



Advanced Material Solutions

for Tomorrow's
Technology Requirements

Company Profile



- ◆ Founded in 1954
- ◆ Publicly Traded, NYSE-PKE
- ◆ Global Market Leader in Multilayer Printed Circuit Materials
- ◆ Over 1200 Employees Worldwide
- ◆ Global Technology Leader in Signal Integrity Materials
- ◆ Worldwide ISO 9002 Certified Manufacturing Locations
- ◆ \$65+ Million Investment in Automation and Advanced Technology Capabilities

Global Operations





**North America
Business Units**

Nelco Products
Fullerton, California

New England Laminates
Newburgh, New York

**FiberCote
Business Unit**

FiberCote Industries
Waterbury, Connecticut

**Neltec
Business Units**

Neltec
Tempe, Arizona

Neltec Europe SA
Mirebeau, France

Neltec SAS
Lannezeman, France

**Asia Pacific
Business Units**

Nelco Products
Singapore

Nelco Technology
Zhuhai, China
(coming in 2006)

Park / Nelco Plants Worldwide



Nelco Asia Pacific
Singapore



Nelco California
Fullerton, CA



Nelco Zhuhai
China



Nelco New York
Newburgh, NY



FiberCote Industries
Waterbury, CT



Neltec
Tempe, AZ



Neltec Europe SA
France



Neltec SA
France

Neltec Companies

- ◆ Launch-point for new and emerging technologies
- ◆ Ongoing process and material solutions
- ◆ Focused on advanced products, high speed digital and RF/Microwave materials
- ◆ High frequency material characterization laboratory
- ◆ Expanded R&D and applications laboratory



Neltec's large platen
50" x 80" PTFE press

FiberCote Industries

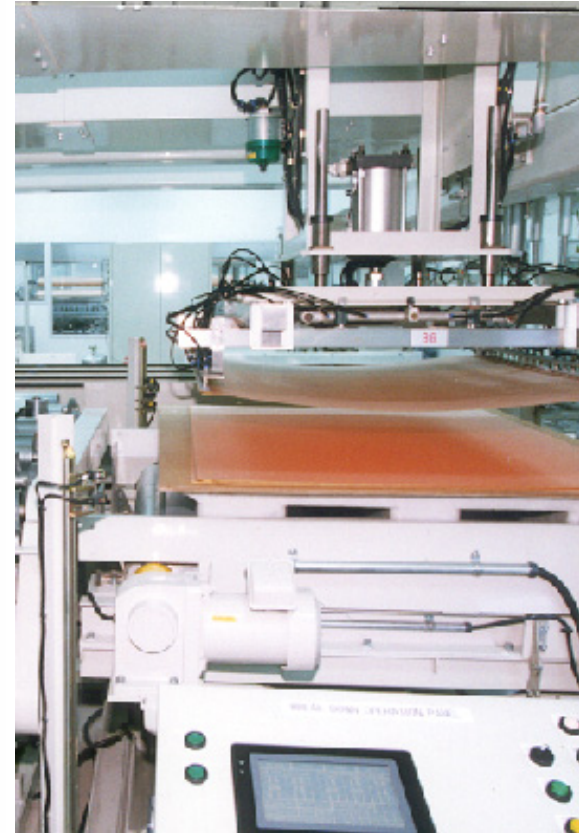
- ◆ Advanced composite prepregs for RF / structures and aerospace
- ◆ Broad goods and unidirectional tape
- ◆ ISO 9001-2000 / AS 9000
- ◆ E-765 FAA accepted design allowables databases
- ◆ www.fibercote.com

FiberCote
Materials you can rely on.



