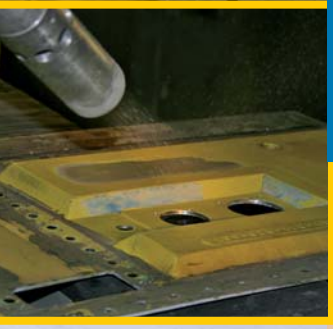
NAVAIR

Program Management Community Support Department (AIR 1.1)
Environmental Support Office (AIR 1.1E)

New Technologies from the Naval Aviation Technology Integration Program



The Latest & Greatest Solutions to the Fleet's Problems

The Naval Air Systems Command's (NAVAIR) Program Management Community Support Department (PMCSD) Environmental Support Office (AIR 1.1E) established the Naval Aviation Technology Integration Program (NATIP) to speed up the transition of innovative maintenance technologies (materials and processes) out of the NAVAIR laboratories and into the hands of the Fleet. NATIP enhances the degree of effectiveness of new technology implementation from the test and evaluation phase through the user level by providing programmatic oversight for all phases of the technology insertion process. NATIP managers work closely with principal investigators and end users to ensure that major milestones are met and successful technology integration is achieved.

New Technologies from the Naval Aviation Technology Integration Program

Sailors perform maintenance on F/A-18 Hornet engine in jet shop aboard USS ABRAHAM LINCOLN (CVN 72). U.S. Navy Photo by Photographer' s Mate Airman Apprentice Nicholas B. Morton.

The fan drive shaft of the F-404 engine has a tendency to coke because of repeated heating and cooling of the engine. U.S. Navy photo by Photographer's Mate Airman Janice Kreischer

Below are brief descriptions of the 2005 projects where NATIP managers, principal investigators and end users are concentrating their efforts.

1 F404 Engine Shaft/ Air Duct Cleaning

Problem: The F404-GE-400 and F404-GE-402 engines are used to power the F/A 18A through F/A 18D "Hornet" aircraft. Unfortunately, the fan drive shafts of these engines have a tendency to coke, because of repeated heating and cooling of the engine. (NOTE: Coke is the petroleum deposits that build up on the engine drive shaft as jet fuel is burned.) Because this shaft is an integral critical component of the F404, improper maintenance could potentially cause an uncontained failure of the engine resulting in possible loss of aircraft and life.

Currently, the Fleet uses a variety of measures to clean the shaft that includes soaking the F404 engine shaft in solvent (that happens to be a Hazardous Air Pollutant (HAP)) over several days and repeatedly scraping the coking deposits from the shaft, which is labor intensive and difficult to accomplish. As a result, the Intermediate (I) level repair facilities have requested an easier and safer way to remove the coking deposits.

Proposed Solution: A recommended solution for removing the coking deposits from the F404 engine shaft is to utilize plastic media blast (PMB) in either a walk-in booth or modified glove box environment at I-level maintenance facilities.

The F-404 Engine Field Service Team (FST) in conjunction with NAVAIR's Engineering Competency (AIR 4.0) and the Naval Air Depot (NADEP) Jacksonville, FL are conducting the required testing and validation to ensure this technology is appropriate during I-level maintenance actions. Currently, this technology is only approved by the F-404 Engine FST for use during Depot (D) level maintenance actions following chemical strip.

Project Benefits:

a. Eliminating the use of a HAP solvent (MIL-C-85704).

b. Eliminating a hazardous waste stream, which will result in reduced record keeping, reduced hazardous material purchases, reduced hazardous waste disposal costs, and a safer working environment.

c. Reducing the repair time of the F-404 engine will increase ready for issue (RFI) quantities and help meet NAVAIR readiness goals.

d. Eliminating a maintenance procedure that is difficult and time consuming to accomplish.

e. Reducing the risk of damaging the F-404 engine shaft during maintenance operations.

This shaft is an integral critical component of the F404 engine.

Hand sanding operations for coating removal is very tedious and labor intensive. Alternative plastic media may be a solution. U.S. Navy photo by Photographer's Mate 3rd Class Lamel J. Hinton.

Type VII GPX media is being demonstrated to remove paint from a thin fiberglass substrate on a H-53 Engine Air Particle Separator (EAPS).

