



High Voltage Test Laboratory

# Making a difference in windfarm transformers

The electric energy industry has long been a conservative business taking very deliberate and measured steps in adopting new technologies. The renewable energy markets have forced companies to adapt to a fast-paced and rapid technology development cycle. The exponential growth and the demand for more power in a smaller envelope continue to drive rapid development.





H-J has accepted these challenges and we are leading the renewable energy transformer industry with material and product development for both high and low voltage bushing applications.

New, higher power solar inverters and wind turbines are being developed and released on a regular basis. This is driving a series of fundamental changes in transformers for renewable applications:

- Solar inverter containers are open and exposed to elements,
- Converting from dry-type to liquid-filled transformers,
- Using high-temperature insulation systems and operating temperatures, and
- Increasing current ratings and the high voltages to 35 kV, 200 kV BIL class and beyond.

At H-J, we are dedicated to developing industry-leading bushing solutions by listening to our customers. Solutions for high voltage bushings include plug-in type technology for 38 kV class with 150 and 200 kV BIL options. Bushings are available with 600, 900 and 1200 A continuous current ratings. Higher voltage and BIL versions are currently under development to support industry needs. These are dry, solid, internally-shielded epoxy resin bushings. The bushing interfaces are designed in accordance with relevant IEC or IEEE Standards to provide interchangeability with different molded rubber elbow solutions in the market.

The standard operating temperature for bisphenol-A and cycloaliphatic epoxies are 105°C and 120°C. However, an important consideration with epoxies is that the maximum temperature must not be exceeded in operation. Above these temperatures the epoxy nears or enters the glass transition range (T<sub>g</sub>) where the material is no longer

rigid. This may compromise the bushing's physical integrity and, most importantly, the sealing integrity of the bushing.

H-J has developed a new high temperature epoxy in order to help manufacturers match the transformer high temperature insulation systems. This new high temperature epoxy is suitable for continuous use at 155°C. This greater range of temperature allows users to pack more power into smaller footprints by running the systems hotter. The efficiency of these liquid-filled high temperature transformers is still far superior to dry-type transformer solutions, and provides tremendous benefits in terms of size and performance in space-limited applications such as solar inverter containers and wind turbine nacelles.

Solutions for low voltage bushings are equally important and present a more customized and diverse range of product needs. The need for matching the generator connection and internal transformer winding connection optimization requires a high level of customization. We embrace this at H-J and provide solutions which work for each individual customer project, big or small.

H-J's low voltage bushing offering includes voltages from 1,2 kV, 30 kV BIL to 5 kV, 75 kV BIL with current ratings up to 12,000 A. These are dry, solid, one-piece epoxy resin bushings which may be exposed to UV rays with no deterioration in life expectancy. H-J offers our proprietary epoxy blend options for 105, 120 and 155°C maximum operating temperatures.

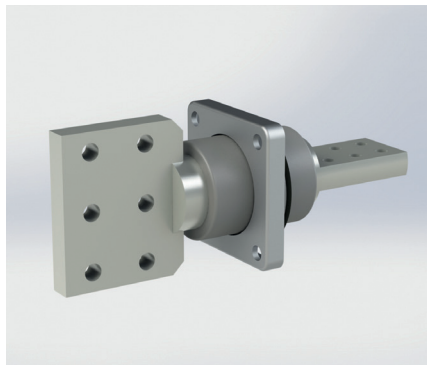
In wind farm applications, turbine designs are continually evolving, growing in power size, while optimizing structural dimensions. The result is a further reduction in the space provided for the transformer in the nacelle area which presents additional challenges in bushings designs: current ratings are increasing and a precise level of customization is required to meet the available space. Different bushing bodies, terminations, hole patterns, and mounting clamp styles are developed to fulfill such requirements. At the same time, since the transformer is enclosed, the ambient temperature will increase considerably requiring the use of high temperature components. H-J's high temperature 155°C epoxy is ideal for this environment.

