

## Chemical Agent Resistant Coatings Status Update

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**DOD CARC Commodity Manager**

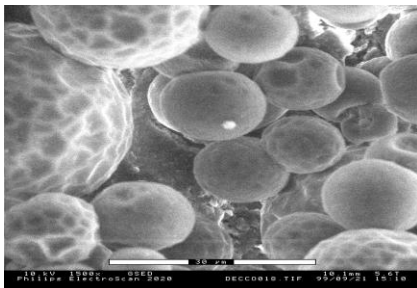
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Courtesy of U.S. DoD



# Report Documentation Page

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- **Who we are & What we do.....**
- **Key areas of Interest and efforts**
  - ❖ **Topcoats, Primers, Pretreatments and Munitions**
- **Water Dispersible & Solvent Based Chemical Agent Resistant Coatings (WD-CARC & Moisture Cure CARC)**
- **Next Generation of Coatings**

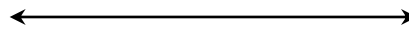


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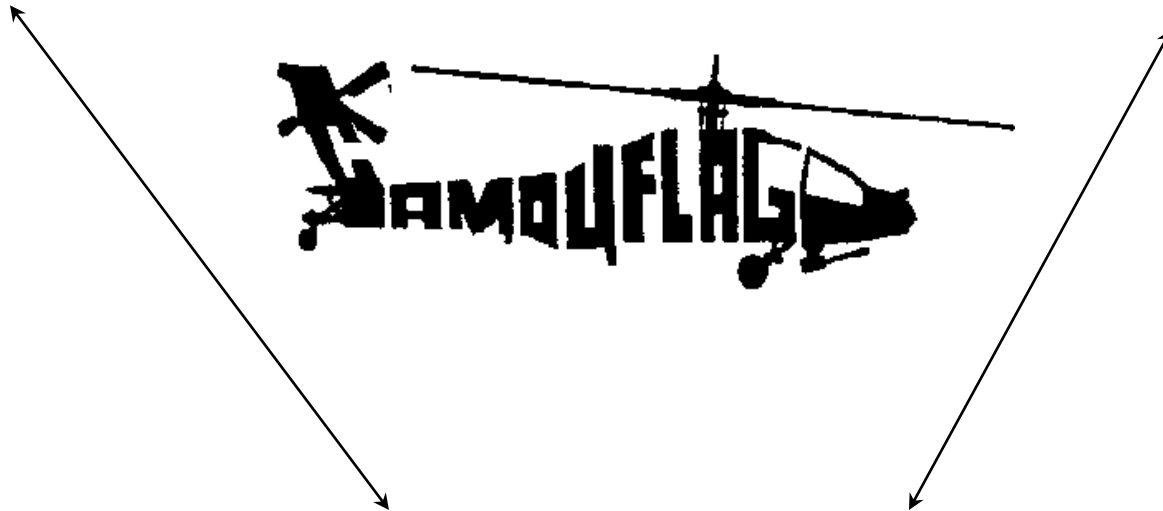


- ARL is the Lead DOD R&D Activity for CARC
  - Innovative formulations approaches
  - New raw materials selections
  - Advanced characterization
- Maintains Ownership for all key specifications regarding pretreatments, primers and topcoats for all tactical and related support equipment and munitions coating
- ❖ Elements assist to implement and transition products

