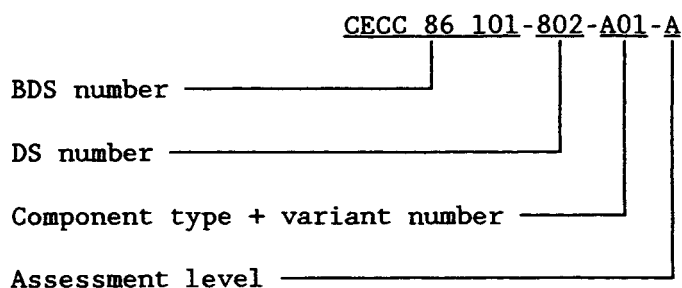
Each variant in a Detail Specification (DS) shall be assigned a unique identification number. This number shall set out as in the example below.

The part of the number designated “Detail specification number” shall be a three digit number. All three digits shall be allocated sequentially except for working group prepared DS(s), where the first digit of the number shall be “8”.

The part of the number designated “Component type” shall be a letter allocated in the DS.

The part of the number designated “Variant number” shall be a two digit number allocated sequentially in the DS to individual variants of each component type.

Example:



2.6.2 Component marking

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

- 1) Manufacturer's identification mark
- 2) Manufacturing date code
- 3) Manufacturer's part number
- 4) Variant identification number.

2.6.3 Package marking

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

- 1) Manufacturer's identification mark
- 2) Manufacturer's part number
- 3) Manufacturing date code (year/week, see ISO 2015)
- 4) Variant identification number(s) (see **2.6.1**)
- 5) The family name (see **2.1.1**)
- 6) The assessment level
- 7) The environmental category
- 8) 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.

2.7 Packaging

Packages shall include instructions for use when required by the relevant specification (see **2.2.6**).

Section 3. Quality assessment procedures

3 Quality assessment procedures

Procedures for quality assessment and release of components consist of:

- qualification approval procedures (see 3.3)
- quality conformance inspection (see 3.4).

3.1 Primary stage of manufacture

The primary stage of manufacture for fibre optic connectors is the manufacturing stage at which the parts, that make up the individual component(s), are aggregated into the product defined in the Detail Specification.

Sub-contracting of the primary stage and subsequent stages is permitted (see 1.2 of CECC 00114-II, RP14-II).

3.2 Structural similarity

The grouping of structurally similar components for the purpose of qualification approval and quality conformance inspection is prescribed by the following boundary limits.

Structurally similar components shall:

- have identical mating face dimensions
- be manufactured from essentially the same materials
- be manufactured to essentially the same design
- be manufactured utilizing essentially the same processes and methods
- utilize the same fibre retention technology (see 2.1.3)
- utilize the same cable retention technology (see 2.1.3)
- utilize the same optical coupling technique (see 2.1.3)
- utilize the same alignment technique (see 2.1.3)

Structurally similar components may:

- accept various fibre sizes
- accept various cable sizes.

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.

3.3 Qualification approval procedures

Qualification approval procedures are specified herein and in the relevant specification.

The qualification approval procedures shall be applied to both:

- connector sets
- connector set components (plug, adaptor, etc.).

Manufacturers shall:

- comply with the general requirements of CECC 00114-I, RP14-I
- comply with the requirements for the performance of the primary stage of manufacture (see 3.1)
- produce test evidence showing successful completion of the qualification test procedures.

The procedures of 3.3.1 and 3.3.2 are alternative methods for qualification as prescribed in 1.4 of CECC 00114-II, RP14-II. The detail specification shall specify which procedure is to be used.

3.3.1 Fixed sample procedure

The fixed sample procedure consists of subjecting a sample of specimens to the fixed sample qualification test sequence as specified in the detail specification. The sample shall be drawn from current production.

3.3.2 Lot-by-lot and periodic procedure

The lot-by-lot and periodic procedure consists of performing the lot-by-lot inspections on a specified number of inspection lots (with a minimum of three) taken in as short a time as possible. The periodic tests are then performed on samples selected from at least one of the lots.

Samples shall be selected from the lots in accordance with IEC 410. Normal inspection shall be used.

3.3.3 Qualifying specimen

When simultaneously qualifying all components of a set, the qualifying specimen shall be a variant for the smallest fibre core diameter within the range of structurally similar components being qualified.

When separately qualifying an individual component, the specimen shall be a complete connector set consisting of the component(s) being qualified and counterpart component(s).

