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## Insulation and Protection of Motors



Electric motors and drives play an incredibly important role in our everyday lives, powering almost every machine in industry and home life. The number and complexity of motors is growing all the time, in established industries and in the next generation of emerging markets.

There is a growing imperative to operate electric motors at maximum efficiency at all times, to improve reliability, reduce emissions, save costs and energy.

Motors and drives are subjected to many stresses, mechanical, thermal, environmental and electrical. These stresses can cause the insulation system to fail if not properly protected. The optimum level of protection of a motor is essential for continuous reliable service, regardless of construction, application or operating environment.

ELANTAS Europe offers a full range of materials for protecting motors in all environments – wire enamels, impregnating resins and varnishes, finishing varnishes, encapsulation and potting resins, sealing and bonding materials, and insulation films.

Our materials meet all current and future demands of motor design. They reduce mechanical stress, improve heat transfer and endurance, seal and insulate windings against destructive environments, and provide a composite dielectric insulation structure.

In order to offer the best solutions, our portfolio is structured around the main classifications of motors.

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## Our Global Presence for a Global Industry

### Worldwide Locations

ELANTAS GmbH  
Wesel – Germany

ELANTAS Europe GmbH  
Hamburg – Germany

ELANTAS Europe S.r.L.  
Ascoli Piceno, Collecchio, Quattordio – Italy

ELANTAS PDG, Inc.  
St. Louis, Olean – U.S.A.

ELANTAS Isolantes  
Elétricos do Brasil Ltda.  
Cerquillo – Brazil

ELANTAS Beck India Ltd.  
Ankleshwar, Pune – India

ELANTAS Zhuhai Co. Ltd.  
Zhuhai – P.R. China

ELANTAS Tongling Co. Ltd.  
Tongling – P.R. China

ELANTAS Malaysia Sdn. Bhd.  
Kapar – Malaysia

ELANTAS is as global as the motor industry. With a worldwide network of production facilities, we can supply customers locally wherever they are. Our local expertise is backed by a worldwide network of R&D, application, and testing laboratories.

Our customer support is no less global. Our worldwide technical sales team ensures that you get full service across all locations. Wherever you need us, we're close by, with local contacts familiar with local conditions.

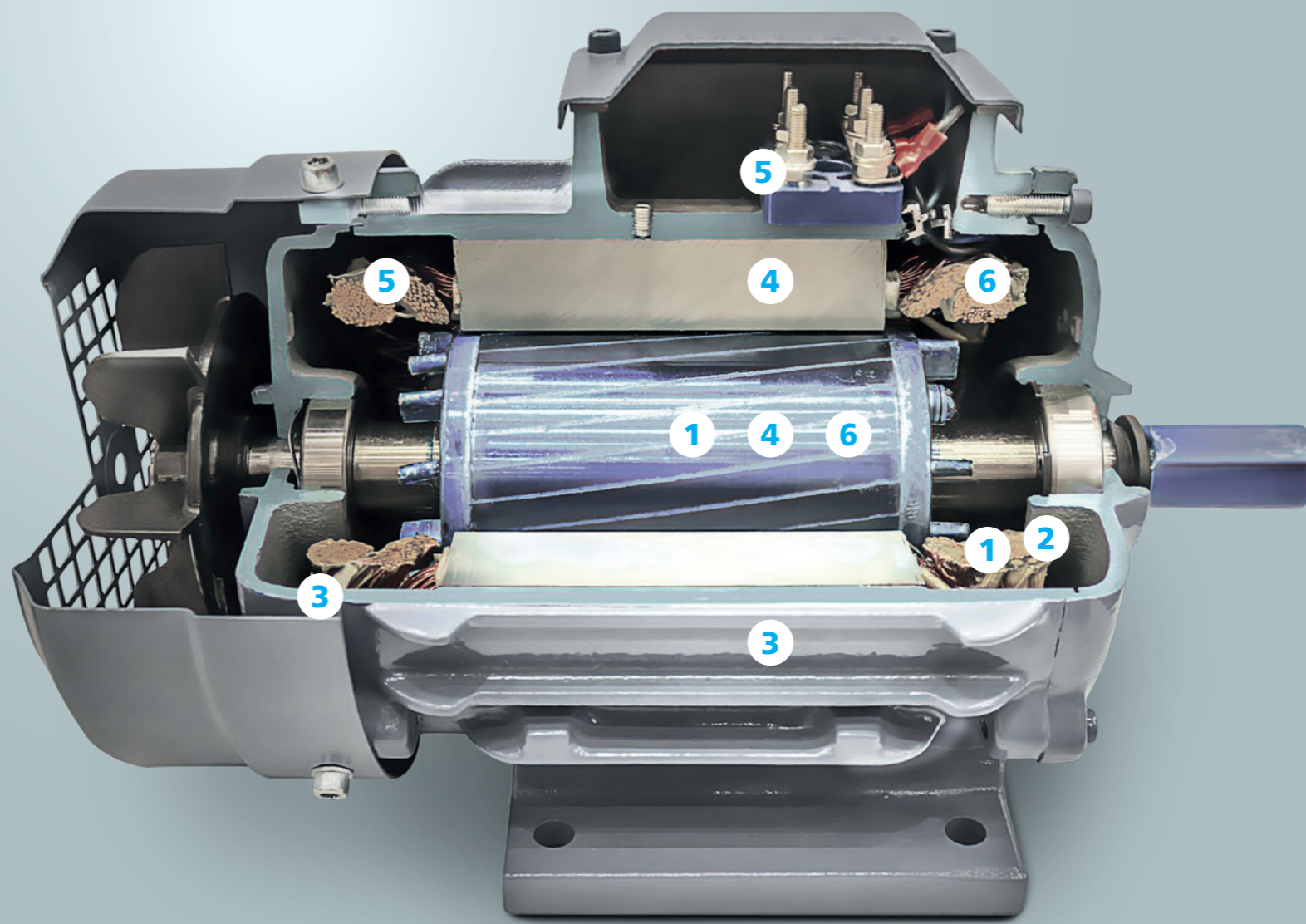
This extensive international presence gives us the flexibility and resilience needed to serve global motor manufacturers.

