

PRESSPAPER & PRESSBOARD

Pressboard

Presspaper

Corrugated board

Presspaper with partial epoxy resin coating

Strips, ladder grids & ladder ducts



1. General

Presspaper is a proven surface insulation material on cellulose basis for the thermal class 105 (A). Depending on the type of cellulose, fibre conditioning and machinery settings, KREMPEL-GROUP supplies a variety of presspaper and pressboard types with very specific characteristics. These high-purity cellulose products are produced on special paper machines, as we have one of the world's largest production facilities for continuous production of presspaper as well as state-of-the-art presses for the production of pressboard. The properties and characteristics of the presspaper and pressboard materials are standardised in IEC 60641. These materials are manufactured for two fundamentally different areas of application.

- **The first area includes insulation in transformers, chokes and capacitors, where the presspaper is impregnated with a fluid dielectric (e.g. insulating oil, ester or others). Finished versions of presspaper and pressboard are also used, such as presspaper with diamond dotted resin coating (KREMPEL-DPP), laminated boards, corrugated boards, pressboard strips, ladder grids and ladder ducts (see "2. Presspaper for oil transformers").**
- **The second area includes all types of insulation for motors, coils and other electrical devices, where the presspaper is not impregnated with a fluid dielectric (see "3. Presspaper & Pressboard for motors & other applications").**

Our presspaper is manufactured using unbleached sulphate cellulose gained from Nordic, slow-growing coniferous wood. At the beginning of presspaper production the cellulose fibre first has to be separated and squeezed in a grinding mill in aqueous suspension. This aqueous fibre mixture then goes through several purification processes to provide the basis for the natural purity of the final product right from the beginning.

- **In manufacturing KREMPEL presspaper, the prepared raw material is transferred to several round screen cylinders, arranged in sequence in our paper-making machines, and through filtration are couched to form the moist, multi-layer fibre non-woven ("sheet"). Following this sheet production process, the fibrous structure is mechanically dewatered, dried and then smoothed and compacted between the rollers of our super calenders. This lends the KREMPEL presspaper its necessary thickness and density and thus its excellent mechanical and electrical properties.**
- **In the production of KREMPEL pressboard, the non-woven fibre is rolled up in multiple layers on a "press roll" and couched. Once the desired number of layers or thickness is reached, the "winding" is cut. The raw pressboard sheet thus obtained is automatically transferred to a high performance press for proper wet compression and drying. Depending on the type of pressboard, this is followed by drying in a multi-daylight heating press under pressure (POWERBOARD AK) or a pressure-free drying either with or without subsequent calendering.**



Paper machine for presspaper



Press roll

To ensure the KREMPEL quality that is valued world-wide, we ensure the strictest quality controls throughout the production chain. The entire production process – from cellulose preparation through formation of the non-woven and on to the drying process – is computer-controlled. Highly sensitive metal detectors installed right on the production line ensure that our different presspaper & pressboard quality levels remain free of metal impurities. Optical detection systems are also used to detect non-metallic impurities or fibre defects. Extensive material tests conducted in our labs ensure the consistently high quality of our KREMPEL presspaper & pressboard products.

All KREMPEL presspaper & pressboard products are evaluated in our labs based on the relevant IEC specifications. Here all of the test pieces are conditioned in the specified climates before the particular tests are performed. Only the measurement values obtained on such test pieces are considered representative and are allowed to be used for assessment. When presspaper or pressboard is too dry or over-moistened, the properties obtained may deviate from the set-point values.



Metal detectors



HV testing station



Bend test



Multi-daylight press for pressboard

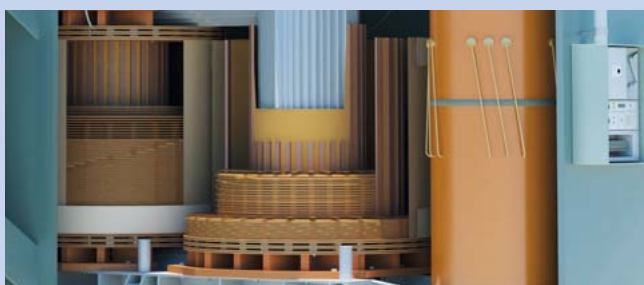


Slitter Winders

2. Presspaper & Pressboard for oil transformers

For applications in oil transformers, we produce a complete range of different presspaper and pressboard types, which are also processed by us to make presspaper with diamond dotted resin coating (KREMPEL-DPP), corrugated boards, pressboard strips, ladder grids and ladder ducts.

Standard types and application areas KREMPEL-GROUP presspaper & pressboard for oil transformers				
Designation	Type	IEC designation	Colour	Applications
POWERBOARD AK	PSP 3052	B.3.1 A IEC 60641-3-1	natural colour	Insulating cylinders, strips, spacers and spacer disks
Pressboard	PSP 3050	B.2.1 B IEC 60641-3-1	natural colour	Insulating components, such as layer insulations, core insulations and punched parts
Pressboard	PSP 3051	B.4.1 IEC 60641-3-1	natural colour	Shaped components such as small insulating cylinders and folded parts
Laminated board	-	LB.3.1 A IEC 60763-3-1	natural colour	Pressure and static rings, bars, pressure plates and spacers
Presspaper	PSP 3055	P.2.1 B IEC 60641-3-2	natural colour	Layer and winding insulation in distribution transformers
Presspaper particularly light	PSP 3055 SL	P.4.1 A IEC 60641-3-2 P.4.1 B	natural colour	Layer and winding insulation, primarily in distribution transformers; dielectric in capacitors
Presspaper two-layer, bonded	PSP 3055-2	P.2.1 B IEC 60641-3-2	natural colour	Layer and winding insulation, primarily in distribution transformers
KREMPEL-DPP	Presspaper with partial epoxy resin coating		natural colour resin: red	Layer and winding insulation in distribution transformers
Corrugated board	Special corrugated quality		natural colour	Cooling channels, primarily in distribution transformers
Ladder duct	Strips with full-surface PSP backing material		natural colour	Cooling channels in distribution transformers
Ladder grids	Strips with partial PSP backing material		natural colour	Cooling channels in distribution transformers
Strips, spacers, blanks made with presspaper	We manufacture pressboard strips, spacers and blanks of all types with POWERBOARD AK to meet customer requirements. Upon request, our sales department will be happy to send you a quotation.			



