ADVANCED COATING
PARYLENE COATING SPECIALISTS

# PARYLENE CONFORMAL COATING SERVICES

Military | Medical | Aerospace | Commercial

Service ■ Quality ■ Competitive Price

## ABOUT US

Advanced Coating was founded in 1987 as a firm specializing in contract services of parylene conformal coating for military, commercial, electronics systems and medical devices.

Since its beginnings, Advanced Coating has established a reputation of providing the highest quality services in the industry.

Our commitment to quality, integrity and customer service combined with an unmatched expertise in applications and processes has provided every one of our customers with superior results.

In addition to an outstanding reputation and performance, Advanced Coating has developed numerous proprietary and patented processes related to the application of coatings and is continually developing new and enhanced procedures and applications to further the advancement of conformal coatings.

## CUSTOMER ENGINEERING

Advanced Coating is a full service organization with an experienced staff that stands ready to assist with design and engineering of conformal coating for specific applications. Our services include:

- Applications Analysis
- Fixturing Design and Consultation
- Production Flow Analysis
- Product Testing

## FDA APPROVED, MIL-SPEC & COMMERCIAL QUALIFIED

Advanced Coating operates facilities, which are continuously certified for military specifications contracts. In addition, Advanced Coating has an established track record of providing on-time top quality services for numerous military-government and FDA programs.

- MIL-1-46058
- IPC-610
- MIL-1-45208
- IPC-CC-830
- UL Approved
- ISO -9002
- FDA USP XXII, Class VI

## Highest Quality Certified

Advanced  Coating provides the absolute highest quality of services in the industry. Every aspect of the coating process is certified by qualified technicians and inspectors to guarantee to all of our customers that the highest level of documented quality is achieved.

# PARYLENE COATING FOR MEDICAL APPLICATIONS

## General Characteristics

- FDA Approved - USPXXII, Class VI Biocompatible
- Hydrophobic
- Completely pin-hole free barrier coating
- Fully conformal on any type of surface material or design
- Inert transparent polymer
- Barrier to oxygen, moisture, chemicals, solvents and carbon dioxide
- Barrier to ionic and moisture species
- Thermal mechanically stable between -200°C and 150°C
- Excellent adhesion properties
- Chemical and fungal resistance
- Particle encapsulation/immobilization
- No outgassing
- Non-contaminating coating and coating process: no solvents, catalysts or other by-product are used during coating
- Entire process is accomplished at room temperature, alleviating temperature stress on parts

## Applications

| | | |
|---|---|---|
| Pressure Sensor | Stints | Mandrels |
| Needles | Transducers | Syringes |
| Elastomeric Devices | Keypads | Tubing |
| Implants | Probes | Catheters |
| Filters | Pacemakers | Rubber Components |
| Guide Wires | Defibrillator | Valves |
| Surgical Instruments | Mold Release | RF Surgical Devices |

## Advantages

| | |
|---|---|
| PTFE Alternatives | Dry Film Lubricant |
| Hydrophobic | Inert Biocompatible Barrier/Non-Reactive |
| Uniform Coatings from 1 to 76 Microns (+/- 20%) | Vacuum Deposition - Non Contaminating Environment |
| Mechanically Flexible | Optically Clear |
| High Dielectric Isolation | Impervious to All Bodily Fluids |

## Highest Quality Certified

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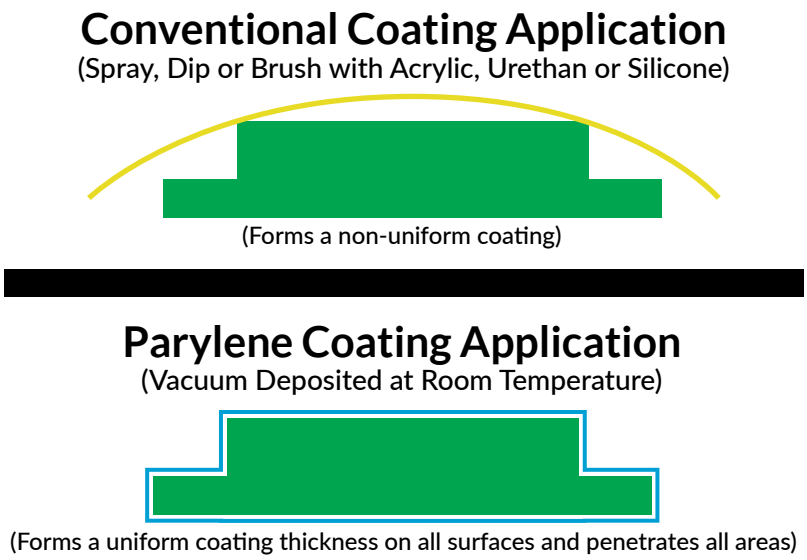
## PARYLENE PROPERTIES

