Chemical Reactivation as a Method for Replacing Scuff Sanding and for Applying Stencils on Aerospace Topcoats

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Why is Reactivation of Aerospace Topcoat Required?

Examples of In-Service Polyurethane to Polyurethane Adhesion Failures

Between Livery Topcoats

On Painted Stencils

Key Properties of Aerospace Topcoats

Key Properties

- **Gloss and Color Retention**
- **Hydraulic Fluid Resistance**
- **Flexibility**
- **UV Resistant**
- **Abrasion Resistant**
- **Corrosion Control**

A consequence of achieving a balance of properties is a highly cross-linked, durable, and inert outer surface that is difficult for subsequent coatings to adhere to.

Baseline Reactivation Method for Aerospace Topcoats: Mechanical Abrasion

Surface Prep

Prime

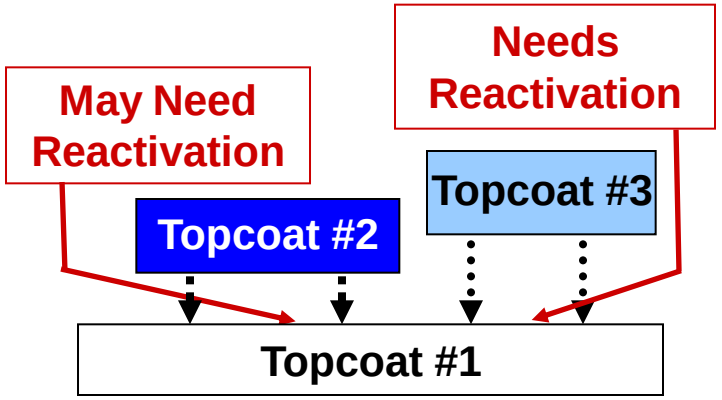
Apply first topcoat over entire body, then cure

Mask for first accent color

Mechanical abrasion reactivation then remove sanding residue with a tack rag

Apply topcoat, cure, then repeat process steps for additional colors

- **Complex liveries require successive topcoat applications.**
- **Boeing requires a reactivation method for topcoated surfaces ambient cured for more than 48 hours or force cured for more than 4 hours above 105 F.**
- **Hand applied mechanical abrasion increases ergonomic related injuries, is non-uniform, and is a contamination producer.**



Advantages of a Chemical Reactivation Method

Environment/Safety

- **Eliminate injuries due to excessive mechanical abrasion**

Production Efficiency

- **Reduce flow time**

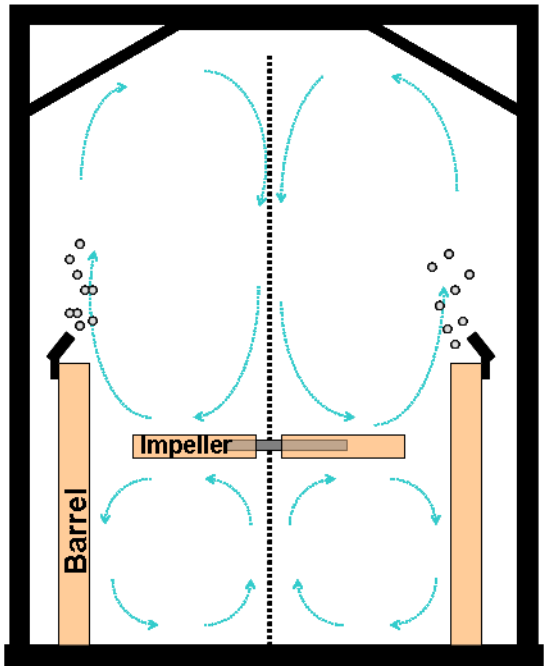
Performance

- **Improve durability with more uniform application**

Stencils

- **Small size and intricacy of lettering eliminates mechanical abrasion as a viable reactivation method**

Rain Erosion – A Key Screening Test



- A passing result has ¼ inch tear length or less from tape edge.
- Rain erosion is good at finding the weakest interface when multiple coatings are applied.

Rain Erosion Results – Chemical Reactivation Equivalent to Mechanical Abrasion

Large Paint Area (Thick overcoat film)

(Topcoat Brand X)

High Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded

Low Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded

Controls: Not Abraded or Abraded

Paintbond SM-1 (Sur-Prep AP-1) Reactivator BMS10-127

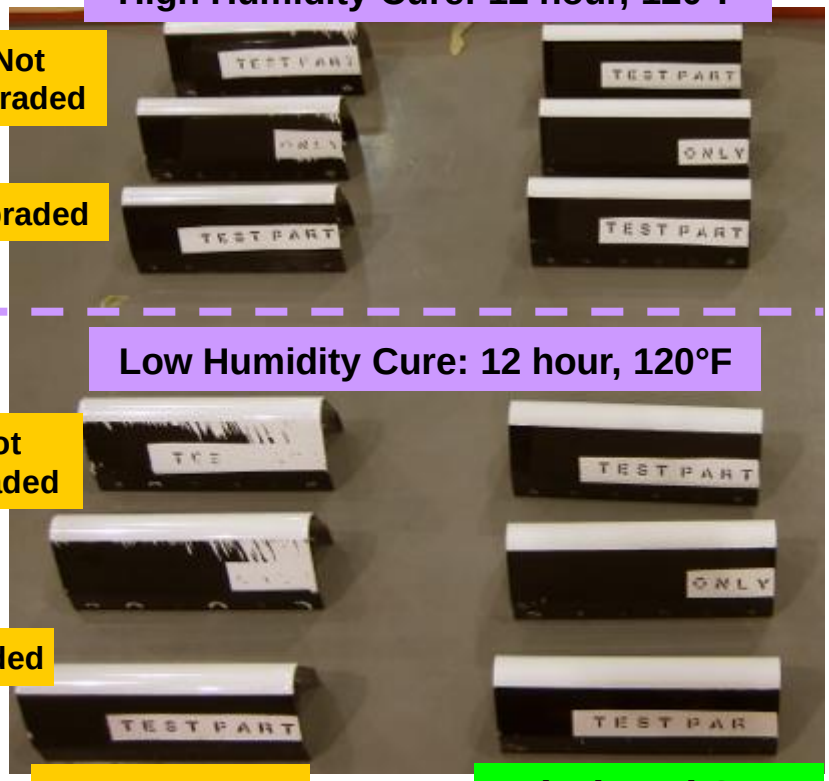
Stencil Lettering (Thin overcoat film)

(Topcoat Brand Y)

High Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded



Low Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded

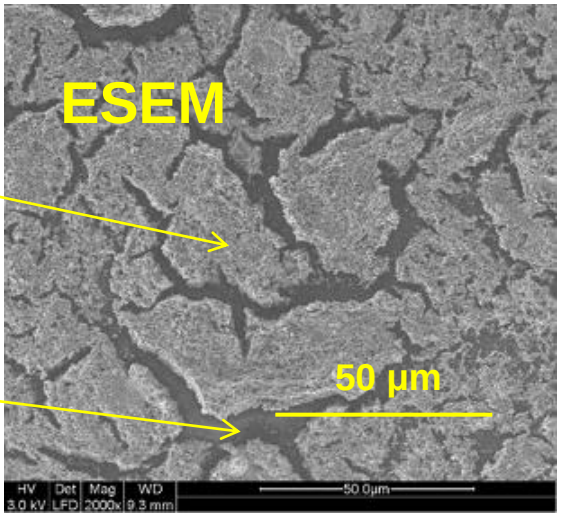
Controls: Not Abraded or Abraded

Paintbond SM-1 (Sur-Prep AP-1) Reactivator BMS10-127

Boeing/CSIRO Joint Formulation
Paintbond SM-1
US Patent Application 20080050598

- **Paintbond SM-1**
  - Proprietary reactivator co-developed by Boeing and CSIRO
  - Zirconium (Metal) alkoxide in solvent formulation
  - Toll produced for Boeing by Zip-Chem® Products as Sur-Prep AP-1
- **Low fly away weight** (< 0.3 lb /1000 sq ft of coverage)
- **Optimized for exterior decorative topcoats** (BMS10-72 and BMS10-125)
- **Solvent based**
  - **Glycol ether:** non-HAP, biodegradable, low VP (0.55 mm Hg at 68˚F)
  - **Alcohol:** non-HAP, biodegradable
  - **ANESHAP compliant** (860 gm/liter)
  - **600-1500 sq ft / gal coverage**

Top View of Applied Reactivator



Application Process for Large Areas Gallon and Pint Size – 2 Part Kits

1. **Mask areas not to receive reactivator and subsequent overcoat**
2. **Remove contamination**
3. **Mix – 2 part kit**
   - **Pour Part A into Part B**
   - **Reseal Part B and shake 5 minutes**
   - **Pour into use container**
   - **Keep use container covered until ready for application**
4. **Spray**
   - **Spray apply with preferred equipment.**
   - **Apply one coat that completely wets the surface. Avoid misting.**
   - **Over-application creates a long solvent flash-off which may induce edge attack of maskant materials**
5. **Ambient dry for 30 minutes minimum**
   - **Visual gloss will go flat as it dries due to the formation of a fine white powder**
6. **Overcoat with subsequent topcoat as soon as possible to avoid contamination, however passing data has been obtained up to 24 hours before overcoat.**
7. **Cure per process document**

