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The MONITOR

Aeronautical Systems Center Weapon System Pollution Prevention Branch (ASC/ENVV)
Bldg 8 • 1801 Tenth St. • Suite 2 • Wright-Patterson AFB, OH 45433-7626

Volume 8, No. 4 **Summer 2002**

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The MONITOR is a quarterly publication of the Headquarters Air Force Materiel Command (AFMC) Pollution Prevention Integrated Product Team (P2IPT) dedicated to integrating environment, safety, and health related issues across the entire life cycle of Air Force Weapon Systems. AFMC does not endorse the products featured in this magazine. The views and opinions expressed in this publication are not necessarily those of AFMC. All inquiries or submissions to the MONITOR may be addressed to the Program Manager, Mr. Frank Brown.

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Weapon System Pollution Prevention Champions

Integration of Environment, Safety, and Occupational Health (ESOH) requires a cultural change that has to be spearheaded by individuals and their organizations. This issue of The MONITOR recognizes the ongoing efforts of the following Pollution Prevention Champions and their respective organizations (see pages 5-16). Integration of ESOH into weapon systems has consistently reduced total ownership cost (TOC) to the warfighter.

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ASC/RAE
RA SPO Environmental Program Manager

Lt. Steven Elliott
PEWG Executive Officer

Organizational Profile: Headquarters Air Force Materiel Command Logistics Environmental Office (HQ AFMC/LGP-EV)

Mission: To support weapon system/industrial community by providing quality leadership and services that are responsive to customer's needs while reducing the Air Force's environmental burden.

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Organizational Structure (Figure 1): HQ AFMC/LGP-EV staff is structured into three teams that perform the following functions:

- **Policies/Guidance** – This team serves as the command lead on Pharmacy issues, in particular, Hazardous Materials Management Program (HMMP). The team also serves as the defense liaison for Ozone Depleting Substances (ODS) and issues related to the insertion of environmental consideration into logistical policies and depot strategies.
- **Research** - This team is responsible for a number of initiatives including: identifying environmental costs in the Depot Maintenance Activity Group (DMAG) operations; identifying future regulatory impacts to logistics operations; inserting environmental considerations into depot operations; and monitoring depot Capital Purchase Program (CPP) funding requirements and priorities.
- **Technical** - This team serves as the lead for identifying AFMC weapon system requirements, developing weapon system pollution prevention strategies, serving as a liaison with the DMAG community, demonstrating/validating alternatives, and transitioning technology to the DMAG modernization process.

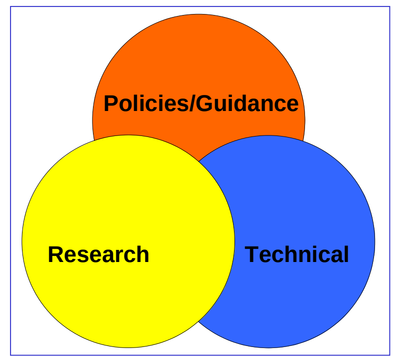
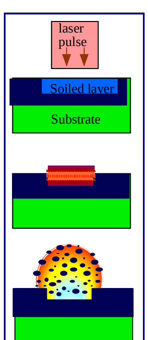


Figure 1. HQ AFMC LGP-EV Organizational Structure

Ongoing Pollution Prevention Projects (Figure 2 on page 6): HQ AFMC/LGP-EV is the Air Force lead for joint pollution prevention projects implemented through the Joint Group on Pollution Prevention (jgpp.com). The team uses a defined weapon system pollution prevention process to identify systemic Air Force needs that have Commercial Off the Shelf (COTS) solutions that can be easily implemented. For more information about ongoing projects, contact the Branch Chief.

Leading Edge Technology: Validation/Demonstration of Affordable Hand Held Laser Coating Removal Systems



Principals of Laser Technology

Historically, mechanical or chemical based processes have been used to remove protective coatings. Lasers represent a leading edge technology to supplement existing depainting processes for stripping components, small areas, aircraft and ground vehicles. The layer of contamination on the surface absorbs the light emitted by the laser. The strong energy absorption creates plasma, which expands, creating a shock wave. The shockwave fragments and ejects the contamination. The light is sufficiently short to avoid thermal phenomena which could otherwise damage the surface to be treated.

Air Force Materiel Command's Logistics Environmental Branch (AFMC/LGP-EV) and Air Force Research Laboratory, Weapon System Logistics Branch (AFRL/MLSC) are currently implementing an AFMC weapon system program and Environmental Security Technology Certification Program (ESTCP) funded project to demonstrate a portable laser coating removal system. This project is being implemented through the Joint Group Pollution Prevention (JG-PP) program and includes

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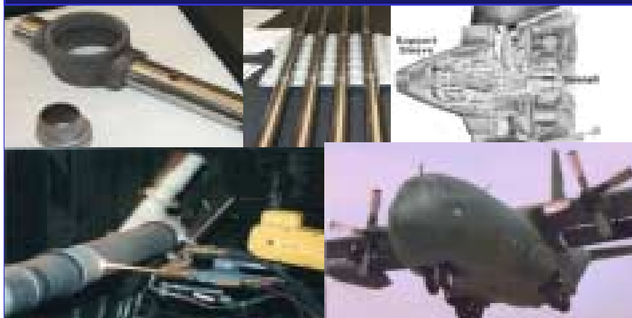
Chromium Electroplating Alternatives (HVOF)



Description: The objective of this project is to demonstrate and validate WC/CoCr HVOF thermal spray coatings as a cost-effective alternative to hard chrome plating on aircraft components. JG-PP is partnering with the HCAT on this project.

Customers: OC-ALC/LIIR (Jerry Zimmerman), WR-ALC/LBRS (Bill Stillman), OO-ALC/LILE (Bart Wood)

POC: HQ AFMC/LGP-EV, Warren Assink and Gene Jeunelot

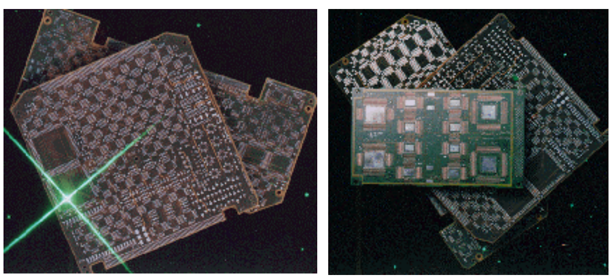
Coating Alternatives for Support Equipment

Description: The objective of this project is to evaluate and validate low/no VOC and nonchromate coating systems for support equipment. The Navy and NASA are full partners in this project.

Customers: WR-ALC/LE, NAVAIR, NASA-KS

POC: HQ AFMC/LGP-EV, Susan Misra

Lead-free Solder



Description: The objective of this project is to demonstrate and validate cost-effective lead-free solder configurations for re-manufacturing. This effort has JLC interest.

Customers: WR-ALC/LY and WR-ALC/LF, OC-ALC, OO-ALC, SPO's, OEM's

POC: HQ AFMC/LGP-EV, Warren Assink

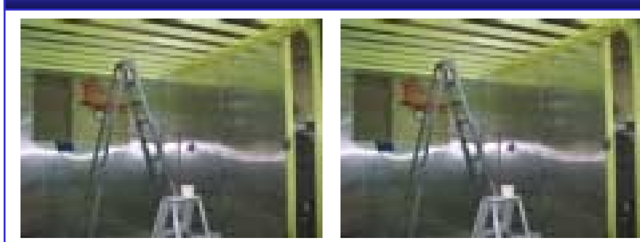
Demonstrate Powder Coating Technology

Description: The objective of this project is to replace existing high VOC and HAP coatings with low/no VOC/HAP Powder coating on non flight critical parts

Customers: WR-ALC, OC-ALC, OO-AL

POC: HQ AFMC/LGP-EV Steve Finley

Low/No VOC Corrosion Preventive Coatings for ICBM Support Equipment



Description: This is a follow-on to Alternative Coatings for Support Equipment Project for ICBM Support Equipment

Customer: OO-ALC/LMST

POC: HQ AFMC/LGP-EV, Susan Misra

Figure 2. Examples of Ongoing HQ AFMC/LGP-EV Projects

ORGANIZATIONAL PROFILE: AERONAUTICAL SYSTEMS CENTER, WEAPON SYSTEM POLLUTION PREVENTION BRANCH (ASC/ENVV)

Mission: Reduce the Environmental, Safety, and Occupational Health (ESOH) burden to the weapon system acquisition process by implementing innovative pollution prevention processes and business practices while ensuring compliance with applicable laws, rules, and regulations.