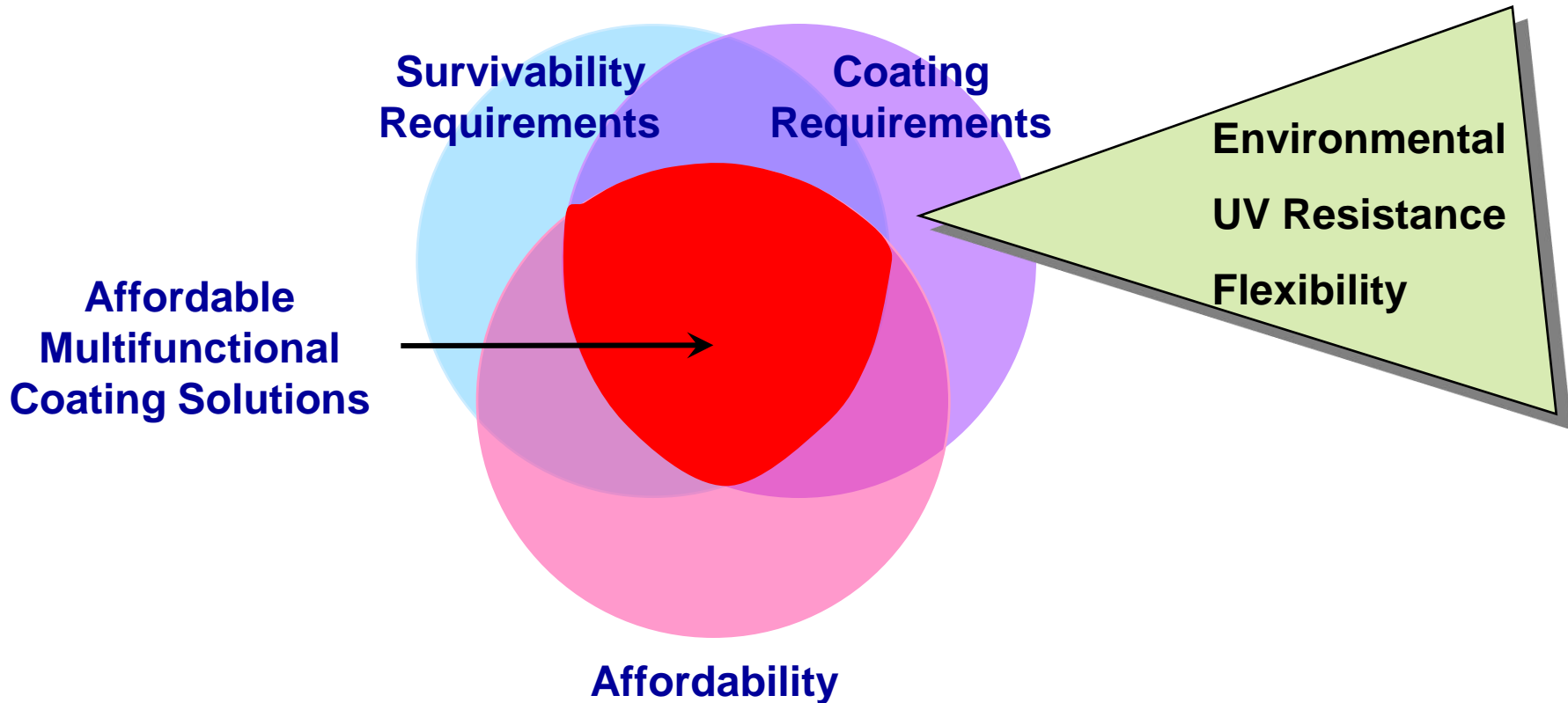
Environmental



Survivability



Durability



***New coatings formulations  
More Survivable and Durable Platforms***

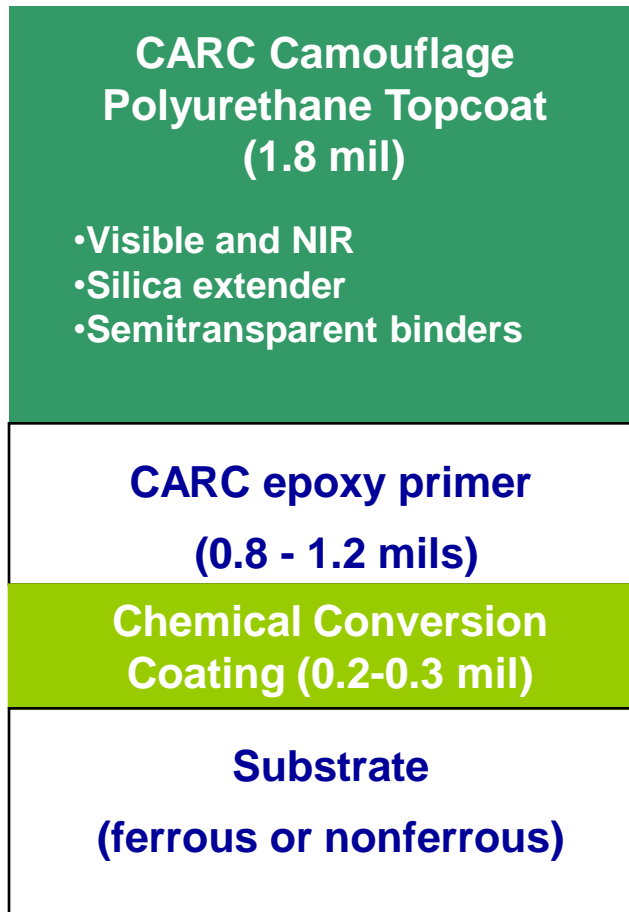


- Develop materials for military unique coatings including pretreatments, primers, and topcoats
  - Chemical Agent Resistant Coatings
  - Munitions coatings
  - Industrial coatings for vehicle interiors
- Produce materials that balance three critical requirements
  - Survivability (camouflage, chemical agent resistance)
  - Durability (appearance, corrosion, compatibility, etc.)
  - Environmental compliance and pollution prevention
- Implement and transition new products
  - Specifications and Standards
  - Troubleshooting, consulting, and problem solving
- Analyze and solve technical problems related to coatings systems used on Army Materiel

