

INTERNATIONAL STANDARD

IEC 61212-3-2

Second edition
2006-05

Insulating materials – Industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes –

Part 3: Specifications for individual materials – Sheet 2: Round laminated moulded tubes



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSULATING MATERIALS –
INDUSTRIAL RIGID ROUND LAMINATED TUBES
AND RODS BASED ON THERMOSETTING RESINS
FOR ELECTRICAL PURPOSES –****Part 3: Specifications for individual materials -
Sheet 2: Round laminated moulded tubes**

FOREWORD

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International Standard IEC 61212-3-2 has been prepared by IEC technical committee 15: Standards on specifications for electrical insulating materials.

This second edition cancels and replaces the first edition published in 1995 and constitutes a technical revision. The main changes from the previous edition are as follows: added application use and safety statements. Reformatted document to bring it up to current IEC document format. New types EP GC 23 and PF CC 24 added and type PF CP 24 removed.

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

FDIS	Report on voting
15/303FDIS	15/327/RVD

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

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- withdrawn;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.

INTRODUCTION

This part of IEC 61212 is one of a series which deals with industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes.

This series consists of three parts:

Part 1: Definitions, designations and general requirements (IEC 61212-1)

Part 2: Methods of test (IEC 61212-2)

Part 3: Specifications for individual materials (IEC 61212-3)

IEC 61212-3-2 contains one of the specification sheets comprising Part 3, as follows:

Sheet 2: Round laminated moulded tubes.

INSULATING MATERIALS – INDUSTRIAL RIGID ROUND LAMINATED TUBES AND RODS BASED ON THERMOSETTING RESINS FOR ELECTRICAL PURPOSES –

Part 3: Specifications for individual materials - Sheet 2: Round laminated moulded tubes

1 Scope

This part of IEC 61212-3 gives requirements for industrial rigid round laminated moulded tubes for electrical purposes, based on different resins and different reinforcements.

Applications and distinguishing properties are given in Table 1.

Materials which conform to this specification meet established levels of performance. However, the selection of a material by a user for a specific application should be based on the actual requirements necessary for adequate performance in that application and not based on this specification alone.

Safety Warning:

It is the responsibility of the user of the methods contained or referred to in this document to ensure that they are used in a safe manner.

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 61212-1:2006, *Insulating materials – Industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements*

IEC 61212-2:2006, *Insulating materials – Industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes – Part 2: Methods of test*

ISO 472, *Plastics – Vocabulary*

3 Terms and definitions

For the purposes of this document, the following modified definition, which is taken from ISO 472, applies.

3.1

moulded tube (as applied to thermosets)

tube formed by rolling impregnated layers of material on a mandrel, curing the assembly in a cylindrical mould under heat and pressure, and then removing the mandrel

[ISO 472, MOD]

4 Designations and abbreviations

4.1 General

The moulded tubes covered by this Part of IEC 61212-3 sheet are classified into types which differ in the resin and reinforcement used, the method of manufacture and their distinguishing properties.

4.2 Designation

Individual types are designated by

- a two-letter abbreviation denoting the resin;
- a second two-letter abbreviation, denoting the reinforcement;
- a serial number of two digits,
the first digit denoting the form of the material, a "3" indicates moulded tubes,
and, a second digit denoting sub-grades of the same type.

The abbreviations are given in 4.3.

The complete designation of the moulded tube is denoted as follows:

- description: moulded tube;
- number of the IEC standard: IEC 61212-3-2;
- designation of the individual type;
- dimensions (in millimetres) of the moulded tube: internal diameter x external diameter x length;
- a letter designating the finish on the external diameter of the moulded tube:
"A" designating moulded tubes in the "as produced" condition;
"B" designating moulded tubes in ground or turned condition.

EXAMPLE:

Moulded tube, IEC 61212-3-2 – EP CC 31 – 25x35x1000-A

4.3 Abbreviations

Types of resin		Types of reinforcement	
EP	Epoxy (epoxide)	CC	Woven cotton cloth
PF	Phenolic	CP	Cellulosic paper

5 Requirements

In addition to the general requirements given in IEC 61212-1, the moulded tubes shall comply with the additional requirements given in Tables 2a, 2b, 3, 4, 5, 6 and 7, with the exception of the length of tube supplied, which shall be subject to agreement between buyer and seller.

