Insulating Systems for the Motor Repair Industry

Dolph's

von Roll

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 electro-technical 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 more compact and efficient machines.

Customers enjoy the following benefits:

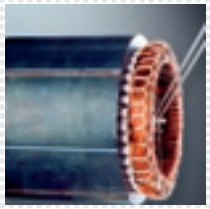
» One single source for all insulating materials
» Thorough expertise from power generation and transmission to its efficient utilization
» Proven compatibility for system components
» Testing at Von Roll of both materials and systems
» Consulting for applications and technologies
» Training in insulation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

Von Roll, the premier supplier of electrical insulating materials to the electrical rotating equipment industry, has developed, tested, manufactured and delivered materials that are specially designed for use in electric motors and generator manufacturing and repair.

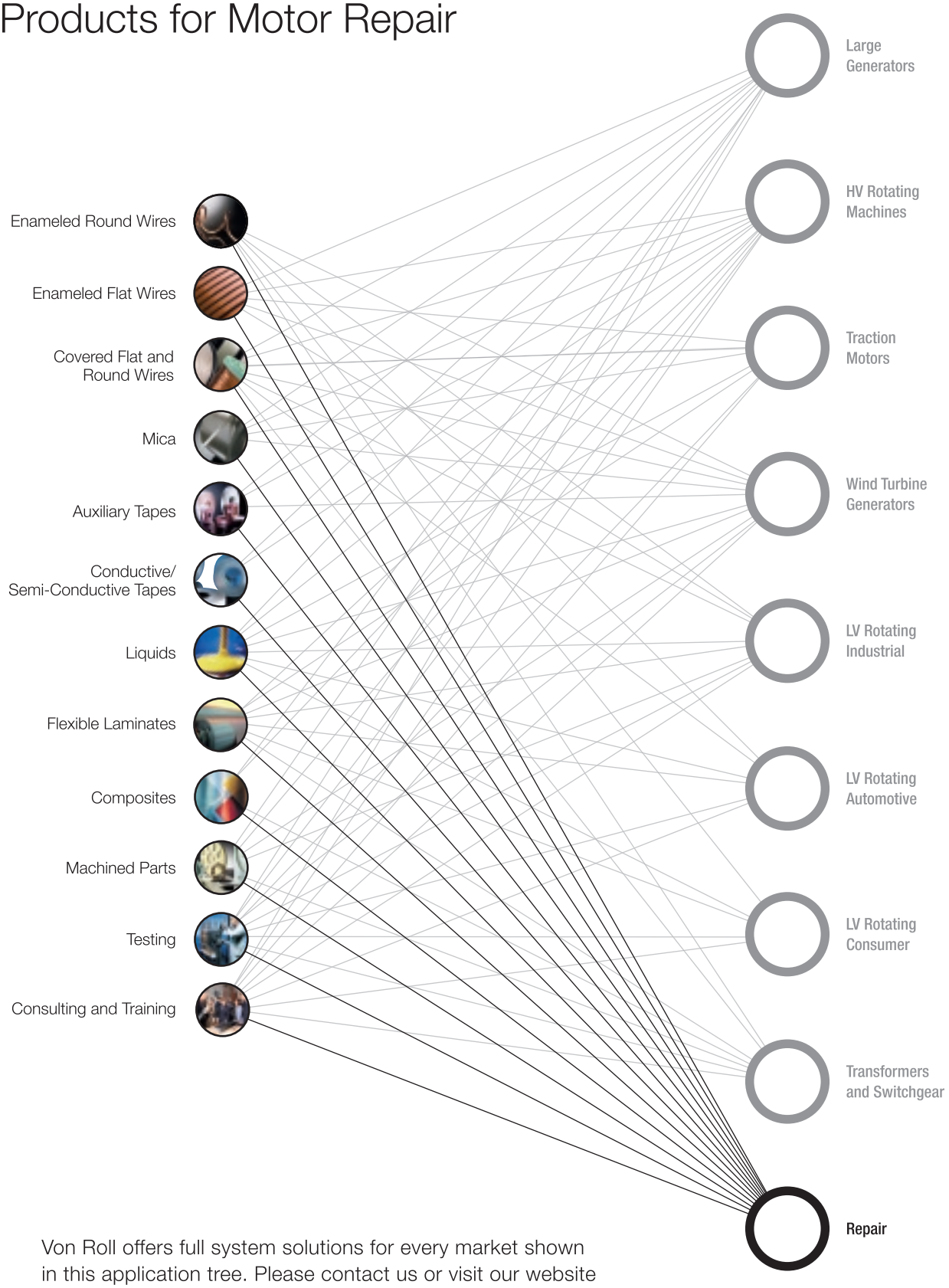
This product and application overview represents just a few of our most popular products, but it should serve as a useful guide for most basic applications.

