MICAFIL dry bushings combine functionality, high performance and long service life.

The optimized solutions are based on our long-term, trustworthy partnerships with customers and our understanding of their needs.
Today’s technology for tomorrow
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OilRIP bushings in detail
Current conductor selection
General information
OilRIP bushings 72.5 – 170 kV
Types with cable bolt for draw lead
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Types with fixed conductor
OilRIP bushings 245 – 550 kV
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Leading in bushing technology
Customer values and advantages
Enquiry form
Today’s technology for tomorrow

MICAFIL OilRIP transformer bushings are the product of a sophisticated design process using a minimal number of components: a fine-graded insulating core, main flange and current conductor. They are produced in a wide variety of designs that can easily fulfill all customer requirements and are easy to install and highly reliable.

OilRIP stands for quality and versatility

High voltage bushings must meet the highest standards of operational safety and minimize risk for people and property. Growing environmental awareness and regulation requires low-impact production and clean operation.

The MICAFIL OilRIP series meets these requirements thanks to high quality materials and reliable processing techniques. ABB maintains high technical standards and regularly reviews development and manufacturing processes. We ensure high product quality through comprehensive testing in our electrical testing laboratory.

Advantages of MICAFIL bushings

- Partial discharge-free up to double phase to ground voltage.
- High temperature resistance (class E, 120°C).
- Low dielectric losses (tan δ ≤ 0.40 %).
- High flexural strength – ‘heavy load’ according to IEC 60137 (2017).
- These are completely dry bushings, meaning that there is no risk of oil leakage or explosion.
- No maintenance or constant monitoring necessary.
- Transport and storage is possible in all positions.
- Flexible design allows adaptation to different customer needs and transformer requirements.
- Easy and safe installation.
- Proven reliability.

OilRIP overview

<table>
<thead>
<tr>
<th>Bushing designation</th>
<th>Um (kV)</th>
<th>Max. SIL (kV)</th>
<th>SIL</th>
<th>Conductor type</th>
<th>Ir (A)</th>
<th>Symbol</th>
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</table>
Insulating core

The heart of the OilRIP bushing is its RIP insulated condenser core that has capacitor inlays for electric field control. The production of RIP is based on time-tested and proven technology. Complex production processes compress the material into a compact, liquid- and gas-tight insulating core. Their high quality allows for the delivery of partial discharge free bushings up to double service voltage. To accommodate current transformers, the lower core part can be extended in steps of 100 mm up to 600 mm. The insulation length in the oil side is consistent with our proven and balanced dimensioning, and optimizes the strength of the interface between the insulating core and transformer oil. These dimensions also guarantee a high level of interchangeability with older bushing types.

Flange

The new flange has an optimized design to withstand high load and ensure mechanical robustness. With a multiple O-ring system, the transition between core and flange is oil- and gas-tight. The aluminum alloy used for this purpose is corrosion-resistant and mechanically robust. This ensures safe handling of bending moments during operation and in bending test loads. The whole series is type-tested in an accredited independent lab in accordance with the highest bending load class of IEC 60137 (2017).

Standard flanges meet the most commonly used dimensions; however, dimensions modifications can be implemented. On request, it is possible to select a double plate flange. In fact, the OilRIP bushings are designed in order to ensure perfect interchangeability of single plate and double plate flanges in the same compact dimensions. The flange is equipped with a test tap and has a de-aerating screw. The flange is mounted with an identification tag, MI2 connection thread for flange earthing and, on larger bushings, eyebolts for lifting purposes.

Transformer oil side end

ABB’s design allows the installation of bushings without shield electrodes for cable and rod conductor applications up to 170kV. Shield electrodes can be ordered as an option. In all other cases, a removable shield is provided which can be easily and safely installed by a bayonet locking system. ABB’s shield electrodes are designed using the most advanced methods and technologies.

Cable side oil terminal and clamping system

The OilRIP bushings are designed for easy and safe installation. The ABB MICAFIL clamping system is well proven to remove the cable bolt or the rod by simple operations. It is also possible to position the cable bolt or the solid rod conductors within +/-10mm from the nominal dimensions. The terminal is a round blank full material copper piece that can be part of a cable bolt, a rod or a fixed conductor. The fixing devices also mean that there is no displacement or rotation of the terminal and conductor during installation and operation. The cable side connection is shielded by a removable shield, which is installed by a bayonet locking system. Variances in lateral access are possible on request. In this case, a customized safe and easy solution is provided in accordance to the ABB MICAFIL highest standard of quality.
ABB offers 3 types of conductors optimized for the selected current rating.

