

## Welcome to the world of electrical insulations

*Presspaper and pressboard*

*Multi-layer insulation materials*

*Prepregs and resin-bonded insulation materials*

*Fibre-reinforced plastic profiles and components*

*Mica and high-voltage products*

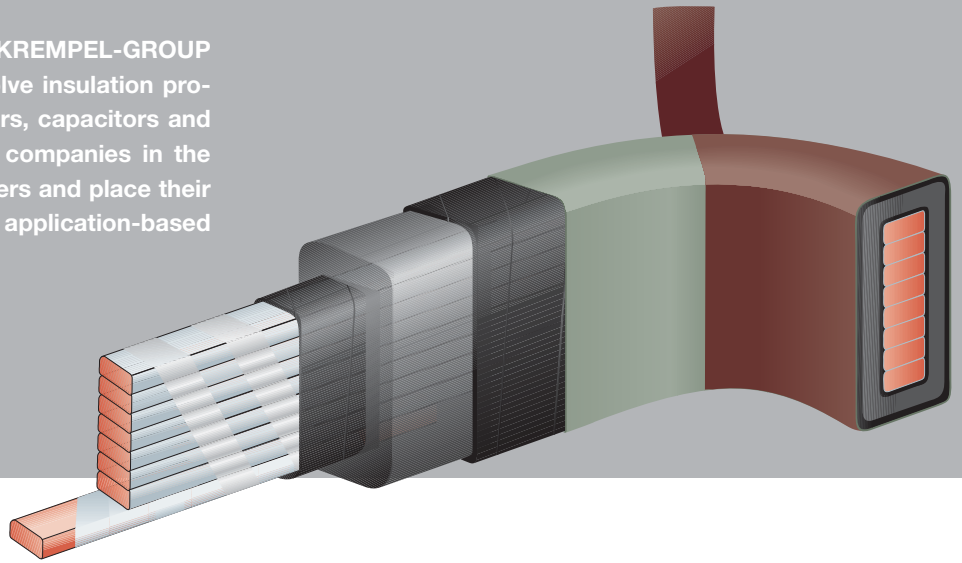
*Insulation sleeves and textile products*



# Best insulated by KREMPEL-GROUP

## Proven across the world

Electrical insulation materials from the KREMPEL-GROUP have been used for many decades to solve insulation problems in motors, generators, transformers, capacitors and other electrical devices. All the leading companies in the global electrical industry are our customers and place their trust in our reliable quality and intensive application-based consulting competence.



### Everything for high-voltage machines

#### Conductor and turn insulation:

KREMICA.*flex* mica tapes

#### Coil and bar consolidation:

TRIPREG-STABIL

Multi-prepreg-system with epoxy resin, for shorter process times as well

PREPREG ELBD

Polyester longitudinal non-woven with epoxy resin

#### Fillers for conductor stacks:

KREMPEL-ERKITT

Electrically conducting epoxy resin mastic

KREMPEL-ISKITT

Electrically insulating epoxy resin mastic

#### Main insulation:

KREMICA.*therm*

Mica tapes for Resin-Rich technique

KREMICA.*por*

Mica tapes for Vacuum-Pressure Impregnation (VPI)

Electrically conductive materials as outer, inner and end corona protection

#### Endwinding sealing:

HYPERSEAL sealing tapes  
(for Resin-Rich & VPI)

