



Insulating Systems for Low-Voltage Motors and Generators

We Enable Energy

As one of the oldest industrial companies in Switzerland, founded in 1803, we focus on products and systems for power generation, transmission and distribution, rotating machines and mechanical engineering. Von Roll is the global market leader for insulation products and the only company to offer the complete range of insulation products, composites, consulting, tests and services for the electrotechnical industry.

For more than 100 years, we have been making outstanding contributions to this market, developing a number of highly innovative products that have enabled both steady increases in power output and smaller and more compact machines.

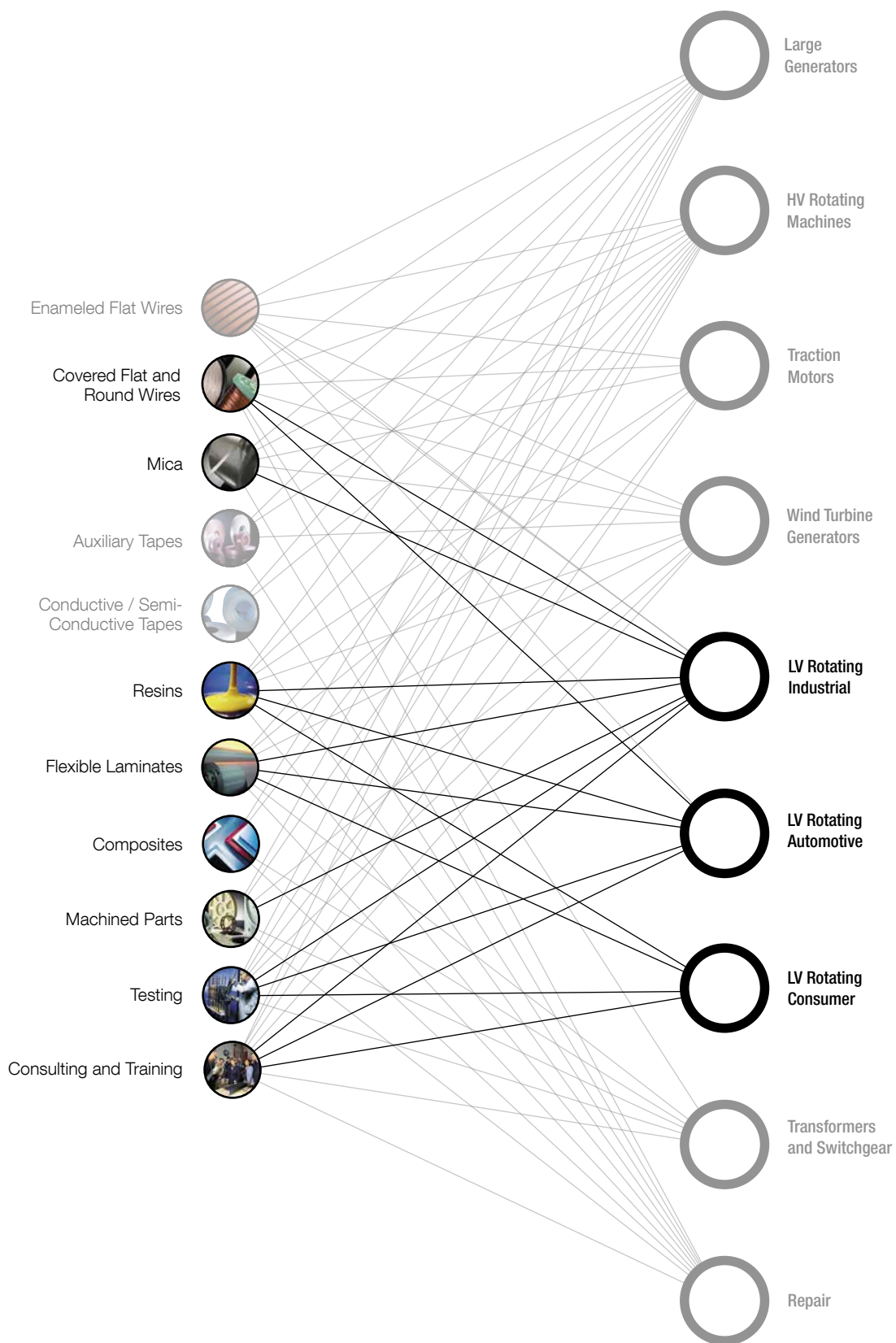
Customers enjoy the following benefits:

- » One single source for all insulating materials
- » Thorough expertise from power generation and transmission to its efficient utilization
- » Proven compatibility for system components
- » Testing at Von Roll of both materials and systems
- » Consulting for applications and technologies
- » Training in insulation materials and systems

The differences in application of low-voltage motors and generators are very extensive, and the requirements concerning electrical, mechanical, environmental and thermal specifications exceptionally varied. For all these requirements there are materials that are specially adapted. Von Roll offers a wide range of high-quality materials, systems and services that are ideal for all these motors and generators such as submersible pumps, tubular and micro motors, power tools, automotive, hermetic motors, inverter driven motors and others.



Our Products for Low-Voltage Applications



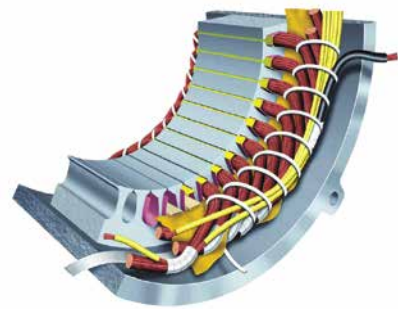
Von Roll offers full system solutions for every market shown in this application tree. Please contact us or visit our website www.vonroll.com for further information.

A Variety of Insulation Systems

Von Roll offers a great variety of insulation materials for low-voltage motors and generators: flexible laminates, resins, tapes and other structural materials. All these have been developed to create the most reliable machines. For every application there is an ideal set of materials that form a fully compatible system. We also supply engineering application support and testing services to maximize production efficiency and optimize approval processes. Von Roll is a global company with multiple manufacturing sites in most continents, allowing optimized regional support.

The insulation systems for low-voltage motors and generators are composed of the following materials and services:

- » Slot insulation
- » Impregnation resin
- » End-winding tape
- » Wedges and closures
- » Finishing varnishes
- » UL testing



Most of these products are listed in UL under different thermal classes.



Flexible Laminates

Von Roll is a world leader in flexible laminates and coated materials. Von Roll materials for slot liners, phase insulation, barrier applications, and closures for low-voltage motors and generators are outstanding. We supply them in a wide variety of thicknesses. The following are some of the suitable products:

	Temperature index	Composition	Special properties
Myoflex® PVS Acuflex® DMD	Class F	three-ply flexible laminate made of PET felt, PET film and a PET felt fully saturated with a synthetic resin	<ul style="list-style-type: none"> » designed for automatic insertion machine » tough, affordable laminate » excellent resistance to cut through and edge tear
Myoflex® PVS H	Class H	three-ply flexible laminate with outstanding thermal endurance	<ul style="list-style-type: none"> » same as PVS with a higher thermal class
Myoflex® 2N50 and 2N80 Acuflex® NMN	Class H	three-ply flexible laminate made of Nomex® paper, polyester film and Nomex® paper bonded with a synthetic resin	<ul style="list-style-type: none"> » outstanding mechanical properties » good resistance to thermal stress thanks to high-performance adhesive system » designed for automatic insertion machine
Myosam®	Class F	three-ply flexible laminate including mica paper	<ul style="list-style-type: none"> » exceptional corona resistance properties » very good mechanical properties

For wedges Von Roll recommends composite materials such as Vetronit® G-11 or Delmat Epoxy 68660, which can be delivered either as sheets or machined parts. U and L profiles with bounded Nomex layers are also part of the slot insulation program.



Flexible laminates

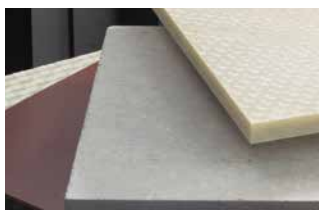


Other Materials

Other applicable materials for low-voltage applications supplied by Von Roll are:

Mica tapes – The use of mica-based tapes in low-voltage applications is mainly for traction and inverted-driven motors. The value of these tapes is very important to protect these machines from voltage peaks that can be 2 to 3 times higher than the rated voltage. Mica is an excellent insulator that is commonly used for high-voltage applications. The commitment of Von Roll to mica is unique, starting with the mining of this raw material followed by the production of paper and mica tapes and going as far as taping conductors.