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Organizational Structure (Figure 3): ASC/ENVV is comprised of approximately 30 military and civilian staff, which perform the following functions:

- Home Office Staff - support development of tools, policies, and procedures to enhance and measure the performance of institutionalizing ESOH into the systems engineering process (ASC/EN).
- SPO ESH Staff - provide direct support to the systems engineering Division of various weapon systems including B-1/B-2, C-17, JSF, F-15/F-117, F-22, F-15, Air Combat SPO, Reconnaissance SPO, Mobility SPO, Propulsion SPO, Special Operations Force SPO, Training SPO, and Aging Aircraft SPO. Co-locates report to the Director of Engineering (DOE).
- Air Force Plant Staff - support pollution prevention initiatives at Air Force Plants. Active programs are currently being executed at Plant 4 (Fort Worth, TX), Plant 6 (Marietta, GA), Plant 42 (Palmdale, CA), and Plant 44 (Tucson, AZ).

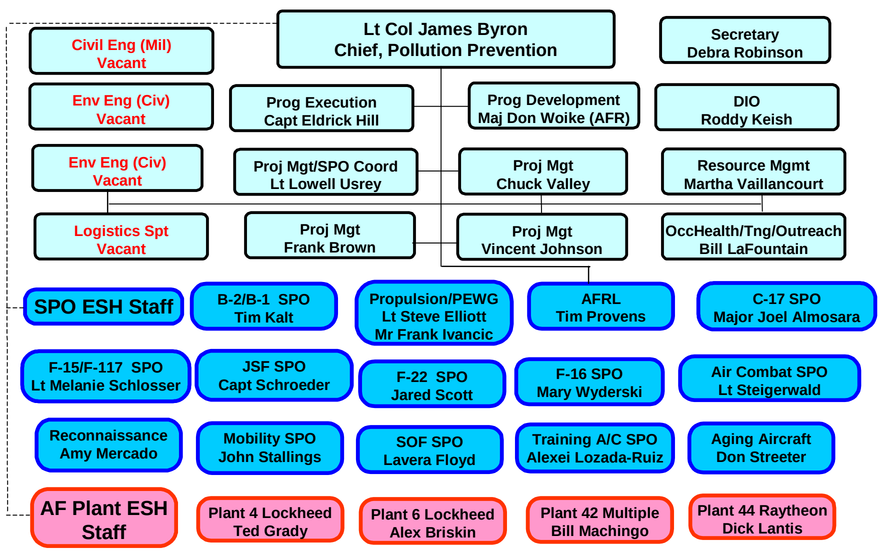

Figure 3. ASC/ENVV Organizational Structure

Ongoing Pollution Prevention Efforts (Figure 4 on page 8): ASC/ENVV executes technology transition projects that impact multiple weapon systems or Air Force Plants. Where appropriate, partnerships with Air Logistics Centers (ALC) are established when implementing common requirements. For more details about the ongoing efforts, contact the Branch Chief.

PLURAL COMPONENT PAINT SYSTEM TECHNOLOGY

Multi-component paints (usually two parts) are supplied as standard-sized kits that require mixing the entire kit for proper mix proportioning. Once painting has been completed, any remaining paint mixture must be disposed of as hazardous waste. Plural component paint systems reduce waste because they draw the components from their individual containers and mix them in proper proportion as needed when the paint spray gun trigger is depressed. The plural component paint system eliminates excessive mixed-component paint waste because it mixes the components only as they are being applied. Paint waste is reduced to a mixture that needs to be cleaned out of the feed lines between the mixing point and the spray gun nozzle.

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Project Title	Customers							
	Depots			AF Plants				Weapon Systems
	Hill	Robins	Tinker	Ft. Worth	Tucson	Marietta	Palm Dale	
Non Chromated Primer		✓				✓		C-130, F-15, C-141
Replace Halon Fire Suppressant		✓		✓				C-130, KC-135
Electro-Spark Deposition	✓		✓	✓			✓	Propulsion Systems
Applique Technology	✓	✓		✓	✓	✓		F-15, F-16, Missies
HVOF Thermal Spray Coatings (LOS)	✓		✓	✓		✓		F-22, C-17, GTE
Cobalt-Phosphorus-Boron Coating (NLS)	✓		✓	✓		✓		F-22, C-17, GTE
GTE Blade Reclamation			✓					All
Laser Based Surface Activation		✓			✓			F-15, F-16, Missiles
Ion Vapor Deposition (Exterior)	✓	✓	✓	✓	✓	✓	✓	All
Sputter Coat Aluminum (Interior)	✓	✓	✓	✓	✓	✓	✓	All
Hydrazine Replacement	✓			✓			✓	U-2, F-16, NASA
Hydraulic Fluid Purification	✓	✓	✓	✓	✓	✓	✓	All
Supercritical CO2 Cleaning			✓		✓			Missiles, Avionics
Pigmented Resins in Composites					✓			Missiles
Electroflotation of Aqueous Cleaners	✓	✓	✓	✓	✓	✓	✓	All
Cad Rpl for C-130 Flap Tracks		✓				✓	✓	C-130
Aluminum Chip Recycler	✓	✓	✓	✓	✓	✓	✓	All
Env Compliant IR Topcoat	✓			✓		✓		F-16, F-22, JSF
Deicing Material Compatibility								C-17, C-5, C-141
Lead Free Anti-Gallants/Solder/Coatings	✓	✓	✓	✓	✓	✓	✓	All
Engineered Solvent Substitution	✓	✓	✓	✓	✓	✓	✓	F-15, F-16, Missiles
Citric Acid Passivation	✓	✓	✓	✓	✓	✓	✓	All
Titanium Conversion Coating	✓	✓	✓	✓		✓	✓	B-2, F-22, C-17
Advanced Topcoat System				✓		✓	✓	B-2, F-22, F-117
Composite Depaint Operations	✓	✓	✓	✓	✓	✓	✓	All
On-Demand Decal Printing	✓	✓	✓	✓	✓	✓	✓	All

Figure 4. Examples of ASC/EN P2 Projects/Customers

Continued from Page 7

Technology Description: Each plural component paint system includes a variable ratio proportioning unit and high-volume low-pressure (HVLP), air-assisted airless paint spray gun. These systems can be either portable or stationary. Pump and Equipment Inc (Model: System 97399) is a Navy Selected vendor this technology. The cost of the technology is $20,000. Implementation of the technology will require ventilation, electrical service, and potentially an air permit, if required by local regulatory agency.

The benefits of the plural component paint system include: lower VOC emissions, elimination of excessive hazardous waste from premixing of multi-component paints, and use of less paint.

Source: Navy Pollution Prevention Equipment Program (PPEP) Book.

Organizational Profile: F-16 Environmental Integrated Product Team (IPT)

Mission: The F-16 Environmental IPT provides environmental consulting expertise and support institutionalization of Pollution Prevention (P2) and minimization of adverse Environmental, Safety, and Occupational Health (ESOH) impacts to cost, schedule, and performance in all phases of the F-16 weapon system life cycle. The chair for the F-16 IPT reports to ASC/YPV. The mission of ASC/YPV is to provide common products, systems engineering processes, program definition, ensure airworthiness, and manage external interfaces and acquisition initiatives for the F-16 weapon systems. The F-16 Program is the largest and most complex acquisition program in DoD. It has over 4000 aircraft produced in over 50 distinct configurations for 20 country programs and the USAF.

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Organizational Structure (Figure 5): The F-16 IPT consists of the F-16 SPO East (ASC/YPVE), F-16 SPO West (ASC/YPVS), and Lockheed Martin Aerospace. The F-16 IPT is supported by an Environmental Working Group (EWG). The core members of the EWG include SPO (East and West), users, maintainers, and producers. The purpose of the EWG is to create a forum to ensure processing of information is timely, complete, and consistent between the SPOs and the users. The EWG meets annually. The F-16 EWG held its last meeting at Luke AFB in May 2002.