#### Packing and wedging for windings:

Insulating top ripple springs

WACOSIT® slot wedges

Electrically conductive side ripple springs

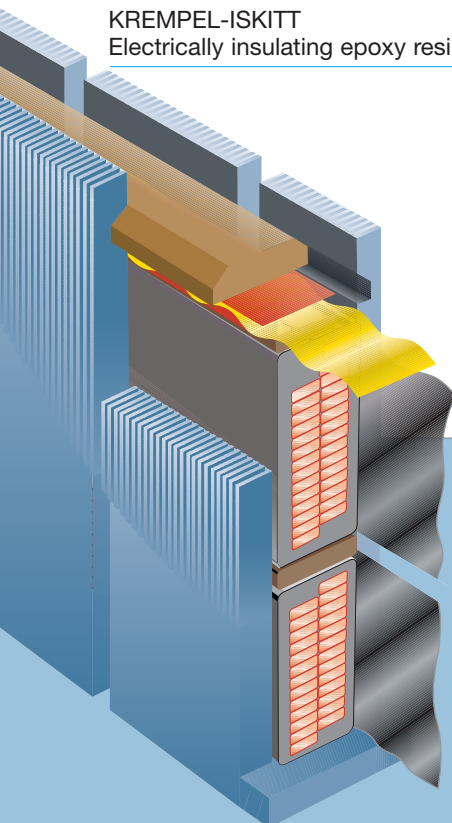
PREGNIT-R

Electrically conductive laminated sheets

#### Endwinding finishing and bracing:

VIDACORD tying cords

VIDATAPE woven tapes



High-voltage coil



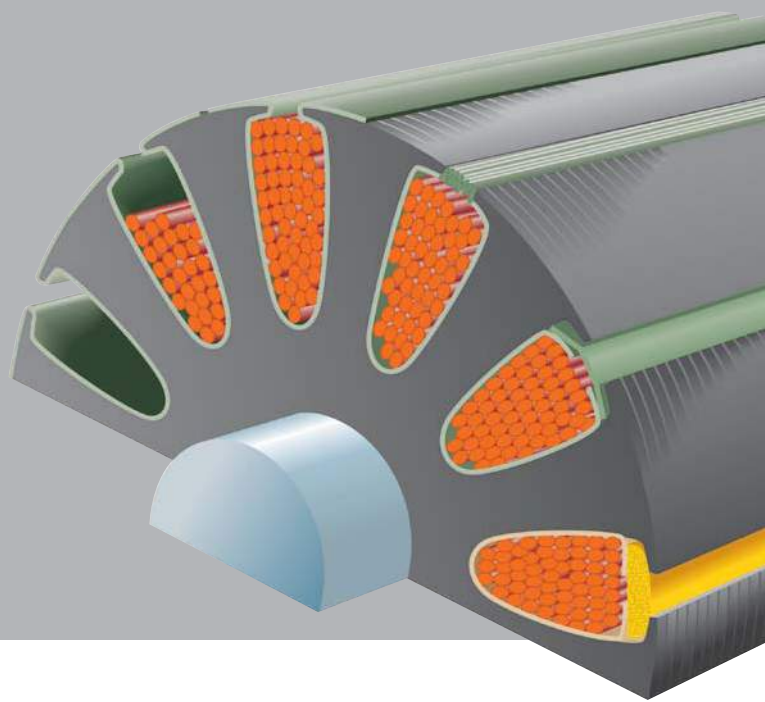
Stator of a high-voltage generator



Components of the insulation system



Because the insulation system is the decisive factor for the functional capability and durability of electrical machines and devices, many electro-technical developments only became feasible thanks to our products. The KREMPEL-GROUP has lots of solutions from one source for this central electro-technical problem in its extensive insulation materials range: from power generation to consumption.



### Everything for motors in all thermal classes

#### Slot insulations, phase insulations, slot closures:

KREMPEL presspaper

KREMPEL multi-layer insulation materials  
for thermal classes 130 to  $\geq 200$

TRIVOLTON H (for thermal class 130):  
Presspaper + PET-film + presspaper

PHASOFLEX (for thermal class 130):  
like TRIVOLTON, grained

TRIVOLTHERM P (for thermal class 130/155):  
PET-non-woven + PET-film + PET-non-woven

EVITHERM SG (for thermal class 155):  
like TRIVOLTHERM P, resin impregnated

TRIVOLTHERM N (for thermal class 180):  
Aramid paper + PET-film + Aramid paper

PHASOTHERM (for thermal class 180):  
Aramid paper NC + PET-film + Aramid paper NC

TRIVOLTHERM NKN (for thermal class 200):  
Aramid paper + PI-film + Aramid paper

TRIVOLTHERM GKG (for thermal class  $\geq 220$ ):  
Glass fabric + PI-film + glass fabric

#### Slot wedges:

WACOSIT® fibre-reinforced plastic profiles  
for thermal classes 155 and 180

#### Armature and rotor bandings:

HYPERTEN banding tapes

#### Finishing and consolidating:

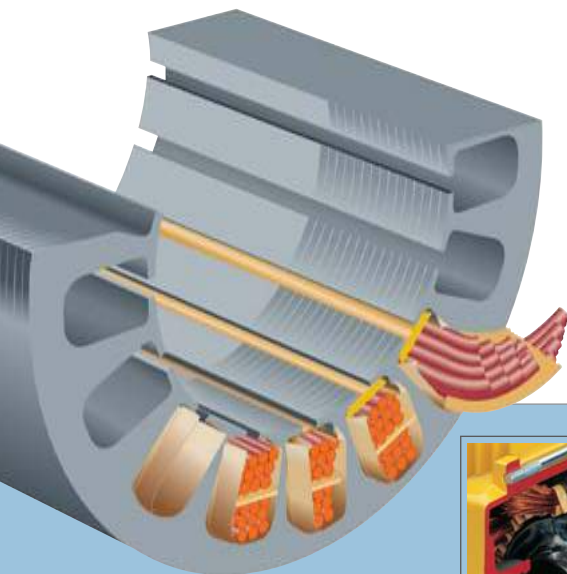
VIDATAPE woven tapes

#### Lead-out and joint insulation:

VIDAFLEX insulation sleeves

#### Endwinding bracing:

VIDACORD tying cords



Permanently excited  
DC motor



Vehicle starter with machine  
presspaper



Stator of a three-phase  
standard motor

# Safety from the power generation to consumption

## Innovative, creative, service-intensive

When developing future-oriented electrical machines and systems, particularly high demands are made of the electrical insulation materials. Because top quality products can only be realised using first-rate insulation materials that can cope easily with higher loads. The KREMPEL-GROUP has a broad production program in which special attention is also paid to subsidiary fields of electrical engineering that are often decisive for the functional security.

