



Organic Finishing Technologies

B-52 Paint Life Cycle Extension



Integrity ★ Service ★ Excellence

Steve Finley, CTC
Support Contractor to
Mr. Tom Naguy
Air Force Research Laboratory

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE AUG 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Organic Finishing Technologies B-52 Paint Life Cycle Extension				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Research Laboratory, Wright Patterson AFB, OH, 45433				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 2011 Air Force Corrosion Conference held 16-18 Aug 2011 at Robins AFB, GA.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 17	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Overview



- **Objective/Approach**
- **Results from Laboratory Testing and Field Evaluations**
- **Summary**



B-52 Paint Life Cycle Extension



Objective

- Determine if current coating system performance is sufficient to eliminate the four year scuff sand and overcoat while maintaining effective corrosion protection

Approach

- Gather baseline data for B-52 refinishing process
- Identify coating performance requirements and non-destructive inspection techniques
- Document performance of current coatings in the laboratory and the field
- Provide recommendation based on results



B-52H

Goal

AFRL Goal

- Increase Depot Paint Facility Availability and efficiency
- Reduce Hazardous Material Usage

How Project Responds to Goal

- Supports C+6 reduction mandated by OSD
- Increase Paint Facility availability
- Facilitates USAF environmental burden by reducing Hazardous Air Pollutant and Volatile Organic Compounds
- Keeps aircraft available for Global Operations





Laboratory Testing



Laboratory Testing of Belly Skin from B-52 60-008

- Previous Strip and Paint May 2001
- Paint Date for scuff sand and overcoat could not be determined
- Current Strip and Paint date 24 May 2010
 - Akzo-Nobel 10P20-13 primer ECM-F-6118 (APC) topcoat

Dry Film Thickness	High 9.3 - Low 6.32 - Average 7.93 mil
Initial Cross Hatch	3B – Indicates 5- 15% of the area was removed
Initial Pencil Hardness	B – Testing done at room temp.
Cross Hatch 30 days room temp in DI Water	0B – Indicates >65% of area was removed
Cross Hatch / 23699 Oil 24 hr @ 120°C	4B – Indicates <5% of area removed
Pencil Hardness / 23699 Oil 24 hr @ 120°C	B – After immersion
Flexibility testing, buy mandrel bend (2" mandrel)	No cracking or peel away noted
Salt Spray B-117	2500 hours exposure mild corrosion in the scribe
UV Weatherability Resistance	$\Delta E \geq 1.5$ after 1000 hours of exposure



Laboratory Testing



Laboratory Testing of Belly Skin from B-52 60-008 (cont.)

- Adhesion Testing using Pneumatic Adhesion Tensile Testing Instrument (PATTI) results
 - Six panels with two pulls per panel
 - Predominant failure mode was cohesive failure at the primer
 - Three panels showed adequate pull strength
 - Three panels were lower than desired

Panel ID	1 st Pull PSI	2 nd Pull PSI	AVERAGE PSI
61A1A007A	1048	1105	1076.5
61A1A007B	1011	1452	1231.5
61A1A008A	1293	1105	1199
61A1A008B	484	713	598.5
61A1A009A	631	541	586
61A1A009B	395	599	497





