

AIR FORCE CORROSION PREVENTION AND CONTROL PROGRAM

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ABSTRACT

The Air Force Corrosion Prevention and Control Office (AFCPCO) manages the Air Force's corrosion program, and is the Air Force's single focal point for all corrosion guidance and policy. Our customers are Air Force field units, command-level corrosion managers, depots, and system program managers. We are also the Air Force's representative to the rest of the corrosion community, including other services and industry. This briefing will describe recent Air Force corrosion-related issues, the actions we are taking to address them, and corrosion maintenance technologies we are investigating to improve the Air Force's corrosion program.

Keywords: Air Force, corrosion, prevention, control, technical orders, maintenance, sustainment

INTRODUCTION

The Air Force Corrosion Prevention and Control Program is an Air Force Headquarters (HQ USAF) level program, defined by Air Force Instructions, to prevent, detect, and control corrosion, and minimize its impact on Air Force combat capability. It is a maintenance support program, directed at the sustainment community, i.e., those who conduct corrosion prevention and control maintenance operations, as well as those who implement technologies for those operations. The need is substantial: documented corrosion maintenance cost the Air Force over \$1.1 billion in 2001; nearly 4% of the Air Force's entire operations and maintenance budget.

The Air Force Corrosion Prevention and Control Office (AFCPCO) is chartered and directed by HQ USAF to manage the program. Our office does this, in broad terms, by providing oversight of Air Force corrosion prevention and control operations, and by providing technical guidance to the Air Force corrosion community. We are the single USAF point of contact for all corrosion issues. Our customers are system managers, major command corrosion managers, depot

corrosion personnel, and field-level maintainers across the Air Force; we support them in implementing and conducting the best possible corrosion prevention and control program.

We are not, of course, the only Air Force activity involved in corrosion prevention and control. Other organizations do research and development of new materials and processes; develop and conduct training of corrosion personnel; manage the sustainment of specific weapon systems; and perform the actual maintenance actions. We work closely with these other partners, as well as with other services, with the Office of the Secretary of Defense, with allied air forces, and with industry.

Our contribution is to ensure Air Force corrosion needs are met, in the most effective and efficient way, using the best available technologies, optimized for Air Force requirements. Our mission statement is to “Ensure the Air Force has an effective program to prevent, detect, and control corrosion, and minimize the impact of corrosion on Air Force combat capability.” This paper discusses in greater detail how we accomplish our mission, and gives examples of some of our recent and on-going efforts.

TASKINGS AND TECHNICAL AREAS

The AFCPCO is governed by Air Force Instruction 21-105, *Air and Space Equipment Structural Maintenance*, which directs us to do the following things:

- Provide expert engineering and technical assistance to AF customers
- Provide engineering management of eight general-series corrosion-related technical orders
- Conduct periodic corrosion surveys of major commands (MAJCOMs) and weapon systems
- Assist weapon system managers in managing their corrosion programs, in part through working groups called Corrosion Prevention Advisory Boards
- Conduct an annual, world-wide USAF corrosion conference
- Support corrosion training for maintainers, engineers, and managers by developing and reviewing curricula
- Document and publish facility requirements for corrosion maintenance
- Conduct Air Force-wide studies to document the actual cost and impact of corrosion
- Transition mature, applicable corrosion technologies to users

We are involved in many corrosion-related technical areas, at all levels of maintenance:

- Coatings (aircraft and equipment primers and topcoats, powder coatings, flexible primers, metal wire-arc spray, non-chromated primers, conversion coatings)
- Paint stripping (environmentally acceptable chemicals, flashjet, laser, plastic media)
- Cleaning processes (scrub pads, aqueous parts washers, environmentally acceptable solvents)
- Corrosion preventive compounds and processes, including vapor corrosion inhibition and dehumidification
- Sealants and gaskets (conductive gaskets, corrosion inhibiting sealants)
- Process-related issues (facilities, air compressors)

- Corrosion management (modeling & prediction, severity assessments, material substitution, cost and mission impact of corrosion)
- On-call customer support

SELECTED EXAMPLES OF CURRENT EFFORTS

Technical Orders:

Technical Orders (T.O.s) direct Air Force maintenance processes, and are one of our most important responsibilities. Field maintainers overwhelmingly tell us their first priority is accurate, up-to-date, clear T.O.s, because T.O.s are used for all corrosion maintenance, and all Air Force corrosion-related technical data refers back to our general-series T.O.s. In essence, our T.O.s, applicable to all systems, define what can and cannot be done Air Force-wide. Keeping them up to date and accurate allows Air Force maintainers to use the best available materials and processes, with least effort, best results, and greatest safety and environmental compliance. Some recent details of our T.O. update efforts follow:

We recently revised the plastic media test requirements in T.O. 1-1-8, *Application and Removal of Organic Coatings, Aerospace and Non-Aerospace Equipment*: all Air Force users of plastic media must either test their media for heavy particle contamination, or change media every 80 hours of use, to prevent damage to aircraft.

We have completed a full rewriting of T.O. 1-1-691, *Aircraft Weapon Systems Cleaning and Corrosion Control*. Until recently this T.O. was a joint publication with the Navy and Army, but there are too many technical and programmatic differences between the way the Navy and the Air Force conduct corrosion maintenance. It required an Air Force appendix to document exceptions and modifications to Navy processes, was ambiguous about which materials and processes are authorized for Air Force use, and had a substantial amount of inapplicable content. We determined the T.O. wasn't able to meet Air Force needs for clear, easily followed direction, so the Air Force has decided to publish it as an Air Force-specific technical order. The rewrite is complete, and the T.O. is now in publication. This does not affect the Army and Navy users-- they will continue to maintain and use the previous joint T.O. as is, using their own current manual numbers.

We are seeking funding to create a technical order for corrosion prevention and control of communications and ground-based electronics systems, such as ground radars, telemetry systems, mobile communications vans, and the like. Corrosion maintenance of these systems is not currently covered in AF technical orders, and the effects of unprevented corrosion are apparent, reducing reliability and increasing maintenance time and cost.

We are well into performing a major update to the corrosion sections of T.O. 36-1-191, *Technical And Managerial Reference For Motor Vehicle Maintenance*, which previous management had allowed to go out of date. We are also rewriting and combining T.O. 35-1-3, *Corrosion Prevention, Painting and Marking of USAF Support Equipment (SE)* and T.O. 35-1-12, *Compounds and Procedures For Cleaning Support Equipment*. Vehicles and support equipment, lacking the attention given to aircraft, are often poorly maintained, and we find major

corrosion problems in the field that must be addressed. Corrosion of these assets accounts for direct maintenance costs to the Air Force of some \$130 million a year.

Corrosion Surveys:

We survey each MAJCOM once every five years; the purpose is not to inspect every piece of equipment, but rather to evaluate the overall health of a command's corrosion prevention and control program. We visit a sample of bases within a command, and look at equipment, maintenance processes, materials used, training, scheduling, and hazardous materials management. We provide technical assistance on-site, and give briefings to unit and MAJCOM leadership to help them improve their programs.

In the last few months we have completed two MAJCOM surveys: Air Force Reserve Command in August and September, and U.S. Air Forces Europe in October and November. What we found is typical of what we see throughout the Air Force.

- Aircraft were generally in good condition, though with some paint eroded from leading edges. Touchup is difficult, due to restrictions on spraying outdoors. Our recommendation is to perform interim touchup with brushes, rollers, or Sempens.
- Support equipment and vehicles, on the other hand, were in fair to poor condition overall. Often stored outdoors, and painted with inadequate coatings, much of this equipment has severe corrosion and needs attention soon.
- Unauthorized materials are sometimes used, such as cheap spray paint or industrial cleaning compounds that can damage equipment and violate environmental restrictions. Usually, in these cases, we can immediately provide information on the correct materials, including T.O. references and ordering information.

Study of the Mission Impact of Corrosion:

The Air Force has conducted periodic Cost of Corrosion studies since 1990, but has recently become interested in understanding the impact of corrosion on combat capability, as measured in non-cost metrics such as aircraft availability, mission capable rate, depot flow time, maintenance down time, or degraded capability. We have a number of isolated examples—such as the fact that corrosion of the C-130's sloping longeron, a single major structural member of that aircraft, results in a fleet-wide loss of 5 aircraft mission available at any given time—but have never documented the impact Air Force-wide. This year we conducted an initial exploratory analysis of a single Air Force weapon system, which revealed that corrosion-related maintenance reduced its mission availability approximately 19%. We are seeking additional funding to expand this study across all AF systems, so we can direct our corrosion prevention and control efforts to the areas that will best improve combat capability.