Power transformer



Spacers

Everything you need for oil transformers

1. Layer insulation:

PSP 3055 RPT (P.2.1B) - presspaper
KREMPEL-DPP
Presspaper with partial epoxy resin coating

2. Insulating cylinders and cooling channels:

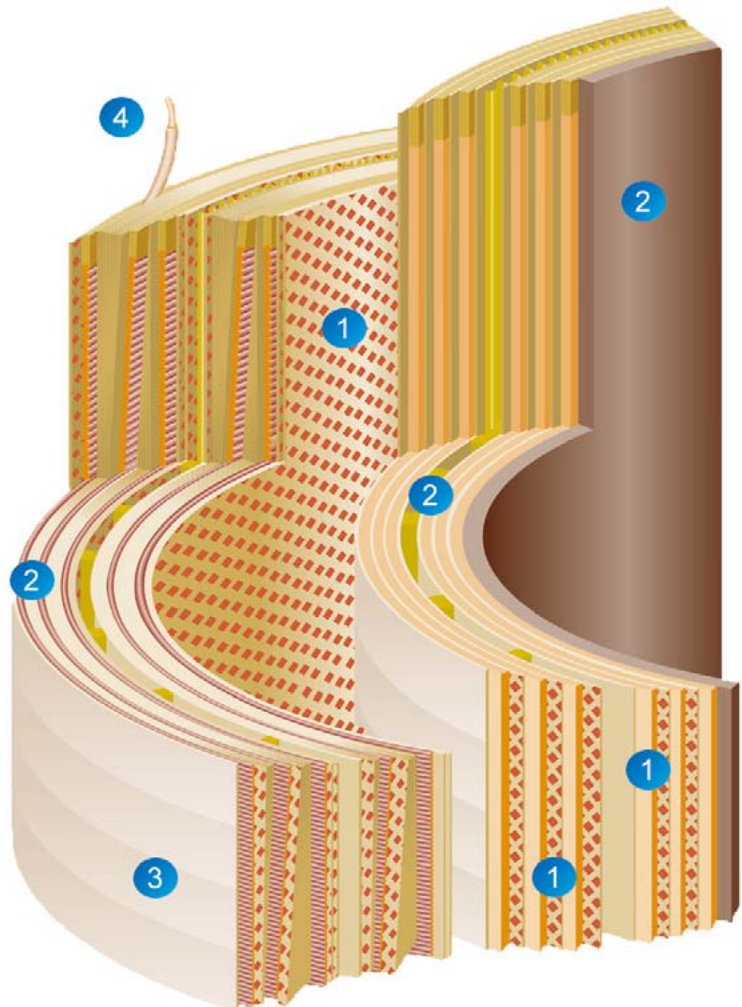
PSP 3050 (B.2.1B) - pressboard
POWERBOARD AK (B.3.1A) - pressboard
KREMPEL corrugated board
Ladder duct made of presspaper
Ladder grids made of presspaper

3. Outer bandings:

PREPREG EFBD
Thread-reinforced PET-non-woven
with epoxy resin impregnation

4. Insulation for coil connections:

Crape paper tubes



Low voltage coils with KREMPEL-DPP and corrugated board



Cooling channel with KREMPEL corrugated board

POWERBOARD AK

B.3.1 A according to IEC 60641-3-1

- POWERBOARD AK is a natural-coloured, hot-pressed pressboard made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents.
- POWERBOARD AK owes its excellent electrical and mechanical properties to the special pressing process in a hot press.
- POWERBOARD AK is virtually shrinkproof, dimensionally stable and has extremely low compressibility.
- POWERBOARD AK is manufactured in thicknesses from 1.0 to 8.0 mm and is primarily used for insulating cylinders, strips, spacers and spacer disks.
- For formats and tolerances, see Page 1.22



Technical data for POWERBOARD AK
Measured in accordance with IEC 60641-2

	mm	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0
Nominal thickness	mm	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0
Tolerance	%	± 7.5	± 7.5	± 5.0	± 5.0	± 5.0	± 5.0	± 5.0	± 5.0	± 5.0	± 5.0
Density	g/cm ³	1.0-1.2	1.0-1.2	1.1-1.25	1.1-1.25	1.1-1.25	1.15-1.3	1.15-1.3	1.15-1.3	1.15-1.3	1.15-1.3
Area weight	g/m ²	1100	1650	2350	2940	3530	4900	6130	7350	8580	9800
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	0.91	0.61	0.43	0.34	0.28	0.20	0.16	0.14	0.12	0.10
Tensile strength MD	MPa	≥ 100	≥ 100	≥ 105	≥ 105	≥ 105	≥ 110	≥ 110	≥ 110	≥ 110	≥ 110
Tensile strength CMD	MPa	≥ 75	≥ 75	≥ 80	≥ 80	≥ 80	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85
Elongation MD	%	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5
Elongation CMD	%	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5
Compressibility C	%	≤ 10	≤ 10	≤ 7.5	≤ 7.5	≤ 7.5	≤ 5	≤ 5	≤ 5	≤ 4.5	≤ 4.5
Resilience C _{rev}	%	≥ 45	≥ 45	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Shrinkage MD	%	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5
Shrinkage CMD	%	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7
Shrinkage thickness	%	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Moisture content	%	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6	≤ 6
Ash content	%	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7
Conductivity of the aqueous extract	mS/m	≤ 5	≤ 5	≤ 6	≤ 6	≤ 6	≤ 8	≤ 8	≤ 8	≤ 10	≤ 10
pH-value of the aqueous extract	-	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9
Oil absorption	%	≥ 11	≥ 11	≥ 9	≥ 9	≥ 9	≥ 7	≥ 7	≥ 7	≥ 6	≥ 6
Dielectric strength in air	kV/mm	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12
Dielectric strength in oil	kV/mm	≥ 45	≥ 45	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35

