IEC 60893-3-2

Edition 2.1 2011-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-2: Specifications for individual materials – Requirements for rigid laminated sheets based on epoxy resins

Matériaux isolants – Stratifiés industriels rigides en planches à base de résines thermodurcissables à usages électriques – Partie 3-2: Spécifications pour matériaux particuliers – Prescriptions pour stratifiés rigides en planches à base de résine époxyde

IEC 60893-3-2:2003+A1:2011

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 29.035.01

ISBN 978-2-88912-739-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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This consolidated version of IEC 60893-3-2 consists of the third edition (2003) [documents 15C/1522/FDIS and 15C/1536/RVD] and its amendment 1 (2011) [documents 15/505/CDV+15/540/CDV and 15/632/RVC+15/592A/RVC]. It bears the edition number 2.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC has been prepared by subcommittee 15C: Specifications, of IEC technical committee 15: Insulating materials.

The amendment introduces new/improved limits of CHARPY impact strength and IZOD impact strength for all types of rigid laminated sheets based on epoxy resins and new/improved limits of breakdown voltage to all EP GC types and a new/improved limit of flexural strength for the EP PC 301 and a new limit of proof tracking index for the EP GC 306 type. This amendment also introduces new types of rigid laminated sheets based on epoxy resins.

In this revision of the IEC 60893 series of specifications, new material types have been included, changes have been made to the property requirements of some existing types, a new method for testing permittivity and dissipation factor has been added, and all non-specification data for each type has been moved to a new Part 4 document – IEC 60893-4 – Typical values.

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability 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.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

This part of IEC 60893 is one of a series which deals with industrial rigid laminated sheets based on thermosetting resins for electrical purposes.

This series consists of four parts:

Part 1: Definitions, designations and general requirements (IEC 60893-1)

Part 2: Methods of test (IEC 60893-2)

Part 3: Specifications for individual materials (IEC 60893-3)

Part 4: Typical values (IEC 60893-4)

IEC 60893-3-2 contains one of the specification sheets comprising Part 3, as follows:

Sheet 2: Requirements for rigid laminated sheets based on epoxy resins

INSULATING MATERIALS – INDUSTRIAL RIGID LAMINATED SHEETS BASED ON THERMOSETTING RESINS FOR ELECTRICAL PURPOSES –

Part 3-2: Specifications for individual materials – Requirements for rigid laminated sheets based on epoxy resins

1 Scope

This part of IEC 60893 gives the requirements for industrial rigid laminated sheets for electrical purposes based on epoxy 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.

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 60893-1:—, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements* [1]

IEC 60893-2:2003, *Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 2: Methods of test*

IEC 61189-2:2006, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 2: Test methods for materials for interconnection structures*

IEC 61249-2-21:2003, *Materials for printed boards and other interconnecting structures – Part 2-21: Reinforced base materials, clad and unclad - Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad*

3 Designation

The sheets covered by this specification are classified into types which differ in the reinforcement employed and in their distinguishing properties. The sheets are designated by:

– the IEC standard number;
– a two-letter abbreviation denoting the resin;
– a second two-letter abbreviation, denoting the reinforcement;
– a serial number;

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[1] To be published

– nominal thickness x width x length in millimetres.

Example of designation: Industrial rigid laminated sheet of type EP GC 201 with a nominal thickness of 10 mm, 500 mm wide, 1 000 mm long:

Sheet IEC 60893-3-2 – EP GC 201 - 10 × 500 × 1 000.

The following abbreviations are used in this Part 3 sheet:

Type of resin		*Type of reinforcement*	
EP	Epoxy (epoxide)	CC	Woven cotton cloth
		CP	Cellulosic paper
		GC	Woven glass cloth
		GM	Glass mat
		PC	Woven polyester fibre cloth

4 Requirements

In addition to the general requirements given in IEC 60893-1, the laminated sheets shall also comply with the dimensional requirements given in Tables 2, 3, and 4 as well as with the other requirements given in Tables 5, 6 and 7.

