EnduraSeal®

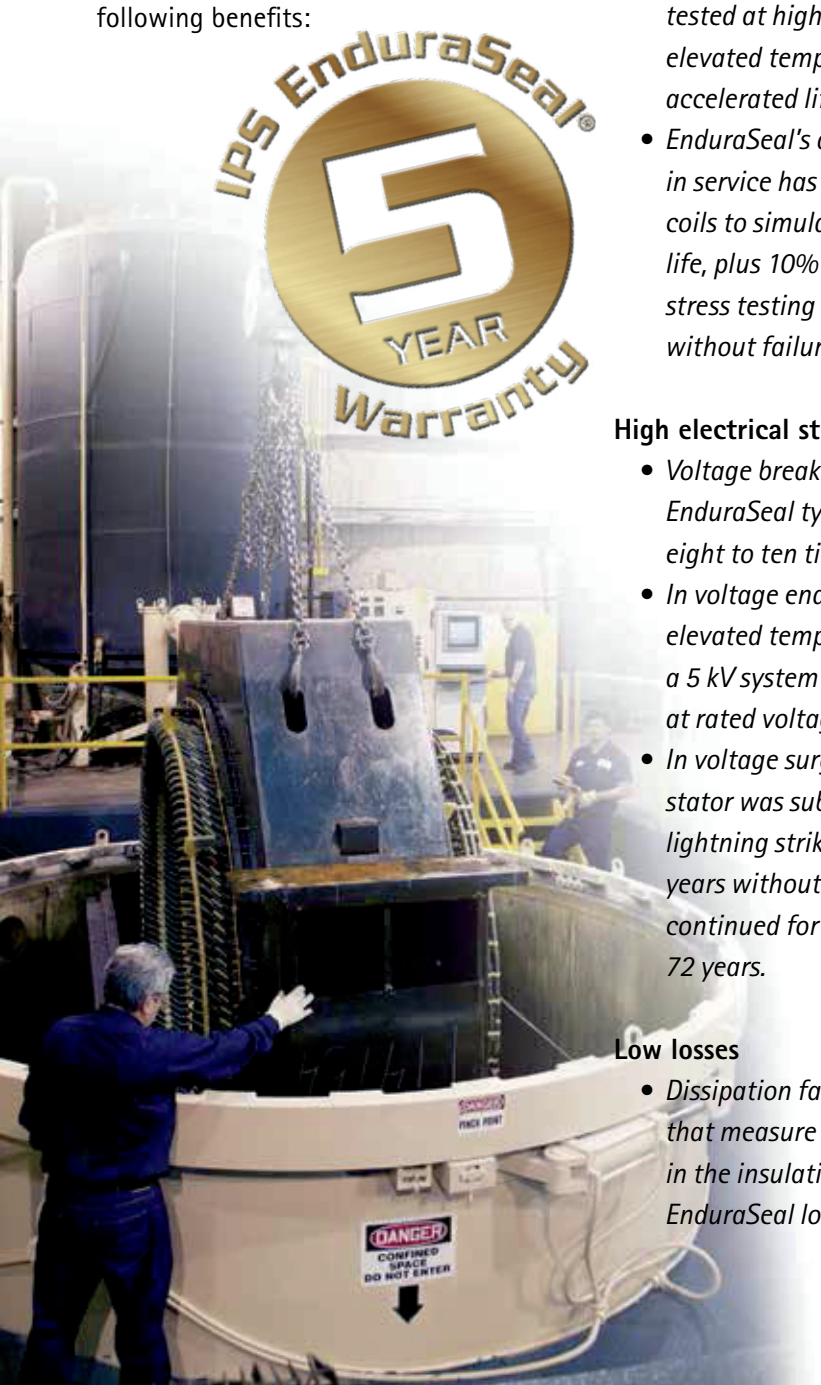
Medium-Voltage VPI Rewinds for AC Motors & Generators

IPS
INTEGRATED POWER SERVICES

EnduraSeal®

OVER FORTY YEARS OF DOCUMENTED EXCELLENCE IN THE MOST EXTREME INDUSTRIAL ENVIRONMENTS

Developed in the research laboratory and proven in forty-plus years of use in motors and generators around the world, this is the sealed stator for the toughest AC medium-voltage applications. The EnduraSeal rewind engineered insulation system is designed to perform in the most severe environments, while offering the following benefits:



Long life

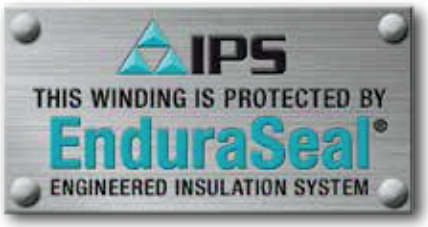
- *During testing, the 100% solids epoxy EnduraSeal resin demonstrated the lowest weight loss and dissipation factor of multiple materials compared at elevated temperatures.*
- *Nomex® Mica tapes demonstrated superior voltage stress endurance, tested at high frequency and elevated temperatures to simulate an accelerated life span.*
- *EnduraSeal's ability to remain sealed in service has been verified by aging coils to simulate a 40-year service life, plus 10% margin with water and stress testing after aging—again, without failure.*

High electrical strength

- *Voltage breakdown tests for EnduraSeal typically range from eight to ten times rated voltage.*
- *In voltage endurance testing at elevated temperatures and frequency, a 5 kV system endured 250,000 hours at rated voltage without failure.*
- *In voltage surge testing, an untreated stator was subjected to two simulated lightning strikes per day for forty years without failure. The test continued for the equivalent of 72 years.*

