

INTERNATIONAL STANDARD

Radio frequency and coaxial cable assemblies – Part 2-1: Sectional specification for flexible coaxial cable assemblies



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2008 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00



IEC 60966-2-1

Edition 3.0 2008-10

INTERNATIONAL STANDARD

**Radio frequency and coaxial cable assemblies –
Part 2-1: Sectional specification for flexible coaxial cable assemblies**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

R

ICS 33.120.10

ISBN 2-8318-1008-4

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	5
4 Design and manufacturing requirements.....	6
4.1 Cable design and construction.....	6
4.2 Connector design and construction.....	6
4.3 Outline and interface dimensions.....	6
5 Workmanship, marking and packaging.....	7
6 Quality assessment	8
7 Test methods – General	8
8 Electrical tests.....	8
9 Mechanical robustness tests.....	9
10 Environmental tests.....	9
11 Specialized test methods.....	11
12 Test schedules	11
Figure 1 – Length definition of cable assemblies.....	7
Figure 2 – Example of a cable assembly.....	7
Figure 3 – Preferred arrangement for the vibration test.....	9
Figure 4 – Example production flow chart for a flexible cable assembly	14
Table 1 – Grouping of tests for specification purposes	12
Table 2 – Test schedule.....	13
Table 3 – Assignment of CQCs	15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIO FREQUENCY AND COAXIAL CABLE ASSEMBLIES –**Part 2-1: Sectional specification for flexible coaxial cable assemblies**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60966-2-1 has been prepared by IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

This third edition cancels and replaces the second edition published in 2003. It constitutes a technical revision.

The major change with respect to the second edition is a better definition of the tests to be performed.

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

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

CDV	Report on voting
46/262/CDV	46/295/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

A list of all parts of the IEC 60966 series, under the general title: *Radio frequency and coaxial cable assemblies*, can be found on the IEC website.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

RADIO FREQUENCY AND COAXIAL CABLE ASSEMBLIES –

Part 2-1: Sectional specification for flexible coaxial cable assemblies

1 Scope

This part of IEC 60966 is a sectional specification that relates to 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.