### Everything for dry-type transformers

#### Layer and winding insulation for low-voltage coils:

PREPREG EVBD + PREPREG EVBE  
Multi-layer insulation with epoxy resin coating

PREPREG NPBE  
Aramid paper with epoxy resin coating

#### Outer bandings for low-voltage coils:

PREPREG EFBE  
Thread-reinforced polyester non-woven with epoxy resin impregnation

#### Spacer strips for low-voltage coils:

HYPERFIL SF  
Polyester non-woven with epoxy resin impregnation

#### Supports and spacers for low-voltage coils:

WACOSIT® corner profiles and dogbones

#### Core bandings:

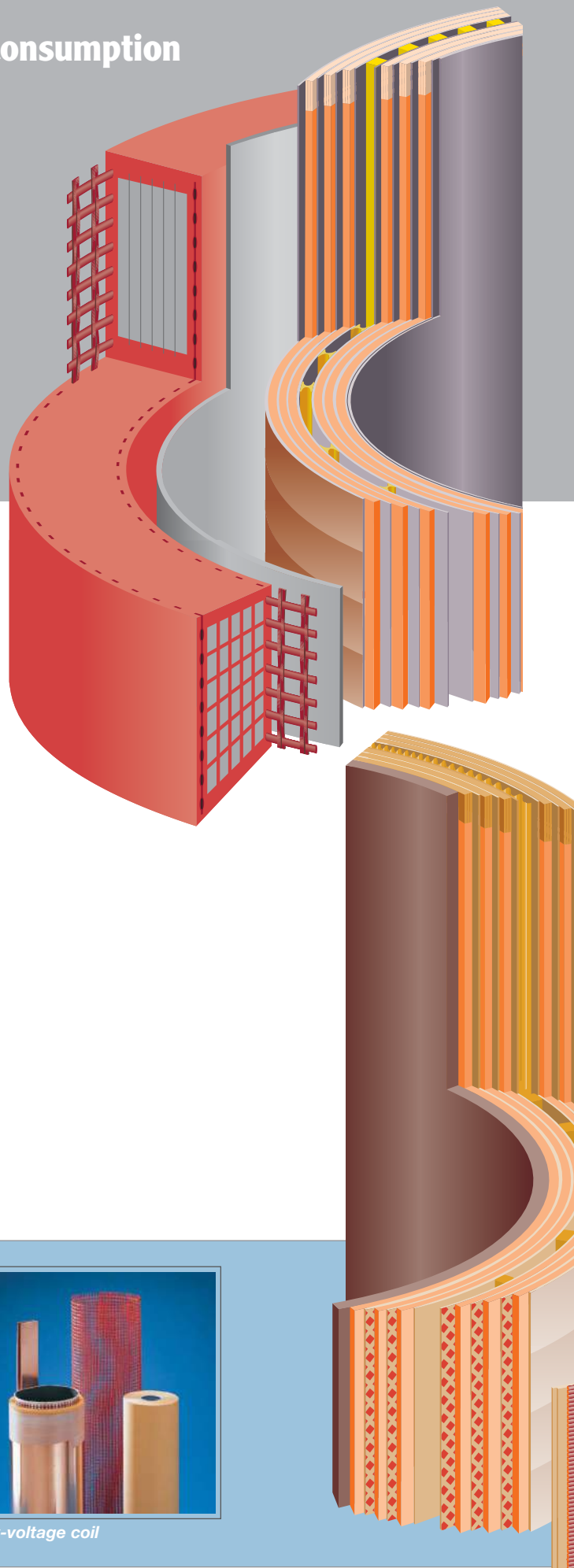
HYPERTEN banding tapes

#### Insulation cylinders:

AKAFOL H polyester film-laminates

#### Cast-resin strengthening for high-voltage coils:

VERDUR GRBE  
Glass roving fabrics with cured epoxy resin



Cast-resin transformer



Components of the insulation system



Low-voltage coil

During the course of the intensive application-specific consulting, the insulation material experts of the KREMPEL-GROUP work together with the customer to find the best technical and economic solution. We will tell you what is important when selecting and using insulation materials.

Many design problems can often be solved by modifying existing products or by developing new, tailor-made materials. Insulation materials from the KREMPEL-GROUP guarantee easy processing, a high level of functional security and best long-term durability.

