BS EN 60966-3:2009

BSI British Standards

Radio frequency and coaxial cable assemblies —

Part 3: Sectional specification for semi-flexible coaxial cable assemblies

National foreword

This British Standard is the UK implementation of EN 60966-3:2009. It is identical to IEC 60966-3:2008. It supersedes BS EN 60966-3:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/46, Cables, wires and waveguides, radio frequency connectors and accessories for communication and signalling.

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

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

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Compliance with a British Standard cannot confer immunity from legal obligations.

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EN 60966-3

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English version

Radio frequency and coaxial cable assemblies - Part 3: Sectional specification for semi-flexible coaxial cable assemblies
(IEC 60966-3:2008)

Ensembles de cordons coaxiaux et de cordons pour fréquences radioélectriques - Partie 3: Spécification intermédiaire pour cordons coaxiaux semi-flexibles (CEI 60966-3:2008)

Konfektionierte Koaxial- und Hochfrequenzkabel - Teil 3: Rahmenspezifikation für halbflexible konfektionierte Koaxialkabel (IEC 60966-3:2008)

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CENELEC

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

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Foreword

The text of document 46/264/CDV, future edition 3 of IEC 60966-3, prepared by IEC TC 46, Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60966-3 on 2009-04-01.

This European Standard supersedes EN 60966-3:2003.

The major change with respect to EN 60966-3:2003 is a better definition of the tests to be performed.

This sectional specification is to be read in conjunction with EN 60966-1:1999. It contains the same clauses as that of EN 60966-1 and completes or amends them when required. When a clause of EN 60966-1 does not appear in this standard, it applies as it is in EN 60966-1. When this standard states "addition", "modification" or "replacement", the relevant text in Part 1 is to be adapted accordingly.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-01-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-04-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60966-3:2008 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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

Publication	Year	Title	EN/HD	Year
IEC 60068-2-6	-[1)]	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008[2)]
IEC 60096-2	-[1)]	Radio-frequency cables - Part 2: Relevant cable specifications	-	-
IEC 60410	-[1)]	Sampling plans and procedures for inspection by attributes	-	-
IEC 60966-1	1999	Radio frequency and coaxial cable assemblies - Part 1: Generic specification - General requirements and test methods	EN 60966-1	1999[2)]
IEC 61169	Series	Radio-frequency connectors	EN 61169	Series
IEC 61196	Series	Coaxial communication cables	EN 61196	Series
IEC QC 001002	Series	IEC Quality Assessment System for Electronic Components (IECQ) - Rules of procedure	-	-
ISO 9000	-[1)]	Quality management systems - Fundamentals and vocabulary	EN ISO 9000	2005[2)]

[1)] Undated reference.

[2)] Valid edition at date of issue.

CONTENTS

RADIO FREQUENCY AND COAXIAL CABLE ASSEMBLIES –

Part 3: Sectional specification for semi-flexible coaxial cable assemblies

1 Scope

This part of IEC 60966 is a sectional specification that relates to semi-flexible coaxial cable assemblies operating in the transverse electromagnetic mode (TEM). It establishes uniform requirements for testing the electrical, mechanical and climatic properties of flexible cable assemblies composed of flexible coaxial cables and coaxial connectors.

NOTE 1 For the purposes of this sectional specification, a cable assembly is always regarded as an integral unit. All specifications apply to the finished assembly and not to individual and non-assembled parts thereof.

NOTE 2 This sectional specification should be supplemented with detail specifications giving additional details as required by the particular application. This application will not necessarily require all tests.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests − Test Fc: Vibration (sinusoidal)*

IEC 60096-2, *Radio-frequency cables – Part 2: Relevant cable specifications*

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

IEC 60966-1:1999, *Radio frequency and coaxial cable assemblies – Part 1: Generic specification – General requirements and test methods*

IEC 61169 (all parts), *Radio-frequency connectors*

IEC 61196 (all parts), *Coaxial communication cables*

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

ISO 9000, *Quality management systems – Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60966-1 apply.