Pressboard PSP 3050

B.2.1 B according to IEC 60641-3-1

- PSP 3050 is a natural-coloured pressboard made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. But in contrast to POWERBOARD AK, it does not get its final properties from the hot-pressed process, but rather through hot-air drying with subsequent calendering.
- PSP 3050 is manufactured in thicknesses from 0.8 to 4.0 mm and primarily is used for core insulations, layer insulations, smaller insulating cylinders and punched parts.
- For formats and tolerances, see Page 1.22



Technical data for pressboard PSP 3050 Measured in accordance with IEC 60641-2							
Nominal thickness	mm	0.80	1.0	1.5	2.0	3.0	4.0
Tolerance	%	± 7.5	± 7.5	± 7.5	± 5.0	± 5.0	± 5.0
Density	g/cm ³	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3
Area weight	g/m ²	1000	1250	1875	2500	3750	5000
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	1.00	0.80	0.53	0.40	0.27	0.20
Tensile strength MD	MPa	≥ 90	≥ 90	≥ 90	≥ 90	≥ 90	≥ 90
Tensile strength CMD	MPa	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60
Elongation MD	%	≥ 6	≥ 6	≥ 6	≥ 6	≥ 6	≥ 6
Elongation CMD	%	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8
Shrinkage MD	%	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7
Shrinkage CMD	%	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0
Shrinkage thickness	%	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Ash content	%	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 10
pH-value of the aqueous extract	-	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9	6 to 9
Oil absorption	%	≥ 6	≥ 6	≥ 6	≥ 6	≥ 6	≥ 6
Dielectric strength in air	kV/mm	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12	≥ 12
Dielectric strength in oil	kV/mm	≥ 40	≥ 40	≥ 40	≥ 30	≥ 30	≥ 30

Other thicknesses and bonded material upon request

Pressboard PSP 3051

B.4.1 according to IEC 60641-3-1

- PSP 3051 is a natural-coloured, specially light and shapeable pressboard made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. PSP 3051 has a very high oil absorption capacity.
- PSP 3051 is manufactured in thicknesses from 1.0 to 3.0 mm and is primarily used for parts with narrow radii, such as shaped components and pipes.
- For formats and tolerances, see Page 1.22



Technical data for pressboard PSP 3051 Measured in accordance with IEC 60641-2					
		1.0	1.5	2.0	3.0
Nominal thickness	mm	1.0	1.5	2.0	3.0
Tolerance	%	± 7.5	± 7.5	± 5.0	± 5.0
Density	g/cm ³	0.85 - 1.1	0.85 - 1.1	0.85 - 1.1	0.85 - 1.1
Area weight	g/m ²	1000	1500	2000	3000
Tolerance	%	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	1.0	0.67	0.50	0.33
Tensile strength MD	MPa	≥ 55	≥ 55	≥ 55	≥ 55
Tensile strength CMD	MPa	≥ 45	≥ 45	≥ 45	≥ 45
Elongation MD	%	≥ 7	≥ 7	≥ 7	≥ 7
Elongation CMD	%	≥ 8	≥ 8	≥ 8	≥ 8
Shrinkage MD	%	≤ 1.0	≤ 0.7	≤ 0.7	≤ 0.7
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Shrinkage thickness	%	≤ 6	≤ 6	≤ 6	≤ 6
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8
Ash content	%	≤ 0.7	≤ 0.7	≤ 0.7	≤ 0.7
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8
pH-value of the aqueous extract	-	6 to 9	6 to 9	6 to 9	6 to 9
Oil absorption	%	≥ 18	≥ 18	≥ 18	≥ 18
Dielectric strength in air	kV/mm	≥ 9	≥ 9	≥ 9	≥ 9
Dielectric strength in oil	kV/mm	≥ 35	≥ 35	≥ 30	≥ 30

Laminated board made of POWERBOARD AK

LB.3.1A according to IEC 60763-3-1

- Laminated board is manufactured through the full-surface bonding of multiple layers of POWERBOARD AK into boards of greater thickness. Boards with high mechanical and electrical resistance from 9 mm in thickness up to a maximum thickness of 120 mm are thus possible. By using hot-pressed POWERBOARD AK pressboard, the excellent properties of this material are also transferred to the laminated board. We make the following three versions of laminated board made with POWERBOARD AK.
- Laminated board POWERBOARD AK-CG: Bonding with an aqueous casein adhesive corresponds to type LB.3.1A.1 according to IEC 60763-3-1.
- Laminated board POWERBOARD AK-PHG: Bonding with a phenol-resin adhesive based on type LB.3.1A.2 according to IEC 60763-3-1.
- Laminated board POWERBOARD AK-PG: Bonding with a polyester adhesive corresponds to type LB.3.1A.2 according to IEC 60763-3-1 (on request).
- Laminated boards made of POWERBOARD AK are primarily used for pressure and static rings, bars, pressure plates and spacers. Please note that with the PHG and PG types it is necessary to bore "diffusion holes" in the components vertical to the layer direction to enable subsequent drying and oil impregnation.
- For formats and tolerances, see Page 1.22



Technical data for laminated board made of POWERBOARD AK
Measured in accordance with IEC 60763-2

Versions		Laminated board POWERBOARD AK-CG	Laminated board POWERBOARD AK-PHG	Laminated board POWERBOARD AK-PG*
Tolerance thickness ≤ 12 mm	%	± 5.0	± 5.0	± 5.0
> 12 mm	%	± 4.0	± 4.0	± 4.0
Density	g/cm ³	1.15- 1.30	1.15- 1.35	1.15- 1.35
Tensile strength MD	MPa	≥ 110	≥ 110	≥ 130
Tensile strength CMD	MPa	≥ 100	≥ 100	≥ 115
Compressibility C	%	≤ 3.5	≤ 3.5	≤ 3.0
Resilience C _{rev}	%	≥ 60	≥ 60	≥ 60
Shrinkage MD	%	≤ 0.5	≤ 0.5	≤ 0.4
Shrinkage CMD	%	≤ 0.7	≤ 0.7	≤ 0.6
Shrinkage thickness	%	≤ 6.0	≤ 6.0	≤ 4.0
Moisture content	%	≤ 8	≤ 8	≤ 6
Conductivity of the aqueous extract	mS/m	≤ 15	≤ 15	≤ 10
pH-value of the aqueous extract	--	6 to 10	6 to 10	5 to 8
Oil absorption	%	≥ 6	≥ 6	≥ 6
Dielectric strength in oil parallel to the layer	kV/mm	≥ 8	≥ 8	≥ 8