**Current conductor selection**

Cable bolt for draw lead

The current is led through a multi-stranded flexible conductor that is joined to the terminal of the winding. The lead is drawn up through the central tube of the bushing and the top connector (cable bolt) is fastened to the bushing clamp. In the standard model, the cable side terminal is a round, blank copper bolt. To avoid unnecessary contact junctions, the draw lead bolt is of a single-piece design. A tried-and-tested fixing device with few parts ensures that no inadvertent displacement in axial direction or twisting is possible. Transformer manufacturers must provide the conductor cable with a thin insulation in order to keep transient voltages to the central bushing tube. The use of high temperature insulation allows for the increase of maximum operating current.

**Recommended maximum drilling depth and hole diameter for a standard cable bolt (draw lead application).**

<table>
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<tr>
<th>Tube diameter ( d_3 ) [mm]</th>
<th>Max. hole diameter ( A ) [mm]</th>
<th>Cable bolt diameter ( B ) [mm]</th>
<th>Max. drilling depth ( C ) [mm]</th>
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<tr>
<td>80</td>
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<td>75</td>
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</table>

**Recommended option**

- Hole for deaeration
- \( C = T-20 \) mm
- \( T = \) Length of cable bolt diameter

Removable solid rod conductor

In order to achieve higher operating currents, the bushings with a central tube are equipped with an additional removable solid rod conductor. This type allows for the use of a single piece conductor without contact junctions which guarantees high current rating and excellent thermal performance. The oil gap is designed to keep the RIP core at a safe temperature, as proven by tests. Conductor installation and de-aeration of the central tube are similar in both versions either with solid rod conductor or with a cable bolt conductor.

Overload

If overload capacity is required for the transformer, according to IEC 60076-7 (normal load cycles), the rated current of the bushing should be chosen with at least 120% of the transformer-rated current in accordance with IEC 60137 (2017). Alternatively it is possible to withstand overload by improving cable insulation for draw lead. The present design allows safe temperature of the RIP even at higher current, by selecting aramid paper insulation with the support of ABB expertise.
General information

Each OilRIP bushing meets all requirements of IEC 60137 (2017) and the electrical values under IEEE C57.19.01 (2000). The Draw lead has also been type-tested accordingly to the IEEE draw lead bushing cap pressure test (C57.19.01-2000 7.2.21).

Recommended installation
Our bushings are designed and tested for mineral oil applications. The field strengths in oil on the lower part of the bushing depend on the shape of the surrounding parts, as well as on the quality and condition of the transformer oil. A guideline, the following table shows the clearance distances (A) to grounded transformer parts under standard conditions.

Recommended distances A from earthed parts (e.g. transformer wall).

<table>
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<th>kV</th>
<th>AC test voltage [kV]</th>
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<tr>
<td>550</td>
<td>750</td>
<td>550</td>
<td>550</td>
</tr>
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</table>

They are valid for the oil side ends (standard and variants) as per the data tables. Due to limiting conditions, additional insulating measures or larger distances may be necessary. uninsulated edges around the bushing should be rounded to Rmin = 5 mm.

The diameter of the current conductor should be at least half of the inner tube diameter d3. Oil access in the central bushing opening and in the open space of the shield electrodes must not be obstructed.

As an option, ABB MICAFIL provides transition connectors for continuous voltage measurements. This is highly recommended in oil-oil applications to allow measurements in safe conditions from external turret wall.

Routine and type tests
The standard routine tests are carried out in accordance with IEC 60137 (2017) with all the protocols supplied. Tests carried out according to other standards are available upon request.

The type tests were performed on representative bushings in accordance with current standards IEC 60137 (2017) and IEEE C57.19.00 (2004) / C57.19.01 (2000). These tests cover the entire OilRIP portfolio and were successfully passed in an accredited independent lab. Bushings always fulfill MICAFIL high quality standards, which are stricter than IEC and IEEE. Protocols can be supplied to customers on request.

Packaging and storage
The bushings are packed and sent in a dry and clean state. On request, we offer long-time orientation that liquid-filled or liquid-insulated bushings have.

