

Overview of State of the Art Paint Removal Processes in the United States Air Force

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Presentation to

AVT-302 Paint Removal Technologies for Military Vehicles

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Outline

- **Chemical Strip**
- **Dry Media Strip**
- **Laser Strip**

Chemical Strip

- **Majority of USAF aircraft are stripped with chemical strippers**
- **Physical stripping methods never get 100% of the aircraft**
 - Chemical strippers needed for “nitpicking”, tight areas
- **Least Damaging to aircraft substrates**
- **USAF does not allow use of acid strippers**
 - Currently have two Purchase Descriptions (PDs) defining requirements
 - Working to merge the requirements and develop a military specifications

Differences in Purchase Descriptions

- **AF PD**

- pH 7.0 – 11.0
- Hydrogen Embrittlement
 - 150 hrs – no failure
- Immersion Corrosion Testing
 - (Weight Loss, Mg/cm²/168 hrs)

2024-T3 Anodized	0.20
2024-T3 Bare	0.02
2024-T3 Clad	0.05
7075-T6 Bare	0.03
7075-T6 Clad	0.50
Ti 6AL-4V	0.10
Steel 1020 Bare	0.08
Steel 1020 Cad Plated	0.27
Mg	0.12

- **OC-ALC PD**

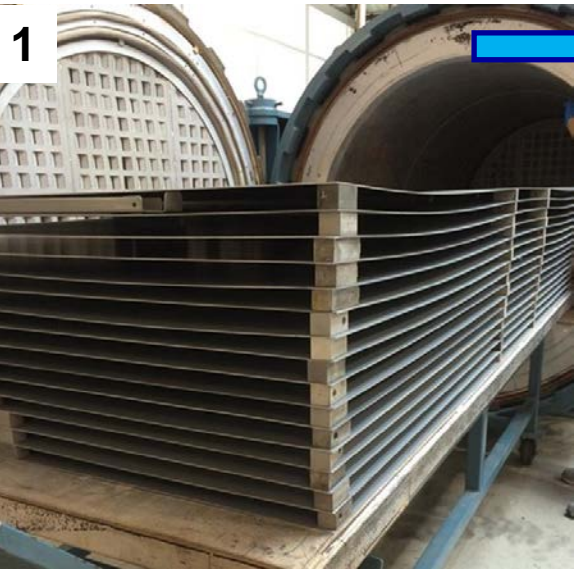
- pH 5.5 – 11.0
- Hydrogen Embrittlement
 - 50 hrs – no failure
- Immersion Corrosion Testing
 - (Weight Loss, Mg/cm²/24 hrs)

2024-T3 Anodized	N/A
2024-T3 Bare	0.10
2024-T3 Clad	0.05
7075-T6 Bare	0.10
7075-T6 Clad	0.05
Ti 6AL-4V	0.10
Steel 1020 Bare	0.10
Steel 1020 Cad Plated	0.05
Mg	0.20