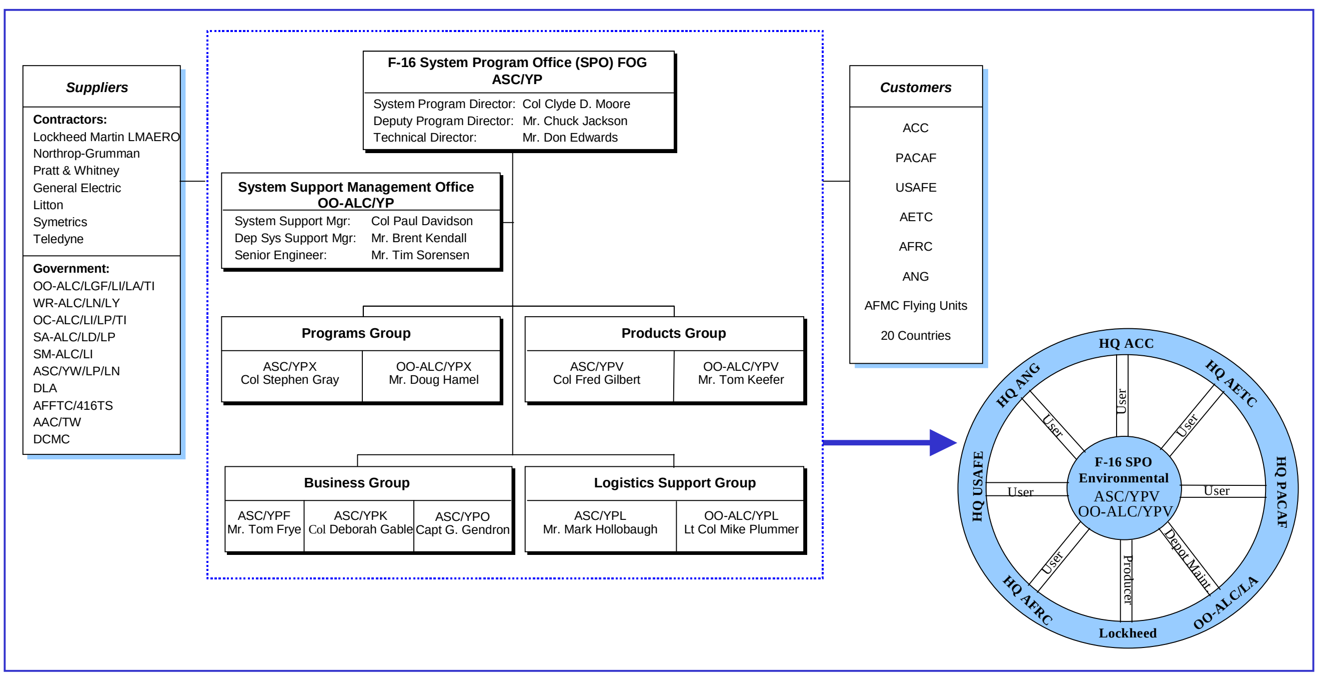

Figure 5. F-16 Environmental IPT Organizational Structure

Ongoing Pollution Prevention Projects (Figure 6 on pages 10-12): For the last five years, the F-16 SPO has been implementing a comprehensive pollution prevention program under CCP 10522. The goal of this program was to identify, test, and qualify substitutes for hazardous materials in the F-16 manufacturing process and maintenance/repair procedures. For more information, contact the F-16 SPO Environmental Program Manager.

Project Name/Description	Solutions
Nonchromated Sealants: Qualify and implement usage of nonchromated corrosion inhibiting sealants in F-16 production. Corrosion inhibiting sealants are used to install structural fasteners on the F-16.	External Fastener Applications: ➔ **PRC DeSoto PR 1775** ➔ **PRC DeSoto PR 1875** ➔ **AC Tech 730** Integral Fuel Tank Applications: ➔ **PRC DeSoto PR 1875** ➔ **AC Tech 730**
Nonchromated Coatings: Develop and implement a program to screen nonchromated, corrosion inhibiting coatings. Find corrosion inhibiting coatings compatible with metal substrate pretreatments and coatings used at LM Aero-Fort Worth. MIL-PFR-85285 FMS-3035, Flexible Primer FMS-1058, Epoxy Touch-up Primer Chemical Conversion Coating MIL-P-85582 Anodize	➔ MIL-P-85582 Waterborne Primer ⇨ **Spraylat EWDY048** and **Dexter 10PW22-2** passed lab qualification ⇨ Flight tested for over three years on four aircraft → Primers performed above expectations → Provided slightly less corrosion protection than chromated primer → Overall, Spraylat performed slightly better than Dexter ⇨ Flight testing on interior parts now being considered under a JG-PP initiative ➔ MIL-P-23377 Solvent-borne Primer ⇨ No candidates passed screening ➔ FMS-3035 Flexible Primer ⇨ **Deft 09Y010** is promising → Passed corrosion resistance as long as FMS-1058 is below it in the stackup ⇨ Slight formula change in mid-test of concern
Miscellaneous Solvents: Eliminate or minimize the use of EPA-17 solvents by using alternative products or revising processes. ➔ Neat solvents used as cleaners and thinners ➔ Solvents used in formulation of other products	➔ Replaced MEK thinner with **MPK for FMS-1015**, **Form III** in tie-coat operations ➔ Replaced MEK with **FMS-2004 and acetone** for wiping down spray gun equipment ➔ Replaced toluene with **PCBTF** for removing acrylic conformal coating ➔ Replaced toluene with **acetone** for thinning of FMS-3014 primer ➔ Implemented MEK-free noncurring retaining compound ➔ Implemented non-HAP/low-VOC acrylic conformal coating ➔ Implemented non-HAP/low vapor pressure cleaning solvent for paint line cleaning ➔ Implemented non-HAP/low vapor pressure cleaning solvent for equipment used in spraying FMS-3049 ➔ Replaced MIL-T-81772 thinner used as wipe solvent ⇨ **IPA** for ballistic liner application ⇨ **Acetone** for paint shop applications ➔ Replaced MIL-T-81772 thinner used as thinner ⇨ 70/30 blend approved for most major coatings ⇨ Some residual use of thinner remains ➔ Replaced A-A-857 lacquer thinner for wipe solvent ⇨ Break-Free Cleaner followed by FMS-2004 ➔ Replaced A-A-857 lacquer thinner for tooling topcoats ⇨ 70/30 blend works, but users prefer lacquer thinner
Cadmium Plating Replacement: Identify an alternative corrosion preventive coating or process for cadmium plated parts. Initial emphasis on parts subject to sanding and grinding operations, which may result in hazardous airborne cadmium dust.	➔ Inlet MS90353 fasteners change from cad to **IVD aluminum** ⇨ Needed exposure reduction during inlet sanding ⇨ Exposures have reduced for forward part of inlet ⇨ Exposures still high for center part of inlet ➔ Electrical connector testing using **high purity aluminum coating** ⇨ Resistivity measurements taken while in salt spray → IVD aluminum → Electroplated aluminum ⇨ Resistivity results appear better than for cad-plated connectors ⇨ Need to test additional connector types → Amphenol testing round MIL-C-38999 connectors

Figure 6. Solutions from Implementation of F-16 SPO Funded Projects

Project Name/Description	Solutions
High VOC Coating Replacement: Identify lower VOC materials to replace several of the high VOC coatings used at LM Aero-Fort Worth. VOC stands for volatile organic compound, and is a measure of the solvent emissions that contribute to the formation of ground-level ozone and smog.	➔ Low-VOC adhesion promoters implemented **(AC Tech AC-135** and **El Dorado Bondaid 2000)** ⇨ VOC reduction of 82-100% ➔ Lower VOC antichafe coating implemented **(Deft 18BK004)** ⇨ VOC reduction of 39% ➔ Lower VOC epoxy topcoat implemented **(Spraylat HS-611)** ⇨ VOC reduction of 49% when unthinned ➔ Low-VOC release agent implemented **(Dexter Aqualine C-210)** ⇨ VOC reduction of 98% ➔ Zinc chromate primer replaced ⇨ VOC reduction of 44% ➔ Low-VOC rubber-based adhesive implemented **(3M 1099)** ⇨ Brush-on applications only ⇨ VOC reduction of 100% ➔ Low-VOC fuel tank coating qualified **(PRC-DeSoto 833K086/930K088)** ⇨ Final tests with F-22 now being conducted ⇨ VOC reduction of 31% when implemented ➔ Zero VOC urethane topcoat qualified **(Deft 55-W-2 and 55-GY-2)** ⇨ Class I change until Navy puts it on MIL-spec ⇨ VOC reduction of 100% when implemented ⇨ Also zero HAPs
Dot Stencil Ink: Replace the current solvent-based aerosol stencil ink (Crown Metro #7081 aerosol) with a less hazardous product or process. The ink is used to identify rivet hole locations and mark parts with identification data.	➔ Aerosolized version of **Groco Amine Dissolvable Ink (red)** has been shop trialed ⇨ Rivet hole locations ⇨ No significant issues ⇨ Implementation in work ⇨ 35% VOC reduction when implemented ➔ Use of transparencies and laser printers being tried by Planning ⇨ Part Identification ⇨ Transparencies have been tested and shop trialed ⇨ Planning wishes to incorporate them into traveler ⇨ Planning testing their printing capabilities ⇨ 100% VOC reduction when implemented
Depainting: Identify non-hazardous chemical strippers to remove coatings in the F-16 paint system. For LM Aero, this would apply primarily to touchup and small part work. For the field, the parts to be depainted will typically be larger.	➔ Testing completed on depainters ⇨ Initial screening ⇨ Corrosion testing ⇨ Composite compatibility and cleanability ⇨ Field trial at Hill AFB ➔ Activated benzyl alcohol candidates selected ⇨ **Turco 6813E, PR3133, Stingray 874B** ⇨ **PR5040**, CEE BEE E2060 highly rated, but not tested
Solid Film Lubricant: Identify solid film lubricants or alternative coatings that contain less hazardous solvents and no lead. These lubricants provide corrosion protection and wear prevention for parts subject to sliding or galling action.	➔ Air-cured lubricant (MIL-L-23398) ⇨ Non-lead **Lubribond K and Tiolube 70** approved ⇨ Met endurance life requirements ⇨ Will be implemented in plant and placed in T.O.s ➔ Heat-cured lubricant (MIL-L-46010) ⇨ Non-lead, water-based **E/M #9002 and Sandstrom #099** approved ⇨ LM Aero-Fort Worth will allow subcontractors to use upon certification
Nonchromated Deoxidizers: Replace the chromium based tri-acid deoxidizer with a nonchromated alternative. Compare several alternatives, and evaluate the effect of their chemistry on subsequent LM Aero-Fort Worth processing (anodize, chemical conversion coating, bonding).	➔ **Nitric/HF** and **Aldox V** selected from qualification tests ⇨ **Nitric/HF** preferred by Process Control ⇨ In use: anodize & chem film processing lines ⇨ Advantage : inexpensive and easy to maintain ⇨ Drawback: higher nitric acid concentration ➔ Nitric/HF will also be used in bond line with the new phosphoric acid anodize process

Figure 6. Solutions from Implementation of F-16 SPO Funded Projects (Cont.)