4 Design and manufacturing requirements

Clause 4 of IEC 60966-1 is applicable except as follows.

Replacement:

4.1 Cable design and construction

Cables should conform to IEC 60096-2 or IEC 61196. Where cable designs deviating from these publications are required, they shall comply with the requirements of the detail specification.

If required, the manufacturer may use additional protective tubing or cable deviating from IEC 61196 in order to comply with the requirements of the detail specification.

The materials used in the cable shall be given as engineering information in the detail specification.

4.2 Connector design and construction

Connectors should conform to IEC 61169. Where connector designs deviating from IEC 61169 are required, the interface should conform to the relevant part of IEC 61169 where available and shall comply with the requirements of the detail specification.

The materials used in the connector shall be given as engineering information in the detail specification.

4.3 Outline and interface dimensions

The outline and interface dimensions shall be in accordance with the detail specification of the cable assembly.

The length, unless otherwise specified in the detail specification, is defined as between the reference planes of the connectors. In case of right angle connectors, the length applies to the axis of the connectors (see Figure 1).

If not indicated in the detail specification, the length tolerance shall be ±1 % for cables equal to, or longer than, 300 mm and ±3 mm for cables shorter than 300 mm.

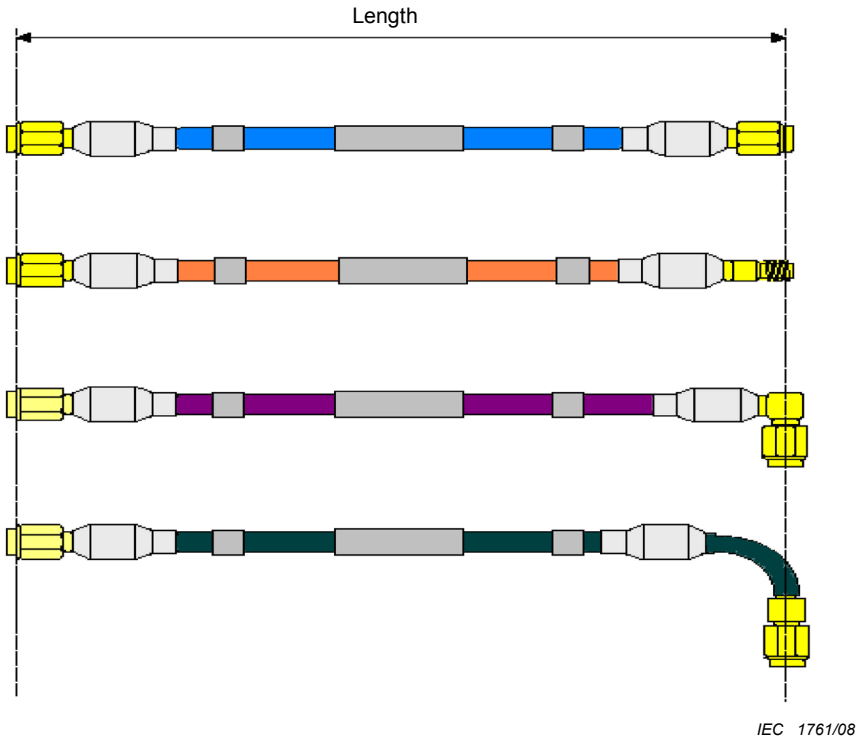


Figure 1 – Length definition of cable assemblies

5 Workmanship, marking and packaging

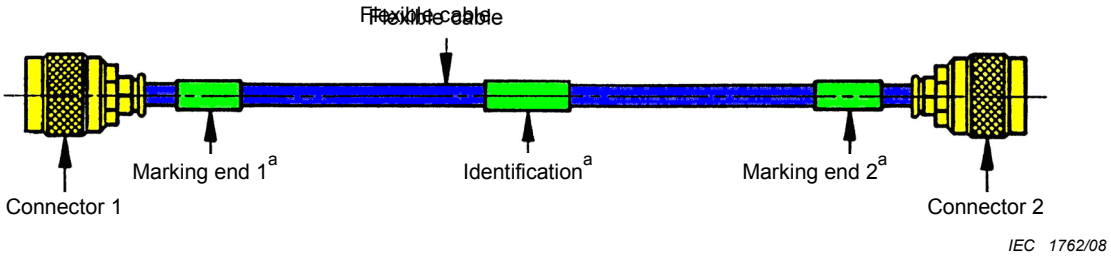
Clause 5 of IEC 60966-1 is applicable, except as follows.

5.2 Marking

Addition:

Cable assemblies made in accordance with this sectional specification comprise a section of cable and two connectors. When specified in the detail specification, the assembly may additionally include markers for identification of the assembly and interconnecting ends. End caps and other accessories may also be specified (see Figure 2).

NOTE Occasionally, the cable assembly will comprise only a cable and one connector.



[a] When specified.

Figure 2 – Example of a cable assembly

6 Quality assessment

Clause 6 of IEC 60966-1 applies.

