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TECHNICAL REPORT

Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 4: Typical values

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FOREWORD

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IEC 60893-4, which is a technical report, has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This second edition cancels and replaces the first edition, published in 2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the typical values of modulus of elasticity in flexure and of comparative tracking index of EPGC (Epoxy Glass Cloth) types have been changed;

b) the typical values of new material types introduced in IEC 60893-3-2:2003/AMD1:2011 have been included.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
15/705/DTR	15/714A/RVC

Full information on the voting for the approval of this technical report 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 list of all the parts in the IEC 60893 series, published under the general title *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes* can be found on the IEC website.

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,
- withdrawn,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 60893 is one of a series which deals with industrial rigid laminated sheets based on thermosetting resins for electrical purposes.

The 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 60893-4 is a technical report that deals with typical value information that is not part of the requirements for these laminates.

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

Part 4: Typical values

1 Scope

This part of IEC 60893 serves as a technical report and presents tables of typical values for properties that are not studied and not given in Table 5 of IEC 60893-3-2:2003/AMD1:2011, IEC 60893-3-3:2003/AMD1:2011, IEC 60893-3-4:2003/AMD1:2012, IEC 60893-3-5:2003/AMD1:2009, IEC 60893-3-6:2003/AMD1:2009, IEC 60893-3-7:2003/AMD1:2009. The purpose of these typical values is to give general guidance and should not be considered as specification requirements.

The following tables give typical values for the different types of industrial laminated sheets for electrical purposes described in the Part 3 sheets of IEC 60893.

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

IEC 60893-3-2:2003, *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*
IEC 60893-3-2:2003/AMD1:2011

IEC 60893-3-3:2003, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-3: Specifications for individual materials – Requirements for rigid laminated sheets based on melamine resins*
IEC 60893-3-3:2003/AMD1:2011

IEC 60893-3-4:2003, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-4: Specifications for individual materials – Requirements for rigid laminated sheets based on phenolic resins*
IEC 60893-3-4:2003/AMD1:2012

IEC 60893-3-5:2003, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-5: Specifications for individual materials – Requirements for rigid laminated sheets based on polyester resins*
IEC 60893-3-5:2003/AMD1:2009

IEC 60893-3-6:2003, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-6: Specifications for individual materials – Requirements for rigid laminated sheets based on silicone resins*
IEC 60893-3-6:2003/AMD1:2009

IEC 60893-3-7:2003, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 3-7: Specification for individual materials – Requirements for rigid laminated sheets based on polyimide resins*
IEC 60893-3-7:2003/AMD1:2009

3 Typical values for industrial rigid laminated sheets

3.1 Typical values for industrial rigid laminated sheets based on epoxy resin

See Table 1.

3.2 Typical values for industrial rigid laminated sheets based on melamine resin

See Table 2.

3.3 Typical values for industrial rigid laminated sheets based on phenolic resin

See Table 3.

3.4 Typical values for industrial rigid laminated sheets based on polyester resin

See Table 4.

3.5 Typical values for industrial rigid laminated sheets based on silicone resin

See Table 5.

3.6 Typical values for industrial rigid laminated sheets based on polyimide resin

See Table 6.

Table 1 – Typical values for EP types
(Reference: IEC 60893-3-2:2003/AMD1:2011, Table 5) *(1 of 2)*

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type							
				EP CC 301	EP CP 201	EP GC 201	EP GC 202	EP GC 203	EP GC 204	EP GC 205	EP GC 306
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	6 000	6 000	22 000	22 000	22 000	22 000	24 000	22 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	230	160	350	350	350	350	350	350
Shearing strength parallel to laminations	5.5	MPa	≥5	10	–	30	30	30	30	20	30
Tensile strength	5.6	MPa	≥1,5	100	80	300	300	300	300	300	300
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	5,3	5,0	5,5	5,5	5,5	5,5	5,5	5,5
Permittivity at 1 MHz	6.2	–	≤3	5,3	5,0	5,5	5,5	5,5	5,5	5,5	5,5
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,04	0,05	0,04	0,04	0,04	0,04	0,04	0,04
Dissipation factor at 1 MHz	6.2	–	≤3	0,04	0,05	0,04	0,04	0,04	0,04	0,04	0,04
Comparative tracking index	6.4	–	≥3	500	100	200	200	175	175	175	500
Thermal endurance	7.1	TI	≥3	130	110	130	130	155	155	155	155
Density	8.1	g/cm^3	All	1,2-1,4	1,3-1,4	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0

