GuardCoat™ EC

GuardCoat™ EC is an electrophoretic coating process that deposits a clear protective layer on conductive metals such as aluminum, brass, copper, nickel, gold, silver, zinc, and other metal finishes. The product is a water-based acrylic lacquer, with a stable emulsion of resins, which provides a uniform level coat no matter the geometrical complexity of the substrate part. Should the coating need a colour, a wide selection of dyes is available to add to the process. GuardCoat™ EC is easy to operate: rinse, electro coat, rinse, and cure in an oven. Once cured in the oven, this acrylic topcoat resists corrosion and improves wear resistance properties while maintaining the colour and brightness of the original finish.

This special E-coat yields an economical and corrosion resistant finish. The clear deposit is completely uniform in the high and low current density areas with no runs, teardrops, rainbows, or bare spots experienced from conventional lacquers. GuardCoat™ EC is not dipped or sprayed as conventional lacquers since it is electrodeposited. This cathodic electro coat provides superior corrosion resistance compared to anodic one and yields higher performance for parts of exterior use and will not attack or discolour the finish.

Features/Benefits

- Clear coat that preserves the look of the substrate
- Low VOC, with reduced fire hazard
- High transfer efficiency (95%) with precise film control
- Allows more efficient jig loading resulting in higher throughput
- Delivers a high quality reproducible finish from a low maintenance process
- Excellent throw power delivers uniform coating on complex parts
- Provides sharper image and higher DOI than traditional spray or dip lacquer parts
- Water based with low VOC
- Even film application regardless of complexity of shape
- Film thickness: 5 – 10 microns
- Humidity/Adhesion (Wet) ASTM D3359-97: 100%
- Crosshatch Adhesion (Dry)ASTM D3359-97: 100%
- Gloss – 60 Degree ASTM D523-89: full gloss
- Salt Spray Resistance ASTM B117: 240 hours – no blisters, 4 – 5 mm creep
- Pencil Hardness ASTM D3363-00: 4H +
- Humidity ASTM D1735-99: 500 hours minimum

Materials Required

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DI Water	Only deionised water with conductivity of less than 5µS should be used in the process.
GuardCoat™ EC	A starting material that needs to be diluted with deionized water to become a working bath. It is also used in replenishment of solids in a working bath. In summary, GuardCoat™ EC is a concentrate and replenisher.

GuardCoat™ EC Solvents

Solvent T	Replenishes the loss of solvent due to evaporation, dragout and ultrafiltration.
Solvent S	Replenishes the loss of solvent due to evaporation, dragout and ultrafiltration.
Solvent No. 2	Replenishes the loss of solvent due to evaporation, drag out and ultrafiltration. Ratio 1:1 Solvent T to Solvent S by volume.
Solvent No. 3	Replenishes the loss of solvent due to evaporation, drag out and ultrafiltration. Special applications.
Solvent No. 4	Replenishes the loss of solvent due to evaporation, drag out and ultrafiltration. Ratio 3:1 Solvent T to Solvent S by volume.

It is imperative and we emphasize only deionized water with a conductivity of less than 5µS (Micro Siemens) be used in this process, for volume adjustment, mixing, or rinsing purposes. The higher the resistivity, the lower the conductivity, which will yield a better quality DI water with excellent E-Coat performance.

Equipment

Tanks	Tanks should be of plastic (polypropylene) or steel (with rubber lining) build that resists acids and solvents. It should be constructed with a weir (built-in over flow compartment) with an optimal circulation pump capable of 5 to 7 turnovers per hour.
Pumps	The tank needs to have a continuous circulation pump installed capable of at least 3 turnovers per hour. Do not use air agitation and do not aerate the solution as it causes undesirable effects.
Filters	Solution must pass through a filter system with 1 micron rating and polypropylene core. Ultrafiltration is used for decontamination from metallic impurities and recovery of solution components.
Rectifier	0-60 Volt capable of keeping ripple under 8%.
Heating	Quartz or Teflon submersible heater is suitable. Use 15 watt/in² or less.