At the same time, as a manufacturer with facilities across the globe, we place great emphasis on consistent and standardized production. We are certified according to DIN EN ISO 9001, DIN EN ISO 14001. Some of our sites are certified according to IATF 16949.

### We adhere to the following industry standards:

- + IATF 16949
- + GS 95011-5 & other OEM approvals
- + IEC 60664-3
- + IPC-CC-830-B
- + IEC 61086
- + IEC 60085
- + UL 94
- + UL 1446
- + UL 746E
- + UL RTI
- + EN 45545-2

# ELANTAS Materials Used In Motors



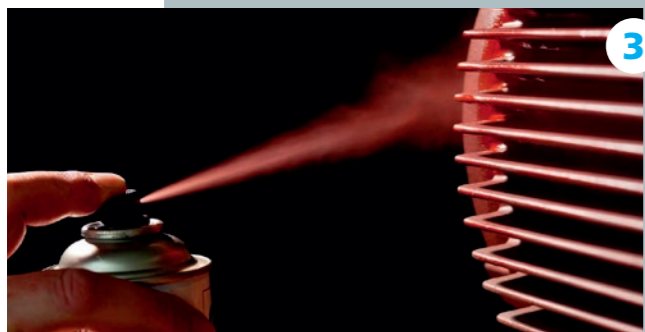
1

Impregnating Resins



2

Impregnating Varnishes



3

Finishing Varnishes



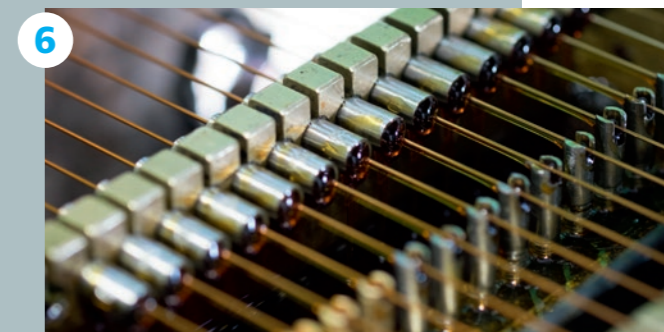
4

Electrically Insulating Films



5

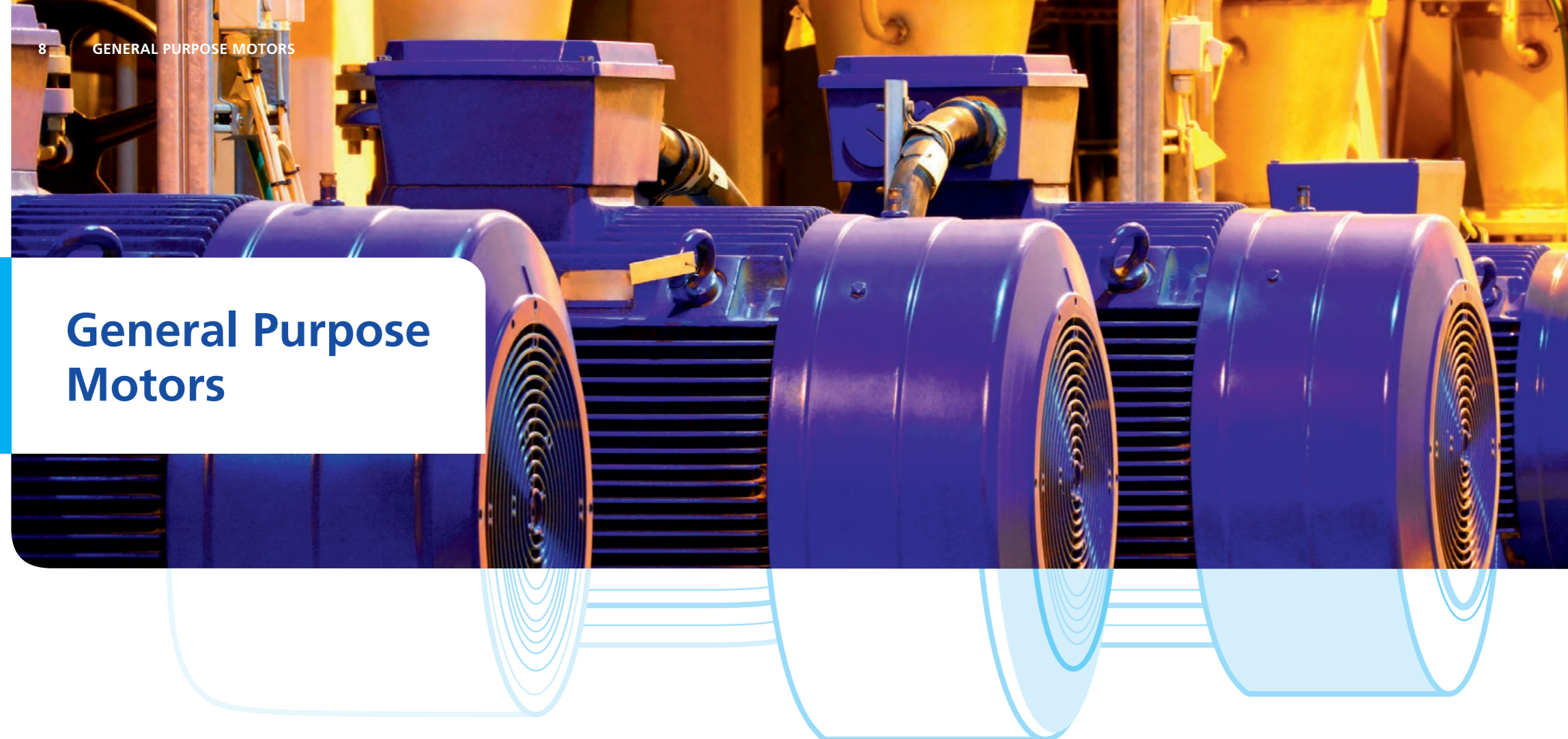
Casting and Potting Resins



6

Wire Enamels

## General Purpose Motors

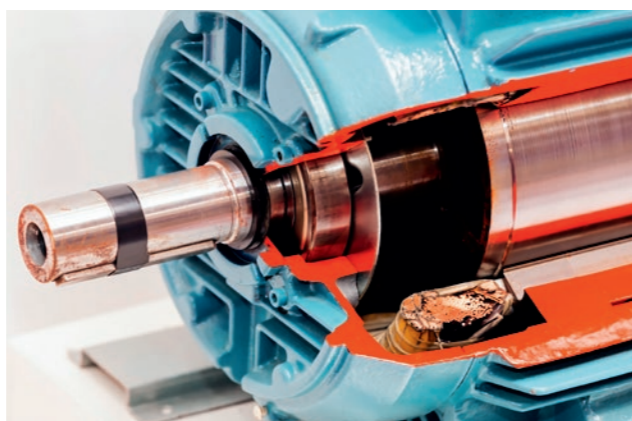


Like the name implies, general purpose motors are used for countless tasks, in low, medium and high voltage applications.

Many industries, including but certainly not limited to manufacturing, paper, water, transport, and mining, rely on motors to work continually, day by day, with optimum performance, efficiency and reliability.

These industrial environments are often harsh, with storage and operational temperature fluctuations, vibration, electrical surges, mechanical movement, high torque especially during startup, and exposure to moisture, chemicals and aggressive substances.

Consumer appliances and power tools also use general purpose motors. Although these are less likely to be exposed to harsh environments, they do have to resist high starting torques, variable speed control, high rotational speeds and mechanical vibration. Furthermore, they have to be lighter and more compact than industrial motors, and they typically get far less maintenance. Users just expect them to work.



The insulation of all these motors thus has to be able to withstand many different mechanical, thermal, electrical and environmental stresses.

ELANTAS Europe has a full portfolio of high-quality materials covering a wide range of chemistries, processing characteristics and cured properties. It includes next-generation environmentally-friendly, low emission, VOC and monomer-free products.



Our materials provide:

- Enhanced mechanical bonding and cohesion
- Uniform coating and environmental protection
- Void-free encapsulation, impregnation and support
- Superior mechanical toughness & resilience
- Efficient thermal conductivity
- High thermal shock resistance
- Excellent compatibility with commonly used insulating materials
- Multiple electrical insulation systems