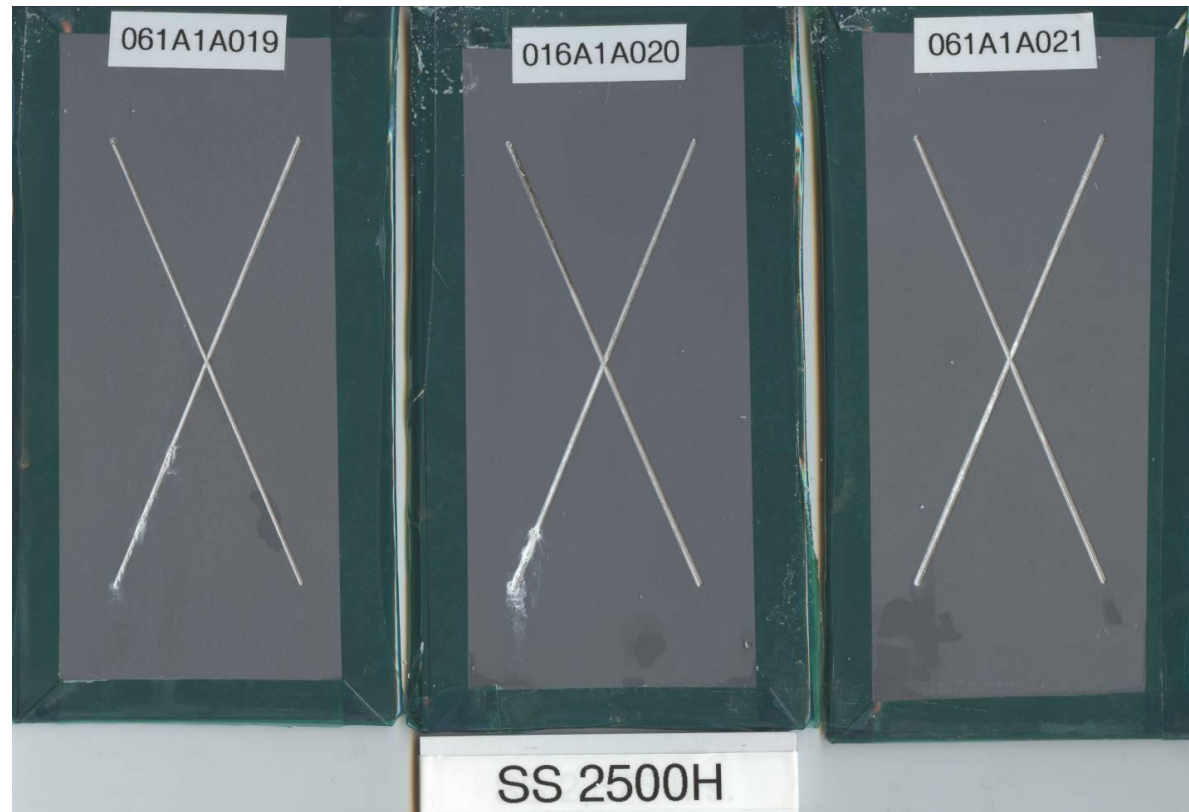
Laboratory Testing



Laboratory Testing of Belly Skin from B-52 60-008 (cont.)

- Neutral Salt Fog Corrosion Resistance Testing

- Tested in accordance with ASTM B-117 *Standard Practice for Operating Salt Fog Apparatus*
- Slight corrosion in the scribe at 500 hours; no change for the remainder of testing





Laboratory Testing



Laboratory Testing of Belly Skin from B-52 60-008 (cont.)

- **X-Ray Photoelectron Spectroscopy**
 - Cr+6 levels in samples were equal to samples taken from freshly applied primer
 - Indicates still enough Cr+6 to provide corrosion protection
- **Conclusions from Laboratory Testing**
 - Coating system next to substrate was nine years old; still had substantial Cr+6 levels
 - Variance in cross hatch and PATTI indicate it was time to paint the aircraft
 - Flexibility of the coating is still adequate

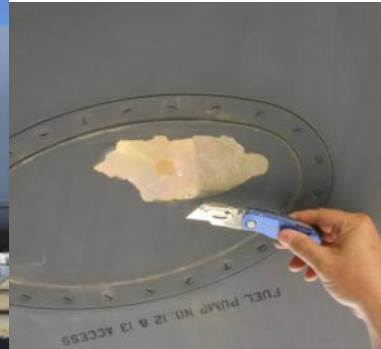




Field Evaluations



- **Aircraft Maintenance and Regeneration Group (AMARG)**
 - Field Visit conducted 7-10 June 2010
- **Barksdale Air Force Base (AFB), LA**
 - Field Visit conducted 23-26 August 2010
- **Minot AFB, ND**
 - Field Visit conducted 12-15 October 2010





Field Evaluations



Serial Number	Base Assigned	Last Paint date	Coating System	AMARG Arrival Date
61-0007	AMARG (MT)	25 Mar 2004	MIL-PRF-23377/85285 Type I	25 Jan 2009
60-0034	AMARG (MT)	17 May 2005		8 Dec 2008
60-0014	AMARG (LA)	1 Oct 2002		8 Feb 2009
61-0024	AMARG (LA)	15 Sep 2005		29 Jan 2009
60-0019	AMARG (LA)	12 Dec 2002		11 Dec 2008

