

# Micalastic insulation

## For high voltage hydro generators

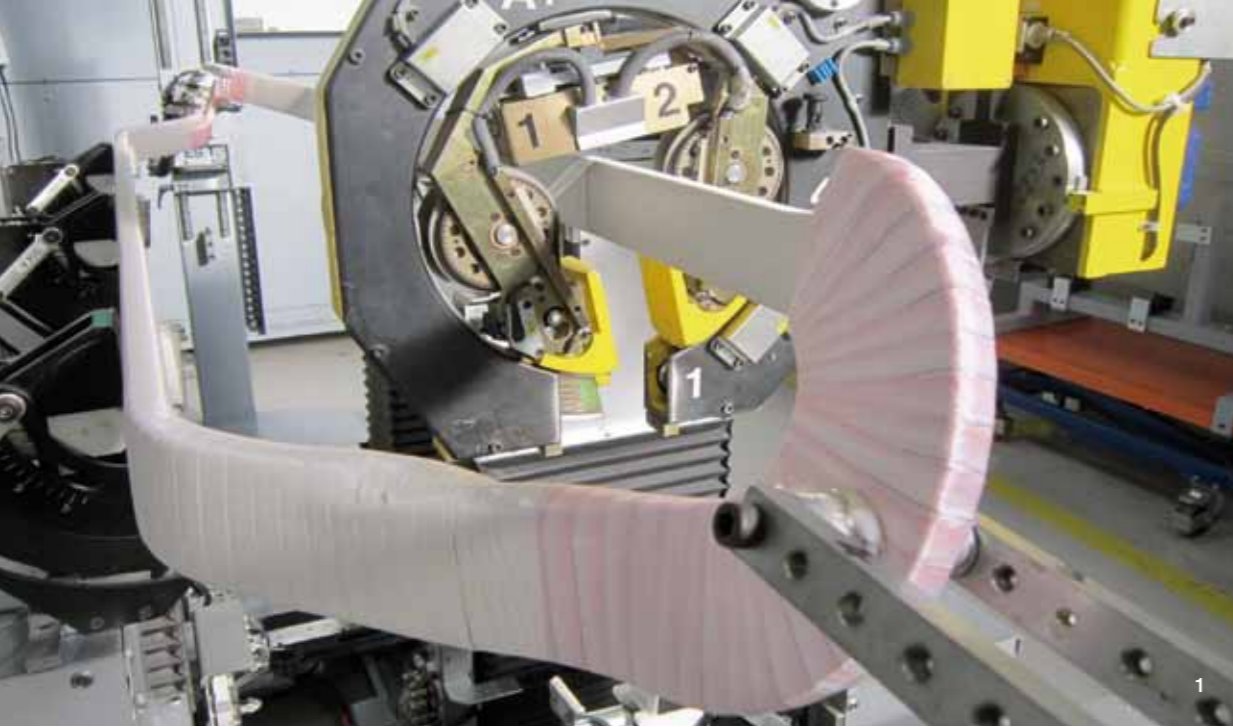
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**VOITH**  
Engineered Reliability







- 1 Six-axis auto taping machine
- 2 Coil forming machine
- 3 VPI Plant

## Micalastic insulation

Voith Hydro is a global leader in hydropower equipment and services for both new and modernization projects. The Canadian Mississauga location has been a market leader in providing generator modernization services within North America having supplied coils for the modernization of over 450 generators located in 340 different generating stations over thirty-five year history of the facility. This represents over one gigawatt of modernization services incorporating coils produced in Mississauga.

Through-out its' history, Voith Hydro in Canada has set new quality and performance standards and by continuously upgrading the engineering and manufacturing resources has consistently delivered best-in-class solutions for the hydro power modernization market. The result is an industry leading reputation for excellence in engineered reliability, world-class solutions and products.

In a globalized world, the generation of sustainable emission-free electricity is more important than ever. Hydro power is well positioned as a major contributor within the renewable energy production. With our long history in hydropower products and services, and excellent processes and tools for engineering and manufacturing, we offer responsive, creative and cost effective solutions in the execution of new or modernization projects.

## Leading-edge in coil manufacturing

Voith Hydro Canada has always pursued a technological leadership approach to the hydro power industry in both its design and manufacturing philosophy.

This is demonstrated by the significant investment in new leading-edge coil manufacturing equipment now installed in Mississauga.

