



# We Enable Energy

As one of the oldest industrial companies in Switzerland, founded in 1803, we focus on products for power generation, rotating machines, composites and mechanical engineering. Von Roll is the global market leader and the only company to offer the complete range of insulation products, process equipment and services for electrical machines such as high-voltage AC and DC motors as well as small generators up 15MW.

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 more compact machines.

## Customers enjoy the following benefits:

- » One single source for all insulating materials
- » Proven compatibility for system components
- » Testing at Von Roll of both materials and systems
- » Manufacturing technology and equipment
- » Consulting in application engineering
- » Training in insulation materials and systems

Von Roll is committed to creating added value for its customers with the materials and processes used in insulating state-of-the-art electrical high-voltage motors as well as small generators with similar design. We offer the solutions you need for higher performance and reliability together with low manufacturing costs. No matter what the precise requirements of your machines, we have materials that will suit them using either resin-rich (RR) or vacuum pressure impregnation (VPI) technologies.

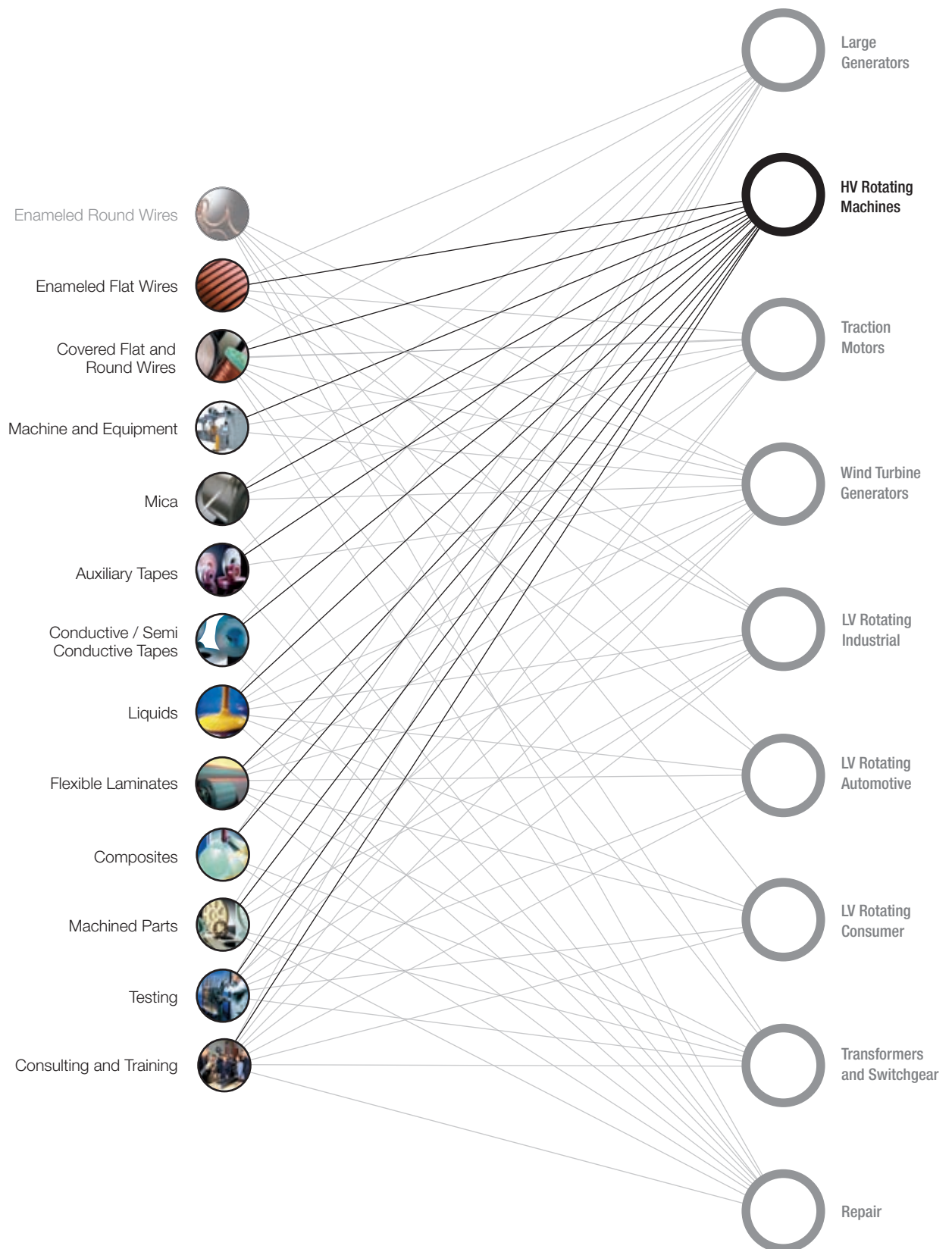
## Von Roll has developed a VPI insulation system, under the name of **Samicabond®**, with a number of distinct advantages:

- » Resins with high tank stability at room temperature
- » Imperviousness to moisture
- » Low viscosity
- » Fast curing with non-accelerated mica tapes
- » Excellent electrical properties
- » Class H
- » Very high price/quality ratio

This document introduces the main products associated with this system.



# Our Products for High-Voltage Motors



Von Roll offers full system solutions for every market shown in this application tree. Please contact us or visit our website [www.vonroll.com](http://www.vonroll.com) for further information.



## Conductors

Von Roll offers a complete range of high-quality conductors for high voltage coils:

- » Covered wires with impregnated glass yarn (Silix®)
- » Covered wires with mixed glass / polyester yarn (Daglas®), with or without coating
- » Samicafilm® tape-covered wires
- » Flat rolled Litz wires with bare or enameled single conductors, covered with Samicafilm® tape

Samicafilm® tape covering on bare or enameled wires is the preferred conductor insulation for stator and rotor coils due to its substantial advantages:

- » Better corona resistance
- » Reduced insulation thickness
- » Softer copper, enabling easier workability
- » Greater manufacturing flexibility

Samicafilm® products are based on Von Roll Samica® mica paper impregnated with modified epoxy resin, reinforced with one or two polyester film backings and with or without adhesive coating.

Product name	Rated voltage			Thickness mm	Weight g/m <sup>2</sup>	Mica g/m <sup>2</sup>	Composition	Adhesive
	<6kV	6–13.8kV	>13.8kV					
Samicafilm® F60+	•	•	•	0.06	76	30	Film/Mica	Yes
Samicafilm® F75	•	•	•	0.075	101	50	Film/Mica	No
Samicafilm® 315.14	•	•	•	0.09	131	75	Film/Mica	No
Samicafilm® 315.15-11	•	•	•	0.09	135	75	Film/Mica	Yes
Samicafilm® F2 90	•	•	•	0.09	124	65	Film Mica/Film	No
Samicafilm® F2 90+	•	•	•	0.09	126	65	Film/Mica/Film	Yes
Samicafilm® 315.23-11	•	•	•	0.09	126	50	Film/Mica/Film	2 sides

Samicafilm® tapes are applied butt-lapped or overlapped to the conductor. We supply both tape and taped conductors to our customers.

Product name	Insulation design	Rated voltage			Thickness mm		Adhesive
		<6kV	6–13.8kV	>13.8kV	Unpressed	Unpressed	
Samicafilm® 315.14 on bare wire	2 butt-lapped layers	•			0.36	0.3	Yes
Samicafilm® 315.15-11 on bare wire	2 butt-lapped layers	•			0.36	0.3	No
Samicafilm® F2 90 on bare wire	3 butt-lapped layers	•	•		0.54	0.43	No
Samicafilm® F2 90+ on bare wire	3 butt-lapped layers	•	•		0.54	0.43	Yes
Samicafilm® F2 90 on enameled copper grade 2	1 1/2 lapped layer	•	•	•	0.5	0.43	No
Samicafilm® F2 90+ on enameled copper grade 2	1 1/2 lapped layer	•	•	•	0.5	0.43	Yes

Silix coverings are impregnated with varnishes based on epoxy, polyester-imide, polyamide-imide, silicone or polyimide resins, depending on the thermal class required. For Silix and Daglas special grades with «B-stage» varnishes are also available for conductor stack consolidation.