Our insulating systems for motors and generators include the following materials:

» Magnet Wire
» Slot and Phase Insulation
» Mica Tape
» Corona Tape
» Mica Splittings and Tubes
» Support Materials
» Resins and Varnishes
» Kits and Compounds


Our Products for Motor Repair



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.

Magnet Wire

Von Roll Austral specializes in the rapid delivery of copper rectangular magnet wires, both enameled and covered. Also offered are unique insulations to provide improved performance and to optimize motor and generator designs.

Rectangular wire is available in sizes ranging from as thin as 0.020” to as wide as 0.700”; 2- to 3-day delivery is available for most constructions.

Product name	Thermal class	Composition	Special properties
HPAM	200 °C	Polyester enameled rectangular MW-36C	– Excellent thermal and chemical properties – Suitable for windings that are subjected to constantly high temperatures and mechanical stress
HDT-3000®	200 °C	Polyester enameled rectangular MW-36C	– 100% in-line testing – HDT-3000 enameled wire exceeds the NEMA-MW-36C volt requirement
Austraflex®	220 °C	Glass over enameled or bare rectangular conductor MW-46C	– A unique Daglas® insulation for AC and DC field coils
Austravolt®	200 °C	Mica covered over rectangular enameled or bare conductor	– The ultimate in conductors for high-voltage machines – Excellent voltage endurance characteristics without additional turn tap
Polyimide HML	220 °C	Polyimide enameled retangular NEMA-MW-20C	– Polyimide heavy and quadruple enameled rectangular wire
Polyimide	240 °C	Polyimide taped rectangular NEMA-MW-62C	– Induction and radiant heat-fused polyimide film – Suitable for windings that are subjected to high-temperature applications

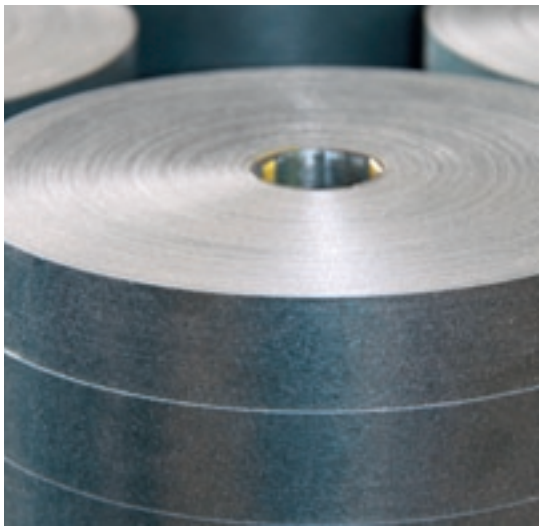
Others

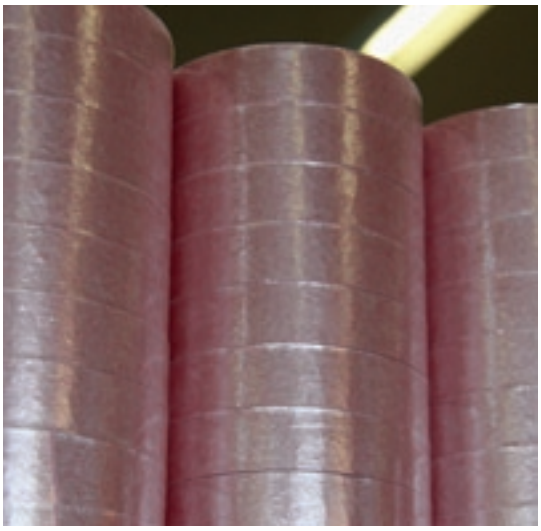
Standard enamel-, film-, paper- and glass-covered wires are, of course, also available with very rapid delivery and unexcelled quality and customer service.