Table 1 *(2 of 2)*
(Reference: IEC 60893-3-2:2003/AMD1:2011, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type											
				EP GC 307	EP GC 308	EP GC 309	EP GC 310	EP GC 311	EP GM 201	EP GM 202	EP GM 203	EP GM 204	EP GM 305	EP GM 306	EP PC 301
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	24 000	22 000	22 000	22 000	22 000	15 000	15 000	15 000	15 000	15 000	15 000	3 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	350	350	350	350	350	350	350	350	350	350	350	200
Shearing strength parallel to laminations	5.5	MPa	≥5	20	30	30	30	30	20	20	20	20	20	20	12
Tensile strength	5.6	MPa	≥1,5	300	300	300	300	300	250	250	250	250	250	250	135
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,3
Permittivity at 1 MHz	6.2	–	≤3	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,3
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,04	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Dissipation factor at 1 MHz	6.2	–	≤3	0,04	0,04	0,04	0,04	0,04	0,05	0,05	0,05	0,05	0,05	0,05	0,05
Comparative tracking index	6.4	–	≥3	500	175	200	200	175	200	200	175	175	175	200	375
Thermal endurance	7.1	TI	≥3	155	180	130	130	155	130	130	155	155	180	180	130
Density	8.1	g/cm^3	All	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,8-2,0	1,2 – 1,4

Table 2 – Typical values for MF types
(Reference: IEC 60893-3-3:2003/AMD1:2011, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type	
				MF CC 201	MF GC 201
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	5 000	14 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	90	275
Shearing strength parallel to laminations	5.5	MPa	≥5	8	12
Tensile strength	5.6	MPa	≥1,5	60	150
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	8,0	7,5
Permittivity at 1 MHz	6.2	–	≤3	8,0	7,5
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,03	0,02
Dissipation factor at 1 MHz	6.2	–	≤3	0,03	0,02
Comparative tracking index	6.4	–	≥3	500	500
Thermal endurance	7.1	TI	≥3	130	130
Density	8.1	g/cm^3	All	1,3-1,5	1,8-2,0

Table 3 – Typical values for PF types
(Reference: IEC 60893-3-4:2003/AMD1:2012, Table 5) *(1 of 2)*

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type								
				PF CC 201	PF CC 202	PF CC 203	PF CC 204	PF CC 305	PF CP 201	PF CP 202	PF CP 203	PF CP 204
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	7 000	7 000	7 000	7 000	7 000	7 000	7 000	7 000	7 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	–	–	–	–	–	300	300	250	250
Shearing strength parallel to laminations	5.5	MPa	≥5	25	20	25	20	20	10	10	10	20
Tensile strength	5.6	MPa	≥1,5	80	60	85	80	80	120	100	100	70
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	–	5,5	–	5,5	–	–	–	–	–
Permittivity at 1 MHz	6.2	–	≤3	–	–	–	–	–	–	5,5	5,5	5,5
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	–	–	–	–	–	–	–	–	–
Dissipation factor at 1 MHz	6.2	–	≤3	–	–	–	–	–	–	0,05	0,05	0,05
Comparative tracking index	6.4	–	≥3	100	100	100	100	100	100	100	100	100
Thermal endurance	7.1	TI	≥3	120	120	120	120	120	120	120	105	105
Density	8.1	g/cm^3	All	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4
NOTE A dash (–) signifies no data available.												

