Outline

◆ Overview of the Bonding Process
◆ Substrate Preparation
◆ Adhesives and Application
◆ Prebake and Cast Process
◆ Troubleshooting Bond Failures
◆ Summary
Substrate Types and Preparation Methods

◆ Various grades of steel and aluminum are common

◆ Solvent degreasing (MEK, toluene, or xylene) removes fabrication or stamping oils, greases, dirt, etc. prior to abrasion

◆ Abrasion (blasting, grinding, machining or sanding) removes surface oxidation and increases surface area for primer or adhesive wetting
Blast Media Types

- **Grit**, angular shape “cuts”, sharp ridges and valleys result
- **Shot**, circular shape “peens”, dimples result
- G25 - 80 grit preferred, yields 1 - 3 mil profile
- Less surface area plus more potential for contamination
Substrate Precautions

- Nylon 6/6 (glass-filled), break surface “skin” to expose glass fibers
- Stainless steel, aluminum oxide or glass bead *only*, steel media can cause rapid underbond corrosion
- Worn down media, adhesive failure from loss of blast profile
- Excessive grooving, VVVV can cause adhesive failure, shear and puddling potential
Preparation Methods

◆ Air blow-off or final solvent degreasing to remove substrate and media fines

◆ Once prepared, apply primer or adhesive ASAP, (<2 hours) avoids formation of weak oxide layer, depends on substrate composition and plant conditions

◆ Caution during the summer months, increased temperature and humidity speed oxidation
Preparation Summary

- Most successful preparation is degrease, abrasion, degrease
- Proper preparation is the “foundation” for subsequent steps
- ~30% of bond failures result from preparation problems
Adhesive Selection

- Chemlok® 210 Adhesive
- Chemlok 213 Adhesive
- Chemlok 218 Adhesive
- Chemlok 219 Adhesive, frequently used primer for other adhesives, designed for hard-to-bond substrates and improved environmental resistance
Adhesive Selection

- Chemlok 248 Thinner, used for spray application of Chemlok 213 Adhesive
- Chemlok 8600 Adhesive, a waterborne version of Chemlok 213 Adhesive
- Additional products for RIM, millable gum and TPU injection
Adhesive Bonding Mechanisms

Mechanical

Chemical
Handling and Mixing Methods

- Always use fresh product, adhere to shelf life, FIFO
- Use proper thinner/solvent and amount, mix during addition to avoid “shock”
- Seal cans when not in use to reduce solvent evaporation and contamination, store at 70 - 80°F in approved areas
Application Techniques

- Brush, spray, roll or dip application - consistent operator technique is key

- Avoid thick and thin areas, puddles, tears and bare spots can result in poor adhesion

- If 213 leaves globs or brush marks, try 2 diluted coats (~4:1 by volume, 213:248) with drying between coats
Drying, Handling and Storage of Coated Parts

◆ Dry for 30 - 60 minutes at room temperature or forced air < 200°F for 15 minutes, allow sufficient solvent flash to avoid product blisters

◆ Minimize handling coated areas, bare hand or dirty gloves can create failure

◆ For long layover of coated parts, cover them to avoid airborne contamination, prefer casting within several shifts
Dry Film Thickness Targets

- Two coat system: 219 at 0.2 - 0.4 mils plus 213 or 218 at 0.6 - 0.8 mils, total of 0.8 - 1.2 mils
- One coat system: 213 or 218 at 0.8 - 1.2 mils
- 1 mil target = 0.001" or 25.4 microns
- 2 options for measurement: digital dry film gauges or 1 mil shim with a micrometer
- Witness panel for visuals (color contrast) for 213
Chemlok 213 Adhesive Dry Film Thickness

Low < 0.5 mils  
Target ~ 1.0 mil
Dry Film Thickness Precautions

- Too thin (<0.5 mils): Lack of active ingredients to provide bond, common occurrence
- Too thick (+3 mils): Shearing (cohesive) within adhesive layer, rare occurrence
- Optimal dry film thickness is determined with testing of your specific materials and processes
Application Summary