Structural materials – A wide range of structural materials can be used for low-voltage applications. Rigid laminates and molded parts as well as prepregs and B-staged materials are the answer to many design challenges in blocking and reinforcements, terminals, switch insulations and others. Polyglas b-stage banding tapes are useful for reinforcements of rotating parts such as armatures, generator exciters and rotor components.



Application Suggestions

Brand names	Small submersible pumps	Tublar and micro motors	Appliance motors	Power tools	Automotive
Flexible laminates					
	Myoflex® PV, PVS	Myoflex® PV, PVS	Myoflex® PV, PVS	Myoflex® LS	Myoflex® N/T
	Acuflex® DMD	Acuflex® DMD	Acuflex® DMD	Myoflex® PV, PVS	Myoflex® PV, PVS
	Acuflex® RM	Myoflex® PVS H	Myoflex® PVS H	Acuflex® DMD	Acuflex® DMD
		Acuflex® NMN	Acuflex® NMN	Acuflex® RM	Acuflex® RM
			Myoflex® NMN		Acuflex® NM, NMN, NMNM
					Myoflex® NMN
Impregnation and potting resins					
	Damival® 13518 PU Potting	Damisol® 2014 Epoxy/Solvent	Damisol® 2014 Epoxy/Solvent	Damisol® 3026-2 UPI	Damisol® 3030-2 UPI, 3040 UPI
	Damival® 15350 Epoxy Potting		Damisol® 3026-2 UPI	Damisol® 3030-2 UPI	Damisol® 3500 HiR Epoxy
			Damisol® 3030-2 UPI	Damisol® 3007-2 Gelcoat	Damisol® 3630 HTP UPI
			Damisol® 3305-2 UPI	Damisol® 3630 HiR UPI	Damisol® 3630 HiR UPI
			Damisol® 3500 HiR Epoxy	Gelgreen 3637 UPI	
			Damisol® 3630 HiR UPI		
			Damisol® 3630 HTP UPI		
Composites and banding tapes					
				Poly Glas® H200, 76870	Poly Glas® K220, P30, H200, 76870
					Vetronite® G-11 Composites



Commercial motors and generators	Industrial motors and generators	Inverter-driven Motors	Hermetic motors	Industrial and traction DC motors and generators	Aircraft and military motors
Myoflex® NPV	Myoflex® NPV	Myosam®	Myoflex® PVS H	Acuflex® NKN	Acuflex® NKN
Myoflex® PV, PVS	Myoflex® PV, PVS	Myoflex® PV, PVS	Acuflex® NM, NMN	Myoflex® NKN	Myoflex® NKN
Myoflex® PVS H	Myoflex® PVS H	Myoflex® PVS H	Acuflex® DMDF	Fusa-Fab® 155	Myoflex® NSN
Acuflex® DMD, DMDF	Acuflex® DMD, DMDF	Acuflex® DMD, DMDF	Myoflex® NMN	Fusa-Fab® 180	
Acuflex® NM, NMN, NMNM	Acuflex® NM, NMN, NMNM	Acuflex® NM, NMN, NMNM		Mica Mat® mica tapes	
Pyrolam® DMD	Pyrolam® DMD	Pyrolam® DMD			
Pyromid® 180 DMD	Pyromid® 180 DMD	Pyromid® 180 DMD			
MEMCO DMD	MEMCO DMD	MEMCO DMD			
Myoflex® NMN	Therm-Al® H Coated glass cloth	Therm-Al® H Coated glass cloth			
	Myoflex® NMN	Myoflex® NMN			
Damisol® 2014 Epoxy/Solvent	Damisol® 2014 Epoxy/Solvent	Damisol® 3040, 3340 UPI	Damisol® 2014 Epoxy/Solvent	Damisol® 3551 Silicone	Damisol® 3308, 3309 UPI
Damisol® 2005 HFP Alk/Solvent	Damisol® 2005 HFP Alk/Solvent	Damisol® 3500 HIR Epoxy	Damisol® 3500 HIR Epoxy	Damisol® 2053 HFP UPI	Permafil® 707 UPI
Damisol® 3040, 3340, 3032 UPI	Damisol® 3500 HIR Epoxy	Permafil® 74041 Thixotropic Epoxy	Permafil® 74041 Thixotropic Epoxy	Damisol® 2005 HFP Alk	Damisol® 3551 Silicone
Permafil® 74041 Thixotropic Epoxy	Damisol® 3040, 3340, 3032 UPI	Damisol® 3630 HTP UPI	Damisol® 3630 HTP UPI	Damisol® 3340 UPI	Damisol® 3340 UPI
	Damisol® 3630 HTP UPI	Damisol® 3630 VPI UPI	Damisol® 3630 HIR UPI	Permafil® 707, 747 UP	Damisol® 3630 HTP UPI
Damisol® 3500 HIR Epoxy	Damival® 13518 PU Potting		Damisol® 3630 VPI UPI	Damisol® 3630 HTP UPI	Damisol® 3630 VPI UPI
Damisol® 3630 HTP UPI	Damival® 15350			Damisol® 3630 VPI UPI	
Damisol® 3630 HIR UPI	Damival 15225 Epoxy Potting				
Damisol® 3630 VPI UPI	Damisol® 3630 VPI UPI				
	Bondable Papers			Poly Glas® H220	Vetronite® G30 Polyimide Laminate
	B-stage glass cloth			Poly Glas® 76870	Vetronite® G7 Silicone Laminate
	Vetronite® Composites			Poly Glas® K220	
	Delmat® GPO Laminates			Vetronite® GPO Laminates	
	Poly Glas® H200			Delmat® Composites	
	Poly Glas® 76870				