7 Test methods – General

Clause 7 of IEC 60966-1 applies.

8 Electrical tests

Clause 8 of IEC 60966-1 is applicable, except as follows.

8.1.4 Information to be given in the detail specification

Addition:

While the parameter return loss (A_r) is preferred, the reflection factor (r) or the VSWR (voltage standing wave ratio) may be specified

where

$$A_r = -20 \log_{10} |r|$$

and

$$\text{VSWR} = \frac{1+|r|}{1-|r|}$$

8.4 Insertion loss stability

Replacement:

This test is not applicable to semi-flexible coaxial assemblies.

8.7.1 Object

Modification:

To measure the difference between two or more cable assemblies. The phase difference shall not exceed the limits specified in the relevant detail specification.

If more than two cable assemblies belong to a matched set, the reference cable shall be clearly marked.

8.9 Screening effectiveness

Replacement:

8.9.1 Requirements

The transfer impedance shall be below the specified limit.

When the test is performed at 30 MHz, the detail specification should indicate one of the preferred maximum values as follows:

– 30 μΩ/m;
– 300 μΩ/m;
– 3 mΩ/m.

8.9.2 Information to be given in the detail specification

The following information is to be given:

a) mounting details of the cable assembly under test;
b) limit of the transfer impedance.

8.10.3 Information to be given in the detail specification

Replacement:

The following information is to be given:

a) test voltage;
b) any special requirements.

If not indicated in the detail specification, the test shall be carried out at sea-level. Additionally, high altitude may be required by the detail specification. Preferred values are:

– sea-level: 86 kPa to 106 kPa;
– 10 km: 25 kPa;
– 20 km: 4,4 kPa.

9 Mechanical robustness tests

Clause 9 of IEC 60966-1 is applicable except as follows:

9.2 Flexure

Replacement:

This test is not applicable to semi-flexible coaxial assemblies.

9.3 Flexing endurance

Replacement:

This test is not applicable to semi-flexible coaxial assemblies.

10 Environmental tests

Clause 10 of IEC 60966-1 is applicable except as follows.

10.2 Vibration, bumps and shock

Replacement:

10.2.1 Vibration

10.2.1.1 Procedure

The tests shall be carried out in accordance with test Fc of IEC 60068-2-6.

The vibration severity shall be chosen from D.2.1 of IEC 60966-1, unless otherwise indicated in the detail specification.