Low losses

- *Dissipation factor (power factor) tests that measure relative dielectric loss in the insulation system show EnduraSeal losses are less than 1.5%.*



Abrasion resistance

- *Sample coils were blasted with glass beads and fly ash, with EnduraSeal demonstrating greater abrasion resistance than other VPI systems.*

Thermal capability

- *EnduraSeal motorette testing per IEEE 1776-2008—including thermal cycling, mechanical stress, humidity and water immersion—produced results at Class F+.*
- *Thermal shock resistance testing subjected EnduraSeal coils to alternating heat aging and immersion in ice water, immersion in salt water, and then energization at rated voltage. The EnduraSeal coils remained sealed.*

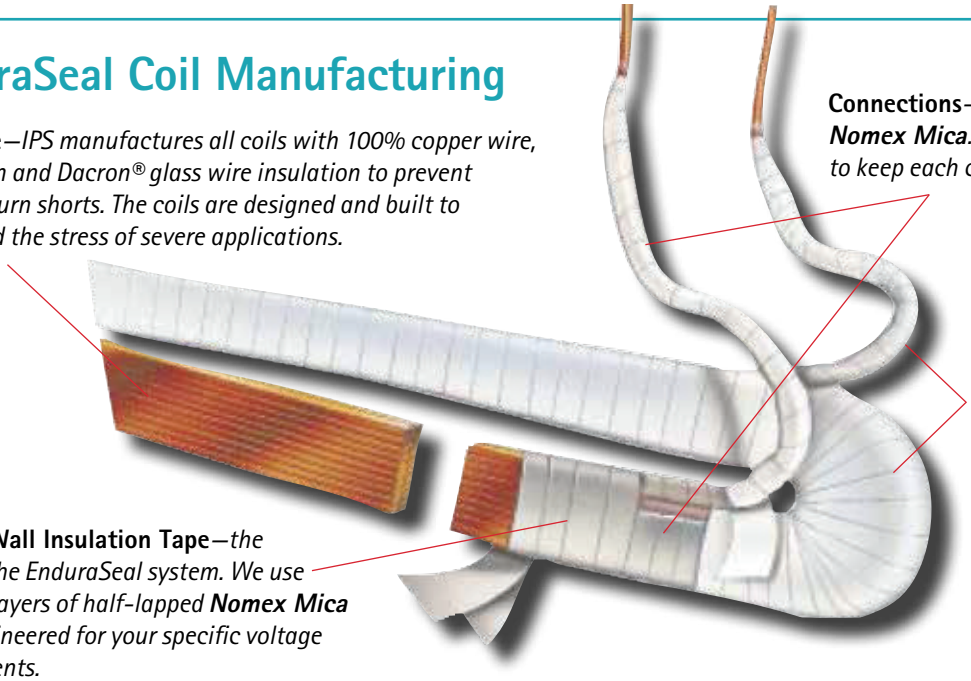
Chemical resistance

EnduraSeal coils have been immersed in concentrated solutions of the following chemicals with no degradation of the insulation system.

- *Sulfuric acid*
- *Hydrochloric acid*
- *Sodium hydroxide*
- *Sodium chloride*
- *Black liquor (paper mill caustic)*
- *Detergent*

EnduraSeal Coil Manufacturing

Coil Wire—*IPS manufactures all coils with 100% copper wire, heavy film and Dacron® glass wire insulation to prevent turn-to-turn shorts. The coils are designed and built to withstand the stress of severe applications.*



Connections—*we tape all conductor leads using **Nomex Mica**. We also use a Dacron® mat seal to keep each connection individually sealed.*

Armor Insulation Tape—*an outer layer of glass tape protects the coil from airborne abrasives, such as fly ash and rock dust. **We use conductive tape on windings above 5,000 volts to provide corona protection.** After final taping and insertion in the core, we surge test each coil individually, using the IEEE 522 process, to ensure no turn-to-turn shorts.*

Ground Wall Insulation Tape—*the heart of the EnduraSeal system. We use multiple layers of half-lapped **Nomex Mica** tape, engineered for your specific voltage requirements.*

Coil head bracing for a fixed position
With the coils in the stator slots and polymer glass laminate top sticks in place, we lash them to a steel, epoxy or impregnated woven glass rope. We block the coil heads with a Dacron mat and polyester laminate to ensure negligible coil movement in severe-duty applications—even during plug reversals and across-the-line startups.

Lead cable construction for Class H requirements
We use oil-resistant, high-stranded leads designed to resist heat (up to 200°C), moisture, fire, mechanical fatigue and exposure to ozone and harsh fluids.

Sealing the deal with VPI
We subject every rewound stator to multiple vacuum pressure impregnations, oven curing after each impregnation. This multi-step process transforms the coils into a solid, rugged system—free of voids and with excellent heat dissipation.

We developed our exclusive 100% solids epoxy formulation resin to provide maximum material penetration, homogenous fill and superior resistance to airborne contamination. Our unique capacitance monitoring system determines when the stator slots have been properly filled with resin, for confirmation of a void-free winding.

Comprehensive testing
All EnduraSeal tests are performed according to applicable IEEE and NEMA MG1 guidelines. Depending on your requirements, we can also perform the following optional tests:

- *Doble® testing*
- *Partial discharge testing*
- *Corona (TVA) Probe*
- *IEEE 1776-2008 water immersion test*

For more information on EnduraSeal, talk to your regional IPS sales representative or visit www.ips.us.

IEEE 1776-2008 water immersion test

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