SIPIOL® UV DIELECTRIC COATINGS – ALL GRADES

Application Guide

Sipiol® UV coating is a single-component, 100% solids, dielectric coating that fully cures in seconds.

Application of Sipiol UV coating on electrically-sensitive components provides comparable dielectric protection as PET film.

Preparing the Coating

Correct mixing and application are critical to performance and adhesion of the coated part.

Mixing Pails: Utilizing a pail or drum roller, mix pail of Sipiol UV coating at 30-60 rpm for 30-60 minutes prior to use.

If using a mixing blade, a round or impeller type mixer is recommended. Do not use dispersion-style blades which can damage the coating.

Mixing Drums: Parker Lord offers drums equipped with an internal mixer. The mixer must be attached to an air-driven motor. The lid with the air-driven motor and mixing blade can be utilized on subsequent drums if desired. The use of this drum configuration eliminates the need for day-tanks, loading material, tank maintenance, and reduces the risk of foreign object debris contaminating the coating.

Utilizing a drum roller or self-mixing drum, mix 55-gallon drum of Sipiol UV coating at 30-60 rpm for 2-4 hours prior to use.

Mixing Notes:

- Protect Sipiol UV coating from incidental light exposure to prevent advancing or curing the coating.
- Mixing above 60 rpm is not recommended as it can result in splashing and lead to an over incorporation of air into the coating.
- If Sipiol UV coating is not being expended from a drum, day-tanks fitted with low-speed agitation are recommended to keep Sipiol UV coating homogenous during use.

Cleaning Substrates Prior to Coating Application

A uniform and clean substrate is imperative to achieve robust coating adhesion.

While final adhesion of the coating can be applied utilizing different substrate preparation techniques, a few basic cleaning rules must be followed to ensure proper application of the coating:

- **Remove burrs** leftover from stamping/extrusion operations. Proper deburring techniques may include honing, manual grinding, punch deburring, automated brushing, electrochemical removal, tumbling, rolling, and media blasting.
- **Remove all surface contaminants** and decomposition products. Some surface preparation techniques (refer to next section) can be utilized to clean a substrate and improve its overall adhesion in the same step. This is common in high-throughput applications in the automotive industry where techniques such as flame treatment, plasma treatment, laser treatment, chemical etchants, and conversion coatings are employed.

  For low-rate production environments, or where the adhesion between the coating and the underlying substrate is not as critical, a simple IPA or MEK wipe is satisfactory.
- Prevent recontamination by practicing good industrial hygiene when handling clean parts and through subsequent industrial steps. Examples include: wearing clean gloves, proactively avoiding contamination of spray lines by compressor oil and condensation via utilization of clean and dry air that has been filtered.

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Preparing Substrates

Additional substrate preparation, beyond cleaning, may be desirable to improve bonding between the coating and the underlying substrate.

Table 1 lists techniques which Parker Lord has characterized.

More detailed data on specific coating formulations and substrates is available to customers upon request.

Substrates most-likely to require adhesion improvement include automotive-grade thermoplastics and certain types of e-coated steel with low surface energy. For these substrates, flame, plasma, and laser treatments should be evaluated.

It is recommended that adhesion be screened on test panels beforehand to determine if and which surface preparation method is necessary for desired performance.

If you are uncertain of how to pre-screen for adhesion utilizing different surface techniques, please contact Parker Lord and a member of our Application Engineering team can assist.

Equipment for Coating Application

The recommended method for applying Sipiol UV coating is spray application.

The ideal spray method for each configuration should be determined by the size and number of parts to be coated and the equipment available.

Application of the coating is generally automated to ensure consistency from part-to-part. If you are in need of an automation integrator familiar with Sipiol UV coating, please contact your Parker Lord representative for recommendations.

Table 1. Common Adhesion Improvement Techniques

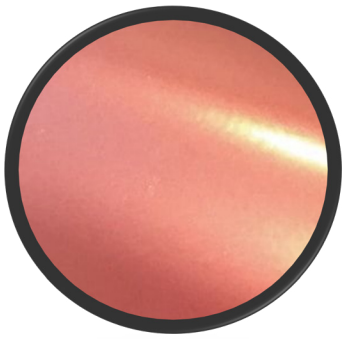
Technique	Speed in Automation	Surface Energy Gain	Typical Capital Cost
Flame Treatment	Fast	★★★★★	$$
Plasma Treatment	Fast	★★★★	$$$
Laser Treatment	Medium	★★★★★	$$$$
Alodine Conversion	Medium	★★★	$$
Chemical Etchant	Medium	★★★★★	$$
Solvent Wipe	Slow	★	$
20-25 Glass Grit Blast	Slow	★★★★★	$

For the most uniform results, the following types of application techniques may be used:

- Airless Spray
- Assisted Airless
- Rotobell Spray
- Electrostatic Spray

Sipiol UV coating can also be applied via HVLP gun, but will generally result in a more mottled, less uniform appearance as a result; refer to Figure 1.