¹⁾ ® Registered trademark: DuPont de Nemours



Resins



Impregnation resins are one of the most important components in any low-voltage machine. We offer a wide range of impregnation resins ideally optimized for every impregnation system, such as vacuum pressure impregnation, trickling, dipping or dip rolling. Below are some materials that are particularly suited to these applications:

	Chemistry	Temperature index	Viscosity at 23°C (mPa.s)	Curing process*	Process	Application	Special properties
Damisol® 3630 MEV	Polyesterimide, green	H	300	8 h at 150°C	VPI	Windturbine, Traction, Repair	Highly reactive, yet very stable room temperature impregnating resin. Good results on static curing. Excellent thermal, electrical and mechanical results in combination with Samicbond™ tape 315.45.
Damisol® 3630 HTP	Polyesterimide, green	H	300 to 600	2 h at 150°C*	VPI/ Dipping/ Roll Dip	Industrial motors and generators	Low viscosity resin for quick and easy impregnation. Highly reactive, yet highly stable resin which allows hot dipping process without any gellification risk.
Damisol® 3630 HIR	Polyesterimid, green	H	300 to 600	30min at 150°C*	Dipping / Trickle / Roll Dip	Industrial motors & powertools, inductive assembly parts	Highly reactive resin for quick continuous process. Strong mechanical properties even at high temperature including 180°C.
Gelgreen 3637	Polyesterimide	H	40.000 thix***	30min at 150°C*	Trickle	Industrial motors & powertools	End of development phase. Excellent bonding resin for power tools collectors. Highly flexible. No cracks even in thick layers.
Damisol® 3630 VPI	Polyesterimide, green	H	3.000 thix***	2 h at 150°C*	VPI / Hot Dipping	Industrial motors & generators, inductive assembly parts, transformers	Thixotrop resin used to improve the resin slot fill as the endwindings bonding and protection. Outstanding thermal resistance properties.
Damisol® 3630 XLE	Polyesterimide, green	H	7000	2 h at 150°C*	VPI/ Hot Dipping	Industrial motors & generators, transformers, chokes	Highly flexible with extremely low emission resin. Outstanding resin slot fill. Excellent end windings bonding and protection.
Damisol® 3500 LoV	Epoxy 1K	H	600	6 h at 160°C*	VPI / Dipping	Industrial motors, generators, traction, transformers	Multipurpose solventless varnish. No VOC. Outstanding stability and dielectrical properties up to class H application. Recommended on atmospheric, V(P)lor hot-impregnation dipping process for low- to medium-voltage motors and transformers.
Damisol® 3500 HiR	Epoxy 1K	H	600	30min at 160°C*	Trickle / Roll Dip		Multipurpose solventless varnish based on epoxy chemistry. No VOC. Outstanding reactivity and mechanical properties up to class H application. Recommended on trickling and dip-rolling process for low-voltage motos.
Damisol® 3551	Silicone	C	750	8 h at 180°C*	VPI	Traction & HT° motors	1K- silicone resin for class C application. Excellent reference for high-temperature-resistant traction motors.