* on request

Presspaper PSP 3055

P.2.1B according to IEC 60641-3-2

- PSP 3055 is a natural-coloured, calendered presspaper made of 100 % unbleached sulphate cellulose that is free of all bonding agents.
- PSP 3055 is manufactured in thicknesses from 0.10 to 1.0 mm and is primarily used for core insulation, layer insulation and winding insulation on distribution transformers.
- Upon request, the presspaper PSP 3055 can also be provided in a special "Thermally upgraded" version (name: Presspaper PSP 3055 TU). Here the thermal ageing process of the presspaper is delayed by adding a small quantity of a nitrogenous additive.
- For formats and tolerances, see Page 1.22



Technical data for presspaper PSP 3055
Measured in accordance with IEC 60641-2

Nominal thickness	mm	0.10	0.13	0.15	0.18	0.20	0.25	0.30
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3
Area weight	approx. g/m ²	125	165	185	225	250	315	375
Area yield	approx. m ² /kg	8.0	6.1	5.4	4.4	4.0	3.2	2.7
Tensile strength MD	MPa	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80	≥ 85	≥ 85
Tensile strength CMD	MPa	≥ 45	≥ 45	≥ 45	≥ 45	≥ 45	≥ 50	≥ 50
Elongation MD	%	≥ 4	≥ 4	≥ 4	≥ 4	≥ 4	≥ 4.5	≥ 4.5
Elongation CMD	%	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 10	≥ 10
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Shrinkage MD	%	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Dielectric strength in air	kV/mm	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 11	≥ 11
Dielectric strength in oil	kV/mm	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Nominal thickness	mm	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3
Area weight	approx. g/m ²	500	630	750	875	1000	1125	1250
Area yield	approx. m ² /kg	2.0	1.6	1.3	1.1	1.0	0.9	0.8
Tensile strength MD	MPa	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85
Tensile strength CMD	MPa	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Elongation MD	%	≥ 4.5	≥ 4.5	≥ 4.5	≥ 4.5	≥ 4.5	≥ 4.5	≥ 4.5
Elongation CMD	%	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10	≥ 10
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Shrinkage MD	%	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Dielectric strength in air	kV/mm	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11
Dielectric strength in oil	kV/mm	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50

Presspaper PSP 3055 SL

P.4.1A or P.4.1B* according to IEC 60641-3-2

- PSP 3055 SL is a natural-coloured, calendered presspaper made of 100 % unbleached sulphate cellulose that is free of all bonding agents, similar to the presspaper PSP 3055. In contrast to the presspaper PSP 3055, however, it has a lower density. For this reason, the capacity for impregnation with fluid dielectrics is improved, which results in shorter impregnation times, greater absorption capacity and greater electric stability after impregnation. But a certain reduction in tensile strengths should be expected.
- Upon request, the presspaper PSP 3055 SL can also be provided in a special "Thermally upgraded" version (name: Presspaper PSP 3055 SL TU). Here the thermal ageing process of the presspaper is delayed by adding a small quantity of a nitrogenous additive.
- PSP 3055 SL is manufactured in thicknesses from 0.05 to 0.50 mm and is primarily used for core insulation, layer insulation and winding insulation on distribution transformers, as well as in capacitors.
- For formats and tolerances, see Page 1.22



Technical data for presspaper PSP 3055 SL
Measured in accordance with IEC 60641-2

		0.05	0.06	0.075	0.10	0.125	0.15	0.175	0.20	0.25	0.30	0.40	0.50
Nominal thickness	mm	0.05	0.06	0.075	0.10	0.125	0.15	0.175	0.20	0.25	0.30	0.40	0.50
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2	1.0-1.2
Area weight	approx. g/m ²	55	66	83	110	135	165	190	220	275	330	440	550
Area yield	approx. m ² /kg	18.2	15.2	12.0	9.1	7.4	6.1	5.3	4.5	3.6	3.0	2.3	1.8
Tensile strength MD	MPa	≥ 70	≥ 70	≥ 75	≥ 75	≥ 75	≥ 75	≥ 75	≥ 75	≥ 80	≥ 80	≥ 80	≥ 80
Tensile strength CMD	MPa	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 40	≥ 40	≥ 40	≥ 40
Elongation MD	%	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3
Elongation CMD	%	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 10	≥ 10	≥ 10	≥ 10
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Shrinkage MD	%	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Dielectric strength in air	kV/mm	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 10	≥ 10	≥ 10	≥ 10
Dielectric strength in oil	kV/mm	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60

* Thicknesses < 0.075 mm correspond to the type P.4.1B

Presspaper, two-layer bonded PSP 3055-2

Similar to P.2.1B according to IEC 60641-3-2

- The two-layer presspaper PSP 3055-2 is a natural-coloured, calendered presspaper made of 100% unbleached sulphate cellulose, which has been bonded with an adhesive for the added electrical safety of two layers of presspaper PSP 3055.
- Presspaper PSP 3055-2 is manufactured in thicknesses from 0.10 to 0.25 mm and is primarily used for layer insulation and winding insulation on distribution transformers. With the two-layered bonding, lower material thicknesses with sufficient electrical stability are possible - and as a result transformer coils can be built smaller and more compact.
- Upon request, the presspaper PSP 3055-2 can also be provided in a special "Thermally upgraded" version (name: Presspaper PSP 3055-2 TU). Here the thermal ageing process of the pressboard is delayed by adding a small quantity of a nitrogenous additive.
- For formats and tolerances, see Page 1.22