Mica Mat® Tapes and Wrappers

Mica is an excellent insulator that is commonly used in formed coil and field coil applications. The commitment of Von Roll to mica is unique, starting with mining of the raw mica followed by production of paper and mica tapes. With literally hundreds of styles and sizes available, Von Roll is the world leader in the design and production of mica tapes with many options available for almost all applications. For the repair market, these are the styles most popular in the shop. For other applications, please contact your Von Roll representative.

Product name	Thermal class	Nominal finished thickness	Binder	Application suggestions
Mica Mat® 77956	155 °C	0.006	Polyester	– Industry standard for dip and bake coil applications – The tape of choice for VPI processing with polyester resins containing DAP monomers
Mica Mat® 77877	155 °C	0.007	Epoxy	– Our premier VPI tape with new technology to provide a flexible tape – Excellent voltage-endurance properties – Compatible with most epoxy and polyester VPI resins used in the motor repair industry
Mica Mat® 77986	155 °C	0.007	Epoxy	– An industry standard for many years – Compatible with most epoxy and polyester VPI resins used in the motor repair industry
Mica Mat® 2473XS	155 °C	0.007	Polyester	– A fully cured four-ply tape offering additional thickness while remaining very flexible – Recommended for VPI systems using resins with a DAP monomer
Mica Mat® 77984	155 °C	0.085	Solventless epoxy	– This three ply B-staged tape is used to manufacture formed coils where VPI processing is not available – Useful in the shop for insulating connections





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

Corona Protection

Anytime voltages are high enough to generate partial discharge or corona, semi-conductive materials are needed to manage the discharge without damaging the insulation. Von Roll offers several styles of tapes and paints that can be used to safely control destructive voltages. These products are generally used for designs of 6 kV and above, but are sometimes useful in improving the life of 4 kV machines in inverter-driven applications.

Product name	Nominal thickness	Color	Special properties
Coronashield® 215	4 mils	Black	– Coated polyester tapes in the 200–1000 ohm/sq range used in slot sections motor or generator to prevent corona discharge
Coronashield® 217	9 mils	Gray	– Variable resistance (grading) tapes used to safely discharge voltages on the extensions or overhangs of coils – Several styles available
Coronashield® 8001	Paint	Gray	– Gray paint loaded with semi-conductive particles useful in repairing damaged grading on extensions or overhangs of high-voltage coils. Dries in 15–30 minutes; tack-free

Coronashield® conductive and semi-conductive tapes.

Slot and Phase Insulation

In random mush-wound motors, as well as some form-wound designs, a high-quality slot liner is the principal guarantee of a long electrical life of the machine. Von Roll offers a very wide range of flexible laminates and coated cloths for any application. All of the flexible laminates are available in 2, 3, 4 or more plies, and most coated materials are available with glass or Daglas® substrates.

Product name	Thermal class	Description	Application suggestions
Acuflex® DMD	155 °C	Nonwoven polyester mat bonded to both sides of an electrical grade polyester film	– Preferred choice in hand-winding applications – Industry standard for class F designs – Available in either 70% or 100% saturated – 70% allows for improved resin absorption
Acuflex® NMN	180 °C	Aramid fiber paper bonded to both sides of an electrical grade polyester film	– Aramid paper-based flexible laminates available in a wide range of constructions – Used where high-reliability performance is required – Also available with polyimide film for high-temperature applications
Thermal H®	180 °C	Polyester-coated glass cloth with or without an acrylic pressure-sensitive adhesive on one side	– Used as slot liners or phase cloth where extreme flexibility is required – Excellent electrical, mechanical and conformability properties
Pyromid®	180 °C	High-density aramid/polyester blend mat-bonded to both sides of an electrical grade polyester film	– An alternative to aramid paper in class H applications – Absorbs resin and varnishes, enhancing the bond of wire and steel to the substrate
Fusa-Flex®	155 °C	Flexible B-stage epoxy resin on Daglas® cloth	– Used as core insulation on field coils as bolt insulators and repairing tubes
Fusa-Fab®	155 °C 180 °C	Flexible B-stage polyester resin on Daglas® cloth	– When properly applied it results in a watertight sealed coil with outstanding electrical strength for use where VPI is not available

Support Materials

Made of 100% electrical grade glass yarns with B-staged resins, Von Roll Poly Glas® banding tapes and ropes are manufactured to provide excellent mechanical strength for supporting structures against rotational forces as well as surge inrush currents on startup. These products are normally fully cured before resin treatment, so compatibility is assured with most dip or VPI resins.

