

WELCOME TO THE



Cleveland, OH  
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## Process Control for Electrocoat Systems

Jeff Paxon  
Axalta Coating Systems



## Process Control

- Coating characteristics, mainly film build, change as the operating parameters vary.

- Voltage
- Temperature
- pH
- Conductivity
- Solvent Content
- Solids
- P/B
- UF Flux Rate

- Are these parameters monitored and controlled?

- Readings recorded
- Charted
- SPC

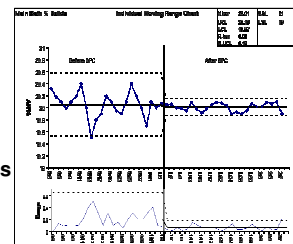


## Process Control

- Utilize "True" SPC Charts.

- Includes Control Limits and Specifications
- Calculates Process Capability

- Identifies well-controlled processes
- Determines if a process can regularly meet specifications
- Process Capability ( $C_{PK}$ ) should be greater than or equal to 1.33.

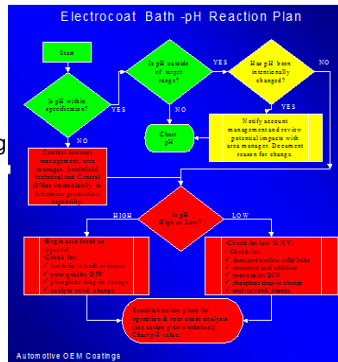


Charts are a visual representation of how well the process is performing.



## Process Control

- Testing and Charting provides awareness of changes
- Enables beginning of troubleshooting
- Reaction Plans provide more detailed response



## Process Control

### ➤ Paint Control Parameters

- Voltage
- Temperature
- Solids
- Conductivity
- P/B
- pH
- Solvent Content
- UF Flux Rate



## Process Control

### ➤ Voltage

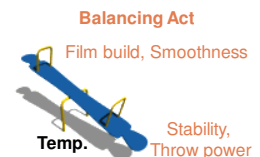
- **Has effects on:**
  - ❖ Film build
  - ❖ Throw Power
  - ❖ Rupture
- **Effects controlled by**
  - ❖ Voltage Adjustment
  - ❖ Automatic Control
    - Amp Draw
    - Recipe



## Process Control

### ➤ Bath Temperature

- **Has effects on:**
  - ❖ Film build
  - ❖ Throw power
  - ❖ Smoothness
  - ❖ Paint Stability
  - ❖ UF Flux
- **Effects controlled by**
  - ❖ Automatic control
  - ❖ Controllers should be set for as little variation as possible
    - + / - 1/2 Degree



## Process Control

### ➤ Bath Solids

#### ▪ Have effect on:

- ❖ Film build
- ❖ Throw power
- ❖ UF flux

#### ▪ Effects controlled by

- ❖ Paint needs to be replaced as depleted
- ❖ Three methods to replace the paint
  - Continuous Feeding
  - Batch Feeding
  - Incremental Feeding



## Process Control

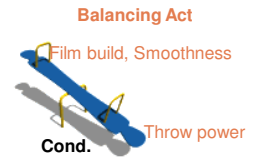
### ➤ Bath Conductivity

#### ▪ Has effects on:

- ❖ Film build
- ❖ Throw power
- ❖ Smoothness
- ❖ Performance

#### ▪ Effects controlled by

- ❖ Solids
- ❖ Purge rate
- ❖ Temperature



## Process Control

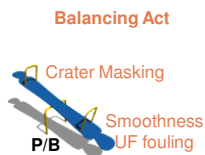
### ➤ Pigment to Binder Ratio (P/B)

#### ▪ Has effects on:

- ❖ Hiding
- ❖ Gloss
- ❖ Film smoothness
- ❖ UF Fouling
- ❖ Contaminant Masking

#### ▪ Effects controlled by

- ❖ Ratio of resin to paste
- ❖ Feed Hold Outs- Pigment coats out preferentially



## Process Control

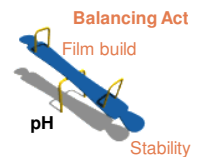
### ➤ Bath pH

#### ▪ Has effects on:

- ❖ Paint stability
  - Settling, dirt, streaking
- ❖ Redissolution
- ❖ Flux rate
- ❖ Film build

#### ▪ Effects controlled by

- ❖ Anolyte conductivity
- ❖ Bare/leaking anodes
- ❖ Solubilizer adds
- ❖ Permeate to drain



## Process Control

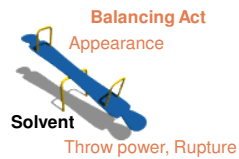
### ➤ Solvent Content

#### ▪ Has effects on:

- ❖ Film build
- ❖ Throw power
- ❖ Reflow
- ❖ Rupture voltage

#### ▪ Effects controlled by

- ❖ Solvent adds
- ❖ Purge rates



## Process Control

### ➤ UF Flux Rates

#### ▪ Have effect on:

- ❖ Paint usage
- ❖ Bath conductivity
- ❖ Paint appearance

#### ▪ Effects controlled by

- ❖ Paint flow
- ❖ Bath solids
- ❖ Paint temperature



## Process Control

### ➤ Summary

#### ▪ Monitoring

- ❖ Monitoring, recording and charting all key bath chemistry parameters is crucial to maintaining consistent quality and film builds
- ❖ SPC charts and reaction plans are excellent tools to red flag trends and to react quickly to issues before they negatively impact quality

#### ▪ Balancing Bath Parameters

- ❖ When adjusting bath parameters moving from one extreme to another has its positive and negative benefits
- ❖ Other parameters may need to be adjusted to compensate to achieve the desired results



Questions?