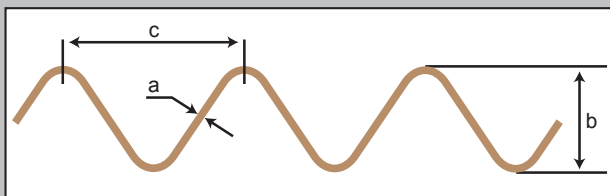
Technical data for presspaper PSP 3055-2 (two-layer bonded)
Measured in accordance with IEC 60641-2

	mm	0.10	0.12	0.15	0.20	0.25
Nominal thickness	mm	0.10	0.12	0.15	0.20	0.25
Tolerance	%	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3	1.2-1.3
Area weight	approx. g/m ²	125	150	190	250	315
Area yield	approx. m ² /kg	8.0	6.7	5.3	4.0	3.2
Tensile strength MD	MPa	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80
Tensile strength CMD	MPa	≥ 45	≥ 45	≥ 45	≥ 45	≥ 45
Elongation MD	%	≥ 4	≥ 4	≥ 4	≥ 4	≥ 4
Elongation CMD	%	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Shrinkage MD	%	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Conductivity of the aqueous extract	mS/m	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Dielectric strength in air	kV/mm	≥ 10	≥ 10	≥ 10	≥ 10	≥ 11
Dielectric strength in oil	kV/mm	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50

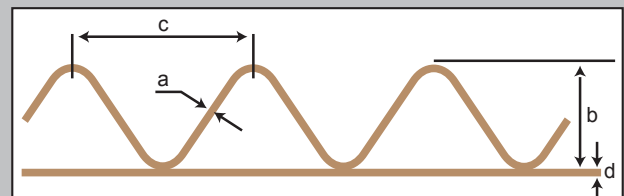
Corrugated board

Symmetric sinusoidal type according to IEC 61628-1

- Corrugated board is manufactured with natural-coloured presspaper made of 100% unbleached sulfate cellulose (similar to P.2.1 according to IEC 60641-3-2) with symmetric sinusoidal corrugation.
- Corrugated board is primarily used in transformer coils, such as winding or layer insulation, and forms a cooling channel system via the corrugation.
- All corrugated boards can also be laminated on one side with a standard web width of 1050 mm with presspaper PSP 3055 0.13 mm thick or with KREMPEL-DPP 0.125 mm (printed on one side with the unprinted side for the corrugated board). This improves the compressive strength and processing capability of the corrugated board. Two corrugated board layers can also be wound with one on top of the other to achieve larger cooling channel cross-section areas. Here it is necessary when winding to ensure that the PSP or DPP layer is always on the outside.
- Corrugated board is available either as rolls or blanks.
- Corrugated board is available in the following dimensions:



- a) Presspaper thickness: 0.5 mm to 1.5 mm
 b) Corrugation height: 4.5 mm, 6.5 mm and 8.0 mm
 c) Corrugation length: 10 mm, 15 mm and 19 mm



- d) Thickness backing material:
 PSP 3055 = 0.13 mm
 KREMPEL-DPP = 0.125 mm

Technical data for corrugated board Measured in accordance with IEC 61628-2

Type (a) x (b) x (c)	---	0.5 x 4.5 x 10	1.0 x 4.5 x 10	0.5 x 6.5 x 15	1.0 x 6.5 x 15	0.5 x 8.0 x 19	1.0 x 8.0 x 19	1.5 x 8.0 x 19
Presspaper thickness (a)	mm	0.5	1.0	0.5	1.0	0.5	1.0	1.5
Corrugation height (b)	mm	4.5	4.5	6.5	6.5	8.0	8.0	8.0
Tolerance	mm	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Corrugation length (c)	mm	10.0	10.0	15.0	15.0	19.0	19.0	19.0
Tolerance	mm	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Shape of corrugation	---	Sinus	Sinus	Sinus	Sinus	Sinus	Sinus	Sinus
Roll width*)	approx. mm	2100	1500	2100	2100	2100	2100	2100
Roll length*)	approx. m	30	30	30	30	30	20	20

*) Blanks in widths from 150 mm to 2000 mm are available (width tolerance: -2 mm). Other dimensions available upon request.

KREMPEL-DPP

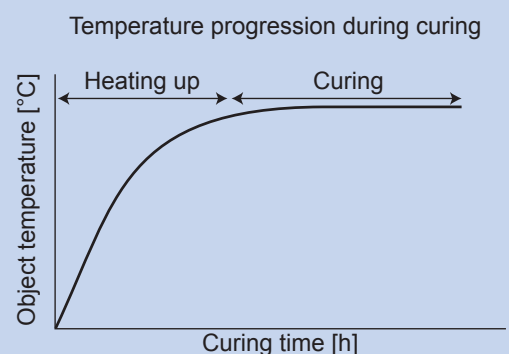
Presspaper with diamond dotted resin coating P.4.1A according to IEC 60641-3-2

- KREMPEL-DPP is a natural-coloured presspaper made of 100% unbleached sulfate cellulose with double-sided diamond dotted, still reactive resin coating. The coating quadrats of KREMPEL-DPP have a lateral length of 9.5 mm and a spacing of 6.35 mm. Approx. 36% of the total surface of each side is thus printed with epoxy resin. The quadrats are arranged so that their diagonals are parallel and perpendicular to the machine direction of the transformer presspaper.
- KREMPEL-DPP is primarily used as layer and winding insulation in the LV and HV coils of transformers. After curing, the partial resin coating bonds the electric conductors with the insulation, which brings about the mechanical consolidation of the coils. In this way the radial and axial forces that arise in the event of short circuit can be safely controlled.
- Coils manufactured with KREMPEL-DPP can be quickly and safely impregnated with insulating oil (transformer oil and silicon oil). This minimizes the risk of partial discharges following inadequate impregnation.
- Our specially developed resin composition for KREMPEL-DPP offers short curing times, high binding strength and excellent long-term storage stability.
- Upon request, KREMPEL-DPP can also be manufactured on two-layer bonded, thin presspaper. Extra compact coils are possible with this version.
- KREMPEL-DPP can also be supplied in the special "Thermally upgraded" version (name: DPP TU). Here the thermal ageing process of the presspaper is delayed by adding a small quantity of a nitrogenous additive.
- KREMPEL-DPP can be supplied as an original roll or narrow roll.
- For formats and tolerances, see Page 1.22



Curing conditions for KREMPEL-DPP

- The curing period varies depending on the temperature selected: 105°C / 3 h or 120°C / 1.5 h.
- The object temperature is the temperature being measured in the coil.
- The heat-up phase of the coils must be finished no later than after 4 hours.
- A curing temperature under 100°C is not recommended.