Table 1 – Types of industrial rigid laminated sheets based on epoxy resins

Laminate type			Applications and distinguishing characteristics [b]
Resin	**Reinforcement**	**Serial number** [a]	
EP	CC	301	Mechanical and electrical applications. Good resistance to electrical tracking, good wear and chemical resistance (fine weave [c])
	CP	201	Electronic applications. Good stability of electrical properties in high humidity. Low flammability
	CG	201	Mechanical, electrical and electronic applications. Extremely high mechanical strength at moderate temperature. Very good stability of electrical properties in high humidity
		202	Similar to type EP GC 201. Low flammability
		203	Similar to type EP GC 201. High mechanical strength at elevated temperature
		204	Similar to type EP GC 203. Low flammability
		205	Similar to type EP GC 203, but with roving cloth
		306	Similar to type EP GC 203, but with improved tracking indices
		307	Similar to type EP GC 205, but with improved tracking indices
		308	Similar to type EP GC 203, but with improved thermal endurance properties
		309	Similar to EP GC 201, but with defined mechanical strength at elevated temperature
		310	Similar to EP GC 202, but with halogen free compound
		311	Similar to EP GC 204, but with halogen free compound
	GM	201	Mechanical and electrical applications. Extremely high mechanical strength at moderate temperature. Very good electrical properties in high humidity
		202	Similar to type EP GM 201. Low flammability
		203	Similar to type EP GM 201. High mechanical strength at elevated temperature
		204	Similar to type EP GM 203. Low flammability
		305	Similar to type EP GM 203, but with improved thermal endurance properties
		306	Similar to type EP GM 305, but with improved tracking indices
	PC	301	Electrical and mechanical applications. Good resistance to SF_6 (coarse weave [c])

[a] This specification was originally based on ISO 1642 [1][2], which is now obsolete. Consequently, the type designations of the 200 series types come from ISO 1642 and those of the 300 series were added later.

[b] It should not be inferred from the contents of Table 1 that laminates of any particular type are necessarily unsuitable for applications other than those listed for them, or that specific laminates will be suitable for all applications within the wide description given.

[c] Fabric weaves of type PC and CC reinforcements:

	Mass per unit area g/m^2	*Thread count* cm^{-1}
Coarse weave	>130	≤30
Fine weave	≤130	>30
Very fine weave	≤125	>38

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.

The definition of halogen free epoxy laminated sheet is given in IEC 61249-2-21:2003:

The maximum total halogens contained in the resin plus reinforcement matrix no greater than 1500 ppm with a maximum chlorine content of 900 ppm and maximum bromine content of 900 ppm. The test method for determination of the halogen content is given in IEC 61189-2:2006.

[2] The figure in square brackets refers to the bibliography.

Table 2 – Tolerances on thickness
(test method: see 4.1 of IEC 60893-2)

Nominal thickness mm	Tolerance (all types) ±mm					
	EP CC 301	EP CP 201	EP GC 201; 202 203; 204 306; 308 309; 310; 311	EP GC 205; 307	EP GM 201; 202 203; 204 305; 306	EP PC 301
0,4	–	0,07	0,10	–	–	–
0,5	–	0,08	0,12	–	–	–
0,6	–	0,09	0,13	–	–	–
0,8	0,16	0,10	0,16	–	–	–
1,0	0,18	0,12	0,18	–	–	–
1,2	0,19	0,14	0,20	–	–	0,21
1,5	0,19	0,16	0,24	–	0,30	0,24
2,0	0,22	0,19	0,28	–	0,35	0,28
2,5	0,24	0,22	0,33	–	0,40	0,33
3,0	0,30	0,25	0,37	0,50	0,45	0,37
4,0	0,34	0,30	0,45	0,60	0,50	0,45
5,0	0,39	0,34	0,52	0,70	0,55	0,52
				For EP GC 205; 307, plus only for 6 mm and above		
6,0	0,44	0,37	0,60	**1,60**	0,60	0,60
8,0	0,52	0,47	0,72	**1,90**	0,70	0,72
10,0	0,60	–	0,82	**2,20**	0,80	0,82
12,0	0,68	–	0,94	**2,40**	0,90	0,94
14,0	0,74	–	1,02	**2,60**	1,00	1,02
16,0	0,80	–	1,12	**2,80**	1,10	1,12
20,0	0,93	–	1,30	**3,00**	1,30	1,30
25,0	1,08	–	1,50	**3,50**	1,40	1,50
30,0	1,22	–	1,70	**4,00**	1,45	1,70
35,0	1,34	–	1,95	**4,40**	1,50	1,95
40,0	1,47	–	2,10	**4,80**	1,55	2,10
45,0	1,60	–	2,30	**5,10**	1,65	2,30
50,0	1,74	–	2,45	**5,40**	1,75	2,45
60,0	2,02	–	–	**5,80**	1,90	-
70,0	2,32	–	–	**6,20**	2,00	-
80,0	2,62	–	–	**6,60**	2,20	-
90,0	2,92	–	–	**6,80**	2,35	-
100,0	3,22	–	–	**7,00**	2,50	-

