METALLIZATION OF PLASTICS

Cybershield
308 Ellen Trout Drive
Lufkin, TX 75904
Tel: 936-633-6387
Email: sales@cybershieldinc.com
Web: www.cybershieldinc.com
PRESENTATION TOPICS

- Introduction to Cybershield
- Metallization Processes, Materials and Design Guidelines
  - Plating on Plastic
  - Conductive Paint Application
  - Dispensed Conductive Gasket
- Additional Services - Streamline Customer Supply Chain
- Shielding Effectiveness of Coating Systems
- RoHS & WEEE Review
- Plastic Metallization Applications
- Summary
Based in Lufkin, TX
Business Focus Since 1987

**Functional & Decorative Metal Coatings on Plastics**
- Electroless & Electrolytic Plating
- Conductive Paint on Plastics
- Dispensed Conductive Gasket

- Turnkey Manufacturing Services
  - Injection Molding
  - Decorative Finishing
  - Mechanical Assembly
  - Hardware Installation
  - Part Marking

**Electronic Component & Equipment Manufacturers**

Registered ISO 9001:2015
## SERVED MARKETS

<table>
<thead>
<tr>
<th>Connectors</th>
<th>Wireless Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecom Infrastructure</td>
<td>Networking Equipment</td>
</tr>
<tr>
<td>Servers/Routers</td>
<td>Storage Devices</td>
</tr>
<tr>
<td>Medical Electronics</td>
<td>Barcode/RFID Equipment</td>
</tr>
<tr>
<td>Military/Aerospace</td>
<td>Antenna</td>
</tr>
<tr>
<td>Industrial Equipment</td>
<td>Semiconductor Packaging</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Test Equipment</td>
</tr>
<tr>
<td>Automotive Electronics</td>
<td>Mobile Handsets</td>
</tr>
<tr>
<td>Audio Electronics</td>
<td>GPS Systems</td>
</tr>
</tbody>
</table>
PLASTIC METALLIZATION APPLICATIONS

- EMI/RFI Shielding
- Decorative Finishes – Bright Chrome Plating
- ESD Coatings
- RF & Microwave Housings
- Antenna
- IR Heat Barrier
- Vapor Barrier
- Mil Spec Finishes, Including CARC
METALS DEPOSITED

- Plating
  - All-Over & Selective Electroless Plating – Copper & Nickel
  - All-over Electrolytic Plating – Copper, Nickel, Chrome
- Conductive Paint
  - EMI Shielding – Copper and Silver
  - ESD – Nickel and Graphite
# PLATEABLE RESINS

## Widely Plateable

<table>
<thead>
<tr>
<th>Resin</th>
<th>Component</th>
<th>Blend</th>
<th>Fill Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Polycarbonate (PC)</td>
<td>PC/ABS</td>
<td>PEI (Ultem) ≥20% Fill</td>
</tr>
<tr>
<td>PPA</td>
<td>Fiberglass</td>
<td>Polystyrene</td>
<td>Liquid Crystal Polymer</td>
</tr>
</tbody>
</table>

## Selected or Custom Blended Plateable Grades*

<table>
<thead>
<tr>
<th>Resin</th>
<th>Component</th>
<th>Blend</th>
<th>Plastic Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noryl</td>
<td>Xylex</td>
<td>Xenoy</td>
<td>Urethane</td>
</tr>
<tr>
<td>Nylon</td>
<td>PEEK</td>
<td>PPS</td>
<td>Polypropylene</td>
</tr>
</tbody>
</table>

* Only Selected or Custom Blended Resins Can Be Plated.

## Not Plateable

<table>
<thead>
<tr>
<th>Resin</th>
<th>Component</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Valox (PBT)</td>
<td>Polyethylene</td>
<td>Polyester</td>
<td>PVC</td>
</tr>
</tbody>
</table>

Avoid Use of Mold Release if Possible and Absolutely Avoid Silicone Mold Release in Molding Process for Any Part Being Plated or Painted.
# PLATING ON PLASTICS

## All-Over Electroless
- Acid/Caustic Etch or Abrade
- Activate with Catalyst
- Plate 1-10 µm (40-400 µ”) Copper, Nickel