## Testing for Electrocoat Systems

David Miga  
BASF Corporation



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## Tests

- Standardized laboratory tests that duplicate real-world conditions in order to predict real-world performance
- Three main categories:
  - Appearance
  - Physical Properties
  - Durability



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## Tests

- **Appearance - How a Coating Looks**
  - Is the part glossy or flat?
  - Is it smooth or rough?
  - Does it have any surface defects like dirt or craters?
  - How does the color compare to a standard?



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## Tests

- **Gloss**
  - **Gloss** reflects the amount of shine a coating has
  - A gloss meter measures the amount of light reflected by the coating surface and is quantified by % of light reflected.
  - It is typically measured at angles of 20°, 60°, & 85°.



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## Tests

### ➤ Smoothness

- A **perfectly smooth surface** will have no localized microscopic variance in film height.



- Real world films have a certain amount of natural lobe to them.



- A “tight film” has more lobes per linear distance.

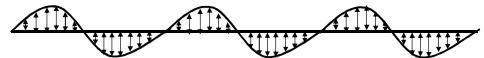


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## Tests

### ➤ Smoothness

- Smoothness, in general, is measured with a device called a profilometer
- The profilometer first finds the mean height of the lobe
- Then, it finds the distance of the lobe from this mean
- $R_a$  is the average of these distances, with a rougher electrocoat having a higher  $R_a$

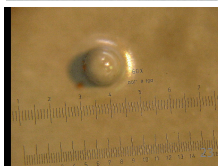
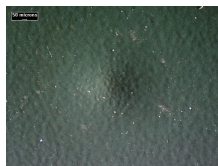


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## Tests

### ➤ Dirt and Craters

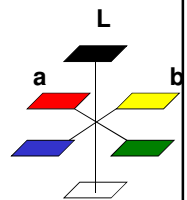
- Craters are caused by contaminants introduced to paint, metal surface before painted, or uncured E-coat film after coating
- Dirt particles, such as the weld ball pictured, need to be identified and categorized before they can be systematically reduced



## Tests

### ➤ Color

- **Color** can be evaluated visually by experience or quantified by a colorimeter.
- A colorimeter creates a relative three dimensional coordinate by determining the lightness-darkness (L), the green-red(a) and the blue-yellow(b).
- It is typically measured at angles of 25°, 45°, & 75°.



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## Tests

### ➤ Physical - How Tough the Coating Is

- Cure/Solvent Resistance
- Adhesion
- Pencil Hardness
- Impact Resistance
- Flexibility
- Chipping Resistance
- Chemical Resistance

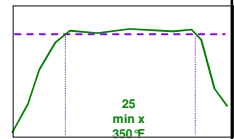


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## Tests

### ➤ Cure

- The most effective way to evaluate cure in an electrocoat system is to compare the current oven chart to the product cure window.
- Solvent resistance is a secondary method if actual datapaq data is unavailable.



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## Tests

### ➤ Solvent Resistance

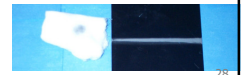
- **Solvent resistance** is an evaluation of the electrocoat cure.
- First, cheesecloth is soaked in a solvent such as MEK, Acetone or MIBK.
- Then, the solvent soaked cheesecloth is used to apply 10 double rubs to the panel.



## Tests

### ➤ Solvent Resistance

- **Solvent resistance** – Rating – Pass  $\leq 1$
- **Rating: 0;** No paint removal to cheesecloth & only slight distortion of film
- **Rating: 1;** Slight removal to cheesecloth
- **Rating: 5;** Very observable paint on cheesecloth & paint removal to substrate.

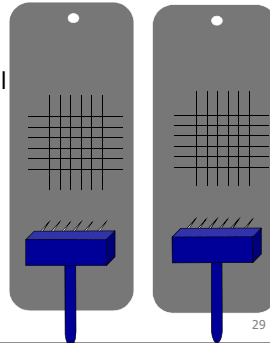


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## Tests

### ➤ Adhesion

- **Destructive Adhesion test** will determine how well the paint layer adheres to the metal & phosphate layers.
- The first step is to scribe the panel with an adhesion scribe.

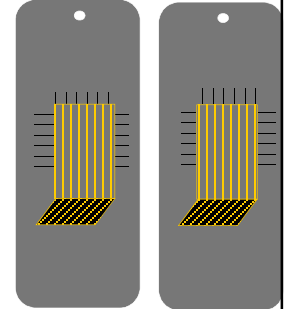


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## Tests

### ➤ Adhesion

- Then, an 898 strapping tape or equivalent is attached to the scribed area of the part.

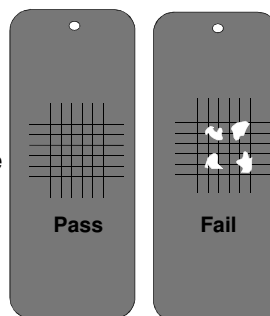
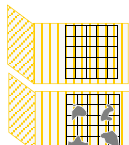


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## Tests

### ➤ Adhesion

- After firmly attached, the tape is abruptly pulled at a 45° angle.
- Generally, a failure is > 5% removal.