- **AMARG Inspection Results**

- One adhesion failure noted on the inboard fuel access panel on the bottom of the right wing aircraft 60-0014
- Aircraft from Barksdale showed higher degree of coating degradation
- Minot aircraft showed little signs of degradation
- No corrosion noted on any of the aircraft observed



Field Evaluations



Serial Number	Last Paint date	Primer	Topcoat
60-016	27 Mar 2003	MIL-PRF-23377	MIL-PRF-85285
61-020	16 Sep 2006	MIL-PRF-23377	MIL-PRF-85285
61-012	24 Jan 2007	MIL-PRF-23377	MIL-PRF-85285
60-001	27 Mar 2006	MIL-PRF-23377	Deft Extended Life Topcoat (ELT) 99-GY-001
60-008	24 May 2010	Akzo Nobel 10P20-13 (MIL-PRF-23377)	Akzo Nobel Aerodur 5000 ECM-F-6118

- **Barksdale Inspection Results**
 - **Several adhesion failures noted on multiple aircraft**
 - **No corrosion was detected during the visual inspection**
 - **No facility to accomplish maintenance touch up**
 - **Color, gloss, and film thickness readings taken on the two aircraft with advanced performance coating (APC)**





Field Evaluations



Serial Number	Last Paint date	Primer	Topcoat
61-032	13 Sep 2007	Akzo 10P20-13	Akzo ECM-6118 (APC)
61-029	16 Jul 2008	Akzo 10P20-13	Akzo ECM-6118 (APC)
61-034	UNK	UNK	UNK
60-055	15 Apr 2010	Deft 02Y-40A	Deft ELT 99-GY-13 (APC)
60-018	16 Oct 2008	Akzo 10P20-13	Akzo ECM-6118 (APC)
60-004	28 Oct 2009	Akzo 10P20-13	Akzo ECM-6118 (APC)
61-035	UNK	UNK	UNK

• Minot Inspection Results

- Several adhesion failures noted on multiple aircraft; some as large as 20 ft²
- No corrosion was detected during the visual inspection
- No facility to accomplish maintenance touch up
- Color, gloss, and film thickness readings taken on three APC aircraft





Field Evaluations



- **PATTI Testing**

- Twelve studs glued to each aircraft
- Six under the right wing
- Six on the aft fuselage right side





Field Evaluations



- **PATTI Results**

Serial Number	Base Assigned	Under Wing Pull PSI	Predominant Failure Mode	Fuselage Pull PSI	Predominant Failure Mode
61-0007	AMARG (MT)	1020.4	Adhesive glue	No Reading	
60-0034	AMARG (MT)	1776.2	Adhesive glue	901.4	Adhesive glue
60-0014	AMARG (LA)	728.5	Adhesive glue	No Reading	
61-0024	AMARG (LA)	1183.1	Adhesive glue	No Reading	
60-0019	AMARG (LA)	1117.0	Adhesive glue	459.9	Adhesive glue
60-0016	Barksdale	2,030.6	Cohesive primer	1,394.5	Cohesive primer
61-0020	Barksdale	2,059.8	Cohesive primer	1,358.4	Cohesive primer
61-0012	Barksdale	1,828.0	Cohesive primer	1,456.5	Cohesive primer
60-0001	Barksdale	2,374.2	Cohesive primer	1,605.4	Cohesive primer
61-0032	Minot	1476.2	Adhesive glue	521.8	Adhesive glue
61-0029	Minot	1880.3	Adhesive glue	776.9	Adhesive glue
61-0034	Minot	1440.3	Adhesive glue	729.9	Adhesive glue



Field Evaluations



- **Color Readings**

- Readings were compared to FED-STD-595B Color Chip
- MIL-PRF-85285 $\Delta E < 1$ requirement is for fresh coatings