Product name	Thermal class	Size range	Application suggestions
Poly Glas® 76870	220 °C	1/4–1“ (20-80 ends)	– A 220 (C) banding tape used in supporting traction and industrial DC armatures – Also used for tying AC stators where maximum support is needed
Poly Glas® 76831	155 °C	1/4–1“ diameter	– Used in conjunction with blocking and tie cords, creating a rigid support for motor and generator windings and end turns during startup and load changes.

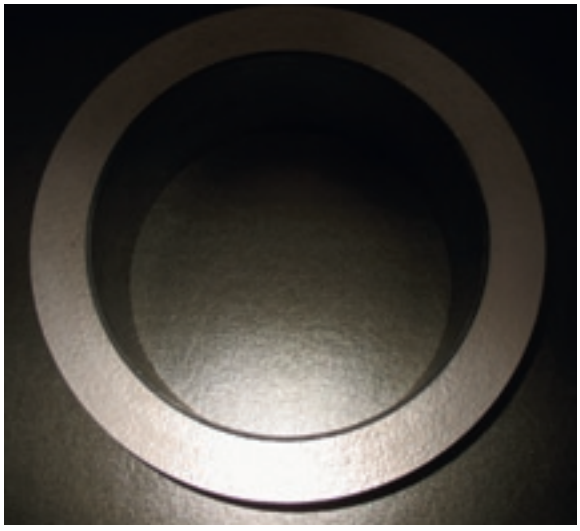
Mica Splittings and Tubes

Sheet materials, plates and tubes made from traditional mica splittings or mica paper laminates provide excellent mechanical strength and unsurpassed electrical performance for the most extreme applications of heat and voltage stress. Special splitting tapes are also available where coil designs require their unique properties.

Molding Plates
Made with high-grade mica splittings and a variety of resins, these flexible sheets can be shaped or molded to specific configurations, then heat-cured for mechanical stability. They are useful in DC armature insulation as well as many other uses in the shop.

Segment Plates
These rigid plates, made from either mica splittings or laminated mica papers, are useful in commutator manufacturing and for mechanical machined parts where glass-based composites are not adequate. Available with modified alkyd, epoxy or inorganic binders.

Tubes
Made from either mica splittings or paper, fully cured tubes can be quickly constructed to virtually any ID or OD. They are very resistant to high temperatures and mechanical forces and are useful as bolt insulators, shaft insulators and as resistor grid components.