Table 3 *(2 of 2)*
(Reference: IEC 60893-3-4:2003/AMD1:2012, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type								
				PF CP 205	PF CP 206	PF CP 207	PF CP 308	PF GC 201	PF WV 201	PF WV 202	PF WV 303	PF WV 304
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	5 000	7 000	5 000	7 000	14 000	14 000	14 000	18 000	18 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	250	250	300	250	–	220	220	80	80
Shearing strength parallel to laminations	5.5	MPa	≥5	20	20	10	20	–	15	15	15	15
Tensile strength	5.6	MPa	≥1,5	60	70	100	70	100	60	60	120	120
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	–	–	–	–	5	–	–	–	–
Permittivity at 1 MHz	6.2	–	≤3	5,5	6,0	–	6,0	–	–	–	–	–
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	–	–	–	–	–	–	0,1	–	0,1
Dissipation factor at 1 MHz	6.2	–	≤3	0,05	0,05	–	0,05	–	–	–	–	–
Comparative tracking index	6.4	–	≥3	100	100	100	100	100	100	100	100	100
Thermal endurance	7.1	TI	≥3	100	105	105	100	120	120	120	120	120
Density	8.1	g/cm^3	All	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4	1,6-1,8	1,3-1,4	1,3-1,4	1,3-1,4	1,3-1,4
NOTE A dash (–) signifies no data available.												

Table 4 – Typical values for UP types
(Reference: IEC 60893-3-5:2003/AMD1:2009, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type				
				UP GM 201	UP GM 202	UP GM 203	UP GM 204	UP GM 205
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	8 000	8 000	8 000	10 000	10 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	200	200	200	250	250
Shearing strength parallel to laminations	5.5	MPa	≥5	20	20	20	20	20
Tensile strength	5.6	MPa	≥1,5	70	70	70	120	120
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	4,5	4,5	4,5	4,5	4,5
Permittivity at 1 MHz	6.2	–	≤3	4,5	4,5	4,5	4,5	4,5
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,05	0,05	0,05	0,05	0,05
Dissipation factor at 1 MHz	6.2	–	≤3	0,05	0,05	0,05	0,05	0,05
Comparative tracking index	6.4	–	≥3	600	600	600	600	600
Thermal endurance	7.1	TI	≥3	130	140	130	140	140
Density	8.1	g/cm^3	All	1,5-1,9	1,5-1,9	1,5-1,9	1,5-1,9	1,5-1,9

Table 5 – Typical values for SI types
(Reference: IEC 60893-3-6:2003/AMD1:2009, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type	
				SI GC 201	SI GC 202
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	13 000	13 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	160	160
Shearing strength parallel to laminations	5.5	MPa	≥5	20	20
Tensile strength	5.6	MPa	≥1,5	70	90
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	4,5	6,0
Permittivity at 1 MHz	6.2	–	≤3	4,5	6,0
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,02	0,07
Dissipation factor at 1 MHz	6.2	–	≤3	0,02	0,07
Comparative tracking index	6.4	–	≥3	450	450
Thermal endurance	7.1	TI	≥3	180	180
Density	8.1	g/cm^3	All	1,6-1,9	1,6-1,9

Table 6 – Typical values for PI type
(Reference: IEC 60893-3-7:2003/AMD1:2009, Table 5)

Property	Test method in IEC 60893-2:2003 Subclause	Unit	Nominal thickness of sheet to which test is applicable mm	Type
				PI GC 301
Apparent modulus of elasticity in flexure	5.2	MPa	≥1,5	22 000
Compressive strength perpendicular to laminations	5.3	MPa	≥5	400
Shearing strength parallel to laminations	5.5	MPa	≥5	35
Tensile strength	5.6	MPa	≥1,5	250
Permittivity at 48 Hz-62 Hz	6.2	–	≤3	5,5
Permittivity at 1 MHz	6.2	–	≤3	5,5
Dissipation factor at 48 Hz-62 Hz	6.2	–	≤3	0,03
Dissipation factor at 1 MHz	6.2	–	≤3	0,03
Comparative tracking index	6.4	–	≥3	150
Thermal endurance	7.1	TI	≥3	160
Density	8.1	g/cm^3	All	1,9-2,1