When the component being individually qualified is an optical fibre connector, it shall be a variant for the smallest fibre core diameter within the range of structurally similar components being qualified. When the component being individually qualified is an adaptor connector, the counterpart component(s) shall be a variant for the smallest fibre core diameter within the range of variants specified in the detail specification.

The components being qualified shall be produced with equipment and procedures used in current production.

3.3.4 Counterpart components

Counterpart components shall meet the applicable requirements of the detail specification. The requirements for the manufacturer to perform the primary stage of manufacture is waived for the counterpart components (see 3.3). However, the manufacturer is responsible for failures which may occur during testing or inspection.

3.3.5 Sample size

The detail specification shall specify the sample size for qualification approval by the fixed sample procedure. Following completion of the group “0” tests for a particular environmental category, the specimens for the other groups shall be randomly selected from the group “0” sample. In addition, one specimen of each component to be qualified by structural similarity shall be provided.

Preparation of specimens

The relevant specification shall specify the fibre/cable sizes, types and lengths to be used. Specimens shall be assembled according to the manufacturer’s instructions for use (see 2.2.6).

3.3.6 Qualification testing

Qualification specimens shall meet the performance requirements given in the relevant specification.

3.3.7 Qualification failures

Manufacturers shall immediately notify the National Supervising Inspectorate (NSI) when a failure occurs during qualification testing. If the NSI determines that the failure has not been adequately explained and corrected, the manufacturer’s Chief Inspector may be directed to conduct a formal failure analysis. When complete, the manufacturer shall prepare and submit a failure report to the NSI. Failure reports shall describe the failure and its cause along with recommended corrective action to be taken. The NSI shall then decide the steps to be taken.

All failure reports, including the directions of the NSI, shall be included in the qualification approval report. (see 3.3.9).

One or more unresolved failures shall be cause for refusal to grant qualification approval.

3.3.8 Maintenance of qualification approval

Qualification approval shall be maintained for components by continuously submitting them to the quality conformance requirements as specified in 3.4.

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

- the production program 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 1.4 and 1.7 of CECC 00114-II, RP14-II.

3.3.9 Qualification report

Qualification testing results shall be recorded in a qualification approval report in accordance with 1.4 of CECC 00114-II, RP14-II.

3.4 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 (see 2.3 of CECC 00 114-II, RP14-II).

Lot-by-lot and periodic inspection schedules shall specify the groupings and be established in accordance with 2.3 of CECC 00114-II, RP14-II.

3.4.1 Lot-by-lot inspection

Lot-by-lot inspection consists of subjecting a sample of specimens to the groups 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 without regard to their quality.

In-process controls of component parts, unrelated to lot sizes of finished units, may be used for inspection in lieu of examination of these components in the finished product.

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 3.2)
- the period over which the production lots were aggregated shall not exceed one (1) month.

The plan for the aggregation of production lots into inspection lots shall be approved by the National Supervising Inspectorate.

Rejected lots

Specimens found defective during lot-by-lot testing shall be treated in accordance with the requirements of 2.4 of CECC 00114-II, RP14-II. Rejected lots may be reworked to correct the defects or to screen them out. The reworked lot shall then be submitted for reinspection using tightened inspection. They shall be separated from new lots and shall be clearly identified as reinspected lots.

3.4.2 Periodic inspection

Periodic inspection consists of subjecting a sample of specimens to the groups C and D tests specified in the detail specification. Each group shall be conducted at the period specified for the relevant assessment level (see 2.1.7). 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.

When periodically inspecting components which were simultaneously qualified as a set, the specimen shall be a complete connector set. The components shall be the same variants which were used for qualification.

When periodically inspecting components which were separately qualified, the specimen shall be a complete connector set consisting of the component(s) being inspected and counterpart components shall be the same variants which were used for qualification. The components being inspected shall be produced with the equipments and procedures used in current production.

Sample size

The detail specification shall specify the sample size for periodic inspection.

Following completion of the group “C0” and “D0” tests for a particular environmental category, the specimens for the other groups shall be randomly selected from the group “C0” and “D0” samples. In addition, one specimen of each component to be inspected by structural similarity shall be provided.

Preparation of specimens

The relevant specification shall specify the fibre/cable sizes, types and lengths to be used. Specimens shall be assembled according to the manufacturer's instructions for use (see 2.2.6).

Periodic inspection

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

Periodic inspection failures

Failures shall be treated according to the procedures of **3.3.6**.

If a specimen fails to satisfy the requirements of a periodic test, the manufacturers Chief Inspector shall immediately initiate the requirements of **1.8** of CECC 00114-II, RP14-II.