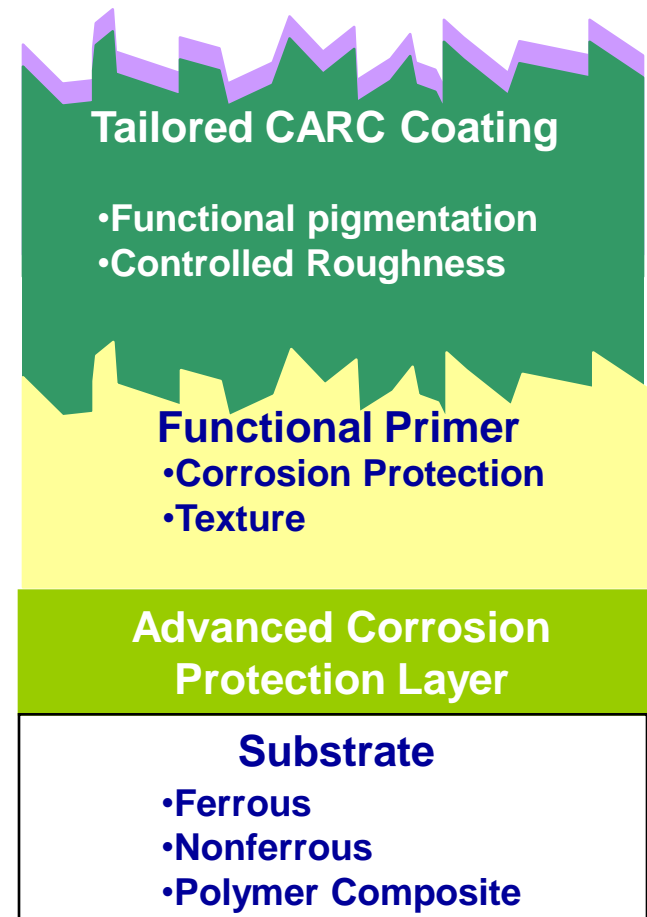
- ❖ Recent Coatings represent superior durability, environmental compliance
- ❖ Stereotypes associated with Emulsions, Water Based or Hexavalent Chromium Free chemistries no longer hold true
- ❖ Current efforts establishes solid foundation for present and future survivability enhancements and multifunctional capabilities
- ❖ ARL has eliminated standard coatings used and are implementing a new generation of coating technology throughout DOD