This new equipment consists of an:

- Automated coil forming machine
- Automated electric press of coils
- Six-axis auto-taping machine
- Micalastic vacuum pressure impregnation (VPI) system

One of the key improvements of the winding manufacturing process is the introduction of six-axis controlled taping of coils. The taping machine wraps the fine mica tape with a consistent overlap and tension around the straight section and end-winding portions of the coils, thus ensuring uniform thickness over the full length of the coil. This Insulation process in combination with specialized and sophisticated VPI technology, ensures a void free, high dielectric insulation system.

Benefits of this new coil manufacturing equipment to our customers are:

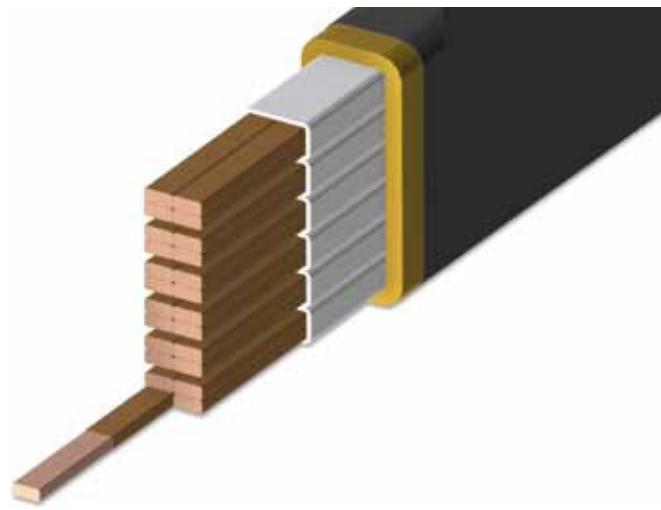
- Best-in-class delivery cycle times driving shorter manufacturing cycles
- 50% less handling of coils in production
- Unprecedented repeatability and reproducibility of coil dimensions

Another key advantage of the new equipment is realized in the design phase for both new and existing generators being modernized. The high precision of the new coil equipment allows the design engineers at Voith Hydro to further optimize the amount of copper in the design which in turn will provide machines that have higher output, efficiencies and lower losses.

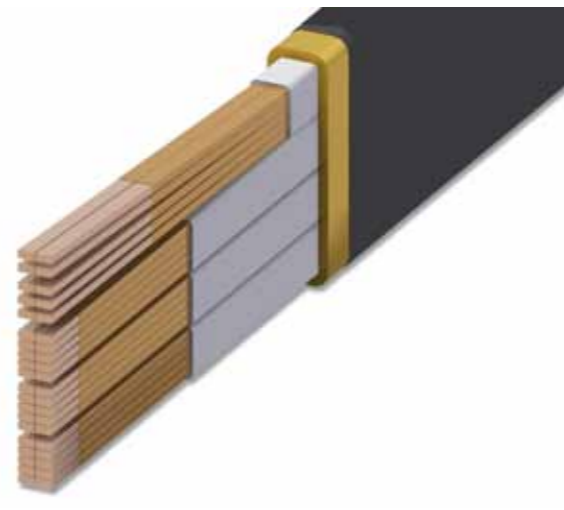
## Micalastic in high-voltage hydro generators

The common characteristics shared by all types of Micalastic insulation are the use of inorganic fine mica tape as a base material, and heat-curing synthetic epoxy resins as a bonding material. This, coupled with state-of-the-art manufacturing techniques provides a high dielectric breakdown strength, long-term resistance to electrical stress, and a low power fac-

tor ( $\tan \delta$ ). The mechanical properties of the tape and resin combination also provide excellent resistance to mechanical and thermal stress. The Micalastic insulation system is based on Vacuum Pressure Impregnation technology and meets Thermal Class 155 (IEC)/Class F (IEEE) standards.



Micalastic insulation: copper wire insulated with mica tape



Micalastic insulation with dedicated turn tape

## Process control

Six sigma tools are used as a standard to monitor the coil manufacturing process and collect data on an ongoing basis. This allows direct comparison of product performance across all location using the standard process. This commitment to

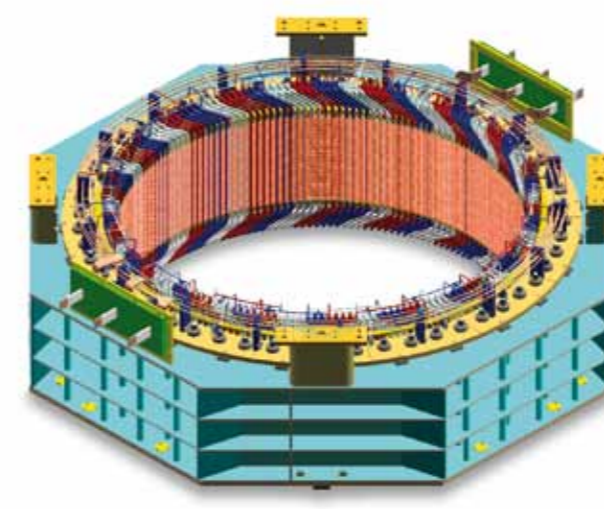
best practice and continuous improvement ensures the products being manufactured in the Voith worldwide network are consistently produced using excellent processes.