Table 1 – Types of industrial round moulded tubes

Resin	Reinforcement	Serial number	Applications and distinguishing characteristics ^{a)} .															
EP	CC	31	Mechanical, electrical and electronic applications. Good resistance to tracking.															
PF	CC	31	Mechanical and electrical applications. fine weave ^{b)} .															
		32	Similar to type PF CC 31, but of coarse weave ^{b)} .															
		33	Similar to type PF CC 31, but of very coarse weave ^{b)} .															
	CP	31	Electrical and mechanical applications. Good electrical properties when exposed to normal relative humidity.															
		32	Similar to type PF CP 31, but with improved mechanical and electrical properties.															
<p>^{a)} It should not be inferred from the contents of Table 1 that round laminated rolled tubes of any particular type are necessarily unsuitable for applications other than those listed for them, or that specific round laminated rolled tubes will be suitable for all applications within the wide description given.</p> <p>^{b)} Fabric weaves of type CC reinforcements:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><i>Mass per unit area</i> g/m²</th> <th style="text-align: center;"><i>Thread count</i> cm⁻¹</th> </tr> </thead> <tbody> <tr> <td>Very coarse weave</td> <td style="text-align: center;">>200</td> <td style="text-align: center;"><18</td> </tr> <tr> <td>Coarse weave</td> <td style="text-align: center;">>130</td> <td style="text-align: center;">18 to 29</td> </tr> <tr> <td>Fine weave</td> <td style="text-align: center;">≤130</td> <td style="text-align: center;">30 to 37</td> </tr> <tr> <td>Very fine weave</td> <td style="text-align: center;">≤125</td> <td style="text-align: center;">>37</td> </tr> </tbody> </table> <p>These values are only for information. They are not to be considered as specification values. In general, the finer weave materials have better machining characteristics.</p>					<i>Mass per unit area</i> g/m ²	<i>Thread count</i> cm ⁻¹	Very coarse weave	>200	<18	Coarse weave	>130	18 to 29	Fine weave	≤130	30 to 37	Very fine weave	≤125	>37
	<i>Mass per unit area</i> g/m ²	<i>Thread count</i> cm ⁻¹																
Very coarse weave	>200	<18																
Coarse weave	>130	18 to 29																
Fine weave	≤130	30 to 37																
Very fine weave	≤125	>37																

Table 2 – External and internal diameters of round moulded tubes**Table 2a – Permissible deviation from nominal external diameter of round moulded tubes in the “as moulded” condition**

Nominal external diameter D mm	Maximum deviation \pm mm	
	Type	
	PF CP	EP CC PF CC
≤ 3	0,08	--
$3 < D \leq 6$	0,1	--
$6 < D \leq 10$	0,15	--
$10 < D \leq 20$	0,2	0,3
$20 < D \leq 30$	0,3	0,4
$30 < D \leq 50$	0,3	0,4
$50 < D \leq 75$	0,4	0,4
$75 < D \leq 100$	0,5	0,5
$100 < D \leq 150$	0,6	0,6
$150 < D \leq 200$	0,7	0,7
$200 < D \leq 300$	0,75	0,75
$300 < D \leq 500$	0,8	0,8
> 500	1,0	1,0

Test method: see 4.2 of IEC 61212-2.

NOTE A double dash “--” signifies that there is no requirement.

Table 2b – Permissible deviation from nominal external diameter of moulded tubes in ground or turned condition, all types

Nominal external diameter D mm	Maximum deviation ^a \pm mm
≤ 25	0,15
$25 < D \leq 50$	0,25
$50 < D \leq 75$	0,30
$75 < D \leq 100$	0,35
$100 < D \leq 125$	0,45
> 125	0,50

Test method: see 4.2 of IEC 61212-2.

^a If a unilateral tolerance is agreed between purchaser and supplier, the tolerance may not be greater than twice the value given in the table.

Table 3 – Permissible deviation from nominal internal diameter of moulded tubes

Nominal internal diameter <i>d</i> mm	Maximum deviation ^a ± mm
≤ 3	0,10 ^b
3 < <i>d</i> ≤ 30	0,15
30 < <i>d</i> ≤ 50	0,20
50 < <i>d</i> ≤ 75	0,25
75 < <i>d</i> ≤ 100	0,30
100 < <i>d</i> ≤ 150	0,50
150 < <i>d</i> ≤ 200	0,70
200 < <i>d</i> ≤ 300	1,00
300 < <i>d</i> ≤ 500	1,50
> 500	2,00

Test method: see 4.3 of IEC 61212-2.

^a If a unilateral tolerance is agreed between purchaser and supplier, the tolerance may not be greater than twice the value given in the table.

^b Applicable to PF CP types only.

Table 4 – Tolerance on wall thickness for round moulded tubes

Nominal wall thickness <i>t</i> mm	Maximum deviation ± mm		
	Types		
	PF CP PF CP 32	EP CC PF CC 31	PF CC PF CC 33 PF CC 34
≤ 1,5	0,25	0,28	0,40
1,5 < <i>t</i> ≤ 3,0	0,40	0,45	0,60
3,0 < <i>t</i> ≤ 6,0	0,55	0,60	0,85
6,0 < <i>t</i> ≤ 12,0	0,90	1,00	1,35
12,0 < <i>t</i> ≤ 25,0	1,30	1,40	1,90
> 25,0	2,00	2,00	2,70

Test method: see 4.4 of IEC 61212-2.