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## Tests

### ➤ Pencil Hardness

- Pencil Hardness utilizes pencils of varying hardness to differentiate the hardness of the film.
- The pencil is held at a 45° angle and pushed away from the operator.
- The hardest pencil that gouges the film determines the rating (See Below).



6B - 5B - 4B - 3B - 2B - B - HB - F - H - 2H - 3H - 4H - 5H - 6H  
Softer Harder

- Generally, minimum spec. is 2H – 4H.



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## Tests

### ➤ Impact Resistance

- A 2 or 4 lb weight is dropped a specified distance to the panel below.
- The force is calculated by multiplying the mass in lbs times the distance in inches dropped.
- Depending on the specification, a passing panel must pass 60 – 120 in-lb of force.



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## Tests

### ➤ Impact Resistance

- A passing result will have no paint removal or damage to the film.
- A failing result will have paint adhesion loss or other appearance change.



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## Tests

### ➤ Flexibility

- Flexibility of E-coat is tested by a conical mandrel bend test.
- The cone has diameters of 3 mm & 38 mm on each end.
- The panel will be bent around the cone and it will be inspected for any cracking or loss of adhesion.



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## Tests

### ➤ Flexibility

- First, the panel is held firmly to the bender.
- Then, the lever is swiftly pulled, rotating the panel 135°.
- Then, the panel should be inspected for cracking & adhesion loss along the bend.
- If evident, the defect radius should be noted.



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## Tests

### ➤ Chip Resistance

- **Chip Resistance** tests the coating's ability to absorb the impact of rocks or stones without permanently damaging the film.
- It is tested by using compressed air, at a specified pressure, to propel rocks or stones at a coated panel.
- The amount and size of the coating chips is evaluated to determine the coating's chip resistance.



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## Tests

### ➤ Chemical Resistance

- Windshield Wiper Solvent
- Gasoline
- Motor Oil
- Anti-freeze
- Brake Fluid
- Transmission Fluid
- Diesel Fuel
- Acids/Bases



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## Tests

### ➤ Durability - How Long the Coating Will Last

- **Weathering**
  - ❖ QUV
  - ❖ WOM
- **Corrosion**
  - ❖ Salt Spray
  - ❖ Cyclic

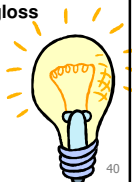
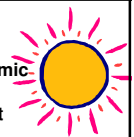


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## Tests

### ➤ Weathering

- **WOM (Weather-O-Meter)**
  - ❖ Accelerated test attempts to best mimic Florida Exposure
  - ❖ Xenon Carbon Light Mimics Sunlight
  - ❖ 1 Cycle = 1.3 KJ Exposure
  - ❖ 2,000 KJ = 1 Year Florida
  - ❖ Acceptable Testing has no cracks, adhesion loss, blistering and good gloss retention (~80 – 90%)
  - ❖ Cycles consist of:
    - 60 min. Dark with DI Water Spray
    - 40 min. Light with No Water Spray
    - 20 min. Light with Front Spray
    - 60 min. Straight Light/No Spray

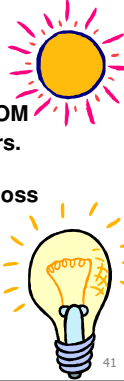


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## Tests

### ➤ Weathering

- **QUV (UV Fluorescence Test)**
  - ❖ Simulates UVB Rays of Sun
  - ❖ Generally More Severe than WOM
  - ❖ General Test Duration: 4,500 hrs.
  - ❖ Acceptable Testing has no chalking, blistering and high gloss retention
  - ❖ Cycle consists of:
    - 8 hours light
    - 4 hours dark

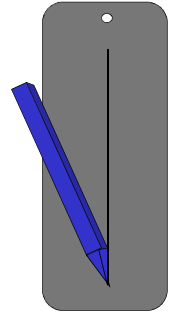


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## Tests

### ➤ Salt Spray/Corrosion

- First, a scribe tool is used to cut the film down to bare metal.
- Then, the panels are put into a salt spray cabinet or cyclical corrosion:
  - ❖ Salt Spray
  - ❖ Humidity
  - ❖ Ambient
  - ❖ Dry-off

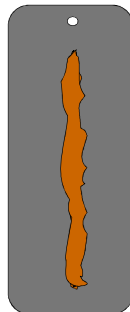


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## Tests

### ➤ Salt Spray/Corrosion

- Over time, the film will corrode away from the scribe mark.
- After the test required duration is completed, the panels are removed from the cabinet.
- Then, the panel is scraped to remove rust

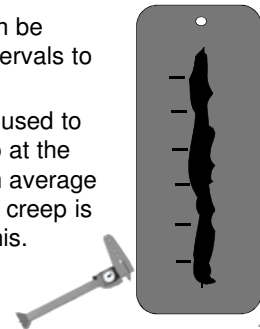


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## Tests

### ➤ Salt Spray/Corrosion

- Now, the creep can be marked at even intervals to be measured.
- Then, calipers are used to measure the creep at the marked points. An average & maximum scribe creep is determined from this.