Test tap
Each bushing is equipped with a standard test tap. The test tap is connected to the outermost capacitor foil and is always grounded during operation. For measurement, the cap must be unscrewed and the supplied 10/4 mm plug coupling must be inserted.
OilRIP bushings 72.5 – 170 kV
Types with cable bolt for draw lead
OilRIP bushings 72.5 – 170 kV
Types with removable solid rod conductor
## OilRIP bushings 123 – 170 kV

### Types with fixed conductor

**Fig. 3**

**Fig. 10**

**Fig. 15**

**Fig. 16**

**Fig. 20**

**Fig. 21**

**Fig. 35**

**Fig. 40**

**Fig. 45**

### IEEE C57.19.01 (2000)

<table>
<thead>
<tr>
<th>Type and drawings</th>
<th>Electronic data</th>
<th>Current</th>
<th>Transformer side</th>
<th>Cable side</th>
<th>Flange</th>
<th>Transformer side terminal</th>
<th>Cable side terminal</th>
<th>Transformer side end</th>
<th>Cable side end</th>
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<td>153 512</td>
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<td>1020 156 90 195 260 12 12</td>
<td>12</td>
<td>65 51</td>
<td>50 125</td>
<td>25 35 38</td>
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<td>12</td>
<td>65 51</td>
<td>50 125</td>
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<tr>
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<td>598</td>
<td>153 512</td>
<td>173 100 74 510 100 71 120</td>
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<td>12</td>
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<td>25 35 38</td>
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**IEC 60137 (2017)**
### OilRIP bushings 245 – 550 kV

Types with cable bolt for draw lead

#### Table: OilRIP bushings 245 – 550 kV

| Type code/series | Length (max.) | Hole diameter | Terminal diameter ø | Hole depth | Terminal Length | Terminal: distance from the flange plate (tolerance ± 5 mm) | Cable bolt: distance from the flange plate | Flange area: min. diameter | Flange designation | Core diameter | Flange: height (max.) | Cable side terminal Transformer side end | Tapered side end Transformer side end | Var.1 | Var.2 |
|------------------|--------------|---------------|---------------------|------------|----------------|------------------------------------------------------------|------------------------------------------|-------------------------------|-----------------|----------------|----------------------------------------|----------------------------------------|---------|-------|
| 20L6             | 560          | Ø140          | 15°                  | 45°        | 1200           | 1210 ± 5 mm                                                | 1200 ± 5 mm                              | 270              | 350            | 200                      | 1600 ± 5 mm                                    | 1210 ± 5 mm                              | 200     | 1210  |

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*Var.1: High temperature for cable side only.
OilRIP bushings 245 – 550 kV
Types with removable solid rod conductor
### OilRIP bushings 245 – 550 kV
Types with fixed conductor

#### Types with fixed conductor

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<th>ELECTRICAL DATA</th>
<th>MECHANICAL DATA</th>
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<th>CABLE SIDE TERMINAL</th>
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<td></td>
<td>Rated voltage $U_{m}$</td>
<td>AC test voltage dry</td>
<td>Lightning impulse voltage, $1.2/50\mu s$</td>
<td>Switching impulse voltage</td>
<td>Maximum Current $I_{r}$ (in dependence of $L_6$)</td>
<td>Thermal short-time current $I_{t,h}$, 2 sec.</td>
<td>Current Mechanical</td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(kV)</td>
<td>(kV)</td>
<td>(kV)</td>
<td>(kV)</td>
<td>(kA)</td>
<td>(kA)</td>
<td>(N)</td>
<td>(kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OilRIP bushings 245-1050/4000 F</td>
<td>230</td>
<td>100</td>
<td>44</td>
<td>211</td>
<td>600</td>
<td>1190</td>
<td>334</td>
<td>51</td>
<td>60</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>OilRIP bushings 245-1050/4000 F</td>
<td>290</td>
<td>100</td>
<td>46</td>
<td>211</td>
<td>600</td>
<td>1190</td>
<td>334</td>
<td>51</td>
<td>40</td>
<td>125</td>
<td></td>
</tr>
</tbody>
</table>


- **Fig. 12**: [Image](#)
- **Fig. 13**: [Image](#)
- **Fig. 14**: [Image](#)
- **Fig. 15**: [Image](#)
- **Fig. 16**: [Image](#)
- **Fig. 17**: [Image](#)
- **Fig. 18**: [Image](#)
- **Fig. 19**: [Image](#)
- **Fig. 20**: [Image](#)
- **Fig. 21**: [Image](#)
- **Fig. 22**: [Image](#)
- **Fig. 23**: [Image](#)
- **Fig. 24**: [Image](#)

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**Types with fixed conductor**

- **Rated voltage $U_{m}$**: 245 – 550 kV
- **AC test voltage dry**: 115 ± 6.5% $U_{m}$
- **Lightning impulse voltage, $1.2/50\mu s$**: 440 ± 10% $U_{m}$
- **Switching impulse voltage**: 65 ± 13% $U_{m}$
- **Maximum Current $I_{r}$ (in dependence of $L_6$)**: 60 – 125 kA


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ABB offers an extensive range of high-quality products. They can be adapted to different transformer and plant designs and thus meet the requirements of a wide variety of applications. We specialize in tailor-made solutions, including custom designs and small series production.