2 Alternative Plastic Media

Problem: Methylene chloride has been the preferred paint stripper and used widely throughout the Navy at Organizational (O), Intermediate (I), and Depot (D) level maintenance for decades. However, methylene chloride is a HAP, is listed as a hazardous waste and a priority pollutant, and reportable on the Toxics Release Inventory (TRI). Furthermore, the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) to methylene chloride for workers has been reduced by 95 percent.

A number of chemical, mechanical, and energy-based paint stripping alternatives to methylene chloride have been tested and transitioned. However, each alternative involves tradeoffs and varying degrees of success. For example, plastic media blasting (PMB) with Type V (acrylic blast media), while environmentally friendly, has the potential to mask cracks in the components being stripped of paint, particularly components with aluminum and magnesium substrates. Undetected cracks can later cause part failure. In addition, PMB is not suitable for stripping paint from many composite panel configurations, therefore requiring labor intensive hand sanding operations to achieve coating removal. As a result, there is a need to approve alternative plastic media types.

Proposed Solution: Efforts are underway to identify and evaluate an alternative plastic media as a drop in replacement for Type V blast media that will strip paint efficiently, can be used on soft alloys prior to Non-Destructive Investigation (NDI), and can strip paint from the vast majority of composite substrates.

The critical measurements will include: 1) the absence of crack closure or masking in soft alloys, and 2) suitability for use on composite panels and components. Initial mechanical testing will be performed at the Naval Aviation Warfare Center–Aircraft Division Patuxent River, MD with the field service evaluation conducted at NADEP Cherry Point, NC.

Project Benefits:

a. The use of a low-pressure media airflow system to strip paint from composite components would be significantly faster than hand sanding. Faster strip rates would provide improved turn-around times for I and D-Level maintenance applications. An estimated labor savings of 200 man-hours per month at NADEP Cherry Point may be realized.

b. An approved PMB process that could be utilized on soft alloys prior to fluorescent penetrant inspecting would significantly improve turn around times on components requiring paint removal and subsequent NDI.

c. Reduction of a chemical-based stripping process will result in an associated reduction in waste stream generation.

Type VII GPX media is being demonstrated on a section of a H-53E blade, which is a fiberglass/nomex honeycomb structure.

Type VII GPX media is being used on an exterior panel from a H-1 helicopter. This substrate is an aluminum/nomex structure honeycomb with a thin fiberglass laminate on the transition area.

Types of Media for the Removal of Organic Coatings

At the present time, the Navy has added eight different types of media for the removal of organic coatings to the performance specification (MIL-P-85891) for use on various substrates. Each media has been evaluated by local authorities to govern the usage approval.

Type	Description
Type I	Polyester (Thermoset)
Type II	Urea Formaldehyde (Thermoset)
Type III	Melamine formaldehyde (Thermoset)
Type IV	Phenol formaldehyde (Thermoset)
Type V	Acrylic (Thermoplastic)
Type VI	Poly (allyl diglycol carbonate) (Thermoset)
Type VII	Starch-g-acrylic
Type VIII	Fiber reinforced Nanocomposite (Thermoset)

Alternative media blast materials are being evaluation for use on numerous substrates and Naval aviation components.
U.S. Navy photo by Photographer's Mate 2nd Class Alan Meza.

The small size of the portable leak detector makes it easy to carry.

Portable leak detector is used for examining blind areas in the wing section of the aircraft.

3 Fuel Cell Leak Detection System — An Alternative to Freon

Problem: The fuel tank leak testing process used Freon (an Ozone Depleting Substance (ODS)) to help repair personnel determine the exact point of a fuel leak in integral fuel tanks. Since Freon has been banned from use, an alternative leak detection method was developed which involves spraying down the surface of the wing section with a soap and water solution. Any bubbles that were visible would indicate an air leak from the fuel tank. This method, however, was not effective for detecting the smallest leaks—especially in hidden or blind spots on the aircraft.

As a result, the Navy Depots require a fuel cell leak detection process that does not use hazardous or regulated materials and is efficient but not labor intensive. The device must be portable with no special infrastructure required (such as a permanent tank or enclosure).

Proposed Solution: Evaluations are underway of new technologies that sense or detect leaks in integral fuel tanks for two specific applications:

1. **Helium for Application on Fixed Wing Fuel Tanks:** Demonstrations are underway that involve the use of helium from a compressed gas bottle and introducing it into the wing section. The wing is pressurized with the compressed air and a helium leak detector is used to scan the surface of the wing. This detection unit is portable and employs a handheld probe with attachments, and provides the operator with a visual and audible alarm when a leak is found. Helium is inexpensive, non-explosive, non-reactive, and environmentally safe. A standard size commercial helium bottle will probably last for a couple of years with this leak detection method.