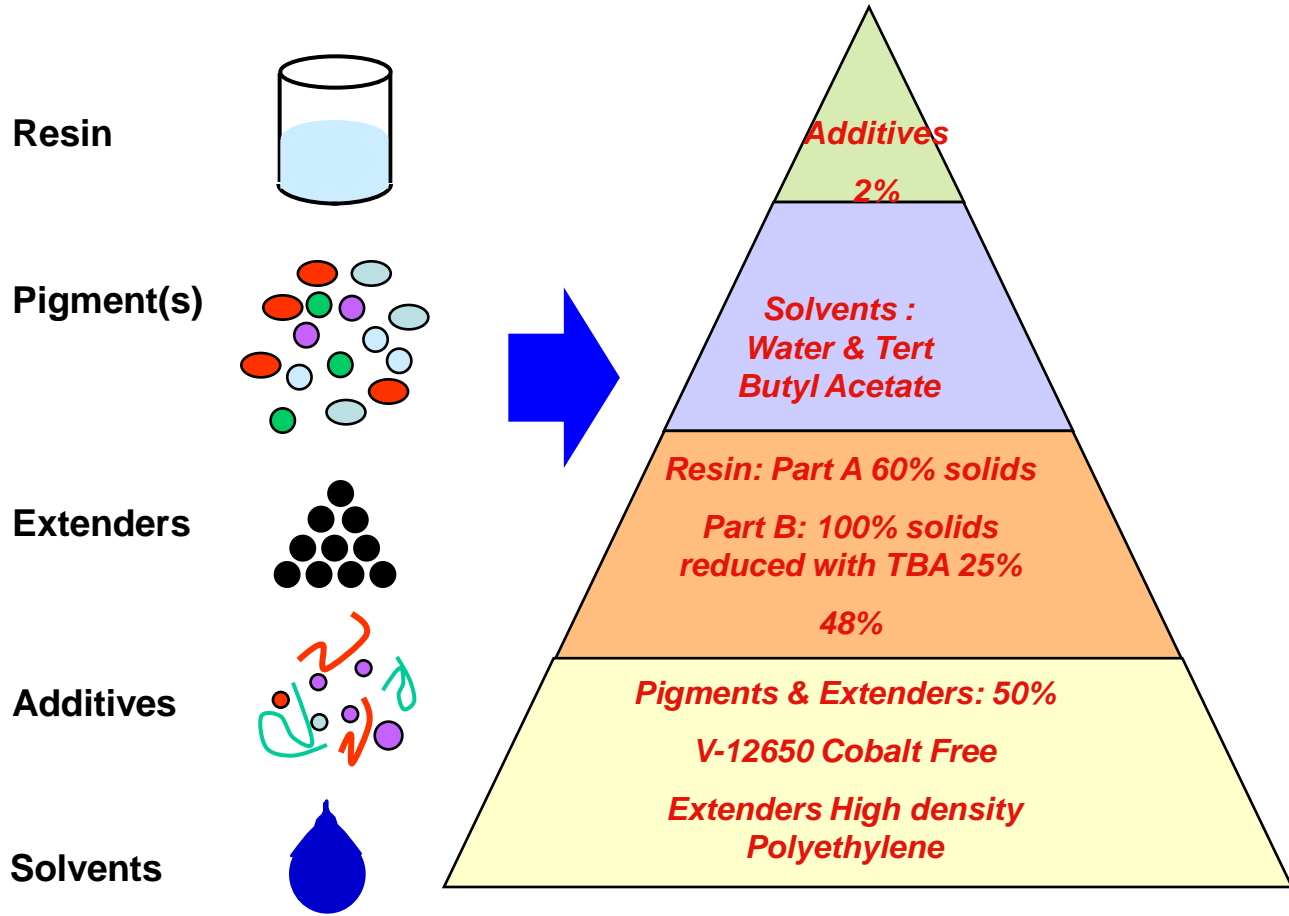
### Today



### Tomorrow



## Individual Coating Components



- ✓ Hexavalent Chrome Free Pre-Treatments
- ✓ Zinc Phosphate Alternatives for Ferrous
- ✓ Low Solar Absorbing and Insulative
- ✓ Reactive or self decontaminating
  - Super hydrophobic & oleophobic coatings
  - UV cured coatings
  - Powder coat ( Primer and Topcoat)
  - Anti-skid CARC
  - High Temperature Resistant
    - Intumescent types



# Cr6+ Free Pretreatment for DoD Applications



- Mandated for all tactical and support platforms
- Free of hexavalent chromium (Cr 6+)
- No volatile HAPs
- Ease of application using existing infrastructure
- Equal or better corrosion performance to current Cr 6+ wash primers
- Broad substrate/topcoat compatibility
- Cost effective

## Multi-Substrates:

- Steel 1010, 1008
- Galvanized steel
- Stainless steel
- Al 2000/5000/6000/7000 series
- Ceramic/Composite
  
- **Coating:** must be compatible with existing military topcoats and primers
  - Three vendors have responded with products
  - SERDP effort with PPG & ARL for Zinc Phosphate Alternative
  
- **Process:** Depot and Repair

- 2 year weathering excellent: Less than 1 color unit change
- Formulated four Primary Colors
- IR requirements will shift from 380nm -900nm to 380nm-2000nm with emphasis on 750nm to 1700nm.
- Visible unchanged
- Key highlight: COST, cobalt spinal increase of 300% and availability erratic
- Formulation will be cobalt free for 383 Green, AC Green, 383 Brown
- 383 Green to change to 808 Green to identify change
- Open to other approaches\*



### Purpose

- Provide capability for new or existing coatings to improve munitions response to IM (Insensitive Munitions) threats

### Result

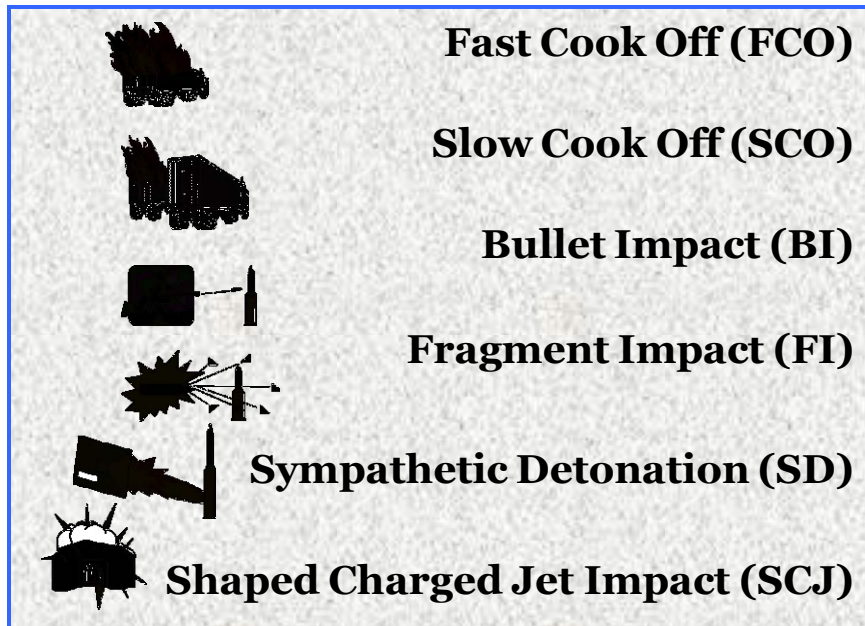
- Coating formulation and technologies for IM design
- Demonstration of integrated technologies for improved IM behavior in packaging and missiles.

