



## PHASE INSULATION NMN 411

*Phase insulation NMN 411 is an insulating laminate consisting of three layers of polyester with uncalendered aramid paper (Nomex) on both sides. An ideal material for phase insulation in electric motors and generators for applications with high working temperatures, NMN 411 is also used for transformers and other electrical applications.*

- Thickness range 250 – 500 µm
- Available in widths up to ca 900 mm, cut and trimmed, widths and punched parts available on request
- Very good dielectric and mechanical properties and high resistance to chemicals and solvents
- Very good absorbency for impregnating varnishes thanks to its coarse, felt-like surface structure
- Approved for insulation class F (+155°C) or for insulation systems which comply with IEC norms up to +180°C

## PRODUCT INFORMATION

Phase insulation NMN 411 is a three-ply laminate insulation material consisting of polyester film with uncalendered aramid paper (Nomex) on both sides. The material's properties warrant a combination of high flexibility, good dielectric, mechanical, temperature and chemical properties.

### Typical applications

Electric insulation material used primarily as phase insulation in electric motors and generators, but also as insulation in dry transformers and other electrical apparatus. Ideal for applications requiring a combination of high flexibility and high absorbency of impregnating varnishes.

### Properties

- Approved for insulation Class F (+155°C) or for insulation systems which comply with IEC norms up to +180°C
- Very good absorbency for impregnating varnishes thanks to its coarse, felt-like surface structure
- The polyester film's good dielectric and mechanical properties combined with the aramid paper's (Nomex) high resistance to chemicals, solvents and high temperatures result in a very high class insulation material.
- Very good durability
- Can be punched or cut

### Composition

- NMN 411 is composed of a central layer of polyester film surrounded by a layer of uncalendered aramid paper (Nomex) on both sides. An adhesive bonds the laminate into a unit whilst retaining inherent properties even when used in the material's higher temperature range.
- The product is manufactured in many thicknesses with Polyester film as the middle layer. See technical data.

### Colour

- Usually pale white

### Dimensions

- NMN 411 manufactured in thicknesses 250 – 500 µm
- Can be slit to desired widths up to max. 900mm
- Can be punched or cut to desired form or shape. In the case of die-cutting a die tool is required (tools available at low costs)

### Packaging

- Standard packaging width ca 470 mm depending on item in rolls of ca 6 kg\* (depending on item, certain thicknesses are held in stock, see item list)
- Standard packaging normal width ca 900 mm in rolls of ca 30 kg\*
- Other slit-to-width dimensions MOQ in kg on request
- Punched/Die-cut items: MOQ amount on agreement

*Product information for which Carbex bears no responsibility is provided by the manufacturer.*





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Item Number	Name /Grade	Dimensions			Weight ca (kg)/roll	Weight g/m <sup>2</sup> (nom.)	Lenght ca (m)/roll	Stock item (usually)
		Thickness (mm)/tol.	Width (ca mm)	Internal diam. . (mm)				
030610028	NMN 411 / 5/1.5/5	0.27 +/-20%	470	76	6	155	82	X
030729027	NMN 411 / 5/1/5	0.25 +/- 20%	950	76	30	145	218	
030729033	NMN 411 / 5/2/5	0.30 +/- 20%	950	76	30	185	170	

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### Technical data

#### NMN 411

The properties in this data sheet are typical values which can vary slightly between different manufacturers' datasheets.

Properties	Value	Value	Value	Value	Value	Value	Value	Unit mm
<b>NMN 411</b>								
<b>Nominal thickness (ca)</b>	250	270	300	330	350	380	510	µm
<b>Mechanical</b>								
Thickness tolerance	20	20	20	20	20	20	20	+/- %
Thickness Nomex (x 2)	130	130	130	130	130	130	130	µm
Thickness polyester film	23	36	50	75	100	125	250	µm
Name/thickness (Grade)	5/1/5	5/1.5/5	5/2/5	5/3/5	5/4/5	5/5/5	5/10/5	N/M/N
Weight/m <sup>2</sup> ca	145	155	185	220	255	290	465	g/m <sup>2</sup>
ca Area / kg	6.9	6.45	5.4	4.5	3.9	3.4	2.15	m <sup>2</sup> /kg
Tensile strength MD	73	73	73	73	117	117	330	N/10mm (min)
Tensile strength XD	73	70	73	73	117	117	290	N/10mm (min)
Elongation MD	10	8	7	10	10	10	20	% (min)
Elongation XD	10	12	10	10	10	10	20	% (min)
<b>Thermal</b>								
Electrical insulation class	F / 155	F / 155	F / 155	F / 155	F / 155	F / 155	F / 155	class /°C
<b>Electrical</b>								
Dielectric strength kV (min)	4	6	6	6	10	14	23	kV (min)

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