BS EN 61212-3-1:2013

BSI Standards Publication

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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National foreword

This British Standard is the UK implementation of EN 61212-3-1:2013. It is identical to IEC 61212-3-1:2013. It supersedes BS EN 61212-3-1:2006, which will be withdrawn on 3 June 2016.

The UK participation in its preparation was entrusted by Technical Committee GEL/15, Solid electrical insulating materials, to Subcommittee GEL/15/6, Rigid fibrous reinforced laminates for electrical purposes.

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 61212-3-1

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English version

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

(IEC 61212-3-1:2013)

Matériaux isolants -
Tubes et barres industriels rigides, ronds, stratifiés, à base de résines thermodurcissables, à usages électriques
-
Partie 3: Spécifications pour matériaux particuliers -
Feuille 1: Tubes ronds stratifiés enroulés
(CEI 61212-3-1:2013)

Isolierstoffe – Runde Rohre und Stäbe aus technischen Schichtpressstoffen auf der Basis warmhärtender Harze für elektrotechnische Zwecke – Teil 3: Bestimmungen für einzelne Werkstoffe – Blatt 1: Runde, gewickelte Rohre aus technischen Schichtpressstoffen
(IEC 61212-3-1:2013)

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Foreword

The text of document 15/699/FDIS, future edition 3 of IEC 61212-3-1, prepared by IEC/TC 15 "Solid electrical insulating materials", was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61212-3-1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-03-03
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-06-03

This document supersedes EN 61212-3-1:2006.

EN 61212-3-1:2013 includes the following significant technical changes with respect to EN 61212-3-1:2006:

Details of test for insulation resistance after immersion in water and values for permissible deviation from nominal external diameter of round rolled tubes in the “as rolled and cured” condition are changed.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61212-3-1:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61212-3 series	NOTE	Harmonized in EN 61212-3 series (not modified).
ISO 472:1999	NOTE	Harmonized as EN ISO 472:2001 (not modified).

Annex ZA
(normative)
Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61212-1	-	Insulating materials - Industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes - Part 1: Definitions, designations and general requirements	EN 61212-1	-
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	EN 61212-2	2006

CONTENTS

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.

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 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *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*

3 Terms and definitions

For the purposes of this document, the following term and definition apply.

3.1
round laminated rolled tube
<thermosets> tube formed by rolling impregnated layers of material on a mandrel between heated pressure rolls, curing in an oven, then removing the mandrel

[SOURCE: ISO 472:1999, modified – The word “round” has been added to the term.]

4 Designations and abbreviations

4.1 General

The round laminated rolled tubes covered by this Part 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 “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 × external diameter × 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 × 30 × 1 000 – 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 2, 3, 4, 5, 6, 7, and 8, 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 rolled tubes

Resin	Reinforcement	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) [b] .
	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.

Table 2 – 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**
≤ 0	0,3	0,5
10 < *D* ≤ 20	0,4	0,6
20 < *D* ≤ 50	0,4	0,6
50 < *D* ≤ 75	0,5	0,7
75 < *D* ≤ 100	0,7	1,2
100 < *D* ≤ 150	1,0	1,7
150 < *D* ≤ 200	1,2	1,9
200 < *D* ≤ 300	1,4	2,2
300 < *D* ≤ 500	1,6	2,5
> 500	1,8	3,0
Test method: see 4.1 of IEC 61212-2:2006.		

[a] If a unilateral tolerance is agreed between purchaser and supplier, the tolerance shall not exceed twice the value given in the table.

Table 3 – 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 61212-2:2006.	

[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 4 – 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* ≤ 30	0,15
30 < *d* ≤ 50	0,20
50 < *d* ≤ 75	0,30
75 < *d* ≤ 100	0,40
100 < *d* ≤ 150	0,50
150 < *d* ≤ 200	0,70
200 < *d* ≤ 300	1,00
300 < *d* ≤ 500	1,50
> 500	2,00
Test method: see 4.3 of IEC 61212-2:2006.	
[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 5 – Tolerance on wall thickness for round rolled tubes

Nominal wall thickness *t* mm	**Maximum deviation** ± mm	
	All PF CP types	**All other types**
≤ 1,5	0,25	0,40
1,5 < *t* ≤ 3,0	0,40	0,50
3,0 < *t* ≤ 6,0	0,50	0,50
6,0 < *t* ≤ 12,0	0,80	0,80
12,0 < *t* ≤ 25,0	1,20	1,20
> 25,0	1,60	1,60
Test method: see 4.4 of IEC 61212-2:2006.		

Table 6 – Departure from straightness for round rolled tubes

Nominal external diameter *D* mm	**Maximum deviation** mm
$D < 8$	$8\ L^2$
$D \geq 8$	$6\ L^2$
Test method: see 4.5 of IEC 61212-2:2006. The departure 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 7– Property requirements for round rolled tubes

Property	Method of test IEC 61212-2:2006 (Subclause No.)	Unit	Maximum or minimum	Type															Remarks
				EP GC 21	EP GC 22	EP GC 23	EP MP 21	MF GC 21	PF CC 21	PF CC 22	PF CC 23	PF CC 24	PF CP 21	PF CP 22	PF CP 23	PF GC 21	SI GC 21	SI MP 21	
Flexural strength perpendicular to laminations	5.1	MPa	minimum	300	300 [a]	300	100	120	90	80	80	100	100	100	100	140	100	75	Generally applicable to tubes where satisfactory test pieces according to IEC 61212-2:2006, 5.1.1, can be produced. For all others the test for cohesion between layers can be an alternative method.
Axial compressive strength	5.2	MPa	minimum	175	175	175	60	80	110	100	100	120	100	80	100	120	40	40	
Cohesion between layers	5.3	MPa	minimum	200	200	200	30	150	90	90	90	100	70	70	70	200	50	25	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	40	40	30	10	10	10	8	10	15	50 [b]	25	15	35	20	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 8															Applicable only to tubes of nominal wall thickness not greater than 3 mm.
Insulation resistance after immersion in water	6.2	MΩ	minimum	1 000	1 000	1 000	100	0,1	10	2	0,5	2	1	1	5	20	100	10	

