



SCS MILITARY COATINGS

Reliable protection for critical applications.



SPECIALTY COATING SYSTEMS™

A KISCO Company

SCS

INNOVATIVE SOLUTIONS FROM THE LEADER IN PARYLENE

With over 45 years of experience in Parylene engineering and applications, Specialty Coating Systems (SCS) is the world leader in Parylene conformal coating technologies. We're a direct descendant of the companies that originally developed Parylene, and we leverage that expertise on every project – from initial planning to process application.

SCS employs some of the world's foremost Parylene specialists, highly experienced sales engineers and expert manufacturing personnel, working in state-of-the-art coating facilities in 12 countries worldwide. Our extensive, proactive approach to production and quality requirements gives our customers peace of mind and minimizes the resources they need to meet even the most challenging requirements and specifications.

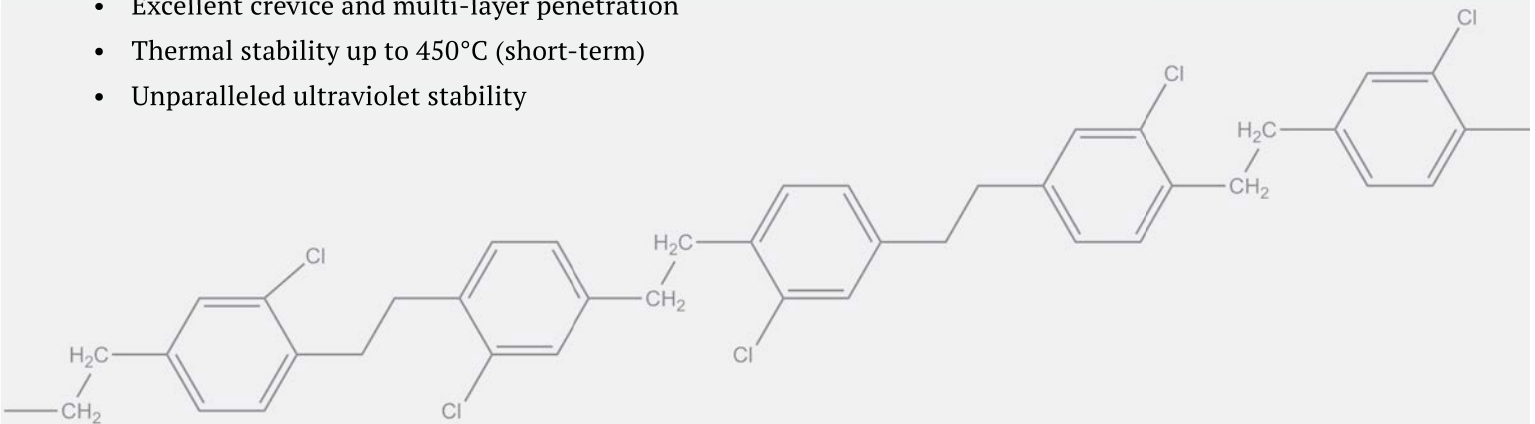


SCS PARYLENE COATINGS

SCS combines the properties of Parylene with its years of experience, vast technology and worldwide resources to provide the military and defense industries with reliable coatings and services, including Parylene HT[®], which is specifically engineered to withstand the most extreme conditions in the industry.

Ultra-thin and pinhole-free, SCS Parylene coatings offer exceptional properties, including:

- Excellent dielectric properties
- Excellent chemical and moisture barrier properties
- Ultra-thin, conformal coating of all exposed surfaces
- Excellent crevice and multi-layer penetration
- Thermal stability up to 450°C (short-term)
- Unparalleled ultraviolet stability



ENVIRONMENT-FRIENDLY COATINGS AND PROCESSES

SCS COMPLIES

As worldwide industry requirements and directives continue to evolve, SCS is at the forefront ensuring our products and services comply with relevant regulatory, environmental and biological standards.

SCS coating centers maintain AS9100C and ISO 9001:2008 certifications. Additionally, SCS Parylenes comply with the European Union's RoHS (Restriction of Hazardous Substances) Directive. SCS also has lead-free, halogen-free and low VOC initiatives to support

our customers. For more information about SCS certifications and standards, visit SCScomplies.com.

METAL WHISKER MITIGATION

As a result of industry directives, pure metal plating is replacing lead in the solders used throughout the worldwide electronics industry. While safer for the environment, metal plating is known to form whiskers, which cause reliability problems for electronic systems. Parylene coatings suppress the formation of metallic whiskers, OSEs (odd shape eruptions) and dendrites.

SCS PARYLENE COATING PROPERTIES

DIELECTRIC PROPERTIES

SCS Parylenes have excellent dielectric properties. Their high dielectric strength is attributable to the fact that they can be formed as thin, continuous films, free from the defects and fillers commonly found in conventional coatings that tend to reduce dielectric strength.

