We Enable Energy

As one of the oldest industrial companies in Switzerland, founded in 1803, we focus on products and systems for power generation, transmission and distribution, rotating machines and mechanical engineering. Von Roll is the global market leader for insulation products and the only company to offer the complete range of insulation products, composites, process equipment, tests and services for the electro-technical industry.

For more than 100 years, we have been making outstanding contributions to this market, developing a number of highly innovative products that have enabled both steady increases in power output and smaller and more compact machines.

Customers enjoy the following benefits:
- One single source for all insulating materials
- Thorough expertise from power generation and transmission to its efficient use
- Proven compatibility for system components
- Testing at Von Roll of both materials and systems
- Consulting in application engineering
- Training in insulation materials and systems

Fires can occur anywhere, but their effects can be particularly hazardous wherever large numbers of people are gathered together and in environments where there is a particularly high fire risk. In case of fire, vital information and functions need to be maintained, and power and signal cables must be adequately protected for a predefined period of time. Fire-resistant cables are used in:
- Offshore oil rigs and onshore oil plants, petrochemical installations
- Transport: e.g. ships, railways, subways, aircrafts
- Buildings and public places: e.g. skyscrapers, airports, hospitals
- Power stations, nuclear plants, industrial plants
- Telecommunication centers
- Tunnels, mines
- Military facilities, marine

By developing and producing state-of-the-art Cablosam® tapes for the manufacture of fire-resistant cables, Von Roll is making an important contribution to disaster prevention. Our Cablosam® mica products have a worldwide reputation and have been specifically developed for use with our customer’s taping technologies, while complying with the most stringent international standards.
Legislation and Standards

Legislation governing safety cables is extensive. Norms follow regional, national and international standards for different levels of protection and cable design. Some of the most important European standards have worldwide significance:

<table>
<thead>
<tr>
<th>Flame-Retardant</th>
<th>These cables ensure that flames extinguish by themselves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire-Retardant</td>
<td>Fire-Retardant These cables ensure that there is no fire propagation, but do not assure circuit integrity</td>
</tr>
<tr>
<td>Fire-Resistance</td>
<td>These cables must guarantee circuit integrity during specified fire conditions Cablosam® is a major contribution to this type of cable</td>
</tr>
<tr>
<td>Smoke Emission</td>
<td>Regulations concerning smoke levels</td>
</tr>
<tr>
<td>Emission of Corrosive and Toxic Gases</td>
<td>Regulations concerning the chemistry and emission of toxic gases</td>
</tr>
</tbody>
</table>

**IEC 60331 Fire Test – International Standard**

This norm provides for different fire tests; they all relate to IEC 60331, which determines tests for electrical cables under fire conditions (circuit integrity):

- **IEC 60331 – 1**: Relates to fire with shock at 830°C, diam. >20mm, 0.6/1.0kV
- **IEC 60331 – 2**: Relates to fire with shock at 830°C, diam. <20mm, 0.6/1.0kV
- **IEC 60331 – 11**: Relates to fire alone and a flame temperature of 750°C
- **IEC 60331 – 21**: Relates to cables up to and including 0.6kV/1.0kV
- **IEC 60331 – 23**: Relates to data transmission cables
- **IEC 60331 – 25**: Relates to optical fiber cables

Note that norm NEK 606 – the Norwegian industry standard for the offshore oil and gas, ship and marine industries – uses IEC fire norm 60331.

**BS 6387 / BS 8434 / EN 50200 – British and European Fire-Resistant Standards**

These standards define the performance of electric cables when subjected to fire conditions, including fire with water spray and fire with mechanical shock. The latest standards in this area are the BS 8434 standard, which is similar to the EN 50200 standard.
Cablosam® Tapes for Fire-Resistant Cables

<table>
<thead>
<tr>
<th>Standard</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS 6387 Cat. C</td>
<td>950°C for 3 hours</td>
</tr>
<tr>
<td>BS 6387 Cat. W</td>
<td>650°C for 15 minutes then 650°C with water for a further 15 minutes</td>
</tr>
<tr>
<td>BS 6387 Cat. Z</td>
<td>950°C for 15 minutes then 950°C with mechanical shock for a further 15 minutes</td>
</tr>
<tr>
<td>EN 50200 PH 30</td>
<td>830°C for 15 minutes for the fire and impact phase, and an additional 15 minutes for the fire, impact and water phase</td>
</tr>
<tr>
<td>EN 50200 PH 120</td>
<td>930°C for 60 minutes for the fire and impact phase, and an additional 60 minutes for the fire, impact and water phase</td>
</tr>
</tbody>
</table>

The EN 50200 standard incorporates mostly national standards.