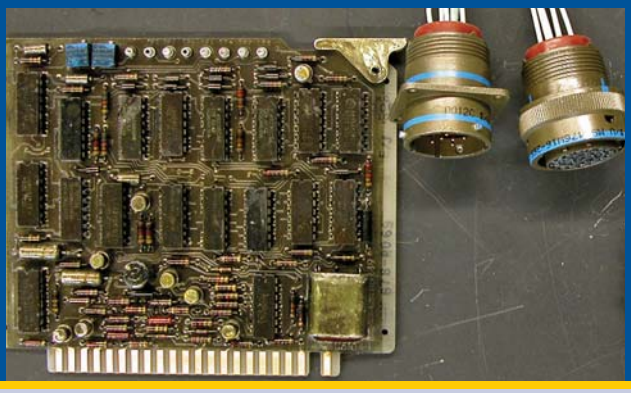
2. **Hydrogen for Application on Bladder Fuel Tanks:** As part of the demonstration phase of this project, the final product will consist of a method and/or equipment that can be used in a portable manner to inspect integral fuel tank systems for leaks prior to ready for issue (RFI) status. The final product will also be used to determine the location of existing leaks after defueling for faster repair. Hydrogen at this concentration (five percent) is inert and inexpensive, safe for occupational environments and plentiful. Furthermore, Hydrogen is a naturally occurring element and has no adverse environmental effects and causes zero disposal problems.

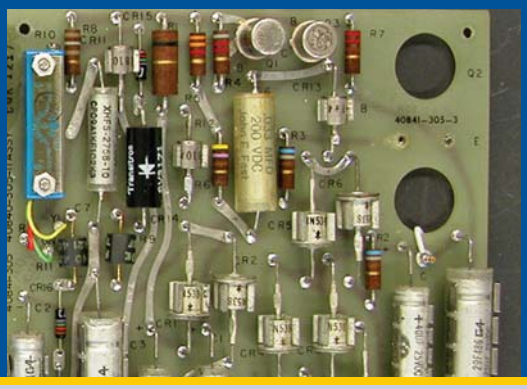
Project Benefits:

a. A reduction in the use of Freon for fuel cell leak testing.

b. A reduction in HAPs from the fuel cell leak detection process.

c. Availability of equipment/technique to any work shop that conducts fuel tank leak detection.





A major area of maintenance operation is the cleaning and lubricating of electrical contacts on circuit boards and electrical plugs. A non-ODS contact cleaner would provide a healthier working environment.

4 Non-Ozone Depleting Substance Contact Cleaner

Problem: A major area of maintenance operation is the cleaning and lubrication of electrical contacts. The current specification (MIL-C-29608) was developed around a Class II ODS, 1, 1-dichloro-1-fluoroethane (HCFC-141b). The manufacture or importation of HCFC-141b into the United States was prohibited after 2003. Several electrical contact cleaners have been identified which comply with MIL-C-29608. However, the primary composition of these alternative contact cleaners is also a Class II material that will be phased out in 2015. Therefore, additional alternatives need to be researched and tested to find acceptable non-ODS cleaners.

Proposed Solution: Recent evaluation of several non-ODS contact cleaner candidates has identified one product that meets the preliminary screening criteria for MIL-PRF-29608. Full conformance testing, including post cleaning contact performance and field service evaluation, has yet to be completed. The inclusion of additional non-ODS products is desirable to foster competitive procurement.

Project Benefits:

a. The ability to clean electrical contacts in a timely and cost effective fashion at all levels of maintenance, but primarily at the Operational level of maintenance.

b. Non-ODS materials would also provide a healthier work environment, as well as an acceptable material that will ensure for the uninterrupted cleaning of electrical contacts.

The dilute chromic acid (DCA) sealed test panel was used as the control failed the salt fog exposure (ASTM B117) criteria after only 1680 hours.

This non-hexavalent chromium containing test panel [coated with the Trivalent Chromium Process (TCP)] has been exposed to salt fog (ASTM B117) for 3144 hours. No sign of corrosion.