## + CHARACTERISTICS

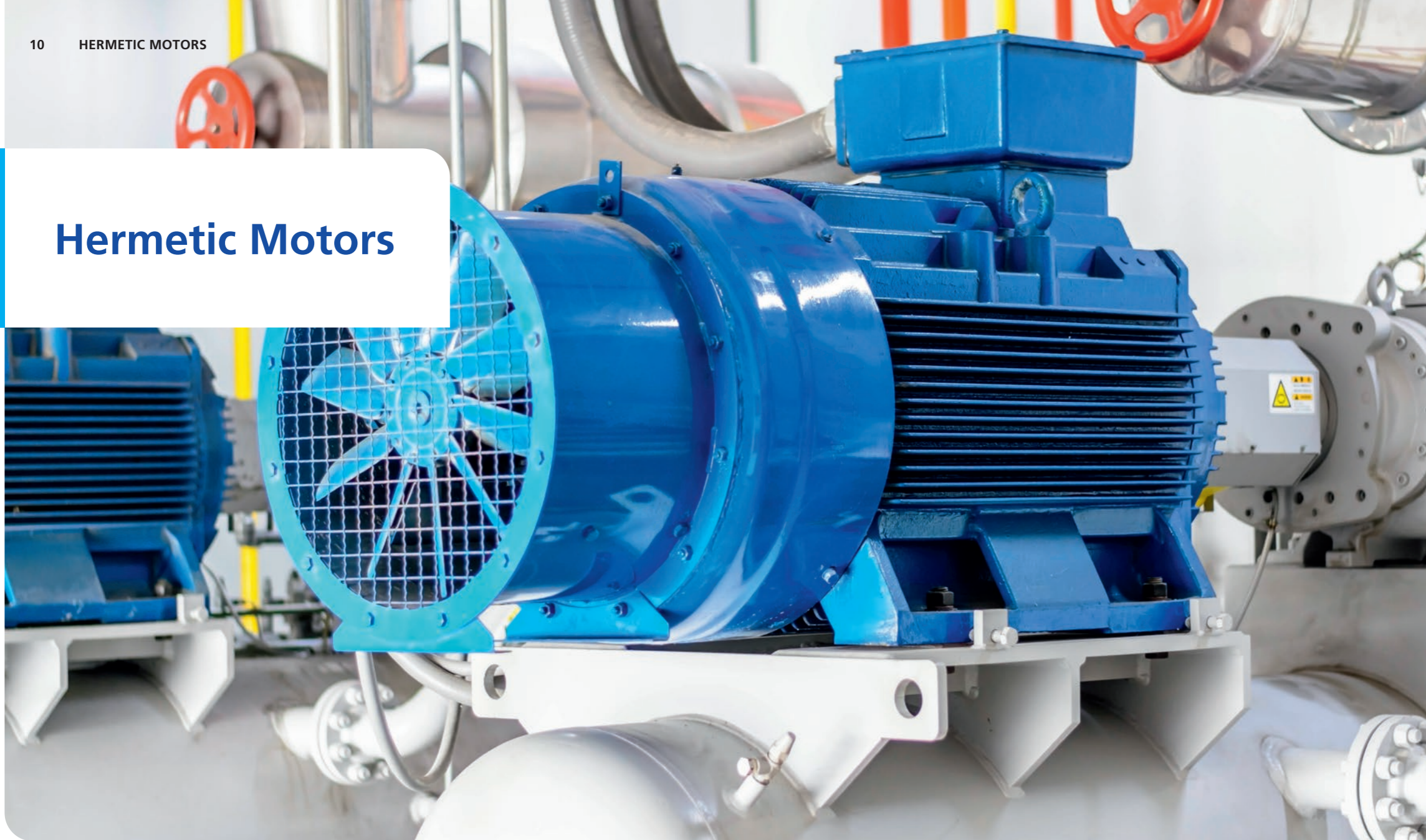
- + Enhanced Bonding & Cohesion
- + Superior Mechanical Toughness and Resilience
- + Efficient Thermal Conductivity
- + High Thermal Endurance
- + Environmental Protection
- + Partial Discharge and Corona Resistance

The use of ELANTAS materials allows motors to perform with full efficiency and reliability, for long term cost savings.

Examples of applications for general purpose motors are:

- Machines
- Conveyors
- Pumps
- Fans
- Actuators
- Cranes
- Household Appliances & Power Tools

# Hermetic Motors



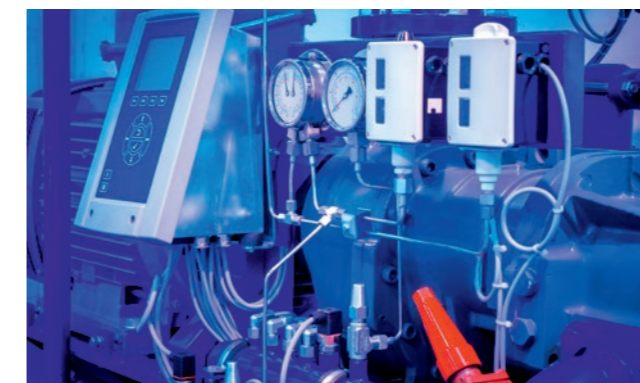
Hermetic motors are designed to operate in harsh chemical environments, and so demand a high level of protection against exposure to refrigeration-based gases, oils and contamination.

To deliver a reliable performance day in and day out, these motors need superior insulation. In addition to protection against chemical agents, motors must naturally also be able to withstand the usual vibration, temperature fluctuations, and electrical stresses.

Accordingly, materials used to protect hermetic motors must provide a higher degree of chemical resistance in their cured state. Our portfolio features modified epoxy, polyester-imide and silicone chemistry products of proven effectiveness.

ELANTAS offers an extensive range of quality approved materials that provide excellent protection:

- Superior chemical protection
- Uniform coating and environmental protection
- Void-free encapsulation and support
- Enhanced toughness and resilience
- High mechanical and cohesive strength
- Efficient thermal conductivity
- High thermal shock resistance



Examples of applications for hermetic motors are:

- Refrigerator Compressors
- Pumps
- Sealed Motors

## + CHARACTERISTICS

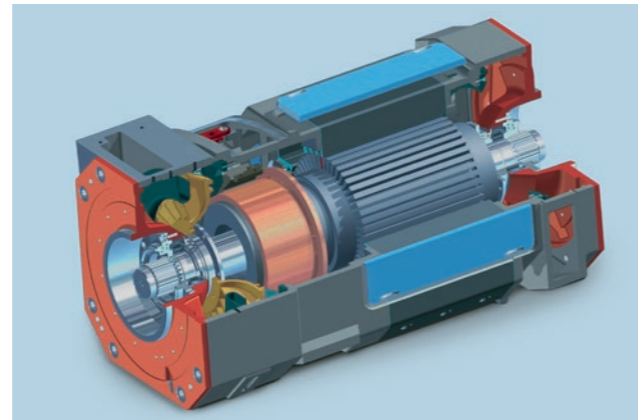
- + Superior Chemical & Environmental Insulation Protection
- + Enhanced Toughness and Resilience
- + High Mechanical and Cohesive Strength
- + Efficient Thermal Conductivity

# Traction Motors

Traction motors are used to propel locomotives and other heavy-duty electric vehicles. These powerful industrial motors require special protection due to their conditions of use.