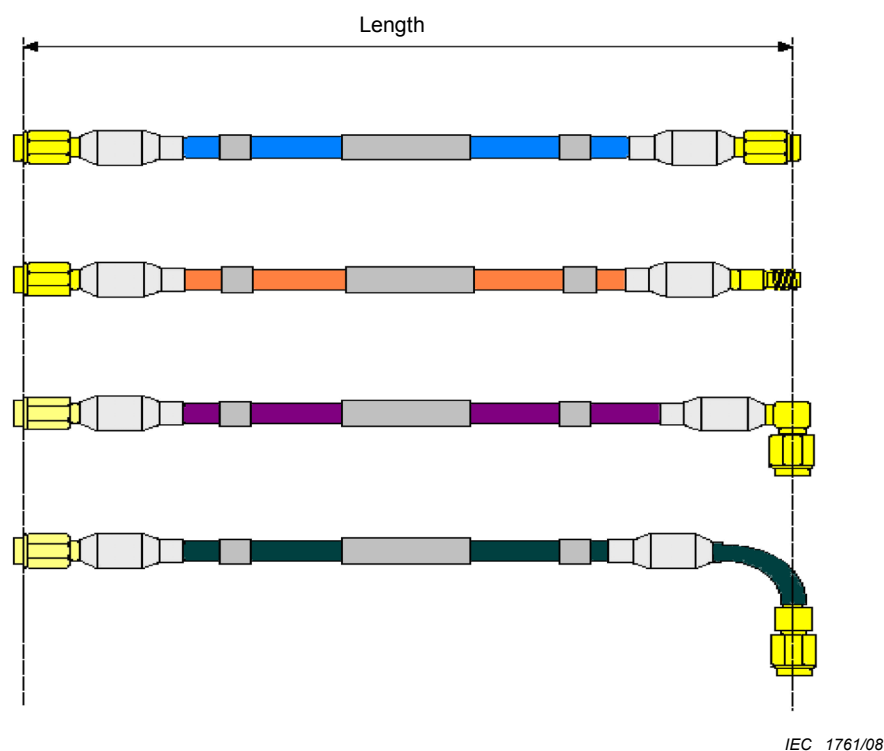


Figure 1 – Length definition of cable assemblies

5 Workmanship, marking and packaging

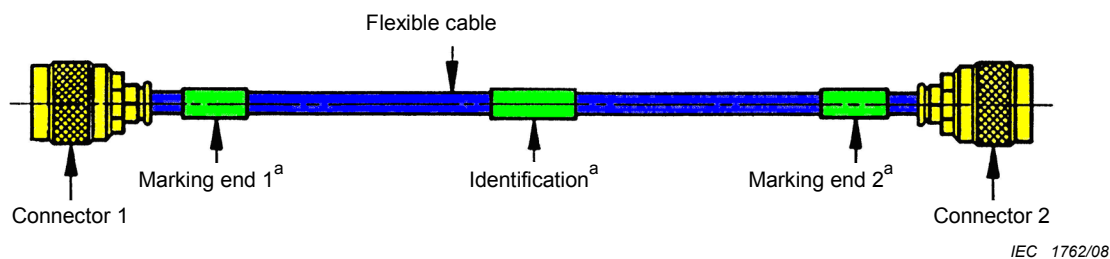
Clause 5 of IEC 60966-1 is applicable, except as follows.

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:

8.4.1 Object

To determine the change of insertion loss when the cable assembly is subjected to bending and twisting (separately).

8.4.2 Procedures

8.4.2.1 Bending

The test is to be performed as in 8.6.2.1 of IEC 60966-1 by measurement of the insertion loss (not the phase).

8.4.2.2 Twisting

The test is to be performed as in 8.6.2.2 of IEC 60966-1 by measurement of the insertion loss (not the phase).

8.4.4 Information to be given in the detail specification

Replacement:

The following information is to be given:

- a) dynamic bending radius of the cable (radius of the mandrel);
- b) whether method 1 or 2 is used for the bending test;
- c) test frequencies;
- d) maximum change of insertion loss.

9 Mechanical robustness tests

Clause 9 of IEC 60966-1 applies.

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.

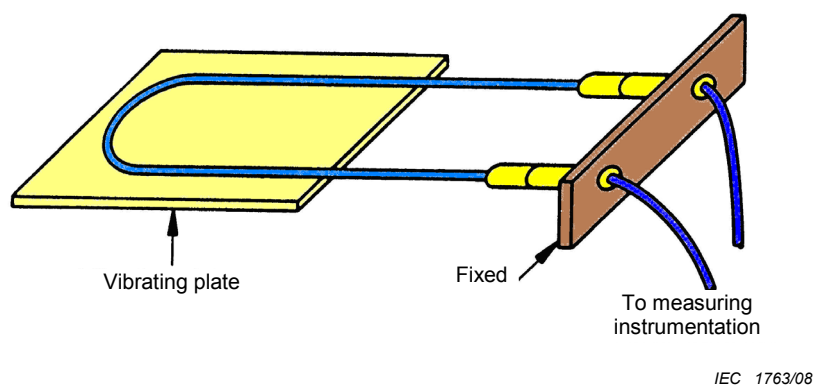


Figure 3 – Preferred arrangement for the vibration test

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 μ s.

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					Notes
Group	Subclause	Tests	Periodicity	IL	AQL	n	c	
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			
	8.4	Insertion loss stability	3 years	S3	4.0			
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
	9.2	Flexure	3 years	S3	4.0			
	9.3	Flexing endurance	3 years	S3	4.0			
	9.4	Cable assembly crushing	3 years	S3				
Vv	10.2	Vibration, 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	*	–			
<p>n is the number of samples to be tested;</p> <p>c is the acceptance criterion;</p> <p>IL is the inspection level according to IEC 60410;</p> <p>AQL is the acceptable quality level according to IEC 60410.</p> <p>* This periodic test should be completed on a CQC (capability qualifying component) defined between the customer and his supplier).</p>								
<p>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).</p>								
<p>NOTE 2 Only one of the tests 8.5 or 8.7 should be specified.</p>								

12.2 Qualification approval procedure

12.2.1 Recommended qualification test schedule

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
	8.4	Insertion loss stability						
	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	Propagation time	X	X				
	8.6	Stability of electrical length						
	8.7	Phase difference						
	8.8	Phase variation with temperature						
Ee	8.9	Screening effectiveness	X					
	9.1	Tensile test	X					
	9.2	Flexure		X				
Mn								
	9.3	Flexing endurance	X	X				
	9.4	Cable assembly crushing						
Vv	10.2	Vibration, bumps and shock				X		
Vc	10.3	Climatic sequence	X	X				
Vt	10.4	Damp heat, steady state					X	X
	10.5	Rapid change of temperature						
	10.6	Solvents and contaminating fluids						
	10.8	Salt mist and sulphur dioxide						
	10.7	Water immersion						
Vf						X		
	10.9	Dust tests						
	10.10	Flammability						

