Electric Insulation: Market Trends, Manufacturing Challenges and High-Performance Products

Demand for high-performance electrical insulation tapes is fueled by industrial needs. Aging electrical infrastructure, increased energy demands, modernization of the electricity grid, electric vehicle sales, an increased demand for higher efficiency electric motors and the scaling of electric charging stations will collectively push demand to an all-time high. The effects of this increased demand will include raw material shortages, logistical challenges and supply chain complications that can lead to inflation and extended lead times.

Saint-Gobain Tape Solutions is uniquely positioned to address these challenges. Their decentralized operations, deep industry knowledge and integrated quality management systems allow for continuous improvements within the supply chain. They have developed operational excellence and can supply their proven brand of high-performance electrical insulation tapes to global markets with on-time delivery while addressing short lead times with their capabilities of short-notice production. The company is a reliable partner encompassing a wide portfolio of high value-added solutions that address demanding electrical insulation requirements.

Market Trends

Recent manufacturing trends focus on design quality with an emphasis on short-notice production, on-time delivery and support for sales growth opportunities.

Transformers

Increased energy demands, renewable and distributed energy sources, micro-grids and the anticipated scaling of digitized substations to fuel a smart grid will all require substantial capital investments. Power transformers, distribution transformers and instrument transformers will likely experience a period of rapid growth. Smart transformers, in particular, will experience a compound annual growth rate (CAGR) of up to 24.4% between 2017 and 2025 as reported by Grand View Research in their recent market report, “Solid State (Smart) Transformer Market Size, Industry Report 2018-2025.”

A wide assortment of transformers are needed to address power generation and distribution systems and each type carries specific requirements. Unique electrical insulation solutions are needed to address operating temperatures, material compatibility issues and general insulation requirements.

Electric Motors

IEC revamped standard IEC 60034-30-1:2014, which defines a classification system for electric motors. In an attempt to meet the minimum requirements of premium efficiency (IE3) and super premium efficiency (IE4) that are defined by this standard, motor manufacturers are incorporating high-performance electrical
insulation tapes and these higher efficiency motors are expected to increase their market share.

Traction motors, in particular, are experiencing the largest growth rate. IHS Markit is forecasting a five-year CAGR of 43.1% between 2016 and 2021, as presented at the 2017 Coil Winding, Electric Motor & Transformer Manufacturing Exhibition (CWIEME) in Berlin. High demand is to be fueled by the increased market share of electric vehicles and wider adaptation of electric locomotives in the transportation sector.

**UL Listings for CHR and h-old Product Brands**

Thermal degradation of insulating materials is the greatest concern for electrical insulation systems (EIS) and electrical insulation materials (EIM) that are subject to hot spot temperatures greater than 105° C. To certify EIS and EIM for use at elevated temperatures and designate their compatibility to their environment, Underwriters Laboratory (UL) developed the standard, UL 1446 “Systems of Insulating Materials.”

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Table 1. Thermal class ratings as defined by UL 1446.

UL 1446 is the de facto standard that defines guidelines and test methods for evaluating the thermal performance of EIM and their interaction as a complete system. Full thermal aging test, high-voltage full thermal aging test and short-term thermal aging test methods are used to monitor thermal degradation over time. These rigorous survivability test subject materials and systems are specified to operating temperatures for 20,000 hours, at a temperature 20 degrees higher than their expected operating temperature for 5,000 hours and address performance of high-voltage systems. A thermal class rating is issued based on test results and a UL Certification report is then issued.

**High-Performance Electrical Insulation Tapes**

Saint-Gobain carries two brands of high-performance electrical insulation tapes. Their CHR and h-old product brands provide a complete portfolio of electrical insulation tapes for the North American and European markets respectively. They offer a combination of backings and adhesives to match application requirements across a broad range of markets including aerospace, oil and gas, electronics, electrical and industrial.

**High Temperature Electrical Insulation Tape Materials — UL Class N (200° C) and UL Class H (180° C)**

**Glass Cloth Tapes** offer high temperature resistance (up to 220° C), high tensile strength and abrasion resistance. Due to their excellent mechanical properties and outstanding flame retardant performance, they are an ideal electrical insulation solution for medium- and large-sized electric motors.

**Polyimide (PI) Film (Kapton®) Adhesive Tapes** are flame retardant according to UL 510, offer high temperature resistance (>180° C) and outstanding dielectric performance. These thin, high-temperature tapes address insulation requirements of traction motors, high-voltage motors and dry-type transformers.

**Figure 2. CHR® Glass Fabric Adhesive Tapes for large electrical motors.**

Source: Saint-Gobain Tape Solutions
PEN (Teonex®) Film offers excellent chemical resistance and high-temperature resistance (up to 180° C). Teonex is recommended for insulating transformers and coils.

