Maintenance Program and New Materials on Boeing Commercial Aircraft

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Maintenance Program and New Materials on Boeing Commercial Aircraft

Surface Finishing and Repair Issues for Sustaining New Military Aircraft Workshop, February 26-28, 2008, Tempe, AZ. Sponsored by SERDP/ESTCP.
Agenda

• Summary of Maintenance Program
• Drivers for implementing new materials
• Replacement of Alodine 1000
• B787 Finishes
BCA Maintenance Program

• Well defined program for all models
• Old system used letters
  • “A” check -- intended to disclose the general condition of the aircraft
  • “C” check -- greater depth of inspection throughout the airplane to ensure continued airworthiness
  • “D” check – Major systems/operational/functional checks, aircraft modifications, cabin refurbishment, painting, structural inspections, etc.
• Operations based system has layered inspections
  – based on flight hours or calendar
  – Varies by aircraft and operator
• System maintenance
  – Lubrication, operational/functional,
• Zonal Inspection
  – Combines general inspections and CPCP
• Structural maintenance
  – Detailed and special detailed inspections
  – Must maintain a “damage tolerance rating”

<table>
<thead>
<tr>
<th>Fleet Average Intervals (hours)</th>
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<tbody>
<tr>
<td>model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>737</td>
</tr>
<tr>
<td>767</td>
</tr>
<tr>
<td>747</td>
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</table>

• Military usage of airframes will not match commercial service
  • Maintenance intervals and practices will need to be adjusted
**“Operations” Maintenance Program**

**B747 Structural Program**

<table>
<thead>
<tr>
<th>NMD</th>
<th>AMM</th>
<th>P</th>
<th>Z</th>
<th>ACCESS</th>
<th>INTERVAL</th>
<th>APPLICABILITY</th>
<th>MAN-HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX-XXX-KK</td>
<td>112</td>
<td>112XL</td>
<td>16800 FC</td>
<td>3000 by 0 by 0 by</td>
<td>ALL</td>
<td>ALL</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**TASK DESCRIPTION**

- AIRPLANE MAINTENANCE MANUAL, PRECISEUR (CHAPTER, SECTION, SUBJECT) WHICH SUPPORTS THE NMD REQUIREMENT.
- NMD Sequence number
- NMD Sequence number
- First two digits = ATA Chapter

**Maintenance Program Type**

(1) Coronal, 17, 3, 9 and 9 Structures

**INTERNAL-GENERAL VISUAL: AREA FORWARD OF LANDING GEAR WHEEL WELL.
LIMITS LIDO SKIN PANELS-FORWARD OF BODY STATION 246.
LONGITUDINAL SKIN LAP SPLICED, FORWARD ACCESS HATCH-OUT.
STRUCTURES including skins within 20 inch periphery of cutouts.
FORWARD ACCESS HATCH-OUT STOP FITTINGS AND BACKUP STRUCTURE.
FORWARD PRESSURE BULKHEAD SIDE STATION 132.5. NOSE GEAR WHEEL WELL-FORWARD BACKBOARD, FLOOR DECKS.

**INSPECTION NOTE:** 126.5 to 180.5 "ONLY"

**INTERVAL NOTE:** Whichever comes first, Repeat interval satisfied by corrosion items 3-653 and 53-43.

**ACCESS NOTE:** Insulation blanket removal/displacement required.

**EXAMPLE**

**B737 Zonal Program**

<table>
<thead>
<tr>
<th>NMD</th>
<th>AMM</th>
<th>P</th>
<th>Z</th>
<th>ACCESS</th>
<th>INTERVAL</th>
<th>APPLICABILITY</th>
<th>MAN-HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>53-806-CD</td>
<td>112</td>
<td>112XNL</td>
<td>4000 FC</td>
<td>750 by 0 by 0 by</td>
<td>ALL</td>
<td>ALL</td>
<td>0.70</td>
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**INTERNAL-ZONAL CVG: AREA FORWARD OF NOSE LANDING GEAR WHEEL WELL.
Perform an Internal Zonal Inspection (CIG) of the area forward of the Nose Landing Gear Wheel well.