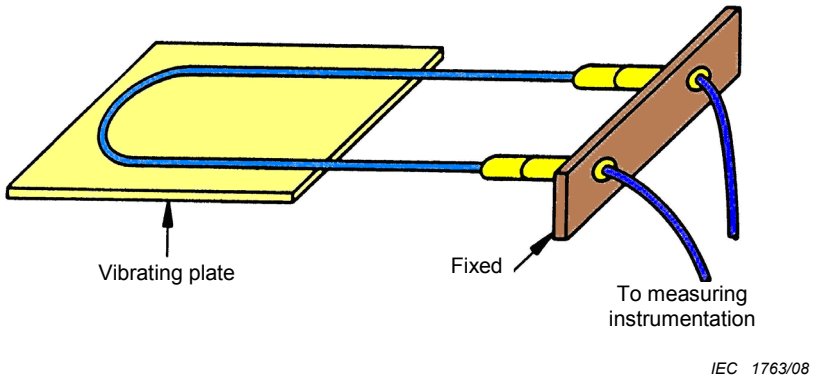


Figure 3 – Preferred arrangement for the vibration test

The preferred arrangement for the vibration test is described in Figure 3. The cable portion of the cable assembly shall be vibrated in each of three perpendicular directions, one of which shall be parallel to the common axis of the connectors. The continuity of the inner and outer conductors shall be monitored during the test.

10.2.1.2 Requirements

There shall be no evidence of cracking, breaking or loosening of parts of a component and there shall be no current discontinuity in excess of 1 µs.

After the test, the insertion loss and return loss shall not exceed the specified limits.

10.2.1.3 Information to be given in the detail specification

The following information is to be given:

a) mounting and fixing details of the cable assembly;

NOTE The length of the cable in relation to its diameter, between the mounting plate and the fixed plate, is an important variable. The fixed plate should be rigid.

b) profile and severity parameters for vibration. These should include duration, frequency and acceleration or displacement.

10.2.2 Bumps

This test shall be specified, if necessary, in the detail specification. For the recommended severities, see D.2.2 of IEC 60966-1.

10.2.3 Shock

This test shall be specified, if necessary, in the detail specification. For the recommended severities, see D.2.3 of IEC 60966-1.

10.3.1 Procedure

Addition:

The test severities indicated in D.2.4 of IEC 60966-1 are preferred.

10.4.1 Procedure

Addition:

See D.2.5 of IEC 60966-1 for test severities.

10.5.1 Procedure

Addition:

See D.2.6 of IEC 60966-1 for test severities.

11 Specialized test methods

Clause 11 of IEC 60966-1 applies.

12 Test schedules

Clause 12 of IEC 60966-1 is applicable except as follows.

Replacement:

12.1 General

In addition to the electrical, mechanical and environmental test requirements, the detail specification shall indicate the tests to be performed with the corresponding inspection levels, acceptance quality levels and periodicities. Whenever possible, in the place of individual tests, complete test groups from Table 1 shall be specified, for example, Eb, Ep, Vt.

Table 1 – Grouping of tests for specification purposes

Recommended grouping of tests			Recommended severities					
Group	**Subclause**	**Tests**	**Periodicity**	**IL**	**AQL**	***n***	**c**	**Notes**
Ba	7.2	Visual inspection	Lot-by-lot	S3	4.0			
	7.3	Dimensions inspection	Lot-by-lot	S3	4.0			
Eh	8.1	Reflection properties	Lot-by-lot	II	1.0			
	8.3	Insertion loss	Lot-by-lot	II	1.0			
Eb	8.10	Voltage proof	Lot-by-lot	II	1.0			
	8.11	Insulation resistance	Lot-by-lot	II	1.0			
	8.12	Inner and outer conductor continuity	Lot-by-lot	II	1.0			
Ez	8.2	Uniformity of impedance	Lot-by-lot	II	1.0			
Ep	8.5	Propagation time	Lot-by-lot	100 %				2
	8.6	Stability of electrical length	1 year	S3	4.0			
	8.7	Phase difference	Lot-by-lot	100 %				2
	8.8	Phase variation with temperature	3 years	*		3	0	1
Ee	8.9	Screening effectiveness	3 years	*	–	3	0	
Mn	9.1	Tensile test	3 years	*	–	3	0	1
	9.4	Cable assembly crushing	3 years	*				
	9.5	Torque	3 years	*				
	9.6	Multiple bending	3 years	*				
Recommended grouping of tests			**Recommended severities**					
Group	**Subclause**	**Tests**	**Periodicity**	**IL**	**AQL**	***n***	**c**	**Notes**
Vv	10.2	V bration, bumps and shock	3 years	*	–	3	0	
Vc	10.3	Climatic sequence	3 years	*	–	3	0	
Vt	10.4	Damp heat, steady state	3 years	*	–			
	10.5	Rapid change of temperature	3 years	*	–			
	10.6	Solvents and contaminating fluids	1 year	*	–			
	10.8	Salt mist and sulphur dioxide	1 year	*	–			
Vf	10.7	Water immersion	3 years	*	–			
	10.9	Dust tests	3 years	*	–			
	10.10	Flammability	3 years	*	–			

