

N4000-7 EF®

165 Tg, Environmentally Friendly Epoxy

Nelco's N4000-7 EF® is a >165°C Tg (by DSC), environmentally friendly epoxy dielectric substrate system. This material provides excellent moisture resistance, electrical values and thermal stability resulting in a halogen-free and lead-free option for many high technology applications. N4000-7 EF® offers the PWB fabricator physical characteristics that enable processing under standard high-Tg FR-4 conditions, while offering the designer electrical properties uncompromised by the elimination of halogens.

This material set is offered in a broad range of laminate and prepreg constructions and will be made available globally through our Nelco and Neltec business units in Asia, North America and Europe. N4000-7 EF® is one of Nelco's newest products designed to respond to the industry's need for more "environmentally responsible" products. This material has been specifically engineered to achieve a UL 94 V-0 flammability rating without the use of bromine or any other halogen-based flame retardant. N4000-7 EF® also provides the thermal robustness required for lead-free assembly environments, providing a completely "green" solution, without impacting electrical performance which has limited the utility of previous halogen-free materials.

This highly-developed material has been designed for use in a wide array of fine-pitch, high density, multilayer applications including wireless communications, data storage and high end computing. N4000-7 EF® provides a low rate of moisture uptake, solving one of the problems commonly found in halogen-free laminates where a high level of moisture absorption may result in instability during temperature excursions and, ultimately reduced reliability. Additionally, N4000-7 EF® has been tested to current industry standards and has demonstrated superior CAF resistance*, making it applicable for use in advanced designs where increased circuit densities and decreased feature pitch produce long-term reliability concerns due to conductive anodic filament (CAF) formation.

As with all Nelco materials, the N4000-7 EF® is vacuum laminated and available in a wide variety of alternative constructions, copper weights and glass styles. It is also available in standard copper, double treat and RTFOIL® Laminate.

Product Application Environments

- Lead-Free Assemblies
- Fine-Line Multilayers
- Surface-Mount Multilayers
- BGA Multilayers
- Automotive Electronics
- MCM-Ls
- Direct Chip Attach
- Wireless Communications
- Telecommunications Infrastructure

Vacuum Lamination Parameters

Full Cure In Press	90 min. @ 193°C
Heat Up Rate (°C/min.)	2 - 4
Critical Range (°C)	80 - 140
Cool Down Rate (°C/min.)	< 3
Pressure (kg/cm ²)/(psi) *	19 - 24/275 - 350

Set platen 3 - 6° C higher than cure temp. & control heat up rate through critical temperature range.

*Large panel sizes, high layer count and/or thick panels require higher pressure depending on heat and pressure distribution during lamination.

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Property / Condition	Value (U.S. Units)		Value (Metric Units)		Test Method
Mechanical Properties					
Peel Strength - 1 oz. (35 micron) Cu					
After Solder Float	6.7	lb/inch	1.20	N/mm	IPC-TM-650.2.4.8
At Elevated Temperature	5.7	lb/inch	1.00	N/mm	IPC-TM-650.2.4.8.2a
After Exposure to Process Solutions	5.6	lb/inch	1.00	N/mm	IPC-TM-650.2.4.8
X/Y CTE [-40°C to +125°C]	15.0/14.5	ppm/°C	15.0/14.5	ppm/°C	IPC-TM-650.2.4.41
Z Axis Expansion [50°C to 260°C]	3.5	%	3.5	%	IPC-TM-650.2.4.41
Young's Modulus (X/Y)	4.5/4.0	psi x 10 ⁶	28.3/23.4	GN/m ²	ASTM D3039
Poisson's Ratios (X/Y)	0.175/0.153		0.175/0.153		ASTM D3039
Thermal Conductivity	0.47	W/mK	0.47	W/mK	ASTM E1461-92
Specific Heat	0.95	J/gK	0.95	J/gK	ASTM E1461-92
Electrical Properties					
Dielectric Constant (50% resin content)					
@ 1 MHz (TFC/LCR Meter)	4.3		4.3		IPC-TM-650.2.5.5.3
@ 1 GHz (RF Impedance)	4.1		4.1		IPC-TM-650.2.5.5.9
@ 10 GHz (Split Post Cavity)	4.0		4.0		Internal Method
@ 10 GHz (Stripline)	3.8		3.8		IPC-TM-650.2.5.5.5
Dissipation Factor (50% resin content)					
@ 1 MHz (TFC/LCR Meter)	0.010		0.010		IPC-TM-650.2.5.5.3
@ 2.5 GHz (Split Post Cavity)	0.011		0.011		Internal Method
@ 10 GHz (Split Post Cavity)	0.013		0.013		Internal Method
Volume Resistivity					
C - 96/35/90	10 ⁷	MΩ - cm	10 ⁷	MΩ - cm	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁷	MΩ - cm	10 ⁷	MΩ - cm	IPC-TM-650.2.5.17.1
Surface Resistivity					
C - 96/35/90	10 ⁶	MΩ	10 ⁶	MΩ	IPC-TM-650.2.5.17.1
E - 24/125	10 ⁶	MΩ	10 ⁶	MΩ	IPC-TM-650.2.5.17.1
Electric Strength	1000	V/mil	3.9x10 ⁴	V/mm	IPC-TM-650.2.5.6.2
Dielectric Breakdown	>50	kV	>50	kV	IPC-TM-650.2.5.6
Arc Resistance	158	seconds	158	seconds	IPC-TM-650.2.5.1
Thermal Properties					
Glass Transition Temperature (T _g)					
DSC (°C)	≥165	°C	≥165	°C	IPC-TM-650.2.4.25c
TMA (°C)	155	°C	155	°C	IPC-TM-650.2.4.24c
Degradation Temp (TGA) (5% wt. loss)	425	°C	425	°C	IPC-TM-650.2.3.40
Pressure Cooker - 2 hour					IPC-TM-650.2.6.16
(10 second solder dip @ 288°C)	Pass		Pass		(modified)
T ₂₆₀	> 30	minutes	> 30	minutes	IPC-TM-650.2.4.24.1
T ₂₈₈	2 - 4	minutes	2 - 4	minutes	IPC-TM-650.2.4.24.1
Chemical / Physical Properties					
Moisture Absorption	0.10	wt. %	0.10	wt. %	IPC-TM-650.2.6.2.1
Methylene Chloride Resistance	0.01	% wt. chg.	0.01	% wt. chg.	IPC-TM-650.2.3.4.3
Density [50% resin content]	1.92	g/cm ³	1.92	g/cm ³	Internal Method

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.

*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.parkelectro.com.

** Tg may exceed printed value and is dependent upon reamination cure time and temperature. Stated Tg is a nominal value and related product properties are determined at this Tg value.

*** Data based on an 8 ply 7628 construction with no innerlayer copper.

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