Field Evaluation of PreKote:

We have completed over two years of a six-year field evaluation of PreKote, a new non-chromated pre-paint surface treatment for aluminum. It is environmentally friendly, non-toxic, and promotes adhesion; it has the potential to replace chromated conversion coatings, reducing chromium use. It has performed very well in operational field testing to date, and has now been

authorized for use by managers for F-16s, T-37, T-38, and T-1 aircraft. Before we can recommend it for use Air Force-wide, though, we intend to complete our flight test program on different aircraft substrates (A-10's and C-130's). It must currently only be used with chromated primers, to assure adequate corrosion inhibition.

Aqueous Parts Washers:

The Air Force has been struggling with problems caused by the introduction several years ago of Aqueous Parts Washers (APW), replacing many solvent cleaning processes. We documented multiple problems: APWs are not always effective in removing soils, requiring supplemental cleaning; they can cause corrosion of parts; the APWs themselves are corroding and failing at a rapid rate; they produce much more hazardous waste than originally predicted; they are not approved in many T.O.s; and they can cause hydrogen embrittlement. We have now completed and published two follow-on studies; one to evaluate improvements that can be made to existing installed parts washers, and the other to test improved designs of new parts washers, optimized for greater effectiveness, reduced maintenance time and cost, and reduced hazardous waste generation. These reports are available publicly at our web site as an informational service to APW users; they are not intended to promote any specific manufacturers or products. We are now working with the Navy to test and authorize the use of non-emulsifying cleaning compounds in APWs, to further improve their effectiveness and efficiency.

Corrosion Facilities Guide:

We have completed an Air Force Corrosion Facilities Reference Guide, also available publicly at our web site. Current civil engineering guidance is inadequate for corrosion maintenance operations. Many existing facilities have deficiencies, resulting in inadequate maintenance of the aircraft, increased risk to personnel, and environmental non-compliance. Commands have had difficulty justifying the cost of building or modifying adequate facilities, because they do not have access to supporting documentation or regulations. Our Guide documents the capabilities needed for effective performance of various corrosion control tasks (in such areas as lighting, heating/cooling, airflow, filtration, power, etc.), and available ways to achieve those capabilities. The Guide captures in one document all the necessary capabilities of effective corrosion maintenance facilities, and provides references to all the original supporting regulations.

Corrosion Management:

AFCPCO is working with AFRL, in an effort being conducted for the Air Force Aging Aircraft System Program Office, to move the Air Force to a new philosophy of corrosion management. The intent is to move away from the current "find-and-fix" process to an ability to "anticipate and manage." This effort is developing tools to better predict, detect, understand, and manage corrosion. Projects are ongoing in environmental severity, modeling, cost of corrosion, analysis of corroded structure, materials substitution, and corrosion suppression. The goal is to be able to safely fly aircraft with known corrosion, deferring repair, and thus saving up to hundreds of millions of dollars a year.

Hosted Conferences:

AFCPCO conducts the annual Air Force Corrosion Program Conference, targeted primarily at field-level and depot-level corrosion maintainers, weapon system and MAJCOM corrosion managers, and those who support them. It emphasizes solutions to current and near-term concerns (other conferences adequately review longer term research and development). For the last several years it has been the largest DoD corrosion conference, with over 400 participants, representing all MAJCOMs, all Air Force depots, over 120 field units, sister services, HQ USAF, AFRL, system managers, and industry. It's one of our primary means to communicate changes in guidance, newly authorized materials, and lessons learned to the entire Air Force corrosion community.

AFCPCO also co-hosts the annual Aerospace Coatings Removal and Coatings Forum, a DoD and industry partnership conference. It is specifically targeted at the developers and implementers of technologies for improvements in the areas of application and removal of aerospace coatings. It's the premier opportunity for civilian airlines, aircraft manufacturers, coatings technology providers, and Department of Defense customers to meet and discuss common problems and share solutions. Information is available at www.dodconf.swri.org.