Serial Number	Coating MFG	Paint Date	Paint Age When Tested	L*	a*	b*	ΔE
Color Chip 36118	FED-STD-595B	N/A	N/A	40.56	-1.12	-4.84	N/A
60-008 LA	Akzo Nobel (APC)	24 May 10	0.25 Years	39.57	-0.95	-4.84	1.00
60-001 LA	Deft (APC)	27 Mar 06	4.41 Years	42.88	-1.37	-4.84	2.52
60-055 MT	Deft (APC)	15 Apr 10	0.50 Years	41.88	-0.83	-4.52	1.39
61-029 MT	Akzo Nobel (APC)	16 Jul 08	2.24 Years	40.78	-1.02	-4.26	0.63
61-032 MT	Akzo Nobel (APC)	13 Sep 07	3.09 Years	40.55	-1.08	-4.52	0.32
60-034 MT AMARG	Deft Type I	17 May 05	5.06 Years	40.50	-1.08	-4.65	1.00
61-024 LA AMARG	Deft Type I	15 Sep 05	5.09 Years	43.30	-1.19	-4.31	2.79



Field Evaluations



- **Gloss Readings**
 - Used to assess coating degradation from UV exposure
 - MIL-PRF-85285 requirement $60^{\circ} \leq 5$ units $85^{\circ} \leq 9$ units

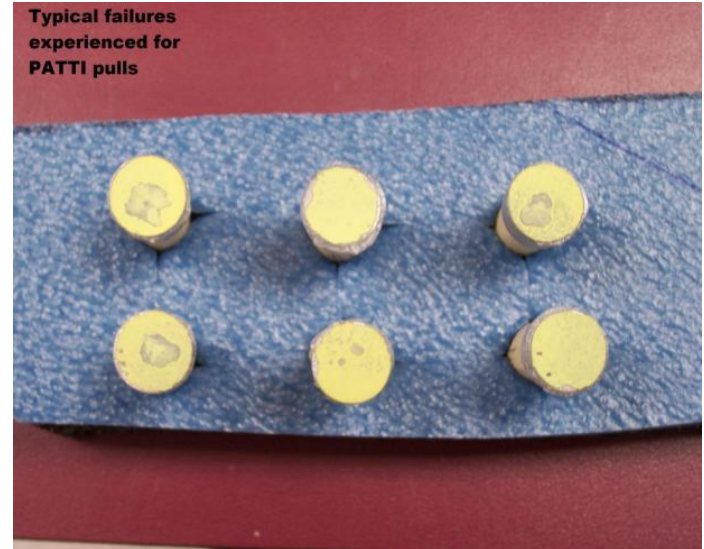
Serial Number	Coating MFG	Paint Date	Paint Age When Tested	60°	85°
60-008 LA	Akzo Nobel (APC)	24 May 10	0.25 Years	3.31	4.29
60-001 LA	Deft (APC)	27 Mar 06	4.41 Years	1.13	4.80
60-055 MT	Deft (APC)	15 Apr 10	0.50 Years	3.23	5.12
61-029 MT	Akzo Nobel (APC)	16 Jul 08	2.24 Years	1.87	3.75
61-032 MT	Akzo Nobel (APC)	13 Sep 07	3.09 Years	2.79	6.03
60-034 MT AMARG	Deft Type I	17 May 05	5.06 Years	0.90	2.90
61-024 LA AMARG	Deft Type I	15 Sep 05	5.09 Years	1.14	5.55



XPS Analysis



- **X-Ray Photoelectron Spectroscopy (XPS)**
 - Primer samples collected for XPS analysis
 - Coating was sanded to the base primer layer
 - Dust was collected on tape
 - PATTI studs were used for analysis
 - Fourteen samples were analyzed
- **Cr +6 level equal to or greater than fresh applied primer in 13 of 14 samples**





Summary



- **Data reported is for the current coatings system (Cr)**
- **Indications from the field evaluations favor eliminating the mid-cycle scuff sand and overcoat**
- **13 out of 14 samples analyzed using XPS showed Cr+6 levels equal to or higher than freshly applied MIL-PRF-23377 primer**
- **No corrosion was identified during visual inspections**
- **Gloss readings indicate aged APC topcoat still meets MIL-PRF-85285 requirement**
- **Lack of a touch-up maintenance facility is cause for concern**
- **The adhesion failures observed can not go untreated for an extended period of time**