Project Name/Description	Solutions
Nonchromated Prebond Etchant: Find a nonchromated prebond etch process for bonded assemblies. The etch follows a tri-acid deoxidizer and precedes application of a chromated adhesive primer (FMS-3018, Form 2).	➜ **Phosphoric acid anodize** selected ⇨ Passed all qualification tests ⇨ Low risk since already in use elsewhere ⇨ Facility upgrade to bond line over the recent holidays ⇨ Production qualification run ⇨ Fully implemented as of February, 2002
Nonchromated Conversion Coating: Replace chromated chemical conversion coating (Alodine 1200S) with a nonchromated alternative that minimizes the effect of corrosion and maximizes primer adhesion.	➜ 18 candidates investigated, 13 screened ⇨ No product from any vendor met MIL-C-81706 ⇨ Continuing to monitor NCMS and JG-PP projects ➜ Alodine 1132 pen completed qualification tests ⇨ Not implemented due to inconsistency from pen to pen and in application techniques ⇨ Thickness of coating affects corrosion resistance and adhesion (in opposite direction) ⇨ Air Force, Boeing, and other LM sites have approved ⇨ Navy issuing QPL revision
HazMats and Obsolete Chemicals in T.O.s: Identify environmentally preferable replacement materials for tasks in the F-16 Technical Orders (T.O.s) ➜ Class I ODCs ➜ Class II ODCs ➜ EPA-17 chemicals ➜ Other HAPs ➜ VOCs ➜ GWPs ➜ Obsolete chemicals ➜ Cancelled specifications	➜ NESHAP Solvent Replacements ⇨ MIL-C-38736, MEK, methanol have vapor pressures over 45 mm Hg → NESHAP restricts these at locations exceeding certain emission thresholds ⇨ Drop-in substitutes provided via AIG message → Detailed on F-16 Website → Some exceptions to MEK, methanol replacement ➜ Substitutes ⇨ Five-part blend for MIL-C-38736 solvent compound → Dynamold H901A › NSN 6850-01-481-1235 (1 gal) › NSN 6850-01-468-8833 (5 gal) › NSN 6850-01-468-8834 (55 gal) ⇨ 50/50 Acetone/MEK blend for MEK → Part No. 3101 › NSN 6850-01-481-1299 (1 gal) › NSN 6850-01-468-8855 (5 gal) › NSN 6850-01-469-1109 (55 gal) ⇨ Isopropyl alcohol for methanol → TT-I-735 › Already in use at all facilities for other applications › NSNs available in procurement system ⇨ Other hazardous materials, cancelled specs and obsolete materials were also addressed
Primer for FMS-3049: To qualify a nonchromated primer to replace the MIL-P-23377 (FMS-3027) epoxy primer for the application of FMS-3049 (ballistic liner).	➜ **Dexter 10PW22-2 (waterborne primer)** lab-qualified for use under FMS-3049 ⇨ As base primer ⇨ As reactivation primer over chromated primers (MIL-P-85582 or MIL-P-23377) ➜ Plan to phase into Have Glass II program ⇨ Signature Materials will conduct tests ⇨ Will serve as flight tests for inlet use
F-16 HazMat Database: To compile a comprehensive database of known hazardous materials in the F-16 aircraft systems and components. The database shall include material location, quantity information and aircraft block. A database of hazardous materials in the aircraft should be useful in operation, support activities, in cases of accident investigation and aircraft retirement/disposal.	➜ Database provided to Air Force ⇨ Contains material name, specification, quantity, location by system, part name, part number, aircraft block, hazardous characteristic ⇨ Fully functional and searchable

Figure 6. Solutions from Implementation of F-16 SPO Funded Projects (Cont.)

Organizational Profile: Joint Strike Fighter (JSF) Environmental, Safety, and Occupational Health (ESOH) Team

Mission: The mission of the JSF ESOH Team is to minimize ESOH life cycle risks by:

- Integrating ESOH concepts and initiatives across JSF Integrated Product Teams (IPTs) to ensure compliance with both internal and external requirements.
- Focusing the support concepts to exploit new technologies and techniques to ensure JSF production, testing, operations, maintenance and disposal have minimal effect on the environment, worker safety, and occupational health and minimize total ownership costs.
- Integrating ESOH considerations into the design and materials selection process in order to minimize a life cycle dependence on hazardous materials and processes.

The vision of the JSF is to be the model acquisition program for joint service and international cooperation and to develop and produce a family of affordable multi-mission fighter aircraft using matured/demonstrated 21st century technology and sustain it worldwide.

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Organizational Structure (Figure 7): The Joint Strike Fighter Program Director, Major General Hudson is located in the Joint Program Office in Arlington, VA. ESOH Team Members are integrated into functional areas of the JSF Program, including system engineering requirements, logistics infrastructure, airframe, and propulsion. The JSF ESOH Team is led by Jean Hawkins (Navy) and Capt Chad Schroeder serves as the Air Force ESOH Team Lead. The JSF Environmental Working Group is comprised of Joint Program Offices (JPOs) members, SMEs, and contract members and meets bi-annually or as needed. The next EWG will be held in the United Kingdom in October 2002 and will focus on international issues.

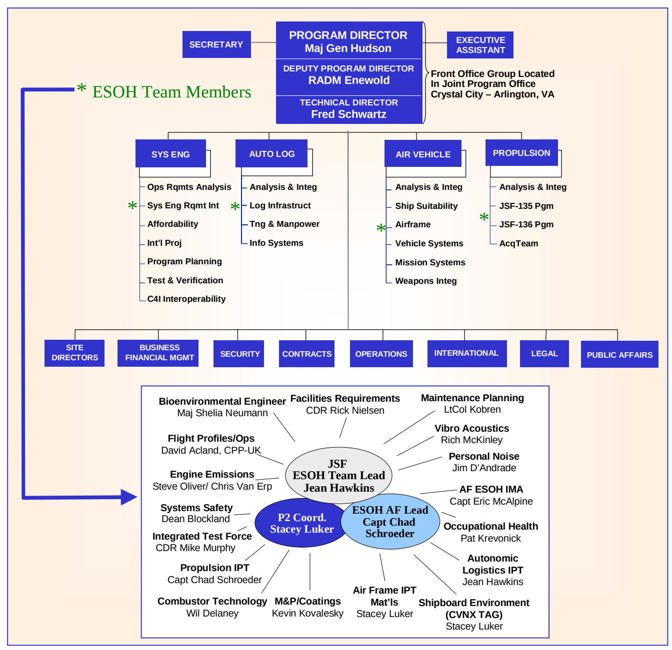


Figure 7. Organizational Structure for the ESOH Team

Ongoing Projects (Figure 8): JSF ESOH Team's main tasks include the following:

- Ensuring compliance with NEPA, Clean Air Act, International ESOH Laws
- Implementing a Pollution Prevention Program (including PESHE) and Environmental Life Cycle Costing
- Addressing noise emissions issues and interfacing with the Corrosion Prevention Advisory Board

For more information about ongoing JSF P2 projects, contact the AF JSF SPO ESOH Manager.

JSF ESOH Projects FY98/99/00/01

- HVOF in Lieu of Hard Chrome Plating for ODs
- Non-Line of Sight Alternatives to Hard Chrome Plating
- ElectroCoat in Lieu of Hex Chrome Primer for Internals
- Non-Chrome Primer under Applique
- Conformity Studies
- Survey of Cadmium Alternatives – Report
- Investigation of Alts to Hard Chrome Plating – Report
- PM_{10} Testing of F402 Engine
- GIS Modeling to Develop JSF Noise Contours

Figure 8. Examples of Ongoing JSF Projects

ORGANIZATIONAL PROFILE: F-22 ENVIRONMENTAL & HEALTH WORKING GROUP

Mission: To proactively integrate hazardous material, environmental and health requirements throughout the F-22 weapon system life cycle.

F-22 SPO Environmental Program Manager: Jared Scott (ASC/YFAI)
DSN: 674-5269
Commercial: 937-904-5269
E-Mail: **Jared.scott@wpafb.af.mil**

Organizational Structure (Figure 9): The environmental function for the F-22 weapon system falls under BGen Shackelford (ASC/YF) at Wright Patterson AFB. The Environmental & Health Working Group is led by Jared Scott and Major Sheila Newman supports Occupational Health at Edwards AFB. The implementation of the program occurs through the interface between the SPO, using Commands, Combined Test Force (CTF), and beddown locations.