### Payoff

- Improved tactical and combat system survivability
- Reduced transportation and storage burden
- Transition technologies

## OBJECTIVE:

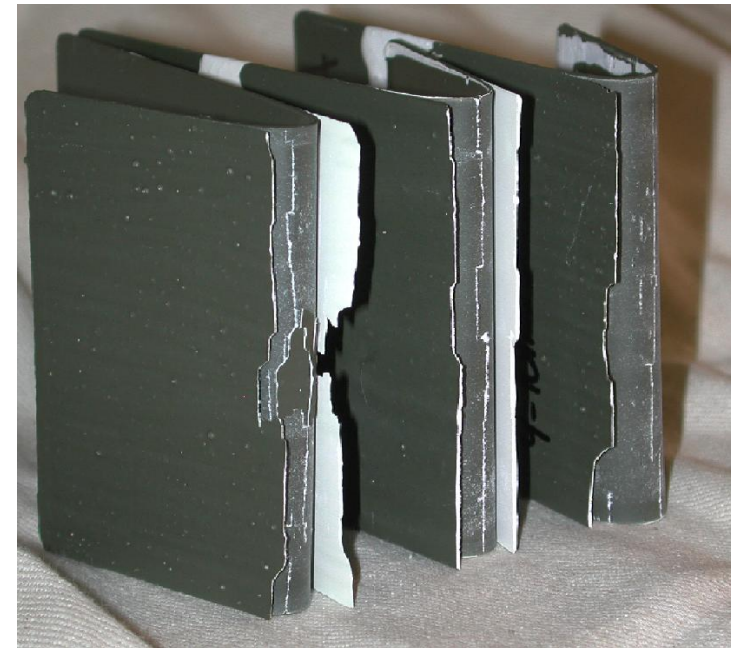
- Develop coatings with improved thermal protection
- Demonstrate coatings to enable a controlled burn and prevent violent reaction



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## Technical Challenge

- Paint delamination
  - ◆ Cracking and chipping
  
  - ◆ Rough Handling – esp. at extreme temp
  
- Impact resistant
  
- Flexibility
  
- Moisture resistance
  
- Material compatibility
  
- Cost



## Technical Thrusts

Coating Development- all munitions that require thermal control

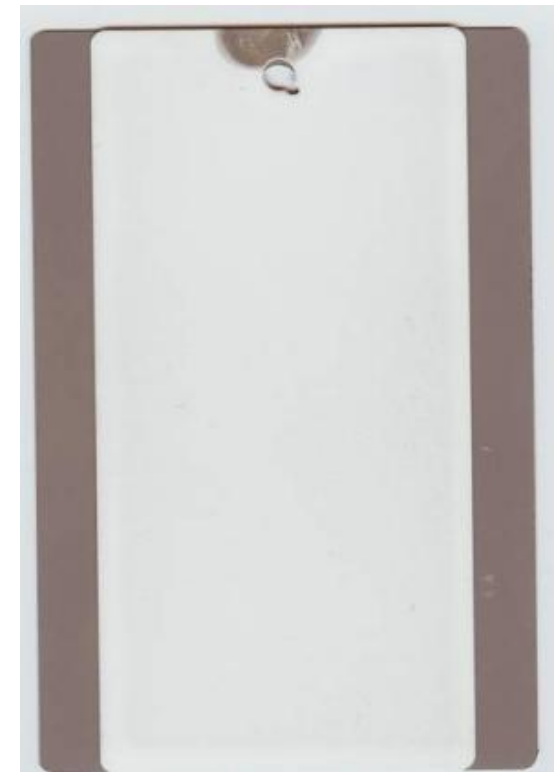
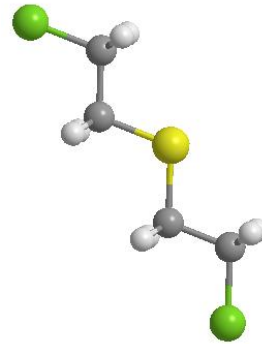
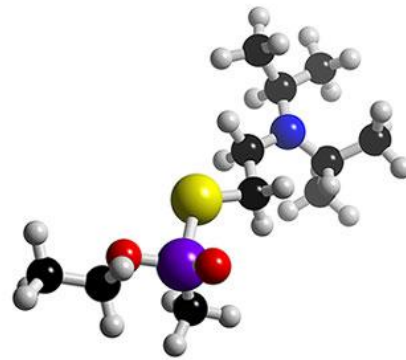
## IM Performance

