



ABB Switzerland Ltd

Micafil High Voltage Insulation Components Cast Epoxy Insulators made of Fluvex[®] Cast Resin Systems

Power and productivity
for a better world™



High Voltage Insulation Components

Specific solutions for our customers

Insulators for high voltage switchgear (Gas Insulated Switchgear & Generator Circuit Breakers) have to meet very demanding requirements regarding mechanical, electrical as well as thermal stress. The criteria for selecting insulation components are complex and diverse due to the variety of applications available. Many installations have unique characteristics that require special solutions.

Based on years of experience, we are able to address the specific needs of our customers in order to provide them with optimal insulation solutions. Customer satisfaction is our top priority. Therefore, we establish long-term trusting partnerships with our customers.

Size, shape, insulation properties, etc. – we can provide the solutions for your insulation needs with insulators based on Fluvex® cast resin systems.

From initial testing to series production: our specialists work in close cooperation with you to deliver optimal high voltage insulation solutions.

Outstanding versatility

Micafil can offer a large number of cast epoxy resin systems suitable for almost any electrical insulation specification. Epoxy systems filled with Al_2O_3 enable Gas Insulated Switchgear to withstand corrosive SF_6 decomposition products. In addition, the insulation components are able to meet challenging specifications regarding mechanical stress even at high service temperatures. As an alternative, epoxy systems filled with silica are used in non-corrosive environments, for instance for cable sealing ends. And as a specialty, Micafil's semiconductive epoxy system is applied to create functional field-control electrodes directly casted into the insulation. The manufacturing technology is based on either Vacuum Casting or Automated Pressure Gelation. These process technologies assure:

- net shape casting
- void-free insulation
- excellent adhesion to metallic inserts
- low process-induced mechanical stresses within the components

Therefore, Micafil is in a position to produce insulation components meeting excellent quality standards especially with regards to:

- partial discharge
- gas-tightness
- mechanical burst strength

High Voltage Gas Insolated Switchgear ELK-14/300



High Voltage Insulation Components

Insulation – our area of expertise

A wealth of creative ideas and solid expertise has made Micafil the preferred partner of the electrical industry for more than 90 years. Micafil is unique in its breadth of expertise which extends from bushings to vacuum plants and insulation components. As a result of a very close collaboration with the ABB Corporate Research Centre, Micafil has built up thorough expertise regarding material technology as well as manufacturing processes. Micafil's high-quality insulation components for high voltage applications (up to 1000 kV)



are used as barrier and support insulators in Gas Insulated Switchgear (GIS), in Generator Circuit Breakers (GCB) and in high voltage cable joints and sealing ends. Micafil offers extended support regarding all aspects of material and process technology for cast epoxy resin systems. New product developments of our customers can be accelerated using advanced tools such as Finite Element Analysis (FEM) for mechanical and electrical analysis as well as other simulation tools for the analysis of the curing behavior of the epoxy system.

Gas Insulated Switchgear (GIS)

Micafil combines its extensive knowledge regarding material technology with advanced process engineering skills to produce GIS insulators with outstanding mechanical and electrical properties for voltage levels up to 1000 kV.

Generator Circuit Breakers (GCB)

Micafil's insulators for power generation plants with outputs up to 1000 MW meet maximum security standards and have a long reliable service life of about 30 years. The insulators are designed for short-circuit currents up to 2500 kA and for creep strength at high temperatures.

Cable accessories

Based on customer-specific designs, Micafil produces and supplies insulators for cable accessories to several major high voltage cable manufacturers.

High Voltage Insulation Components

Advanced production facilities

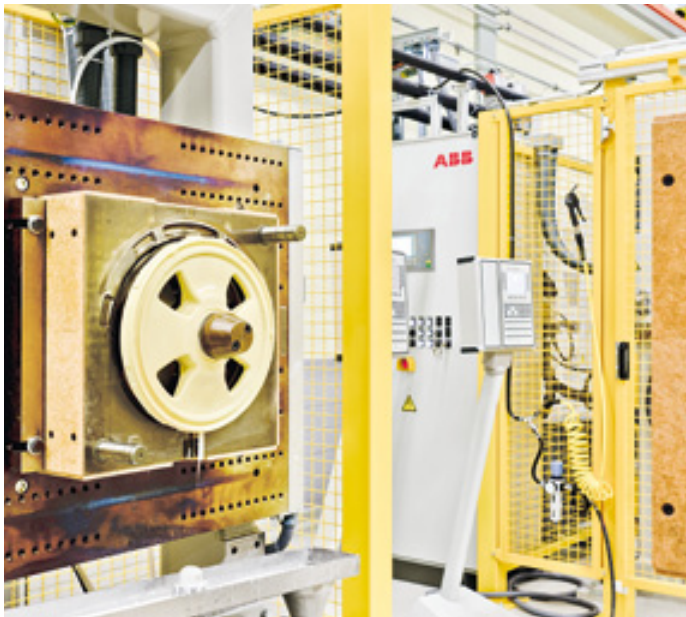


Vacuum Casting Process (VCP)

The resin is premixed in batch mixers and finally mixed in a static mixer. The resin passes directly from the static mixer through the casting valve into an aluminum or steel mold placed inside the vacuumized casting chamber.

