

Slot insulation NMN 411 is an insulating laminate consisting of three layers of polyester with calendered aramid paper (Nomex®) on both sides.

An ideal material for slot insulation in electric motors and generators for applications with high working temperatures, NMN 411 is also used for transformers and other electrical applications.



## Typical applications

Electric insulation material used primarily as slot insulation in electric motors and generators, but also as insulation in dry transformers and other electrical apparatus.

## Properties

- Approved for insulation Class F (+155°C) or for insulation systems which comply with IEC norms up to +180°C.
- Withstands short-term temperature peaks up to +200°C without major impact on the breakdown voltage or dielectric resistance.
- Very suitable for rational production of Class F motors.
- Very good adhesion to impregnation varnishes despite the material's smooth 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 410 (NPN 410) is composed of a central layer of polyester film surrounded by a layer of calendered 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 four variants with varying thicknesses of polyester film as the middle layer. See technical data.

- NMN 410-5 with Nomex® layer thickness of 2x50 µm. Normally of calendered Nomex® type 464.
- NMN 410-8 with Nomex® layer thickness of 2x80 µm. Normally of calendered Nomex® type 416.
- NMN 410-13 with Nomex® layer thickness of 2x130 µm. Normally of calendered Nomex® type 416.
- NMN 410-18 with Nomex® layer thickness of 2x180 µm. Normally of calendered Nomex® type 410.

## Colour

Usually pale white.

## Dimensioner

NMN 410 (NPN 410) manufactured in thicknesses 140–740 µm.

Can be slit to desired widths up to max. 900 mm.

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).

## Förpackning

- Standard packaging width ca 900 mm depending on item in rolls of ca 25–30 kg.
- Standard packaging normal width ca 450 mm depending on item in rolls of ca 6 kg.



## Article list

Item number	Type/grade	Dimensions			Weight/roll ca (kg)	Weight g/m <sup>2</sup> (nom.)	Length/roll ca (m)
		Thickness (mm)	Width (mm)	Internal diam (mm)			
125523	NMN 410-5/ 2/1.5/2	0.15+/-15 %	450	76	5	162	69
106261	NMN 410-5/ 2/2/2	0.17+/-15 %	450	76	15	170	196
106263	NMN 410-5/ 2/3/2	0.20+/-15 %	450	76	6	217	61
106264	NMN 410-5/ 2/5/2	0.24+/-15 %	450	76	6	270	49
106265	NMN 410-5/ 2/7.5/2	0.30+/-15 %	450	76	6	360	37
106266	NMN 410-5/ 2/10/2	0.36+/-15 %	450	76	6	450	30
125522	NMN 410-5/ 2/3/2	0.20+/-15 %	900	76	30	217	154
118989	NMN 410-5/ 2/5/2	0.24+/-15 %	914	76	30	270	122
125526	NMN 410-5/ 2/7.5/2	0.30+/-15 %	914	76	30	360	91

## Technical data

Properties											Unit
NMN 410/NPN 410-XX	5	5	5	5	5	5	5	5	5	5	
Nominal thickness	140	150	170	200	220	240	300	360	420	470	µm
<b>Mechanical properties</b>											
Thickness tolerance	15	15	15	15	15	15	15	15	15	15	+/- %
Thickness Nomex® (x 2)	50	50	50	50	50	50	50	50	50	50	µm
Thickness polyester film	23	36	50	75	100	125	190	250	300	350	µm
Name/thickness (grade)	2/1/2	2/1.5/2	2/2/2	2/3/2	2/4/2	2/5/2	2/7.5/2	2/10/2	2/12/2	2/14/2	N/M/N
Weight/m <sup>2</sup> (nominal)	140	162	170	217	240	270	360	450	520	580	g/m <sup>2</sup>
Area/kg cirka	7.1	6.2	5.9	4.6	4.2	3.7	2.8	2.2	1.9	1.7	m <sup>2</sup> /kg
Weight tolerance	12	12	12	12	12	12	12	12	12	12	%
Tensile strength MD	100	150	160	185	190	225	280	330	380	410	N/10 mm (min)
Tensile strength XD	80	110	120	150	150	200	220	300	320	320	N/10 mm (min)
Elongation MD	15	15	15	15	15	15	15	15	15	15	% (min)
Elongation XD	20	20	25	20	25	25	25	25	25	25	% (min)
Shrinkage MD	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2	% (max)
Shrinkage XD	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2	% (max)
<b>Thermal properties</b>											
Electrical insulation class	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	class/°C
<b>Electrical properties</b>											
Dielectric strength	6	7	9	11	12	14	16	20	21	23	kV (min)

## Technical data

Properties											Unit
NMN 410/NPN 410-XX	8	8	8	8	8	8	8	8	8	8	
Nominal thickness	190	200	220	240	270	300	360	420	480	530	µm
<b>Mechanical properties</b>											
Thickness tolerance	15	15	15	15	15	15	15	15	15	15	+/- %
Thickness Nomex® (x 2)	80	80	80	80	80	80	80	80	80	80	µm
Thickness polyester film	23	36	50	75	100	125	190	250	300	350	µm
Name/thickness (grade)	3/1/3	3/1.5/3	3/2/3	3/3/3	3/4/3	3/5/3	3/7.5/3	3/10/3	3/12/3	3/14/3	N/M/N
Weight/m <sup>2</sup> (nominal)	194	212	220	255	302	325	420	500	570	652	g/m <sup>2</sup>
Area/kg cirka	5.1	4.7	4.5	3.9	3.3	3.1	2.4	2.0	1.75	1.5	m <sup>2</sup> /kg
Weight tolerance	12	12	12	12	12	12	12	12	12	12	%
Tensile strength MD	160	180	200	270	270	300	330	380	430	450	N/10 mm (min)
Tensile strength XD	100	140	170	190	240	250	300	300	375	420	N/10 mm (min)
Elongation MD	20	20	15	15	20	20	20	20	20	20	% (min)
Elongation XD	20	20	25	20	25	25	25	25	25	25	% (min)
Shrinkage MD	2	2	1.5	1.5	1.5	2	2	2	2	2	% (max)
Shrinkage XD	2	2	1.5	1.5	1.5	2	2	2	2	2	% (max)
<b>Thermal properties</b>											
Electrical insulation class	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	class/°C
<b>Electrical properties</b>											
Dielectric strength	7	8	9	12	13	15	20	23	25	28	kV (min)

Properties									Unit
NMN 410/NPN 410-XX	13	13	13	13	13	13	13	18	
Nominal thickness	330	360	380	410	470	530	630	730	µm
<b>Mechanical properties</b>									
Thickness tolerance	15	15	15	15	15	15	10	10	+/- %
Thickness Nomex® (x 2)	130	130	130	130	130	130	130	180	µm
Thickness polyester film	50	75	100	125	190	190	350	350	µm
Name/thickness (grade)	5/2/5	5/3/5	5/4/5	5/5/5	5/7.5/5	5/10/5	5/14/5	7/14/7	N/M/N
Weight/m <sup>2</sup> (nominal)	330	365	400	435	525	610	730	861	g/m <sup>2</sup>
Area/kg cirka	3.0	2.75	2.5	2.3	1.9	1.65	1.4	1.16	m <sup>2</sup> /kg
Weight tolerance	12	12	12	12	12	12	12	12	%
Tensile strength MD	200	220	250	300	320	400	550	750	N/10 mm (min)
Tensile strength XD								525	N/10 mm (min)
Elongation MD	7	7	7	7	15	15	15	15	% (min)
Elongation XD									% (min)
Shrinkage MD	2	2	2	2	2	2	2	2	% (max)
Shrinkage XD	2	2	2	2	2	2	2	2	% (max)
<b>Thermal properties</b>									
Electrical insulation class	F/155	F/155	F/155	F/155	F/155	F/155	F/155	F/155	class/°C
<b>Electrical properties</b>									
Dielectric strength	10	13	14	16	20	20	20	24	kV (min)

### How to contact BEVI

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Please visit [www.bevi.com](http://www.bevi.com) to access the information direct.

BEVI AB (Headquarters)  
Blomstermåla, Sweden  
Tel. +46 499 271 00  
[info@bevi.se](mailto:info@bevi.se)

