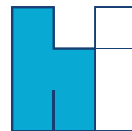




ELECTRO MECHANICAL INNOVATION IN
High Voltage Coils



Houghton International
Electro mechanical innovation



Houghton International

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Houghton International
Electro mechanical innovation

High Voltage Coils

Houghton International improves the performance of electro mechanical assets around the world. We use our technical expertise to work with customers to solve their problems offering the highest quality high voltage coils and engineering support. Underpinned by rigorous testing standards, proven manufacturing processes and over 30 years of knowledge and experience, our reputation for quality has stood the test of time.

We supply a range of coils specifically designed for the repair market, including HiFLEX - our fully cured, fully tested, totally flexible insulation system for improved fit, quicker installation and reduced risk of damage. As market leading repairers ourselves, we understand the challenges associated with rewinds and have optimised our coil designs and technical support, providing a flexible and fast service bespoke to each job.

In addition to our standard range of coils we also work with customers to develop coils for bespoke applications, redesign coils for performance upgrades and achieve personalised testing specifications as required.

Quality coils, designed with repairers in mind...

Manufactured in house, we offer a range of resin rich and global VPI insulation systems for industrial, power generation and specialist applications. With absolute control over quality, we manufacture stator, armature, field and rotor coils for all types of motors and generators up to 15kV, in diamond and concentric designs.

With over 30 years multi industry experience in electro mechanical engineering we offer:

- Supply and manufacture of premium high voltage coils and auxiliary winding kits
- Fully tested with a 5 year warranty 
- Specialist electro mechanical engineering support
- Computer aided design, performance upgrade and reverse engineering capabilities
- Worldwide in situ winding, project lead and supervisory support services
- ISO certified manufacturing facility with state of the art coil press

We export to over 30 countries globally with customers in North America, South America, Europe, Africa, Asia and Australia.

Customers are kept up to date using our Houghton Exchange video communication technology which offers live work in progress updates, visual diagnostic reports and live test results via video link to all them to keep track of their HV coils wherever they are in the world.

All full data quotes are presented using our new AutoCoil design software, utilising the latest technology to offer 3D coil design and slot build drawings for improved design and accurate fit.

Our range of High Voltage Coils

Using our extensive manufacturing expertise, we have developed a comprehensive range of insulation systems suitable for all applications, including -

- **HiFLEX™** Our innovative, fully tested, totally flexible, insulation system
- **HiRES™** Our B-stage end winding solution
- **HiBRID™** Our unique insulation system combining the merits of Vacuum Pressure Impregnation (VPI) and resin rich technology
- **HiVAX™** Our VPI insulation system

We manufacture high voltage coils up to 15kV and 50MW with the capability for diamond coils up to 6.4 meters (21ft) in length knuckle to knuckle, 4.5 meters (14.10ft) slot pressing capabilities and a span of 1.82 meters (6ft).

We are also experienced in the manufacture of half bar systems, which are used in the winding of turbo generator machines up to 100MW.

Winding kits

We supply full windings kits, including wedges, packing strips, tapes, felt, blocks and ropes, bespoke to each set of coils to ensure optimum fit and ease of winding. Comprising of the highest quality materials and delivered alongside your coils, the winders have everything they need to complete the rewind either in the workshop or on site.

Secure packaging and global shipment

All coils and winding kits are securely packaged using custom spacers and vacuum sealed in foil bags to protect the integrity of the coils during transit. Bespoke crates are manufactured for each order and we work with a network of logistics companies globally to ensure we comply with all legislative requirements and that customers receive their coils in the timescales agreed.



Specialist technical support

Based on our own extensive experience and in house rewind requirements we offer specialist electro mechanical engineering support. Our skilled and knowledgeable team have worked on a wide range machines globally and can provide training and support in relation to taking motor data, specifying the most appropriate insulation systems and improving/upgrading the performance of machines.

This includes upgrading insulation materials and increasing the copper in the cross section to improve motor efficiency and improving the winding design to minimise the risk of Partial Discharge and maximise power output.

Our engineers are also skilled in reverse engineering. Where data cannot be provided, we can work backwards from a sample coil to provide a detailed coil specification and accurate fit.

Emergency / fast response service

Mirroring the needs of our customers we offer both standard and emergency turnaround services. We understand in some cases speed is critical and have processes in place to ensure that coils can be supplied in the required timescales without compromising on quality or performance.

Worldwide in situ rewind services

In addition to supplying the coils we can also provide additional support to assist with carrying out the rewind. Our engineers routinely work both on site and at our customers' premises, either carrying out the full rewind or simply providing high voltage expertise to support the engineers carrying out the work in a supervisory capacity.

We also provide in situ inspection, testing and fault diagnostics including air gap checks and Partial Discharge testing and other condition monitoring services to enable maintenance and rewinds to be planned in line with pre-arranged shutdowns and reduce any unexpected downtime.

HiFLEX™

Fully tested, fully flexible and a perfect fit

HiFLEX™ is a fully cured film/mica paper/film tape with unidirectional glass to enhance mechanical characteristics, bound with an acrylic resin.