n is the number of samples to be tested;

c is the acceptance criterion;

IL is the inspection level according to IEC 60410;

AQL is the acceptable quality level according to IEC 60410.

NOTE 1 If the manufacturer wishes to replace these tests by analogous tests made on the connectors and the cable separately, he should demonstrate to the customer that the tests are such that the requirements of the detail specification will have been met at the final stage of inspection (modification of IEC QC 001002 and 12.3.4 of the present document).

NOTE 2 Only one of the tests 8.5 or 8.7 should be specified.

* This periodic test shall be completed on a CQC (capability qualifying component) defined between the customer and his supplier.

12.2 Qualification approval procedure

The recommended qualification test schedule is given in Table 2.

Table 2 – Test schedule

Group	Subclause	Tests			Specimens				
			1	2	3	4		5	6
	7.2	Visual inspection							
Ba			X	X	X	X		X	X
	7.3	Dimensions inspection							
	8.1	Reflection properties							
Eh	8.3	Insertion loss	X	X	X	X		X	X
	8.10	Voltage proof							
Eb	8.11	Insulation resistance	X	X	X	X		X	X
	8.12	Inner and outer conductor continuity							
Ez	8.2	Uniformity of impedance	X	X					
Ep	8.5 8.6 8.7	Propagation time Stability of electrical length Phase difference	X	X					
	8.8	Phase variation with temperature							
Ee	8.9	Screening effectiveness	X						
	9.1	Tensile test	X						
	9.4	Cable assembly crushing		X					
Mn									
	9.5	Torque	X						
	9.6	Multiple bending		X					
Vv	10.2	Vibration, bumps and shock				X			
Vc	10.3	Climatic sequence	X	X					
Vt	10.4 10.5	Damp heat, steady state Rapid change of temperature							
	10.6 10.8	Solvents and contaminating fluids Salt mist and sulphur doixide							
	10.7	Water immersion							
Vf									
	10.9	Dust tests							
	10.10	Flammability							

12.3 Capability approval procedures

12.3.1 General

The purpose of the subclauses below is to give some guidance for the choice of CQCs.

The guidance is given by an example flow chart (see Figure 4 with applicable CQCs for processes and boundaries (see Table 3)).

The actual CQCs used shall be specified in the CM (capability manual) (see E.3.2 of IEC 60966-1).