- Mechanical properties (-65 to 165°F)
- Blast protection
- Thermal protection

≡ **Survivability**  
≡ **Readiness**







First Generation Coatings

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



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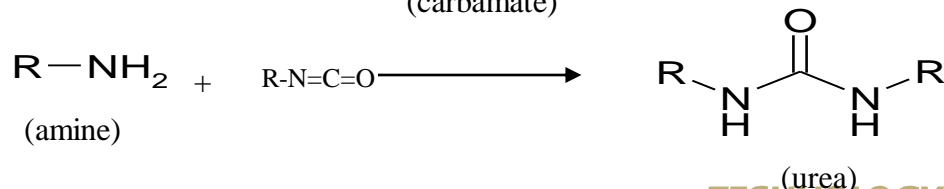
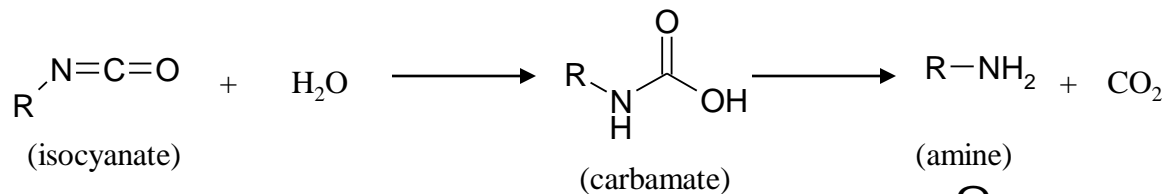
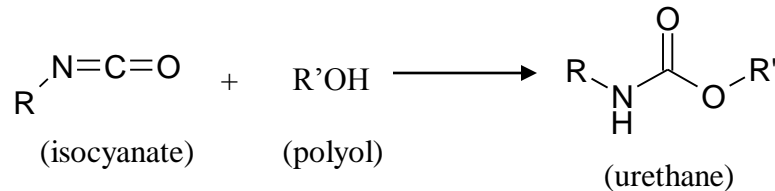
James Wynne



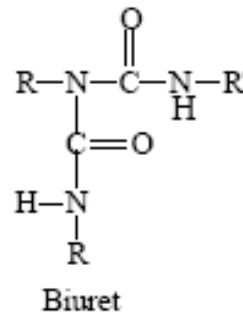
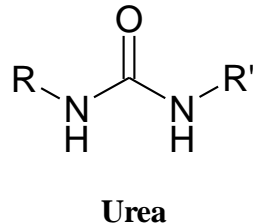
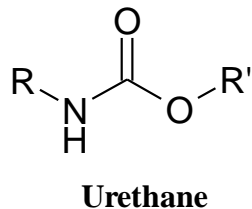
David McGarvey



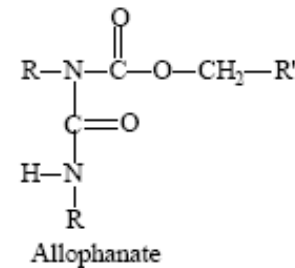
- **New Polyols**
  - Completely water soluble, no co-solvents needed
- **Tert-butyl acetate (VOC exempt) to dissolve and disperse isocyanate**
- **Attempt to reduce NCO:OH indexing to reduce solvent content**



- Unacceptable CAR at NCO:OH < 4
- NMR and FTIR to measure quantify ratio of side products vs. NCO:OH ratio
- Adjust additives, reaction conditions, etc.
  - to make more favorable distribution

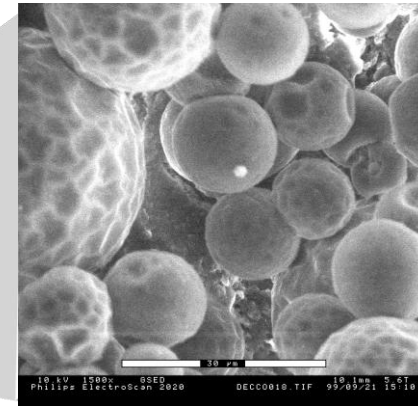
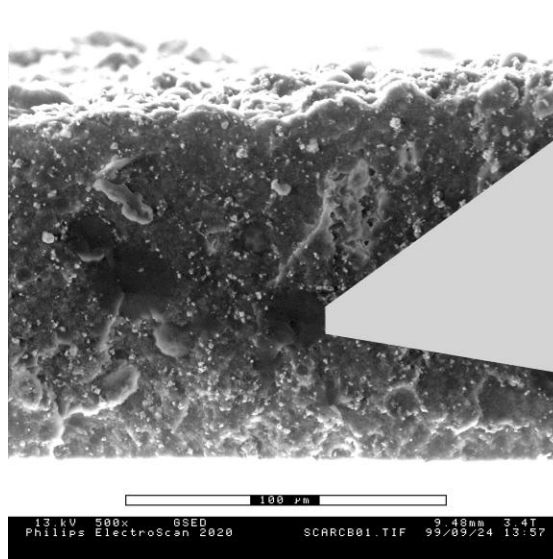