Litz wire conductors instead of solid flat wires allow smaller overhang, bigger cross-section and a higher efficiency due to lower proximity and skin losses.

Product name	Rated voltage			Dimensions	Description
	<6kV	6–13.8kV	>13.8kV		
Silix® on bare wire	•			On request	Glass-lapped wire with or without B-stage overcoat.
Silix® on enameled wire	•	•	•	On request	Glass-lapped wire with or without B-stage overcoat.
Daglas on bare wire	•			On request	Daglas-lapped wire with or without B-stage overcoat.
Daglas on enameled wire	•	•	•	On request	Daglas-lapped wire with or without B-stage overcoat.



## Coil Production

We offer complete systems and are involved in every aspect of high-voltage technology, including processing equipment. For high voltage motors and small generators Von Roll has developed a line of state-of-the-art coil technology. This line of equipment includes the following units:

- » Wire dispensing and preparation
- » Loop winding
- » Taping
- » Coil forming



## Stack Consolidation

Employing Samicafilm® with hot-melt adhesive or glass-lapped wires at B stage enables rapid consolidation of conductor stacks without the need for additional consolidation products.

When using Samicafilm® without hot-melt adhesive or non-B-stage wires, traditional hot-press consolidation is preferred. This system can be achieved by overlapping the stack with Thermopreg® 251.78.

Von Roll standard materials for stack consolidation:

Product name	Form	Rated voltage			Thickness mm	Description
		<6kV	6–13.8kV	>13.8kV		
Thermopreg® 251.78	Tape	•	•	•	0.1	Impregnated glass cloth.
Polyester fleece 101.74-07	Tape	•	•	•	0.56	Nonimpregnated polyester fleece.
Glasoflex 261.10-03	Tape	•	•	•	0.5	Impregnated glass fleece with high resin content.
Damival® 15182/9030	Resin	•	•	•		Solventless two-component epoxy resin.



## Main Wall Insulation for the VPI System

Von Roll is highly committed to mica. Our added value is visible throughout the complete manufacturing chain. It starts by mining, preparation of the mica scrap, preparation of the mica paper pulp, production of mica paper and finally production of mica tapes that can be used to the highest standards to make main wall insulations.

Von Roll has the right solution to improve the quality and cost-effectiveness of the high-voltage insulation you need for your applications.

With Samicapor®, Von Roll has designed a range of outstanding VPI mica tapes that fulfill the requirements of main wall and end-winding insulation, namely:

- » High dielectric strength
- » Corona discharge resistance
- » Fast and easy impregnation
- » Resin retention without draining
- » Smooth application without creasing
- » Both manual and fast-running machine application
- » Full compatibility with predefined resin systems



Von Roll's commitment to mica starts with mining and stops with the production of mica taped wires.

Product name	Rated voltage			Thickness mm	Weight g/m <sup>2</sup>	Mica g/m <sup>2</sup>	Composition	Resin compatibility and thermal class		
	<6kV	6–13.8kV	>13.8kV					Non-accelerated epoxy-anhydride	Accelerated epoxy VPI systems	Polyesterimide Samicabond® system
Samicapor® 366.55-10	•	•	•	0.15	200	160	Glass/Mica	F		
Samicapor® 366.58	•	•	•	0.15	195	160	Glass/Mica		F	H
Samicapor® 366.58-18	•	•	•	0.15	213	180	Glass/Mica		F	H
Samicapor® 366.58-20	•	•	•	0.17	224	180	Glass/Mica		F	H
Samicapor® 374.04	•			0.18	241	160	Glass/Mica/Fleece		F	F
Samicapor® 374.15	•			0.18	241	160	Glass/Mica/fleece	F		
Samicapor® P 315.33	•			0.18	241	160	PET-film/Mica	F		
Samicapor® P 315.45	•			0.18	241	160	PET-Film/Mica		F	F