The conductors are typically aluminum or copper with plating options such as tin, silver and nickel. The entire bushing can be

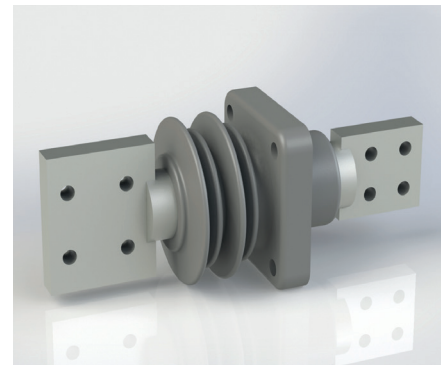




3.6KV 60KV BIL 5000A epoxy bushing



1.2KV 30KV BIL 6000A epoxy bushing



5KV 75KV BIL 5000A epoxy bushing

customized, from the insulator to the internal terminal to the external terminal.

Our low voltage bushings are single-piece design which provides several advantages:

- No need for assembly at OEM site
- Fewer gaskets mean fewer possibilities for leaks
- Bushing leak tested as a complete system at H-J

The epoxy resin is directly molded into the conductor, making it a single unit. There are only three components required for a complete bushing assembly: a bushing, a mounting clamp and a mounting gasket all provided direct from H-J.

Epoxy resin bushings are ideal for windfarm

transformers. Here's why:

- High level of customization: dimensions and features can be easily changed to match the specific needs for internal and external connections.
- Ability to offer high current options: epoxy resin is molded directly onto the conductor, allowing for significant cross-sectional areas of copper to carry large amounts of current safely.
- Ability to withstand cantilever and short circuit forces: epoxy resin is more forgiving than porcelain insulators while still maintaining strength and performance integrity.
- Less fragile than porcelain: epoxy resin can better withstand rough handling and

strenuous usage.

- Hydrophobicity: water molecules accumulated on sheds are better repelled and thus use less space than porcelain, resulting in fewer chances for creating an electric path.
- Flexible installation: bushings can be mounted in vertical or horizontal orientation since there is no oil inside.
- Compact Design: distances are reduced while meeting voltage and creep distance requirements due to fewer components needed for construction.
- Fewer chances for oil leakage: single-piece bushing design mitigates potential leak points and provides for better sealing between epoxy and conductor.
- Quick development process: the design and production of an epoxy resin mold are quicker than porcelain, thus shortening lead times.

#### Why choose H-J bushings?

H-J is constantly innovating to meet the market's needs, positioning ourselves to provide value without sacrificing quality to our customers. Vertical integration is one of our strengths to develop the product from raw materials to final solution.

With our proprietary, in-house formulations and production H-J maintains control over the components that go into the bushing design, streamlining the flow of production.

H-J has established manufacturing, engineering and commercial facilities around the world to stay closer to our customers and better support each market:

High Ridge, Missouri, USA

Toronto, Canada

Leon, Mexico

Bogota, Colombia

Pereira, Colombia

Blumenau, Brazil



Engineering and QA working together



38KV 200KV BIL 600A plugin epoxy bushing 155C rated operating temperature



Epoxy resin customized mold press

Belo Horizonte, Brazil

Barcelona, Spain

Frankfurt, Germany

Mysore, India

Manila, Philippines

Tianjin, China

Xi'an, China

Busan, South Korea

Taipei, Taiwan

The H-J Family of Companies has continuously developed new designs since 1969, helping shape and improve our industry through innovation and reliability in good times as well as in times of need. We will continue to do so moving forward.

#### About our company:

The H-J Family of Companies celebrated our 50th anniversary in 2019 - a major milestone for our family-owned company located outside of St. Louis, Missouri, USA. We offer a broad range of products for the electrical transformer and switchgear industry from bushings to connectors, fuses, tap changers, valves, and even transformer manufacturing machinery. H-J's global manufacturing facilities include an epoxy resin casting facility, chemical engineering and development laboratory, state-of-the-art tool and die machine center, non-ferrous foundry, porcelain manufacturing, multiple machining and plating centers, and a state-of-the-art high

voltage test laboratory.

Quality, R&D and production process capabilities have been at the forefront of the company's values, but our people are what make the difference. Our bushings have been used for many decades in various applications such as pole-mounted transformers, pad-mounted transformers, compact substation transformers, submersible transformers, completely self-protected transformers, and more. The bushing technology used in each transformer design can be customized, and we offer multiple insulation types such as porcelain, silicone, thermoplastic, and five different proprietary epoxy resins.

[www.h-j.com](http://www.h-j.com)