(Urea +  
isocyanate)



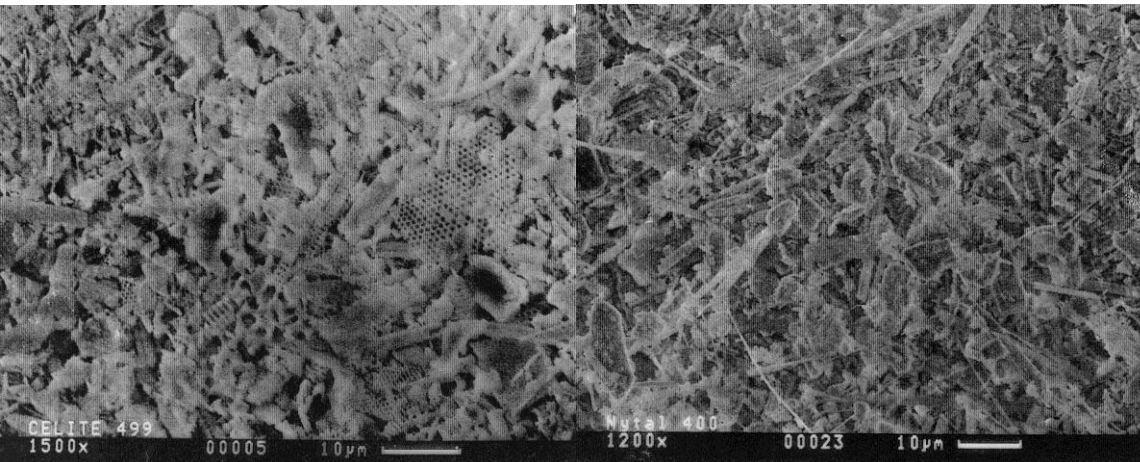
(Urethane  
+  
isocyanate)

Polymeric beads



- Integrated within Film

- **Polymeric beads**
  - Reduce chalking effect
  - Improve UV resistance
  - Improve performance



Diatomaceous silica

Talc

- Development and implementation of Water-Dispersible and Moisture Cure CARC System— affects 3 million gallons of paint annually
  - 2.3 Million Topcoat & approximately 1 million in Primers
  - New Generation CARC topcoat: enhanced flexibility and UV resistance.
  - Elimination of Hazardous Air Pollutants from existing primers
- Low Solar loading pigmentation development
  - Reduce temperature build up on military assets
  - Prolong service life of coating
  - Enhance camouflage capabilities

- New types to include 1.0, .5 and zero VOC (Lbs/gal) with zero HAPs flattened with non-silica based raw materials.
- Inclusion of 34201 color ( Woodland Desert Sage) . Currently used on CH-47
- Elimination of reference to MIL-T-81772 Aircraft Thinner ( 100% VOCs)
- Allowing vendors to provide exempt solvent package

## ❖ Touch up Kits –QPL Specifications as TYPE III- Self Contained Kits

- ❖ Aerosol
- ❖ Roller
- ❖ Brush
- ❖ Cartridge



VENDORS: Hentzen Coatings

MILSPRAY/Spectrum

Sherwin Williams





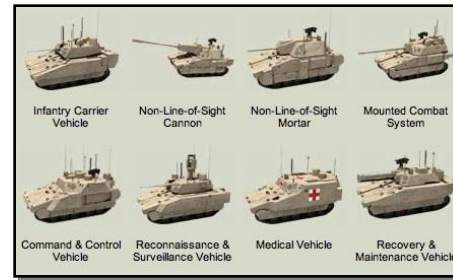


## Aluminum Alloy 5059 For Armor Applications Foreign Comparative Test Program

- Updated military Al armor specification MIL-DTL-46027K
- Over \$14M to date in acquisition
  - \$12M+ in direct procurement of AA5059 for RG-33 MRAP
  - Over \$1.1M of acquisition by OEMs for internal testing, design, and prototyping
  - AA5059-H131 chosen as primary (100%) common hull material for all 8 variants of the PM FCS-BCT Manned Ground Vehicle (MGV) by Boeing (LSI), General Dynamics, and BAE Systems