SCS Parylene HT has the lowest dielectric constant and dissipation factor and a high dielectric strength, enabling electrical signal transfer without absorption or loss.

THERMAL STABILITY

Many components in the military, avionics and aerospace industries require protection in the midst of extreme environments. SCS Parylene HT is specifically engineered to provide long-term thermal stability up to 350°C, with short-term stability up to 450°C, offering excellent protection to many automotive, military and aerospace applications.

BARRIER PROPERTIES

SCS Parylene coatings are excellent moisture and chemical barriers. Applied in the micron range, much thinner than industry standard coatings, Parylene provides a superior pinhole-free, uniform barrier to protect against corrosive liquids, fluids, gases and chemicals, even at elevated temperatures.

Circuit boards coated with SCS Parylene HT were salt-fog tested by an independent testing facility. The coated boards showed no corrosion or salt deposits after 144 hours of exposure in accordance to ASTM B117-(03) (See Figure 1). Boards coated with Parylene C exhibited similar results.

UV STABILITY

SCS Parylene HT offers measurable UV stability after more than 2,000 hours of UV exposure (ASTM G154). Its chemical structure provides protection from degradation and discoloration as a result of such exposure.

PARYLENE C-UVF®

Because Parylene coatings are optically clear, there is an inherent level of difficulty involved in identifying whether a component has been coated with Parylene. As a solution to this challenge, SCS developed a unique technology to assist customers in the process of identifying Parylene coated boards — SCS Parylene C-UVF. For more information about this product, contact SCS.



SCS PARYLENE PROPERTIES

	Method	Parylene HT	Parylene C	Parylene N	Acrylic (AR) ^{a,b}	Epoxy (ER) ^{a,b}	Polyurethane (UR) ^{a,b}	Silicone (SR) ^{a,b}
Dielectric Strength V/mil	1	5,400	5,600	7,000	3,500	2,200	3,500	2,000
Dielectric Constant	60 Hz	2.21	3.15	2.65	–	3.3 – 4.6	4.1	3.1 – 4.2
	1 KHz	2.20	3.10	2.65	–	–	–	–
	1 MHz	2.17	2.95	2.65	2.7 – 3.2	3.1 – 4.2	3.8 – 4.4	3.1 – 4.0
Dissipation Factor	60 Hz	<0.0002	0.020	0.0002	0.04 – 0.06	0.008 – 0.011	0.038 – 0.039	0.011 – 0.02
	1 KHz	0.0020	0.019	0.0002	–	–	–	–
	1 MHz	0.0010	0.013	0.0006	0.02 – 0.03	0.004 – 0.006	0.068 – 0.074	0.003 – 0.006
Water Vapor Transmission Rate (g•mm)/(m²•day)	3, 4, 5	0.22	0.08	0.59	13.9 ^c	0.94 ^c	0.93 – 3.4 ^c	1.7 – 47.5 ^c
Water Absorption (% after 24 hours)	6	<0.01	<0.1	<0.1	0.3	0.05 – 0.10	0.6 – 0.8	0.1
Service Temperature	Continuous	350°C	80°C	60°C	82°C	177°C	121°C	260°C
	Short-Term	450°C	100°C	80°C	–	–	–	–
UV Stability	7	≥2,000 hrs	≤100 hrs	≤100 hrs	–	–	–	–
Tensile Strength (psi)	8	7,500	10,000	7,000	7,000 – 11,000	4,000 – 13,000	175 – 10,000	350 – 1,000
Penetration Ability^d		50 x dia.	5 x dia.	40 x dia.	Spray or Brush	Spray or Brush	Spray or Brush	Spray or Brush

a. *Handbook of Plastics, Elastomers, and Composites*, Chapter 6, “Plastics in Coatings and Finishes,” 4th Edition, McGraw Hill, Inc., New York, 2002.

b. *Conformal Coating Handbook*, Humiseal Division, Chase Corporation, Pennsylvania, 2004.

c. *Coating Materials for Electronic Applications*, Licari, J.J., Noyes Publications, New Jersey, 2003.

d. Depth into tubing and crevices.

Test Methods:

1. ASTM D149
2. ASTM D150
3. ASTM F1249 (at 100% RH, 38°C) (Parylene HT only)
4. ASTM F1249 (at 90% RH, 37°C) (Parylene C only)
5. ASTM E96 (at 90% RH, 37°C) (Parylene N only)
6. ASTM D570
7. ASTM G154
8. ASTM D882

PROTECTION FOR ADVANCED APPLICATIONS

SCS can apply Parylene coatings to virtually any surface material, including metals, elastomers, resins, plastics and ceramics, in thicknesses ranging from a few hundred angstroms to several mils. Parylene polymerizes as a uniform, thin-film coating that conforms to all surfaces, edges and crevices of a substrate, including the interior of multi-layer electronic packages. As a result of its ultra-thin application, Parylene adds little dimension or mass to critical, weight-sensitive components.