Table 5 – Departure from straightness for round moulded tubes

Nominal external diameter D mm	Maximum deviation mm
$D < 8$	$8 L^2$
$D \geq 8$	$6 L^2$

Test method: see 4.5 of IEC 61212-2.

The deviation from straightness of any tube shall not exceed the appropriate limiting value given above, where L is the length of the tube in metres.

Table 6 – Property requirements for round moulded tubes

Property	Method of test in IEC 61212-2 (subclause No.)	Unit	Maximum or minimum	Type						Remarks
				EP CC 31	PF CC 31	PF CC 32	PF CC 33	PF CP 31	PF CP 32	
Flexural strength perpendicular to laminations	5.1	MPa	Minimum	80	80	80	80	80	80	Generally applicable to tubes of internal diameter greater than 100 mm but to all tubes where satisfactory test pieces can be produced. For tubes of internal diameter less than 100 mm however, the test for cohesion between layers is an alternative method.
Axial compressive strength	5.2	MPa	Minimum	125	100	100	100	70	100	
Cohesion between layers	5.3	MPa	Minimum	100	90	90	90	60	70	Applicable only to tubes of nominal internal diameter not greater than 100 mm.
Breakdown voltage at 90 °C in oil parallel to laminations	6.1	kV	Minimum	40	5	5	5	10	30	The 20 s step-by-step test and the 1 min proof test for breakdown voltage at 90°C in oil, parallel to laminations, are alternatives.
Electric strength at 90 °C in oil perpendicular to laminations	6.1	kV/mm	Minimum	See Table 7						Applicable only to tubes of nominal wall thickness not greater than 3 mm.
Insulation resistance after immersion in water	6.2	MΩ	Minimum	75	10	5	1	0,1	75	Applicable to tubes of minimum 10 mm nominal external diameter and 8 mm nominal internal diameter.
Dissipation factor 1 MHz 48 Hz to 62 Hz	6.3	–	Maximum	(0,05)	--	--	--	--	--	Conformance with the requirement for either test constitutes conformance with the specification in this respect.
Permittivity 1 MHz 48 Hz to 62 Hz	6.3	–	Maximum	(6,0)	--	--	--	--	--	Conformance with the requirement for either test constitutes conformance with the specification in this respect.
Thermal endurance	7.1	TI		(130)	(120)	(120)	(120)	(120)	(120)	
Water absorption	7.2	mg/cm ²	Maximum	3,0	5,0	6,0	8,0	8,0	3,0	
Density	7.3	g/cm ³	Range	(1,20 – 1,40)	(1,20 – 1,40)	(1,20 – 1,40)	(1,20 – 1,40)	(1,20 – 1,40)	(1,20 – 1,40)	
Values in brackets "()" are intended to give only general guidance and are not to be considered as requirement of this standard.										
NOTE A double dash "--" signifies that there is no requirement.										

Table 7 – Electric strength at 90 °C in oil, perpendicular to laminations for laminated tubes (1 min proof test or 20 s step-by-step test)^a (kV/mm)

Type	Nominal wall thickness of test specimen ^b											
	mm											
	1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,5	2,6	2,8	3,0
EP CC 31	7,5	6,8	6,3	5,9	5,5	5,3	5,1	5,0	4,9	4,8	4,7	4,7
PF CC 31	2,4	2,3	2,2	2,1	2,1	2,0	1,9	1,9	1,8	1,8	1,7	1,6
PF CC 32	2,4	2,3	2,2	2,1	2,1	2,0	1,9	1,9	1,8	1,8	1,7	1,6
PF CC 33	--	--	--	--	--	2,0	1,9	1,9	1,8	1,8	1,7	1,6
PF CP 31	7,5	6,8	6,3	5,9	5,5	5,3	5,1	5,0	4,9	4,8	4,7	4,7
PF CP 32	9,7	9,0	8,2	7,8	7,4	7,0	6,7	6,5	6,4	6,3	6,2	6,1

Test method: see 6.1 of IEC 61212-2.

NOTE A double dash "--" signifies that there is no requirement.

^a The requirements for the 20 s step-by-step test and the 1 min proof test for electric strength at 90 °C in oil, perpendicular to laminations, are alternatives. A material meeting either requirement is deemed to comply with the specification with respect to electric strength at 90 °C in oil, perpendicular to laminations.

^b If the nominal wall thickness of the test specimen lies between two values of wall thickness shown in the above table, the limit is obtained by interpolation. If the nominal wall thickness is below the minimum thickness for which a limit is given, the electric strength limit appropriate to the minimum thickness shall apply. For nominal wall thicknesses greater than 3,0 mm, the values for 3,0 mm shall apply.



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