MRAP RG-33



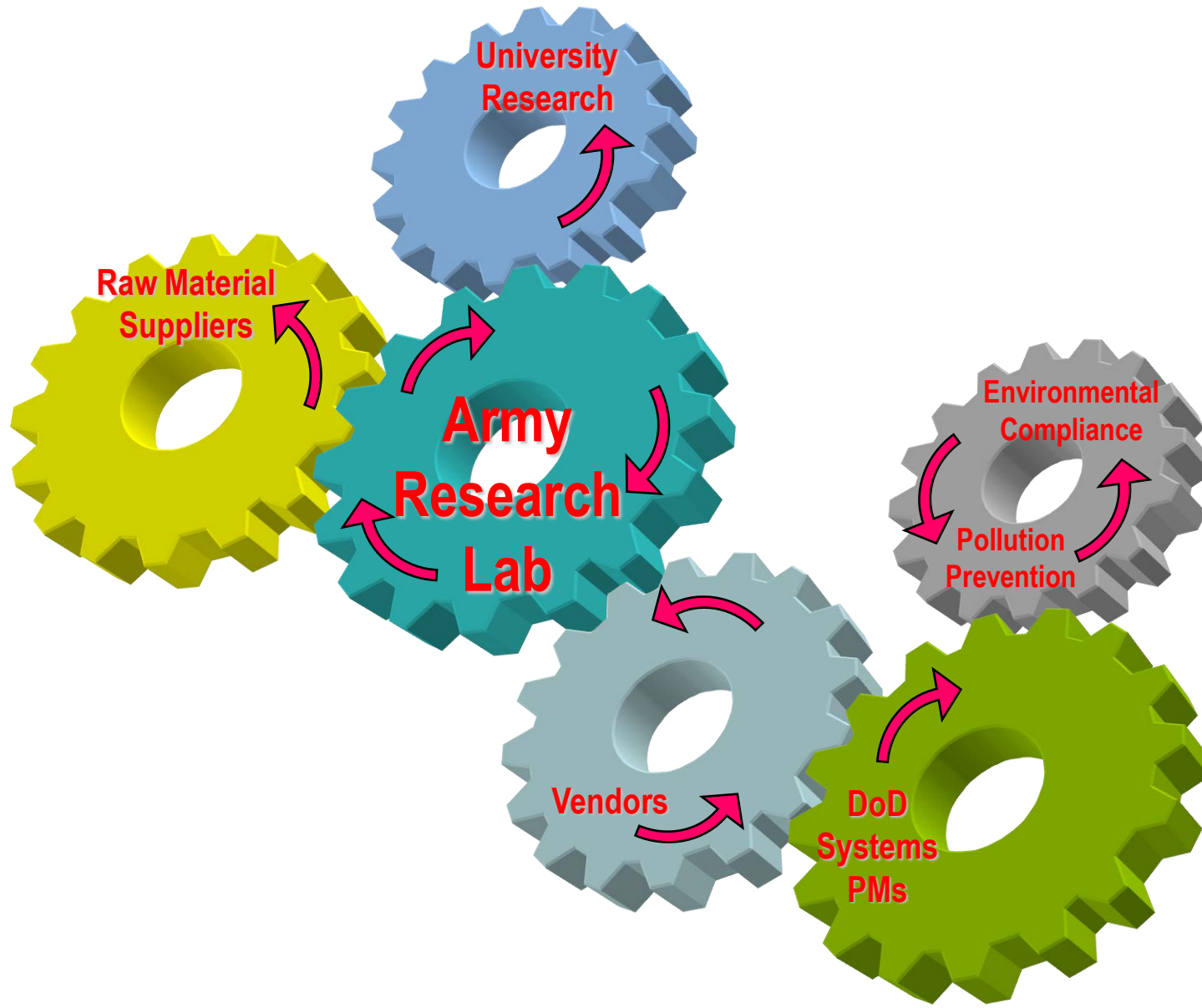
(8) MGV Mission Based Variants



- Related work - military specification MIL-DTL-32262 created for 6061 Al



# Synergistic Interaction for Maximum Impact



- **Survivability**

- **Topcoat Agent & Bio Resistant**

- **Passive: completely inert**

- **Active: self-decontaminating**

- **Appearance**

- **Functional pigmentation and extenders**

- **Controlled surface morphology**

- **Durability**

- **UV resistant**

- **Enhanced Corrosion resistant**

- **Environmental Compliance**

- **Water Dispersible resins/Low VOCs**

- **Elimination of Hazardous Air Pollutants**

- **Polymeric Flattening agents used for all topcoats**