- General Characteristics
- Mil-I-46058, Type XY Approved
- FDA Approved - USP XXII, Class VI Biocompatible
- UL Approve
- Hydrophobic
- Completely pin-hole free barrier coating
- Fully conformal on any type of surface material or design
- Inert transparent polymer
- Barrier to ionic and moisture species
- Thermal mechanically stable between -200°C and 150°C




- Extremely high dielectric 5,000 volts per 0.001” minimum
- Excellent adhesion properties
- Low/minimal impact on package cooling
- Barrier to oxygen, moisture, chemicals, solvents and carbon dioxide
- Low stress coating that does not form sites prone to crack initiation
- Chemical and fungal resistance
- Particle encapsulation/immobilization. No outgassing
- Non-contaminating coating and coating process: no solvents, catalysts or other by-products are used during coating
- Entire process is accomplished at room temperature, alleviating temperature stress on parts

| | Parylene C | Parylene N | ASTM Method |
|---|---|---|---|
| **ELECTRICAL PROPERTIES** | | | |
| Dielectric Strength Voltage breakdown (volts/mil) | 5,600 Volts | 7,000 Volts | D149 |
| Dielectric constant | | | D150 |
| 60 Hz | 3.15 | 2.65 | - - |
| 1 kHz | 3.10 | 2.65 | - - |
| 1 MHz | 2.95 | 2.65 | - - |
| Dissipation factor | | | D150 |
| 60 Hz | 0.020 | 0.0002 | - - |
| 1 kHz | 0.019 | 0.0002 | - - |
| 1 MHz | 0.013 | 0.0006 | - - |
| Volume resistivity @23°C, 50% RH, ohm | 8.8 x $10^{16}$ | 1.4 x $10^{1/}$ | D257 |
| Surface resistivity @23°C, 50% RH, ohm | 1 x $10^{14}$ | 1 x $10^{13}$ | D257 |
| **BARRIER PROPERTIES** | | | |
| Water Absorption % (24hr) | 0.06 (.029") | 0.01 (.019") | D570 |
| Moisture Vapor Transmission G-mil/100 $in^2$ - 24hr @37°C, 90% RH | 0.14 | 1.50 | D570 |

| | Parylene C | Parylene N | ASTM Method |
|---|---|---|---|
| **MECHANICAL PROPERITES** | | | |
| Density g/cm3 | 1.289 | 1.10 | D1505 |
| Refractive index ND23 | 1.639 | 1.661 | - - |
| Tensile Modulus GPa | 3.2 | 2.4 | D882 |
| Tensile Strength MPa | 70 | 43 | D882 |
| Tensile Strength psi | 10,000 | 6,500 | D882 |
| Yield Strength MPa | 5.5 | 43.4 | D882 |
| Elongation to Break % | 200 | 40 | D882 |
| Yield Elongation % | 2.9 | 2.5 | D882 |
| Coefficient of Friction - Static | 0.29 | 0.25 | D1894 |
| Coefficient of Friction - Dynamic | 0.29 | 0.25 | D1894 |
| Rockwell Hardness | R80 | R85 | D785 |
| **THERMAL PROPERTIES** | | | |
| Melting Point | 290° C | 420° C | - - |
| Liner Coefficient of Expantion ($10^{-5}$/ °C) | 3.5 | 6.9 | D696 |
| Thermal Conductivity @ 25° C | 2.0 | 3.0 | C177 |
| Specific Heat @ 20°C (cal/g/ °C) | 0.17 | 0.20 | - - |

## ELECTRICAL PROPERTIES OF PARYLENE VS. OTHER COATING TYPES

| Properties | ASTM Method | Parylene C | Epoxies | Silicones | Urethanes |
|---|---|---|---|---|---|
| Dieletric Strength Volts/inch short time | D149-64 | 5,000 volts (@ .001") | 400-500 Volts (@ .125") | 550 Volts (@ .125") | 450-500 Volts (@ .125") |
| Volume Resistivity ohms (23°C, 50%, RH) | D257-61 (Dielectric -- 1 $in^2$ mercury) | 8.8 X $10^{16}$ | $10^{12}$ - $10^{17}$ | 2 X $10^{15}$ | 2 X $10^{11}$ - $10^{15}$ |
| Dielectric Constant 60 Hz | D160-65T (Dielectric -- 1 $in^2$ mercury) | 3.15 | 3.5 - 5.0 | 7.75 - 3.05 | 4 - 7.5 |
| Dissipation Factor 60 Hz | D150-65T (Dielectric -- 1 $in^2$ mercury) | 0.020 | 0.002 - 0.01 | 0.007 - 0.001 | 0.015 - 0.017 |