12.3.2 Example production flow chart for a flexible cable assembly

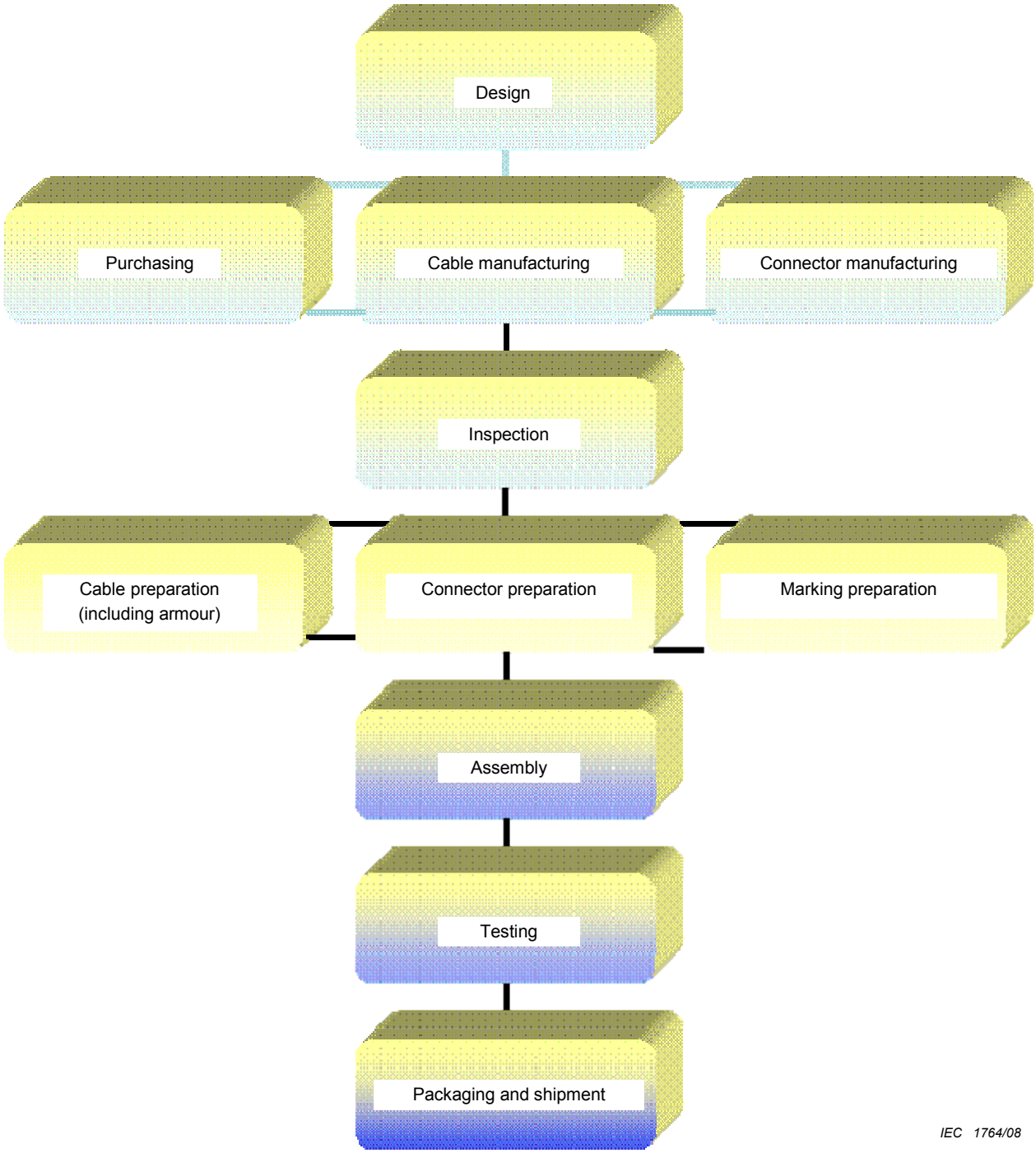


Figure 4 – Example production flow chart for a flexible cable assembly

12.3.3 Assignment of CQCs

Table 3 – Assignment of CQCs

Design	The design shall lie within the boundaries which are verified by the boundary CQCs	
Purchasing	Verified by audits against ISO 9000	
Cable manufacturing	CQCs according to the relevant cable specification	
Connectors manufacturing	CQCs according to the relevant connector specification	
Inspection	CQC No. aaa CQC No. bbb CQC No. ccc	Right-angle connector Highest frequency cable Piece parts
Cable preparation	CQC No. ddd	
Connector preparation	CQC No. eee	
Marking preparation	CQC No. fff	
Assembling	Inner conductor Outer conductor Additional armour	Process CQC No. ggg (soldering, crimping, clamping) Process CQC No. hhh (soldering, crimping, clamping) Verified by boundary CQCs
Final testing	Verified by audits against ISO 9000 and measurements on boundary CQCs	
Packaging and shipment	Verified by audits against ISO 9000	

12.3.4 Purpose of boundary CQCs

The purpose of boundary CQCs is, together, to give evidence of the claimed boundaries against the subclauses in Table 1 and any other claimed characteristics.