Nelco Products Pte Ltd

**Combining
Next-Generation
Automation Technology**



Nelco Products Pte Ltd

Company Profile (Singapore)

- ◆ **Incorporation:** Established in 1986
- ◆ **Employees:** 250 (3 shifts)
- ◆ **Equipment:** 4 Treaters, 6 Lamination Presses
1 Automated Lamination System
1 Automated Finishing System
- ◆ **Capacity :** Laminate- 55,000 sheets/wk
Prepreg - 200,000 sq. m /wk
- ◆ **Resin Systems:** N4000-2, -6,-7,-13, -11, -12
- ◆ **Tech Service:** Application & Development Laboratory



Automated Laminate Set-Up Line

Advanced Clean Room

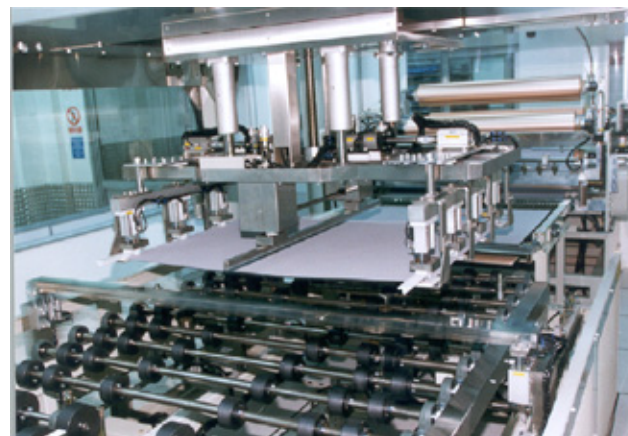
**Class 1,000 Designed
Clean Room**

**Fully Automated Set-up
& Break-down**

**Greater Yields, Quality
Improvement**



Entrance to Scrubber



Copper Station 1





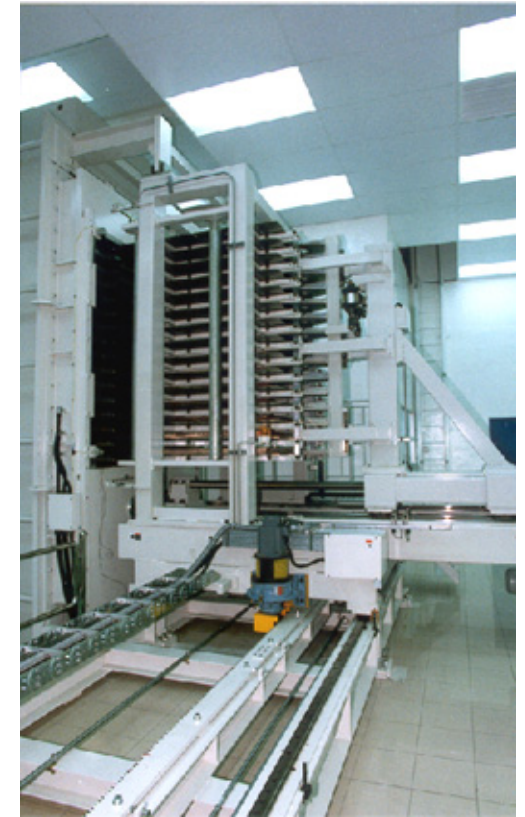
Automated Pressing Line



Load / Unload

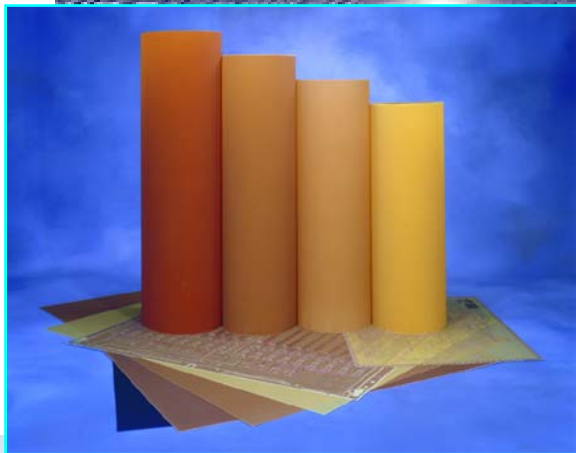


Operator Lift



Press Loading

Advanced Multilayer Materials Technology Overview



Technology Overview

- ◆ We live in a world of unprecedented technology acceleration
- ◆ Electronic systems are trending toward “passive” operation
- ◆ The further integration of electronic systems into our everyday lives will create tremendous opportunity
- ◆ Successful companies will learn to innovate at an increasing pace
- ◆ Park/Nelco is accelerating innovation
 - ▢ Enhancing our ability to develop and characterize
 - ▢ Looking for opportunities for Technology Alliances
 - ▢ Focus will be on *differentiated* products

