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Second edition
2006-03

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

**Part 3:
Specifications for individual materials –
Sheet 1: Round laminated rolled 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 1: Round laminated rolled tubes**

FOREWORD

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International Standard IEC 61212-3-1 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
15/272/FDIS	15/305/RVD

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

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

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

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- withdrawn;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.

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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 61212-3-1 contains one of the specification sheets comprising Part 3, as follows:

Sheet 1: Round laminated rolled tubes.

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

Part 3: Specifications for individual materials – Sheet 1: Round laminated rolled tubes

1 Scope

This part of IEC 61212-3 gives requirements for industrial rigid round laminated rolled 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*¹

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.

¹ To be published

3.1**round laminated rolled tube (as applied to thermosets)**

tube formed by rolling impregnated layers of material on a mandrel between heated pressure rolls, curing in an oven, then removing the mandrel

[ISO 472 MOD]

4 Designations and abbreviations**4.1 General**

The round laminated rolled tubes covered by this standard 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 “2” indicates rolled tubes, and, a second digit denoting sub-grades of the same type.

The abbreviations are given in 4.3.

The complete designation of the rolled tube is denoted by:

- description: rolled tube;
- number of the IEC standard: IEC 61212-3-1;
- designation of the individual type;
- dimensions (in millimetres) of the rolled tube: internal diameter x external (diameter) x length;
- a letter designating the finish on the external diameter of the rolled tube:
 - “A” designating tubes in the “as produced” condition;
 - “B” designating tubes in ground or turned condition.

EXAMPLE

Rolled tube, IEC 61212-3-1 – EP GC 21 – 25×6×1000 – A

4.3 Abbreviations

Types of resin		Types of reinforcement	
EP	Epoxy (epoxide)	CC	Woven cotton cloth
MF	Melamine	CP	Cellulosic paper
PF	Phenolic	GC	Woven glass cloth
SI	Silicone	MP	Mica paper

5 Requirements

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

Table 1 – Types of round rolled laminated tubes

Resin	Reinforce-ment	Serial number	Applications and distinguishing characteristics ^a
EP	GC	21	Mechanical, electrical and electronic applications. Extremely high mechanical strength at moderate temperatures. Very good stability of electrical properties when exposed to high relative humidity.
		22	Similar to EP GC 21, but with high mechanical strength at elevated temperature.
		23	Similar to EP GC 21, but with improved flame resistance.
	MP	21	Mechanical, electrical and electronic applications. Good stability of electrical properties when exposed to high relative humidity. Good heat resistance.
MF	GC	21	Mechanical and electrical applications. High mechanical strength. Good arc and tracking resistance.
PF	CC	21	Mechanical and electrical applications. Fine weave ^b .
		22	Mechanical and electrical applications. Coarse weave ^b .
		23	Mechanical applications. Very coarse weave ^b .
		24	Similar to PF CC 21. For close tolerance machining applications (very fine weave) ^p
	CP	21	Mechanical and low voltage electrical applications. Good electrical properties when exposed to normal relative humidity.
		22	High voltage electrical applications at power frequencies. High electric strength in oil.
		23	Similar to type PF CP 21, but with improved electrical properties when exposed to high relative humidity.
	GC	21	Mechanical and electrical applications. Very high mechanical strength at moderate temperatures.
SI	GC	21	Mechanical, electrical and electronic applications when exposed to high relative humidity.
	MP	21	Mechanical, electrical and electronic applications. Good stability of electrical properties at elevated temperatures.

^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.

^b Fabric weaves of type CC reinforcements:

	Mass per unit area g/m ²	Thread count cm ⁻¹
Very coarse weave	>200	<18
Coarse weave	>130	18 to 29
Fine weave	≤130	30 to 37
Very fine weave	≤125	>37

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.

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

Nominal external diameter D mm	Maximum deviation ^a ± mm	
	Type	
	PF CP	All other types
≤ 10	0,2	0,4
10 < D ≤ 20	0,3	0,5
20 < D ≤ 50	0,3	0,5
50 < D ≤ 75	0,4	0,7
75 < D ≤ 100	0,5	1,0
100 < D ≤ 150	0,6	1,5
150 < D ≤ 200	0,7	1,7
200 < D ≤ 300	0,9	2,0
300 < D ≤ 500	1,2	2,2
> 500	1,5	2,5
Test method: see 4.2 of IEC 61212-2		
^a If a unilateral tolerance is agreed between purchaser and supplier, the tolerance shall not exceed twice the value given in the table.		

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

Nominal external diameter D mm	Maximum deviation ^a ± mm
≤ 10	0,15
10 < D ≤ 25	0,20
25 < D ≤ 50	0,25
50 < D ≤ 75	0,30
75 < D ≤ 100	0,35
100 < D ≤ 125	0,45
125 < D ≤ 200	0,50
>200	b
Test method: see 4.2 of IEC 61212-2	
^a If a unilateral tolerance is agreed between purchaser and supplier, the tolerance shall not exceed twice the value given in the table.	
^b By agreement between purchaser and manufacturer.	

Table 3 – Permissible deviation from nominal internal diameter of round rolled tubes, all types

Nominal internal diameter d mm	Maximum deviation ^a ± mm
≤ 3	0,10
$3 < d \leq 30$	0,15
$30 < d \leq 50$	0,20
$50 < d \leq 75$	0,30
$75 < d \leq 100$	0,40
$100 < d \leq 150$	0,50
$150 < d \leq 200$	0,70
$200 < d \leq 300$	1,00
$300 < d \leq 500$	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.

Table 4 – Tolerance for wall thickness for round rolled tubes

Nominal wall thickness t mm	Maximum deviation ± mm	
	All PF CP types	All other types
$\leq 1,5$	0,25	0,40
$1,5 < t \leq 3,0$	0,40	0,50
$3,0 < t \leq 6,0$	0,50	0,50
$6,0 < t \leq 12,0$	0,80	0,80
$12,0 < t \leq 25,0$	1,20	1,20
$> 25,0$	1,60	1,60

Test method: see 4.4 of IEC 61212-2

Table 5 – Departure from straightness for round rolled tubes

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

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.

Test method: see 4.5 of IEC 61212-2