AGC
Your Dreams, Our Challenge

nelco

N9000

PTFE Laminates

Nelco N9000 PTFE laminates are designed for critical RF/Microwave components, antennas, power amplifiers and subassemblies. Superior mechanical and electrical performance make the N9000 PTFE laminate system the material of choice for your lowest electrical loss and high frequency applications.

Key Features

Complete spectrum of controlled dielectric constants
- Dk of 2.08 through Dk of 4.50
- Reinforced PTFE laminate with a dielectric constant less than 2.17 available for very low loss antenna designs
- PTFE / glass ratio tightly controlled
- Available in sheets up to 80 inches long (2.03 meters) by 48 inches wide (1.22 meters)

Enhanced N9000 IM materials available
- Superior passive intermodulation in antenna and high power designs
- Offers two-tone passive intermodulation performance of less than -163 dBc (guranteed by measurement and batch to bach with N copper).

Consistent Quality (ISO 9001)
- Statistic Process Control "SPC" methods provide consistent dielectric values from sheet to sheet and batch to batch
- Meets UL 94V-0 and IPC-4103/A specifications and measured according to IPC-TM-650
- All AGC Nelco materials are RoHS compliant
- Each batch is tested and a test report is provided

Optimized N9000 PTFE processing
- Superior guaranteed foil adhesion
- Superior solvent absorption resistance

Claddings Available
- RTFoil: 18, 35 and 70 µm (0.5, 1 and 2 oz)
- Shiny Copper: 18, 35 and 70 µm (0.5, 1 and 2 oz)
- N Copper: 18, 35 and 70 µm (0.5, 1 and 2 oz)
- Heavy backed material: Aluminum and brass upon request

UL file number: E36295

Applications

- 5G All Frequencies Band
- Massive MIMO
- Antennas
- Wireless Communications
- Power Amplifiers
- Multi Hi Power Passive Circuits
- Automotive Applications
- Digital/Microwave Hybrid Multilayer PCB Assemblies
- Millimeter Wave Components
- Satellite Communications
- Microwave Links

Available Materials

NY Series: PTFE / woven-glass composite.
Low glass to PTFE ratio for lowest loss applications.

NX Series: PTFE / woven-glass composite.
Medium glass to PTFE ratio for increased mechanical strength.

NH Series: PTFE / woven-glass / ceramic composite.
Medium glass to PTFE ratio with ceramic added for thermal stability and Dk uniformity at higher Dks.

NL Series: PTFE / woven glass / ceramic composite.
Higher Dk, Low glass to PTFE ratio for low loss applications.

N9000 PTFE Laminates - Typical Engineering Values

Typical Parameter	Test Method	NY SERIES	NX SERIES	NX SERIES
Dielectric Constant at 10 GHz (Dk) (range)	IPC-TM-650, 2.5.5.5	2.08 - 2.33	2.40 - 2.60	2.70 - 3.20
Dissipation Factor at 10 GHz (Df) (range)	IPC-TM-650, 2.5.5.5	0.0006 - 0.0011	0.0016 - 0.0019	0.0020 - 0.0024
Passive Intermodulation Formulation Availability		Yes	Yes	Yes
Passive Intermodulation Performance		-163 dBc	-163 dBc	-163dBc
Dielectric Breakdown	IPC-TM-650, 2.5.6	50kV	50kV	50kV
Volume Resistivity	IPC-TM-650, 2.5.17	10^9 MΩ - cm	10^9 MΩ - cm	10^8 MΩ - cm
Surface Resistivity	IPC-TM-650, 2.5.17	10^7 MΩ	10^7 MΩ	10^7 MΩ
Arc Resistance	ASTM D-495	180 sec.	180 sec.	180 sec.
Flexural Strength Lengthwise	IPC-TM-650, 2.4.4	82.7 MPa	82.7 MPa	158.6 MPa
Flexural Strength Crosswise	IPC-TM-650, 2.4.4	68.9 MPa	68.9 MPa	131.0 MPa
Copper Peel Strength	IPC-TM-650, 2.4.8	2.33 kN / m	2.33 kN / m	2.33 kN / m
18, 35, and 70µm copper (1/2 oz, 1 oz, and 2 oz copper)				
After Thermal Shock (30 sec. at 260°C)		2.31 kN / m	2.31 kN / m	2.31 kN / m
Moisture Absorption	IPC-TM-650, 2.6.2.1	0.02%	0.02%	0.05%
Specific Gravity	ASTM D-792, A	2.23 g / cm^3	2.23 g / cm^3	2.25 g / cm^3
Thermal Conductivity	ASTM E-1225	0.272 W / m / K	0.272 W / m / K	0.251 W / m / K
Coefficient of Thermal Expansion (CTE)				
X	IPC-TM-650, 2.4.41	25 ppm / °C	25 ppm / °C	12 ppm / °C
Y	IPC-TM-650, 2.4.41	35 ppm / °C	35 ppm / °C	18 ppm / °C
Z	IPC-TM-650, 2.4.24	260 ppm / °C	260 ppm / °C	150 ppm / °C
Flammability	IPC-TM-650, 2.3.10	V-0	V-0	V-0

Product	Dk	Df
NY9208	2.08±.02	0.0006
NY9217	2.17±.02	0.0008
NY9220	2.20±.02	0.0009
NY9233	2.33±.02	0.0011

Product	Dk	Df
NX9240	2.40±.04	0.0016
NX9245	2.45±.04	0.0016
NX9250	2.50±.04	0.0017
NX9255	2.55±.04	0.0018
NX9260	2.60±.04	0.0019

Product	Dk	Df
NX9274	2.74±.04	0.0020
NX9294	2.94±.04	0.0022
NX9300	3.00±.04	0.0023
NX9320	3.20±.04	0.0024

All test data provided are typical values and not intended to be specification values. For review of critical specification tolerances, please contact a company representative directly.

*DMA is the preferred method for measuring Tg - other methods may be less accurate.

Ordering Information

Please specify the product and / or Dk, material thickness, copper thickness, copper type and panel size. Request Passive Intermodulation Formulation when necessary for antenna applications. Example: 9220, .010" thick, 1 oz two sides, ED copper, 12"x18" or Dk=2.20, .010" thick, 1 oz copper two sides, ED copper, 12"x18". For Passive Intermodulation Formulation material, add the IM suffix, i.e.: 9220IM and specify N Copper.

N9000 PTFE Laminates - Typical Engineering Values

Typical Parameter	NH SERIES
Dielectric Constant at 10 GHz (Dk)	2.94 - 4.50
Dissipation Factor at 10 GHz (Df)	0.0022 - 0.0030
PIM Formulation Availability	Yes
Passive Intermodulation Performance	-163 dBc
Dielectric Breakdown	45kV
Volume Resistivity	10^8 MΩ - cm
Surface Resistivity	10^7 MΩ
Arc Resistance	180 sec.
Flexural Strength Lengthwise	158.6 MPa
Flexural Strength Crosswise	131.0 MPa
Copper Peel Strength - 18, 35, 70 µm (1/2 oz, 1 oz, and 2 oz copper)	2.33 kN / m
After Thermal Shock (30 sec. at 260°C)	2.31 kN / m
Moisture Absorption	0.08%
Specific Gravity	2.459 g / cm^3
Thermal Conductivity	0.230 W / m / K
Coefficient of Thermal Expansion (CTE)	
X	9 ppm / °C
Y	12 ppm / °C
Z	71 ppm / °C
Flammability	V-0

Product	Dk	Df
NH9294	2.94±.07	0.0022
NH9300	3.00±.07	0.0023
NH9320	3.20±.07	0.0024
NH9338	3.38±.10	0.0025
NH9348	3.48±.10	0.0030
NH9350	3.50±.10	0.0030
NH9410	4.10±.10	0.0030
NH9450	4.50±.10	0.0030

Typical Parameter	Test Method	NL SERIES
Dielectric Constant at 10 GHz (Dk)	IPC-TM-650, 2.5.5.5	2.94 - 3.50
Dissipation Factor at 10 GHz (Df)	IPC-TM-650, 2.5.5.5	0.0017
PIM Formulation Availability		Yes
Pressure Cooker-60 min then solder dip @288°C until failure (max 10 min)	IPC-TM-650, 2.6.16 (modified)	Pass
Dielectric Breakdown	IPC-TM-650, 2.5.6	>50kV
Volume Resistivity	IPC-TM-650, 2.5.17.1	$6.1x10^7$ MΩ - cm
Surface Resistivity	IPC-TM-650, 2.5.17.1	$4.4x10^6$ MΩ - cm
Arc Resistance	IPC-TM-650, 2.5.1	215 sec.
Flexural Strength Lengthwise	IPC-TM-650, 2.4.4.0	58.6 MPa
Tensile Strength (warp/fill)	ASTM D3039	64.1 / 48.9 MPa
Copper Peel Strength - 35 µm (1 oz)	IPC-TM-650, 2.4.8	1.8 kN / m (10.3 lb/in)
Modulus (warp)	ASTM D3039	1.1 x 10^6 MPa
Moisture Absorption	IPC-TM-650, 2.6.2.1	<0.05%
Specific Gravity		2.25 g / cm^3
Thermal Conductivity	ASTM E1461	0.381 W / m / K
Coefficient of Thermal Expansion (CTE)		
X		25 ppm / °C
Y		35 ppm / °C
Z	IPC-TM-650, 2.4.24	320 ppm / °C
Flammability	IPC-TM-650, 2.3.10	V-0
Poisson's Ratio (warp/fill)	ASTM D3039	0.180 / 0.221

Product	Dk	Df
NL9294	2.94±.05	0.0017
NL9300	3.00±.05	0.0017
NL9320	3.20±.05	0.0017
NL9350	3.50±.05	0.0017

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N9000 PTFE Laminates - Standard Thicknesses

		0.005	0.010	0.015	0.020	0.030	0.031	0.045	0.060	0.062	0.125	inches
Series	Product	0.127	0.254	0.381	0.508	0.762	0.787	1.143	1.524	1.575	3.175	mm
NY	9208				X	X		X	X		X	
NY	9217	X	X	X	X	X	X	X	X	X	X	
NY	9220	X	X	X	X	X	X	X	X	X	X	
NY	9233	X	X	X	X	X	X	X	X	X	X	
NX	9240	X	X	X	X	X	X	X	X	X	X	
NX	9245	X	X	X	X	X	X	X	X	X	X	
NX	9250	X	X	X	X	X	X	X	X	X	X	
NX	9255	X	X	X	X	X	X	X	X	X	X	
NX	9260	X	X	X	X	X	X	X	X	X	X	
NX	9274				X	X	X	X	X	X	X	
NX	9294				X	X	X	X	X	X	X	
NX	9300				X	X	X	X	X	X	X	
NX	9320				X	X	X	X	X	X	X	
NH	9294	X	X		X	X	X		X	X		
NH	9300	X	X	X								
NH	9320	X	X	X	X							
NH	9338	X	X	X	X	X	X	X	X	X	X	
NH	9348	X	X	X	X	X	X	X	X	X	X	
NH	9350		X	X	X	X	X	X	X	X	X	
NL	9294	X	X		X	X	X					
NL	9300	X	X		X	X	X					
NL	9320				X	X	X					
NL	9350				X	X	X					

Additional Materials for RF/Microwave Applications

Meteorwave 1000 — Low Dk/Df Modified Epoxy
Dk 3.40 / Df 0.0047 at 10 GHz

Meteorwave 2000 — Low Dk/Df Modified Epoxy
Dk 3.20 / Df 0.0034 at 10 GHz

Meteorwave 3000 — Low Dk/Df Modified Epoxy
Dk 3.47 / Df 0.0039 at 10 GHz

Meteorwave 4000 — Low Dk/Df Modified Epoxy
Dk 3.31 / Df 0.0024 at 10 GHz

Meteorwave 8000 — Low Dk/Df Modified Epoxy
Dk 3.28 / Df 0.0016 at 10 GHz

Mecurywave™9350 — Controlled Dk/Df Modified Epoxy
Dk 3.50 / Df 0.004 at 10 GHz

N4350-13 RF — Controlled Dk/Df Modified Epoxy
Dk 3.50 / Df 0.0065 at 10 GHz

N4380-13 RF — Controlled Dk/Df Modified Epoxy
Dk 3.80 / Df 0.0070 at 10 GHz

Meteorwave 3350 — Controlled Dk/Df Modified Epoxy
Dk 3.50 / Df 0.0038 at 10 GHz

Meteorwave 8350 — Controlled Dk/Df Modified Epoxy
Dk 3.50 / Df 0.0018 at 10 GHz

N9000-13 RF — PTFE and Epoxy Composite
Dk 3.00 / Df 0.0040 at 10 GHz
Dk 3.20 / Df 0.0045 at 10 GHz
Dk 3.38 / Df 0.0046 at 10 GHz
Dk 3.50 / Df 0.0055 at 10 GHz

Bond Ply Materials

M-Ply™ — Ultra Low Loss Bonding Ply
Dk 3.28 / Df 0.0020 at 10 GHz

Meteorwave 1000NF — Low Dk/Df No Flow Prepreg
Dk 3.40 / Df 0.0047 at 10 GHz

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