Processing of KREMPEL-DPP

- KREMPEL-DPP is dry and non-adhesive upon delivery and can be processed as winding and layer insulation according to all known processes. When winding, it is necessary to ensure adequate tensile strength of conductors and DPP so that coils can be produced as compact as possible.
- The curing of the coils wound with KREMPEL-DPP can be performed at either 105°C or 120°C. The curing must not be performed using a "vapour-phase drying" procedure as this will cause corrosion of DPP resin that has not yet cured. A vapour-phase drying method should only be performed on fully cured coils.

Technical data for KREMPEL-DPP									
Measured based on IEC 60641-2									
KREMPEL-DPP Type	---	DPP 0.04	DPP 0.05	DPP 0.06	DPP 0.075	DPP 0.10	DPP 0.125	DPP 0.175	DPP 0.20
Nominal thickness *)	mm	0.065	0.075	0.085	0.10	0.125	0.15	0.2	0.225
Tolerance	%	± 15	± 15	± 15	± 15	± 12	± 10	± 10	± 10
Resin layer **)	approx. µm	25	25	25	25	25	25	25	25
Area weight DPP*)	g/m ²	50	60	70	90	120	140	195	225
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	20	16.7	14.3	11.8	8.7	7.1	5.1	4.4
Tensile strength MD	MPa	≥ 70	≥ 70	≥ 70	≥ 75	≥ 75	≥ 75	≥ 75	≥ 75
Tensile strength CMD	MPa	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35	≥ 35
Shrinkage MD	%	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Moisture content	%	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0
Conductivity of the aqueous extract	mS/m	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0
Breakdown voltage in air	kV	≥ 0.4	≥ 0.45	≥ 0.54	≥ 0.7	≥ 0.9	≥ 1.1	≥ 1.6	≥ 1.8
KREMPEL-DPP Type	---	DPP 0.25	DPP 0.30	DPP 0.38	DPP 0.50	DPP 0.10-2 two-layer bonded	DPP 0.12-2 two-layer bonded	DPP 0.15-2 two-layer bonded	DPP 0.25-2 two-layer bonded
Nominal thickness *)	mm	0.275	0.325	0.405	0.525	0.125	0.145	0.175	0.275
Tolerance	%	± 10	± 10	± 10	± 10	± 12	± 10	± 10	± 10
Resin layer **)	approx. µm	25	25	25	25	25	25	25	25
Area weight DPP*)	g/m ²	280	340	420	560	115	145	170	280
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	3.6	2.9	2.4	1.8	8.7	6.9	5.9	3.6
Tensile strength MD	MPa	≥ 80	≥ 80	≥ 80	≥ 80	≥ 75	≥ 75	≥ 75	≥ 80
Tensile strength CMD	MPa	≥ 40	≥ 40	≥ 40	≥ 40	≥ 35	≥ 35	≥ 35	≥ 40
Shrinkage MD	%	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0
Shrinkage CMD	%	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Moisture content	%	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0
Conductivity of the aqueous extract	mS/m	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0
Breakdown voltage in air	kV	≥ 2.5	≥ 3.0	≥ 3.8	≥ 4.5	≥ 0.9	≥ 1.1	≥ 1.4	≥ 2.5

*) Nominal thickness and Area weight = presspaper + resin coating / **) Resin layer = double-sided total coating

Ladder grids and ladder ducts

- Ladder grids and ladder ducts are used in transformers to form cooling channels. With suitable dimensions (ladder geometry and ladder spacing), the size of the cooling channels can be adapted to the relevant requirements.
- The pressboard strips used are manufactured with KREMPEL POWERBOARD AK. With the specially rounded edges of these pressboard ladders, damage to layer and winding insulation or conductor and turn insulation is avoided, even at high radial pressures. For backing material, both presspaper PSP 3055 and KREMPEL-DPP with one-sided diamond dotted resin are used with different thicknesses. For ladder grids, two or three 50 mm wide carrier tapes are used. Ladder ducts include the desired backing material over the full wide.
- KREMPEL ladder grids and ducts are supplied either as blanks in the desired lengths or rolled up on standard cardboard tubes (ID 76 mm) in lengths from 10 up to a maximum of 30 running meters.



Standard dimensions and standard formats
Ladder grids and ladder ducts

	Dimensions (mm)	Tolerances	Structure
Thickness of strips	(a) 3.0 – 10.0	± 5 %	
Width of strips	(b) 4.0 – 17.0	≤ 12: ± 0.3 mm > 12: ± 0.5 mm	
Ladder spacing (centre-centre)	(c) 20; 25; 30; 35	± 1.0 mm	
Total width (ladder length)	(d) ≤ 1300	± 0.5 %	
Thickness of backing material	0.125; 0.20; 0.25	± 0.2 mm	
Tape width on ladder duct	(f) 50	+0 / -0.5 mm	
Edge distance with ladder grids	(g) 50 or 70 depending on (d)		

3. Presspaper & Pressboard for motors & other applications

For insulation of motors, coils and other electrical devices where the presspaper is not impregnated with fluid dielectric, we produce different types of presspaper & pressboard which have properties that are in part tailored to specific applications.