These typically include frequent variations in load conditions, high rates of acceleration and deceleration, high-torque low-speed hill climbing, and low-torque high-speed sustained cruising. Thus traction motors operate within a wide range of speeds, unlike standard industrial motors, which are generally optimized for their rated speed.

To minimize weight, traction motors must be compact in design, while to move heavy loads they need to be



able to operate for extended periods at extreme temperatures, under elevated electrical stress, and in harsh environments.

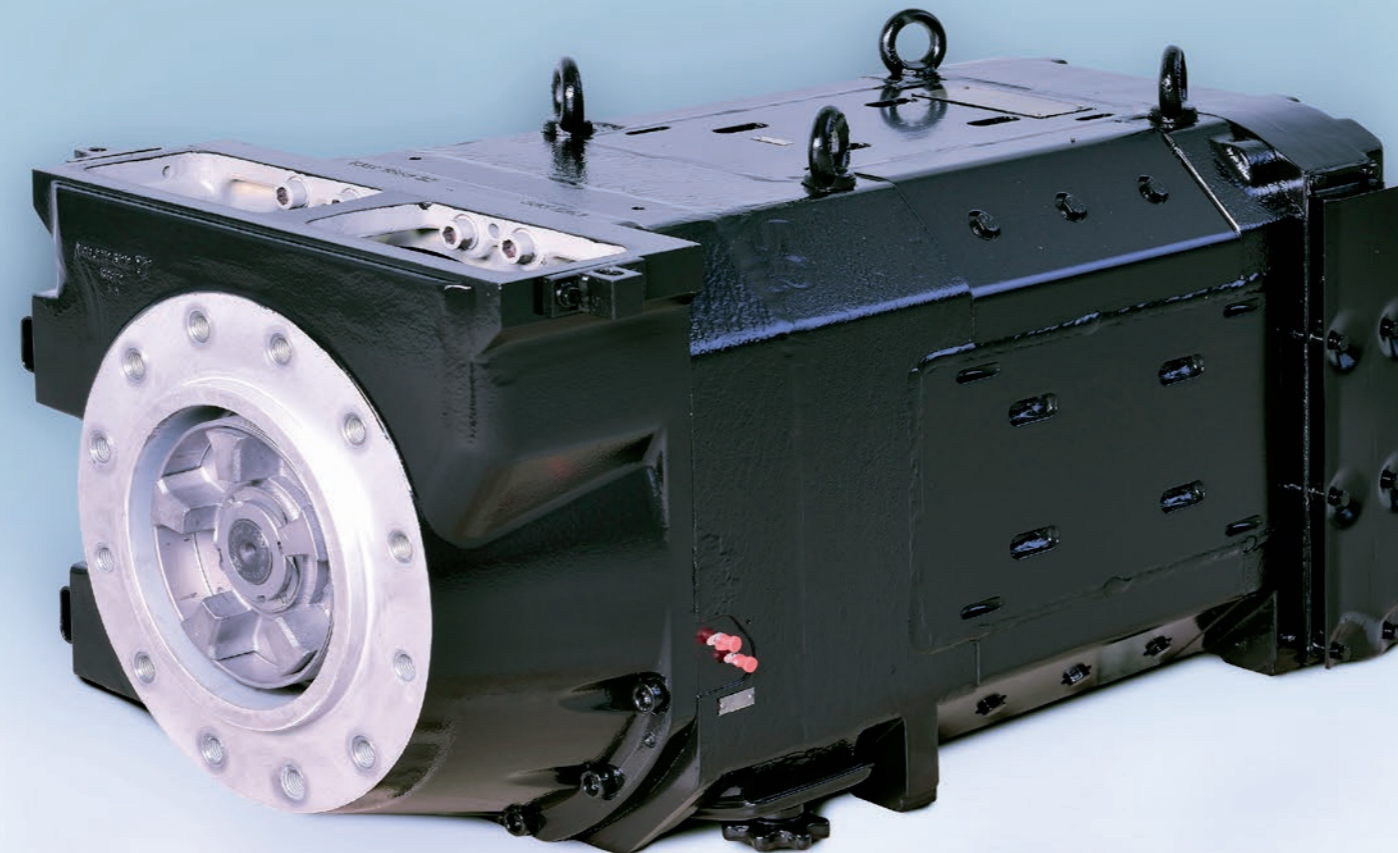
To meet these requirements, we offer specially formulated impregnating resins and casting & potting compounds. Our products are compatible with commonly used traction motor insulation materials and systems. They have the properties needed for the challenging environment of traction motors:

- Superior thermal endurance
- High mechanical and cohesive strength.
- Improved shock resistance
- Protection against exposure to aggressive environments
- Enhanced thermal conductivity
- Multiple electrical insulation systems
- Excellent compatibility with commonly used insulating materials



Examples of applications for traction motors are:

- Electric Vehicles
- Electric and Diesel-electric Locomotives
- Trams and Busses
- Industrial and Commercial Vehicles



## + CHARACTERISTICS

- + Superior Thermal Endurance
- + Excellent Mechanical Shock Resistance
- + Efficient Thermal Conductivity
- + Superior Environmental and Chemical Resistance
- + Excellent Compatibility with Commonly used Insulating Materials

## eMobility Motors



eMobility motors are used in more and more road and off-road vehicles, ships and even aircraft. They can be the sole engine, or they can be combined with combustion motors (hybrids). For example, hybrids can be in connection in series like an in-gearbox system, or operate in parallel such as an in-wheel eMotor. Each design places its own special requirements on the insulation system.

