2022 Secretary of Defense

Environmental Awards

Environmental Excellence in Weapon Systems Acquisition, Team C-130 Program Office and Support Team

Introduction

The U.S. Air Force (USAF) issued its original design specification of the C-130 in 1951, yet the remarkable C-130 remains in production. The latest C-130 produced, the C-130J, entered the inventory in February 1999. Lockheed-Martin Aeronautics Company (LMA) is still delivering C-130J aircraft through Fiscal Year (FY) 22.

The C-130J is a post-Milestone C, Acquisition Category 1C program in full-rate production for the U.S. Government and Foreign Military Sales (FMS). The weapon system meets warfighter/allied force operational needs by directly supporting the warfighting Combatant Commanders' airlift mission. This support consists of transporting payloads into and out of the combat theater without refueling, delivering cargo and personnel via airdrop and airland, augmenting aeromedical evacuation, and performing emergency nuclear transportation and other special missions. Throughout this all, the C-130 platform continues to focus on improvements to environmental safety and health through its many corrosion prevention and control programs and sustainment efforts.

The C-130 Program Office and Support Team consists of members of the C-130 Program Office (PO), Air Force Life Cycle Management Center (AFLCMC)/EZVV, 402nd Aircraft Maintenance Group (AMXG), LMA, and MEC Energy Services (MES) and includes the following:

- USAF:
  - Dana Allen, Chief, Acquisition Environmental Integration Branch
  - Morgan Russell, Pollution Prevention Integrated Product Team (IPT) Lead
  - Tim Clendenin, Weapon System Environmental Scientist
  - Teresa Finke, Pollution Prevention Engineer
  - Daniele Johnson, Pollution Prevention Program Manager
  - Emily Spilker, Palace Acquire Intern
  - Kelly McNamara, Weapon System Environmental Scientist
  - Joshua Gallo, Aerospace Engineer/Corrosion Manager
  - Brad Gravot, Lead Equipment Specialist
  - Al Lopez, Equipment Specialist
  - Rick Sargent, Equipment Specialist
  - Hutch Thompson, Structural Engineer
  - Todd Lavender, Process Engineer
- LMA:
  - Heather Kuemmerle, Pollution Prevention Lead
  - Alex Stovall, Project Manager
  - Kevin Detring, Project Manager
  - Ryan Thompson, Project Manager
  - Kelly Grubbs, Project Manager
- MES:
  - Mike Ballard, Senior (Sr) Corrosion Program Analyst
  - Mike Forgue, Sr Corrosion Program Analyst
  - Rick Johnston, Materials Engineer
  - Perry Plaxico, C-130 Subject Matter Expert (SME) Aircraft Equipment Specialist
  - Dallas Rhoad, Mechanical Engineer
  - Mike Surratt, Sr Program Manager
  - Scott Ward, C-130 SME Corrosion Program Analyst
  - Kevin Wilson, Program Manager/Sr Corrosion Program Analyst

Personnel Depicted: *Upper left photo (left to right):* Ryan Thompson, Kevin Detring, Alex Stovall, Heather Kuemmerle, and Kelly Grubbs. *Upper right photo (from left to right):* Mike Forgue, Scott Ward, Mike Ballard, Dallas Rhoad, Mike Surratt, Kevin Wilson, Joshua Gallo, Todd Lavender, Hutch Thompson, Al Lopez, Brad Gravot, and Perry Plaxico. *Bottom photo (from left to right):* Teresa Finke, Morgan Russell, Kelly McNamara, Dana Allen, Daniele Johnson, Tim Clendenin, and Emily Spilker.

Background

The C-130H is in the Operations and Sustainment Phase with ongoing modification programs. After the first C-130J aircraft was purchased commercially by the United Kingdom, the U.S. Government procurement of the C-130J began in 1995.

Current efforts for the C-130J include ongoing development, production, and installation of Block Upgrades, sustainment of the fielded aircraft, and depot-level maintenance and long-term sustainment.