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Racks	Same racks as in electroplating can be used.
Oven	Oven with a temperature range of 137-180°C, forced air circulation and temperature control.
Ventilation	Exhaust ventilation above tank and oven exhaust is necessary to keep exposure under limit. See SDS of GuardCoat™ EC for more detail.
Anodes	304/316 stainless steel (diamond mesh preferred)

Operating Conditions

Parameter	Range	Nominal
Solids	Start at 5.5 to 9.0% by weight; maintain 9 to 11% b.wt throughout the life of the solution.	
Solvent T	2.0- 3.2%	
Solvent S	0.6-1.2%	
pH	5.0-5.5	
Tank Conductivity	About 750 µS at 28°C with 10% solids	
Tank Temperature	25°C-30°C	28°C
Time	10-120 seconds	
Anode to cathode ratio	1: 5 – 1: 2	1:4
Voltage	30-50V	
Ripple	< 8%	
Current density	0.5-1.0 A/ft²	
Deposit rate	6 to 8 microns in the first 30 seconds at 30 to 40 Volts	
Process Time	10 to 120 seconds: dwell time of 20 to 30 seconds before applying current	
Agitation	Continuous circulation	
Filtration	3-5 turnovers per hour	
Curing	137-180°C	160°C

Make-Up Procedure for GuardCoat™ EC tank.

1. Clean and leach all equipment that comes in contact with GuardCoat™ EC such as tanks, plumbing, filter, valves, heat exchanger, etc.
2. Condition the tank with 5% solution of 1:1 ratio of Solvent T to Solvent S for 24 hours. Use only deionized water.
3. Make a 30% solution of GuardCoat™ EC using deionized water. Add DI water to the concentrate with constant low speed stirring.
4. Age the solution by circulating it for 48-72 hours in a tank with the cover off and at temperature of 26-28°C.
5. Racks used in the GuardCoat™ EC process need to be cured in the oven at 160-180°C for 30-45 minutes before dipping in the solution. This ensures that any organic matter will not contaminate the bath. Be sure the oven is well ventilated.

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Make-Up Procedure for Pre- and Post-dip tanks.

1. Clean and leach tanks.
2. Make a 1% by volume solution of Guardcoat™ EC and deionized water or 1.3% by volume of Solvent No.2 and deionized water.
3. Mix thoroughly.

Process Procedure

1. Ensure that all parts that are processed are cleaned thoroughly.
2. Rinse with deionised water in a two stage tank to remove any drag-ins from pretreatment and hard water. Be sure conductivity of water is below 5µS.
3. Dip in the predip tank for half a minute with agitation to condition the parts.
4. Attach the parts on the cathodic end and the stainless steel on the anodic end. Process the surface at 30-50 volts with a 10-30 second delay before turning on the current. As the coat builds on the surface there will be a drop in amperage and a rise on voltage. Do not adjust these parameters back to initial setting. Leave the parts for 10-120 seconds, depending on thickness desired and surface area to be coated.
5. Dip in the postdip tank for up to half a minute with agitation.
6. Rinse in deionised water to remove excess GuardCoat™ EC. Be sure conductivity of water is below 5µS.
7. Air dry parts for about 5 minutes.
8. Cure parts in the oven at 160°C for about 20 minutes. Before handling the parts let cool to room temperature.

Maintenance

1. Always make sure the water level in the E-Coat bath does not fall below the point where the pump starts sucking in air. Any air getting into the circulation system will cause pitting. Replenish only with deionized water with conductivity less than 5µS conductivity. The post dip liquid can be also be used to replenish the bath.
2. The concentration of the bath is maintained by analysis of solids as well as solvents. The proper way of adding Guardcoat™ EC is to premix it with working solution in a separate container and then add it to the bath at the end of the day so the new solution addition can pass through filtration system before use.
3. Always make smaller and regular additions of GuardCoat™ EC rather than large to avoid having inconsistent quality of the deposit.
4. Consumption rate depends on dragout as well as film thickness. It is recommended that the solids content is checked once or twice a week to determine consumption rate. See below determination of Guardcoat™ EC Solids. In general, 1 liter of

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Guardcoat™ EC yields 13.8 to 18.4 m^2 of work with a film thickness of 0.2 to 0.3 mils.