## MECHANICAL PROPERTIES OF PARYLENE VS. OTHER COATING TYPES

| Properties | ASTM Methods | Parylene C | Epoxies | Silicones | Urethanes |
|---|---|---|---|---|---|
| Secant Modulus psi | ASTM D882-56T @ 1% strain | 400,000 | 350,000 | 900 | 1,000 - 10,000 |
| Tensile strength psi | ASTM D882-56T @ 10% strain/min | 10,000 | 4,000 - 13,000 | 800 - 1,000 | 175 - 10,000 |
| Elongation to break % | ASTM D882-56T @ 10% strain/min | 200 | 3 - 6 | 100 | 100-1,000 |
| Density gm/cc | ASTM D1505-57T | 1.289 | 1.11 - 1.40 | 1.05 - 1.23 | 1.10 - 2.5 |
| Index of Refraction ND 23 | Abbe Refractometer | 1.639 | 1.55 - 1.61 | 1.43 | 1.50 - 1.60 |
| Water Absorption 24 hrs | ASTM D570-57T | 0.06 | 0.08 - 0.15 | 12 (7 Days) | 0.02 - 1.5 |
| Rockwell Hardness | ASTM D785-65 | R80 | M80 - M110 | 40 - 45 (shore A) | 10A - 230 (shore) |

## THERMAL PROPERTIES OF PARYLENE VS. OTHER COATING TYPES

| Properties | ASTM Method | Parylene C | Epoxies | Silicones | Urethanes |
|---|---|---|---|---|---|
| T (melting) °C | Secant Modulus Temp. Curve | 290 | Cured | Cured | 170 |
| Linear Coefficient of Expansion ($10^{-5}$ / °C) | ASTM D696-44 | 3.5 | 4.5 - 6.5 | 25 - 30 | 10 - 20 |
| Thermal Conductivity @ 25°C | ASTM C177 | 2.0 | 4 - 5 | 3.5 - 7.5 | 5 |
| Specific Heat @ 20°C (cal / g / °C) | - - | 1.639 | 1.55 - 1.61 | 1.43 | 1.50 - 1.60 |

## IMPACT RESISTANCE OF PARYLENE VS. URETHANE AND EPOXY

| Material | Thickness (Microns) | Impact Resistance (Kg - Cm) |
|---|---|---|
| Parylene C | 3 to 73 | >85 |
| Urethane | 63 | 25 |
| | 125 | 51 |
| | 250 | 74 |
| | 375 | >85 |
| Epoxy | 125 | 35 |
| | 250 | 81 |
| | 375 | >85 |

## WHAT IS PARYLENE

Parylene is a conformal protective polymer coating material utilized to uniformly protect any component configuration on such diverse substrates as metal, glass, paper, resin, plastic, ceramic, ferrite and silicon. Because of its unique properties, Parylene conforms to virtually any shape, including sharp edges, crevices, points; or flat and exposed internal surfaces.

**Conventional Coating Application**
(Spray, Dip or Brush with Acrylic, Urethan or Silicone)

(Forms a non-uniform coating)