### Everything for oil-filled transformers

#### Layer and winding insulation:

PSP 3055 RPT (P.2.1) – Presspaper

PREPREG CTBD

Presspaper with epoxy resin coating

KREMPEL-DPP

Diamond dotted presspaper

#### Insulation cylinders and cooling channels, supports etc.:

PSP 3050 (B.2.1) – Pressboard

POWERBOARD AK PSP 3052 (B.3.1) – Pressboard

KREMPEL corrugated board

Ladder duct made of presspaper and pressboard

Ladder grid made of presspaper and pressboard

#### Moulded parts made of pressboard for power transformers:

Angle rings and caps

Chimney segments

Other moulded parts

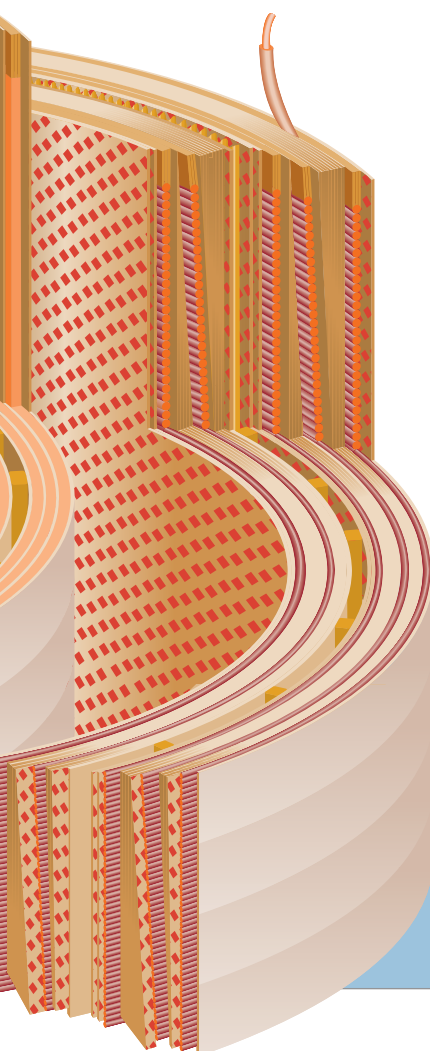
#### Outer bandings:

PREPREG EFBD

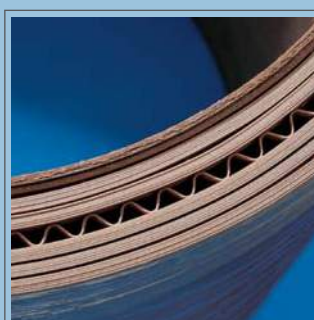
Thread-reinforced polyester non-woven with epoxy resin impregnation

#### Insulations for coil connections:

Crepe paper tubes



Low-voltage coil with  
KREMPEL-DPP



Cooling-channel system with  
KREMPEL corrugated board



Moulded parts made of  
pressboard



# Presspaper and Pressboard

*Presspaper, pressboard, corrugated board*

*Diamond dotted presspaper*

*Ladders, ladder grids, ladder ducts, moulded parts, crepe paper tubes*

Presspaper and pressboard are proven insulation materials on a cellulose basis for the thermal class 105. Depending on the type of cellulose, fibre conditioning and machinery settings, the KREMPEL-GROUP supplies a variety of presspaper and pressboard types with very specific characteristics. These highly pure cellulose products are produced on special paper machines; we have one of the largest production systems for the continuous production of presspaper in the world.



*Continuous presspaper production*

The properties and characteristics of the **presspaper and pressboard** materials are standardised in IEC 60641. Besides the high breakdown voltage and the high capacity for impregnation with transformer oil (dielectric mix of oil-cellulose), the pressboard can withstand high heat loads for short periods of time (e.g. 350 °C for a few seconds) because the material has no melting point. Also, the presspaper and pressboard can be punched, folded, cut and in some cases be shaped as well.

With "KREMPEL-DPP" – **Diamond-P**attern epoxy-coated **P**apers – KREMPEL **presspaper** is available with a **diamond dotted resin coating**. After curing, the partial resin coating leads to partial adhesive bonding of the electrical conductors with the layer insulation. The channels that thereby develop can be used to remove air and the moisture from the transformer and to fill the transformer with liquid insulation material.

**Corrugated board** in various geometries, and **ladder grids and ladder ducts** are also used to form the cooling channels. The KREMPEL **moulded parts** made of pressboard finally serve as barriers at the ends of the coils of the power transformers.

## Application fields KREMPEL-GROUP presspaper and pressboard

Machine type	Punched and moulded parts, coil bobbins, stators and rotor end disks, cutting boards
High-grade type	Slot liners, circumferential insulations, interleaving insulations for electrical machines, punched parts
POWERBOARD AK	Insulation cylinders, ladders, spacers in oil transformers
Transformer type	Insulating components in oil-filled transformers, layer insulation, core insulations
Capacitor type	Insulating components in oil-type capacitors, layer insulation
Special presspaper NUTOFLEX	Circumferential insulations, slot liners, punched and moulded parts
Corrugated board	Cooling channels in oil-filled transformers
Ladder duct	Cooling channels in oil-filled transformers
Ladder grid	Cooling channels in oil-filled transformers
KREMPEL-DPP	Layer and winding insulation in oil-filled transformers