## Selective Plating Catalyst
- Mask Part
- Apply Auto-Catalytic Primer
- Plate 1-5 µm (40-200 µ”) Copper, Nickel

## Electrolytic Plating
- All-Over Electroless Plate
- Rack & Contact
- Plate 5-75 µm (200 µ”–.003”) Copper, Nickel, Chrome
SELECTIVE PLATING

- Mask Selected Areas of Part & Apply Catalytic Plating Primer
- Apply Electroless Copper Plating and Finish with Electroless Ni, Sn, Au
- Mask Line Tolerance +/- 0.020” (0.5 mm)
- Maintain Unplated Part Molded Color & Texture

Auto Darkening Welding Helmet Covers
2-SHOT MOLDING

- Utilize All-Over Plating Process on 2-Shot Molded Parts
  - Plateable Resin - Catalyzed to Promote Plating
  - Non-Plateable Resin
  - Feature Size to <0.20” (0.5 mm)

- Mold Tool Designed for 2-shot Molding Process

- Resins Must Have Compatible Molding Parameters
ELECTROLYTIC PLATING

- Start with Electroless Copper or Nickel Plated Plastic Part
- Plating Material Options: Copper, Nickel, Chrome
- Thicker Coatings, Faster Deposition & Lower Plating Material Cost
- Line-of-Sight Process with Wider Thickness Variation
- Decorative Bright Chrome Plating
# PLATING DESIGN ISSUES

<table>
<thead>
<tr>
<th>Design Don’t</th>
<th>Design Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-sided Box or Cup Design Trap Air and/or Drag Out Plating Chemicals</td>
<td>Include Drain Holes</td>
</tr>
<tr>
<td>Impact Plating Quality &amp; Cost</td>
<td>Design Part to Prevent Entrapment of Air or Plating Solution</td>
</tr>
<tr>
<td>Tight Crevices Can Trap Plating Solution</td>
<td>Eliminate Crevices in Design or Include Drain Hole</td>
</tr>
<tr>
<td>Small Blind Holes Trap Plating Solution Later Weep Out &amp; Damage Plating</td>
<td>Utilize Through-holes</td>
</tr>
<tr>
<td></td>
<td>If Blind Holes Required, Plug to Prevent Plating Solution Entrapment</td>
</tr>
</tbody>
</table>

**Inserts**
- Brass or Stainless Inserts - Ultrasonic or Heat Stake Before/After Plating
- Inserts Installed Before Plating - Mask Threads with Screws During Plating

Avoid Use of Mold Release if Possible and Absolutely Avoid Silicone Mold Release in Molding Process for Any Part Being Plated or Painted
CONDUCTIVE PAINT

- Air Atomization of Metallic Paints
- Coatings
  - Graphite, Ni, Cu, Ag, Hybrid Cu-Ag
  - Thickness: 0.5-2.0 mils (12-50 µm)
  - Electro-form Mask for Selective Application
- Thickness Uniformity & Repeatability via Robotic Application
- Wide Resin Capability
- “Flexible” Conductive Paint for Application onto Paper or Fabric
## PAINTABLE RESINS

### Common Paintable Resins

<table>
<thead>
<tr>
<th>Resin</th>
<th>First Resin</th>
<th>Second Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Polycarbonate (PC)</td>
<td>Polybutylene Terephthalate (PBT)</td>
</tr>
<tr>
<td>PC/ABS</td>
<td>Poly Aryl Amide</td>
<td>Polyphenylene Oxide (PPO)</td>
</tr>
<tr>
<td>PC/PBT</td>
<td>Polychthalamide (PPA)</td>
<td>Polyether Imide (PEI)</td>
</tr>
<tr>
<td>Nylon</td>
<td>Polystyrene (PS)</td>
<td></td>
</tr>
</tbody>
</table>

### Difficult to Paint Resins (May Require Primer)

<table>
<thead>
<tr>
<th>Resin</th>
<th>First Resin</th>
<th>Second Resin</th>
<th>Third Resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teflon (PTFE)</td>
<td>Polyethylene</td>
<td>Liquid Crystal Polymer</td>
<td></td>
</tr>
<tr>
<td>PEEK</td>
<td>Polyimide</td>
<td>Polypropylene</td>
<td></td>
</tr>
</tbody>
</table>
## CONDUCTIVE PAINT DESIGN