## Main Wall Tapes for the RR System

Assuring optimum quality of the main wall insulation requires careful selection of the micaceous tape and detailed attention to the way the tape is applied and processed. The solutions we have devised to get you the best possible results include a complete range of resin-rich (RR) main wall insulation tapes and systems under the name of Samicatherm® for both conventional and hydrostatic pressing and under the names of Filosam® and Samicaflex® for the overhang areas.

The advantages of these tapes are that they:

- » Have high dielectric strength
- » Resist corona discharge
- » Can be applied smoothly without creasing
- » Can be applied by fast-running
- » Have short cutting times

Main wall tapes for conventional hot pressing:

Product name	Rated voltage			Thickness mm	Weight g/m <sup>2</sup>	Mica g/m <sup>2</sup>	Description
	<6kV	6–13.8kV	>13.8kV				
Samicatherm® 366.28	•	•		0.19	303	120	Glass/Mica with interleaving foil.
Samicatherm® 366.28-02	•	•		0.19	265	120	Glass/Mica without interleaving foil.
Samicatherm® 366.32	•	•		0.26	458	240	Glass/Mica tape.
Samicatherm® 366.33-62	•	•	•	0.25	350	180	Glass/Mica tape.
Samicatherm® P315.20-02	•			0.16	252	150	PET film/Mica tape.
Samicatherm® P 315.51	•			0.09	117	60	Polyimide film/Mica tape class H.

Overhang tapes for conventional hot pressing:

Product name	Thickness mm	Weight g/m <sup>2</sup>	Mica g/m <sup>2</sup>	Description
Filosam® 366.57-20	0.15	206	109	PET film / Mica / Glass threads; highly flexible.
Filosam® 366.57-50	0.13	177	75	PET film / Mica / Glass threads; highly flexible.
Samicaflex® 366.18	0.12	150	75	Glass / Mica tape, class H flexible for higher voltages.
Samicaflex® 366.19	0.18	215	120	Glass / Mica tape, class H flexible for higher voltages.



## Taping Machines

Careful and optimum application of Samicapor® and Samicatherm® tapes can be achieved using high-speed taping machines.



High-speed taping machine.



## Pressing in the RR Process

RR processed coils need to be heated and pressed in order to achieve the proper final dimensions, while allowing flow of the resin, filling of possible voids and finally curing of the total insulation. State-of-the-art presses are the ideal solution.



CoronaShield® conductive and semi-conductive tapes.



## Corona Protection

Electrical stress control measures are an essential component of any high-voltage machine. Von Roll has developed a number of superior products under the trade name CoronaShield®, namely:

- » Conductive tapes impregnated and in paper form
- » Semi-conductive tapes
- » Conductive varnishes

All these tapes can be applied as:

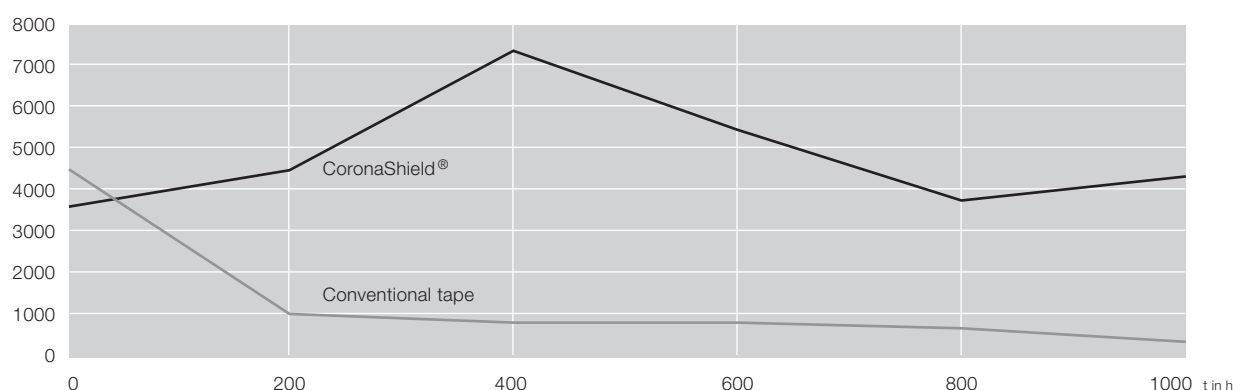
- » External corona protection (AGS) – within the slot
- » End corona protection (EGS) – outside the slot

Product name	Form	Rated voltage			Thickness mm	Resistivity Ohm sq	Description
		<6kV	6–13.8kV	>13.8kV			
CoronaShield® conductive 215.51	Tape		•	•	0.1	200–400	Based on impregnated nonwoven polyester fleece; not compatible with epoxy anhydride VPI resin.
CoronaShield® conductive 215.55	Tape		•	•	0.085	200–400	Based on impregnated non woven polyester fleece.
CoronaShield® 2500 NB 70	Tape		•	•	0.07	2500	Conductive tape made with Nomex® paper technology (not impregnated).
CoronaShield® semi-conductive 217.01/217.21	Tape		•	•	0.22	Variable	B-stage semi-conductive tape with different characteristics.
CoronaShield® semi-conductive 217.31	Tape		•	•	0.25	Variable	Fully cured silicone carbide-filled resin tape impregnated in a non-woven fabric.

CoronaShield® NB is a newly developed tape based on a revolutionary paper technology that has the following advantages:

- » High resistivity
- » Considerably better aging compared to conventional tapes
- » High thermal resistance (class 220°C)
- » Free of binder resin
- » No washing out of carbon/graphite particles
- » No abrasion
- » Can be taped with the main wall taping machine

R in Ohm cm/cm Surface Resistivity at TEA 17 kV/175 °C





# Finishing Tapes

To protect your equipment, the use of finishing tape is highly recommended. This material will protect the main wall insulation in the overhang area against:

- » Moisture
- » Mechanical load
- » Damage
- » Resin flow
- » Atmospheric pollutants



Mica tapes for VPI applications.

With Epoflex® Von Roll found the right solution to meet these requirements:

Product name	Form	Rated voltage			Thickness mm	Description
		<6kV	6–13.8kV	>13.8kV		
Epoflex® 324.03	Tape	•	•	•	0.09	Polyester glass fabric with a polyester film and reduced binder quantity.



## Winding and Bracing of Machines

The simplicity of the winding process for machines with «dry» coils is a recognized benefit of VPI technology. Substantial advantages arise during the end-winding bracing and support procedure. Von Roll has developed a range of ropes, cords and sleeves for «surge ring» intercoil lacing and tying applications.

The main advantages of these products are:

- » Class C (glass) and F (polyester) applications
- » Compressibility and resilience
- » Glass or polyester yarn on the outside
- » Wide range of dimensions
- » Un-impregnated for use with VPI; no further processing
- » Impregnated polyester shrink cord for RR uses

Product name	Form	Rated voltage			Thickness mm	Description
		<6kV	6–13.8kV	>13.8kV		
Isocord® 151.10	Cord	•	•	•	From 1.8 to 50	Braided silane E glass yarn outside with staple glass filler
Isocord® 151.12	Cord	•	•	•	From 1.5 to 60	Braided polyester yarn outside with staple glass filler



Glass or glass polyester cords.