Space in vehicles is limited, so power density is paramount. Efficient thermal management and a highly effective insulation system are important in achieving this design goal.

This fast-growing market encourages rapid innovation, with the speed and efficiency of production being very important drivers on the business side. The use of flat-wire motors is becoming standard in eMobility applications, because of their high copper fill factor and levels of efficiency.

With 800 V power levels set for future high-performance drive systems, partial discharge resistance of the

insulation system is a key parameter in achieving long machine life times. Therefore a successful combination of wire enamels, flexible insulation materials and impregnating as well as casting & potting resins is in demand.

To address consumer expectations, OEM and Tier1 manufacturers are demanding more and more materials that meet rigorous standards of environmental sustainability and health & safety.

## + CHARACTERISTICS

- + Withstand Combination of Various Influences during Life Time
- + Partial Discharge and Corona Resistant
- + Constant Development of Health, Safety & Environmental Criteria
- + High Thermally Conductive Materials
- + Temperature Shock Resistance



ELANTAS Europe offers an extensive portfolio of high-performance materials that meet the conflicting requirements for protecting eMobility motors.

They feature:

- Very good chemical resistance
- Temperature shock resistance
- VOC-free product range
- Fast and safe application
- High thermal conductivity materials
- Corona resistance

eMobility motors are used in many vehicles:

- PHEV
- HEV
- EV
- Buses (hybrid and all-electric)
- Light Utility Vehicles
- Helicopters
- Small Planes
- Ships
- Motorbikes

Insulation materials for eMobility motors face conflicting requirements. The same motor is used at high torque for brief periods and low torque for long periods. It has to work in hot conditions as well as very cold temperatures, and must be resistant to oils, water, and salt from winter streets. Long-term reliability is an absolute must. The insulation must be rigid enough to withstand high temperatures and chemicals, but also flexible enough to absorb temperature shocks and torque in the motor.



## Motor Repair

Electric motors are complex pieces of equipment, and like any machine they are subject to wear and tear. Lack of maintenance, electrical, thermal or mechanical stress on the motor and winding insulation, contamination or simply old age can cause deterioration in performance over time and ultimately failure of the motor.

Accordingly, electric motor repair is a very important industry. During repair, the protection must be restored or even improved over the original condition.

Not knowing which type of machine will come into the workshop, an electric motor repair shop has a broad knowledge of all machine types and a wide range of capabilities. This includes a full suite of materials to cover the many different motor repair demands.

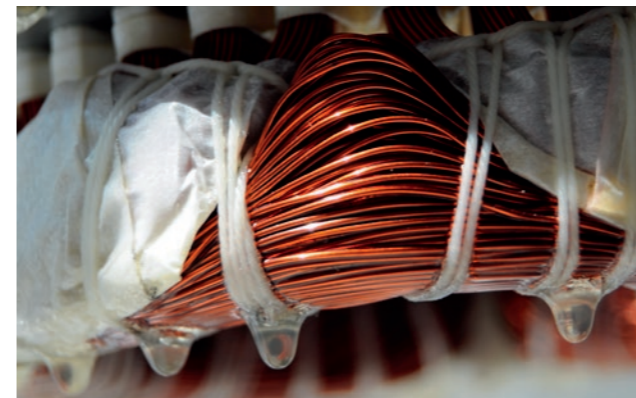
ELANTAS meets this need with a full portfolio of high-performance, multiple-chemistry products, for sealing, filling, bonding, insulating, coating, impregnation, and casting & potting, for all application processes, including brush, spray, dip, trickle and vacuum pressure impregnation. Our extensive portfolio features:

- Ease of application
- Superior chemical & environmental protection
- Excellent electrical protection
- High mechanical resistance
- Excellent storage stability
- Excellent compatibility with commonly used insulating materials

### + CHARACTERISTICS

- + Extensive Product Portfolio
- + Ease of Application
- + Excellent Chemical & Environmental Protection
- + High Resilience with Good Dielectric Properties

## Our Brands For Motor Applications



As a manufacture with over 100 years of experience in the field of electrical insulation protection. Our products have proven their viability in thousands of electrical insulation systems the world over, and help motors operate at peak performance.