Customer Assistance:

We are continually providing direct engineering, technical, and policy assistance to customers across the Air Force. We have been the Air Force's representative to the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics for their Congressionally directed initiative to improve DoD corrosion mitigation efforts. We recently provided information and demonstrations of currently available and approved corrosion technologies to several Central and South American Air Forces in support of Air Force Security Assistance Center's treaty obligations. We provide expert technical advisors to support the corrosion prevention board meetings held by each Air Force weapon system program management office. We participated in on-site evaluation and solution of corrosion damage on mobile air traffic control radars before deployment in support of Operation Iraqi Freedom. We wrote new corrosion-specific guidance and had it incorporated into MIL-STD-1530B, "Aircraft Structural Integrity Program." We have been the Air Force's lead for assisting the General Services Administration in updating and digitizing the government's specification for all colors used in procurement, Federal Standard 595.

FUTURE DEVELOPMENTS

We have on-going projects in many areas. We are working with Air Force Space Command to test metal wire-arc spray coatings on launch towers, to reduce the immense need for rework after the stress of a rocket launch. We are developing a new specification for cleaning processes that will be fully performance based, allowing us to qualify materials and processes that don't meet current formulation-based specifications. We are working with other organizations to resolve problems with degradation of aircraft fuel tank coatings. We plan to create new training curricula specifically targeted to weapon system program managers and engineers. Other projects we have on-going are being presented separately at this conference.

AIR FORCE CORROSION CONCERNS

These are what we consider the top issues that face the Air Force Corrosion Prevention and Control Program today:

The single greatest need is for better communication within and among the Services. We need a centralized awareness of user needs, available solutions, test results, on-going developments, and project proposals. Often we see a need and don't know what work is already being done to address it. Though each Service should implement its own corrosion management program (due to valid differences in equipment, operating environments, and maintenance concepts), the sharing of such information would reduce duplication and improve efficiency.

We need to improve corrosion awareness and understanding managers and engineers in system program offices. These offices have the direct responsibility for authorizing what materials and processes will be used on their weapon systems. Despite this authority and responsibility, many have no specific corrosion training. Many are assigned corrosion responsibilities as an additional duty, and do not have much time to devote to it. We have proposed for several years to develop a training program tailored specifically for SPOs, but have not been able to fund it.

We need capability to get new and innovative materials and processes tested for applicability to AF maintenance processes. We rely on the capabilities of the Air Force laboratories, but they often do not have time or funding to support our needs. The evaluation projects we manage are almost exclusively funded by external funding sources, under other organizations' control, which requires repeated solicitation and competition for the funds.

We continue to need better tools and methods to manage corrosion; i.e., to give the AF the ability to detect and quantify existing corrosion, and predict its growth and structural impact, with enough confidence to safely fly aircraft with certain amounts of known corrosion. Much work is being done, and this capability is still many years away, but the potential payoff has been estimated at some \$400 million/year.

In the wake of Operation Iraqi Freedom, many Air Force systems are returning with large amounts of contamination from sand and dust, which promote corrosion, and must be removed thoroughly to reduce the cumulative damage. Though the Air Force is conducting massive reconstitution efforts, we expect to see a significant increase in the cost of corrosion over the next few years.

TECHNOLOGY NEEDS

Looking ahead to the future, we have identified the highest priority technology needs for the Air Force R&D community to address to meet upcoming corrosion challenges:

- Better methods to predict, detect, and manage corrosion
- Non-chromium corrosion-inhibiting coatings
- Improved corrosion preventive compounds
- Materials to prevent degradation of advanced composites

- Improved, environmentally acceptable plating or surface treatment technologies
- Advanced coatings removal technologies

SUMMARY

In summary, the AFCPCO manages the Air Force corrosion program for HQ USAF. We are the Air Force's single, central point of contact with resident expertise--experienced engineers, technicians, and senior enlisted staff. We provide formal technical guidance and on-call problem solving for MAJCOMs, depots, system managers, and field units. We address cross-cutting corrosion problems, provide continuity throughout the Air Force corrosion community. We serve as a bridge between developers and users, helping transition technologies into operational use.

For more information, contact:

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