The choice of CQCs shall take into account the interdependence of characteristics.

CQC No. aaa

The purpose of this CQC is to demonstrate the ability of the manufacturer to achieve inspections on the connectors if they are not purchased with a compliance certificate against either a capability approval or a qualification approval.

The CQC consists of the smallest right-angle connector for a cable assembly within the limits of the capability approval.

Recommended test schedule for CQC No. aaa : Periodicity 1 year

– Dimensions inspection
– Surface finish (nature, thickness)
– Inner conductor retention

CQC No. bbb

The purpose of this CQC is to demonstrate the ability of the manufacturer to achieve inspection on the cables if they are not purchased with a compliance certificate against either a capability approval or a qualification approval.

This CQC consists of a standard length or the maximum length permitted for measurements of the characteristics to the highest frequency limits declared in the CM.

Recommended test schedule for CQC No. bbb : Periodicity 1 year

– Characteristic impedance
– Return loss
– Attenuation
– Dimensions inspection

CQC No. ccc

The purpose of this CQC is to demonstrate the ability of the manufacturer to achieve inspection on piece parts with respect to the characteristics that shall influence the performances of the finished cable assembly.

The CQC should be a sensitive piece part intended to be used in a cable assembly.

The choice of this CQC and its test schedule shall be made in agreement between the manufacturer and the NSI.

CQC No. ddd

The purpose of this CQC is to demonstrate the ability of the manufacturer to cut the cable and prepare the cable ends. This CQC should be a length of the most critical cable (i.e. the smallest cable with wrapped, foam, or solid dielectric) declared in the CM.

Recommended test schedule for CQC No. ddd: Periodicity 1 year

– Visual inspection
– No cut mark or neck
– Not any groove
– Dimensions inspection
– Stripping dimensions

CQC No. eee

The purpose of this CQC is to demonstrate the ability of the manufacturer to achieve any preparation (for example, degolding) on piece parts of connectors if declared in the CM.

This CQC consists of piece parts taken from CQC No. aaa.

The choice of this CQC and its test schedule shall be made in agreement between the manufacturer and the NSI.

CQC No. fff

The purpose of this CQC is to demonstrate the ability of the manufacturer to obtain legible and durable labels.

This CQC consists of the smallest sized text for all the technologies within the limits of the capability approval as described in the CM.

Recommended test schedule for CQC No. fff Periodicity 1 year

– Dimensions inspection
– Legibility
– Resistance to solvents
– Abrasion

CQC No. ggg

The purpose of this CQC is to demonstrate the ability of the manufacturer to provide good liaison between the inner conductor of the cable and that of the connector by any means as declared in the CM.

This CQC consists of a piece of the smallest cable with a stranded inner conductor if any, to which a relevant inner contact shall be attached by means of soldering or crimping, as declared in the CM. In the case of soldering, the CM shall state how operators are trained and educated.

Recommended test schedule for CQC No. ggg : Periodicity 1 year

– Tensile strength
– Contact resistance
– Visual inspection

CQC No. hhh

The purpose of this CQC is to demonstrate the ability of the manufacturer to provide a good liaison between the outer conductor of the cable and that of the connector by any means as declared in the CM.

This CQC consists of pieces of cable with each type of outer conductor as declared in the CM on which a relevant outer contact shall be attached by means of soldering or crimping, as declared in the CM. In the case of soldering, the CM shall state how operators are trained and educated.

Recommended test schedule for CQC No. hhh: Periodicity 1 year

– Tensile strength
– Contact resistance
– Visual inspection

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