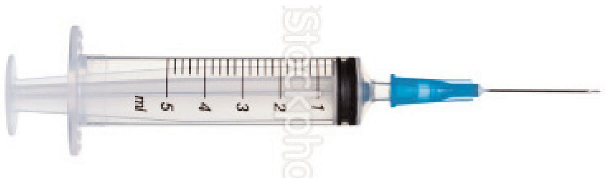
# Parylene:
# Improving and Protecting Elastomer Components

Enhanced Elastomer Performance

- Dry film lubricity
- Pinhole-free
- Thoroughly conformal
- High surface bond strength
- Thickness consistency
- Chemical resistance
- Solvent resistance

## Elastomers

Parylene's thin, transparent and flexible characteristics enhance the performance of rubber and elastomer components by protecting surfaces and modifying surface properties. These improvements are made without degrading the functional performance of the part. Parylene yields a truly conformal coated part with a consistent thickness on both flat surfaces and around the internal dimensions of openings and features as small as 0.01mm. Pinhole-free Parylene can prevent the transfer of substances into or out of a coated substrate. In particular, high molecular weight compounds such as silicone plasticizers are retained beneath the film barrier, and the coating also prevents solubilizing chemicals from intruding into an elastomer.




## Lubricity, Elasticity, Resistance to Surface Wear

Objects coated with Parylene film include a diverse range of rubber and elastomer components, from gaskets and seals to keypads and medical catheters. During the vacuum deposition coating process, the Parylene monomer is able to penetrate the surface of rubbers and plastics, providing outstanding adhesion. A 2 micron coating imparts exceptional dry lubricity as well as resistance to surface wear. For example, silicone rubber keypads are coated to improve the 'feel' of the surface by removing the elastomer tack while protecting the keyboard against dirt and oils, and shielding printed legends.

'O'-rings are coated to reduce friction in syringes. Parylene's static and dynamic coefficients of friction, which are in the range of 0.25 to 0.33, allow coated elastomers to approach the dry film lubricity of PTFE. Increased coating thicknesses further improve chemical and solvent resistance. Parylene film's elasticity and surface adhesion integrity enable the coating to accommodate elongation of the underlying elastomer without fracture or loss of the bond between the film and the substrate.

## Properties of Parylene

Enhanced Elastomer Performance

| 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)

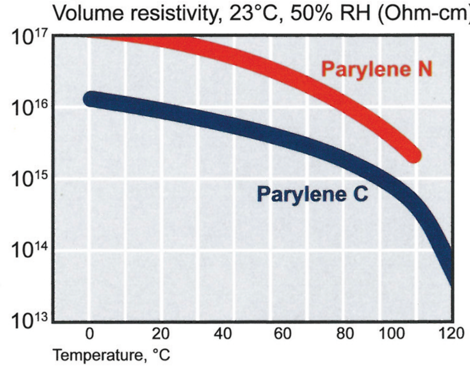



Fig. 2
Dielectric constant, 1,000 Hz

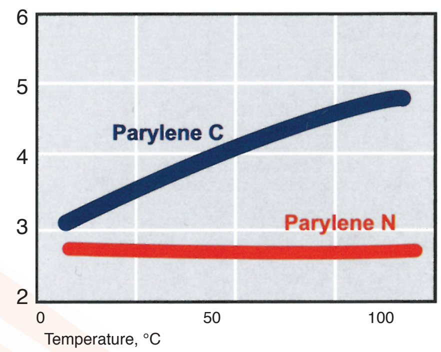
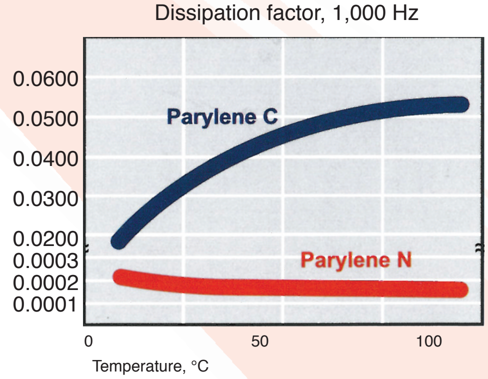
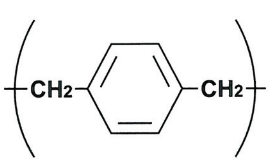



Fig. 3
Dissipation factor, 1,000 Hz

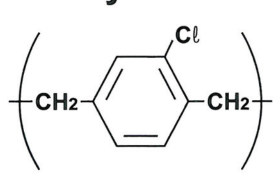



### Parylene N




*Where lubricity is needed*

### Parylene C




*Excellent barrier protection*

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