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*Questions?*



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*Refreshment Break*



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*Preventative Maintenance  
for Electrocoat Systems*

**Jonathan Quick  
BASF Corporation**



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*Preventive Maintenance*

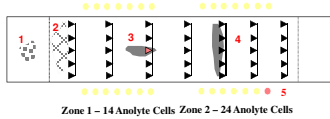
- General Maintenance
- Circulation System
- Anolyte System
- UF System
- Bacteria
- E-coat Oven



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## General Preventive Maintenance

- “Drop” tank twice a year for inspection



Company: ABC Coating  
Date: 7/9/02  
Person: MJT

Checklist:  
Lining OK  
Debris Comments  
Anolyte Cells Comments  
Pump Screens OK

### Comments:

1. Sealer collecting in tank incline. Removed 7/10/02. Alerted Sealer Line.
2. Parts collecting in front of the tank. Removed 7/10/02.
3. 4<sup>th</sup> Eductor Nozzle on Header 3 plugged. Replaced 7/10/02. Removed Settled Solids.
4. 5<sup>th</sup> Header damaged and closed. Repaired 7/10/02. Removed Settled Solids.
5. Zone 2, 22<sup>nd</sup> Anolyte Cell on South Side Leaking. Replaced 7/10/02.



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## General Preventive Maintenance

- “Drop” tank twice a year for inspection.
- Remove parts, settled paint and other debris that have accumulated since last inspection.



- Make other repairs that can only be made with the electrocoat tank empty.



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## General Preventive Maintenance

- Repair or replace eductors
- Keep pump screens and bag filters clean
- Inspect circulation pump
  - Look for worn impeller
  - Inspect for corrosion of metal parts
  - Degradation of suction piping



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## Circulation System Maintenance

- Paint Settling
- Filter Bag Loading

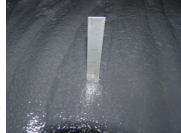


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## Circulation System Maintenance

### ➤ Paint Settling - Removal

- E-coat paint settling should be removed with a dull shovel or a powerwasher.
- Care should be used when using a shovel to avoid damaging the lining and activities should be discontinued if the tool is penetrating the lining.
- Powerwash pressures should be limited to 4,000 psi because damage can occur to linings & fiberglass at pressures > 5,000 psi.

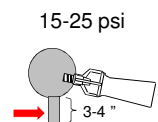


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## Circulation System Maintenance

### ➤ Paint Settling Troubleshooting

- Check for missing or clogged floor eductors.
- Ensure that the floor eductor headers have a slight downward pitch (5-15°) to sweep the floor.
- Check for proper floor eductor pressure (15 – 25 psi).



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## Circulation System Maintenance

### ➤ Paint Settling - Troubleshooting

- Check for increased bath pH.
- Check for high DI/RO water conductivity.
- Check pigment paste addition point for poor circulation.
  - ❖ Move feed point to circulation header.
  - ❖ Ensure good eductor circulation at feed point.
  - ❖ Feed pigment paste at slow rates (< 2 gpm).
- Check the circulation pump for proper flow.
  - ❖ Supplier can check w/ultrasonic flow meter.
  - ❖ Contact pump manufacturer.



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## Circulation System Maintenance

### Filter bag loading - Symptoms



- Excessive filter bag loading is considered a rapid building of pressure differential in a relatively short period of time (1–2 days/less).



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## Circulation System Maintenance

- Filter bag loading - Troubleshooting
  - Check for proper filter size, including OA filter bags.
  - Don't mix media types in filter vessels or parallel sets of vessels.
  - Check for bacteria.
  - If a biocide hit is needed directly to the E-coat tank, it must be diluted 5:1 with DI water or permeate.
  - Rapid feed of paste to suction line of pump prior to filters can increase filter loading.
    - ❖ Move feed location.
    - ❖ Make additions prior to filter changes.
  - Avoid system "Dead Legs".



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## Circulation System Maintenance

- Filter bag loading - Troubleshooting
  - Check for increased bath pH – Adjust with acid or adjust anolyte conductivity if necessary.
  - Check for high DI/RO water conductivity.
  - Check for unusual bath contamination, such as caustic cleaner, conveyor oil or heat exchanger rust inhibitor.
  - Send filter debris to paint supplier for analysis.



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## Preventive Maintenance: Anolyte System

- Leaking Anolyte
- Biological Growth
- Anode Degradation



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## Preventive Maintenance: Anolyte System

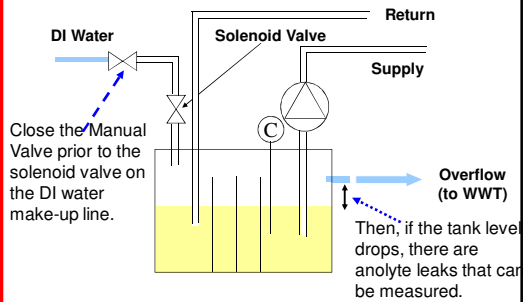
- Leaking Anolyte
  - When the E-coat tank is empty, some normal anolyte weeping is expected due to the pressure on the membranes.
  - However, leaks that can be physically identified, such as that above, are unacceptable.



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## Preventive Maintenance: Anolyte System

### How do you determine if there are anolyte leaks?



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## Preventive Maintenance: Anolyte System

### ➤ Biological Growth

- Anolyte biological growth is generally referred to as Mother of Vinegar (MOV).
- MOV thrives in the acidic conditions of the anolyte system (pH: 1.5 – 3.0).
- MOV is generally comprised of molds and yeasts, not aerobic bacteria like that which is found in the E-coat system closed loop.



