

# Nelco Advanced Circuitry Materials

## Nelco N4000-13 Nelco N4000-13 SI®

### High-Speed Multifunctional Epoxy Laminate & Prepreg



The Nelco N4000-13 series is an enhanced epoxy resin system engineered to provide both outstanding thermal and high signal speed / low signal loss properties. The N4000-13 SI® is excellent for applications that require optimum signal integrity and precise impedance control, while maintaining high reliability through CAF\* and thermal resistance.

#### Key Features

##### **Tg >210°C, outstanding thermal, electrical and signal loss properties**

- Excellent thickness control for tight tolerance impedance applications
- Low Df and Dk allows for low signal distortion and faster signal propagation required by high frequency (1 - 10 GHz) and high reliability applications
- Suitable for high layer count designs where lead-free assemblies are needed

##### **CAF\* Resistant**

- The low Z-CTE and proven CAF resistance provide long-term reliability for both RF and digital applications

##### **Signal Integrity and Buried Capacitance™ Options**

- When used, SI glass provides enhanced electrical performance for even the most demanding applications
- Approved ZBC-2000® substrate available for thinner, more reliable assemblies and increased board densities

##### **Proprietary advanced resin technology**

- Industry standard material with well documented dielectric constant and loss tangent properties

##### **High-Tg FR-4 processing**

- Processes similar to traditional high Tg FR-4 materials
- 90 min press at 193°C and 275-350 psi

##### **Available in a variety of constructions**

- Vacuum laminated
- Available in a wide variety of constructions, copper weights and glass styles including standard copper, double treat and RTFOIL® laminate.
- Meets UL 94V-0 and IPC-4101/29 specifications
- All Nelco materials are RoHS compliant.

#### Applications

- Fine-Line Multilayers
- Backplanes
- Surface-Mount Multilayers
- BGA Multilayers
- MCM-Ls
- CSP Attachment
- Wireless Communication Infrastructure
- High Speed Services
- High Speed Storage Networks
- Internet Switching / Routing Systems

#### Global Availability

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**Park's UL file number: E36295**