5. Solvent is lost by evaporation, ultrafiltration and dragout. The concentration is maintained by additions of Solvent T and Solvent S.
6. The pH of solution should be maintained at 5 to 5.5. Do not use pH papers as means of measurement. Use a calibrated pH Meter with dedicated clean probe. It is a good practice to check the pH daily. Low pH (below 4.7) reduces cathode efficiency causing rough and spotted deposits, which may cause solids to precipitate. High pH (above 5.7) increase deposit rate. This can mean drag-in of alkali or dissolved metal parts at the bottom of the tank. The solids will precipitate if alkali is present. Fallen parts must be removed daily from the tank bottom.
7. Avoid contamination of the bath as it will change the pH and decrease efficiency of deposition. Salts that are dragged in can cause rough deposits or no deposition at all.
8. Filter cartridge will need to be changed at regular intervals as they become clogged. The filter cartridge and bag filter should be change once a month based on minimal usage rates. Filter cartridges must be 1 micron rating and constructed of polypropylene. Filter cartridges and bags require leaching with 5% Solvent No. 2 or No. 4 for 24 hours.
9. Should the tank become idle, cover the tank with a cover and turn off the circulation. However, it is not recommended to do so when the tank is idle only over the weekend.

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Analytical Determination for Guardcoat™ EC Solids

Equipment

Disposable aluminum weighing dish with finger grip handle; diameter 23/8" with depth 5/8". Transfer disposable polyethylene pipets, size – 7.5 ml.
Analytical Balance.
Desiccator with silica gel.
Whatman 934AH glass fiber filter or 4.7 cm diameter.

Procedure

1. Place a dried glass fiber filter into the aluminum dish with forceps and weigh on the analytical balance to the nearest ten-thousandth gram. Record the weight as W_1.
2. Weigh 0.5 grams (± 0.05 gram) of Guardcoat™ EC solution using a polyethylene pipet into the previously weighed aluminum dish and record the weight as W_2.
3. Place the weighed aluminum dish in the drying oven at 110°C for one hour. Temperature is critical in analyzing Guardcoat™ EC solids in the EC bath. Please place the sample in close proximity to the thermometer bulb.
4. Cool to room temperature in the desiccator for 20 minutes.
5. Weigh the dried dish with Guardcoat™ EC solids on the Analytical Balance and record weigh as W_3.

Calculation

% Solids = $[(W_3 – W_1) / (W_2 – W_1)]$ x100

To raise the solid content in the E-Coat bath the amount of Guardcoat™ EC required is calculated as follows:

Liters of Guardcoat™ EC = 3.3 x% solids by weight needed x Tank Volume in Liters / 100

Analytical Determination for Guardcoat™ EC Solvents

This requires a GC. For the analysis procedure please contact Aqua Bond representative.

pH Measurement

1. Calibrate the pH meter.
2. Rinse the electrode(s) in deionized water. Dry and immerse in E-Coat bath solution.
3. After measuring, rinse the electrode (s) in Solvent No.2 to remove the E-Coat bath solution completely.
4. Rinse in acetone.
5. Rinse in deionized water to remove the solvent.