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## Preventive Maintenance: Anolyte System

### ➤ Biological Growth – Symptoms

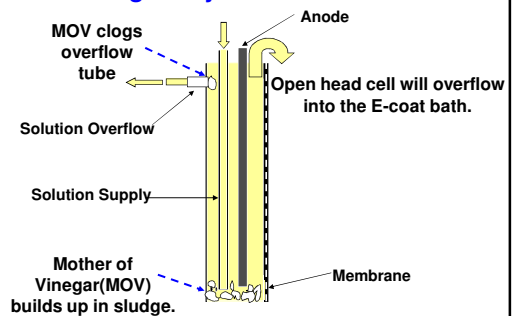
- Build-up of white/brown biological growth or Mother of Vinegar (MOV) on anolyte pump screens
- MOV in the anolyte flow meters
- Overflowing anolyte cells



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## Preventive Maintenance: Anolyte System

### Overflowing Anolyte Cells



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### Preventive Maintenance: Anolyte System

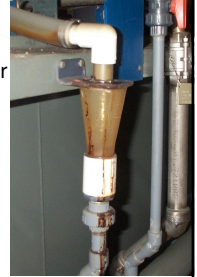
- Biological Growth – Potential Solutions
  - Hydrogen peroxide sterilization
  - Increased anolyte flow by isolating sections
  - Anolyte biocide
  - Filter bag on anolyte return
  - UV Light or ozone
  - Copper bar
  - Manual removal



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### Preventive Maintenance: Anolyte System

- Anode Erosion - Symptoms
  - Coffee brown anolyte color
  - Brown staining on clear tubing or return piping
  - High iron content in electrocoat bath
  - Rough electrocoat appearance



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### Preventive Maintenance: Anolyte System

#### Anode Erosion - Symptoms



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### Preventive Maintenance: Anolyte System

- Anode Erosion = Potential Solutions
  - Monitor and rotate anodes regularly.
    - ✦ Weight
    - ✦ Amp Draw
  - Passivate anodes with nitric acid.
  - Additional anodes (particularly in front).
  - Consider ruthenium oxide or iridium oxide anodes for decreased anode wear.
  - Check anode quality.
  - Check color of anolyte solution daily.
  - Check anolyte flow daily
  - Check electrical connections weekly



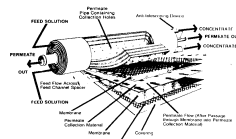
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### Preventive Maintenance: UF System

- UF Monitoring
- Fouling Factors Overview
- Cleaning/Flushing



### Spiral-Wound Module



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### Preventive Maintenance: UF System

- ## UF System Monitoring
- UF Flux &  $\Delta P$  should be monitored daily.
  - Monitor & record **rinse stage solids** daily.
  - Monitor & record rinse stage pH daily.
  - Monitor & Change Pre Filters.
  - Temperature Alarm** at 100°F for E-Coat Bath.
  - Accumulation of solids in rinses indicate insufficient UF flux.
  - Insufficient UF flux indicates UF fouling or inadequate design.



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### Preventive Maintenance: UF System

- ## UF System – Fouling Factors
- High paint temperature (  $>105^{\circ}\text{F}$  )
  - Low paint flow / Low  $\Delta P$
  - Idle paint in cartridges ( 2 hour rule )
  - Excessive paint %NV and P/B
  - Iron contamination
  - Dirt & oil contamination
  - Bacteria contamination
  - Phosphate contamination



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### Preventive Maintenance: UF System

- ## UF Fouling – Cleaning/Flushing
- Clean UF systems when they reach 70% of the original flux.
  - Clean entire UF bank at one time.
  - Do not allow idle paint to sit in cartridges – Flush with RO/DI water immediately when deactivated (2 hour rule).
  - Soaking in cleaning chemical overnight can greatly improve cleaning recovery.



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## Preventive Maintenance: UF System

- UF Fouling – Cleaning/Flushing
  - Utilize special cleaning chemicals for special contaminants, including:
    - ❖ Normal Fouling/Metal Fines: **UF Cleaner**
    - ❖ Iron Contamination: **UF Cleaner & Citric Acid**
    - ❖ Bacteria Contamination: **UF Cleaner & Biocide**
    - ❖ Phosphate Drag-In: **UF Cleaner & Nitric Acid**
    - ❖ Oil Contamination: **UF Cleaner & OA Filters**



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## Preventive Maintenance: Bacteria

- What are its symptoms?
- How can it be eliminated?



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## Preventive Maintenance: Bacteria

There are a few options to consider in identifying the presence of bacteria by testing:

- Field easy culture testing
- Dip slides
- External laboratory testing
- Bacteria enzyme activity detection



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## Preventive Maintenance: Bacteria

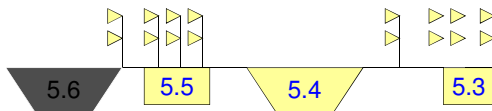
- Other Symptoms
  - Bath pH increase
  - Rinse pH above bath pH
  - Paint kickout
  - Filter loading
  - UF fouling
  - Biological growth in rinses
  - Very large dirt particles on jobs



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## Preventive Maintenance: Bacteria

### Loss of pH Control



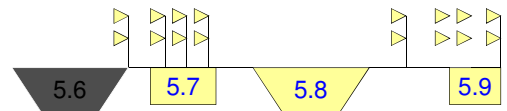
Stable closed loop pH will have a slight decrease in each successive rinse stage because the UF system allows more acid to pass into the permeate.



