

## Electrical Insulation Materials

### Nomex® Type 411 | FI 15010

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**Structure:** Nomex® Type 411 | FI 15010 is an uncalendered aramid paper and in regard to the properties it can be compared to Nomex® Type 410 FI 15000.

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**Characteristics:** Nomex® Type 411 | FI 15010 has a good impregnation, is humidity-resistant and can be used with all common electrical varnishes and resins (polyimide-, silicone-, epoxy-, polyester-, acrylic-, phenol and synthetic resins). Furthermore Nomex® Type 411 | FI 15010 is compatible with different transformer liquids like mineral and silicone oils and other synthetic liquids as well as lubricating oils and coolants.

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**Application:** Nomex® Type 411 | FI 15010 is mainly used in in the transformer industry as motor phase insulation or layer insulation.

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**Delivery Forms:** Nomex® Type 411 | FI 15010 is available as die-cut or formed parts, sheets, cuts, on rolls or as reel in thicknesses of 0.13 up to 0.58 mm. Further dimensions and delivery forms are available on request.

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Property	Test method	Unit	Value				
Limiting oxygen index, 0.13 mm thick, Room temperature	-	%	28.5				
Limiting oxygen index, 0.13 mm thick, 220°C	-	%	21.8				
Nominal thickness	-	mm mil	0.13 5.0	0.18 7.0	0.25 10.0	0.38 15.0	0.58 23.0
Typical thickness	TAPPI-411	mm mil	0.14 5.5	0.20 8.1	0.26 10.2	0.43 16.8	0.66 26.0
Dielectric strength, 10 – 20 Sec at 60 Hz	ASTM D149	V/mil kV/mm	220.0 9.0	240.0 9.0	240.0 9.0	240.0 9.0	230.0 9.0
Full wave impulse	ASTM D3426	V/mil kV/mm	450 18	450 18	450 18	400 16	400 16
Dielectric constant at 60 Hz	ASTM D150	-	1.2	1.2	1.2	1.3	1.3
Dielectric constant at 1 kHz	ASTM D150	-	1.3	1.3	1.3	1.4	1.4
Dissipation factor at 60 Hz	ASTM D150	x10 <sup>-3</sup>	3				
Dissipation factor at 1 kHz	ASTM D150	x10 <sup>-3</sup>	5				
Area weight	ASTM D646	g/m <sup>2</sup>	42	64	82	134	205
Density	-	g/cc	0.30	0.31	0.31	0.31	0.31
Tensile strength MD	ASTM D828	N/cm	18	27	35	55	71
Tensile strength CD	ASTM D828	N/cm	9	14	20	33	47
Elongation MD	ASTM D828	%	3.6	3.8	3.4	3.7	3.2
Elongation CD	ASTM D828	%	4.8	5.6	5.2	5.3	3.9
Elmendorf method MD	TAPPI 414	N	1.1	1.6	1.9	4.1	7.4
Elmendorf method CD	TAPPI 414	N	1.5	2.5	2.5	5.8	9.4
Initial tear strength MD, 90°	ASTM D1004	N	7	10	13	21	30
Initial tear strength CD, 90°	ASTM D1004	N	4	5	8	14	21
Shrinkage at 240°C MD	-	%	0.6	0.6	0.6	0.6	0.5
Shrinkage at 240°C CD	-	%	0.7	0.7	0.9	0.3	0.2

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**Trademark information:** Nomex® is a registered trademark of the company DuPont.

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**Information:**

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