Nomex® Aramid Paper Tapes are offered with acrylic and rubber adhesives. They offer higher tensile strengths as well as high dielectric and impregnation properties and are an ideal choice for increased durability in motors and transformers.

Glass Filament Reinforced PET Film and Paper Tapes offer high chemical and mechanical resistance. They are offered with acrylic adhesive for better chemical resistance to oils and solvents for applications in dry or oil-filled transformers.

PTFE Tapes with silicone adhesive exhibit outstanding temperature resistance and a low coefficient of friction. They are an ideal insulator of high frequency motors.

Medium Temperature Electrical Insulation Tape Materials — UL Class F (155° C), UL Class B (130° C) and UL Class A (105° C)

PET Film/Non-Woven and Paper Laminated Tapes offer good conformability, strength and are puncture resistant. They are often used for phase insulation and coil wrapping.

PET Film Adhesive Tapes are offered with rubber, silicone or acrylic pressure sensitive adhesives and are available in a wide range of thicknesses and colors. They exhibit high tack properties for good adhesion to a wide array of substrates. They also offer good conformability, breakdown voltage and tensile strength. They are flame retardant and printable with good compatibility to varnishes and resins. They are used for interlayer insulation and final binding as well as insulating of smaller dry type transformers or toroidal coils.

Acetate Cloth Backed Tapes are offered with a thermosetting rubber adhesive that provides for a very good initial tack. They are highly conformable and are used for the wrapping of bobbins and smaller transformers.

Double-sided Adhesive Tapes offer good initial adhesion and electrical properties. They are used to fix insulating material by the initial unwinding when manufacturing transformers.

Copper Foil Tapes are offered with conductive acrylic adhesive. They are used for static electricity discharging as well as shielding from electromagnetic and electro-static fields.

Co-development Program
Saint-Gobain Tape Solutions offers endless permutations for backing materials and adhesives. They offer a wide selection of CHR and h-old high-performance electrical insulation tapes that are each tailored to address a particular application. From their h-old PS.249 polyester film/glass filament electrical insulating tapes with best-in-class oil compatibility for low-temperature oil-filled transformers to their CHR G565 glass cloth backing silicone adhesive pressure sensitive tape for large- and medium-sized electrical motors, they seem to have a solution to fit every need.

In instances where a stock CHR and h-old brand solution is not available for a given application, their tape development engineers are available to formulate a custom tape solution to address unique requirements and demanding applications. Through co-development with their partners, they are able to design a highly effective tape product.

Co-development Case Study
An electric vehicle battery module requires an electrical insulating tape that offers improved thermal conductivity, electrical insulation and mechanical properties while addressing manufacturing time and cost limits. Saint-Gobain Tape Solutions addressed these requirements by co-developing an adhesive coated silicone rubber and PTFE film that was die-cut for the EV battery application.

Figure 3. Co-developed silicone rubber and PTFE film with adhesive coating for electric vehicle battery applications.
Source: Saint-Gobain Tape Solutions
WCM is **Saint-Gobain** Tape Solutions manufacturing excellence program that allows for continuous improvement of lead time and component quality. It is a collection of tools and processes put in place to help manage continuous improvement of these eight pillars: health and safety, environment and risk prevention, reliability, industrial efficiency, quality and process control, customer focus and service, people development, and innovation development and growth.

**Conclusion**

The anticipated CAGR of emerging markets and technologies creates a need for innovation. As product manufacturers address performance and efficiency challenges, they are in need of a reliable partner who can readily supply high-performance electrical insulation tapes.

**Saint-Gobain** Tape Solutions offers a wide range of high-performance electrical insulation tapes that are developed for specific applications. Their broad portfolio of **CHR** and **h-old** electrical insulation tapes address a diverse set of needs and in cases when a stock product is insufficient, a co-development program exists to address the most demanding and specialized applications with short lead times for both low- and high-volume orders.

For more information on their high-performance electrical insulation tapes and co-development capabilities, view their new **Tape Solutions for Electrical Insulation brochure**, visit them online or contact Customer Care at (518) 686-7301.

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**About Saint-Gobain Tape Solutions**

**Saint-Gobain** Performance Plastics Tape Solutions offers solutions for bonding, protection and insulation to the automotive, aerospace, energy, construction, electronics, medical and general industry sectors.

Through the support of our global research and development centers and our advanced polymer technology expertise, we create innovative solutions that enhance performance in the most extreme environments. Backed by a proud heritage of product innovation, technological expertise and market leadership, we are dedicated to working with our customers to solve today’s most extreme and demanding application issues and the challenges that lie ahead.