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## Preventive Maintenance: Bacteria

### Loss of pH Control (Cont.)



Unstable pH influenced by bacteria, will have higher pH in the rinses because bacteria can more easily grow in the later rinses, which have less paint solids.



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## Preventive Maintenance: Bacteria

### System Limits must be maintained:

E-coat Bath:	< 1 count/ml
Closed Loop Rinses:	< 500 counts/ml
DI/RO Water:	< 10 counts/ml
Pretreatment Final Rinse:	< 10,000 counts/ml



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## Preventive Maintenance: Bacteria

- If Limits are Exceeded:
  - E-coat Bath: **Full system biocide hit**
  - Closed Loop Rinses:
    - ❖ **Full system biocide hit**
    - ❖ **Hydrogen peroxide treatments**
  - DI/RO Water:
    - ❖ **Hydrogen peroxide sterilization**
    - ❖ **UV light/ozone injection/other passive bacteria control**
  - Pretreatment Final Rinse:
    - ❖ **Hydrogen peroxide treatments**
    - ❖ **Ozone injection/other passive bacteria control**



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## Preventive Maintenance: Bacteria

### ➤ Biocide Treatment

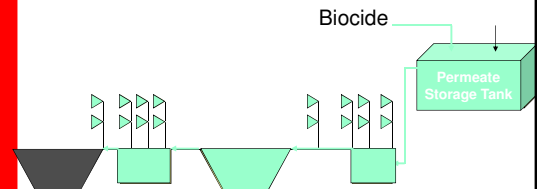
- Liquid Biocide (Isothiazolinone 1.5%)
- Addition Points:
  - ❖ Permeate Storage Tank
  - ❖ Rinse Stages with Solids Levels below 2%
  - ❖ E-Coat Bath when diluted 5:1 with DI Water
  - ❖ **Add During Non-Production!**
- **Safety Considerations!** Splash Goggles, Rubber Gloves, Protective Apron & Respirator (Optional)
- Contact paint supplier for Procedure.



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## Preventive Maintenance: Bacteria

### Full System Biocide Hit



A **full system biocide** hit should be added to the **permeate storage tank**, where it will counterflow to the entire system. If there is no storage tank, it should be made to the final rinse.



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## Preventative Maintenance: Bacteria

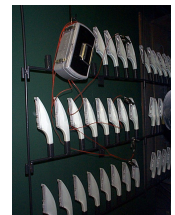
### ➤ Passive Biocide Control

- UV light on water systems
- Ozone
- Microfiltration (Under investigation)
- Silver/Copper ions (Preventive Measure)



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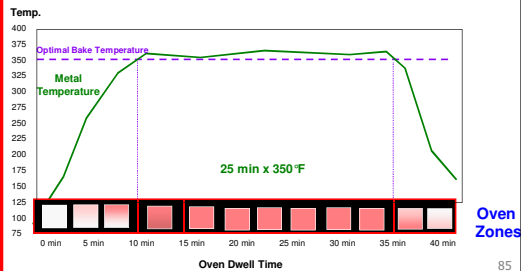
## Preventive Maintenance: E-coat Oven



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## Preventive Maintenance: E-coat Oven

Run an **Oven Curve** (Datapaq or Grant Recorder) frequently to confirm metal temperatures and oven performance.

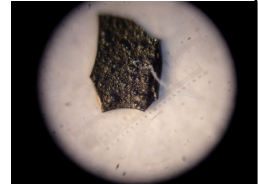


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## Preventive Maintenance: E-coat Oven

### ➤ Oven Dirt

- Oven dirt is generally carbon black in color and typically sits on the surface of the E-coat or near the surface.
- It is black because of ongoing exposure to extreme temperature and it eventually flakes off onto horizontal surfaces.



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## Preventive Maintenance: E-coat Oven

### ➤ Oven Dirt: Potential Solutions

- Regular cleaning of E-coat ovens (2x per year)
- Inspect for condensate quarterly (air seals).
- Aluminum foil on oven floor – easily removed & replaced to avoid accumulation of debris on floors
- Check oven air filters & replace as necessary.
- Ensure oven is properly balanced with sufficient exhaust to avoid accumulation of oven condensate & keep oven pressure negative.



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## Questions?



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# Advanced Electrocoat Troubleshooting

Jim Gezo  
PPG Industrial Coatings



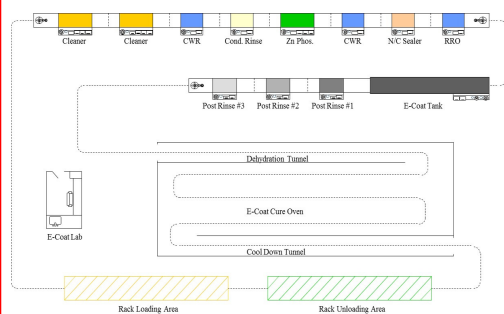
## Advanced Electrocoat Troubleshooting

- Understanding the system
  - Troubleshooting begins when the parts enter the facility
  - Troubleshooting is a process with defined criteria
  - Ability to separate systems
  - Understand the limitations of the finishing system
- Tools for troubleshooting
  - On-line needs
- Conducting on-line trials
  - Ability to re-create the defect
  - Eliminate portions of the system
  - Narrow scope of investigation
  - Change system based on test results
- Common Ecoat Defects
- The "Not So Common" Defects



Electrocoat Process:

## Sample Process Layout



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## Understanding The Finishing System

- Understand the limitations of the finishing system
  - Line capacity
    - ❖ Part silhouette
    - ❖ Equipment and chemistry constraints
  - Quality requirements
    - ❖ Customer
    - ❖ Corporate
  - Labor requirements
    - ❖ In line racking vs. off line racking
    - ❖ Tooling
- Ability to separate systems
  - Load / Handling
  - Pretreatment
  - Ecoating
  - Rinsing
  - Cure



## *Understanding The Finishing System*

- Troubleshooting is a process with well defined criteria
  - Time bound – It has a beginning and an end
  - Specific
- Troubleshooting begins when the parts enter the facility
  - Containers
  - Bins
  - Packing materials
- Troubleshooting ends
  - Change must occur
  - Document and communicate



## *Tools for Troubleshooting*

- Safety
  - Review
    - ❖ SOP, Lock-Out-Tag-Out
    - ❖ MSDS
    - ❖ Documentation of supplier's materials
    - ❖ Common Sense
- Define
  - Documentation
    - ❖ Defect numbers (\$\$)
    - ❖ Trials
    - ❖ Metrics – definition of success
  - Track success



## *Tools for Troubleshooting*

- Tooling
  - Ability to change hang pattern / orientation
  - Line metal / most common substrate
  - Laboratory phosphate
- Access to off-line equipment
  - Rinsing
  - Curing
  - Coating
    - ❖ Typically provided by supplier
    - ❖ Feed material for control bath



## *Conducting On-line Trials*

- Ability to re-create the defect
  - Identify changes made to create defect
  - Something changed within the system
  - Something must change to correct
- Eliminate portions of the system
  - Laboratory phosphated vs. line phosphated
  - Skip stages
  - Rotate parts after phosphate / ecoat tank / post rinses
- Narrow scope of investigation
  - Once a portion of the system eliminated
  - Repeatability
- Change system based on test results
  - Monitor for success
  - Document and share results





## Common Ecoat Defects

- Contamination
  - Dirt
  - Ionic
  - Metals
- Craters
- Rupture

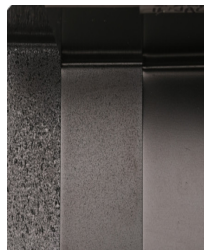


## Dirt / Stability

- Poor appearance
- Kick-out
- Paint sludging
- Poor horizontal settle
- Filter bags fouling
- Loss in flux rate/Ultrafilter fouling



## Dirt/Stability



## Dirt/Stability

Roughness seen on horizontal surfaces only; vertical surfaces remain smooth in appearance.

### Common causes:

- Tank parameters out of spec
- Bacteria
- Poorly cleaned metals
- External contaminants
  - ❖ Dust, Dirt, etc.
- Tank settle

### Solutions:

- Filter the paint tank
- Maintain proper tank parameters
- Increase bath solubility by adjusting pH and solvent levels
- Eliminate contaminants
- Maintain a clean environment
  - ❖ Parts, Conveyors, Racks, etc.
- Probe the tank



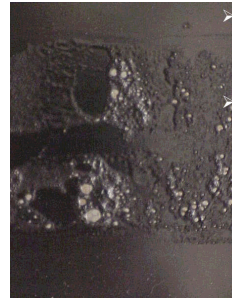
## *Ionic Contamination*

- Poor appearance
- Patchy roughness
- Rupture
- High conductivity



## *Ionic Contamination*

Blistered streaks or spots in a cured electrocoat film; usually areas of bare substrate are seen



### Common causes:

- Contaminated water
- Pretreatment carryover
- External contamination

### Solutions:

- Use clean DI water
- Eliminate contaminate
  - Pretreatment carry-over
  - Poor water quality
  - External
- Put permeate to drain
  - Remove water soluble contaminants
  - Document change in bath conductivity



## *Iron Contamination*

- Symptoms:
  - Difficulty building film
  - Rough appearance
    - Over all substrates
    - Not localized
- Potential Causes
  - Fallen parts
    - ❖ Probe & clean
    - ❖ Metal fines, blasting media
  - Corrosive anolyte
    - ❖ Ruptured membranes, color
    - ❖ Exposed mild steel
    - ❖ Plumbing & tank liner



### Factors Affected

- Appearance
- Performance

## *Iron Contamination*



## Iron Contamination

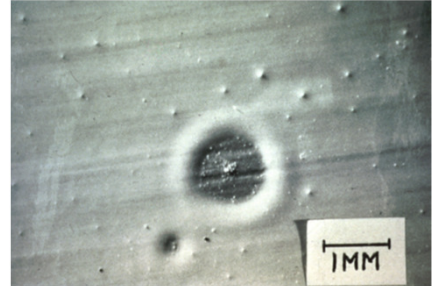
### ➤ Solutions

- Prevention
- Eliminate the source
- Coat out
- Incorporate fresh material

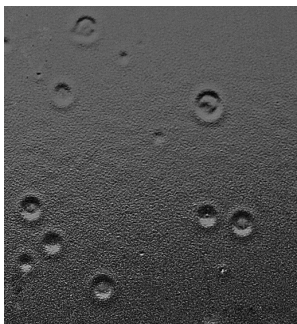


## Craters

➤ Bowl shaped depressions with raised circular edges; can be dimples in a cured electrocoat film or exposed bare substrate in the centers



## Craters



Common causes:

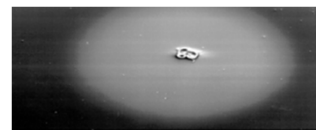
- incompatible oils
- lubes, or greases that contaminate the paint bath, post rinses or substrates
- material left on the surface of the substrate



## Craters

### ➤ Solutions

- Prevention
- Eliminate the source
- Coat out
- Raise pigment concentration
- Filter



## Rupture

Bursting and excessive film of the deposited coating



### Common causes

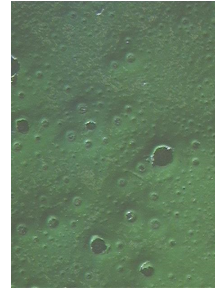
- - excessive voltage
- - excess ripple
- - high film build
- - ionic contamination
- - electrode/counter electrode in close proximity to part
- - high bath temperature
- - excess solvent
- - high bath solids



## Rupture

### Solutions:

- Ensure proper pretreat coverage
- Minimize voltage
  - ❖ Bath parameters
  - ❖ Bath temperature
- Slow coating process
- Extend ramp time to coating voltage



## The Not So Common Ecoat Defects

- Premature Drying
- Pretreatment Telegraphing
- Thread Voids
- Edge Build-up
- And a few more....



## Premature Drying

Splotchy, rash-like areas in a cured film



### Common causes:

- low solvent level
- low solubilizer
- conveyor stoppages
- high p/b
- extreme differences in plant air temperature / humidity

### Solutions:

- minimize time to first rinse
- bath parameters
- environmental conditions



## Pretreatment Mapping



## Pretreatment Mapping

Areas of roughness or the cured electrocoat film mirroring the underlying surface



### Common causes:

- poor cleaning
- poor pretreatment

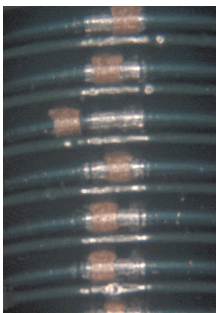
### Solutions:

- ensure proper cleaning
- eliminate flash rusting between stages



## Thread Voids

Exposed substrate in thread wells



### Common causes:

- poor grounding
- excess part loading
- low solvent
- low bath solids
- low conductivity
- improper rack design

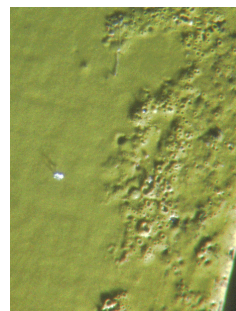
### Solutions:

- adjust bath parameters
- ensure proper loading or contact to basket or tooling



## Edge Build-Up

Excess film that is usually seen on the edges of ware; sometimes appears as rupture



### Common causes:

- excessive voltage
- electrode/counter electrode in close proximity

### Solutions:

- Minimize coating voltage, distance to electrode



## *Air Entrapment*

Bubbles in a smooth, even electrocoat film; usually seen on the undersides of horizontal surfaces



### Common causes:

- foam on bath surface
- odd shaped ware entering the electrocoat bath at angles

### Solutions:

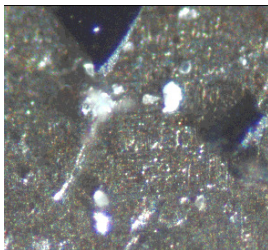
- greater agitation to move liquid into recessed areas
- tilting/movement of rack/carrier to move air pocket

## *Wet Film Adhesion Loss*



## *Wet Film Adhesion Loss*

Easy removal of the deposited but uncured electrocoat film by touching and/or normal spray rinsing



### Common causes:

- poor cleaning
- aggressive post rinses
- bath contamination

### Solutions:

- ensure proper cleaning
- adjust post rinse spray pressure, bath parameters

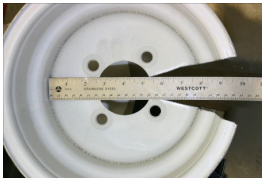
## *Bridging*





## Bridging

Paint build-up that bridges two portions of the part

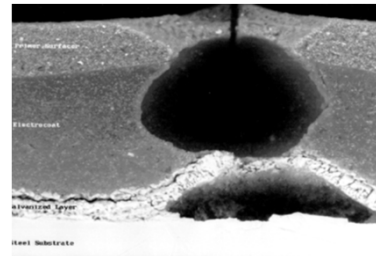


- Common causes:
  - minimal gap between portions of part
  - excessive throw power into gap
  - liquid trapped in gap that boils out during cure
- Solutions:
  - ensure consistent gapping
  - minimize throw
  - racking
  - minimize liquid in seam



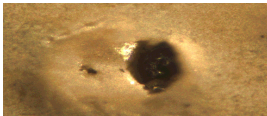
## Blow-out / Gassing

Galvanized gassing, blow-out actually originates in the galvanized layer and blows through phosphate and subsequent layers of paint



## Blow-out / Gassing

Areas of paint blow out, usually exposing bare substrate



- Common causes:
  - poor galvanized coatings
  - poor metal quality
  - excessive voltage

### Solutions:

- proper galvanizing -
- minimize voltage
- bath parameters



Questions?



*Group Lunch*



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*Panel Discussion*



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## Electrocoating Seminar

Thank you for joining us  
and have a safe trip  
home after the  
**PPG Coating Services –  
MetoKote Corporation  
Plant Tour!**



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