5 Thin Film Sulfuric Acid Anodize (TSFAA)— An Alternative to Chromate Anodize Coatings

Problem: HAP emissions from surface coatings, solvents, and chemical strippers account for 50-85 percent of military HAP emissions. Even though individual coatings may comply with applicable laws, their use still results in many facilities exceeding the major HAP source threshold. Facilities that exceed this threshold are subject to rules that apply exclusively to major HAP sources.

Proposed Solution: Demonstrations/evaluations are underway to replace chromate anodize coating processes with TSFAA.

TSFAA produces a thin oxide film on aluminum for enhancing corrosion resistance and paint adhesion while minimizing fatigue loss and does require a post chromate sealing.

Project Benefits:

a. A reduction in the use of HAP emissions and chromate anodize coating from chromate anodize coating process.

b. Only minor additional equipment is needed for transition, will not significantly alter the existing production line, and will result in a considerable production cost saving.

The AV8B HARRIER is a potential candidate for field-testing of TSAFF.
U.S. Navy photo by Photographer's Mate Airman Recruit Staci Betzer.

Brush plating process can be used on various aircraft components.

The J-52 Drive Shaft is a good candidate for the Zinc-Nickel brush plating process.

6 Zinc-Nickel as Brush Cadmium Replacement

Problem: Low Hydrogen Embrittlement (LHE) cadmium brush plating process is used in the manufacture and support of Department of Defense weapon systems/components for corrosion treatment on parts that need coatings for repair and dimensional restoration. However, cadmium has been targeted by the U.S. Environmental Protection Agency (EPA) and is currently subject to regulation under the Clean Air Act, Clean Water Act and Resource Conservation and Recovery Act. Therefore, there is a need to develop an acceptable replacement for repair and touch-up applications where cadmium depositions are required.

Proposed Solution: Demonstrate and validate Zinc-Nickel to replace the use of cadmium in the LHE cadmium brush plating process.

The Zinc-Nickel alloy was selected as the best alternative for cadmium because it has high corrosion resistance and serves to be sacrificial to steel components. Final test results showed good adhesion and corrosion resistance when applied as a repair coating, however, a conversion coating is required.

Project Benefits:

a. The reduction and eventual elimination of cadmium deposition from military systems would greatly reduce the environmental, safety and health risks associated with cadmium-based solutions.

b. Some cost avoidance would be realized immediately as a result of decreased monitoring, Personal Protective Equipment (PPE), and other cadmium emission-related requirements in the coating area.

The E-2 Rotodome is a potential candidate for field testing of alternative methods being evaluated under the Radome Repair Project. U.S. Navy photo by Photographer's Mate Airman Ryan O'Connor.

The nose radome of the P-3 Orion is another good candidate for alternatives being evaluated under the Radome Repair project. U.S. Navy photo by Photographer's Mate Airman Chris Otsen.

7 Radome Repair

Problem: EPA is proposing a new National Emission Standard for Hazardous Air Pollutants (NESHAP) for new and existing reinforced plastic composite production facilities. This proposed standard regulates production and related processes used to manufacture products with thermoset resins and gel coats. Some specific chemicals to be targeted include styrene, methyl methacrylate and methylene chloride. As a result, unauthorized resins, catalysts, fabric reinforcement, or coatings will deteriorate radome performance, impede efficiency, and reflect radar signals.

Proposed Solution: Demonstrate and validate vapor-suppressed resins (various epoxies) and various mechanical and energy driven paint removal methods, mainly a blast media, one of the environmentally friendly corn products produced by ADM/Ogilvie, such as eStrip™ GPX (a Type VII blast media).

This project involves the testing and evaluation of alternative methods to overhaul and repair radomes, finding a suitable substitute for polystyrene/polyester resins and a chemical paint stripper (Turco 6088A) for use in radome repair, or isolate materials to limited use.

Project Benefits:

a. A reduction in the use of a chemical paint stripper (Turco 6088A, Epoxy Clear Coat Kit, Part Number 530K017/930K105, National Stock Number 8010-LL-L95-0380).

b. Use of Type VII blast media will not cause damage to the radome substrate.

c. By using a non-HAPs material to repair the radome, no styrenes will be released during the repair process.

Aviation Structural Mechanic 3rd Class Bryan Brinkley, of Atlanta, Ga., repairs a nose radome on a P-3 Orion aircraft. U.S. Navy photo by Photographer's Mate Airman Jesse Praino.

U.S. Navy photo by Photographer's Mate Airman Kathaleen A. Knowles.

U.S. Navy photo by Photographer's Mate Airman Ricardo J. Reyes.