**DIN 4102 part 12 functionality of electric cable systems – German standard**

DIN 4102 part 12 tests cables in conjunction with cable trays and clamp used in real-life situations. The specimens are mounted in the test chamber and supported by the structures provided for this purpose or fastened to the ceiling or wall in order to simulate real-life applications. The temperatures may be as high as 1050°C; the test voltage is 400V for power cables and 110V for communication cables. The test applies the following classifications, subject to the measured duration of circuit integrity (no short circuit and no interruption of current):

- E 30 > 30 minutes
- E 60 > 60 minutes
- E 90 > 90 minutes

**Australian standard**

The above represent some of the standards that are applied to fire-resistant cables. Other countries have even more stringent requirements, among the most difficult being the Australian standard. This requires 120 minutes at 1030°C followed by a mechanical test and a water spray. Circuit integrity is to be maintained at all times.

**Manufacturing processes**

Our cross-wound spools provide the following benefits to our customers:

- Zero scrap
- Lower machine downtime
The Cablosam® Product Range

The Cablosam® product range consists of mica tapes that enable cable manufacturers to meet the most demanding standards.

» Cablosam® tapes comprise Samica® mica paper, a support of glass fabric or polyethylene film and silicone resin.

» Cablosam® tapes are free from halogens and do not create hazardous fumes.

» Cablosam® tapes withstand mechanical pressure at high temperatures.

» Cablosam® tapes provide a reliable flame barrier within the survival cables.

Two types of Samica® paper, with muscovite or phlogopite mica, are used for Cablosam® tapes. This alumino silicate mineral retains its laminar structure up to its melting point of 1200 to 1300°C, thus ensuring that the tapes have outstanding fire-resistant properties.

When exposed to fire, Cablosam® tapes sinter to each other and to the copper conductor, forming a mechanically resistant and electrically insulating layer. This layer is then responsible for maintaining electrical integrity during a fire.

Cablosam® HP

Cablosam® “high-performance” fire-resistant tapes are used to meet the most demanding standards as well as to satisfy the highest requirements during the cable manufacturing process (taping).

Our glass-backed special muscovite mica Cablosam® 366.21-10 is extremely soft, due to the special manufacturing process of the mica paper and the appropriate formulation of the silicone resin. It exhibits a dry surface which is slightly sticky and available in tape widths from 4mm and joint-free.

Cablosam® AP, Cablosam® N and Cablosam® G

Fire-resistant tapes Cablosam® AP, Cablosam® N and Cablosam® G also meet all international standards. They offer a cost-effective solution for standard fire-resistant cables that are subject to mass-volume production. They exhibit a dry, non-tacky surface and are available in tape widths from 6mm upwards. AP quality has the additional joint-free feature.
This table shows an overview of the Cablosam® product range:

<table>
<thead>
<tr>
<th>Product</th>
<th>Total weight (g/m²)</th>
<th>Thickness (mm)</th>
<th>Mica paper (g/m²)</th>
<th>Support (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cablosam® HP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cablosam® HP 366.21-10</td>
<td>130 ± 11</td>
<td>0.12 ± 0.02</td>
<td>Special muscovite (75)</td>
<td>Glass fabric (23)</td>
</tr>
<tr>
<td>Cablosam® AP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cablosam® AP MG90</td>
<td>120 ± 10</td>
<td>0.09 ± 0.02</td>
<td>Muscovite (80)</td>
<td>Glass fabric (23)</td>
</tr>
<tr>
<td>Cablosam® AP PG90</td>
<td>120 ± 10</td>
<td>0.09 ± 0.02</td>
<td>Phlogopite (80)</td>
<td>Glass fabric (23)</td>
</tr>
<tr>
<td>Cablosam® AP PG110</td>
<td>161 ± 12</td>
<td>0.11 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (23)</td>
</tr>
<tr>
<td>Cablosam® AP PG130</td>
<td>170 ± 13</td>
<td>0.13 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cablosam® N PG95</td>
<td>127 ± 11</td>
<td>0.095 ± 0.02</td>
<td>Phlogopite (80)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® N PG100</td>
<td>129 ± 11</td>
<td>0.10 ± 0.02</td>
<td>Phlogopite (80)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® N PG120</td>
<td>172 ± 14</td>
<td>0.12 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® N PG125</td>
<td>175 ± 14</td>
<td>0.125 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cablosam® G PG80</td>
<td>109 ± 11</td>
<td>0.08 ± 0.02</td>
<td>Phlogopite (65)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G PG95</td>
<td>127 ± 11</td>
<td>0.095 ± 0.02</td>
<td>Phlogopite (80)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G PG100</td>
<td>129 ± 11</td>
<td>0.10 ± 0.02</td>
<td>Phlogopite (80)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G PG105</td>
<td>149 ± 12</td>
<td>0.105 ± 0.02</td>
<td>Phlogopite (100)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G PG120</td>
<td>172 ± 14</td>
<td>0.12 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G PG125</td>
<td>175 ± 14</td>
<td>0.125 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G PG150</td>
<td>212 ± 16</td>
<td>0.15 ± 0.02</td>
<td>Phlogopite (160)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G PG155</td>
<td>215 ± 16</td>
<td>0.155 ± 0.02</td>
<td>Phlogopite (160)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G MG95</td>
<td>130 ± 12</td>
<td>0.095 ± 0.02</td>
<td>Muscovite (80)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G MG100</td>
<td>133 ± 12</td>
<td>0.10 ± 0.02</td>
<td>Muscovite (80)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G MG105</td>
<td>153 ± 13</td>
<td>0.105 ± 0.02</td>
<td>Muscovite (100)</td>
<td>Glass fabric (30)</td>
</tr>
<tr>
<td>Cablosam® G MG110</td>
<td>156 ± 13</td>
<td>0.11 ± 0.02</td>
<td>Muscovite (100)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G MG125</td>
<td>175 ± 14</td>
<td>0.125 ± 0.02</td>
<td>Muscovite (120)</td>
<td>Glass fabric (32)</td>
</tr>
<tr>
<td>Cablosam® G PPE100</td>
<td>137 ± 12</td>
<td>0.10 ± 0.02</td>
<td>Phlogopite (100)</td>
<td>Polyethylene (24)</td>
</tr>
<tr>
<td>Cablosam® G PPE110</td>
<td>159 ± 13</td>
<td>0.11 ± 0.02</td>
<td>Phlogopite (120)</td>
<td>Polyethylene (24)</td>
</tr>
<tr>
<td>Cablosam® G PPE130</td>
<td>200 ± 16</td>
<td>0.13 ± 0.02</td>
<td>Phlogopite (160)</td>
<td>Polyethylene (24)</td>
</tr>
</tbody>
</table>
Processing

Cablosam® tapes are applied to stranded wires, conductors and cables by strip-winding machines in one or more tangentially or radially overlapping layers. The tapes have to be applied with the glass fabric facing outwards and the mica paper inwards, against the conductor. Adhesive tapes are used to join the ends of pads or cross-wound spools during production.

Conductors, stranded wires or cables insulated in this manner can then be covered with thermoplastic material to form the final product.

Form of Delivery

Cablosam® tapes are available from widths of 4mm upwards and as rolled pads or cross-wound spools. The length of the tape on a pad depends on the material and dimensions required and is available up to 1600m.

Cross-wound spools may be up to 20km in length depending on the width and dimensions of the spool. Used in conjunction with a suitable taping machine, such spools can be extremely cost-effective, permit extended runtimes and reduce production downtime. Mini-cross-wound spools, a variant of the cross-wound option, offer the possibility for use on existing equipment to optimize the taping process.

Von Roll offers the market the possibility for fully taped conductors using bare, tinned, single or stranded wires, which can be produced to individual customer specifications.
We Enable Energy

Von Roll is the sole full-range supplier of materials and systems for the insulation of electrical machines as well as high-performance products for various high-tech industries.

Mica
All materials related to high-voltage insulation. Von Roll’s commitment to mica starts with mining and ends with finished tapes.

Wires
Insulated round, flat and Litz wires for high-voltage, low-voltage and electronic applications.

Cables
Mica tapes for fire-resistant cables. Von Roll provides a wide range of products that are ideally suited to all commonly used standards.

Resins
Impregnation resins for high- and low-voltage, potting resins, casting resins, as well as encapsulating and conformal coatings.

Composites
Engineered materials made from a resin and a support structure with distinct physical, thermal and electrical properties. They can be molded, machined or semi-finished.

Flexibles
Insulating flexible materials for low-voltage applications such as flexible laminates.

Ballistic Protection
High-quality systems for armored defense based on thermostet / thermoplastic products in single-use or tailored combinations.

Testing
Von Roll provides electrical, thermal and mechanical testing of individual materials as well as complete insulating systems.

Training
Von Roll Corporate University provides a training program in high- and low-voltage insulation for its customers.

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About Von Roll
We Enable Energy – As one of Switzerland’s longest-established industrial companies, Von Roll focuses on products and systems for electrical power generation, transmission, storage and industrial applications. Von Roll’s business portfolio is divided into the following businesses: Von Roll Insulation offers electrical insulation products, systems and services for generators, high- and low-voltage motors, transformers and other applications. Von Roll Composites produces composite materials and parts for a variety of industrial equipment.