After the casting process, the molds are transferred into a separate gelling oven where the first part of the crosslinking reaction takes place.

Afterwards, the insulator is demolded and then cured in a hardening oven for several hours.



Automatic Pressure Gelation (APG)

The APG process permits short cycle times thanks to rapid gelation and demolding with automatic opening and closing of a steel mold. This results in a reduction of process steps and hence time and costs.

One central mixing and metering system can serve several clamping machines. Each clamping machine has its own static mixer and also has its own shrinkage compensation unit to maintain the pressure.

After preparing and mixing in batch mixers, the degassed cast resin compound is injected under pressure from below into the APG mold that is fixed on a clamping unit.

During the gelling process, fresh material is supplied continuously to the mold under pressure in order to prevent cracks and voids and to compensate for the shrinkage of the material.

Afterwards, the insulator is demolded and then cured in a hardening oven for several hours.

High Voltage Insulation Components

No compromise in quality



In order to ensure a high and consistent quality level, the inserts are prepared shortly before using them in the casting process.

Washing and sandblasting

The surface of the inserts must be free of contamination (like grease, dust, etc.). To get an optimal result during adhesion, washing is performed before and after sandblasting.

A combined inversion/ultrasonic cleaning step, followed by a vapor phase cleaning step in a completely closed process, ensures that the inserts are as clean as possible.

Sandblasting enlarges and activates the surface of the inserts remarkably. This results in optimum adhesion between insert and resin. In addition, sandblasted surfaces are more error tolerant than when using other surface-activation methods and up to today yield the best properties.

Quality

Quality assurance on a high level is one of Micafil's driving forces.

The Quality Assurance department has all the means as well as skilled personnel to perform critical material and component tests to guarantee the mechanical, electrical and physical parameters specified for the respective product.

All raw materials as well as the finished products are subject to thorough inspections.