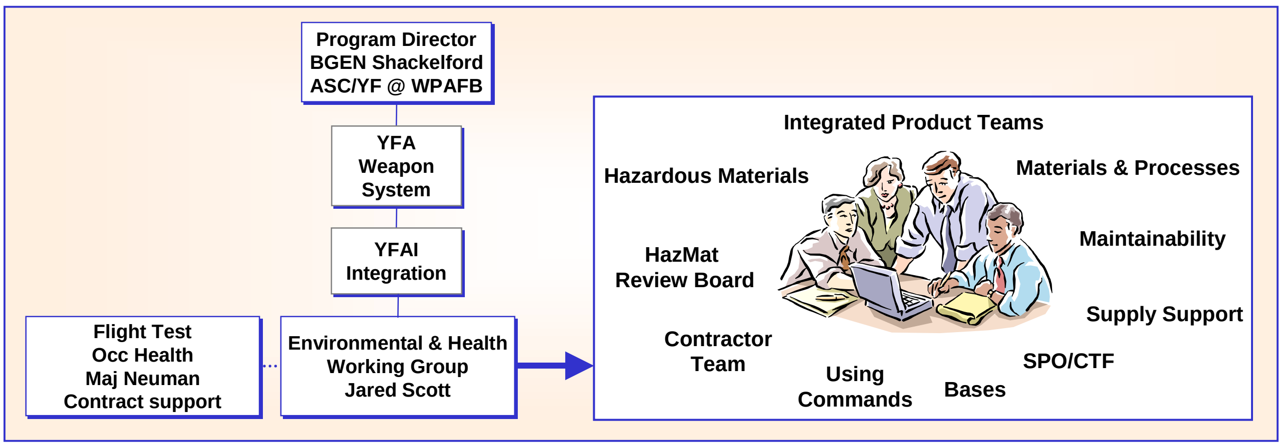


Figure 9. F-22 Environmental & Health Working Group Structure

Ongoing Projects (Figure 10): The F-22 Environmental & Health Working Group has been very proactive in minimizing/eliminating the use of hazardous materials from the F-22 weapon systems. For example, the weapon system has completely eliminated the use of methylene chloride from use for mold release, the use of lead and methylene dianiline in adhesive, the use of cadmium for landing gear and fuel tank coatings, the use of chrome in sealants, and has minimized the use of VOCs in various coating applications. Noteable ongoing efforts include the qualification of a non-chromated primer for Outer Mold line (OML) (see related article on page 18). For more information about ongoing projects, contact the F-22 SPO Environmental Program Manager.

Chemicals Targeted for Reduction	Application	Status
Ozone Depleting Chemicals Class I & II	Fire Suppression Aircraft Refrigerant Mold Releases Wipe Solvents Electronics Cleaning Vapor Degreasing	Ship 4009 and Production Replaced Replaced Replaced Replaced Replaced
Volatile Organic Compounds	Multiple Coatings Primers, Special Tech, etc. Solvents Brush/Roll repair	Minimized Minimized Minimized
Methylene Chloride	Mold Release	Eliminated
Cadmium	Landing Gear Fasteners Fuel Tank Coating	Eliminated Minimized (< .1%) Eliminated
Chrome	Primers: Flexible, Outer Mold Line Sealant Anodize	Replacements qualified, Implementation phase in Eliminated Minimized
Lead	Adhesive	Eliminated
Methylene Dianiline	Adhesives	Eliminated

Ongoing P2 Projects

- Non-Chromated Primers - Outer Mold Line (OML), Flexible
- Depaint Technology Study / Laser Stripping
- Exempt Solvent OML Coatings
- Chrome Free Landing Gear Project

Figure 10. F-22 HazMat Reduction Efforts and Ongoing P2 Projects

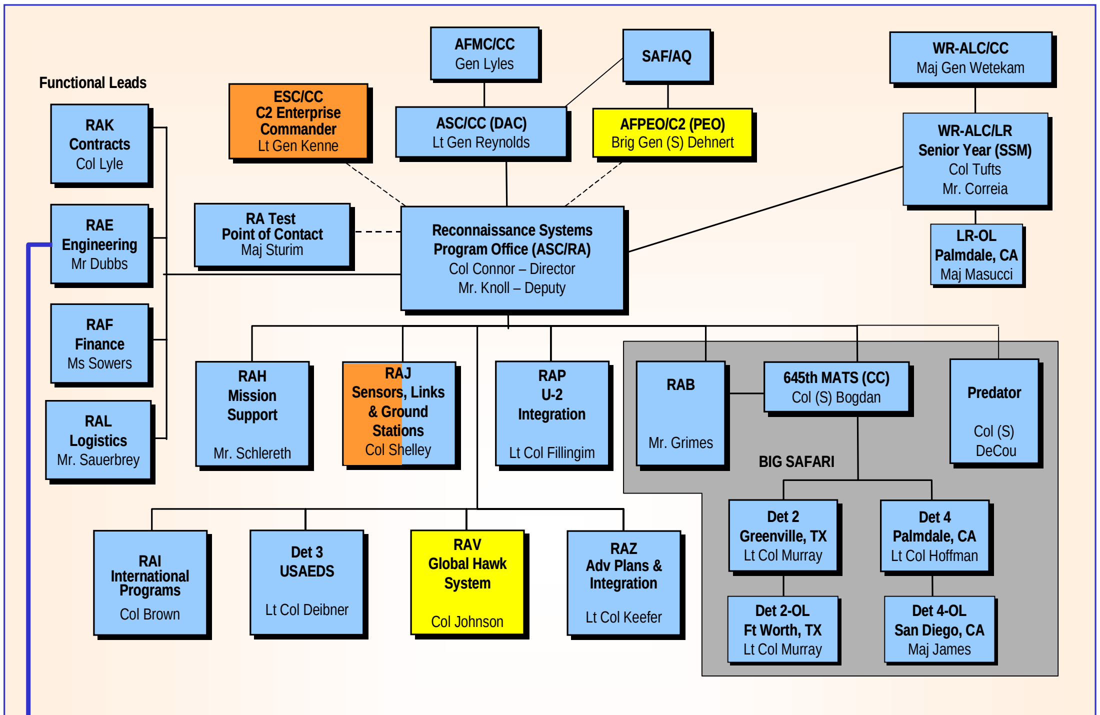
Organizational Profile: Reconnaissance System Program Office (SPO) Environmental Working Group (EWG)

Mission: To institutionalize Environmental, Safety, and Health (ESH) requirements into the systems engineering process for all RA Programs.

RA SPO Environmental Program Manager: Amy Mercado Vince (ASC/RAE)
DSN: 785-1747
Commercial: 937-255-1747
E-mail: Amy.Vince@wpafb.af.mil
Website: https://rasgweb.wpafb.af.mil/

Organizational Structure (Figure 11): The Reconnaissance SPO EWG is co-chaired by the Director of Engineering, Mr. Ron Dubbs, and Ms. Amy Mercado Vince, the Environmental SPO Program Manager. Programs participating in the EWG include Senior Year, Det 3, RAB (Big Safari), RAJ, RAV (Global Hawk), RAP (U-2), and RAI (International Programs).

Ongoing Projects: Currently a project is underway to evaluate the elimination of hydrazine from the U-2S. Future projects may include paint delamination, JSF LO Coating Systems Flexible Non-Chrome Primer, and evaluating alternatives to cadmium and nickel for electrical connectors. For further information, contact the RA SPO Environmental Program Manager.



Co-Chair: Mr. Ron Dubbs
Co-Chair: Ms. Amy Mercado Vince
Env. Collocate Alt/System Safety POC: Mr. Alan Owens
Env. Mgt. Officers: Capt Joe Nieto, Capt Tom Wehrle

Program	POC	Alternate
Senior Year	Ms. Bonnie Jones	Mr. Robert Davis
Det 3	Capt Bryan Armstrong	TBD
RAB	Mr. Jeff Brunson	Maj Don Miceli
RAJ	Capt Rich Cheng	TBD
RAV	Mr. Al Owens	Mr. Kennon Cooksey
RAP	Mr. Jeff Brunson	Mr. Richard Lee
RAI	Mr. Dave Ewing	TBD

Figure 11. Reconnaissance SPO Environmental Working Group (EWG) Structure

Organizational Profile: Propulsion Environmental Working Group (PEWG)

Mission: The PEWG's mission is to discover and validate environmentally advantaged clean and dry processes that extend life and performance of gas turbine engine (GTE) components, improve time on wing (TOW), and reduce total ownership costs. The group's priorities include clean and dry repair/overhaul process and transition of "green" technologies to fielded systems and new engines.

PEWG Chair: Colonel Carey G. Mumford
DSN: 785-6406
Commercial: 937-255-6406
PEWG Executive Officer: 1Lt Steven J. Elliott
DSN: 785-4169, X3185
Commercial: 937-255-4169, X3185
E-Mail: Steven.Elliott@wpafb.af.mil
Website: www.pewg.com

Organizational Structure (Figure 12): The PEWG chair reports directly to the Air Force Propulsion Product Group Manager (AF PPGM), Mr. Timothy Dues (OC-ALC/LR), who serves as the chair for the Joint Propulsion Coordinating Committee (JPCC). The PEWG is a DoD and industry consortium that address all environmental engine related issues.