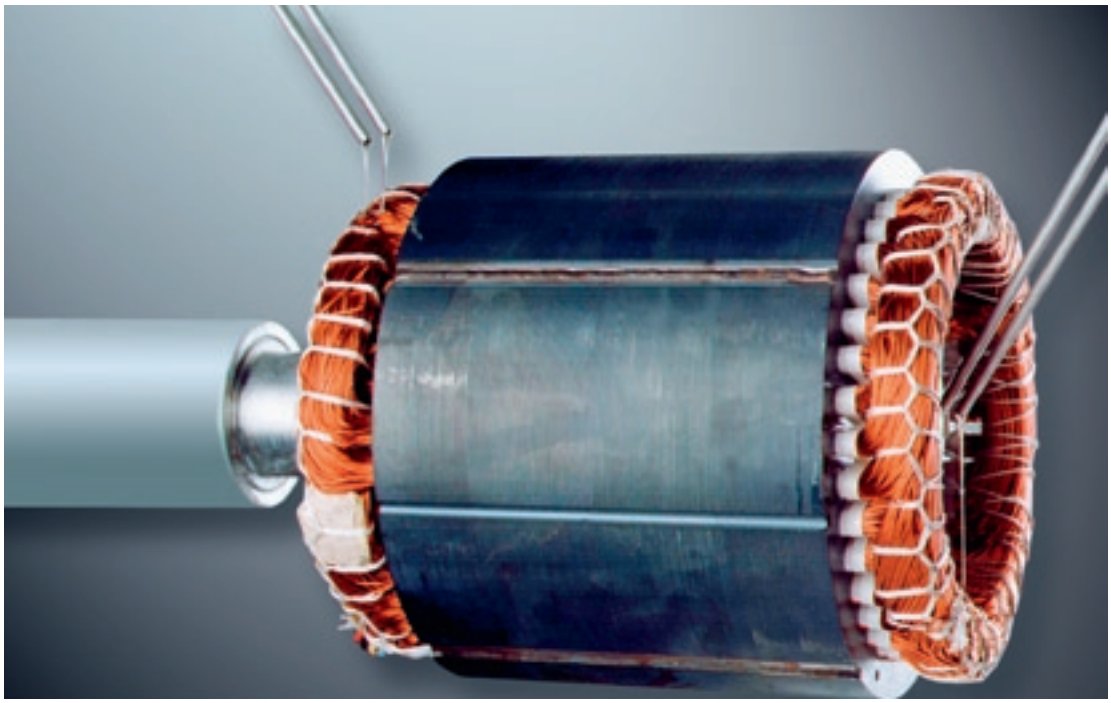


Varnishes and Resins

Permafil® varnishes and resins have been used for manufacturing and repairing motors and generators for over 100 years and have broad acceptance among repair companies expecting the highest in quality and performance. Available in different chemistries, there is a product for almost any application that requires high quality and performance.

Product name	Thermal class	Chemistry	Flash point °F	Special properties
Permafil® 9637	220 °C	Solvent polyester	88	– General purpose polyester varnish for motors and transformers in dip tanks
Permafil® 74043	155 °C	Solvent epoxy	88	– General purpose epoxy varnish for motors and hermetic motors in dip tanks
Permafil® 1217	180 °C	Solvent polyester	88	– Fast RT curing polyester varnish for general purpose applications – Available in clear, red or yellow
Permafil® 712/716	220 °C	Solventless polyester	200/132	– These two polyester resins use a DAP monomer allowing for excellent room temperature stability – Permafil 716 contains a blend of monomers allowing it to be used in a dip or VPI application
Permafil® 707/724	220 °C	Solventless polyester	132	– 707 sets the standard for performance in high-vibration and high-temperature applications – Used in many VPI tanks – An excellent choice for repair shops that support the steel and mining industries – 724 is a general purpose resin used in industrial and commercial applications
Permafil® 74041	180 °C	Solventless epoxy	200	– High-performance resin for general purpose industrial and mining motors in VPI applications
Permafil® 74050	220 °C	Solventless epoxy	132	– High-performance resin used in high-voltage insulation systems – When used with the proper mica tapes this insulation system can be used for motors and generators up to 18 kV

Product name	Thermal class	Chemistry	Flash Point °F	Special properties
Synthite® AC-41	155 °C	Solvent polyurethane	81	– High-temperature, fast-cure, air-dry polyurethane varnish with excellent circuit board-coating properties – Available in aerosol
Synthite® AC-43	155 °C	Solvent polyester	81	– High-temperature, fast-cure, air-dry polyester varnish – Perfect for dip, spray or brushing – Air-dries in 1 hour or can be baked to speed-cure
Synthite® AC-46		Solvent polyurethane	81	– Air-dry polyurethane that has excellent moisture and fungus resistance – Available in aerosol spray
Hi-Therm® BC-346A	220 °C	Solvent polyester	88	– High-temperature varnish used in a wide range of dip and bake applications
Hi-Therm® BC-352	200 °C	Solvent epoxy	88	– Excellent dipping varnish used for motors exposed to moisture and harsh environments or hemetic applications
Dolphon® CC-1105	220 °C	Solventless polyester	200	– High-flash, high-bond solventless polyester resin which provides excellent storage at room temperature
XL®-2103	220 °C	Solventless polyester	200	– Low-odor, high-flash very low VOC solventless polyester resin. Formulated for high build in dip and bake applications
Synthite® ER-41/EB-41		Solvent polyurethane	81	– Red or black high-temperature, fast-cure, air-dry varnish, used as an insulator coating – Both are available in aerosol spray cans



Kits and Compounds

Often, repairing electric motors and generators for special applications requires many specialty compounds, potting materials and top coats. Here are just a few of the materials available from Von Roll.