#### Impregnating / Finishing Resins and Varnishes:

- **Aquanel®**  
Water based and co-solvent based impregnating and coating varnishes
- **Dobeckan®**  
Polyester(imide) impregnating resins
- **ELAN-protect®**  
Environmentally friendly unsaturated polyester(imide), epoxy & alkyd based impregnating & coating resins

- **ELAN-Volt®**  
Impregnating resins for HV impregnation
- **Elmotherm®**  
Solvented impregnating and finishing varnishes
- **EpoxyLite®**  
Epoxy based impregnating resins
- **Isonel®**  
Solvented impregnating varnishes

#### Electrically Insulating Film:

- **ELAN-Film®**  
Flexible film Insulation

#### Casting and Potting Resins:

- **Elan-tron®**  
Epoxy, silicone and PU potting & encapsulation resins

#### Wire Enamels:

- **Allotherm®**  
Polyamide-imide magnet wire enamels
- **Terebec®**  
Polyester-imide magnet wire enamels
- **Wire Enamel PU**  
MDI based polyurethane wire enamel



# ELANTAS Product Solutions for Motor Applications

Product Type	T.I. (°C)	Viscosity (mPas @ 25°C)	Typical Curing Conditions	Description	Advantages	Processing	UL recognized	GENERAL PURPOSE	HERMETIC	TRACTION	eMOBILITY	MOTOR REPAIR
<b>Impregnating Resins</b>												
<b>Dobeckan® FT Series</b>	Up to 200	50–1,200	Elevated Temperatures	Single or two component, unsaturated polyester and polyester-imide resins, viscosity reduced with styrene or vinyl toluene monomer.	Reduced process and cure times, excellent mechanical, electrical and thermal properties, good chemical and moisture resistance	Dip, Dip Roll, Vacuum Dip, Trickle and Vacuum Pressure Impregnation	✓	✓	-	✓	-	✓
<b>Dobeckan® LE &amp; MF Series</b>	Up to 200	900–12,000	Elevated Temperatures	Single or two component, monomer and VOC free, low emission, unsaturated polyester resins.	Reduced process and cure times, excellent mechanical, electrical and thermal properties, good chemical and moisture resistance, very low emissions on cure, excellent tank stability	Dip, Dip Roll, Vacuum Dip, Hot Dip, Hot Dip + UV, Trickle and Vacuum Pressure Impregnation	✓	✓	✓	✓	✓	✓
<b>EpoxyLite® Series</b>	Up to 200	1,000–10,000	Room or Elevated Temperatures	Single or two component, modified low emission and VOC free epoxy resins.	Excellent mechanical, electrical and thermal properties, superior chemical and moisture resistance, very low emission on cure, excellent tank stability	Dip, Dip Roll, Vacuum Dip, Trickle and Vacuum Pressure Impregnation	✓	✓	✓	✓	✓	✓
<b>ELAN-protect® Series</b>	Up to 200	250–7,500	Elevated Temperatures	One and two component, VOC free and low emission environmentally friendly resins.	Reduced process and cure times, excellent mechanical, electrical and thermal properties, superior chemical and moisture resistance, very low emissions on cure, excellent tank stability	Dip, Dip Roll, Vacuum Dip, Hot Dip, Hot Dip + UV, Trickle and Vacuum Pressure Impregnation	✓	✓	✓	✓	✓	✓
<b>ELAN-Volt® Series</b>	Up to 180	100–2,000	Elevated Temperatures	Single component, epoxy, unsaturated polyester-imide and hybrid resin systems for impregnation of high voltage motors up to 15 kV.	Reduced process and cure times, excellent mechanical, electrical and thermal properties, good chemical and moisture resistance, very low emissions on cure, excellent tank stability, compatible with standard and bespoke insulation systems	Vacuum Pressure Impregnation	✓	✓	-	-	-	✓
<b>Impregnating Varnishes</b>												
<b>Elmotherm® Series</b>	Up to 200	200–600	Room or Elevated Temperatures	Single component, solvented modified alkyd, polyester-imide and epoxy phenolic impregnating varnishes.	Good mechanical electrical and thermal properties, excellent chemical and moisture resistance, excellent tank stability, anti-tracking, fungicidal protection	Dip, Vacuum Dip, Dip Roll, Vacuum Pressure Impregnation	✓	✓	✓	-	-	✓
<b>Aquanel® Series</b>	Up to 180	100–500	Room or Elevated Temperatures	Single component, water-based VOC free and co-solvented modified polyester, alkyd and epoxy phenolic varnishes and epoxy emulsions.	Good mechanical, electrical and thermal properties, excellent chemical and moisture resistance, excellent tank stability	Dip, Vacuum Dip, Dip Roll, Vacuum Pressure Impregnation	✓	✓	✓	-	-	✓
<b>Finishing Varnishes</b>												
<b>Elmotherm® Series</b>	Up to 200	200–600	Room or Elevated Temperatures	Single and two component solvented alkyd and modified epoxy finishing varnishes available in a range of different colours.	Good mechanical electrical and thermal properties, excellent chemical and moisture resistance, excellent tank stability, anti-tracking, fungicidal protection	Dip, Dip Roll, Brush, Spray	✓	✓	✓	✓	-	✓
<b>Aquanel® Series</b>	Up to 180	100–500	Room or Elevated Temperatures	Single component, water-based VOC free and co-solvented modified polyester, alkyd and epoxy phenolic varnishes and epoxy emulsions.	Good mechanical, electrical and thermal properties, excellent chemical and moisture resistance, excellent tank stability	Dip, Dip Roll, Brush, Spray	✓	✓	✓	✓	-	✓
<b>ELAN-protect® Series</b>	Up to 180	50–5,500	Room or Elevated Temperatures	Single component, water-based finishing varnishes.	Reduced process and cure times, excellent mechanical, electrical and thermal properties, superior chemical and moisture resistance, very low emissions on cure, excellent tank stability	Dip, Dip Roll, Brush, Spray	✓	✓	✓	✓	✓	✓