## Design

Computerized design tools allow modeling of the performance of the whole generator. Based on extensive test results on completed projects, the calibrated calculation allows the winding performance to be optimized and guaranteed. The range of applicability for multi-turn coil winding is up to 200 MVA and voltages up to 18 kV.

Voith Hydro's approach has always been to provide customers with the best engineered solution for their unique applications. Micalastic offers technological advantages that will benefit customers in many ways:

Leading-edge technology in insulation will ensure continuation of the best engineered insulation systems for customer applications.



Generator frame assembly solid modeling and analysis

## Micalastic insulation system for field assembly

The Micalastic insulation system has been developed for the field assembly of the winding components. A combination of fine mica tape, epoxy resin and a room-temperature curing agent provide good dielectric properties and mechanical resistance.

Components insulated in the field:

- Connection between coils and circuit ring
- Circuit ring
- Jumper between coils
- Connection between coils



## Power Plants with Micalastic Multi-turn coils

### Costa Rica:

Sandillal - 2 units  
17.64 MVA, 13.8 kV, 300 RPM, 50 Hz

### Europe:

Rånåsfoss III  
Akershus Energi  
Norway - 6 units  
14.67 MVA, 13.2 kV, 250 RPM, 50 Hz

### Uluabat

Akenerji Elektrik Ueretim A.S.  
Turkey - 1 unit  
55 MVA, 13.8 kV, 600 RPM, 50 Hz

### Akocak

Akenerji Elektrik Ueretim A.S.  
Turkey - 1 unit  
46 MVA, 13.8 kV, 750 RPM, 50 Hz

### Toeging

Germany - 6 units  
8.5 MVA, 10.5 kV, 214.3 RPM, 50 Hz

### Eitting

Germany - 3 units  
14 MVA, 16.3 kV, 166.7 RPM, 50 Hz

### Vohburg

Germany - 3 units  
12 MVA, 6.6 kV, 90.9 RPM, 50 Hz

### Goesgen

Switzerland - 4 units  
12.5 MVA, 10 kV, 142.9 RPM, 50 Hz

### Tiefencastel

Switzerland - 2 units  
16.1 MVA, 7 kV, 600 RPM, 50 Hz

### Froustul

Norsk Hydro  
Norway - 1 unit  
50 MVA, 11 kV, 240.3 RPM, 50 Hz

### Tevla

Norway - 2 units  
30 MVA, 9 kV, 500 RPM, 50 Hz

### Planatovryssi - Greese

2 units  
68 MVA, 15.75 kV, 200 RPM, 50 Hz

### North America:

Gaston  
Dominion Generation  
Virginia - 1 unit  
55.6 MVA, 14.4 kV, 100 RPM, 60 Hz

Moose River  
Fortis US Energy Corp.  
New York - 1 unit  
13.26 MVA, 13.8 kV, 327.3 RPM, 60 Hz

### Smith Mountain

American Electric Power AEP  
Virginia - 2 units  
212.5 MVA, 13.8 kV, 100 RPM, 60 Hz

### Ohio Falls

Louisville Gas & Electric  
Kentucky - 5 units  
14.68 MVA, 14.0 kV, 100 RPM, 60 Hz

### Corra Linn

FortisBC  
British Columbia - 2 units  
20 MVA, 7.2 kV, 85.7 RPM, 60 Hz

### Spray

TransAlta Generation Partnership, Alberta - 1 unit  
62.2 MVA, 13.8 kV, 450 RPM, 60 Hz

### Bay D'Espoir

Nalcor Energy  
Newfoundland and Labrador - 4 units  
85 MVA, 13.8 kV, 300 RPM, 60 Hz

### Wheeler

TVA  
Alabama - 1 unit  
48.4 MVA, 13.8 kV, 85.7 RPM, 60 Hz

### Wyman

FPL Energy Maine  
Maine - 1 unit  
33 MVA, 13.8 kV, 138.5 RPM, 60 Hz

### Safe Harbor

Safe Harbor Water Power Corp.  
Pennsylvania - 1 unit  
36 MVA, 13.8 kV, 109.1 RPM, 60 Hz