Standard types and areas of application KREMPEL-GROUP presspaper & pressboard for unimpregnated applications				
Designation	Type	IEC designation	Colour	Applications
Pressboard	PSP 3010	B.6.1 A IEC 60641-3-1	orange brown	Punched and moulded parts, coil bobbins, stator and rotor end disks, stator shims
Presspaper	PSP 3020	P.6.1 A IEC 60641-3-2	orange brown	Slot linings, circumferential insulations, interleaving insulations for electrical machines, punched parts
Presspaper	PSP 3040	P.6.1 B IEC 60641.3.2	greyish black or natural-coloured	Punched and moulded parts, coil bobbins, layer insulations, stator and rotor end disks
Presspaper	NUTOFLEX	Special type	red brown	Circumferential insulations, slot linings, punched and moulded parts



Stator of a winch drive with PSP end disks



Rotor of a windscreen wiper motor insulated with PSP 3040

Pressboard PSP 3010

B.6.1 A according to IEC 60641-3-1

- PSP 3010 is an orange brown pressboard made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. It receives its final electrical and mechanical properties after wet compression through a hot-air drying process followed by calendering.
- PSP 3010 is manufactured in thicknesses from 0.8 to 4.0 mm and is primarily used for punched and moulded parts, coil bobbins, stator and rotor end disks, and stamed shims. Because of the hygroscopic performance of this pressboard, which always brings about a change in properties, an impregnation or coating with synthetic resin should always be included after processing.
- For formats and tolerances, see Page 1.22

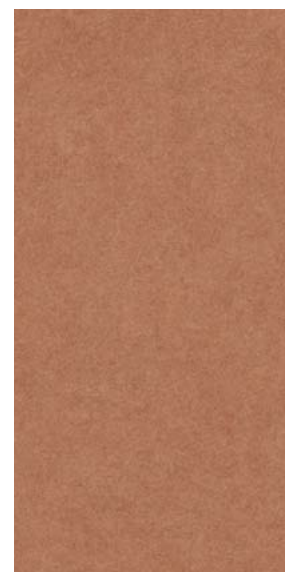


Technical data for pressboard PSP 3010 Measured in accordance with IEC 60641-2							
		0.80	1.0	1.5	2.0	3.0	4.0
Nominal thickness	mm	0.80	1.0	1.5	2.0	3.0	4.0
Tolerance	%	± 7.5	± 7.5	± 7.5	± 5.0	± 5.0	± 5.0
Density	g/cm ³	1.2- 1.3	1.2- 1.3	1.2- 1.3	1.2- 1.3	1.2- 1.3	1.2- 1.3
Area weight	g/m ²	1000	1250	1875	2500	3750	5000
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	1.00	0.80	0.53	0.40	0.27	0.20
Tensile strength MD	MPa	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Tensile strength CMD	MPa	≥ 40	≥ 40	≥ 40	≥ 40	≥ 40	≥ 40
Elongation MD	%	≥ 5.5	≥ 5.5	≥ 5.5	≥ 5.5	≥ 5.5	≥ 5.5
Elongation CMD	%	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Ash content	%	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0
Conductivity of the aqueous extract	mS/m	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
Dielectric strength in the air	kV/mm	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11

Presspaper PSP 3020

P. 6.1 A according to IEC 60641-3-2

- PSP 3020 is an orange brown presspaper made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. It receives its final electrical and mechanical properties after wet compression through a hot-air drying process followed by calendering.
- PSP 3020 is manufactured in thicknesses from 0.1 to 1.0 mm and primarily is used for slot linings, circumferential insulations and interleaving insulations on electrical machines and for punched parts and support parts. Because of the hygroscopic performance of this presspaper, which always brings about a change in properties, an impregnation or coating with synthetic resin should always be included after processing.
- For formats and tolerances, see Page 1.22



Technical data for presspaper PSP 3020
Measured in accordance with IEC 60641-2

		0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Nominal thickness	mm	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2	1.0 - 1.2
Area weight	g/m ²	115	175	230	290	345	460	575	690	805	920	1035	1150
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	8.70	5.70	4.35	3.45	2.90	2.20	1.75	1.45	1.20	1.10	1.00	0.90
Tensile strength MD	MPa	≥ 75	≥ 75	≥ 75	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80	≥ 80
Tensile strength CMD	MPa	≥ 45	≥ 45	≥ 45	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Elongation MD	%	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3	≥ 3
Elongation CMD	%	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8	≥ 8
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Ash content	%	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0
Conductivity of the aqueous extract	mS/m	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
Dielectric strength in air	kV/mm	≥ 10	≥ 10	≥ 10	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11

Presspaper PSP 3040

P. 6.1 B according to IEC 60641-3-2

- PSP 3040 is a greyish black or natural-coloured presspaper made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. It receives its final electrical and mechanical properties after wet compression through a hot-air drying process followed by calendering.
- PSP 3040 is manufactured in thicknesses from 0.1 to 1.0 mm and primarily is used for punched and moulded parts, coil bobbins, layer insulations and for stator and rotor end disks. Because of the hygroscopic performance of this presspaper, which always brings about a change in properties, an impregnation or coating with synthetic resin should always be included after processing.
- For formats and tolerances, see Page 1.22



Technical data for presspaper PSP 3040
Measured in accordance with IEC 60641-2

		0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Nominal thickness	mm	0.10	0.15	0.20	0.25	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Density	g/cm ³	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25	1.0-1.25
Area weight	g/m ²	120	180	240	300	360	480	600	720	840	960	1080	1200
Tolerance	%	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10	± 10
Area yield	approx. m ² /kg	8.35	5.55	4.20	3.35	2.80	2.10	1.70	1.40	1.20	1.05	0.90	0.85
Tensile strength MD	MPa	≥ 80	≥ 80	≥ 80	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85	≥ 85
Tensile strength CMD	MPa	≥ 45	≥ 45	≥ 45	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
Elongation MD	%	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5	≥ 3.5
Elongation CMD	%	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Moisture content	%	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8
Ash content	%	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0	≤ 2.0
Conductivity of the aqueous extract	mS/m	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
Dielectric strength in air	kV/mm	≥ 10	≥ 10	≥ 10	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11	≥ 11