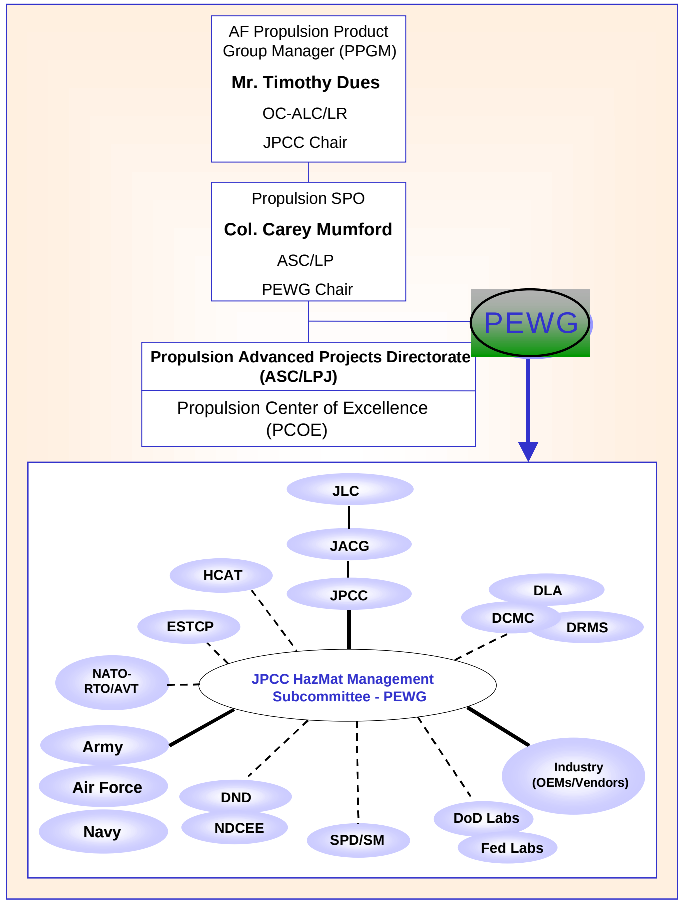


Figure 12. PEWG Organizational Structure

Ongoing Projects (Figure 13): PEWG's major activities include the following:

- Performing joint assessment of engine related environmental issues
- Discovering advanced "green" technology opportunities
- Exchanging information about "green" technology advances
- Executing joint projects to demonstrate and qualify environmentally superior materials and process technologies
- Leveraging government and industry funds
- Promoting product stewardship
- Implementing technical document changes within DoD.

Technology Assessments

- Cametizing (Metallic Coating Process)
- Physical Vapor Deposition (PVD)
- Super Hard Coatings
- Gas Dynamic (Cold) Spray
- Laser Cladding
- Low Hazard Metalworking Fluids
- Filmless X Ray
- Nickel Tungsten Plating (Chrome Alternative)
- HVOF Spray of Nickel

Technology Demonstrations

- Advanced Cleaning Technologies
  - – Waterjet
  - – Abrasive Flow
  - – Cathodic cleaning
  - – Carbon Dioxide
- Engine Oil Conservation/Reclamation
- Sermetel Coatings (Non-Chrome)
- Electrospark Deposition for GTE Repair

Qualifications

- Engineered Substitutes for ODCs
- Engineered Substitutes for EPA-17 Materials
- Alternatives to Zinc Chromate Primers
- Lead Free Low VOC Dry Film Lubricants
- Reclamation of GTE Superalloy Materials
- Hot Engine Leak Test (HCFC-141b Alternate)
- HVOF Thermal Spray Coatings
- Alternatives to Aluminum Ceramic Coatings (Sermatel W)

Figure 13. Ongoing PEWG Projects

For further information about ongoing projects and initiatives, contact the PEWG Executive Officer.

Continued from Page 5

stakeholders from the Department of Defense (DoD), National Aeronautics Space Administration (NASA), and Original Equipment Manufacturers (OEM) e.g., Boeing Aerospace, Lockheed Martin Aircraft. The project will demonstrate the feasibility of using a compact, portable, low-powered, hand-held laser system on small areas, complex geometry, irregular surfaces and hard-to-reach areas on aircraft, components, and support equipment to remove their paint systems.

In 2000, the Portable Laser Coating Removal System (PLCRS) conducted site surveys at MCLB Barstow (Marines), Corpus Christi Army Depot (Army), Warner Robins Air Logistics Center (Air Force), and Jacksonville Naval Air Station (Navy) to baseline the existing depaint processes and to define representative strip rates and coating system requirements.

The Joint Test Protocol (JTP), which was developed with the stakeholders, defines the tests (including substrate, tests, and criteria) to qualify alternate laser technologies. Various weapon system managers within the Air Force, Army, NASA, and Marines have endorsed the JTP.

The Potential Alternatives Report (PAR) has been completed and contains laser technology information on fifteen different laser companies. The stakeholders down selected four companies and based on visits to the manufacturers. The manufacturers of the selected technology included Laserline (Germany), Quantel (France), CleanLaser System (Germany) and SLCR (Germany). Figure 14 depicts the four laser systems under evaluation.

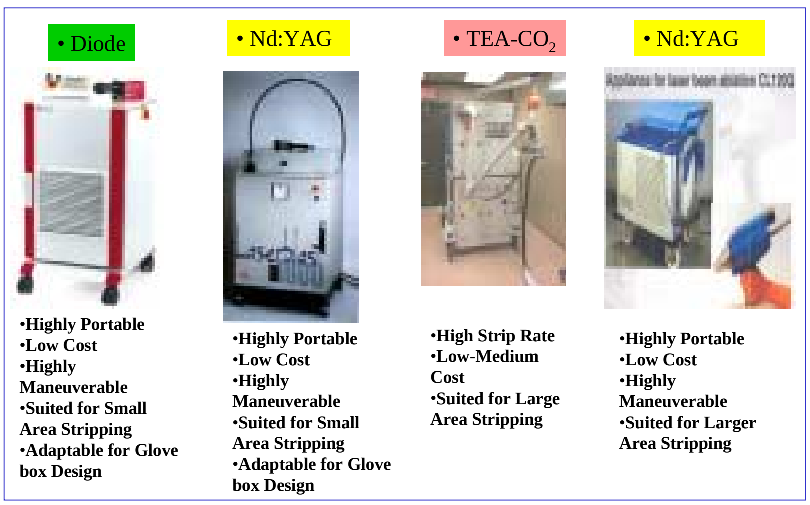


Figure 14. Overview of the Selected Laser Technologies

Currently, the four lasers are at Air Force Research Laser Hardened Material Evaluation Laboratory (LMHEL) Wright Patterson AFB OH, for further testing. The testing will determine which system can be best used on various substrates such as aluminum and composite surfaces. While the majority of the testing will be performed on 2024-T3 and 7075-T6 aluminum and graphite epoxy composite substrates, this program will also include steel, kevlar, metallic honeycomb core, and fiberglass epoxy panels. The test plan will examine laser depainting rates and analyze the effect(s) of the laser removal process through four paint/de-paint cycles. Strip rate and temperature measurements will be determined for a host of different coating and substrate types. The coating will include epoxy polyurethane, CARC, powder-coatings, NASA-specific, APC, and Gemcoat chemistries. The test program will include damage assessments and mechanical testing, including fatigue. An effluent analysis (air sampling) and safety review are part of the test program.

Laboratory evaluations and testing of the potential alternative technologies will be completed by December 03. A Joint Test Report (JTR) will document the results of the laboratory testing. Once the laboratory testing is complete, the program will begin field evaluation testing with an estimated completion of October 2004 to determine the reliability and maintainability of the laser systems. A final Joint Test Report (JTR) will also be prepared, along with procurement specifications.

For further information, please contact Ms. Debbie Meredith (Program Manager) at DSN 787-7505, Mr. Tom Naguy (Technical Lead) at DSN 986-5709, or Mr. Jerry Mongelli (Project Manager) at DSN 787-7693.

F-22 Program Qualifies the Use of Nonchromated Primer for Use on the Outer Mold Line (OML)

The F-22 Program has successfully qualified the use of two nonchromated primers Akzo Nobel (Dexter) 10PW22-2/8 and Spraylat EWDY048 and one flexible nonchromated primer (Deft 09Y10) for use on the F-22 Outer Mold Line (OML). Historically, the F-22 has used MIL-PRF-85582 and MIL-PRF-23377 chromated primers and TT-P-2760 Type I Class 1 flexible chromated primer (Koroflex) on the OML. Ten potential candidate primers were identified and chosen for testing, six primers and four flexible primers as shown in Figure 15.