Von Roll provides as well a wide range of potting materials perfectly suited for low-voltage motors and generators. The following is an example of these high quality products:

	Temperature index	Chemistry	Viscosity (mPa)	Geltime	Glass transition	Special properties
Damival® 13518 // 13500	F	PUR	2000 (at 25°C)	35-90 min at 25°C	80°C	Hard, UL-94 V0 (all colors), smoke gas class I3F1 after NF16-101/102
Damival® 13553 // 13500	F	modified PUR	3500 (at 25°C) 900 (at 50°C)	40 min at 25°C	10°C	Semiflexible, UL94: V0, NF16-101/102: I3F1 high thermal conductivity, black
Damival® 15350 // 15210	H	Epoxy	2300 (at 25°C)	50 min at 25°C	68°C	UL94 V0, high thermal conductivity, cold-curing.
Damival® 15225 OA // 15225 OB	F	Epoxy	2500 (at 50°C)	25 min at 120°C	40°C 75	Semiflexible, complies UL94: HB, high thermal shock-resistance, warm to hot curing.

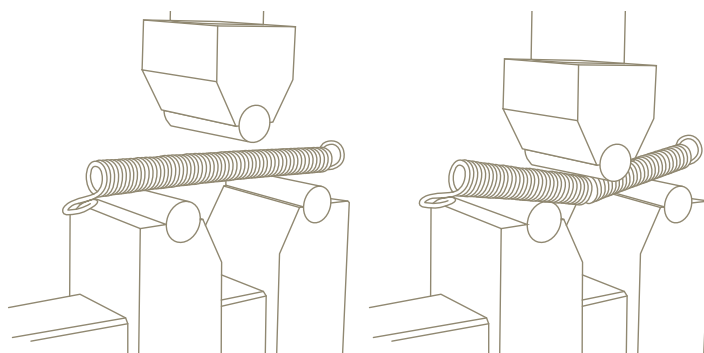
Potting resin and impregnation resins



Testing and UL

Von Roll has specialized low-voltage applications labs that are focused on customer needs and requirements. We can process customer parts in the lab by dipping, trickle, roll-through, vacuum-aided dipping or VPI processing methods to produce prototype parts. In the USA, we have a certified UL testing center where we develop and maintain the many Von Roll UL 1446 insulation systems as well as customize systems for customers. Von Roll can provide:

- » tests per UL 1446 standard
- » long thermal aging – full system testing
- » short-term component aging (sealed-tube test)
- » full system testing: GPM/Motorette
- » twisted pair testing (TP)
- » helical coil testing (HC)



Round wire pieces being tested with regard to the adhesive power of the wire coating



Training

We offer a unique program of low-voltage insulation training, known as Von Roll Corporate University. The objectives of this training are:

- » Better understanding of low-voltage insulation technology for rotating machines and up-to-date knowledge on insulating materials and systems.
- » Practical experience in the application of electrical insulating materials.

Dates and further information are available in a separate brochure.



Our training courses are attended by customers and partners from around the globe.

We Enable Energy

Von Roll is the sole full-range supplier of materials and systems for the insulation of electrical machines as well as high-performance products for various high-tech industries.



Mica

All materials related to high-voltage insulation. Von Roll's commitment to mica starts with mining and ends with finished tapes.



Wires

Insulated round, flat and Litz wires for high-voltage, low-voltage and electronic applications.



Cables

Mica tapes for fire-resistant cables. Von Roll provides a wide range of products that are ideally suited to all commonly used standards.



Resins

Impregnation resins for high- and low-voltage, potting resins, casting resins, as well as encapsulating and conformal coatings.



Composites

Engineered materials made from a resin and a support structure with distinct physical, thermal and electrical properties. They can be molded, machined or semi-finished.



Flexibles

Insulating flexible materials for low-voltage applications such as flexible laminates.



Ballistic Protection

High-quality systems for armored defense based on thermoset / thermoplastic products in single-use or tailored combinations.



Testing

Von Roll provides electrical, thermal and mechanical testing of individual materials as well as complete insulating systems.



Training

Von Roll Corporate University provides a training program in high- and low-voltage insulation for its customers.

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About Von Roll

We Enable Energy – As one of Switzerland's longest-established industrial companies, Von Roll focuses on products and systems for electrical power generation, transmission, storage and industrial applications. Von Roll's business portfolio is divided into the following businesses: **Von Roll Insulation** offers electrical insulation products, systems and services for generators, high- and low-voltage motors, transformers and other applications. **Von Roll Composites** produces composite materials and parts for a variety of industrial equipment.

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