<table>
<thead>
<tr>
<th>Design Don’t</th>
<th>Design Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult to Paint Tight Bosses, Crevices and Holes</td>
<td>Eliminate Crevices &amp; Small Holes Requiring Coating</td>
</tr>
<tr>
<td>Line-of-Sight Paint Process</td>
<td></td>
</tr>
</tbody>
</table>

**Inserts**

- Brass or Stainless Inserts - Ultrasonic or Heat Stake Before/After Painting
- Inserts Installed Before Painting - Mask Threads with Screws During Plating
# Shielding Effectiveness

<table>
<thead>
<tr>
<th>Coating System</th>
<th>Thickness</th>
<th>Resistivity (m-ohms/sq)</th>
<th>30 MHz</th>
<th>100 MHz</th>
<th>300 MHz</th>
<th>1 GHz</th>
<th>5 GHz</th>
<th>10 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-Over Plating</td>
<td>40-400 µ” (1.0-10.0 µm)</td>
<td>5-50</td>
<td>90</td>
<td>108</td>
<td>104</td>
<td>120</td>
<td>113</td>
<td>87</td>
</tr>
<tr>
<td>Selective Plating</td>
<td>80-200 µ” (2.0-5.0 µm)</td>
<td>15-100</td>
<td>77</td>
<td>73</td>
<td>71</td>
<td>71</td>
<td>60</td>
<td>63</td>
</tr>
<tr>
<td>Copper Paint</td>
<td>0.001-.0015” (0.025-.375 mm)</td>
<td>25-100</td>
<td>65</td>
<td>63</td>
<td>59</td>
<td>70</td>
<td>81</td>
<td>63</td>
</tr>
<tr>
<td>Copper-Silver Paint</td>
<td>0.0008-.001” (0.020-.25 mm)</td>
<td>15-50</td>
<td>78</td>
<td>73</td>
<td>72</td>
<td>69</td>
<td>85</td>
<td>82</td>
</tr>
<tr>
<td>Silver Paint</td>
<td>0.0005-.001” (0.0125-.025 mm)</td>
<td>15-50</td>
<td>70</td>
<td>71</td>
<td>70</td>
<td>62</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

Source: Enthone, Spraylat and Cybershield
COATING QUALITY METRICS

- **Metal Deposition Thickness** – X-Ray Diffraction to Measure Individual Plating or Conductive Paint Layers
- **Resistivity – Point-to-Point or Ohms/Square**
  - Plating with 10 micro-inches (0.25 µm) Ni over 40-400 micro-inches (1.0 µm) Cu: 0.005-.100 Ohms/Square
  - Copper & Silver Conductive Paint 0.025-0.050 Ohms/Square @ 0.001” Dry Film Thickness
- **Adhesion – ASTM D-3359**
  - Destructive or Non-Destructive Test Method
  - Tape Test: Measure Plating Pulled on Visual Scale (1-5 with 5 Best – No Metal Pulled
- **UL QMRX2 Certification**
  - Certified Resins: [www.cybershieldinc.com/electroless.htm](http://www.cybershieldinc.com/electroless.htm)
CONDUCTIVE GASKET CAPABILITIES

- Silicone with Silver Plated Nickel, Copper or Aluminum Filler
- Dispense onto Metal, Painted or Plated Plastic via PC Controlled Robot
- Shielding Effectiveness: 85-120 dB
- Compression Set: <20% @ 50% Deflection
- Shore A Hardness: 48-70
- Gasket Size Range
  - Height: 0.015”-0.090” (0.38-2.3 mm)
  - Width: 0.018”-0.125” (0.46-3.2 mm)
INJECTION MOLDING

- Two 220T Presses & 1 125T Press
  - Capable of Wide Range of Resins
  - Part Size up to 8” x 10”
  - Up to 13 Ounce Shot
- Manage Molding Part Quality for Plating
- Streamline Supply Chain
- Eliminate Freight Costs
DECORATIVE PAINT

- Decorative Paint Applied over Plating
  - Meet Cosmetic Requirements
  - Color Match Surrounding Components
  - Protect Plating from Abrasion