Surface Finish as applied via Airless, Assisted Airless, Rotobell, and Electrostatic Guns



Surface Finish as applied via HVLP Gun

Figure 1. Surface Finish by Spray Gun Type

Regardless of the spray-gun chosen, all fluid lines to and from the gun, dosing systems, and drum must be insulated from light to prevent curing of the coating.

Refer to Table 2 for additional equipment parameters to consider.

Applying the Coating

Because Sipiol UV coating is a functional coating, eliminating the risk of dry-spray defect is critical to ensuring proper functionality of the parts coated.

As such, **when applying Sipiol UV coating, Parker Lord recommends a two-pass, two-cure method, referred to as the "2/2-method".**

In practice, the 2/2-method involves:

- applying approximately 50% of the final dry film thickness in the first 2-4 spray gun passes across the substrate.
- tack-curing the first applied layer of coating (20% of full cure); and then
- applying the remaining 50% of the final dry film thickness, again in 2-4 passes of the spray gun; before
- sending to final cure.

This 2/2-method greatly reduces the potential for pin-hole defects potentially induced in a high-rate production environment.

Table 2. Additional Equipment Parameters

Equipment Considerations	Parameters
Hose Material	Nylon, Opaque
Hose Diameter	3/8" ID minimum
Atomization Pressure (at gun)	20 - 80 psi
Fluid Pressure (at gun)	<25 psi
Nozzle Size	0.8 - 1.4 mm
Filter Size	150 - 250 microns
Line Pressure	Will change with configuration. Work with your integrator to ensure line-pressure calculations have been done before installation.

Table 3. Application Environment

Property*	Range
Application Temperature, Production Facility Temperature	18 - 35°C (64 - 95°F) ideal range: 22 - 25°C (72 - 77°F)
Substrate Temperature**	10-50°C (50 - 122°F)
Spray Pressure	2 - 5 bar
Spray Temperature***	20 - 50°C (68 - 122°F)
Booth Temperature	18 - 35°C (64 - 95°F) ideal range: 22 - 25°C (72 - 77°F)
Booth Relative Humidity	⩽80 %RH ideal range: 40 - 50 %RH

*Sipiol UV coating can be sprayed in a variety of environmental settings without risk to the coating. Application process parameters listed above are a starting point and may need to be changed to reflect a changing environment and experiences at your specific plant location. Please refer to your equipment provider for recommended changes per the results experienced.

**Substrate temperature should be controlled so that the parts do not see contamination or environmental effects such as condensation.

***Recent testing with suppliers indicate heating may not be necessary for uniform spray application depending on spray equipment and room temperature swings. If heating is ultimately needed for material viscosity control, indirect on-demand heating is recommended leading up to the spray guns.

Coating Application Warnings

- Other coating methods, such as one-coat, one cure (1/1-method) have been investigated. The use of a 1/1-method increases the risk for equipment-induced, dry-spray defect.
- Exceeding 230 microns of application before curing will leave uncured material below the surface of the coating.
- Heating the coating is not necessary for its application. Some manufacturers prefer to heat coatings at a constant temperature to avoid potential viscosity changes induced by changing seasonal temperatures in non-temperature controlled facilities. If this is implemented, it is strongly recommended that:
  - » Drum heaters, heated pressure pots, and heated baths not be used. These units often lack precise temperature control and can result in significant build-up of caked-on-coating next to heating coils/sidewalls that can potentially clog downstream guns, filter pumps, and dosing meters.
  - » The coating is only heated via a line-heater, immediately before the spray gun and after all flow-controllers and pumps. This will eliminate clogging from particulate cured via friction-created heat from the gearing and dosing of these systems.
  - » Coating temperature must not exceed 70°C. Doing so will irreparably damage the coating.

Curing

It is recommended to cure the coating using a broad-spectrum bulb with strong UV output, such as an H-bulb or D-bulb.

For metal-halide bulbs, a minimum lamp intensity of 600 mW/cm^2 is recommended. Lower intensity lamps will work, but the cure time will be longer to reach the recommended UVA energy.

Measure the total UV energy with a radiometer to ensure the appropriate cure energy is achieved.

