

Technical Information

VETRELAM^â 410

Slot insulation laminates, sheets, strips, channel sections (L + U)

MATERIAL A laminate consisting of glass fabric, heat-resisting epoxy resin and aramid fiberpaper (Nomex®), additionally an electrically insulating foil as reinforcing - dielectric and tracking resistant top layers.

GENERAL PROPERTIES High mechanical strength, good resistance to heat and moisture, low dielectric losses and high electric strength.

Temperature class F - H

APPLICATION Typical application as thin-walled insulation material. Good flexibility e.g. for slot liners insulation, top channels and interstice insulation for heavy electrical machines.

For mechanical and electrical applications in electrical machines and equipment operating at high temperatures.

SUPPLY

Channels and other sections

The most common sections are L- and U-shaped channel sections. Micafil's own manufacturing technology does not limit the length. Various cross sections are possible to meet individual customer requirements.

Straightness, deflection

Admissible tolerance 1 mm/m on an even surface. When checking with a ruler (full length of component), slight pressure is acceptable provided it does not cause distortion.

Surface

Slot insulation components are supplied machined to according to drawings. "As pressed" surfaces do not require varnishing. Machined surfaces ready for fitting can be varnished on request.

Standard varnish color: clear. Other colors are possible on request.

Testing of slot insulation

In order to ensure maximum security against slot insulation failures, specimens of material and finished components are tested at regular intervals. High voltage tests according to table 2 are performed as routine test on the whole surface of the insulation.



DIMENSIONS

Table 1: Standard dimensions and tolerances

| | | | L-sections | | U-sections | |
|------------------------------|-------|----|---------------------|-------------|---------------------|-------------|
| | | | Standard dimensions | Tolerance | Standard dimensions | Tolerance |
| Length | L | mm | ≤12'000 | ± 1 | ≤12'000 | ± 1 |
| Width | Ba/Bi | mm | 20 - 250 | ± 0.5 | 15 - 50 | ± 0.2 |
| Height | H | mm | 5 - 50 | ± 0.5 | 5 - 50 | ± 0.5 |
| Wall thickness | s | mm | 0.7 - 2.5 | ± 0.1 | 0.7 - 2.5 | ± 0.1 |
| Wall thickness (curved part) | a | mm | 0.7 - 2.5 | +0.1 / -0.2 | 0.7 - 2.5 | +0.1 / -0.2 |
| Inside radius | Ri | mm | 3 | ± 0.25 | 1 | ± 0.25 |
| Outside radius | Ra | mm | Ra = Ri+s | +0.3 / -0.2 | Ra = Ri+s | +0.3 / -0.2 |
| Angle | α | ° | 90 | + 5 / -2 | 90 | ± 3 |

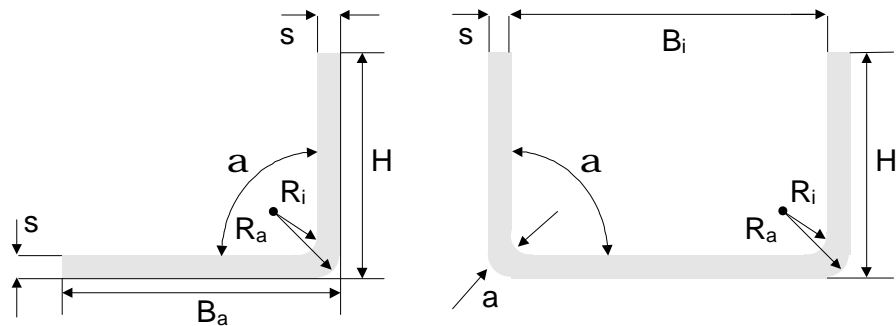


Table 2: Vertical test voltage application ⊥

| The test voltage at 50 Hz, 1 minute is applied in vertical direction. The voltage level considers the shape and surface of the slot insulation as well as the necessary flashover distances. | | | | |
|---|---------------------------------|---------------|---------------|---------------|
| Test voltage 50 Hz, 1 min | Thickness s in mm ¹⁾ | | | |
| | ≥ 0.5 - < 1.0 | ≥ 1.0 - < 1.2 | ≥ 1.2 - < 1.5 | ≥ 1.5 - < 2.0 |
| Sheets / strips | 8 · s kV | 8 kV | 10 kV | 12 kV |
| L-sections | 10 · s kV | 10 kV | 12 kV | 15 kV |
| U-sections | 8 · s kV | 8 kV | 10 kV | 12 kV |

¹⁾ For very short legs (one-sided) H = 3 to 10 mm, the test voltage should be reduced to about 80% of the flashover voltage. No side electrodes are used for this test.

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| | Properties | | Standards | Units | Values |
|-----------------------------------|--|------------------------------------|-------------|-------------------|----------------------------|
| Composition | Resin: epoxy resin (EP) | | | | |
| | Support: glass fabric | | ISO 1172 | mass % | ≈ 35 |
| | Apparent density: | | ISO 1183 | g/cm ³ | 1.4 - 1.7 |
| Electrical properties | Electric strength \perp 50 Hz, 1 Min., h = 1 mm | 23 °C 90 °C | IEC 243 | kV/mm | 35 - 50 35 - 50 |
| | Volume resistivity | | IEC 93 | M Ω · cm | 10 ¹⁴ |
| | Surface resistivity | | IEC 93 | M Ω | 10 ¹² |
| | Dissipation factor tan δ 50 Hz | 23 °C 90 °C | IEC 250 | - | 0.04 - 0.08 0.05 - 0.10 |
| | Relative permittivity ϵ_r 50 Hz | 23 °C 90 °C | IEC 250 | - | 4.0 - 5.0 4.5 - 5.5 |
| | Comparative tracking index (solution A) | | IEC 112 | CTI | 500 |
| | Mechanical properties | Tensile strength | 23 °C | ISO 527 | MPa |
| Flexural strength | | 23 °C 150 °C | ISO 178 | MPa | >250 >150 |
| Flexural modulus of elasticity | | MR | ISO 178 | GPa | 12 - 20 * 10 ³ |
| Thermal properties | Temperature class | | IEC 85 | °C | F - H |
| | Linear thermal expansion (20 - 100°C) | MR | DIN 52328 | K ⁻¹ | 15 - 25 * 10 ⁻⁶ |
| | Thermal conductivity (20 - 100°C) | \perp | VDE 0304 T1 | W/m K | 0.25 - 0.35 |
| | \perp | vertical to layers | | | |
| | \parallel | parallel to layers | | | |
| | MR | machine direction along to support | | | |
| | QR | cross direction to support | | | |

The properties have been determined for 1 mm thick laminates. The values specified here have been measured by the above shown methods and apply for standard test specimen from factory only. For laminates thinner than 0.9 mm the glass content is approx. 30 % (w/w).

Unless otherwise specified, all data were measured at ambient temperature. The contents of this publication are based on our present experience. They are an indication for application of our products without any liability for us. Notice of legal requirements and existing patent rights has to be taken. Due to the many application and manufacturing possibilities, we cannot give any warranty for the technical results in individual cases.



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