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Troubleshooting Guide

Problem with Deposits	Cause	Remedy
Thick lacquer film	• Voltage too high	• Reduce voltage
	• Bath temperature too high	• Adjust to 25 to 30 °C
	• Plating time too long	• Reduce plating time
	• Solvent too high	• Purge with ultrafiltration (UF) unit
Orange Peel	• Solvent too high	• Purge with (UF) unit
	• Thick film caused by high surge current	• Reduce voltage
Thick, rough/uneven film	• Initial surge current too high	• Lower surge current to less than 5 A/ft^2
		• Reduce anode area
	• Bath temperature too high	• Reduce temperature
	• Ionic contamination	• Purge with UF unit
Thin lacquer film	• Voltage too low	• Increase voltage
	• Plating time too short	• Increase plating time
Thin film with high density pitting	• Solvent too low	• Analyze and adjust solvent level
	• Bath temperature too low	• Adjust to 25 to 30 °C
Iridescent deposit	• Deposit too thin	• Increase voltage and/or plating time
	• Bath temperature too low	• Adjust to 25 to 30 °C
Thin patchy deposit	• Parts are not making contact	• Change electrical contacts
	• Solvent too low	• Analyze and adjust solvent level
	• Solids too low	• Analyze and adjust solid level
	• pH too low	• Check pH - refer to corrective action in this section
Rough, Spotty, scattered pits	• Substrate defects	• Strip lacquer coating and check substrate condition
	• Metallic contamination	• Purge with UF unit
	• Dirty, dusty oven	• Clean oven thoroughly
	• Insoluble particles	• Batch filter followed up with ultrafiltration
	• Poor quality rinse water	• Use deionized water with a conductivity not exceeding 5 µS
Water breaks during post rinsing	• Solvent too high	• Purge with UF unit
	• Solvent too low	• Analyze and adjust solvent
Water marks after curing	• Incorrect or insufficient post-rinsing	• Refer to post-rinsing procedure
	• Incorrect drying procedure	• Refer to drying procedure

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Gas Pits/Voids	• Too much aeration in the solution	• Switch off pumps and allow solution to clear • Correct pump problem and use gentle agitation to minimize aeration and foaming actions
	• Poor part alignment on rack	• Re rack parts to allow hydrogen gas to escape
	• Incomplete wetting of part surface prior to plating	• Refer to pre-rinsing procedure
Soft lacquer film; poor chemical resistance	• Low curing temperature	• Cure at metal temperature of 138 to 180 °C for 20 to 30 minutes
	• Insufficient curing time	• Increase curing time
Darker/discoloration	• Curing temperature too high	• Decrease curing temperature
	• Curing time too long	• Decrease curing time
Low gloss/hazy deposit	• Deposit too thick	• Reduce voltage
	• Solvent too low	• Analyze and adjust solvent level
	• Contamination	• Purge with UF unit
Inconsistent quality	• Irregular or large additions of solids and/or solvents	• Make smaller, regular additions of Guardcoat™ EC and solvents
	• Insufficient mixing time after solids or solvent additions	• Allow one to two hours of solution circulation.
Light brownish-yellow liquid	• Polymerization of resin due to localized heating	• Check agitation/filtration • Use low watt density heaters (less than 15 watt/in^2)
	• Solution temperature too high	• Adjust to 25 to 30 °C
Pink-orange liquid	• Solvent too low	• Analyze and adjust solvent level
	• Iron contamination	• Decant or replace
Slow amperage drop during plating	• Solvent too high	• Purge with ultrafiltration
Poor throwing power	• Incorrect anode-to- cathode ratio	• Use 1:5 minimum or 1:2 maximum anode-to- cathode for better distribution.
	• Anode length shorter than cathode	• Use anodes that are at least the same length as the cathode for better distribution.
Solution pH falling	• Contamination from cleaning cycle and predip	• Replace predip solution Operate ultrafiltration for approximately 8 to 12 hours and discard the permeate generated.

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		• Replace a portion of the solution with new GuardcoatTM EC solution if the problem is serious
	• Poor quality deionized water	• Check deionized water system; it may need to be regenerated.
	• Bath solubilizer build-up	• Operate ultrafiltration for one solution turnover and replace permeate.
Solution pH rising/ Precipitation of lacquer	• Drag-in of alkali or metallic contamination	• Purge with ultrafiltration • Replace portion of bath, pump out tank, clean it and pump solution back through filter bag
Low conductivity (less than 800 µS)	• Low on solids	• Analyze and adjust solids
	• Low on solvents	• Analyze and adjust solvents
High conductivity (more than 1300 µS)	• Solids too high	• Reduce voltage
	• Solvents too high	• Purge with ultrafiltration
	• Ionic contamination	• Purge with ultrafiltration

READ THE SDS BEFORE USING THIS PRODUCT

The data and statements contained in this bulletin are based on testing information and are believed to be accurate and reliable. This bulletin is not a Guarantee or Warranty, express or implied regarding the products use. The product is sold on the condition that the purchaser will do their own tests to determine the suitability of the product in a particular application.

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