Where the nominal thickness is not one of the preferred thicknesses listed, then the tolerance for the next higher preferred nominal thickness shall apply.

NOTE Other tolerances may be agreed between the supplier and the purchaser.

Table 3 – Flatness
(test method: see 4.2 of IEC 60893-2)

Thickness ***d*** mm	**Length of straight edge** mm	
	1 000	**500**
$3 < d \leq 6$	10	2,5
$6 < d \leq 8$	8	2,0
$8 < d$	6	1,5

Table 4 – Tolerances on width of cut strips (minus tolerances only)

Nominal thickness ***d*** mm	**Nominal width, all types** mm					
	$3 < b \leq 50$	**$50 < b \leq 100$**	**$100 < b \leq 160$**	**$160 < b \leq 300$**	**$300 < b \leq 500$**	**$500 < b \leq 600$**
0,4	0,5	0,5	0,5	0,6	1,0	1,5
0,5	0,5	0,5	0,5	0,6	1,0	1,5
0,6	0,5	0,5	0,5	0,6	1,0	1,5
0,8	0,5	0,5	0,5	0,6	1,0	1,0
1,0	0,5	0,5	0,5	0,6	1,0	1,0
1,2	0,5	0,5	0,5	1,0	1,2	1,2
1,5	0,5	0,5	0,5	1,0	1,2	1,2
2,0	0,5	0,5	0,5	1,0	1,2	1,5
2,5	0,5	1,0	1,0	1,5	2,0	2,5
3,0	0,5	1,0	1,0	1,5	2,0	2,5
4,0	0,5	2,0	2,0	3,0	4,0	5,0
5,0	0,5	2,0	2,0	3,0	4,0	5,0

NOTE Unilateral, all-negative tolerances are normally applied to the width of cut strips, and are given in the above table. Other tolerances may be agreed upon between purchaser and supplier.

Table 5 – Property requirements

Property	Test method in IEC 60893-2 Subclause	Unit	Minimum or maximum	Nominal thickness of sheet to which test is applicable mm	Type								Remarks
					EP CC 301	EP CP 201	EP GC 201	EP GC 202	EP GC 203	EP GC 204	EP GC 205	EP GC 306	
Flexural strength	5.1	MPa	Minimum	≥1,5	135	110	340	340	340 [1)]	340 [1)]	340 [1)]	340 [1)]	[1)] Flexural strength measured at 150 °C ± 3 K after 1 h at 150 °C ± 3 K not to be less than 50 % of the specified value
Charpy impact strength parallel to laminations	5.4.2	kJ/m^2	Minimum	≥5	3,5	--	33	33	33	33	50	33	Conformance with the requirements for either the Charpy or Izod test constitutes, in this respect, conformance with this specification
Izod impact strength parallel to laminations	5.4.3	kJ/m^2	Minimum	≥5	6,5	--	34	34	34	34	54	35	
Electric strength at 90 °C in oil perpendicular to laminations	6.1	kV/mm	Minimum	≤3	See Table 6								
Breakdown voltage at 90 °C in oil parallel to laminations	6.1	kV	Minimum	>3	35	20	35	35	35	35	35	35	
Insulation resistance after immersion in water	6.3	MΩ	Minimum	All	$1x10^3$	$1×10^4$	$5×10^4$	$5×10^4$	$5×10^4$	$5×10^4$	$1×10^4$	$5x10^4$	
Proof tracking index	6.4	–	Minimum	–									
Thermal endurance	7.1	TI	Minimum	≥3									
Flammability	7.2	Category		3	–	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 laminates. The results so obtained should not in any circumstances be considered as an overall indication of the potential fire hazards presented by these laminates under actual conditions of use
Water absorption	8.2	mg	Maximum	All	See Table 7								