**INTERVAL NOTE:** Whichever comes first
Drivers for change in aerospace finishing technology...

Safety / Environment

Performance

Process
When does “change” occur?

- Technologies introduced with new models / major redesign
  - Need to meet engineering performance requirements and have production volume capability
    - New Substrates
      - High strength steels
      - Light metals
      - Composite structure
    - Chromium plating replacements
      - Most models now have HVOF
    - Chromate conversion coating replacements
      - Need to maintain or improve performance
    - Chromate corrosion inhibitor replacements
      - Nonchromate systems not yet as capable
    - Cadmium replacements
      - Alternatives moving toward implementation
    - Repair/Maintenance of new materials is important

- Technologies introduced for significant performance or process improvement
  - Replacement of Alodine 1000 for aircraft painting operations
Each process and material in the exterior coating system is critical to ensure overall durability.
Changes require careful consideration....and a lot of testing and verification.
Performance Driver - Rivet Rash Reduction

Paint delaminates from rivets but not fuselage skins
- Affects all models and decorative paint systems
- Conventional conversion coating identified as contributing factor
Comparison of two 777-200LRs with different pretreatments

- Rivet Rash on First 777-200LR (conventional conversion coating) <400 Flight Hours
- No Rivet Rash on 2nd 777-200LR (AC131-CB / Boegel EPIII) <400 Flight Hours
Depainting – Production Trial Airplane

4-12 mils of paint

1st Strip Coat
6.5 hours dwell

1st Strip Coat
8 hours dwell + squeegee

2nd Strip Coat
6 hours dwell + squeegee

4th Strip Coat
8 hours dwell + squeegee

Abrade and rinse
Process Optimization

- Solvent clean
- Deoxidize (chemical or mechanical)
- Water break free check
- Mask for Prime

1. Mix 2-part kit & shake 5 Min
2. 30 minute induction time
3. 24 hour pot life
4. Apply with air-assisted airless paint gun with small fluid tip
5. Spray top down
6. Apply minimum amount to wet surface
7. Allow 10 minutes drip
8. Wipe off excess, if necessary
9. Tape after dry, 1 hour min

- Complete mask for prime
Everett Decorative Paint Operations implemented AC131-CB/Boegel EPII for 777s in March 2007

Elimination of ~ 400 gallons of chromated pretreatment and wastewater material per 777
## Impact to Boeing

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>AC-131-CB / Boegel EP-II</th>
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</thead>
<tbody>
<tr>
<td><strong>Health &amp; Safety</strong></td>
<td>Contains Hexavalent chromium pH = 2.1</td>
<td>No Hexavalent chromium pH = 6</td>
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</table>
| **Environmental Impact** | Volume of chromated coating:  
  ~100 gallons/twin aisle  
  ~25 gallons/single aisle  
  Rinse water that requires remediation:  
  ~300 gallons/twin aisle  
  ~75 gallons/single aisle | Volume of chromated coating: None  
  Rinse water that requires remediation: None |
| **Durability**       | Rivet Rash is Problematic                          | Reduces Rivet Rash                               |
Selectively Strip-able Topcoats

BMS10-13 paint stripper is applied to the paint system

Over time, the paint stripper swells and delaminates the BMS10-120 intermediate coat from the BMS10-118 primer, removing the topcoat and most of the intermediate coat

During repaint, a thin layer of primer, the intermediate coat and the decorative paint is applied
Summary – Opportunities and Challenges

- Maintenance program is based on operations experience
  - Manual has sections for all models and operators

- New materials must meet performance requirements

- Must meet OEM production and sustainment cost objectives

- Need to facilitate new technologies to production ready status

- Overall objective is to produce a safe vehicle that is economical to acquire and operate
Questions?