### Des Cedres

Hydro Quebec  
Quebec - 1 unit  
11.0 MVA, 6.6 kV, 52.9 RPM, 60 Hz

### Beauharnois

Hydro Quebec  
Quebec - 2 units  
57.0 MVA, 13.8 kV, 75 RPM, 60 Hz

### Shettisham, US Army Corps of Engineers,

Alaska - 2 units  
34.5 MVA, 13.8 kV, 600 RPM, 60 Hz

### Dardanelle, U S Army Corps of Engineers,

Arkansas - 4 units  
32.63 MVA, 13.8 kV, 75 RPM, 60 Hz

### Pensacola

Grand River Dam Authority  
Oklahoma - 6 units  
19.65 / 22.6 MVA, 13.8 kV, 150 RPM, 60 Hz

### High Falls

Great Lakes Power  
Canada - 2 units  
25.0 MVA, 12.0 kV, 276.9 RPM, 60 Hz

### South Africa:

Steenbras - 4 units  
50 MVA, 12 kV, 600 RPM, 50 Hz

### South America:

Santa Clara  
Brazil - 3 units  
21 MVA, 13.8 kV, 257.1 RPM, 50 Hz

### Rio de Peixe

Brazil - 2 units  
5.5 MVA, 6.6 kV, 720 RPM, 50 Hz

### Antas II

Brazil - 2 units  
7 MVA, 6.6 kV, 720 RPM, 50 Hz

### Pinhal

Brazil - 1 unit  
4 MVA, 6.9 kV, 257.1 RPM, 50 Hz

### Elloy Chaves

Brazil - 1 unit  
11 MVA, 6.9 kV, 360 RPM, 50 Hz

## Power Plants with Micalastic Bars

### Africa:

Gigel Gibe II  
EEPCO Ethiopian Electric Power Corp.  
Ethiopia - 4 units  
125 MVA, 15 kV, 333.3 RPM, 50 Hz

### China:

Ji Lin Tai,  
Ji Lin Tai Co Ltd. - 4 units  
128 MVA, 15.75 kV, 214.3 RPM, 50 Hz

### Three Gorges

China Yangtze Three Gorges  
Develop. Corp. - 6 units  
840.0 MVA, 20 kV, 75 RPM, 50 Hz

### Europe:

Vuzenica  
Dravske Elektrarne Maribor  
Slovenia - 3 units  
26 MVA, 10.5 kV, 125 RPM, 50 Hz

### Wehr

Schluchsee Werr  
Germany - 4 Units  
300 MVA, 21 kV, 600 RPM, 50 Hz

### North America:

Holtwood  
Pennsylvania Power and Light  
USA - 2 units  
74.3 MVA, 15.75 kV, 85.7 RPM, 60 Hz

### Grand Coulee

U S Bureau of Reclamation  
USA - 3 units  
825.6 MVA, 15.0 kV, 85.7 RPM, 60 Hz

### Bath County

Virginia Electric and Power Company  
USA - 6 units  
530 MVA, 20.5 kV, 257.1 RPM, 60 Hz

### La Tuque

Hydro Quebec  
Canada - 3 units  
65 MVA, 13.8 kV, 138.5 RPM, 60 Hz

### Raccon Mountain

Tennessee Valley Authority  
USA - 4 units  
425 MVA, 23 kV, 300 RPM, 60 Hz

### South America:

El Platanal  
Cementos Lima S.A.  
Peru - 2 units  
120 MVA, 13.8 kV, 450 RPM, 60 Hz

### Itaipu 50 Hz

Itaipu Binacional  
Brazil/Paraguai - 6 Units  
823.5 MVA, 18 kV, 90.9 RPM, 50 Hz

### Itaipu 60 Hz

Itaipu Binacional  
Brazil/Paraguai - 5 Units  
737 MVA, 18 kV, 92.3 RPM, 60 Hz

### Irape

CEMIG  
Brazil - 3 units  
140 MVA, 13.8 kV, 300 RPM, 60 Hz

### Peixe Angical

Grupo Rede  
Brazil - 3 units  
175.0 MVA, 13.8 kV, 85.7 RPM, 60 Hz

### Pedra do Cavalo

Votorantim  
Brazil - 3 units  
90 MVA, 13.8 kV, 257.1 RPM, 60 Hz

### Aimores

Cia. Energetica de Minas Gerais  
Brazil - 3 units  
116 MVA, 14.4 kV, 105.9 RPM, 60 Hz