## Standard types (in brackets types acc. to IEC 60641-3) KREMPEL-GROUP presspaper and pressboard

Designation	Types Presspaper	Types Pressboard	Colour
Machine type	Psp 3020 (P.6.1)	Psp 3010 (B.6.1)	brown
High-grade type	Psp 3040 (P.6.1)	Psp 3030 (B.6.1)	grey/black
POWERBOARD AK	–	Psp 3052 (B.3.1)	natural colour
Transformer type	Psp 3055 (P.2.1)	Psp 3050 / 3051 (B.2.1) (B.4.1)	natural colour
Capacitor type	Psp 3065 (P.0.1)	Psp 3060 (B.0.1)	natural colour
Special presspaper NUTOFLEX	Special quality with a high elongation		violet
Corrugated board	Corrugated special quality		natural colour
Ladder duct	Ladders with full presspaper carriers		natural colour
Ladder grid	Ladders with partial presspaper carriers		natural colour
KREMPEL-DPP	Transformer presspaper with partial resin coating (diamond dotted)		natural colour Resin: red

Machine presspaper

POWERBOARD AK

KREMPEL DPP

Corrugated board

Ladder duct

# Multi-layer insulation materials

*Flexible multi-layer insulation materials*

*Special multi-layer insulation materials*

*Special films*

Flexible multi-layer insulation materials from the KREMPEL-GROUP are produced by laminating plastic films with press-paper, non-wovens, fabrics or plastic paper materials. The decisive know-how is contained both in the special lamination systems and also in the adhesive formulations that have been developed by our own technicians.



*Special lamination systems*

**Multi-layer insulations** are normally produced as three-layer combinations whereby the plastic film is in the middle. Depending on the material combination, very specific ranges of values can be designed for the operating temperature, ductility, tensile strength, elongation, breakdown voltage, capacity for impregnation and the stiffness of the multi-layer.

The combination of plastic film and fibrous material has both technical as well as economic advantages. The plastic film guarantees the outstanding electrical and mechanical properties whereas the fibrous material ensures good impregnation and protects the film. Flexible multi-layer insulations can be cut, folded, embossed and to a certain extent, can be cold and hot-shaped as well.

Some electro-technical design tasks can only be solved using **special multi-layer insulation materials** from the KREMPEL-GROUP. The laminates are produced with two, three, four or five layers - depending on requirements. The materials used are polyester films, polyimide films, vulcanised fibres, fabrics, non-wovens, aramid papers, multi-layer insulation materials or metal foils which are adhered to each other.

**KAPTON® polyimide film** manufactured by DuPont is an excellent insulation film that is ideally suited for applications with high operating temperatures. KREMPEL is the authorised distributor for KAPTON® for Germany, Austria and Eastern Europe.

## Application fields

### KREMPEL-GROUP multi-layer insulation materials

Designation	Applications
TRIVOLTON® H	Slot insulations, slot closures, circumferential insulations, layer insulations and core insulations, punched parts
TRIVOLTON® HP	Slot insulations, slot closures, circumferential insulations, layer insulations and core insulations, punched parts
TRIVOLTON® HPH	Slot insulations, slot closures, circumferential insulations, layer insulations and core insulations, punched parts
PHASOFLEX II	Phase insulations
TRIVOLTHERM® P	Slot insulations, slot closures, punched parts
TRIVOLTHERM® TF	Slot insulations, slot closures
EVITHERM SG	Slot insulations, slot closures
TRIVOLTHERM® N	Slot insulations, slot closures, punched parts
TRIVOLTHERM® N-XS	Slot insulations, slot closures, punched parts
TRIVOLTHERM® N-HT	Slot insulations, slot closures, punched parts
PHASOTHERM	Phase insulations
TRIVOLTHERM® NKN	Slot insulations, slot closures, interleaving insulations
TRIVOLTHERM® GKG	Slot insulations, conductor insulations, layer insulations
AKAFOL H	Insulation cylinder, punched parts
AKAFOL PH-2	Inter-turn insulation

## Standard versions

### KREMPEL-GROUP multi-layer insulation materials

Designation	Structure	for thermal class
TRIVOLTON® H	Presspaper + PET-film + presspaper	130
TRIVOLTON® HP	PET-film + presspaper	130
TRIVOLTON® HPH	PET-film + presspaper + PET-film	130
PHASOFLEX II	like TRIVOLTON HP, grained	130
TRIVOLTHERM® P	PET-non-woven + PET-film + PET-non-woven	130/155
TRIVOLTHERM® TF	like TRIVOLTHERM P, impregnated with resin on both sides and particularly smooth surface	155
EVITHERM SG	like TRIVOLTHERM P, impregnated with resin on both sides	155
TRIVOLTHERM® N	Aramid paper + PET-film + Aramid paper	155/180
TRIVOLTHERM® N-XS	with particularly smooth surface	155/180
TRIVOLTHERM® N-HT	for short-term overload	155/180
PHASOTHERM	Aramid paper-NC + PET-film + Aramid paper-NC	155
TRIVOLTHERM® NKN	Aramid paper + PI-film + Aramid paper	180
TRIVOLTHERM® GKG	Glass fabric + PI-film + glass fabric	200
AKAFOL H	Multi-layer PET-film	130
AKAFOL PH-2	PET-film + PEN-film	155

PHASOFLEX

EVITHERM SG

TRIVOLTHERM N

TRIVOLTHERM NKN

TRIVOLTHERM GKG



# Prepregs and resin-bonded insulation materials

## Prepregs

### Banding tapes & sealing tapes

### Insulation materials with cured resins

KREMPEL-GROUP prepregs are produced by impregnating or coating a broad range of insulation materials with various resins which are still in the reactive B-stage. This means it is possible to attach the impregnation substance (resin) into the slots of electrical machines or windings of transformers at the same time as the insulation. There is no need for the complex impregnation process.