Program Description

The C-130 PO coordinates a detailed strategy for C-130J environmental, safety, and occupation health (ESOH) management with AFLCMC/EZVV and LMA. Through the Programmatic Environment, Safety, and Occupational Health Evaluation document, status of the ESOH efforts and ESOH risk management, responsibilities, and ESOH progress tracking are communicated to the C-130 community.

ESOH risks are briefed and discussed quarterly with contractors, using Commands, and C-130 PO staff. ESOH is addressed

throughout the life of the program, from material selection in the design and engineering development phases through to production, deployment/fielding, and sustainment of the weapon system. Each engineering change is assessed to ensure that no hazardous materials, processes, or procedures are inadvertently introduced into the weapon system in any of the lifecycle phases.

Accomplishments

Hazardous Materials Management and Pollution Prevention

The C-130J ESOH Team developed a Hazardous Materials Management Process to identify and minimize hazardous chemical usage throughout the manufacturing process. During FY 2020 and 2021 alone, over 15 C-130J Program Pollution Prevention projects were being tracked by AFLCMC/EZVV, C-130 PO, MES, LMA, and 402 AMXG at the USAF-owned C-130J manufacturing facilities in Marietta, GA. The team aimed to eliminate several classes of high-risk hazardous materials that were common in manufacturing processes. The C-130J ESOH Team has eliminated tons of volatile organic compounds (VOCs), hazardous air pollutants (HAPs) and significantly reduced the use of hexavalent chromium, or hex-chrome. The Environmental Protection Agency (EPA) considers hex-chrome as a highly toxic chemical. The Occupational Safety and Health Administration (OSHA) considers hex-chrome as a carcinogen, causing it to be heavily regulated for environmental and safety control.

The team has implemented several initiatives to eliminate these materials, as well as communicated and shared these results and lessons learned with other DoD and defense industry entities for other aircraft/airframes so they too can benefit from the knowledge gained. These projects are discussed further below.

Solvent Borne Non-Chrome Primer

This project is the culmination of a 16-year investigation, evaluating over 70 finish systems seeking chrome-free alternatives for required long-term environmental and corrosion protection, and durability required on C-130H and C-130J exterior surfaces.

Through this and several related projects, low or non-chrome finish systems consisting of surface pretreatment (conversion coating), non-chrome primer, and topcoat underwent a full array of laboratory and flight testing on select components of two C-130Hs. From those efforts, five chrome-free finishes worthy of implementation were identified. Now that qualification is complete, the USAF is recommending a single production C-130J be finished on the exterior using one of the chrome-free systems for airworthiness assessment and fleet implementation.

Once fully implemented, this will eliminate the use of hex-chrome epoxy primer from C-130J exterior finish systems, reduce the AF Plant (AFP) 6 EPA and Superfund Amendments and Reauthorization Act reportable hex-chrome by 2000 lbs/year, reduce hazardous material issues with life-cycle/maintenance of aircraft painting, and reduce employee exposure to this extremely hazardous material. Additionally, this will save $10K per year on the production of C-130Js, with a break-even in less than 13 years.

C-130J in the Paint Crib where the new Solvent Borne Non-Chrome Primer is applied, and Primer Reactivation Solvent is used as needed.

Primer Reactivation Solvent Qualified, C-130J

This project qualified three products, two wipes, and one bulk spray and implemented them on the C-130J production line, eliminating the need for scuff sanding. Traditionally cured primer surfaces are scuff-sanded and often require a subsequent tack-coat of chromate epoxy primer (tack priming) to improve adhesion before top coating. The scuff sand operation and tack-coat increase personnel's risk of exposure to particulate matter containing hexavalent chromium and sprayed chromate epoxy primer and generates a large amount of hex-chrome hazardous waste.

This implementation has reduced the risk of employee exposure to a harmful carcinogen and eliminated an estimated 500 lbs of hazardous chromated waste annually while saving $551,933 annually, with a break-even time of 2 months.