Property	Method of test IEC 61212-2:2006 (Subclause No.)	Unit	Maximum or minimum	Type															Remarks
				EP GC 21	EP GC 22	EP GC 23	EP MP 21	MF GC 21	PF CC 21	PF CC 22	PF CC 23	PF CC 24	PF CP 21	PF CP 22	PF CP 23	PF GC 21	SI GC 21	SI MP 21	
Dissipation factor 1 MHz 48 Hz to 62 Hz	6.3	-	maximum	(0,04) (0,05)	(0,04) (0,05)	(0,04) (0,05)	(0,04) --	(0,02) --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	(0,04) --	(0,01) (0,05)	(0,02) --	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	(5,2) --	(5,2) --	(5,2) --	(5,2) --	(8,0) --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	(6,0) --	(5,0) --	(5,3) --	Conformance with the requirement for either test constitutes conformance with the specification in this respect.
Thermal endurance	7.1	TI		(130)	(155)	(130)	(155)	(130)	(120)	(120)	(120)	(120)	(120)	(120)	(120)	(130)	(180)	(180)	
Water absorption	7.2	mg/cm^2	maximum	1,5	1,5	1,5	2,0	5,0	5,0	10,0	13,0	5,0	10,0	10,0	5,0	3,0	2,0	3,5	
Density	7.3	g/cm^3	Range	(1,70 – 1,90)	(1,70 – 1,90)	(1,70 – 1,90)	(1,50 – 1,80)	(1,70 – 1,90)	(1,15 – 1,35)	(1,15 – 1,35)	(1,15 – 1,35)	(1,15 – 1,35)	(1,10 – 1,20)	(1,05 – 1,15)	(1,10 – 1,20)	(1,70 – 1,90)	(1,60 – 1,80)	(1,60 – 1,90)	
Flammability	7.4	Cate-gory	-	--	--	V-0	--	V-0	--	--	--	--	--	--	--	--	V-0	V-0	The small-scale laboratory test used in this standard for assigning a flammability category is primarily for monitoring consistency of production of products. The results so obtained should not in any circumstances be considered as an overall indication of the potential fire hazards presented by these products under actual conditions of use.

Values in brackets "( )" are typical values intended to give only general guidance and are not to be considered as requirement of this standard.

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

[a] For type EP GC 22: The flexural strength measured at 150 °C ± 5 K after conditioning for 1 h at 150 °C ± 5 K in air shall not be less than 50 % of the value specified in the table.

[b] After preconditioning in air at 105 °C ± 5 K for 96 h immediately before test and transferring immediately into the hot oil.

Table 8 – Electric strength at 90 °C in oil, perpendicular to laminations, for round rolled tubes (1 min proof test or 20 s step-by-step test) [a] (kV/mm)

Type	Nominal wall thickness of test specimen[b] mm														
	0,5	**0,6**	**0,8**	**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 GC 21	--	--	12,2	11,6	11,0	10,4	9,8	9,4	9,0	8,7	8,4	8,2	8,1	7,9	7,7
EP GC 22	--	--	12,2	11,6	11,0	10,4	9,8	9,4	9,0	8,7	8,4	8,2	8,1	7,9	7,7
EP GC 23	--	--	12,2	11,6	11,0	10,4	9,8	9,4	9,0	8,7	8,4	8,2	8,1	7,9	7,7
EP MP 21	17,0	16,5	15,8	15,0	14,0	13,5	13,0	12,5	12,0	11,8	11,6	11,5	11,4	11,2	11,0
MF GC 21	--	--	4,9	4,8	4,6	4,4	4,2	4,1	4,0	3,9	3,8	3,7	3,6	3,4	3,3
PF CC 21	--	--	2,5	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 22	--	--	--	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 23	--	--	--	--	--	--	--	--	2,0	1,9	1,9	1,8	1,8	1,7	1,6
PF CC 24	--	--	2,5	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 CP 21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PF CP 22 [c]	--	--	--	13,5	12,8	12,2	11,6	11,2	10,8	10,5	10,3	10,2	10,1	10,0	9,9
PF CP 23	13,0	12,2	10,7	9,7	9,0	8,2	7,8	7,4	7,0	6,7	6,5	6,4	6,3	6,2	6,1
PF GC 21	--	--	7,0	6,8	6,5	6,3	6,0	5,8	5,6	5,4	5,3	5,2	5,1	4,9	4,8
SI GC 21	--	--	8,6	8,3	8,0	7,8	7,5	7,3	7,0	6,8	6,6	6,5	6,4	6,2	6,0
SI MP 21	17,0	16,5	15,8	15,0	14,0	13,5	13,0	12,5	12,0	11,8	11,6	11,5	11,4	11,2	11,0

Test method: see 6.1 of IEC 61212-2:2006.

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.

c After preconditioning in air at 105 °C ± 5 K for 96 h immediately before test and transferring immediately into the hot oil.

Bibliography

IEC 61212-3 (all sheets), *Insulating materials – Industrial rigid round laminated tubes and rods based on thermosetting resins for electrical purposes – Part 3: Specifications for individual materials*

ISO 472:1999, *Plastics – Vocabulary*

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