# UV-Curable Powder Coatings for Military Applications

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# Outline

- UV-Curable Powder Coatings Overview
- Robotics as an aid to Curing
- Current Status of ESTCP Project WP-0801
- Future UVCPC efforts

# UV-Curable Powder Overview

- Previous ways of thinking about powder
  - Coating cure temperatures – typically above 428°F
  - Prohibitive for use on tempered metals (Al, Mg, Ti)
  - Prohibitive to use on composites
  - Powder coatings were designed as barrier protection

# UV-Curable Powder Overview

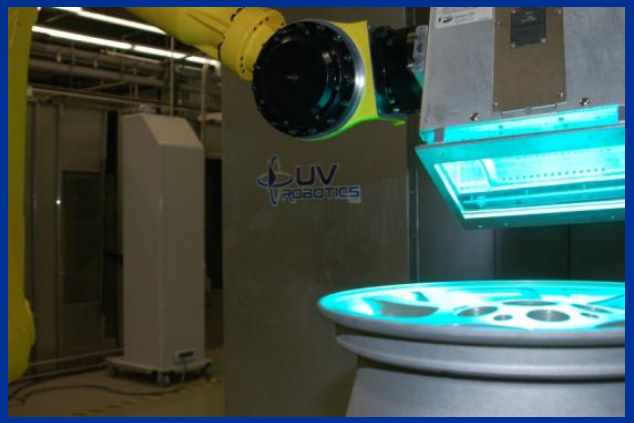
- Modern powder coatings can be formulated to have:
  - Lower melt & flow temperatures (< 225°F)
  - UV or EB cure functionality can be added
  - Various advanced non-chrome corrosion inhibitors

# UV-Curable Powder Overview

- Advantages of UV-cure powder coating:
  - Elimination of volatile organics (VOC)
  - Elimination of hazardous air pollutants (HAP)
  - Reduction/elimination of hazardous waste
  - Transfer efficiencies as high as 95% (w/reclaim)
  - Decrease in thermal exposure.
  - Large bulky parts that cannot fit into existing ovens can be coated and cured.
  - UV-cure powder requires less energy because the energy is focused to a specific part only as long as needed.

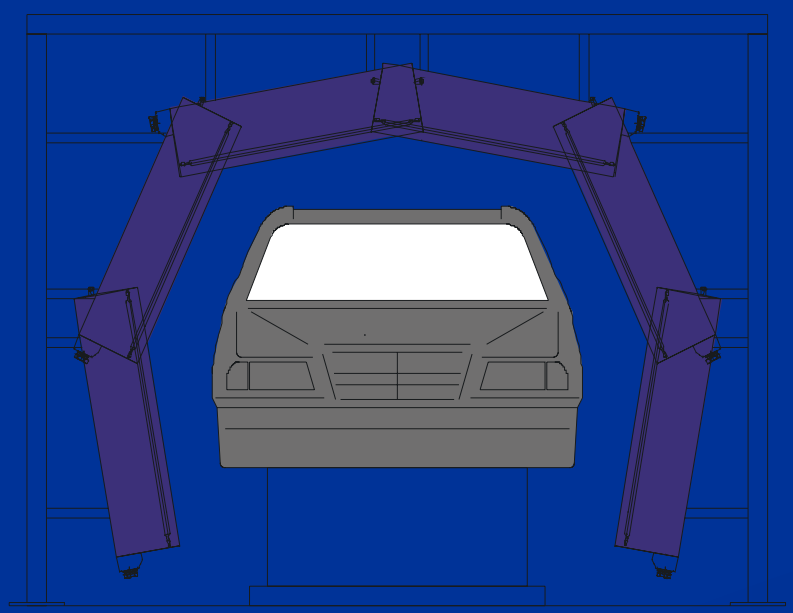
# Robotics as an Aid to Curing

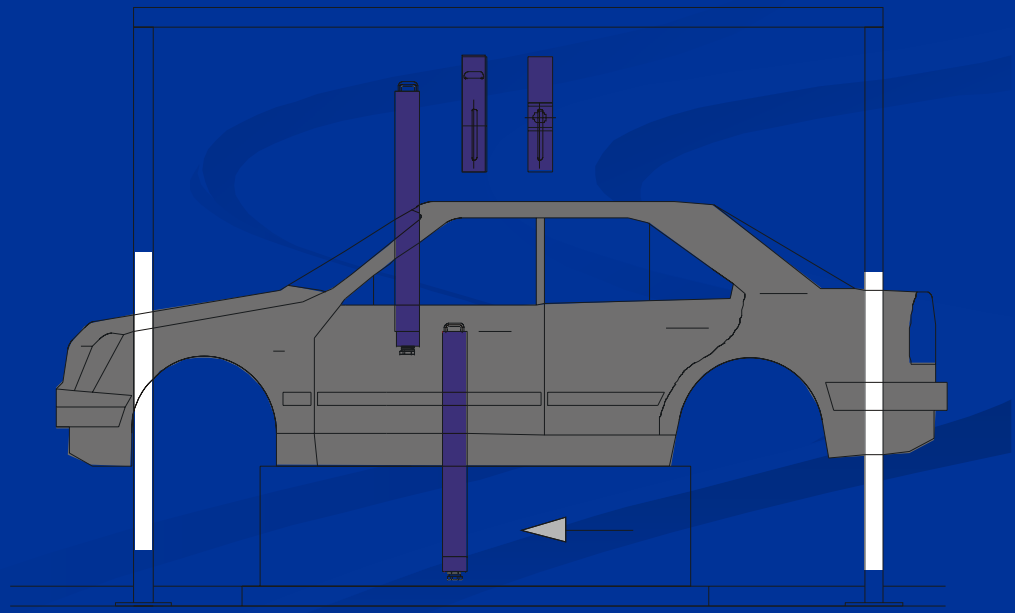
- Why Use Robots?