## Composite Materials

Von Roll offers a variety of state-of-the-art composite materials that can be delivered as U & L profiles, strips and sheets, machined parts or special components for use in different areas of high-voltage rotating motors. The following are just a selection. Please ask our specialists about additional products.



Machined parts for to customer specifications.

Different materials used for rotor and stator components:

Product name	Form	Rated voltage			Stator slot insulation	Magnetic stator slot wedges	Rotor slot wedges	Commutator
		<6kV	6–13.8 kV	>13.8kV				
Vetronit® G-11	Machined component or full-size sheet	•	•	•	•		•	
Delmat® epoxy 68660	Machined component or full-size sheet	•	•	•	•		•	
Delmat® polyester 68420	Machined component or full-size sheet	•	•	•	•			
Samicanite® 41120	Machined component or full-size sheet	•	•	•				•
Mica rings	Part on design	•	•	•				•
Vetroferrite® 432.20/ 432.21	Machined component	•	•	•		•		



## VPI Impregnation Resins

Our wide range of high-performance resins are designed to meet the expected electrical and mechanical characteristics of high-voltage rotating machines. The factors that influence the final choice of resin are complex. Important considerations relate to features of the design of the machines and the choice of insulating system, taping and VPI processes. Important criteria include:

- » Resin thermal class
- » Tank stability
- » Storage conditions (cooled or ambient temperature)
- » Moisture sensitivity
- » VOCs (volatile organic compounds)
- » Impregnating temperature
- » Necessity of rotating curing
- » Curing time
- » Total processing time
- » Compatibility with mica tapes and remaining materials
- » Rated voltage
- » Dielectrical properties
- » Mechanical properties
- » Thermal conductivity
- » Continuous and maximum peak operating temperature

We offer a variety of high-performance resins:

	Type	Thermal class	Rated voltage			Impregnation temperature	Curing process	
			<6.6kV	6.6–15 kV	15–22 kV			
Damisol® 3340	Polyesterimide Samicabond® system	H	•			23 °C	8h at 150°C	Highly reactive, yet highly stable room-temperature impregnating resin. Good results on static curing.
Damisol® 3032	Polyesterimide Samicabond® system	H	•			23 °C	8h at 140°C	Highly reactive, yet highly stable room-temperature impregnating resin. Good results on static curing.
Damisol® 3308	Polyesterimide Samicabond® system	H	•	•		23 °C	8h at 140°C	Highly reactive, yet highly stable room-temperature impregnating resin. Good results on static curing.
Damisol® 3309	Polyesterimide Samicabond® system	H	•	•		23 °C	8h at 150°C	Highly reactive, yet highly stable room-temperature impregnating resin. Good results on static curing.
Damisol® 3413	Epoxy/anhydride 2K	F	•	•		23 °C	10h at 150°C	Low-viscosity 2K accelerated epoxy resin with outstanding mechanical properties.
Permafil® 74038	Epoxy 1K	H	•	•		23–60°C	8h at 160°C	1K epoxy resin without diluent. Very low organic emission (VOC<2%).
Damisol® 3407	Epoxy/anhydride 2K	F	•	•	•	40–70°C	10h at 170°C	Accelerated tape needed.
Damisol® 3415	Epoxy/polyester	F	•	•	•	23°C	8h at 150°C	Highly reactive room-temperature impregnating epoxy-modified resin. Storage below 5°C.