Aerosol for Stencil Applications and Small Areas

Sur-Prep AP-1 pre-blended then injected into cans along with liquid propellant

Promoter

After Application

Promoter Application

Final Product

Implementation

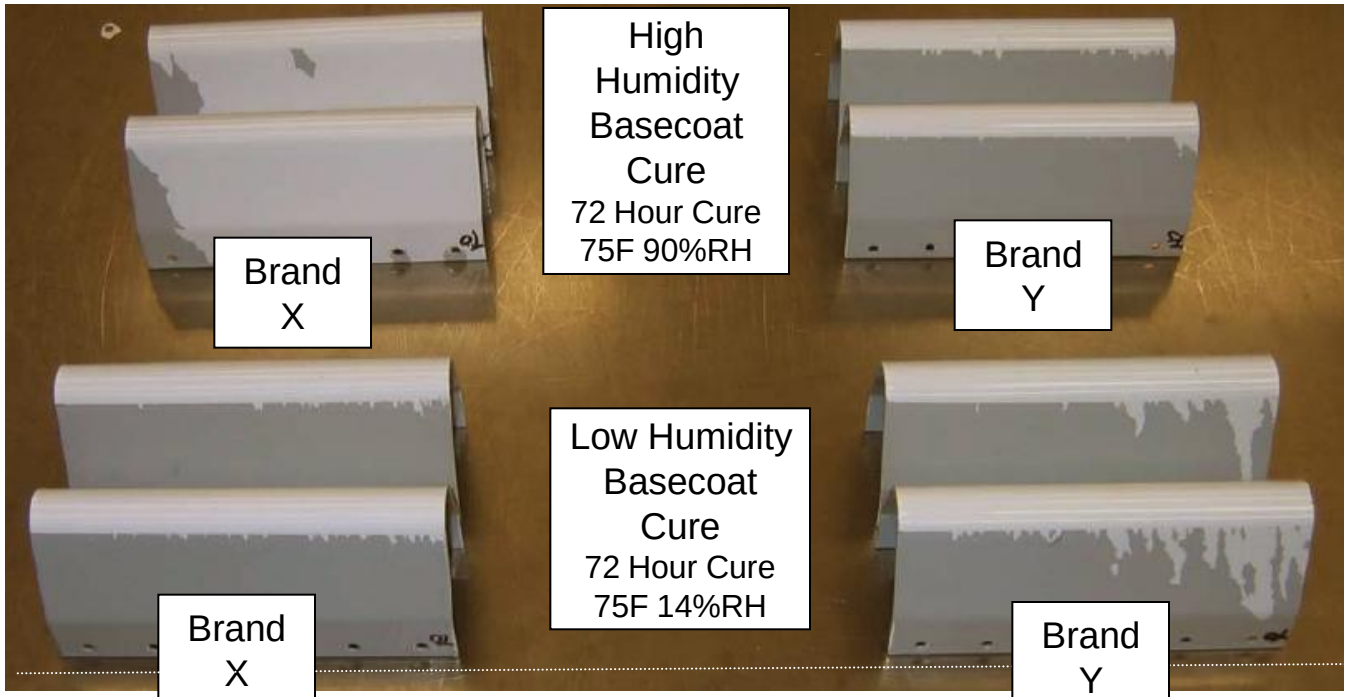
- **June 2008: First Production Trial on 737 (SWA)**

- **Sept 2008: First Qualified on D6-1816**
- **May 2009: First 777**
- **July 2009: First C-17 (BMS10-72 paint)**
- **May 2010: First 767 Use**
- **May 2010: First 787 Use**
- **Feb 2011: First 747 Use**

Key Lesson Learned – Humidity Effects

High Humidity Basecoat Cure
72 Hour Cure
75F 90%RH

Low Humidity Basecoat Cure
72 Hour Cure
75F 14%RH



- **Humidity during cure of polyurethane substrate is a key variable when evaluating a coating's ability to be chemically reactivated.**
- **For most but not all topcoat brands, low humidity cure was the most favorable for chemical reactivation.**
- **Recommend that future coating evaluations involve controlled curing at both ends of the humidity range.**

Summary

- **A chemical reactivator for intercoat bonding of livery colors to replace mechanical abrasion of paint hangar cured paint has been developed.**

Implementation has reduced

- Ergonomic injuries
- Dust exposure and rework due to dust contamination
- Paint hangar flow time

Implementation should

- Improve the uniformity of intercoat livery bonding and the durability of stencils
- Reduce the need for field repair touch-up and paint usage

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Backup Slides

Paintbond SM-1 Qualification Testing

Engineering Tests:

- **Rain Erosion**
- Dry & Wet Scribe
- Condensing Humidity
- Impact Adhesion
- Conical Mandrel Bend
- Fluid Resistance Low
- Temperature Shock
- Thermal Moisture Cycling
- Acrylic Crazing
- Sandwich Corrosion
- Metal/Composite Compatibility
- Sealant Compatibility
- Paint Stripability

Manufacturing Tests:

- **Define Limits of Use on Paint Hangar Topcoat**
- **Define Promoter Application Window (T, RH)**
- Ability to mix and use (Pot and Storage Life)
- Sprayability
  - ✓ HVLP, Electrostatic, air assisted airless paint guns
  - ✓ Electrical resistivity
- Cover with less than two paint coats
- Process Equipment Compatibility
- Pre-mask/Stencil/Paper Compatibility
- Promoter (Overspray) Removability
- Waste/Environmental Assessment
- Shop Trials (Large Panel & Tube)