# Nelco N4000-13 and N4000-13 SI®

## High-Speed Multifunctional Epoxy Laminate & Prepreg

<b>Mechanical Properties</b>	<b>N4000-13</b>	<b>-13 SI</b>	<b>U.S. Units</b>	<b>N4000-13</b>	<b>-13 SI</b>	<b>Metric</b>	<b>Test Method</b>
Peel Strength - 1 oz. (35 micron) Cu							
After Solder Float	7.5	7.5	lb/inch	1.31	1.31	N/mm	IPC-TM-650.2.4.8
At Elevated Temperature	8.1	8.1	lb/inch	1.42	1.42	N/mm	IPC-TM-650.2.4.8.2a
After Exposure to Process Solutions	9.0	9.0	lb/inch	1.58	1.58	N/mm	IPC-TM-650.2.4.8
X/Y CTE [-40°C to +125°C]	10 - 14	9 - 13	ppm/°C	10 - 14	9 - 13	ppm/°C	IPC-TM-650.2.4.41
Z Axis CTE Alpha 1 [50°C to T <sub>g</sub> ]	70	70	ppm/°C	70	70	ppm/°C	IPC-TM-650.2.4.41
Z Axis CTE Alpha 2 [T <sub>g</sub> to 260°C]	280	280	ppm/°C	280	280	ppm/°C	IPC-TM-650.2.4.41
Z Axis Expansion [50°C to 260°C]	3.5	3.5	%	3.5	3.5	%	IPC-TM-650.2.4.41
Young's Modulus (X/Y)	4.2/3.3	TBD	psi x 10 <sup>6</sup>	28.5/22.4	TBD	GN/m <sup>2</sup>	ASTM D3039
Poisson's Ratios (X/Y)	0.13/0.11	TBD		0.13/0.11	TBD		ASTM D3039
Thermal Conductivity	0.350	0.294	W/mK	0.350	0.294	W/mK	ASTM E1461
Specific Heat	1.20	1.30	J/gK	1.20	1.30	J/gK	ASTM E1461
<b>Electrical Properties</b>							
Dielectric Constant (50% resin content)							
@ 1 GHz (RF Impedance)	3.7	3.4		3.7	3.4		IPC-TM-650.2.5.5.9
@ 2.5 GHz (Split Post Cavity)	3.7	3.2		3.7	3.2		
@ 10 GHz (Stripline)	3.6	3.2		3.6	3.2		IPC-TM-650.2.5.5.5
@ 10 GHz (Split Post Cavity)	3.7	3.3		3.7	3.3		
Dissipation Factor (50% resin content)							
@ 2.5 GHz (Split Post Cavity)	0.009	0.008		0.009	0.008		
@ 10 GHz (Stripline)	0.009	0.008		0.009	0.008		IPC-TM-650.2.5.5.5
@ 10 GHz (Split Post Cavity)	0.008	0.007		0.008	0.007		
Volume Resistivity							
C - 96/35/90	10 <sup>8</sup>	10 <sup>8</sup>	MΩ - cm	10 <sup>8</sup>	10 <sup>8</sup>	MΩ - cm	IPC-TM-650.2.5.17.1
E - 24/125	10 <sup>7</sup>	10 <sup>8</sup>	MΩ - cm	10 <sup>7</sup>	10 <sup>8</sup>	MΩ - cm	IPC-TM-650.2.5.17.1
Surface Resistivity							
C - 96/35/90	10 <sup>7</sup>	10 <sup>7</sup>	MΩ	10 <sup>7</sup>	10 <sup>7</sup>	MΩ	IPC-TM-650.2.5.17.1
E - 24/125	10 <sup>7</sup>	10 <sup>7</sup>	MΩ	10 <sup>7</sup>	10 <sup>7</sup>	MΩ	IPC-TM-650.2.5.17.1
Electric Strength	1200	1000	V/mil	4.7x10 <sup>4</sup>	3.9x10 <sup>4</sup>	V/mm	IPC-TM-650.2.5.6.2
Dielectric Breakdown	>50	>50	kV	>50	>50	kV	IPC-TM-650.2.5.6
Arc Resistance	123	123	seconds	123	123	seconds	IPC-TM-650.2.5.1
<b>Thermal Properties</b>							
Glass Transition Temperature (T <sub>g</sub> )							
DSC (°C)	210	210	°C	210	210	°C	IPC-TM-650.2.4.25c
TMA (°C)	200	200	°C	200	200	°C	IPC-TM-650.2.4.24c
DMA (°C) (Tan δ Peak)	240	240	°C	240	240	°C	IPC-TM-650.2.4.24.3
Degradation Temp (TGA) (5% wt. loss)	365	365	°C	365	365	°C	IPC-TM-650.2.3.40
Pressure Cooker-60 min then solder dip							IPC-TM-650.2.6.16
@288°C until failure (max 10 min.)	Pass	Pass		Pass	Pass		(modified)
T <sub>260</sub>	30+	30+	minutes	30+	30+	minutes	IPC-TM-650.2.4.24.1
T <sub>288</sub>	10+	10+	minutes	10+	10+	minutes	IPC-TM-650.2.4.24.1
<b>Chemical/Physical Properties</b>							
Moisture Absorption	0.1	0.1	wt. %	0.1	0.1	wt. %	IPC-TM-650.2.6.2.1
Methylene Chloride Resistance	0.7	0.7	% wt. chg.	0.7	0.7	% wt. chg.	IPC-TM-650.2.3.4.3
Density [50% resin content]	1.77	1.64	g/cm <sup>3</sup>	1.77	1.64	g/cm <sup>3</sup>	Internal Method

Park Electrochemical Corp. is a global advanced materials company which develops and manufactures high-technology digital and RF/microwave printed circuit materials and advanced composite materials. The company operates under the Nelco® and Nelcote™ names.

All test data provided are typical values and not intended to be specification values. For review of critical specification tolerances, please contact a Nelco representative directly. Nelco reserves the right to change these typical values as a natural process of refining our testing equipment and techniques.

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\*CAF resistance has been established to greater than 500 hours using a specific OEM coupon design and test procedure. For details on this or other CAF tests, please visit [www.parkellectro.com](http://www.parkellectro.com). Nelco reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Nelco does not assume any liability arising out of the application or use of any product described herein; neither does it convey any license under its patent rights nor the rights of others. This disclaimer of warranty is in lieu of all warranties whether expressed, implied or statutory, including implied warranties of merchantability or fitness for a particular purpose. Park is an Equal Opportunity Employer.