Prepreg production

**Prepregs** are produced at the KREMPEL-GROUP using a variety of technologies. Backing materials for the epoxy or polyimide resin systems can be fabrics, non-wovens, papers, presspapers, films or multi-layer insulation materials. Prepregs are used in transformer and electrical machinery construction to insulate and secure current-carrying parts. The electrical conductors are firmly bonded to the insulation when the reactive resin is cured.

Type	for thermal class
HYPERTEN 2000 HP	180
HYPERTEN 3000 ZF	180 - extremely high tensile strength

HYPERTEN tapes are resin-impregnated, unidirectional glass **banding tapes** and are used in rotors to control the centrifugal forces in conductors and winding elements, as well as to brace the cores in transformer construction.

HYPERSEAL **sealing tapes** are made from glass or polyester fabrics or combinations of the two, whereby manufacturing can be controlled to give low-resin (VPI) or resin-rich (B-state) sealing tapes. The B-state of the impregnating resins is adjusted so that a defined resin flow and, as a result, the designed sealing characteristics, will be reached.

Certain construction tasks in electrical engineering call for the use of single-layer **insulations with a cured-resin impregnation or coating**. Despite their low material thickness, KREMPEL polyester hard non-wovens, glass hard fabrics and vulcanised fibres are characterised by very high values for the breakdown voltage and for the creep resistance, as well as by their high stiffness and compressive strength.

#### Standard types KREMPEL-GROUP prepregs

PREPREG type series	Backing material	Resin type	for thermal class
CTBD	Presspaper	Epoxy	120
CTBD-VST	Presspaper	Epoxy	120
EDBD	PET-film	Epoxy	130
CVBD-VST	TRIVOLTON® H	Epoxy	130
EVBD	TRIVOLTHERM® P	Epoxy	130
EVBE	TRIVOLTHERM® P	Epoxy	130
NVBD-VST	TRIVOLTHERM® N	Epoxy	155
NVBE	TRIVOLTHERM® N	Epoxy	155
PVBD	AKAFOL PH-2	Epoxy	155
NPBE	Aramid paper	Epoxy	155
ELBD	PET-longitudinal non-woven	Epoxy	130
ELBE	PET-longitudinal non-woven	Epoxy	155
EFBD	Thread-reinforced PET-non-woven	Epoxy	130
EFBD-VST	Thread-reinforced PET-non-woven	Epoxy	130
EFBE	Thread-reinforced PET-non-woven	Epoxy	155
GWBD	Glass tangled non-woven	Epoxy	155
GWBE	Glass tangled non-woven	Epoxy	155
GGBD	Glass fabric	Epoxy	130
GGBE	Glass fabric	Epoxy	155
GRBE	Glass roving fabric	Epoxy	155
GGHH	Glass fabric	polyimide	200

PREPREG EVBD

PREPREG EFBD

HYPERTEN 2000 HP

HYPERSEAL V

VERDUR B 122 2F

VERDUR GRBE



# Fibre-reinforced plastic profiles and components

*Pultruded plastic profiles*

*Plastic sheets and moulded parts*

*Injection mouldings*

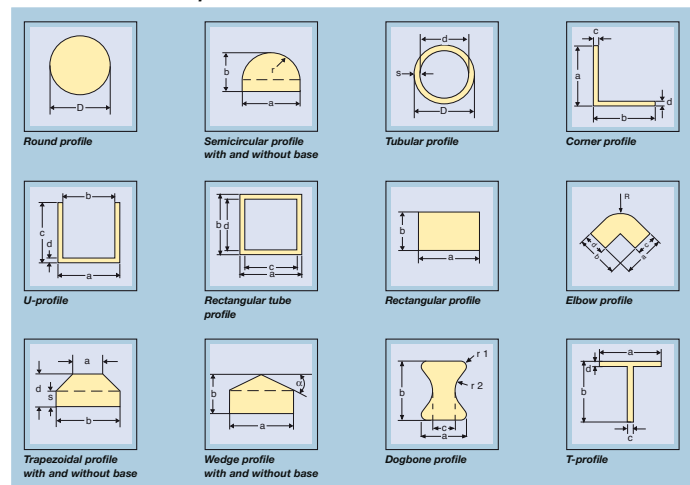
Fibre-reinforced plastics have properties and application capabilities that conventional materials cannot offer. We have innovative products. We have complex production systems. We have extensive engineering competence in the fields of fibres, resins and processing technologies. And of course, we also help our customers design their fibre-composite components.