For standard film thicknesses typically seen, up to 230 µm built in two layers with a tack cure, the following standard cure process is recommended:

Standard cure for coatings up to 230 microns in two layers where the fist layer may be up to 150 microns

	H-Bulb		D-Bulb	
	Tack Cure	**Full Cure**	**Tack Cure**	**Full Cure**
UVA Energy (mJ/cm^2)	800 - 1200	2000 - 3400	1850 - 2780	4000 - 6000
UVB Energy (mJ/cm^2)	800 - 1200	2000 - 3400	590 - 890	1300 - 2000
UVC Energy (mJ/cm^2)	180 - 280	400 - 700	120 - 180	200 - 400

For applications where thick coating layers are needed, such as 300 µm, the cure process needs to be modified. For best results, this thick of a film should be applied in a 2-coat, 2-cure process, and target energies are listed below:

Extended cure for thick films, building to final film with 2 coats and a tack cure where the first layer may be up to 150 microns

	H-Bulb		D-Bulb	
	Tack Cure	**Full Cure**	**Tack Cure**	**Full Cure**
UVA Energy (mJ/cm^2)	1300 - 1500	5000 - 7000	3000 - 3500	11500 - 16200
UVB Energy (mJ/cm^2)	1300 - 1500	5000 - 7000	950 - 1120	3650 - 5200
UVC Energy (mJ/cm^2)	260 - 350	1250 - 1750	190 - 230	725 - 1100

LED curing is possible with high-intensity lamps in the 365-385 nm range, but the coating will initially have surface tack. Surface tack will resolve within 24 hours. If using LED equipment to cure Sipiol UV coating, a minimum lamp intensity of 2 W/cm^2 is recommended. Lower intensity LED lamps will work, but the cure time will be longer to reach the recommended UVA energy and surface tack may be more apparent. Measure the total UVA energy with a radiometer to ensure the appropriate cure energy is achieved. When curing with LED, Sipiol UV coating needs to achieve a total UV cure energy in the UVA range of 4000-6500 mJ/cm^2 for 2 W/cm^2 LED. Optimum cure conditions should be determined empirically for each light source by measuring the effect of exposure time and intensity on the cured properties. The coating needs direct line-of-sight to the bulb to ensure full cure.

Contact a Parker Lord representative to confirm lamp selection is appropriate for use with Sipiol UV coating.

Shelf Life/Storage

Shelf life of Sipiol UV coating is nine months from date of manufacture when stored below 27°C (81°F) in original, unopened container. Do not allow product to freeze.

Shelf life is subject to change as new data from production batches becomes available.

Cautionary Information

Before using this or any Parker Lord product, refer to the Safety Data Sheet (SDS) and label for safe use and handling instructions.

Verify Volatile Organic Compounds (VOC) requirements with the applicable local, regional and state air quality authorities before importing, selling or using this product. VOC rules, thresholds and reporting obligations vary by jurisdiction; compliance is the responsibility of the importer/seller/owner.

For industrial/commercial use only. Must be applied by trained personnel only. Not to be used in household applications. Not for consumer use.

Troubleshooting

Visual Spray Defects: Visual spray defects can have a number of causes, including not breaking the coating up with adequate atomization, contamination, or too heavy of film build. Causes and solutions are outlined below:

Cause	Solution
Too low atomization	Adjust spray pressure.
Contamination (e.g. fisheyes) or debris	Add an inline filter to remove moisture, oil, and any contaminants from air supply line. Clean substrate to remove contamination. Protect from recontamination after cleaning.
Too heavy wet film thickness	Apply coating with multiple thin passes across the substrate to build film. This prevents defects from causing appearance and performance issues.

Sag/Running: Caused by too heavy of film build.

Solutions – Apply thinner coating layers. Move nozzle further from substrate, apply thinner coating layers and cure in between, reduce atomization or reduce fluid flow.

Uncured Areas: Caused by too heavy film thickness or poor cure lamp positioning.

Solutions – Apply thinner coating layers, cure in between coats if necessary to build heavy films. Reposition part or lamp to ensure direct line-of-sight between the part and UV bulb.

Hi-pot Failure: This is often caused by application methods and modifying spray application can resolve this concern. Causes and solutions are listed below:

Cause	Solution
High humidity in test area	Test hi-pot in a controlled environment [22°C (72°F), 50% RH].
Low film thickness	Adjust spray settings, increase fluid flow and atomization. Apply additional layers.
Uneven coating thickness	Check nozzles for clogs, clean nozzles, measure shot sizes, adjust gun positioning.
Too heavy wet film thickness	Apply coating with multiple thin passes across the substrate to build film to ensure a continuous coating film and prevent defects from causing performance issues.
Debris, damage	Clean substrate, protect from recontamination after cleaning. Protect coated part from damage after coating including during packaging and assembly.

Poor Adhesion: Caused by substrate cleanliness or substrate type.

Solutions – Clean substrate, especially removal of oils, and protect from recontamination after cleaning. For certain substrates, it may be necessary to use a primer or plasma to improve adhesion. Use a mechanical method to increase surface roughness such as selecting a mill finish over a mirror finish, grit blast, or laser texture the surface.

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