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. N4000-13 SI® is excellent for applications that require optimum signal integrity and precise impedance control, while maintaining high reliability through CAF\(^2\) and thermal resistance.

**Key Features**

**Lead-Free Assembly Compatible**
- Ideally suited for assemblies with a maximum reflow temperature of 245°C\(^1\)
- Nelco N4000-13 has shown acceptable results in reflow conditions up to 260°C\(^1\) depending on the PCB design and manufacturing processing

**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

**CAF\(^2\) Resistant**
- The low Z-CTE and proven CAF resistance\(^2\) 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\(^\text{®}\) substrate available for thinner, more reliable assemblies and increased board densities

**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.
- Available as a 2 mil core product meeting the specifications of a capacitive laminate
- Meets UL 94V-0 and IPC-4101/29 specifications
- All Nelco\(^\circ\) materials are RoHS compliant.
## Mechanical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>N4000-13</th>
<th>-13 Si</th>
<th>U.S. Units</th>
<th>N4000-13</th>
<th>-13 Si</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peel Strength - 1 oz. (35 micron) Cu</td>
<td>7.5</td>
<td>7.5</td>
<td>lb / inch</td>
<td>1.31</td>
<td>1.31</td>
<td>N / mm</td>
</tr>
<tr>
<td>After Solder Float</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Elevated Temperature</td>
<td>8.1</td>
<td>8.1</td>
<td>lb / inch</td>
<td>1.42</td>
<td>1.42</td>
<td>N / mm</td>
</tr>
<tr>
<td>After Exposure to Process Solutions</td>
<td>9.0</td>
<td>9.0</td>
<td>lb / inch</td>
<td>1.58</td>
<td>1.58</td>
<td>N / mm</td>
</tr>
<tr>
<td>X / Y CTE [-40°C to +125°C]</td>
<td>10 - 14</td>
<td>9 - 13</td>
<td>ppm / °C</td>
<td>10 - 14</td>
<td>9 - 13</td>
<td>ppm / °C</td>
</tr>
<tr>
<td>Z Axis CTE Alpha 1 [50°C to Tg]</td>
<td>70</td>
<td>70</td>
<td>ppm / °C</td>
<td>70</td>
<td>70</td>
<td>ppm / °C</td>
</tr>
<tr>
<td>Z Axis CTE Alpha 2 [Tg to 260°C]</td>
<td>280</td>
<td>280</td>
<td>ppm / °C</td>
<td>280</td>
<td>280</td>
<td>ppm / °C</td>
</tr>
<tr>
<td>Z Axis Expansion [50°C to 260°C]</td>
<td>3.5</td>
<td>3.5</td>
<td>%</td>
<td>3.5</td>
<td>3.5</td>
<td>%</td>
</tr>
<tr>
<td>Young’s Modulus (X / Y)</td>
<td>4.2 / 3.3</td>
<td>2.4 / 2.3</td>
<td>psi x 10^6</td>
<td>28.5 / 22.4</td>
<td>16.5 / 15.9</td>
<td>GN / m²</td>
</tr>
<tr>
<td>Poisson’s Ratios (X / Y)</td>
<td>0.13 / 0.11</td>
<td>0.18 / 0.17</td>
<td>J / gK</td>
<td>0.13 / 0.11</td>
<td>0.18 / 0.17</td>
<td>J / gK</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>0.350</td>
<td>0.294</td>
<td>W / mK</td>
<td>0.350</td>
<td>0.294</td>
<td>W / mK</td>
</tr>
<tr>
<td>Specific Heat</td>
<td>1.20</td>
<td>1.30</td>
<td>J / gK</td>
<td>1.20</td>
<td>1.30</td>
<td>J / gK</td>
</tr>
</tbody>
</table>

### Electrical Properties

#### Dielectric Constant (50% resin content)

- @ 1 GHz (RF Impedance) 3.7 3.4  3.7 3.4
- @ 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
- @ 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
- @ 10 GHz (Split Post Cavity) 0.008 0.007  0.008 0.007

#### Volume Resistivity

- C - 96 / 35 / 90 10^8 10^8 MΩ - cm  10^8 10^8 MΩ - cm
- E - 24 / 125 10^7 10^8 MΩ - cm  10^7 10^8 MΩ - cm

#### Surface Resistivity

- C - 96 / 35 / 90 10^7 10^7 MΩ  10^7 10^7 MΩ
- E - 24 / 125 10^7 10^7 MΩ  10^7 10^7 MΩ

#### Electric Strength

- 1200 1000 V / mil 4.7x10^4 3.9x10^4 V / mm

#### Dielectric Breakdown

- >50 >50 kV

#### Arc Resistance

- 123 123 seconds 123 123 seconds

### Thermal Properties

#### Glass Transition Temperature (Tg)

- DSC (°C) 210 210 °C  210 210 °C
- TMA (°C) 200 200 °C  200 200 °C
- DMA (°C) (Tan d Peak) 240 240 °C  240 240 °C
- Degradation Temp (TGA) (5% wt. loss) 350 350 °C  350 350 °C

#### Pressure Cooker-60 min then solder dip @288°C until failure (max 10 min.)

- Pass Pass  Pass Pass (modified)

#### T260

- 30+ 30+ minutes 30+ 30+ minutes

#### T288

- 10+ 10+ minutes 10+ 10+ minutes

### Chemical / Physical Properties

#### Moisture Absorption

- 0.1 0.1 wt. %  0.1 0.1 wt. %

#### Methylene Chloride Resistance

- 0.7 0.7 % wt. chg.  0.7 0.7 % wt. chg.

#### Density (50% resin content)

- 1.91 1.79 g / cm³  1.91 1.79 g / cm³

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1Refer to the N4000-13 Best Practices document and Contract Manufacturing DMA for PCB processing recommendations. CAF resistance has been established to greater than 500 hours using a specific OEM coupon design and test procedure. Visit www.parkelectro.com for more information.