12.3 Capability approval procedures

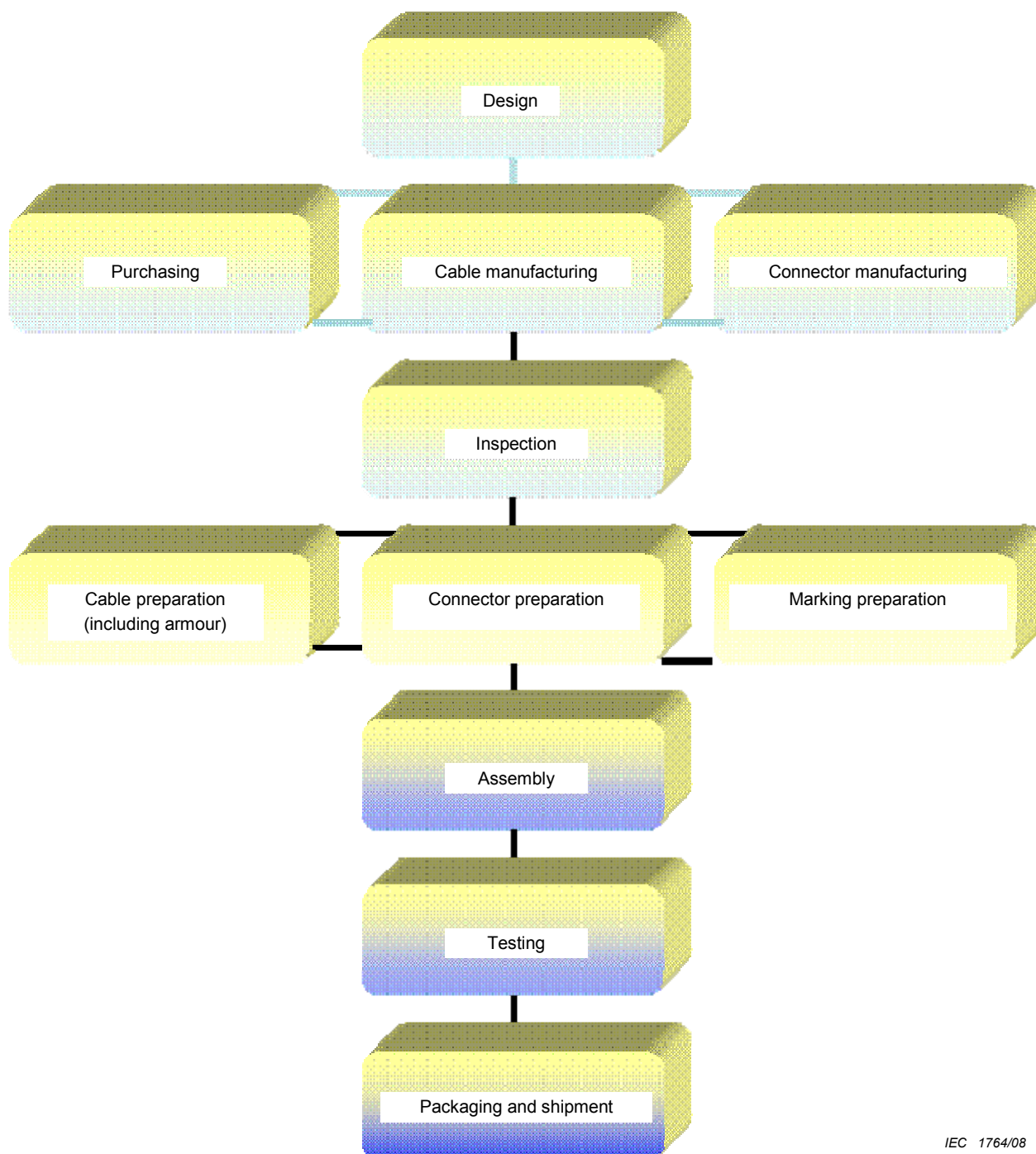
12.3.1 General

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



IEC 1764/08

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch