

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 (guaranteed by measurement and batch to batch 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 | Product Dk Df | Product Dk Df |
| | | NY9208 2.08±.02 0.0006 | NX9240 2.40±.04 0.0016 | NX9274 2.74±.04 0.0020 |
| | | NY9217 2.17±.02 0.0008 | NX9245 2.45±.04 0.0016 | NX9294 2.94±.04 0.0022 |
| | | NY9220 2.20±.02 0.0009 | NX9250 2.50±.04 0.0017 | NX9300 3.00±.04 0.0023 |
| | | NY9233 2.33±.02 0.0011 | NX9255 2.55±.04 0.0018 | NX9320 3.20±.04 0.0024 |
| | | | NX9260 2.60±.04 0.0019 | |

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 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", .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 | NL SERIES |
|---|---------------------------|-----------------------------|
| Dielectric Constant at 10 GHz (Dk) | 2.94 - 4.50 | 2.94 - 3.50 |
| Dissipation Factor at 10 GHz (Df) | 0.0022 - 0.0030 | 0.0017 |
| PIM Formulation Availability | Yes | Yes |
| Passive Intermodulation Performance | -163 dBc | Pass |
| Dielectric Breakdown | 45kV | >50kV |
| Volume Resistivity | 10 ⁸ MΩ - cm | 6.1x10 ⁷ MΩ - cm |
| Surface Resistivity | 10 ⁷ MΩ | 4.4x10 ⁶ MΩ - cm |
| Arc Resistance | 180 sec. | 215 sec. |
| Flexural Strength Lengthwise | 158.6 MPa | 58.6 MPa |
| Flexural Strength Crosswise | 131.0 MPa | 64.1 / 48.9 MPa |
| Copper Peel Strength - 18, 35, 70 μm (1/2 oz, 1 oz, and 2 oz copper) | 2.33 kN / m | 1.8 kN / m (10.3 lb/in) |
| After Thermal Shock (30 sec. at 260°C) | 2.31 kN / m | <0.05% |
| Moisture Absorption | 0.08% | 2.25 g / cm ³ |
| Specific Gravity | 2.459 g / cm ³ | 0.381 W / m / K |
| Thermal Conductivity | 0.230 W / m / K | 25 ppm / °C |
| Coefficient of Thermal Expansion (CTE) | X | 35 ppm / °C |
| | Y | 320 ppm / °C |
| | Z | V-0 |
| Flammability | V-0 | 0.180 / 0.221 |
| Product | NH9294 | NL9294 |
| Dk | 2.94±.07 | 2.94±.05 |
| Df | 0.0022 | 0.0017 |
| Product | NH9300 | NL9300 |
| Dk | 3.00±.07 | 3.00±.05 |
| Df | 0.0023 | 0.0017 |
| Product | NH9320 | NL9320 |
| Dk | 3.20±.07 | 3.20±.05 |
| Df | 0.0024 | 0.0017 |
| Product | NH9338 | NL9338 |
| Dk | 3.38±.10 | 3.38±.05 |
| Df | 0.0025 | 0.0017 |
| Product | NH9348 | NL9348 |
| Dk | 3.48±.10 | 3.48±.05 |
| Df | 0.0030 | 0.0017 |
| Product | NH9350 | NL9350 |
| Dk | 3.50±.10 | 3.50±.05 |
| Df | 0.0030 | 0.0017 |
| Product | NH9410 | NL9410 |
| Dk | 4.10±.10 | 4.10±.05 |
| Df | 0.0030 | 0.0017 |
| Product | NH9450 | NL9450 |
| Dk | 4.50±.10 | 4.50±.05 |
| Df | 0.0030 | 0.0017 |

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N9000 PTFE Laminates - Standard Thicknesses

| Series | Product | 0.005 0.127 | 0.010 0.254 | 0.015 0.381 | 0.020 0.508 | 0.030 0.762 | 0.031 0.787 | 0.045 1.143 | 0.060 1.524 | 0.062 1.575 | 0.125 3.175 | inches 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 | Mecurywave™9350 | Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.004 at 10 GHz |
| Meteorwave 2000 | Low Dk/Df Modified Epoxy Dk 3.20 / Df 0.0034 at 10 GHz | N4350-13 RF | Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.0065 at 10 GHz |
| Meteorwave 3000 | Low Dk/Df Modified Epoxy Dk 3.47 / Df 0.0039 at 10 GHz | N4380-13 RF | Controlled Dk/Df Modified Epoxy Dk 3.80 / Df 0.0070 at 10 GHz |
| Meteorwave 4000 | Low Dk/Df Modified Epoxy Dk 3.31 / Df 0.0024 at 10 GHz | Meteorwave 3350 | Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.0038 at 10 GHz |
| Meteorwave 8000 | Low Dk/Df Modified Epoxy Dk 3.28 / Df 0.0016 at 10 GHz | Meteorwave 8350 | Controlled Dk/Df Modified Epoxy Dk 3.50 / Df 0.0018 at 10 GHz |

Bond Ply Materials

| | | | |
|-------------------|---|-------------|--|
| M-Ply™ | Ultra Low Loss Bonding Ply Dk 3.28 / Df 0.0020 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 |
| Meteorwave 1000NF | Low Dk/Df No Flow Prepreg Dk 3.40 / Df 0.0047 at 10 GHz | | |