One or more unresolved failures shall be cause to withdraw qualification approval.

Periodic inspection report

Periodic testing results shall be maintained in accordance with the requirements of **2.5** of CECC 00114-II, RP14-II.

3.5 Certified test records of released lots

Detail specifications shall specify if a certified record of released lots is required. When required, the record shall be prepared in accordance with 3 of RP 9 and contain the following information as a minimum:

- attribute information (i.e. number of components tested and number of defective components with reference to the parameter for which rejection was made)
- variable information for the change of optical performance during and after the endurance and environmental tests, as required in the relevant specification.

3.6 Delayed deliveries

Released components which have been in store for a period longer than two years, unless otherwise specified in the relevant specification, 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 product may be placed back into stores for another specified period.

NOTE 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 number — see ISO 2015) together with any requirements or precautions concerning hazards or environmental conditions for storage.

3.7 Delivery release before completion of group B tests

When the conditions of IEC 410 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.

3.8 Alternative test methods

Alternative test methods to those specified in the relevant specification may be used. However, the manufacturer must 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 relevant specification shall be used.

3.9 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.

Section 4. Measurement and environmental test procedures

4 Measurement and environmental test procedures

4.1 Standard conditions.

The standard atmospheric conditions, including specimen recovery, of IEC 68-1 apply. The relevant specification shall specify the pre-conditioning and recovery procedures.

4.2 Specimen

The specimen, including the fibre/cable to be used, shall be defined in the relevant specification.

4.3 Cleaning of optical surfaces

Cleaning the optical surfaces is permitted as part of test pre-conditioning and recovery unless otherwise specified in the detail specification. Cleaning shall be in accordance with the requirements for instructions for use (see 2.2.6).

4.4 Measurement procedures

Table 5 — List of measurement procedures

Procedure	Clause
Visual inspection	4.4.1
Dimensions	4.4.2
Examination of product	4.4.3
Gauge retention force	4.4.4
Engagement and separation force	4.4.5
Flammability	4.4.6
Insertion loss	4.4.7
Change in transmitted optical power	4.4.8
Cross talk	4.4.9
Ambient light coupling	4.4.10
Spectral loss	4.4.11
Return loss	4.4.12

4.4.1 *Visual inspection*

Purpose

The purpose of this procedure is to ensure that the specimen conforms to the design, construction and marking requirements of the relevant specification.

General description

The specimen is examined to ensure that it contains the proper number and types of components, that the workmanship is satisfactory and that the marking is correct.

Apparatus

As required.

Procedure

- pre-condition the specimen as specified
- visually inspect the specimen to the specified requirements
- perform specified recovery procedure.

Requirements

- the number and type of components which comprise the specimen shall be as specified in the relevant specification
- workmanship shall be in accordance with 2.3.2
- marking shall be in accordance with the requirements of the relevant specification.

Details to be specified

The following details, as applicable, shall be given in the relevant specification:

- number and type of components
- marking
- pre-conditioning procedure
- recovery procedure
- deviations.

4.4.2 Dimensions**Purpose**

The purpose of this procedure is to ensure that the specimen conforms to the dimensional requirements given in the relevant specification.

General description

All size dimensions are measured for conformance to the relevant specification.

Apparatus

When a size measurement method is specified in the relevant specification (see 2.2.4), the method shall be used. Otherwise, appropriate measuring instruments may be used.

Procedure

- a) pre-condition the specimen as specified
- b) measure the size dimensions
- c) perform specified recovery procedure.

Requirements

All size dimensions shall be in accordance with the relevant specification.

Details to be specified

The following details, as applicable, shall be given in the relevant specification:

- size dimensions
- size measurement methods, if required (see 2.2.4)
- pre-conditioning procedure
- recovery procedure
- deviations.

4.4.3 Examination of product**Purpose**

The purpose of this procedure is to examine a specimen for changes which may result from an environmental test.

General description

The specimen is initially examined, using visual techniques. After the environmental conditioning, the specimen is again inspected for damage resulting from the conditioning.

Apparatus

Optical inspection instruments may be used as appropriate. The maximum allowable optical magnification is 5X power.

Procedure

- visually inspect the specimen at the initial measurement time
- repeat the inspection at the measurement time(s) specified during the test.

Requirements

- the specimen shall show no evidence of broken, loose, deformed or displaced parts, cracks, chips or other damage detrimental to normal operation
- marking shall be legible.