Future Technology Requirements

- ◆ More robust products
- ◆ Broader high speed digital and RF/Microwave products offering
- ◆ Technical service expertise available worldwide to service leading edge customers with advanced products
- ◆ State of the art quality and manufacturing processes globally
- ◆ Transparency of technology globally

Next Generation Technology Building Blocks

- ◆ Infra-red Profiling Treaters
 - ◆ Unsurpassed Quality
 - ◆ State of the Art Productivity
- ◆ Fully Automated Lamination
 - ◆ “Hands-off” Operation
 - ◆ Excellent Surface Quality
- ◆ Automated Fabrication

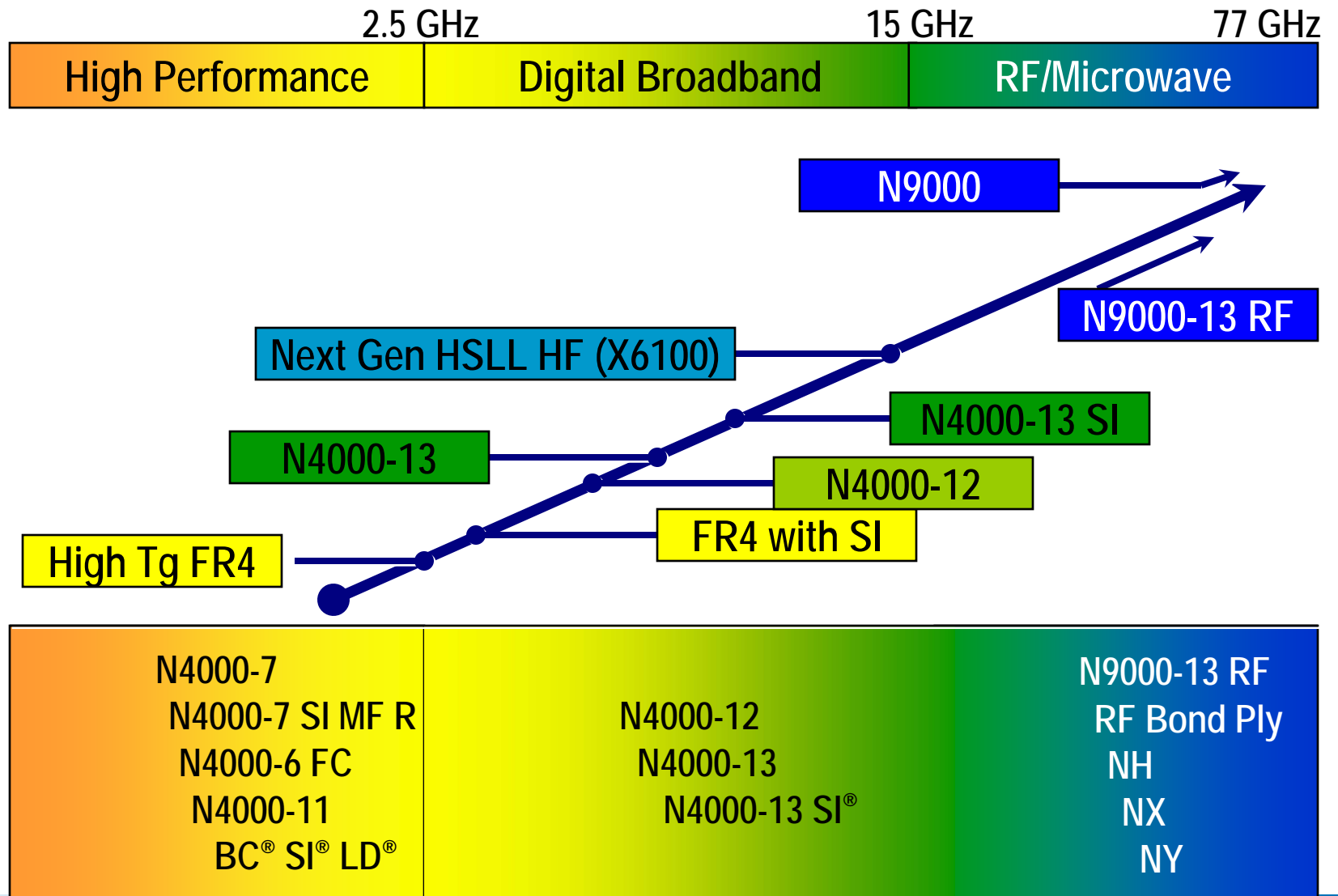


Automated Breakdown

Global Electronics Industry Technology Drivers

- ◆ Rapidly Increasing Bandwidth
- ◆ Miniaturization
- ◆ Environmental Sensitivity
- ◆ Enhanced Product Reliability
- ◆ Rapidly Increasing Functionality
- ◆ Higher Degree of Integration
- ◆ Optoelectronic Integration

Park / Nelco High Speed Low Loss Spectrum



Global FR-4 Products

N4000-2	Standard Multifunctional Epoxy System, Tg 140°C
N4000-6	High-Tg Multifunctional Epoxy System, Tg 180°C
N4000-6 FC	Fast Cure, High Performance Epoxy, Tg 175°C
N4000-6(FC) BC [®]	Buried Capacitance, High-Tg Multifunctional Epoxy Laminate
N4000-7	CAF Resistant *, Low Z-CTE Epoxy, Tg 155°C
N4000-7 SI [®]	CAF Resistant *, Low Z-CTE Epoxy Signal Integrity
N4000-11	CAF Resistant*, Low CTE, High Tg Epoxy, Tg >175°C
LD [®] Prepregs	Modified Glass Reinforcement for Improved Laser Drilling

*CAF Resistance of >625 hours under Tellabs Test Method GR-78-CORE PAR. 13.1.5 using a Sun Microsystems Test Vehicle
#1, CAF TV1 6/15/00.

