

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

**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**

<https://standards.iteh.ai/catalog/standards/sist/3494bc06-626c-4215-b1f0->

<https://standards.iteh.ai/catalog/standards/sist/3494bc06-626c-4215-b1f0->

**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**



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FOREWORD

This amendment 1 of IEC 60893-3-2 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This 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.

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

CDV	Report on voting
15/505/CDV	15/632/RVC
15/540/CDV	15/592A/RVC

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

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 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, <https://standards.iteh.ai/catalog/standards/sist/3494bc06-626c-4215-b1f0-85cebc58ba99/iec-60893-3-2-2003-amd1-2011>
- withdrawn,
- replaced by a revised edition, or
- amended.

2 Normative references

Add the following references to the existing list:

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*

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*

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

Below type designation EP GC 308, add the following new designations:

EP	GC	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

Below Table 1, add the following text to the notes:

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.

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Table 2 – Tolerances on thickness

[IEC 60893-3-2:2003/AMD1:2011](http://standards.iteh.ai/catalog/standards/sis/60893-3-2-2003-amd1-2011)

In the heading of the 4th column (EP GC), add 309, 310, 311.

<http://standards.iteh.ai/catalog/standards/sis/60893-3-2-2003-amd1-2011>

Replace the existing Table 5 with the following new Table 5:

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	110	340	340	340 ^a	340 ^a	340 ^a	340 ^a	340 ^a	340 ^a	^a 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 or 5.4.3	kJ/m ²	Minimum	≥5	--	42	42	50	50	50	70	50	50	Conformance with the requirements for either the Charpy or Izod test constitutes, in this respect, conformance with this specification.
Electric strength at 90 °C in oil perpendicular to laminations	6.1.	kV/mm	Minimum	≤3										
Breakdown voltage at 90 °C in oil parallel to laminations	6.1	kV	Minimum	>3	35	45	45	45	45	45	45	45	45	
Insulation resistance after immersion in water	6.3	MΩ	Minimum	All	1×10 ³	1×10 ⁴	5×10 ⁴	5×10 ⁴	5×10 ⁴	5×10 ⁴	1×10 ⁴	5×10 ⁴	5×10 ⁴	
Proof tracking index	6.4	-	Minimum	-	-	-	-	-	-	-	-	-	500	
Thermal endurance (TI)	7.1	-	Minimum	≥3	-	-	-	-	-	-	-	-	-	
Flammability	7.2	Category	-	3	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 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

NOTE A dash “-” indicates that there is no requirement for this grade.

Table 5 (continued)

Property	Test method in IEC 60893-2 Subclause	Unit	Maximum or Minimum	Nominal thickness of sheet to which test is applicable mm	Type								Remarks		
					EP GC 307	EP GC 308	EP GM 201	EP GM 202	EP GM 203	EP GM 204	EP GM 305	EP GM 306		EP PC 301	
Flexural strength	5.1	MPa	Minimum	≥1,5	340 ^a	340 ^a	320	320	320 ^a	320 ^a	320 ^a	320 ^a	320 ^a	140	a 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 or Izod impact strength parallel to laminations	5.4.2 or 5.4.3	kJ/m ²	Minimum	≥5	70	50	50	50	50	50	50	50	50	55	Conformance with the requirement for either Charpy or Izod test constitutes conformance with the specification in this respect.
Electric strength at 90 °C in oil perpendicular to laminations	6.1	https://standards.iteh.ai/catalog/standards/sist/3494bc06-626c-4215-b1f0-8f6c6c58ba99/iec-60893-3-2-2003-amd1-2011	Minimum	≥3	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	See Table 6	
Breakdown voltage at 90 °C in oil parallel to laminations	6.1	kV	Minimum	>3	45	45	35	35	35	35	35	35	35	45	
Insulation resistance after immersion in water	6.3	MΩ	Minimum	All	1×10 ⁴	5×10 ⁴	5×10 ³	5×10 ³	5×10 ³	5×10 ³	5×10 ³	5×10 ³	5×10 ³	1×10 ²	
Proof tracking index	6.4	-	Minimum	-	500	-	-	-	-	-	-	-	500	-	The thermal endurance test is regarded as a classification test for types EP GC 308, EP GM 305 and EP GM 306. The test is not normally regarded as a production control test.
Thermal endurance (TI)	7.1	-	Minimum	≥3	-	180	-	-	-	-	-	-	180	-	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.
Flammability	7.2	Category	-	3	-	-	-	-	V-0	-	-	-	-	-	
Water absorption	8.2	mg	Maximum	All	-	-	-	-	-	-	-	-	-	-	

NOTE 1 For all EP GM types, compliance with this standard is not required for the outer 13 mm strip from the edges of the untrimmed sheets.

NOTE 2 A dash “-” indicates that there is no requirement for this grade.

