ESOH Requirements for UAVs

Boeing – St. Louis
Integrated Defense Systems

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Report Documentation Page

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UAVs

- Unmanned Air Vehicles
  - Used for Surveillance Missions

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Scan Eagle Launch

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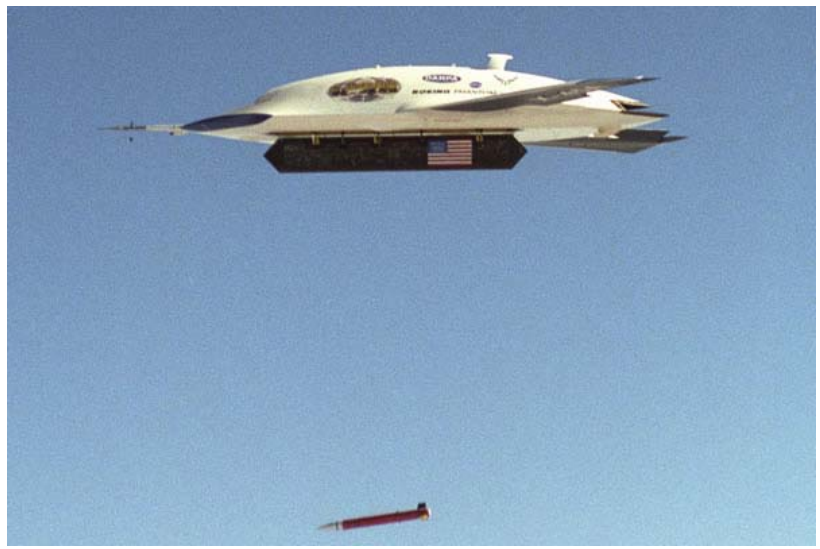
UCAVs

- Unmanned Combat Air Vehicles
  - Used for Strategic Bombing



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X-45 UCAVs

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ESOH Requirements for UAVs

- Environment, Safety and Occupational Health (ESOH) Requirements
  - UAV Proposals Meet All Federal, State and Local Regulations Regarding Hazardous Material Usage
    - Thoroughly Reviewed by Boeing
  - Contracts Are Modified and Updated to Reflect the Latest Regulations
    - Boeing Complies with All ESOH Requirements

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Chromium and Cadmium Usage on UAVs

- Performance Specifications, System Specifications, Statement of Work for UAVs Do Not Restrict or Prohibit the Use of Cadmium or Chromium
  - Cadmium and Chromium Elimination is Not a Customer Requirement
  - However, Cadmium and Chromium Alternatives Are Used Because of Performance Issues
    - Titanium Landing Gear – *Increased Durability*
    - Stainless Steel Fasteners – *Corrosion Resistance*
    - Composite Structure – *Enhanced Performance*

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Nickel and Cr^{+6} Metal Finishing Processes on UAVs

- Nickel Alternatives Are Not Considered Because They Do Not Exist
  - Cobalt Alternatives Are More Toxic Than Nickel
    - EPA and OSHA Will Increase Regulation When Usage Increases
- Cr^{+6} Alternative Processes for Aluminum Are Not Considered Because They Do Not Exist
  - Aluminum Conversion Coating
    - Current Alternatives Do Not Meet MIL-DTL-81706 Corrosion Resistance Requirement on 2024 Aluminum
      - TCP Qualification in Work
  - Anodize Seal
    - Low Chrome Seal - <u>CONTAINS Cr^{+6}</u>
    - No Seal
      - Does Not Meet MIL-A-8625 Salt Spray Requirements
  - Chromic Acid Anodize
    - Still Needed for Parts with Entrapment

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UAV Design Objectives

- Majority of Engineering Effort Is Spent on Meeting UAV System Performance Requirements
  - Speed, Altitude, Flight Time, Weight, Performance, Payload, etc.
    - Elimination of Cadmium and Chromium is Not a Priority Item
  - Need to Meet Cost and Schedule Targets
    - High Risk Options Such As Cadmium and Chromium Alternatives Impact Cost and Schedule

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“Green” UAVs

- DoD Customers Need to Be Willing to Invest In “Green” UAVs
  - UAV System Requirements Should Prohibit Cadmium and Chromium (and Nickel and Cr^{+6} Metal Finishing)
    - Need to Eliminate Cadmium and Chromium from Initial Design Phase
    - Customer Needs to Be Willing to Pay Extra and Accept a Delayed Schedule for First Flight
      - Reduce or Modify Requirements
  - Work with OEMs to Build a “Green” UAV

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Is Technology Available to Build a "Green" UAV?

- Before Customer Requires a "Green" UAV
  - Make Sure Technology is Available
    - Chrome Plate Replacements?
      - Need Hard Wear Resistant Coatings
        - » ID and OD Applications
    - Cadmium Plate Replacements?
      - Need Sacrificial Coatings That Protect Steel and Are Compatible with Aluminum
    - Can Replacements Contain Nickel, Cobalt, Cr^{+3}, or Cr^{0} (HVOF Coating WC-Co-Cr)?

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Remaining Needs

- Cadmium Plating Replacements
  - Prefer a Non-Embrittling Process
  - Or Need Embrittlement Test Results < 24 Hours
  - Need to Coat Both ID and OD Surfaces
- Chrome Plate Replacements
  - HVOF with Better Adhesion (No Spalling)
  - Non-HVOF Processes (Plating Bath or PVD)
  - Need to Coat Both ID and OD Surfaces
- Non Cr^{+6} Processes Needed to Work with Non-Cr Primers
  - Use a Coating Systems Approach
- Implementation Issues for Alternatives Exist

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Scan Eagle UAV Participating in the UK Ministry of Defence's Trial Vigilant Viper off the Coast of Scotland

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