Primers for the OML

- Aeroglaze 9741 (Lord Corporation)
- 10 PW22-2 (Akzo Nobel/Dexter)
- Kem Aqua Hydralon P (Sherwin Williams)
- 09-W-01 (Deft)
- W4104 (US Paint)
- EWDY048 (Spraylet)

Flexible Primers for the OML

- 09-W-01 (Deft)
- 10 PW22-7 (Akzo Nobel/Dexter)
- 55-GY-18 (Deft)
- 09-Y-10 (Deft)

Figure 15. Candidate Primers Tested

The candidate alternative primers were subjected to the following qualification tests: wet adhesion tape test, ambient and low temperature flexibility, corrosion resistance, film properties, primer fluid soaks, gap filler compatibility, humidity resistance, 28 day fluid soaks, 7 day deicer soaks, porta-pull adhesion, flatwise tensile adhesion, crazing and tensile tests, boot compatibility (only for flexible primers), film density, and RCS testing.

Based on the testing results Akzo Nobel (Dexter) 10PW22-2/8 was qualified as a non-chromated primer for outer mold line surfaces with the exception of the 5PTMEL03 boots and parts made with PEEK. 10PW22-2/8 met all the requirements of MIL-PRF-85582 Type I Class N except for ambient temperature flexibility. Spraylat EWDY048 was also qualified as a non-chromated primer for outer mold lines and will be used as a secondary option. Deft 09-Y-10 was the only candidate that met the requirements of TT-P-2760 Type I Class N and was subsequently qualified as a flexible non-chromated primer for use over the FPTMEL03 boots on outer mold lines.

Partial implementation of the recommended solutions will begin during the downstream coatings operations for Lot 2 (4018-4040), where assembly sequence permits. Lot 2 implementation will include all applications after airframe substrate. Full implementation is scheduled for Lot 3 (4041 and on down to airframe substrate). The full implementation of this solution will allow the F-22 program maximum flexibility to meet the maintenance concept of operations by not restricting OML restoration activities to limited Corrosion Control Facilities.

For further information, please contact Jared Scott, ASC/YFAI at (937) 904-5269 or e-mail jared.scott@wpafb.af.mil.

The Ultimate "Green" Engine: A Vision for New Engine Technology Initiatives

The Propulsion Environmental Working Group's (PEWG's) vision for the ultimate green engine is as follows:

> *"A gas turbine engine designed and built so that the parts do not corrode or wear out during the period the engine is deployed. The engine contains no toxic materials or components. No hazardous substances are used/released during manufacturing, maintenance, or rework of the engine. Engine operations should have minimal environmental impacts from noise and air emissions. Finally, valuable components and/or materials are recovered when the use of period ends."*

The PEWG, in concert with engine Original Equipment Manufacturers (OEMs), such as Pratt & Whitney and General Electric are identifying various technologies to support this vision for the ultimate green engine. Alternative solutions and technologies being evaluated have been identified in Figure 16 on the next page. Implementing these initiatives will not only have an environmental benefit but will greatly impact total ownership costs. Mainte-

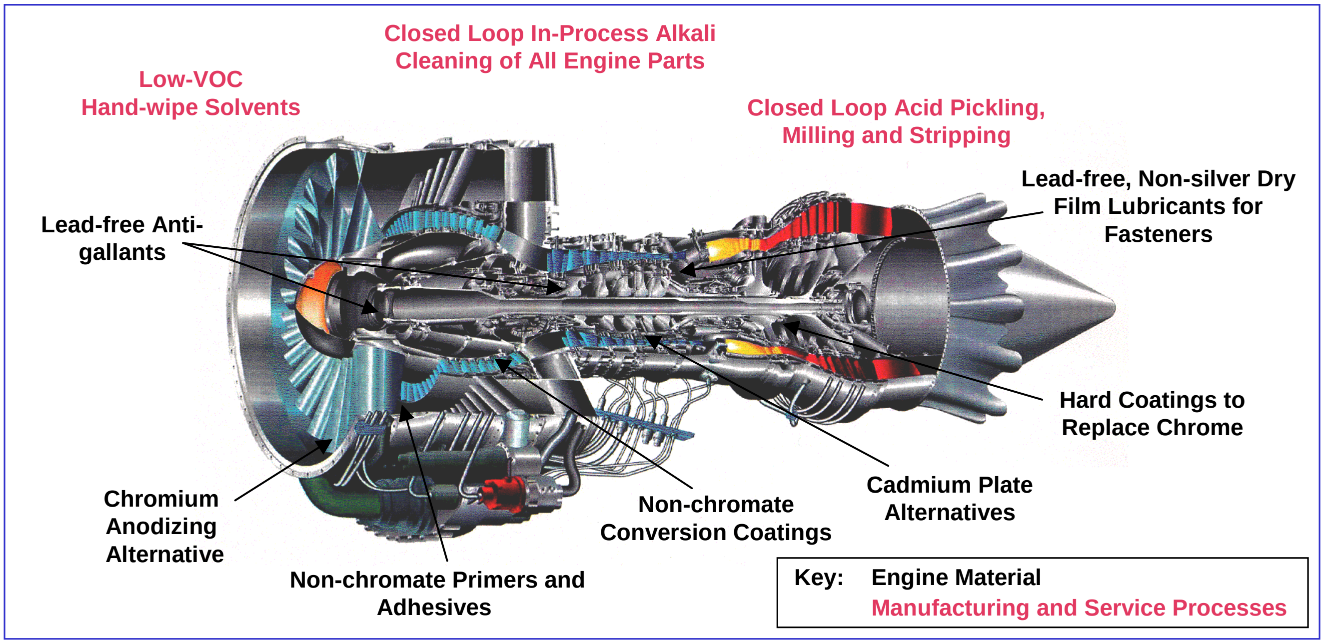


Figure 16. New Green Engine Technology Initiatives

nance and repair costs account from almost 50% percent or more of engine life cycle costs. At OC-ALC (see related article), the use of chromium, cadmium, and solvents adds a high burden in the repair process.

For further information, please contact Mr. Bob Bondaruk at 937-255-0444 ext. 3183 or visit the PEWG website at: http://www.pewg.com.

Greening Engine Repair Processes at Oklahoma City Air Logistics Center (OC-ALC)

Oklahoma City Air Logistics Center Propulsion (OC-ALC/LP) is responsible for repair of the F-15, F-16, E-3A, B-52, B-1B, and the KC-135 engines. The key repair processes that have an environmental impact include chemical cleaning, plating/chemical stripping, and painting. OC-ALC/LP is pro-active in inserting available green technologies for iterative repair of aircraft and missile engine components. The successes achieved to date are summarized below.

Chemical Cleaning Process

The chemical cleaning process at OC-ALC/LP is a 38,000 square feet facility that contains 65 tanks which are used to clean all base materials. The existing chemical cleaning process is completely automated. Environmental advances in this process include the elimination of benzene, toluene, and xylene. The use of methylene chloride has been reduced by 75% and the use of perchloroethylene has been replaced with parts washers. Remaining areas of concern include phenol and methylene chloride.

OC-ALC/LP Chemical Cleaning Process

Plating/Chemical Stripping Process

The plating/chemical stripping process supports repair of 15 jet engine series and contains over 200 tanks used for various plating applications (e.g., chrome, nickel, silver). Environmental advances in this process include the elimination of cyanide, and the substitution of Ion Vapor Deposited (IVD) aluminum and Zinc-Nickel plating for cadmium plating. Additionally, the use of nickel plating has been reduced by 60% and ongoing efforts include evaluating the use of a hot oil/alkaline cleaner to replace perchloroethylene degreasing. For elimination of hexavalent chromium, OC-ALC is installing High Velocity Oxygen Fuel (HVOF) and Chemical Vapor Deposition (CVD) technologies. Future initiatives will focus on eliminating the use of chrome, toluene, and perchloroethylene.

OC-ALC/LP Painting Process

OC-ALC/LP Plating/Chemical Stripping Process

Painting/Lubricating Processes

The painting process comprises of seven lighted and ventilated spray booths for a total of approximately a 30,000 square feet facility. Environmental advances in this process include the reduction of lead in dry film lubricants (early 2001), and the reduction of volatile organic compounds by 50%. Eliminating the remaining VOCs in solvent used in paints, sealants, and adhesives is an ongoing environmental initiative.

Source: PEWG July 2002 Meeting.

Operational Utility Evaluation/Field Demonstration of Hydraulic Fluid Purification Units for Use on Air Force Aircraft

The Air Force consumes 1.5 million gallons of hydraulic fuel annually. Currently, the General Technical Order (TO) for Hydraulic Fluid (42B2-1-3) does not allow use of recycled aircraft hydraulic fluid and this waste stream is disposed of as hazardous waste. A change in this TO that promotes and permits the use of purified fluid is in work and has the potential to save up to $19.5 million annually AF wide. Preliminary estimates indicate such a change, if implemented on F-16 aircraft currently in the field, would result in $1.3M in life cycle cost savings based on the current fluid usage at one location.