**Parylene Coating Application**
(Vacuum Deposited at Room Temperature)

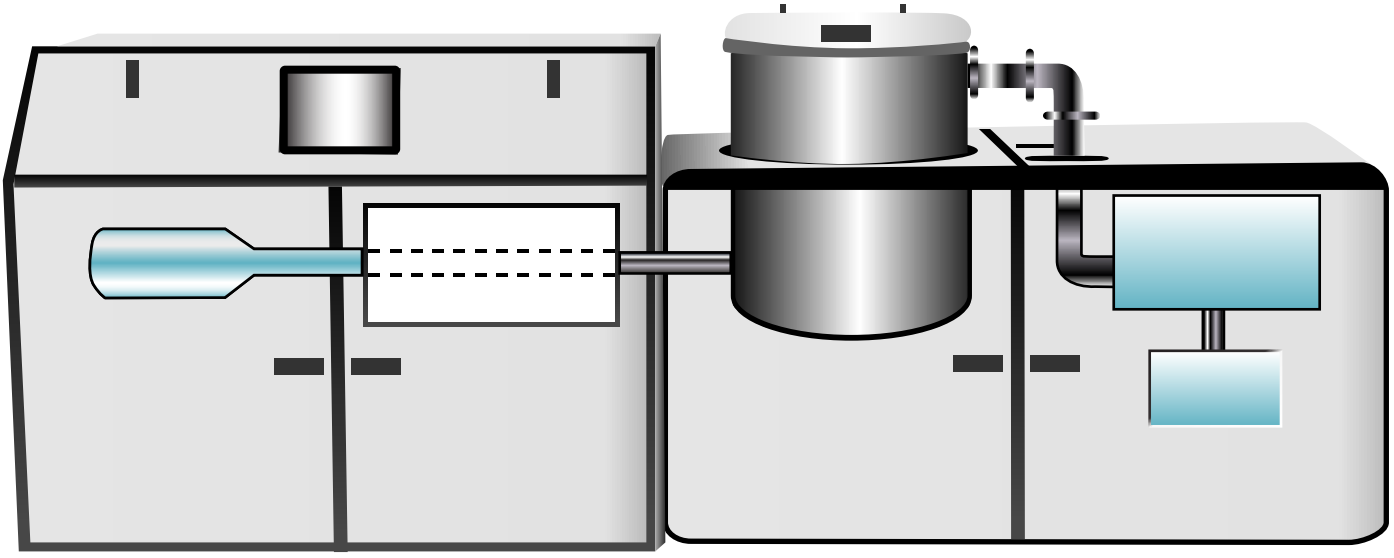
(Forms a uniform coating thickness on all surfaces and penetrates all areas)

### Vacuum Deposition:

Parylene is applied at the molecular level by a vacuum deposition process at an ambient temperature. Film coatings from 1 to 76 microns can be easily applied in a single operation. No catalysts or solvents are required; and no foreign substances are introduced that could degrade the coated surface.

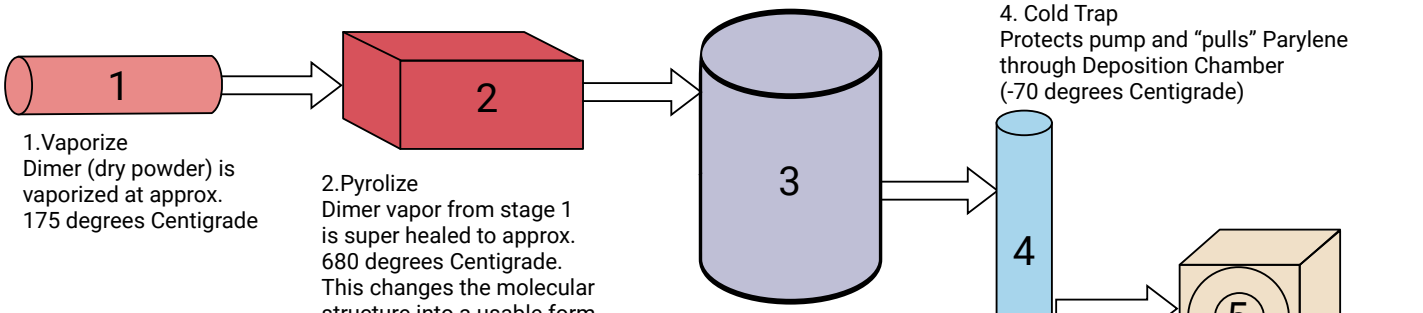
## Temperature Independent Properties:

Parylene exhibits excellent dielectric strength, exceptionally high surface and volume resistivities; and electrical properties that are essentially independent of temperature. It provides a conformal, pinhole free coating that is unexcelled for corrosion resistance and dielectric protection.



## The Parylene Process

Parylene is applied at room temperature with specialized vacuum deposition equipment that permits control of coating rate and thickness. The deposition process takes place at the molecular level as the chemical, in the dimer form, is converted under vacuum and heat to dimeric gas; pyrolized to cleave the dimer; and finally deposited as a clear polymer film.




1.Vaporize
Dimer (dry powder) is vaporized at approx. 175 degrees Centigrade

2.Pyrolize
Dimer vapor from stage 1 is super healed to approx. 680 degrees Centigrade. This changes the molecular structure into a usable form.

