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

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Report Documentation Page

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Standard Form 298 (Rev. 8-98)  
Prepared by ANSI Std Z39-18
Why is Reactivation of Aerospace Topcoat Required?

Examples of In-Service Polyurethane to Polyurethane Adhesion Failures

Between Livery Topcoats

On Painted Stencils
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.
• 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
- **Paintbond SM-1** *(Sur-Prep AP-1)* Reactivator BMS10-127
- **Controls:** Not Abraded or Abraded

**Stencil Lettering** (Thin overcoat film) *(Topcoat Brand Y)*

- **High Humidity Cure:** 12 hour, 120°F
- **Paintbond SM-1** *(Sur-Prep AP-1)* Reactivator BMS10-127
- **Controls:** Not Abraded or Abraded

Not Abraded

Abraded

Not Abraded

Abraded

Low Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded

High Humidity Cure: 12 hour, 120°F

Not Abraded

Abraded

Low Humidity Cure: 12 hour, 120°F
**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**
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 Application

After Application

Promoter

Final Product

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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

• 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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  - Kim Puglisi

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  - Ranya Simons

- Technician
  - Emma Simmonds

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- Dimitriy Shapiro (SWA Photo)
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)