Aeronautical Systems Center, Air Frame Branch, Aging Aircraft Division, Aeronautical Enterprise Program Office (ASC/AAAV), in collaboration with Air Force Research Laboratory, Materials and Manufacturing Directorate (AFRL/MLBT) is currently conducting a Pollution Prevention (P2) project (FY 2001-2004) to establish and validate the use of Pall Portable Fluid Purifier units for Hydraulic Fluid Purification (HFP). Two of the aforementioned hydraulic fluid purifier units will be demonstrated at AFOTEC Det 1 in order to collect the necessary information to develop and establish HFP processes and generate the necessary TOs. This effort will formally establish/authorize the reuse of Purified Hydraulic Fluid across the Air Force. The technology has already been validated to purify hydraulic fluid for reuse on air, land, and sea systems for the other Services.

During the Phase I of this project, AFOTEC Det 1 generated a Master Test Plan and conducted a Performance Assessment Study documenting the history of all joint service testing for the Pall Unit and generated a Phase I report. The purpose of this effort was to verify and validate, through proof of process, the use of this system for hydraulic purification. Phase II, which is currently in the planning stage, will include an extended Operational Utility Evaluation (OUE) at Det 1. Information obtained from the OUE will be used to develop and document standard HFP processes, and enable the development and necessary changes to General TOs. Both MIL-PRF-83282 and 87257 fluids will be used during the test, and safe-to- fly quality requirements for used fluids will be determined if the purifiers cannot purify fluid to new fluid Mil Spec condition. The HFP tests are planned to be conducted on four types of aircraft and will include a fighter, bomber, airlifter, and trainer. If the Phase II OUE is successful, the project will continue (if funded) with AFOTEC monitored demonstration/field trials during Phase III, and will include depot trial implementation. If the Phase III is deemed to be not required, or if conducted is successful, the MAJCOMs will then start their own implementation projects to begin the Air Force wide implementation. The suggested order for platform implementation, based on aircraft size, is provided in Figure 17. Currently a new Integrated Product Team to conclude project planning and expedite HFP implementation is being formed by MSgt Dave Gorby also of ASC/AAAV. For more info on this IPT, he can be reached at (937) 255-7210 X3522, DSN 785-7210 X3522.

- C-5
- KC-10
- C-17
- C/KC-130
- C/KC/135
- B-1 - ASC/YDE (3-5 locations) *
- B-2 - ASC/YSE (1 Location)
- B-52
- A-10
- F-15
- F-117 *
- F-22 *
- F-16 - OO-ALC/YP-LG Mod/PDM Line (1 Location) YPLD Wants Depot Only (Subject to Change if Conditions Warrant)
- Halvorsen (Next Generation Small) Loader - ASC/GRG (19 Locations) *
- Ground Systems TBD

* Are Actively Interested in Participation

Figure 17. Platform for Implementing the HFP Technology

For more information, about HFP, please contact the individuals listed below.

Don Streeter	Lois Gschwender	Ed Snyder	Shashi Sharma
ASC/AAAV	AFRL/MLBT	AFRL/MLBT	AFRL/MLBT
(937) 255-7210, x3611	(937) 255-7530	(937) 255-9036	(937) 255-9029
DSN 785-7210, x3611	DSN 785-7530	DSN 785-9036	DSN 785-9029

LEAD FREE SOLDER UPDATE

The use of lead in the electronics industry raises concerns about occupational exposure, lead waste from manufacturing processes, and the disposal of electronic assemblies. Potential sources for occupational exposure in electronics are some of the soldering processes due to the inhalation of lead vapors or lead bearing dust generated during the wave soldering operation. The problems arising from the disposal of lead containing waste will be of even greater importance in the future as the rapidly increasing amounts of electronic assemblies (personal computers, radio and TV sets, mobile phones, household appliances, etc.) become obsolete. The world market for Printed circuit board assemblies alonoe has more than doubled within five years from 20B USD in 1992 to 42.2B USD in 1997, with an increase in Europe from 3.2B to 9.7B USD within the same five-year period.

Regulatory Drivers: In the United States legislation to limit the use of lead has been proposed in both the Senate and the House of Representatives. It is clear that the use of lead will be restricted severely in the near future. A Michigan based company announced recently the production of the first lead-free solder electronic module (a passive anti-theft system) for use in automobiles. Japan's Ministry of International Trade and Industry (MITI) drafted legislation eliminating lead usage. This would prohibit lead from being sent to landfills and other waste disposal sites, which leaves manufacturers with the option of either attaining 100% recycling of lead or using lead-free solder materials. On 13 Jun 00 the European Union (EU) Commission officially adopted the Waste for Electrical & Electronic Equipment (WEEE) proposals as two separate but associated draft Directives for submission to the European Parliament - WEEE (04/07) and Reduction of Hazardous Substances (ROHS). The ROHS proposals required substitution of lead and various other heavy metals and brominated flame retardants from 1 Jan 08. This legislation will impact not just on solder alloys but component finishes and temperature ratings, board finishes and flame retardancy issues. The European Commission (EC) has also passed a Directive on End-of-Life Vehicles which is mainly aimed towards recycling and re-use targets with additional clauses affecting the use of hazardous materials. Lead in solders for automotive applications have a temporary exemption from the lead ban. This Directive pre-dates the similar WEEE proposals and can be used as an indicator of likely legislative direction. The EC is entertaining proposed regulations that would "ban import, sales and production of lead and products that contain lead". As a result, most circuit card manufacturers fear that the consequences of these practices could suddenly take them by surprise with some change in law or environmental policy. The WEEE directive in Europe and similar mandates in Japan have instilled concern that a legislative body will prohibit the use of lead in electronics soldering.

Solutions: Although it is now widely agreed that there is no drop-in replacement for the standard lead-tin solders (mostly Sn37Pb and Sn40Pb) that are currently used worldwide, a range of possible alternatives has been investigated. Some consensus seems to have developed for using one family of alloys based on tin, silver, and copper, especially by the telecommunications industry. Possible candidates are alloys like Sn3.5Ag, Sn0.7Cu, or Sn3.8Ag0.7Cu with melting points (around 220°C) more than 30 degrees higher than their traditional lead-containing counterparts. The final choice of a solder material will still be product/application dependent, factors like temperature compatibility and/or cost might make other alloys more appealing so that automotive, telecommunications, consumer, military and aerospace industries might be inclined to use different solutions. A partial listing of ongoing projects is summarized in Figure 18. Within DoD, the Joint Group on Pollution Prevention (JG-PP) has a project to address this issue (www.jgpp.com).

Project	Web Site
National Center for Manufacturing Sciences (NCMS) – Pb-Free Solder – High Temp Fatigue Resistance Pb-Free Solder – Pb-Free Solder for Harsh Environments	www.lead-free.ncms.org
National Electronics Manufacturing Initiative (NEMI) - Pb-Free Solder Project	www.nemi.org
Computer Aided Life Cycle Engineering (CALCE) Electronic Products and Systems Center - Durability of Pb-Free Solders	www.calce.umd.edu/
Industrial Technology Research Institute (ITRI) - Pb-Free Laminate and surface finishes	www.itri.org/
IPC - Pb-Free Roadmap	www.lead-free.org
Open University - The Solder Programme	www.open.ac.uk/
National Physical Laboratory (NPL) - Pb-Free Soldering Technology	www.npl.co.uk/npl/ei/
Swedish Institute of Production Engineering (IVF) - Integrity of Pb-Free Solders	www.extra.ivf.se/defee/
IDEALS - Improved Design Life….by Pb-Free Soldering	www.lead-free.org/

Figure 18. Ongoing Lead-Free Solder Projects

Plural Component Paint System Technology

Multi-component paints (usually two parts) are supplied as standard-sized kits that require mixing the entire kit for proper mix proportioning. Once painting has been completed, any remaining paint mixture must be disposed of as hazardous waste. Plural component paint systems reduce waste because they draw the components from their individual containers and mix them in proper proportion as needed when the paint spray gun trigger is depressed. The plural component paint system eliminates excessive mixed-component paint waste because it mixes the components only as they are being applied. Paint waste is reduced to a mixture that needs to be cleaned out of the feed lines between the mixing point and the spray gun nozzle.

Technology Description: Each plural component paint system includes a variable ratio proportioning unit and high-volume low-pressure (HVLP), air-assisted airless paint spray gun. These systems can be either portable or stationary. Pump and Equipment Inc (Model: System 97399) is a Navy Selected vendor this technology. The cost of the technology is $20,000. Implementation of the technology will require ventilation, electrical service, and potential an air permit, if required by local regulatory agency.

The benefits of the plural component paint system include: lower VOC emissions, elimination of excessive hazardous waste from premixing of multi-component paints, and use of less paint.

Source: Navy Pollution Prevention Equipment Program (PPEP) Book.

The MONITOR on Internet

This issue of the MONITOR is available on the Internet at the ASC site (http://www.engineering.wpafb.af.mil/esh/news/news.htm#monitor). The current issue of the MONITOR is in a Portable Document Format (PDF) file which requires a reader program for viewing or downloading. The Adobe Acrobat reader is available for downloading at no cost.

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