Our range of products encompasses bushings for oil-air, oil-SF\(_6\), oil-oil transformer systems, and air-SF\(_6\) bushings for GIS. If you would like any more information, please contact us – we can address your individual needs in a highly professional, flexible, and efficient manner. Our bushings are developed and approved for mineral oil applications. Bushings for other oils are available on request.

### RIP Transformer bushings, oil-air
**Series:** AirRIP / RTKF KSI
- Silicone composite insulator available with straight or helical sheds
- Voltage range: from 24 to 550 kV
- Current range: up to 5,000 A

**Series:** AirRIP / RTKF
- Porcelain insulator
- Voltage range: from 24 to 550 kV
- Current range: up to 5000 A

**Series:** SeismicRIP® / RTKF KSI
- Silicone composite insulator
- Voltage range: from 69 to 550 kV
- Current range: up to 5,000 A
- High seismic performance level

**Series:** HI/RTXF high-current RTXF
- Porcelain insulator
- Voltage range: up to 36 kV
- Current range: up to 40,000 A

### RIP Transformer bushings, oil-SF\(_6\)
**Series:** GARIP / RTKG
- Voltage range: from 36 to 550 kV
- Current range: up to 4,000 A

### RIP Wall bushings
**Series:** RMF / RTAK
**Series:** RMI indoor-indoor
**Series:** RMF outdoor-indoor
**Series:** RMFF outdoor-outdoor
- Porcelain or silicone composite insulator
- Voltage range: from 245 to 300 kV
- Current range: up to 5,000 A

### RIP Railway bushings
**Series:** RMF / RTAK
- Voltage range: from 15 to 36 kV
- Current range: up to 2,000 A

### RIP air-SF\(_6\) bushings for GIS
**Series:** RAKF
- Porcelain or silicone composite insulator
- Voltage range: from 245 to 550 kV
- Current range: up to 4,000 A

### RIS Transformer bushings, oil-air
**Series:** EasyDry / DMB-DA
- Silicone composite insulator with straight sheds
- Voltage range: from 24 to 170 kV
- Current range: up to 2500 A

### Leading in bushing technology

32 33
Customer values and advantages

- More compact design with even higher performance.
- Fully type tested product portfolio according to IEC 60137 (2017) and IEEE C57.19.01 (2000) standards in an accredited and independent test laboratory.
- Partial discharge-free up to double phase to ground voltage.
- Low dielectric losses (tan δ ≤ 0.40 %).
- Interchangeability: The availability of both the single and double flange allows for the bushing dimension to remain the same.
- Remote measuring tap for single flange is available as an option.
- Easy and safe installation due to the new clamping system.
- Safer testing with a bayonet shield, optimized for different test configurations.
- Flexibility in design allows easy customization upon request.
- Detailed simulation and analyses prove the reliability of the product.
- All MICAFIL bushings are maintenance free.
- 100 years of experience in developing and worldwide marketing of high voltage bushings.
ABB MICAFIL combine functionality, high performance and long service life. The optimized solutions are based on our long-term, trustworthy partnerships with customers and our understanding of their needs. With proven components and a variety of designs, our new OilRIP series meets customer-specific requirements. To date, our factory in Zurich Altstetten has delivered more than 600,000 bushings. The world’s leading transformer manufacturers and electric power utilities rely on us. With the new MICAFIL OilRIP series, we will continue to live up to our reputation.

Enquiry form
Our order confirmation includes drawings of the bushing and a detailed bushing data sheet.

Custom modifications
On request, ABB MICAFIL can make custom modifications to various such as flange dimensions, terminal variants, and other lower part lengths. We are happy to provide information on feasibility, price and delivery time of each custom modification.

ABB Switzerland Ltd
Insulation and Components
MICAFIL Bushings, Badenerstrasse 780, CH-8048 Zurich, Switzerland
abb.com/transformercomponents

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Current conductor
- Cable bolt for draw lead
- Fixed conductor
- Solid module conductor

Type:
- IEC Standard
- ANSI Standard

Voltage:
- 72.5 kV
- 123 kV
- 145 kV
- 170 kV
- 245 kV
- 362 kV
- 420 kV
- 550 kV

Current:
- 800 A
- 1,250 A
- 1,600 A
- 2,000 A
- 2,500 A
- 3,150 A
- 4,000 A
- 5,000 A

Company name

Name / First name

Phone

Email

End customer name

Project name

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ABB Switzerland Ltd
Insulation and Components, MICAFIL Bushings, Badenerstrasse 780, CH-8048 Zurich, Switzerland
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