# Parylene: Protection For a World of Electronics

Safeguarding Electronic Devices

- Medical
- Telecommunications
- Industrial
- Military
- Automotive
- Consumer
- Aerospace
- Solar

## Safeguarding Electronic Devices

A variety of different materials can be used to coat and protect electronics. Parylene is by the far the most effective conformal coating offering the highest level of protection for a wide range of applications. Parylene is a thin, transparent polymer that lends no weight to the device on which it is deposited while providing physical, chemical and mechanical protection to components and circuit assemblies. It is deposited under vacuum at ambient temperatures and requires no curing. This eliminates risks from thermal stress. Parylene protects electronics from chemicals, moisture, temperature excursion, atmospheric variation, humidity and other conditions that induce damaging corrosion, mold, current leakage and dendritic growth.

## RoHS Compliance

Recent environmental guidelines that restrict the use of lead in consumer products mean lead-free solders are more and more frequently found in electronic assemblies. Typically, lead-free solders reflow at higher temperatures, have greater moisture sensitivity and are more susceptible to metallic whiskers and other similar dendritic growth. RoHS compliant Parylene is able to protect electronic devices from these factors, making it an essential consideration for today's electronics.

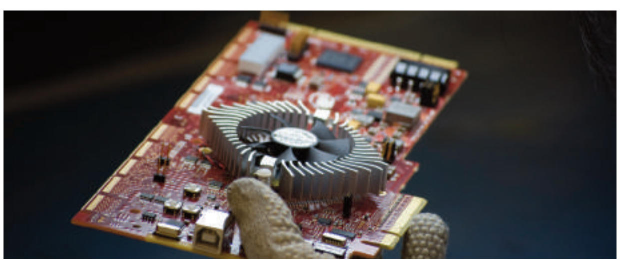

Photo courtesy of www.nbscorp.com

## Miniaturization and Mobility

Miniaturization and mobility are two fundamental driving trends in the electronics of all industry segments. Smaller, lighter weight devices and more intricate component packaging configurations challenge traditional assembly processes and other coating alternatives. Parylene adds virtually no weight or volume to the devices it coats, and it conforms without sag or buildups to contours and crevices while maintaining pin-hole free film thicknesses of 0.5 microns or less.

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## Properties of Parylene

| TYPICAL PHYSICAL & MECHANICAL PROPERTIES | Parylene N | Parylene C |
|---|---|---|
| Tensile strength, psi | 6,500 | 10,000 |
| Tensile strength, MPa | 45 | 69 |
| Yield strength, psi | 6,300 | 8,000 |
| Tensile strength, MPa | 43 | 55 |
| Tensile modulus, MPa | 2,400 | 3,200 |
| Elongation at break, % | 40 | 200 |
| Yield elongation, % | 2.5 | 2.9 |
| Density, g/cm³ | 1.110 | 1.289 |
| Coefficient of friction: Static | 0.25 | 0.29 |
| Dynamic | 0.25 | 0.29 |
| Water absorption: % (24hr) | 0.01(.019”) | 0.06 (.029”) |
| Index of refraction, $n_D^{23}$ | 1.661 | 1.639 |
| **TYPICAL ELECTRICAL PROPERTIES** | **Parylene N** | **Parylene C** |
| Dielectric strength, short time (Volts/mil at 1 mil) | 7,000 | 6,800 |
| Volume resistivity, 23°C, 50% RH (Ohm-cm) | $1x10^{17}$ | $6x10^{16}$ |
| Surface resistivity, 23°C, 50% RH (Ohm) | $10^{15}$ | $10^{15}$ |
| Dielectric constant: 60 Hz | 2.65 | 3.15 |
| 1,000 Hz | 2.65 | 3.10 |
| 1,000,000 Hz | 2.65 | 2.95 |
| Dissipation factor: 60Hz | 0.0002 | 0.020 |
| 1,000 Hz | 0.0002 | 0.019 |
| 1,000,000 Hz | 0.0006 | 0.013 |
| **TYPICAL BARRIER PROPERTIES** | **Parylene N** | **Parylene C** |
| GAS PERMEABILITY cm³ - mil/100 in²-24hr – atm(23°C) | | |
| Nitrogen | 7.7 | 0.95 |
| Oxygen | 30 | 7.1 |
| Carbon dioxide | 214 | 7.7 |
| Hydrogen sulphide | 795 | 13 |
| Sulfur dioxide | 1.89 | 11 |
| Chlorine | 74 | 0.35 |
| MOISTURE VAPOR TRANSMISSION g-mil/100 in²-24hr, 37°C, 90%RH | 1.50 | 0.14 |
| 1 mil = 1/1000 in = 25.4 microns | | |
| **TYPICAL THERMAL PROPERTIES** | **Parylene N** | **Parylene C** |
| Melting temperatures (°C) | 410 | 290 |
| Linear coefficient of expansion ($10^{-5}$/°C) | 6.9 | 3.5 |
| Thermal conductivity, @ 25°C watts/Meter.Kelvin | 0.120 | 0.082 |

Fig. 1
Volume resistivity, 23°C, 50% RH (Ohm-cm)

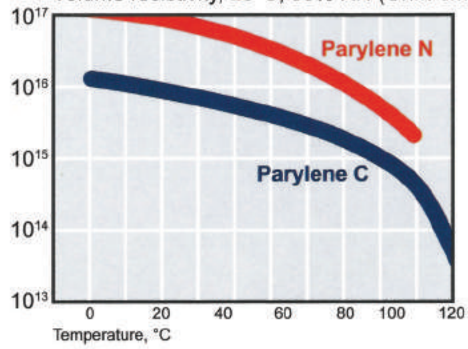



Fig. 2
Dielectric constant, 1,000 Hz

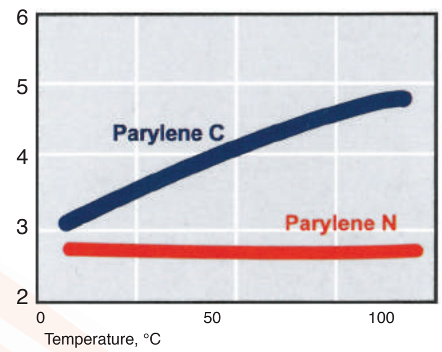
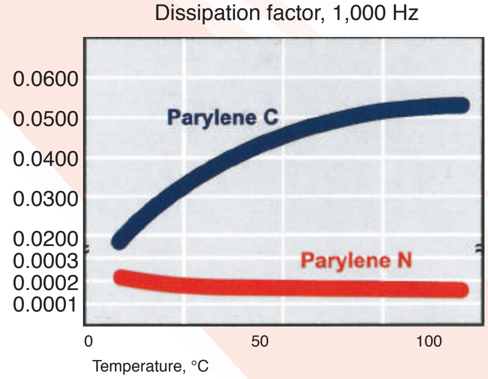
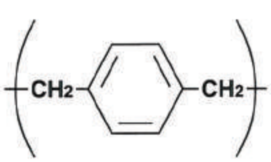



Fig. 3
Dissipation factor, 1,000 Hz

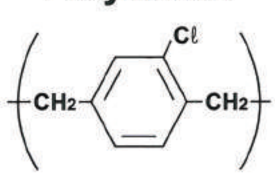



**Parylene N**




*Where lubricity is needed*

**Parylene C**




*Excellent barrier protection*

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