- Coils are fully tested at point of manufacture guaranteeing dielectric integrity.
- Coils can then be step-down tested before being inserted and throughout the repair process.
- Coils are fully cured but totally flexible in the end-winding (coil extension).
- Requires no baking after winding.
- Requires no varnishing or impregnation.
- 5 year guaranteed storage life – the coils are fully cured so they cannot change state in storage.
- Can be manufactured with a moisture proof insulation system.
- Coils are supplied in a vacuum packed, moisture proof bag inside a heavy-duty wooden crate as standard.
- Class F 160°C as standard > 6.6kV.

The flexibility of our HiFLEX coils makes them ideal for large two-pole windings, rewinding in situ and for skewed alternator coils. Winders also tell us they love working with HiFLEX coils. They reduce winding time as a result of improved fit and minimise process time (no baking, varnishing or impregnation) to speed up the job and reduce risk. What's more, because each coil is fully tested prior to dispatch guaranteeing dielectric integrity and comes with up to a 5 year warranty, you can complete the job with absolute confidence in the outcome.



*"Excellent fit, windability second to none,
highly recommended..."*

Jason Znidarich

Traction & Mining Motor Repairs, Australia



Quality coils designed for the repair market



Proven processes and premium materials

All coils produced by Houghton International meet the relevant electrical standards, such as BS EN 60034, BS EN 50209 and IEEE 1553 & 1043.

Our time proven processes have been refined over the past 30 years and our culture of continuous improvement and innovation ensures each set of coils manufactured is to the highest quality.

Regularly reviewed and independently verified we only use premium insulation materials and copper in our coils. Our supply chain is routinely audited by our engineering department and on site quality managers are responsible for ensuring the traceability of all materials.



Specialist coil manufacturing technologies

Our state of the art manufacturing facility comprises of a comprehensive range of automated shaping machines, taping machines and electrically heated hydraulic presses. Combined with skilled operatives, proven processes and a vast wealth of winding and manufacturing experience customers can rely on the quality of our coils.

In house testing capabilities

All coils produced by us are designed to meet the relevant electrical standards, such as BS EN 60034, BS EN 50209 and IEEE 1553 & 1043 and our in-house testing facility has the capability to test up to:

- Surge comparison or turn to turn test up to 50kV
- Tan δ / Tip Up measured at intervals of $0.2 U_N$, loss tangent maximum increment = 5×10^{-3}
- Hi-pot (AC and DC flash) test up to 50 kV
- Lamination test - when there are multiple conductors per / turns @ 240V AC
- Partial discharge test
- Voltage Endurance test up to 50kV

In addition, we can also test to customer specification as required.

Bespoke packaging and worldwide delivery

Vacuum packed and moisture sealed, bespoke packaging is manufactured for each coil set to ensure safe and effective transportation. We work with a network of global hauliers and can arrange export globally within days, via sea, road or air, providing insurance and logistics support as required.

Quality assurance

Our quality assurance model, accredited to ISO 9001:2015, is designed around the requirements of each individual type of coil, meaning we create a dedicated quality management system bespoke to each individual product. This process consistently produces industry-leading coils.



Fully tested with a 5 year warranty

We are confident in the quality of our coils and insulation systems and are proud to stand by them by offering an extended warranty. Our coils are designed to the highest standards and are fully tested prior to being dispatched, meaning that we are confident they will perform in line with the life expectancy of the refurbished machine.

As repairers ourselves, we understand the repair market is increasingly competitive and want to support our customers to give them the best chance of securing the rewind contract. By working with our customers to offer longer term quality assurance and standing by our workmanship we believe we can support a more attractive offer to the end user/asset owner where reliability is a key concern.

Warranty cost and duration can be tailored in line with customer requirements and the criticality of the repair.



Independent Testing

Our HiFLEX™ coils were subjected to the following tests by a leading independent Canadian testing laboratory, with satisfactory results:

- Visual inspection and tap tests on the coils before and after VE test
- Partial discharge (PD) analysis at 7.3kV before the VE tests, as per IEEE Standard 1434-2000
- Dissipation factor (DF) measurements as per IEEE Standard 286-2000 from 2kV to 16kV in 2kV steps before the VE test
- Turn to turn insulation test before VE test as per IEEE Standard 522-2004
- Voltage Endurance Test as per IEEE Standard 1043-1996 at 31.7kV, 90°C for 500 hours
- Dissection and microscopic examination of coil after VE test
- Insulation thickness measurements of one coil after VE test

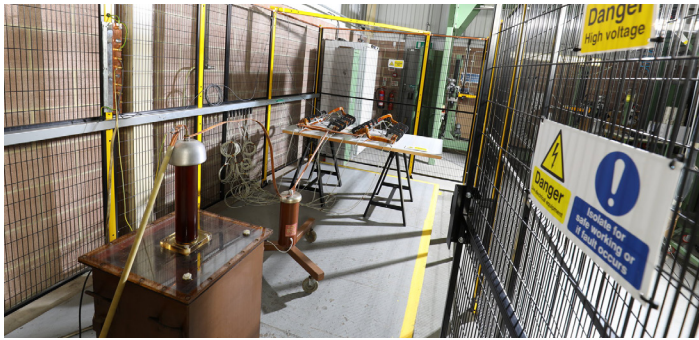
Independent Testing Results

Turn Insulation Test complied to:

- As per IEEE Standard 522-2004
- 5 successive voltages were applied to the coils with both polarities before the VE test

Voltage Endurance Test

- Coils were satisfactorily subjected to an accelerated insulation-ageing program
- As per IEEE Standard 1043-1996 and IEEE Standard 1553-2002
- Test parameters were 31.7kV at 90°C for 500 hours
- Both coils passed the 250 hours required by IEEE 1553. Coil 1 passed by 161% and coil 2 passed by 182%



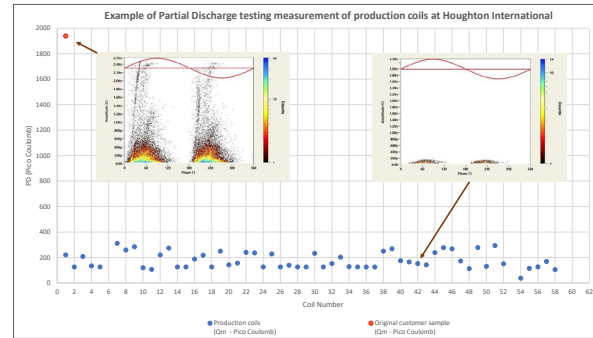
In house Voltage Endurance testing

In response to increasing demand for customer led research and development projects we have invested in a fully functional Voltage Endurance (VE) test lab for bespoke projects and internal product development. VE is a test that quantitatively measures the capability of an insulation system to withstand partial discharge (Corona) at operating temperature, which in turn is a measure of the quality of the design of the materials, and of the manufacturing process.

High voltage stress causes aging of stator winding insulation and eventually leads to insulation failures. This, widely accepted, accelerated life cycle test is used as a measure of quality by applying a much higher than normal machine-operation stress to coils/bars within a short period of time to accelerate insulation aging which occurs during machine service.

This means customers can be assured that coils are manufactured to maximise the lifetime performance of the coils and reduce any potential partial discharge which could cause premature failure.

VE tests can be carried out on sample coils.



Partial Discharge testing

We also carry out PD testing on our coils.

We control the PD to less than 300 pC (picocoulombs). This gives both ourselves and our customers the confidence that a much longer life expectancy can be achieved and the security that any PD emanating from the coils in the wound motors and generators can be minimised.

We use a 20kV partial discharge free transformer and divider together with Lifeview QTD digital capacitance / loss factor ($\tan \delta$) and partial discharge analyser, which is calibrated to UK national physical laboratory standards.

If required, we can PD test each coil as it is manufactured which gives increased confidence in the quality of the coils and their ability to maximise the life of the asset once rewound.

Working with Houghton International

We work collaboratively with customers around the world to improve performance and reliability by solving complex engineering problems, supplying high quality coils to extend the life of electro mechanical assets.

As specialists, we have invested in industry-leading technologies and patented solutions to eliminate failures, improve reliability, increase lifespans, and significantly reduce cost and frequency of maintenance activities.

Innovation drives our business and we are committed to continuous improvement both to internal processes and customer service. We aim to solve our customers' problems and add value through innovation, providing an unrivalled service as we do.



Selecting the right insulation system

Insulation System:	HiFLEX™	HiRES™	HiVAX™	HiBRID™
Description	Resin rich hot pressed cell incorporating fully cured flexible coil extension outhangs	Resin rich hot pressed cell incorporating B stage material applied to the coil extensions	Green coil requiring full VPI impregnation	Resin rich hot pressed cell incorporating VPI accepting material applied to the coil extensions
Up to 15,000V	✓	✓	✓	✓
Guaranteed Flexibility in outhangs	✓		✓	✓
Full Corona Protection on Coils ≥ 6,000V	✓	✓	✓	✓
Guaranteed Storage Life Under Approved Conditions	✓			
Optional Tropical Climate Protection	✓	✓	✓	✓
Guaranteed Tan δ / Tip Up Integrity	✓	✓	✓	✓
Thermal Performance:				
Class F155°C	✓	✓		✓
Class H180°C			✓	
Class C220°C			✓	
Surge Comparison or Turn To Turn Tested	✓	✓	✓	✓
AC Flash Tested	✓	✓	✓	✓
Moisture Proof Capability	✓	✓	✓	✓
Oven Baking Required To Cure		✓	✓	✓
Fully Cured Before Insertion	✓			
Tested Before Dispatch	✓*	✓	✓	✓

* Coils fully tested before dispatch.

"We are extremely happy with the service received throughout the project and the exceptional quality of the coils they produced. We were particularly impressed with HiFLEX™ system that they recommended to us. This is our first experience with Houghton International and we would not hesitate to use them again in the future."

Pedro Farreras

Equipo de Pruebas, Mexico



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