SCS employs the unique properties of Parylene to provide specialized conformal coating solutions to customers in the following industries:

MILITARY

As the military continues to integrate COTS (commercial off-the-shelf) components, which were not specifically designed for demanding environments, into their systems, Parylene provides protection to increase the life of these components. The coating’s outstanding barrier and complete encapsulation properties provide reliable protection for critical applications.

Parylene also ensures trouble-free performance life for emission control, engine management and fuel systems used in automotive and heavy-duty military vehicle applications.

The UAV (unmanned aerial vehicle) segment continues to expand into new categories such as micro, autonomous land and underwater vehicles. Parylene is an ideal conformal coating in these applications due to its ultra-thin and lightweight nature. Additionally, Parylene is optically clear and does not interfere with electrical, optical or RF signals.

When space is a premium and weight is a determining factor, Parylene coatings provide unmatched protection for critical electronic systems.

SPACE

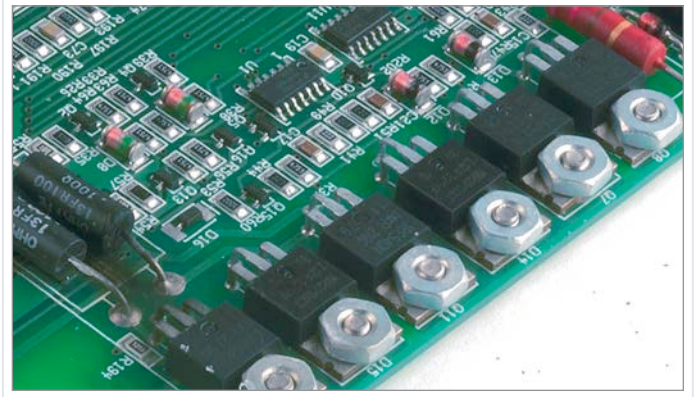
Parylene has a long history of protecting components used in satellites, space-borne instrumentation and vehicles. Since Parylene is applied in a vacuum, there are no hidden voids or incomplete coverage that, when exposed to altitude, may present pathways for failure. Parylenes also offer excellent dielectric properties for aerospace applications. Please refer to <http://outgassing.NASA.gov> for further information on the use of Parylene in space applications.

AVIATION

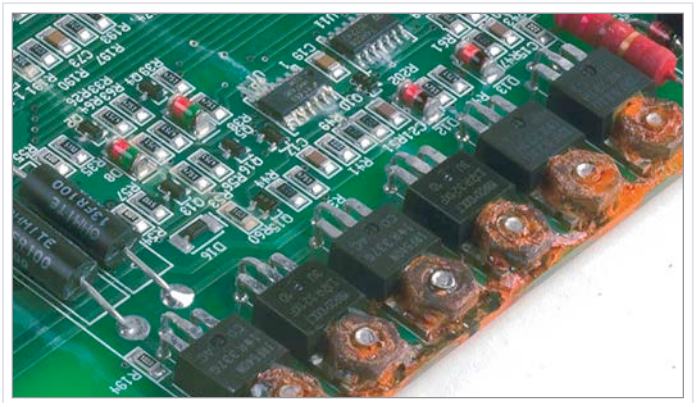
Aircraft manufacturers are continually seeking ways to reduce weight in order to increase operating efficiencies. Parylene coatings, which are typically applied in micron-level thickness, are ultra-thin and lightweight. They provide avionic components with excellent barrier properties, including pinhole-free protection from corrosive liquids, fluids, gases and chemicals, even at elevated temperatures. Parylene is an ideal coating for circuit boards, sensors and other components used to monitor electrical, air handling, fuel and engine systems, and flight control systems.

SCS Parylene HT offers excellent UV stability, providing a reliable solution for interior and exterior LED applications. In addition, Parylene does not contain any fillers, so there is very little light reduction.

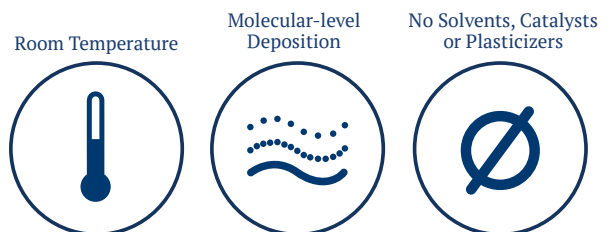
FIGURE 1: Circuit boards after 144 hours of salt-fog exposure



Coated with SCS Parylene HT



Uncoated



THE PARYLENE PROCESS

SCS Parylene coatings are applied in a room temperature vacuum chamber via a vapor deposition polymerization (VDP) process. Components to be coated are only required to have a reasonable vacuum tolerance. There are no solvents, catalysts or plasticizers involved in the coating process and, since Parylene coatings require no elevated temperature cure cycle, there are no associated cure stresses. Unlike Parylene coatings, conventional dipped, sprayed or brushed coatings may require catalysts, cross-linking, elevated temperatures or UV cure cycles to improve coating properties.



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