Implementation of Non-Chromated Corrosion Inhibiting Sealants

This six-year study was initiated due to pressing European Union (EU) regulations on hex-chrome which could impact production of aircraft components in Europe, operations and maintenance in the European Theater, and sales to European customers. Four different products completed qualification testing showed no degradation in corrosion protection in field testing, and three different non-chromate sealants were implemented for production use in faying surfaces cabin, fuel tank, and dissimilar metal sealing, and wet installation of fasteners for the USAF, U.S. Navy, and FMS customers around the world. These sealants have also been implemented in the sustainment and repair of the USAF C-5 program. This significantly reduces worker exposure to a harmful carcinogen and detrimental impacts to the environment due to hex-chrome waste. It eliminates 13,500 lbs. of chromate waste annually, and for the C-130 production line alone, saves $253,024 per year, with a break-even time of 0.8 years.

Sustainability

Non-Hex Chrome Inner Mold Line Finish Qualification

The C-130J production interior finish system contains high levels of hex-chrome, both in the conversion coating and primer.

This current effort focuses on newly available NCP and non-hex-chrome pretreatment combinations to implement an inner mold line finish stack-up completely free of hex-chrome.

Elimination of hex-chrome from C-130J interior finish systems can reduce over 2100 lbs hex-chrome/year, reduce hazardous material issues with life-cycle/maintenance of aircraft painting, and reduce employee carcinogen exposure.

Interior of a production C-130J with new non-hex chrome finish.

Replacement for Product Containing NMP

The C-130J production line currently uses products to paint the interior of the C-130J that contain N-Methyl pyrrolidone (NMP) solvent. NMP is a high-priority chemical under the EPA's Toxic Substances Control Act (TSCA), resulting in more stringent controls. It has been placed onto the EU's Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH), Substance of Very High Concern list, the Annex XVII list of restricted substances, and classified as toxic to reproduction which may cause damage to fertility or the unborn child. It is also harmful

if exposure occurs by inhalation or contact with the skin or eyes.

Once finalized, this new product will eliminate the use of 760 lbs of NMP annually, significantly reduce employee exposure to this hazardous material, and eliminate necessary precautions to identify and control its presence. It will allow continued production of C-130 components by European partners and will be applied to the maintenance and repair of the C-130, C-5, and U.S. Navy P-3 at European facilities and flight lines.

C-130J Interior with Topcoat
Top Coat Replacement for NMP Products applied to C-130J Inner Mold Line

Alternative Biocidal Dyes for C130J Fuel Tank Coatings

The C-130J production site currently utilizes a biocidal dye when coating the lower surface of C-130 integral (in-wing) fuel tanks. This additive sterilizes microbial colonies that could otherwise damage the fuel tank coating and lead to microbial corrosion, degrading the structural integrity of the aircraft. The dye that is currently utilized is under scrutiny from the EU and future regulation in the U.S. is anticipated. These dyes are extremely toxic to humans, plants, and aquatic fauna and can cause carcinogenesis damage to the kidney and liver. The team tests biocidal dyes to implement a new compliant biocide into the fuel tank coating.

When implemented, the new dyes will maintain EU regulatory compliance while also protecting C-130 fuel tanks against microbial corrosion. This will eliminate 100% of C-130 biocidal dyes banned by the EU Chemical Agency.

Alternative Coatings on C-130J Fuel Tank
Alternative Biocidal Dyes and Non-Chrome Fuel Tank Coating applied to the lower surface of a C-130J integral fuel tank.

Non-Hex Chromium Touch Up Conversion Coating

The C-130J production site currently uses touch-up chromate conversion pretreatments to finish or repair damaged small areas on previously finished surfaces of the C-130J, C-5, and P-3. The use of hex-chrome as a corrosion inhibitor in these conversion coatings has reduced corrosion-driven maintenance and aided in the service life extension of the aircraft. When implemented, the use of non-chromated conversion coatings will reduce approximately 1800 lbs per year of hex-chrome, significantly reducing the risk of worker exposure to a harmful carcinogen and detrimental impacts to the environment due to hex-chrome waste.