FLUVEX® Cast Resin Systems

For medium and high voltage engineered solutions/products

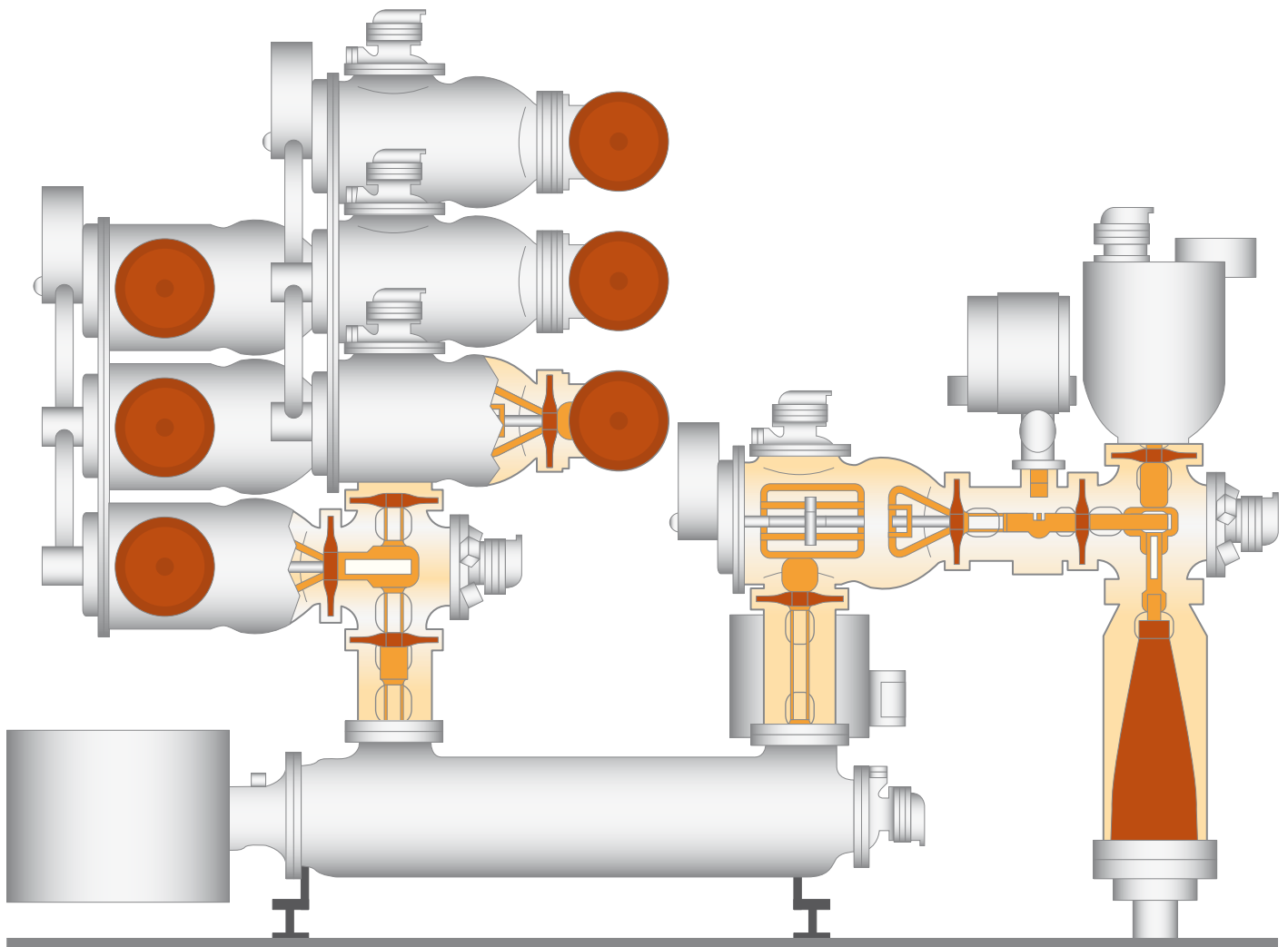
General purpose

FLUVEX® cast epoxy resins are specifically developed casting systems for electrical applications. A number of different standard formulations meet the high demands on epoxy castings. In addition to the standard systems, Micafil's engineering department is well prepared to offer you customized systems. With our long experience in epoxy resin applications we can guarantee our customers the best possible solution for their epoxy castings. Up-to-date laboratories and testing equipment as well as strict quality control procedures throughout manufacturing, from the raw material to the finished component, guarantee the constant quality and security of our products.

Applications

FLUVEX® cast resin components have been giving excellent service in a wide variety of electrical systems up to a rating of 1000 kV for many years. FLUVEX® cast resins, such as for spacers, bushings or cable end terminations, are widely used in medium and high voltage Gas Insulated Switchgear all over the world. In the field of cable accessories, many FLUVEX® cast resin components are utilized. Micafil's expertise in epoxy castings ensures components free of voids and partial discharges.

Insulator applications in Gas Insulated Switchgear



Technical Data

Properties	Standards	Units	Fluvex® 1402	Fluvex® 1441	Fluvex® 1443	Fluvex® 1444	Fluvex® 1447	Fluvex® 1448	Fluvex® 1450	Fluvex® 1451	Fluvex® 1462	Fluvex® 1463
Color (natural)	approx. RAL 70 13 ¹ approx. RAL 10 14 ¹		ivory ²	ivory ²	black	brown- grey ¹	brown- grey ¹	brown- grey ¹	grey	ivory ²	brown- grey ¹	ivory- yellow
Density	ISO 1183/ DIN 53479	g/cm ³	2.1	2.1	1.7	1.8	1.8	1.8	2.3	2.0	1.9	2.1
Filler			Al ₂ O ₃	Al ₂ O ₃	SiO ₂ carbon black	SiO ₂	SiO ₂	SiO ₂	SiO ₂	Al ₂ O ₃	SiO ₂	Al ₂ O ₃
Tensile strength	DIN EN ISO 527	MPa	70	45	> 40	75	65	70	65	70	70	70
Flexural strength	DIN EN ISO 178	MPa	140	60	–	110	100	110	110	120	110	(130)
Flexural modulus of elasticity	DIN EN ISO 178	GPa	8	8	8	11	8.5	8	–	8	8	8
Charpy impact strength	DIN EN ISO 179	kJ/m ²	2.2	1.6	–	1.4	1.7	1.7	1.5	–	1.8	2.2
Glass transition temperature	IEC 1006	°C	120	120	150	155	150	120	130	145	120	125
Coefficient of thermal expansion (CTE)	DIN 52328	10 ⁻⁶ /K	35	35	38–40	35	38	35	–	35	–	35
Relative permittivity ε_r 50 Hz	IEC 250/53483		6.5	5.5	–	3.2	4.0	3.2	5.5	6.0	3.5	5.7
Dissipation factor tan δ 350 Hz	IEC 250/53483	%	1	1	–	0.5	3.5	0.6	2.8	<1	<1	<1
Volume resistivity	IEC 93	Ω cm	10 ¹⁵	10 ¹⁵	4 x 10 ³	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵
Surface resistivity		Ω	10 ¹⁵	10 ¹⁵	–	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵	10 ¹⁵
Comparative tracking index CTI (solution A)	DIN IEC 112	CTI	600	600	–	600	600	600	600	600	600	600
Fluvex® resin systems	1402		Solid resin: Bisphenol-A-based epoxy resin Solid hardener: Phthalic acid anhydride hardener									
	1441, 1442, 1443, 1444, 1447, 1448, 1451, 1462		Liquid resin: Bisphenol-A-based epoxy resin Liquid hardener: Carbonic acid anhydride hardener									
	1450		Liquid resin: Cycloaliphatic epoxy resin Liquid hardener: Anhydride hardener									

Contact us

Micafil cast epoxy insulators combine best-in-class quality with superior production know-how using state-of-the-art Vacuum Casting and Automated Pressure Gelation.

We serve numerous world-class suppliers of high voltage apparatus such as:

- Gas Insulated Switchgear (GIS)
- Generator Circuit Breakers (GCB)
- Cable Joints and Sealing Ends

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