BC[®], ZBC-2000[®], and Buried Capacitance[™] are trademarks of Sanmina-SCI Corporation

Global Advanced Materials

- N4000-12 High-Speed, Low-Loss, Lead-Free Epoxy, Tg 190°C
- N4000-13 High-Speed, Low-Loss CAF Resistant* Epoxy, Tg 210°C
- N4000-13 BC[®] Buried Capacitance[™], High-Speed, Low-Loss Epoxy
- N4000-13 SI[®] Next-Generation Signal Integrity
- N4380-13 RF Microwave Performance, Modified Epoxy
- N7000-1 MDA-Free Polyimide, Tg 260°C
- N7000-2HT / -3 Toughened Fracture-Resistant Polyimide 94V-1, Tg 250°C
- N7000-2 V0 High-Tg Toughened Polyimide 94V-0, Tg 255°C
- N8000 Cyanate Ester, Tg 250°C
- N9000 RF / Microwave Materials
- N9000-13 RF Next-Generation PTFE Performance Blended Laminate

*CAF Resistance of >625 hours under Tellabs Test Method GR-78-CORE PAR. 13.1.5 using a Sun Microsystems Test Vehicle #1, CAF TV1 6/15/00.

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Specialty Materials

N5000

BT Epoxy, Tg 185°C

N5000-30 / 32

High-Performance Chip-Packaging BT
(not available in Asia)

ZBC-2000®

Ultrathin Laminate for Buried Capacitance™

Structural Composites

FiberCote structural grade prepregs for RF applications and other aerospace structures

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N4000-12 Product Highlights

- ◆ High Tg Enhanced Epoxy FR-4 Resin System
- ◆ Superior Thermal Resistance/Stability
- ◆ High Speed (low Dk), Low Loss (low Df)
- ◆ CAF Resistant
- ◆ Lead-Free Assembly Compatible
- ◆ Low Z-axis CTE
- ◆ Stable loss profile across frequencies
- ◆ High Peel Strength and ILBS
- ◆ Processing window is similar to other enhanced epoxy materials
- ◆ Reduced Wicking/Crazing
- ◆ More Cost-Effective than N4000-13
- ◆ Meets UL 94 V-0