Presspaper NUTOFLEX

- NUTOFLEX is a red brown special presspaper made of 100 % unbleached sulphate cellulose and extra pure water that is free of all bonding agents. It receives its final electrical and mechanical properties after wet compression through a hot-air drying process followed by calendering. By means of a targeted selection of raw materials and process control, NUTOFLEX has excellent elasticity with simultaneously high elongation values.
- NUTOFLEX is manufactured in a thickness of 0.2 mm and due to its excellent flexibility is mainly used for circumferential insulations and slot linings on electrical machines and for moulded parts. Because of the hygroscopic performance of this presspaper, which always brings about a change in properties, an impregnation or coating with synthetic resin should always be included after processing.
- For formats and tolerances, see Page 1.22



Technical data for presspaper NUTOFLEX
Measured in accordance with IEC 60641-2

Nominal thickness	mm	0.20
Tolerance	%	± 10
Density	g/cm ³	1.15 - 1.35
Area weight	g/m ²	250
Tolerance	%	± 10
Area yield	approx. m ² /kg	4.0
Tensile strength MD	MPa	≥ 70
Tensile strength CMD	MPa	≥ 40
Elongation MD	%	≥ 6
Elongation CMD	%	≥ 12
Moisture content	%	≤ 8
Ash content	%	≤ 2.0
Conductivity of the aqueous extract	mS/m	≤ 20
Dielectric strength in air	kV/mm	≥ 8

Other thicknesses available upon request.

4. Forms of delivery for pressboard & presspaper

- Pressboard is delivered in original formats. Presspaper and KREMPEL-DPP are delivered in master rolls, narrow rolls or format blanks.
- The standard dimensions and tolerances are listed in the following tables.
- Different formats and tolerances are available upon agreement. However a certain amount of off cut when working with pressboard and presspaper should be expected.

Dimensions and formats of pressboard		
Type	POWERBOARD AK	PSP 3050, PSP 3051, PSP 3010, PSP 3030
Thicknesses in mm	1.0 - 8.0	0.8 - 4.0
Sheet formats (trimmed) in mm	2200 x 4200 1100 x 4200 1100 x 2100 2200 x 2100	1000 x 2000 1000 x 1000 1000 x 650
Tolerances of sheets	± 0.5 %	± 0.5 %

Dimensions and formats of laminated board made of POWERBOARD AK		
Versions	POWERBOARD AK-CG	POWERBOARD AK-PHG
Thickness in mm	9 - 120	9 - 120
Sheet formats (trimmed) in mm	1050 x 2050	1100 x 4150 2150 x 4150
Tolerances of sheets	± 0.5 %	± 0.5 %

Dimensions and formats of presspaper Type PSP 3055, PSP 3055 SL, PSP 3055-2, PSP 3020, PSP 3040, NUTOFLEX		
Plant	Thalheim	Kuppenheim
Thicknesses in mm	0.10 - 1.0	0.04 - 1.0
Sheet formats in mm	1000 x 2050 1000 x 1000 1000 x 700	1200 x 2050 1200 x 1000 1200 x 700
Tolerances of sheets	± 0.5 %	± 0.5 %
Minimum roll width in mm	5.0	3.95
Maximum roll width in mm	2000 (thickness ≤ 0.5 mm) 1000 (thickness > 0.5 mm)	1240

Dimensions of KREMPEL-DPP				
Thicknesses in mm	DPP 0.05 – 0.075	DPP 0.10-2* – 0.15-2*	DPP 0.10 – 0.50	DPP 0.25-2*
Minimum roll widths in mm	5.0	5.0	5.0	5.0
Maximum roll widths in mm	1240	1240	1240 and 1600	1240 and 1600

* KREMPEL-DPP two-layer bonded

5. Delivery and storage of presspaper & pressboard products

Presspaper & pressboard always exists as part of a balance with the surrounding air moisture. For that reason, presspaper & pressboard must be stored in the original packaging in dust-free, air-conditioned rooms to prevent excess drying or moistening. Direct sunlight exposure or any other heat influence must be avoided at all times. This must be taken into account for purposes of transporting and storing presspaper & pressboard.

Pressboard & presspaper deliveries are therefore packed in plastic films in our plants after manufacture to ensure that the required atmosphere is maintained. For this reason, where possible the material should only be removed from the original packaging right before processing. Unneeded leftover material must be repacked in the plastic film, as in the original packaging.

With pressboard & presspaper, a disruption in the moisture balance can result in deviations in dimensions and material deformations, with very negative consequences during

processing. With presspaper & pressboard, deviations can arise in the dimensions in the thickness and width due either to drying out or humidity absorption and this can cause negative changes in the material form or properties. This can cause considerable problems, particularly in highly automated rapid manufacturing processes.

Presspaper & pressboard products are always delivered in plastic films: Presspaper on Euro pallets, pressboard and laminated board on adapted pallets and smaller blanks and narrow rolls in cardboard boxes. When roll material is delivered on cardboard tubes, these tubes typically have an inner diameter of 76mm.

KREMPEL-DPP is highly sensitive to environmental influences (temperature and moisture). For that reason DPP is always stored in the original packaging in dry and clean rooms. DPP must not be exposed to direct sun or heating sources.

6. Processing of presspaper & pressboard products

KREMPEL presspaper & pressboard can be bent, folded, punched, cut and drilled and if necessary ground. Within certain limitations, thin materials can be deep-drawn to form small moulded parts. When processing presspaper, it is important to ensure optimal cutting quality, as poorly cut edges can considerably reduce tear resistance and thus may cause production downtimes (breakage of tapes). For that reason, diamond or hard metal-fitted tools are strongly recommended. With thicker materials (e.g. thicker than 0.5 mm) the fibre orientation of the presspaper and pressboard plays a certain role and should be taken into account in processing.

A higher fibre orientation in machine direction can lead to higher tensile strength and rigidity, and in transverse direction it may result in greater flexibility. By appropriately choosing the processing direction, the material can be used to optimal effect and problems in bend, fold or shaping processes can be avoided. A sharp-edged bending of pressboard starting at 1 mm of thickness should only be performed after a previous carefully moistening of the pressboard. Moistening of pressboard is also recommended before rolling thicker pressboard to insulating cylinders with small diameters.

All of the data shown here is provided merely as a guideline. We reserve the right to introduce changes.

We do not accept any obligations or liabilities in respect of this information. Version: 08/2014

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