Product name	Chemistry	Flash point °F	Gel time	Main characteristics
Permafil® 704	Polyester	132	3–4 h at 25 °C	– Two-component pour-through resin for general purpose motors
Permafil® 74036	Epoxy	200	15 min at 40 °C	– Two-component pour-through resin for general purpose motors
Permafil® 74010A/74010	Epoxy	200	2–4 h at 25 °C	– High-performance two-component clear coating for spray or flooding applications
Permafil® 74115	Epoxy	200	Single part	– Thixotropic wet winding compound for DC pole-wound coils
Permafil® 277	Krytox® [1]	55	Single part	– Masking compound for use on surfaces where adhesion of a cured resin is not desired
Dolphon® CB-1069	Epoxy	200	R/T cure	– General purpose, high thermal conductivity black epoxy casting compound for use in all types of electrical assemblies
Dolphon® CB-1078	Epoxy	200	R/T cure	– Black epoxy compound for use in all electrical assemblies – Also used to cast end windings of wind generators and induction heaters
Dolphon® CB-1109	Polybutadiene	200	R/T cure	– Two-part low-viscosity polybutadiene compound – Can be used for potting, casting and coating electrical apparatus
Dolphon® CB-1128	Polybutadiene	200	R/T cure	– Two-part flexible black polybutadiene compound formulated for motor and generation encapsulation – Excellent for high abrasion and moisture environments
Dolphon® CC-1120	Polybutadiene	200	R/T cure	– Low viscosity – Clear compound for potting coils and transformers – Easily repaired
Dolphon® CR-1034-H	Epoxy	200	R/T cure	– Two-part semi-rigid epoxy compound specifically formulated for encapsulation by “buttering” on electric motors

[1] Registered trademark of DuPont de Nemours.

Testing and Laboratory Systems

Von Roll has specialized low-voltage application system testing labs that are focused on client 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.

We customize systems for customers and offer the following tests:

» Full system testing
  – Long term thermal aging
  – Motorette testing
  – Formette testing
» Chemical compatibility testing
  – Short-term component aging (sealed-tube test)
» Component thermal aging
  – Twisted pair testing (TP)
  – Helical coil bond strength testing (HC)

The wire test pieces are being tested with regard to the adhesive power of the wire coating.

Our laboratory in Schenectady, New York, is a recognized, UL-certified testing center, where we develop and maintain the many Von Roll UL 1446 and IEEE 1776 insulation systems.

We work closely with UL to bring UL-recognized systems and components to our customers.

Resin and Varnish Analysis Program

At Von Roll, our focus is always on customer satisfaction and long-term relationships forged in the industry, based in part on the technical support we offer before, during and after the decision to purchase has been made. An example of this is our unique, pro-active resin analysis program, designed to promote regular testing and adjustment, if required, of resins and varnishes at our many installations at both manufacturing and repair facilities. The periodic testing of resin properties ensures manufacturing consistency yielding predictable results. An added benefit is the peace of mind that comes from the knowledge that your resin or varnish is safe and stable. The provided shipping kits and friendly reminders help keep your testing on a regular schedule, and all required adjusters are shipped directly from the factory, assuring prompt delivery and fresh material.

Basic stability tests – viscosity, gel time, moisture content, liquid and cured appearance – are performed free of charge. Additional testing such as film build, dielectric strength and helical coil bond strength is available for a nominal charge. All of this is to keep your facility producing good machines every day. Join the many Von Roll customers who have secured their investment through timely analysis, feedback and recommendations from Von Roll on keeping their tanks stable.

Laboratory Services

- UL-certified 1446 systems and component testing
- NEMA-RE-2 resin compliance testing
- High-voltage testing
- IEEE 1043 voltage-endurance testing
- IEEE 1776 systems performance testing
- Partial discharge evaluation and testing
- US Army Corps of Engineers qualified testing
- Accelerated testing capabilities
- Thermal conductivity testing

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.

» Development and applications support

» UL systems consulting and development

» Evaluation of systems/systems development

» Systems engineering consulting

» Plant design evaluation and consulting services

» On-site applications and engineering support

» Resin and varnish analysis program

» Development of testing protocols

» VPI processing of sample bars, coils and units

» Materials and resin prototype development

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.

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

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

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 and adhesive tapes.

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

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

Transformers
High-perfomance transformers for power transmission and distribution, tailored solutions to all applications of today's energy-supply companies.

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

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** for further information:

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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 power generation, transmission and distribution. Von Roll's business portfolio is divided into five business segments: **Von Roll Insulation** is the global market leader in insulation products, systems and services. **Von Roll Composites** produces composite materials and parts for assorted industry appliances. **Von Roll Transformers** offers complete solutions for the fast expanding market of high performance transformers. **Von Roll Water** provides solutions for process engineering tasks in the field of water and waste water management. **Von Roll Solar** is developing a third-generation solar cell.