In Table 5 (continued), add the following columns behind EP GC 308:

Table 5 (continued)

Property	Test method in IEC 60893-2 Subclause	Unit	Maximum or Minimum	Nominal thickness of sheet to which test is applicable mm	Type			Remarks
					EP GC 309	EP GC 310	EP GC 311	
Flexural strength	5.1	MPa	Minimum 340 ^a	≥1,5 IEC 60893-3-2:2005/AMDI:2011 https://standards.iteh.ai/catalog/standards/sist/3494bc06-626c-4215-b1f0-83cbbc58ba99/iec-60893-3-2-2005-3-amdi-2011	340 ^a	340 ^b	<p>^a Flexural strength measured at 130 °C ± 3 K after 1 h at 130 °C ± 3 K not to be less than 50 % of the specified value</p> <p>^b 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</p>	
Charpy impact strength or Izod impact strength parallel to laminations	5.4.2 or 5.4.3	kJ/m ²	Minimum	≥5	42	50	Conformance with the requirement for either Charpy or Izod test constitutes conformance with the specification in this respect.	
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	45	45		
Insulation resistance after immersion in water	6.3	MΩ	Minimum	All	5×10 ⁴	5×10 ⁴		
Proof tracking index	6.4	–	Minimum	–	–	–		
Thermal endurance	7.1	Tl	Minimum	≥3	–	–	The thermal endurance test is regarded as a classification test for types EP GC 308, EP GC 305 and EP GC 306. The test is not normally regarded as a production control test.	
Flammability	7.2	Category		3	V-0 ^c	V-0 ^c	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. ^c The compound must be free of halogens.	
Water absorption	8.2	mg	Maximum	All	See Table 7			

NOTE A dash “–” indicates that there is no requirement for this grade.

Replace the existing Table 6 by the following new Table 6:

Table 6 – Electric strength at 90 °C in oil, perpendicular to laminations
(1 min proof test or 20 s step-by-step test)^a (kV/mm)

Type	Mean measured thickness of test specimens ^b mm																	
	0,4	0,5	0,6	0,7	0,8	0,9	1,0	1,2	1,4	1,5	1,8	2,0	2,2	2,4	2,5	2,6	2,8	3,0
EP CC 301	-	-	-	-	10,0	9,6	9,2	8,6	8,2	8,0	7,4	7,1	6,8	6,5	6,4	6,2	5,6	5,0
EP CP 201	19,0	18,2	17,6	17,1	16,6	16,2	15,8	15,2	14,7	14,5	13,9	13,6	13,4	13,3	13,3	13,2	13,0	13,0
EP GC 201	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 202	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 203	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 204	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 205	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,0
EP GC 306	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 307	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,0
EP GC 308	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 309	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 310	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GC 311	16,9	16,1	15,6	15,2	14,8	14,5	14,2	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2
EP GM 201	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP GM 202	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP GM 203	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP GM 204	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP GM 305	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP GM 306	-	-	-	-	-	-	-	-	12,3	12,0	11,0	10,5	10,0	9,8	9,6	9,4	9,2	9,0
EP PC 301	-	-	-	-	-	-	-	13,7	13,2	13,0	12,2	11,8	11,4	11,1	10,9	10,8	10,5	10,2

- a The two tests are alternatives. A material meeting either requirement shall be deemed to comply with the specification with respect to electric strength at 90 °C in oil, perpendicular to laminations.
- b If the arithmetic mean of the measured values of thickness of the test specimen lies between two values of thickness shown in the above table, the limit shall be obtained by interpolation. If the arithmetic mean of the measured values of thickness is below the minimum thickness for which a limit is given, the electric strength limit appropriate to the minimum thickness shall apply. If the nominal thickness is 3 mm and the arithmetic mean measured thickness exceeds 3 mm, the limit for 3 mm shall apply.

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Replace the existing Table 7 by the following new Table 7:

Table 7 – Limits for water absorption (mg)

Type	Mean measured thickness of test specimens ^a mm																					
	0,4	0,5	0,6	0,8	1,0	1,2	1,5	2,0	2,5	3,0	4,0	5,0	6,0	8,0	10,0	12,0	14,0	16,0	20,0	25,0	22,5 ^b	
EP CC 301	-	-	-	67	69	71	76	80	85	90	100	110	118	135	149	162	175	186	202	219	263	
EP CP 201	30	31	31	33	35	37	41	45	50	55	60	68	76	90	-	-	-	-	-	-	-	-
EP GC 201	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 202	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 203	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 204	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 205	-	-	-	-	-	-	-	-	-	-	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 306	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 307	-	-	-	-	-	-	-	-	-	-	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 308	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 309	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 310	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GC 311	17	17	17	18	18	18	19	20	21	22	23	25	27	31	34	38	41	46	52	61	73	73
EP GM 201	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP GM 202	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP GM 203	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP GM 204	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP GM 305	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP GM 306	-	-	-	-	-	-	25	26	27	28	29	31	33	35	40	44	48	55	60	70	90	90
EP PC 301	-	-	-	-	-	130	135	140	145	150	160	170	180	200	220	240	260	280	320	370	440	440

^a If the arithmetic mean of the measured values of thickness of the test specimen lies between two values of thickness shown in the above table, the limit shall be obtained by interpolation. If the arithmetic mean of the measured values of thickness is below the minimum thickness for which a limit is given, the water absorption limit appropriate to the minimum thickness shall apply. If the nominal thickness is 25 mm and the arithmetic mean measured thickness exceeds 25 mm, the limit for 25 mm shall apply.

^b Sheets of nominal thicknesses greater than 25 mm shall be machined to a relatively smooth surface on one face to a thickness of 22,5 mm ± 0,3 mm.