Artificial Aging

3-Step Process

1



Coated Panels (4x8 ft)
Heat-Aged @ 210° F, 96 h

2



Scuff-Sanded & Recoated

Process repeated to generate 3 layers of aged and reapplied coating

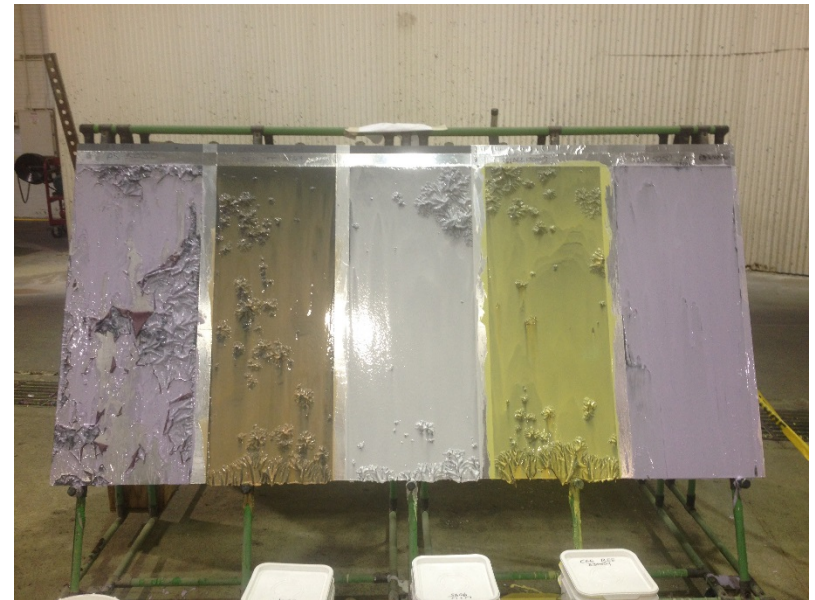
3



8 Panels: prepared by aging, scuff/recoat x3

8 Panels: prepared by aging only (single application)

Chemical Stripper Evaluation



- **Chemical strippers applied replicating depot process**
- **No more than 3 applications of stripper, totaling 24 hours**
- **Goal is $\geq 90\%$ total strip**
- **Accept, $\geq 90\%$ topcoat and $\geq 70\%$ primer**

Chemical Stripper Process

- **Mask aircraft, aluminum foil tape and plastic sheeting**
 - Openings, windshield/canopies, areas not need stripped
- **Spray apply chemical stripper**
 - Hydrogen Peroxide or Benzyl Alcohol
- **Dwell dependent on wetness of chemical stripper and activity of chemical stripper with coating**
 - If temperature outside of 70-85 degrees it will cause delays
- **Rinsed and reapplied if coating remains**
 - Aquamiser used for stubborn coatings



Dry Media

- **MIL-P-85891, Plastic Media, for Removal of Organic Coatings**
 - Type I – Polyester
 - Type II - Urea Formaldehyde
 - Type III – Melamine Formaldehyde
 - Type IV – Phenol Formaldehyde
 - **Type V – Acrylic** *Approved for Aircraft*
 - Type VI – Polyallyl Diglycol Carbonate
 - **Type VII – Starch-g-acrylic** *Approved for Aircraft*
- **Type V – Metallic substrates**
- **Type VII – Composite substrates**
 - Requires auger feed
 - Vibrating hopper
 - Dryer
- **Maximum of 3 PMB strip cycles**
- **Robotic PMB Hanger for Smaller Aircraft**



Laser Systems

Lasers are used for aerospace coatings removal in several configurations

Handheld – for small area operations and “nit-picking” in areas of complex geometry



Off-Aircraft – automated systems capable of processing components removed from the aircraft during routine depot maintenance

Full-Aircraft – large automated systems capable of processing the OML of aircraft



Handheld Laser Applications

- Handheld lasers used to perform small area stripping operations
 - 300 W Nd:YAG from Clean Lasersysteme - preferred system
- Several end effector modifications are currently being developed to add to system safety
 - **Motion sensor** - This sensor will detect when the end effector optic is moving and allows laser firing only if the optic is moving.
 - **Temperature sensor** - This sensor will detect temperature of surface on which the laser is being used. It will shut off laser firing if temperatures reach certain thresholds to be specified later.
 - **Distance sensor** - This sensor will detect if the optic is at an allowable distance from the surface. The laser will only fire if the optic is in a certain distance window.



LADS II

- 1 hr vs. 16-20 hrs to strip
- \$300k/yr savings
- COTS
 - 3'x 7'x 9' footprint
 - 8 kw LASER by Rofin Sinar
- Eliminated worker exposure
 - Repetitive motion injuries
 - Haz chemicals and waste
- Success led to Full AC project



Robotic Lasers

- System uses 6 kW/1070 nm fiber laser to thermally remove coatings
- Removes approximately 95% of OML coating
 - Nit-picking – chemical or handheld laser
- Critical parameters are locked-in to prevent overheating substrate
 - Laser power
 - Spot size
 - Scan speed
 - Sweep speed
 - Time delay between passes
- Virtual masking
- Selectively strips coating layer(s)
 - Strips 100% of topcoat on metallic surfaces
 - Primer removal optional
 - Strips 95% of topcoats on composites
 - Leaves max 0.2 mils topcoat
 - Leaves all primer



Questions