# ELANTAS Product Solutions for Motor Applications

Product Type	T.I. (°C)	Viscosity (mPas @ 25°C)	Typical Curing Conditions	Description	Advantages	Processing	UL recognized	GENERAL PURPOSE	HERMETIC	TRACTION	eMOBILITY	MOTOR REPAIR
								✓	✓	✓	✓	✓
<b>Electrically Insulating Film</b>												
<b>ELAN-Film®</b>	Up to 200	–	–	Flexible Insulation films, applications include slot liners, phase and layer insulations, wedges and slot closures.	Flexible and moisture resistant insulating films with excellent electrical, thermal and mechanical properties, easily processable, fully compatible with a wide range of impregnating and casting and potting resins	Manual or Automated	✓	✓	✓	✓	✓	✓
<b>Casting and Potting Resins</b>												
<b>Elan-tron® MC &amp; EP (Epoxy) Series</b>	Up to 180	2,000–130,000	Room or Elevated Temperatures	One and two component filled and unfilled epoxy resin systems.	Good mechanical, electrical and thermal properties, excellent chemical and moisture resistance, wide range of Tg values available, shock resistance, various viscosity and gel time options, excellent resin flow and penetration, low shrinkage, high thermal conductivity, extended pot-life	Casting and Potting, Total Encapsulation	✓	✓	–	✓	✓	–
<b>Elan-tron® PU (Polyurethane) Series</b>	Up to 155	1,000–12,000	Room or Elevated Temperatures	One and two component filled and unfilled polyurethane systems.	Good mechanical, electrical and thermal properties, good chemical and moisture resistance, very wide range of Tg values available, shock resistance, various viscosity and gel time options, excellent resin flow and penetration, low shrinkage, low isothermic peak, high thermal conductivity, extended pot-life	Casting and Potting, Total Encapsulation	✓	✓	–	✓	✓	–
<b>Elan-tron® SK / SH (Silicone) Series</b>	Up to 200	2,000–Paste	Room or Elevated Temperatures	One and two component modified silicone systems.	Good electrical and thermal properties over a wide temperature range, excellent chemical and moisture resistance, highly flexible, even at low temperatures, various viscosity and gel time options, excellent resin flow and penetration, low shrinkage	Casting and Potting, Total Encapsulation	✓	✓	–	✓	✓	–
<b>Wire Enamels</b>												
<b>Terebec® Series</b>	Up to 200	23–6,000 (@ 23°C)	Elevated Temperatures	Polyester-imide theic modified magnet wire enamel, with excellent technical properties, usable on a wide range of operating conditions	Best compromise between technical parameters process applicability, ideally suited to flat wire coating	Enamelling process on horizontal and vertical ovens	✓	✓	✓	✓	✓	✓
<b>Allotherm® Series</b>	Up to 220	1,800–6,000 (@ 23°C)	Elevated Temperatures	Polyamide-imide magnet wire enamel, with high thermal class, developed for round and flat wire production	Excellent mechanical properties, good chemical resistance and heat shock, low coefficient of friction, corona resistant product variants available, suitable for larger diameter wires	Enamelling process on vertical ovens	✓	✓	✓	✓	✓	✓
<b>PU Series</b>	Up to 180	20–1,200 (@ 23°C)	Elevated Temperatures	MDI based Polyurethane, registered in class H (180), usable on a wide range of operating conditions	Excellent thermal properties while being solderable directly, pinhole resistant, usable for fine and ultrafine enameled wire production	Enamelling process on horizontal ovens	✓	✓	–	–	–	✓

# Technical Expertise and Broad Capabilities



## State-of-the-art Research Laboratories

With expertise in a very broad range of chemistries, we cover the entire development process, from initial research in state-of-the-art laboratory facilities to final added value. Our R&D specialists have a deep understanding of many different classes of materials, including polyester, polyesterimide, alkyd, epoxy, polyurethane and silicone resins, along with chemical engineering, design, and processing. Thus, we are able to develop solutions that combine different materials and product properties.

A major focus of our research effort is the development of next generation materials, products with superior electrical protection, high thermal endurance, efficient thermal conductivity, and good mechanical and chemical resistance. This includes the latest generation of environmentally friendly, VOC-free, low emission and lower temperature curing materials.

## Quality Testing Laboratories

ELANTAS quality testing laboratories perform the full range of standard chemical, physical and electrical tests on all ELANTAS materials, starting from incoming goods inspection and continuing to in-process checks and final product release approvals. We also carry out UL approvals and provide Certificates of Analysis.

Automated systems ensure swift and efficient documentation for customers, as well as full material traceability.



## Application Laboratories

It's one thing to make a product, it's another to know how it performs in real life. We make sure we do with thorough testing. This gives us in-depth technical expertise on the application of all of our products, and enables us to offer expert product selection and application guidance. We also offer application training courses for customers.

Our application laboratories are fully equipped to test hot dip (UV), dipping, roll-dipping, vacuum pressure impregnation, trickle, potting and encapsulation, coating, and conductor enameling. We also perform many additional tests on processed components, including mechanical, electrical, chemical, environmental testing, as well as finished product testing and evaluation.

## Sustainability

At ELANTAS we are very aware of our environmental responsibility. We are focused on providing tomorrow's environmental solutions, with the use of non-hazardous raw materials, reduction of VOCs, and reduced energy requirements for processing as a fundamental goal of ELANTAS product development. Helping our customers to reduce emission outputs and lower their energy use are top priorities. Currently all of our plants work to the highest industrial environmental standards, and we plan to be a carbon neutral company by 2025.