8 Advanced Bath Processes

Problem: The rinse process is instrumental in the quality of subsequent processing. The disposal is costly and there are environmental requirements to reduce waste streams (Executive Order 13101). Currently, NADEP North Island (San Diego, CA) manually samples rinse waters and disposes of them when an arbitrary contamination level is reached/approached. Because the measurements are taken weekly, there can be a problem in product quality if the water quality suddenly changes (for example, with a surge in workload). Occasional spills occur when the baths are manually filled with makeup solutions. These spills are costly and reportable. Therefore, there is a need for a technology that will more accurately monitor the baths and actively control the constituents and provide optimum and reproducible coatings while reducing wastes, defects and needless rework while increasing quality and lowering costs.

Project Solution: Develop an autonomous process control system that will filter, monitor, add/change solution, and remotely monitor tank solutions.

The rinse bath will be autonomously and continuously monitored with a process controller, and have an active purification system that removes contaminates, thus extending the bath life. In addition, the process controller will log the bath quality. This process controller will be used to analytically determine the maximum contamination allowable prior to process degradation. This historical information will also be used to extend the bath disposal intervals. The solution will also be remotely monitored and tracked via the Internet by all relevant support groups including chemical handlers, engineers, and production control personnel. In addition to physical alarms, this system will also have a paging alarm function via the Internet if the tank becomes out of parameters.

Project Benefits:

The benefits of this project range from cost savings from water conservation, to minimizing spills, meeting regulatory mandates for wastewater reduction, and improved product quality.

U.S. Navy photo by Photographer's Mate Airman Ricardo J. Reyes.

Test panels are prepared for the laboratory test phase for all projects.

The Benefits of Using AIR 1.1E Product & Services

Through the effective planning, management, tracking, and monitoring of available resources, AIR 1.1E is institutionalizing sound ESOH management principles across NAVAIR. The benefits of this process include:

a. Reducing environmental risks and liabilities,

b. Achieving environmental benefits and cost savings,

c. Improving industrial processes,

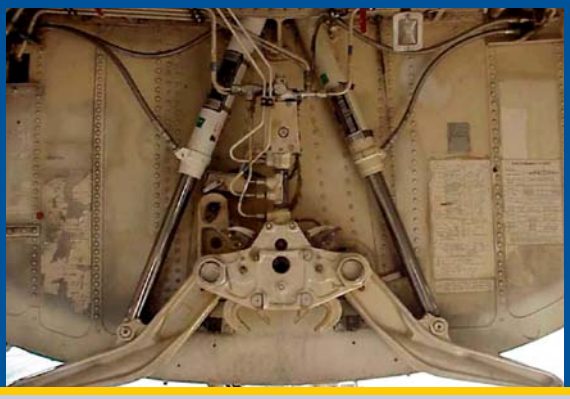
d. Achieving program missions at a competitive advantage, and

e. Maintaining environmental compliance.

How to Acquire AIR 1.1E Products and Services

To acquire any of the products or services offered by AIR 1.1E, contact the AIR 1.1E representative listed on the back page at least 12-18 months prior to a scheduled milestone review. AIR 1.1E will provide a proposal and cost estimate for the products and services required and assign an ESOH Coordinator to the task.

U.S. Navy photo by Photographer's Mate Airman Cristina R. Morrison.



P-3 Bomb Bay Actuator Door is coating with a High-Velocity Oxygen Fuel coating. This HVOF coating application has been approved as an alternative to hard chrome plating.

This P-3 Main Landing Gear is being coated with a High-Velocity Oxygen-Fuel coating, an alternative to hard chrome plating.
Photo by Jon Devereaux, Naval Air Depot Jacksonville, FL.

Summary

In support of the NAVAIR vision to provide cost-wise readiness and dominant maritime combat power to make a great Navy/Marine Corps team even better, NATIP ensures that the ultimate user of the technology (the Fleet) plays an integral part in identifying technology needs and integrating successful technologies into the NAVAIR community. Upon successful demonstration/validation of each project effort, end users will appreciate the seamless integration of approved technologies into the NAVAIR community. NATIP innovative technologies ensure Fleet readiness and a maximum return on NAVAIR's investments.

For more information about AIR 1.1E products and services, visit the NAVAIR environmental website at www.enviro-navair.navy.mil or contact an AIR 1.1E representative.

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www.enviro-navair.navy.mil

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