3. Deposition
Parylene is deposited onto parts at room temperature (25°C) and approx. 0.1 TORR vacuum.

4. Cold Trap
Protects pump and "pulls" Parylene through Deposition Chamber (-70 degrees Centigrade)

5. Vacuum Pump
Mechanical Pump keeps entire process under closed vacuum.

## TYPICAL USES FOR PARYLENE:

- Conformal Coating for Circuit Boards & Electronic Assemblies (Meets MIL-I-46058)
- Partial Immobilization
- Lubricity (e.g. Catheter Guide Wires)
- Dielectric (e.g. Cores/Bobbins)
- Hydrophobic (e.g. Biomedical Tubing)
- Barrier (e.g. Filters, Membranes, Valves)

## PARYLENE APPLICATIONS

| | | |
|---|---|---|
| Accelerometers | Catheters | Coils |
| Cores | Bobbins | Fiber Optic Components |
| Heat Exchangers | Pacemakers Implants | Flow Meters |
| Magnets | Photoelectric Cells | Electro-Surgical Instruments |
| Sensors | Transducers | Circuit Boards |
| Hybrid Circuits | Elastomeric Keypads | Plastic Encapsulated Microcircuits (PEMS) |

### Ferrite Cores & Bobbins:

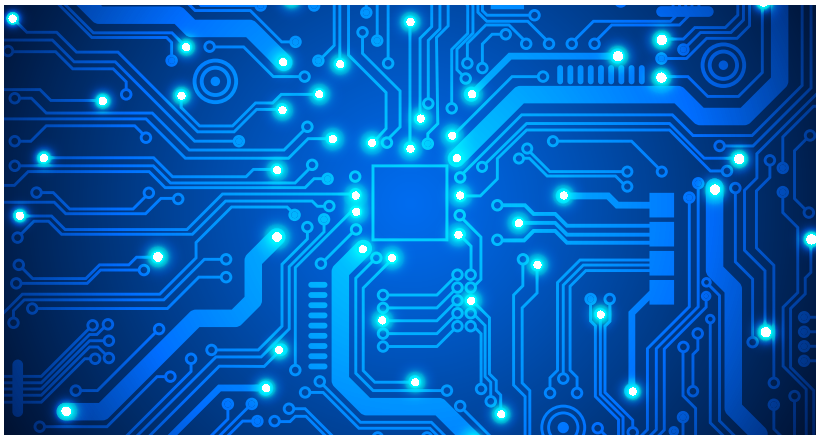
Eliminates insulation stripping from magnetic core windings. Provides low friction interface to speed stringing & windoing operations. Smooths rough edges and prevents chipping and dusting. Permits greater cross section winding area and greater coil Q.

### Corrosion Resistant Coating:

Protects sensing elements used in process control loops. Easily applied to flexing bellows.

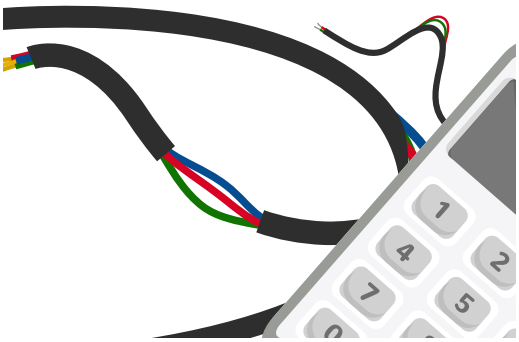
### Circuit Boards:

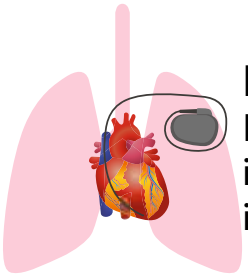
Qualified under MIL-I-46058. Fully Coats fine lead wires and ends. Highly reliable in hostile environments. Provides dielectric protection for resistors, thermocouples and other components.



## Micro-Electronics:

Provides strength, stability, security and particle immobilization. Provides purity, maximum border protection and total surface conformity. Solvent free application at room temperature.





## Medical Applications:

Provides non-reactive, inert, pinhole-free barrier for biomedical instrumentation. Permits comparable functional utilization with body implant devices.

## Hybrid Circuits:

Strengthens wire bonds and deters electrical shorting. Provides protection from environmental hazards. Eliminates moisture, metallic ions and other contaminants from critical surfaces. Lower mass and weight than other coatings. Molecular deposition provides superior penetration. Coats into, under and around ALL components.