*Pultrusion production*

Under the name WACOSIT®, the KREMPEL-GROUP supplies continuous **pultruded plastic profiles and tubes**. Rovings and/or fabric tapes made of glass, carbon or aramid fibres and epoxy or polyester resins are used here. More than 5000 standard geometries are available. We also have special expertise in the field of complex-shaped special profiles.

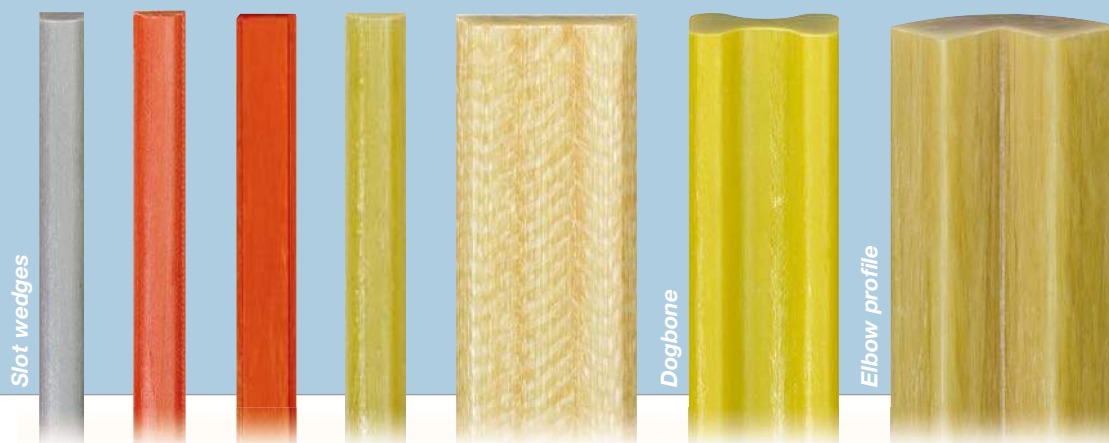
## WACOSIT® standard profiles and tubes



WACOSIT® plastic profiles can also be used in a variety of ways in electrical motors as slot closures and in transformers as cooling channel spacers.

**Plastic sheets and moulded parts** are produced by the KREMPEL-GROUP from our own prepreps or very high-grade thermoplastics. This allows us to satisfy our customers' needs to the maximum and achieve an extremely high standard of quality. We use modern multi plates and moulded part presses as well as autoclaves and vacuum tables. Our own tool construction facility allows rapid production „from the draft to the finished product“.

We produce top quality **injection mouldings** made of technically sophisticated plastics on computer-controlled injection moulding systems of the latest generation. Our complex 3-D modelling procedures make effective solutions possible for materials and production.



*Slot wedges*

*Dogbone*

*Elbow profile*

# Mica and high-voltage products

## Mica tapes

### Electrically conductive materials

### Fibre-reinforced slot springs

The insulation system for high-voltage machines comprises several components that need to be ideally matched to each other. Top quality mica products are used for the main insulation and conductor insulation. However, electrically conductive materials are required to control the whole insulation as these ensure safe potential equalisation. Finally, electrically conductive side ripple springs and electrically insulating top ripple springs are required to fill the slots and brace the winding.



Mica products production

Mica is a high-grade mineral insulating material with unique insulation properties. At the KREMPEL-GROUP **micapaper** is used as the base material which is then combined with synthetic resins and suitable backing materials, e.g. glass fabrics or films, to give the required mechanical strength. The resin-rich KREMICA.therm mica tapes are processed in the so-called Resin-Rich technique (= hot pressing), the resin-poor, porous KREMICA.por mica tapes are processed by the VPI-method (= Vacuum Pressure Impregnation).

#### Application fields KREMPEL-GROUP mica tapes

Mica tape type	Applications
KREMICA.flex	Conductor insulation, main insulation, flexible coil leads, flexible endwindings
KREMICA.therm	Main insulation
KREMICA.por	Main insulation

#### Standard types KREMPEL-GROUP mica tapes

Mica tape type	Structure	Processing
KREMICA.flex	Fabric (e.g. glass) and/or films (e.g. PET; PI) + micapaper, resin-impregnated	Resin-Rich technique and VPI-technique
KREMICA.therm	Fabrics (e.g. glass) and/or films (e.g. PET; PI) + micapaper, high resin content	Resin-Rich technique
KREMICA.por	Fabrics (e.g. glass) and/or films (e.g. PET; PI) + micapaper, low resin content	VPI-technique

**Electrically conductive materials** from the KREMPEL-GROUP contain electrically conductive particles in various concentrations. There are **conductive non-wovens** and **conductive fabrics** available as banding material, and there are **conductive sheets** and **glass-fibre reinforced plastic springs** with individually settable resistance values as slot filling materials.

By the interaction between the spring effect and the electrical conductivity, **side ripple springs** constitute the electrically securing element in closing the side slot; by the interaction between the spring effect and the electrical insulation, **top ripple springs** constitute the mechanically securing element in closing the slot.