Product Highlights - N4000-13

- ◆ High-reliability, CAF-resistant, enhanced epoxy high speed low loss substrate system
- ◆ Low Z-axis CTE
- ◆ Superior thermal resistance
- ◆ 100% thermosetting for lot-to-lot consistency
- ◆ Toughened for crack resistance
- ◆ Low- D_k for improved signal speed
- ◆ Low- D_f for improved signal integrity
- ◆ Extremely stable electrical properties over freq. & temp.
- ◆ Now manufactured worldwide
- ◆ Signal Integrity (SI[®]) glass option

Product Highlights - N4380-13 RF

- ◆ Enhanced modified epoxy system for RF / Microwave use
- ◆ Tightly controlled electrical properties
- ◆ Tg 210°C
- ◆ Uses industry-standard N4000-13 as base
- ◆ High-Tg processing methods
- ◆ Low signal loss
- ◆ LNBS, power amplifiers, automotive telematics

N9000-13 RF Specifications

◆ Dk

- ☐ 3.0 (N9300-13 RF)
- ☐ 3.2 (N9920-13 RF)
- ☐ 3.38 (N9338-13 RF)
- ☐ 3.5 (N9350-13 RF)

◆ Core Thicknesses

- ☐ .010"
- ☐ .020"
- ☐ .030"
- ☐ .060"

◆ Cladding Weight

- ☐ ½ oz
- ☐ 1 oz
- ☐ 2 oz

◆ Copper

- ☐ ED
- ☐ ULP (RTF)
- ☐ Shiny Copper

◆ Panel Sizes

- ☐ 48"x36" standard
- ☐ 12"x18", 24"x18", 48"x36" typical
- ☐ Special 42"x54" available for long antennas

◆ UL Under Current N9000 / N4000-13 Mixed Package

Product Highlights - N4000-11

- ◆ Fully commercialized product
- ◆ FR-4 epoxy laminate and prepreg system
- ◆ Filled dielectric
- ◆ Superior thermal performance
- ◆ Low Z-Axis expansion rate
- ◆ Superior moisture resistance
 - ◆ PCSD
 - ◆ Wet relamination tolerance
- ◆ Outstanding performance in lead free assembly
- ◆ CAF resistant (> 750 hours)
- ◆ UL recognition under Nelco FR-4 family
- ◆ Available in North America and the Far East

N4000-7EF Halogen Free Properties

TEST	N4000-6FC	N4000-7	N4000-11	N4000-7EF
Tg (DSC)	175°C.	155°C.	175°C.	165 °C
Tg (TMA)	170°C.	150°C.	165°C.	157 °C
Z axis CTE (below Tg)	68ppm/°C.	50ppm/°C.	65ppm/°C.	67 ppm/°C
Z axis CTE (above Tg)	320ppm/C	270ppm/°C.	265ppm/°C	248 ppm/°C
Z axis expansion (50 to 260°C.)	3.60%	3.50%	3.30%	3.50%
Z axis expansion (50 to 288°C.)	4.50%	4.30%	4.00%	3.90%
Moisture Resistance (24 hr. immersion)	0.15%	0.07%	0.15%	0.15%
T ₂₆₀	7 min.	16 min.	30 min.	>30 min
T ₂₈₈	1.4 min.	1.4 min.	5 min.	5 min
Degradation Temperature (TGA - 5% weight loss)	325°C	330°C.	363°C	444 °C
Peel Strength (½ oz. Foil)	7.4lbs/in	7.4lbs/in	5.0 lbs/in	7.5lbs/in (1.3N/mm)
Dielectric Constant (50% RC @ 1MHz)	4.31	4.48	4.3	4.3
Dissipation Factor (50% RC @ 1MHz)	0.023	0.017	0.02	0.013
Lamination Cure Time with 10°F / min. heat rise.	60 min. @ 360°F	45 min @ 340°F	60 min @ 360°F	90 min @380 F
Contains Bromine	YES	YES	YES	NO

www.parknelco.com

- ◆ 24 hour availability
- ◆ Most current product listing
- ◆ Up-to-date technical data sheets and processing information
- ◆ Bulletins and technical reports
- ◆ Technical papers
- ◆ Product resources and information



We Believe Park/Nelco Offers



- Strongest brand name in the market
- Strong OEM and CEM programs
- State-of-the-art manufacturing capabilities
- Customer focused organization
- Broadest product line in the industry
- Flexible quick turnaround programs globally
- Consistent product quality and technical service worldwide