◆ Produce a uniform application at target dry film thickness

◆ Once process is established, make it repeatable

◆ ~50% of bond failures result from inconsistent application or insufficient adhesive
Prebake Process Guidelines

- Suggest prebake of coated parts of 2 hours at ~250°F, then load hot to mold.
- Prebake allows an equilibrium between all materials, improves environmental performance of adhesive.
- Thermocouples to monitor oven and part temperatures, avoid hot or cold spots.
Prebake Process Guidelines

- Withstand 12+ hours at 250°F, several cycles may be acceptable
- ~10% of failures result from insufficient prebake conditioning
- Determine optimal prebake times and temperatures with bond testing of your materials and processes
Casting Process Guidelines

- Caution with silicone release agents, specifically edges where the mold and coated substrate meet
- Follow supplier’s instructions for casting and post bake parameters
- Typical casting cycle: <2 hours in mold at 212ºF, then postbake of 16 hours at 212ºF
Bond Performance Data

- Primary Adhesion @ RT
- 14 day RT water
- 3 days in 100°F grease
- Test @ 30°F
- Test @ 200°F
- Test @ 200°F (no prebake)
- 7 day salt spray B117

Chemlok 218 Adhesive
Chemlok 213 Adhesive

ASTM D429B (mod. 45° peel @ 2 in./min.)
Cast Polyurethane to Grit Blasted Steel
2 hr. pre-bake @ 250°F
2 hr. cure @ 212°F/post bake 16 hrs. @ 212°F
Troubleshooting Tips for Failures

1) Provide background of the failure, new or existing job, production or service
2) Define the amount, location and mode of failure(s)
3) Review processes, materials, equipment and operators, *what’s changed?*
Troubleshooting Tips for Failures

4) List potential problems, use process of elimination and common sense

5) Implement an action plan, change only one parameter at a time

6) Education of operators and supervisors can reduce or prevent future occurrences, periodic audits are valuable
Failure Types Per ASTM D429B

- **R** = Rubber retention
- **RC** = Rubber-to-Cement
- **CP** = Cement-to-Primer
- **COH** = Cohesive
- **CM** = Cement-to-Metal
Cement-to-Metal Type

- Designated as CM, cement = primer or adhesive
- Primer or adhesive failure at the metal or substrate interface
- Clean metal with primer or adhesive transferred to urethane (rubber) surface

### 2 Coat System

- **CM**
- Primer
- Adhesive
- Rubber

### 1 Coat System

- **CM**
- Adhesive
- Rubber

Metal/Substrate
Cement-to-Metal Cause and Resolution

◆ Insufficient abrasion
  • Change/refresh media, belts, or grinding wheel

◆ Grit and/or substrate fine contamination
  • Remove fines with solvent wash or clean air blow-off

◆ Excessive oxidation (flash rust) before primer or adhesive application
  • Reduce layover time. Review plant conditions
Rubber-to-Cement Type

- Designated as RC, cement = adhesive
- Failure occurs between urethane (rubber) and adhesive
- Look for evidence of adhesive adhering to substrate, but not to urethane (rubber) surface

2 Coat System

<table>
<thead>
<tr>
<th>RC</th>
<th>Rubber</th>
<th>Adhesive</th>
<th>Primer</th>
<th>Metal/Substrate</th>
</tr>
</thead>
</table>

1 Coat System

<table>
<thead>
<tr>
<th>RC</th>
<th>Rubber</th>
<th>Adhesive</th>
<th>Metal/Substrate</th>
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</thead>
</table>
Rubber-to-Cement Cause and Resolution

- Contamination of coated substrates
  - Identify contaminant, reprocess

- Insufficient application thickness
  - Review application process. Re-apply thicker coat

- Insufficient prebake conditions
  - Check temperatures with thermocouple. Use 250°F for longer period
Summary

◆ Conduct bond tests to optimize preparation, application, prebake and cure conditions

◆ *Process control* leads to low scrap rate and customer satisfaction

◆ Call 877-ASK-LORD (275-5673), extension 3225 or contact your local distributor to discuss your bonding applications

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