Technology Development

Low VOC, Low HAP Cleaning Solvents for Hand Wipe Applications

The C-130J production line currently uses hand wipe solvents to clean various contaminants from surfaces of the aircraft or aircraft components during fabrication and assembly operations. Workers clean with acetone, isopropyl alcohol, or a blended solvent with methyl ethyl ketone or methyl isobutyl ketone. These solvents can contain high amounts of VOC/HAP or have a low

flash point increasing the risk of fire. The team is seeking to qualify nine new viable alternative cleaning solvents to minimize hazardous substances and promote personnel safety.

These new solvents will lower VOCs and flammability and be implemented for use on various substrates. This will reduce the risk of worker exposure to flammable solvents, detrimental environmental impacts, and VOC/HAP emissions by 55% annually, saving $44,752 per year, with a break-even time of 10 months.

Non-Hexavalent Chromium Seal Qualification for the Sulfuric Acid Anodizing Process

The C-130J production line currently uses a dichromate-based or chromic acid seal containing hex-chrome for corrosion resistance and primer adhesion for most aluminum airframe parts. This effort investigates alternative non-hex-chrome sulfuric acid anodize seals.

C-130J Production Line
C-130Js on the Government Owned, Contractor Operated Air Force Plant 6 Production Line in Marietta, GA

Elimination of hex-chrome from the C-130J sulfuric acid anodize process has the potential to reduce hex-chrome and related waste by over 16,000 lbs per year. This elimination can also decrease hazardous material issues with life-cycle/maintenance of aircraft painting, and lessen employee exposure to this extremely hazardous material. Additionally, this will reduce environmental, safety, and health burdens at depots and field service centers.

C-130J Forward Fuselage Section Assembly on the Government Owned, Contractor Operated Air Force Plant 6 Production Line in Marietta, GA

External Coordination of ESOH Risk Management

The C-130J ESOH Team maintains a schedule of actions and milestones required to comply with the National Environmental Policy Act (NEPA) and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*. These publicly coordinated environmental studies include analysis of how C-130Js may impact the local community.

ESOH Integration

The C-130J ESOH Team participates in the intensive C-130 production and sustainment process across the DoD and on behalf of foreign customers to ensure that system users, installations, and training locations understand the system's hazards, risks and have the data they need to support system and NEPA documentation, which is essential in basing and operating decisions, and fundamental to mission accomplishment. ESOH requirements are integrated into SE processes by engaging Integrated Product Teams to plan initiatives, review their statuses, and mitigate potential risks. ESOH criteria are included in Systems Engineering Plans, Life Cycle Sustainment Plans, post-production planning documents, and

demilitarization/disposal planning documents for installation use. The team also provided aircraft maintainers' guidance on ESOH hazards and mitigation practices.

ESOH Risk Management

The C-130J ESOH Team applies the methodology in Military Standard 882E, *Department of Defense Standard Practice System Safety*, to identify hazards, evaluate risks, develop corrective actions, and track corrective action status. At least annually, risk management updates are coordinated with C-130J Program stakeholders via the C-130J Program ESOH Working Group and System Safety Group.

As part of the ESOH risk management for FMS customers, the C-130J ESOH Team performs a detailed gap analysis comparing U.S. ESOH laws and regulations to equivalent international requirements. U.S. regulations govern C-130J development and production, and these analyses identify gaps or differing international requirements to ensure any ESOH risks are mitigated before C-130J international operations and maintenance are impacted.

Additional Stakeholder Coordination

The ESOH Team developed training for ESOH and Programmatic Risk management and mitigation with hands-on practical exercises. They sponsored and created content for three Air Force Institute of Technology acquisition ESOH classes, offering intensive level ESOH courses available DoD-wide to the U.S. Military personnel, civil servants, and their support contractors. Additionally, they created and taught an ESOH and pollution prevention course specifically for Air Force Program Managers. They've taught four ESOH, NEPA, and Hazardous Material management courses targeted to system acquisition for AFLCMC personnel. Finally, the team briefs these projects, results, and lessons learned at industry conferences, DoD symposia, and USAF IPTs and working groups.