#### Standard types KREMPEL-GROUP conductive non-wovens and fabrics

Type	Backing material	Applications	Settable surface-resistance ( $\Omega / \square$ )
06 EWR 15 AA	PET-tangled non-woven	Corona protection, slot filling	400 - 6 000
07 EWR 05 AA	PET-tangled non-woven	Corona protection, slot filling	400 - 5 000
10 EWR 02 AA	PET-tangled non-woven	Corona protection, slot filling	400 - 20 000
03 ELR 19 AA	PET-longitudinal non-woven	Corona protection, banding	400 - 1 000
06 ELR 14 AA	PET-longitudinal non-woven	Corona protection, banding	400 - 1 000
06 ELR 14 CC	PET-longitudinal non-woven	Corona protection, slot filling	150 - 1 500
03 EFR 13 AA	PET-non-woven thread-reinforced	Corona protection, banding	1 000 - 2 000
07 EFR 18 AA	PET-non-woven thread-reinforced	Corona protection, banding	400 - 5 000
04 ESR 22 AA	PET-stretch non-woven	Potential equalisation in measuring transformers	400 - 1 000
04 ESR 22 AA-sk (self-adhesive)	PET-stretch non-woven	Potential equalisation in measuring transformers	400 - 1 000
05 GGR 32 AA	Glass fabric	Corona protection, banding	400 - 1 000
10 GGR 31 AA	Glass fabric	Corona protection, banding	400 - 1 000
AKASIC 4b	Glass-PET-blended fabric	End corona protection (Resin-Rich technique)	-

KREMICA.flex

KREMICA.therm

KREMICA.por

Conductive non-woven

Top ripple spring

Side ripple spring



# Insulation sleeveings and textile products

## Insulation sleeveings

### Woven tapes

### Cords

The KREMPEL-GROUP has a large pool of textile machines to weave, braid and knit woven tapes, insulation sleeveings and cords. These textile products are required for electrical machines and transformers.



Textile products production

**VIDAFLEX insulation sleeveings** can either be extruded from silicone elastomer compounds or braided/knitted using glass or polyester yarns. The fibre-based sleeveings are then impregnated/coated with silicone, acrylic or polyurethane resins.

Excellent protection against electrical, thermal and mechanical stresses is given for cables, strands and conductors depending on the type of VIDAFLEX insulation sleeveing used. The quality grades available for VIDAFLEX meet BS, IEC, ASTM and NEMA standards. Various types are also CSA and UL-recognised.

#### Types KREMPEL-GROUP sleeveings

Structure VIDAFLEX-Types	for thermal class
Silicon elastomer sleeveings	> 180
Glass or polyester sleeveings with acrylic or polyurethane resin coating	155
Glass sleeveings with silicon resin or elastomer coating	> 180
Glass sleeveings	> 200
Expandable sleeveings for cable harnesses	-

**VIDATAPE woven tapes** are made from either glass or polyester yarns as well as from combinations of different yarn types, e.g. glass/polyester, glass/aramid or glass/copper wire. Special variants: Tapes made using pre-shrunk or high-shrinkage polyester yarns.

VIDATAPE woven tapes are used for a variety of banding applications in the electrical machine construction and for producing transformers.

**VIDACORD and KREM.cord tying cords** are glass and/or polyester-braided or knitted tying cords which can have a glass or polyester fibre filler. The outer sleeve construction depends on the requirements - for easier handling, for example, a polyester-braided outer with a glass filler is preferred.

VIDAFLEX S 550

VIDAFLEX 111

VIDAFLEX 942

VIDATAPE P

VIDATAPE C

VIDACORD BP

VIDACORD PB / C / GF

## Parent company and world-wide distribution

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Vaihingen plant



Kuppenheim plant



Thalheim presspaper plant

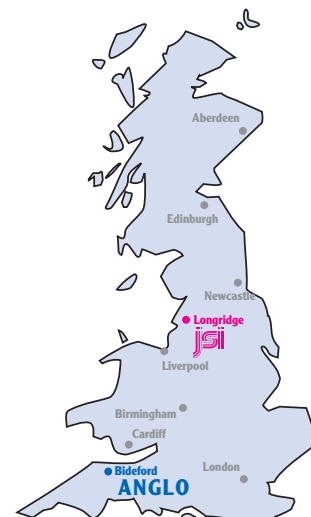
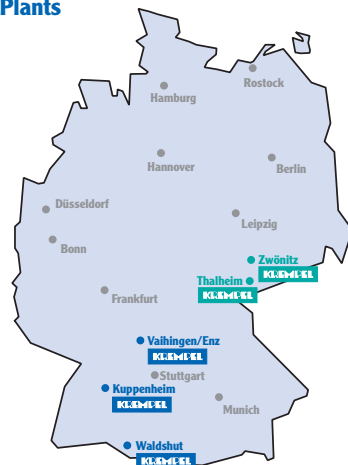


Zwönitz presspaper plant



Waldshut plastics plant

## Plants



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**JSI**



Longridge plant

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**ANGLO**



Bideford plant

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