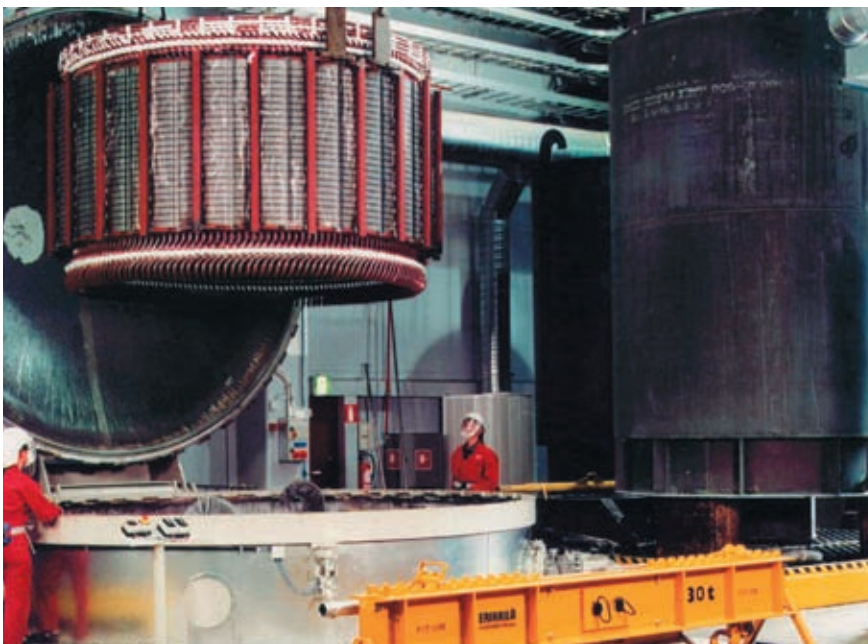
## Drying and Impregnation

The principles of air drying, controlled rate impregnation, pressuring and curing the resin are well understood by VPI process users or potential users.

Von Roll offers VPI systems tailored to meet the needs of all sections of the rotating machine industry.

For new equipment or upgrading existing plants, we ensure state-of-the-art VPI technology to increase our customers' efficiency.

Instrumentation for measuring capacitance, temperature, pressure and time are vital for in-line quality control of impregnation and can be built into the systems.



Large Vacuum Pressure Impregnation (VPI) unit.



## Finishing Coating

The Damicoat® range of finishing and overcoat varnishes includes air-drying and oven-curing solutions. They are all single components for easy processing by spray, brush and even dipping and dip-rolling processes.

Product name	Color	Rated voltage			Thermal class	Drying time	Comments on products and use
		<6kV	6–15 kV	15–22kV			
Damicoat® 2404	N/RB/G	•	•		F	15–20 h	Highly chemically resistant overcoat varnish.
Damicoat® 2407	RB	•	•		F/H	1–2 h	High-temperature-resistant overcoat varnish, used for up to class H high-voltage and traction machines.



## Testing

Materials and systems have to be tested in order to ensure the requested specifications concerning mechanical, electrical and thermal characteristics.

At Von Roll HV laboratories we are able to test our customers' materials and systems according to IEC, UL and other specifications.

- » Thermal, electrical and mechanical aging tests
- » Tan  $\delta$  measurements at different temperatures
- » Partial discharge measurements with different voltage ranges



Testing in the Von Roll laboratory.



## Training

For a number of years we have been offering a unique program of high-voltage insulation training within our Von Roll Corporate University. The objectives of this program are:

- » Better understanding of high-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



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.



## Liquids

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



## Flexibles

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



## 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.



## Machines

Processing machines for high-voltage applications. Von Roll supplies a wide range of machinery from coil and bar taping up to VPI (Vacuum Pressure Impregnation) equipment.



## Testing

Von Roll provides electrical, thermal and mechanical testing of individual materials as well as complete insulating systems. We are UL-certified.



## Training

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

Please contact us or visit our website [www.vonroll.com](http://www.vonroll.com) for further information:

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## About Von Roll

As one of Switzerland's longest-established industrial companies, founded in 1803, Von Roll focuses on products and systems for power generation, motors in the high- and low-voltage sectors, composites and other specialty products for the mechanical engineering. Von Roll is the global market leader in insulation products, systems, process equipment and services and is represented in 18 countries with around 3,100 employees at 32 sites.