# Robotics as an Aid to Curing

- Light tunnel approach using various size UV lamps to optimize cost and exposure





# Robotics as an Aid to Curing

- Drawbacks of fixed lamp approach
  - High Capital Costs
    - Lamps, cooling, fixtures, integration
  - High Operating Costs
    - Replacement parts
    - Energy
    - Downtime
  - Technical Adequacy
    - Complete cure
    - Proper Re-alignment
    - Mixed product

# Robotics as an Aid to Curing

- Advantages of Robotic Curing
  - Robots ensure repeatability
  - Robots with UV sources can maintain extremely close target distances
  - Robots can be re-programmed in seconds
  - Robotic curing is well suited to large or complex parts
  - Robots eliminate need for many lights

# Current Status of ESTCP Project WP-0801

- The Problem:
  - DoD spends millions of dollars annually on solvent-based coatings
  - Hexavalent chrome primer use still very widespread
  - Contains or requires volatile solvent use
  - Significant hazardous waste costs
  - Hazardous materials pose risks to human health and environment
  - Process times measured in hours to days
  - Transfer rates are less than 60%

# Current Status of ESTCP Project WP-0801

- The WP-0801 Objectives are:
  - Demonstrate a VOC/HAP-free, Ultraviolet cure powder coating (UVCPC) on DoD hardware
  - Demonstrate state-of-the-art robotics for curing

# Current Status of ESTCP Project WP-0801

- Requirements of a UVCPC for military use:
  - Must perform at least as well as MIL-PRF-23377 primer
  - Must also perform as well as MIL-PRF-85285 topcoat
  - Can be prepared in gloss, semi-gloss, and flat finishes

# Current Status of ESTCP Project WP-0801

- Planned demonstration weapon systems:


EA-6B wheels, landing gear

HH-65 helicopter

P-3 wheels, landing gear, radomes

Mk-48 ADCAP torpedo


HC-130 main landing gear doors

KC-135 wing flap, refueling boom

# Current Status of ESTCP Project WP-0801

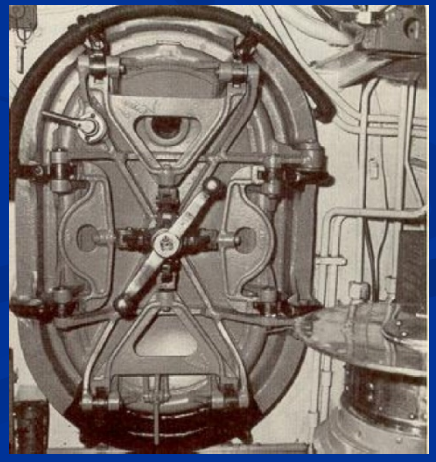
- Planned demonstration weapon systems (cont.):

Submarine icecaps

EA-18G wheels, landing gear

Ammunition and storage cases

Submarine communication buoys



Submarine interior components

# Current Status of ESTCP Project WP-0801

- Powders:
  - Currently considering two vendors
  - Two colors, gloss white, semi-gloss gray
  - All will undergo strict validation testing at CTIO
- Robotics system:
  - Robot carries the IR and Hg vapor UV lamps
  - Evaluation of alternative UV sources continue
  - Evaluation of alternative application methods continue

# Current Status of ESTCP Project WP-0801

- Major Program Milestones:
  - Joint Test Protocol submitted Sept 2008
  - Robot acquired and integration underway
  - Component identification complete
  - Powder and substrates order Jan 2009
  - Validation testing starts Feb 2009
  - Draft Demonstration Plan June 2009
  - Field Service/Demonstration begins Mar 2010
  - Joint Test Report draft Sept 2010
  - Final Report Mar 2012

# Current Status of ESTCP Project WP-0801

Demonstration on composite Navy part
30 June 2009

# Future UVCPC Efforts

- Future follow on efforts include large marine applications

# Future UVCPC Efforts

- Future efforts in alternative UV light sources


High Energy UV LEDs

Pulsed Xenon lamps

# Thank You!

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