- Decorative Paint System Can Include Prime, Texture & Color

- Applied Manually or in Cybershield Paint Robots
CHROMATE CONVERSION COATING

- Aluminum Finishing per MIL-DTL-5541
  - Non-Hexavalent Chromium
  - Clear
  - Low Electrical Resistance
  - Pass 168 Hours Salt Spray per ASTM B117

- Conversion Coated Parts Can Be Plated and/or Painted
NICKEL PLATING OF ALUMINUM

- Per Industry Specifications
  - MIL-C-26074, AMS-C-26074 or AMS 2404
  - Electroless Nickel Plating
  - Pass 100 Hours Salt Spray per ASTM B117

- Nickel Plated Parts Can Be Plated with Additional Finishes and/or Painted
RoHS/REACH & WEEE

- **RoHS: EU Directive - Restriction of Hazardous Substances**
  - Lead, Cadmium, Mercury, Hexavalent Chromium, Polybrominated Biphenyl (PBB), Polybrominated Diphenyl Ether (PBDE) Flame Retardants
  - All Cybershield Coatings RoHS Compliant

- **REACH (Registration, Evaluation, and Authorization of Chemicals)**
  - No Substances of Very High Concern (SVHC) in Any Coatings

- **WEEE - Waste from Electrical and Electronic Equipment**
  - Raise Level of Recycling of Electrical and Electronic Equipment
  - Manufacturers Responsible for Recycling Costs
  - Cybershield Processes to Remove Plating & Paint Coating to Allow for Plastic Recycling (Can Transfer Know-How)
APPLICATIONS
CHROME PLATING

- RoHS Compliant Trivalent Chrome Plating
- State-of-the-Art Automated Chrome Plating Line
- Serve Several Automotive & Industrial Equipment Manufacturers
SHIELDED CONNECTORS

- Increasing Need for Shielded Interconnection
  - Medical
  - Military/Aerospace
  - Telecommunications

- Eliminate Weight, Space and Cost for Metal Shell

- Miniaturization

- Wireless Connectivity
SATellite INTERNET

- Satellite Internet Service
- Plated Plastic Waveguide
  - 50 micro-inches (1.25 µm) Nickel over 150 micro-inches (3.75 µm) Copper
  - Replaced Plated Die Casting Due to Cost & Weight Savings
- Critical Attributes
  - Plating Thickness Tolerance
  - Surface Roughness
  - Tight Dimensional Requirements
    - Thickness & Length
    - Twist & Bow
TELECOM SWITCH FACEPLATES

- All-Over Plated & Decoratively Painted Injection Molded Faceplates
  - Meet EMI Requirements
  - Color Match to Metal Chassis
- Mechanical Assembly
GPS SURVEY EQUIPMENT

- Light Weight, Durable, Housing
- EMI Shielding
  - All-Over Electroless Plating on Polycarbonate Frame
  - Conductive Paint on Xenoy (PC/PET) Housing
- Inserts and Part Marking
MOBILE ANTENNA

- Mobile Satellite Antenna Waveguide
- All-Over Plated
  - Copper 300 micro-inches (12.5 µm)
  - Nickel Flash
CONDUCTIVE GASKET

- Silicone Filled with Silver Plated Nickel, Copper or Aluminum
- Dispensed onto Metal Housing
  - Provide EMI Shield with 85-120 dB Attenuation
  - Mate with PC Board Traces
- High Volume Capability and Repeatable Precision Dispensing
ROUTER CHASSIS

- All Plastic Router Chassis
- All-Over Cu/Ni Plating
- Install 130 Inserts
- Assemble & Bond Chassis
- Decorative Paint
- EMI Shielding: 1-10 GHz
- Cost Effective Option to Sheet Metal Chassis
- Router: 65% Lighter Than Sheet Metal Design – Eliminated Cabling
SUMMARY

- Offer Several Metallization Processes with Available Capacity
  - All-Over Plating & Selective Plating with Process Identical to Seleco
  - Conductive Paint
  - Form-in-Place Conductive Gasket

- Streamline Supply Chain Manufacturing
  - Injection Molding
  - Assembly, Hardware Installation, Part Labeling
  - Decorative Finishing (Painting or Plating)