

# ***Air Force Petroleum Agency***

---

*Integrity - Service - Excellence*



**U.S. AIR FORCE**



***Military Specification Updates &  
Deicing Working Group Initiatives***

***Michael Sanders***

***AFPA / PTPT***

***Air Force Corrosion Conference***

***August 18, 2011***

---



**U.S. AIR FORCE**

# ***Military Specification Updates***



- **MIL-PRF-27617 – Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant.**
  - **Coordination closed August 6, 2011**
  - **Workmanship requirement has been added**
  - **Type V Grease is now required to pass Liquid Oxygen Impact testing**
- **MIL-PRF-25681 – Lubricant Molybdenum Disulfide, Silicone**
  - **Comments close 29 August 2011**
  - **Modernized for Toxicity, MSDS, and Shelf-Life clauses**
- **MIL-PRF-83261 – Grease, Aircraft, Extreme Pressure, Anti-Wear**
  - **Modernized for Toxicity, MSDS, and Shelf-Life clauses**
- **MIL-PRF-25017**
  - **Wording changed from “Inhibitor” to “Additive” for clarification**
  - **Removed A-A-52557, as Diesel is procured to ASTM D975**



**U.S. AIR FORCE**

## ***Revision to MIL-PRF-32014***



- It is expected that MIL-PRF-32014 will be revised later in 2011.
- Proposed changes:
  - Change the corrosion prevention requirement to a more suitable test method.
    - Currently in the spec: ASTM D5969 using 5% synthetic sea water
    - Most grease samples are currently failing this requirement. No corrosion reports have been received from the field (AF/Navy).
    - While AFRL/MLBT was the MIL-PRF-32014 Preparer, they considered other more suitable alternatives such as the Corrosion Rate Evaluation Procedure (CREP) but it was never formally proposed.
    - Being proposed: ASTM D6138 Emcor Rust Test using 3% synthetic sea water
      - D6138 takes longer to run (7 days vs. 1 day), combines standing and dynamic testing; more accepted test method for greases in industry than D5969
  - Address other issues, such as the temperature at which ASTM D5706 (SRV Extreme Pressure) should be run at. It is 80°C.



**U.S. AIR FORCE**

## ***Revision to MIL-PRF-87937***



- It is proposed to revise MIL-PRF-87937 in the next year or so.
- Proposed changes
  - Increase the qualification lifetime from 3 to 5 years
  - Remove Type II cleaning compounds. AFTT decided to phase out Type II compounds while AFPET was at San Antonio TX.
    - Type II compounds were considered as dilute Type IV compounds so it was decided to eliminate from the specification
    - Currently there are no qualified Type II compounds
  - A non-terpene containing Type I (designated as either Type Ib or Type V) has been considered
- Input has been/is requested from AF to ensure that all materials and requirements (including environmental) addressed by MIL-PRF-87937 are properly addressed.



**U.S. AIR FORCE**

# *Environmentally Benign & Reduced Corrosion Runway Deicing Fluid*



Partnership with Battelle Memorial Institute (lead agency), AFRL/ ASC, Army (CRREL), Navy (NAVAIR), Octagon, AMIL (University of Quebec)  
Developed & evaluated novel chemistry to formulate RDF from inexpensive, bio-based raw materials

- Identified 2-3 runway formulations
- Transesterification of vegetable oils & other fats (Company proprietary polyol(s) & salts)

Performed Demonstration /Validation in Winter 2009-2010

- Performed Comparably to Hazardous Potassium Acetate
- Is environmentally benign
- Reduces / eliminates hazardous potassium acetate
- Reduce corrosion of Cd-plated parts & carbon brakes

Reduced cost RDF discharge/treatment by 50%



Crude  
Material

Refined  
RDF

**Received 2008 Top 100 Inventions Award from R & D Magazine**



U.S. AIR FORCE

# Novel Aircraft Anti-Ice Coating Material – Seashell Technology



## Objective:

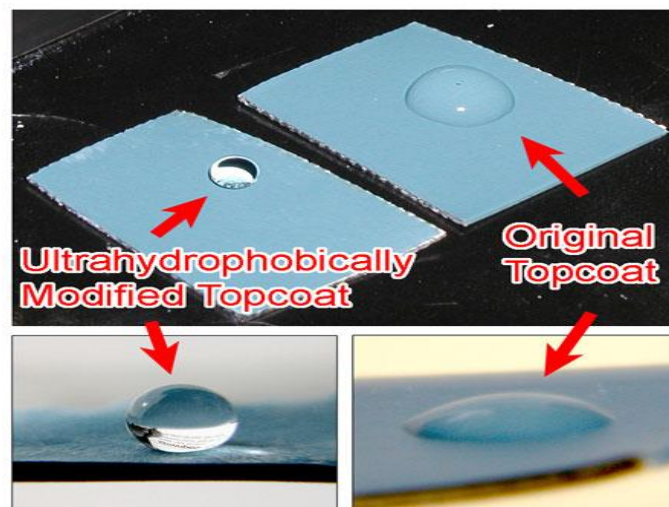
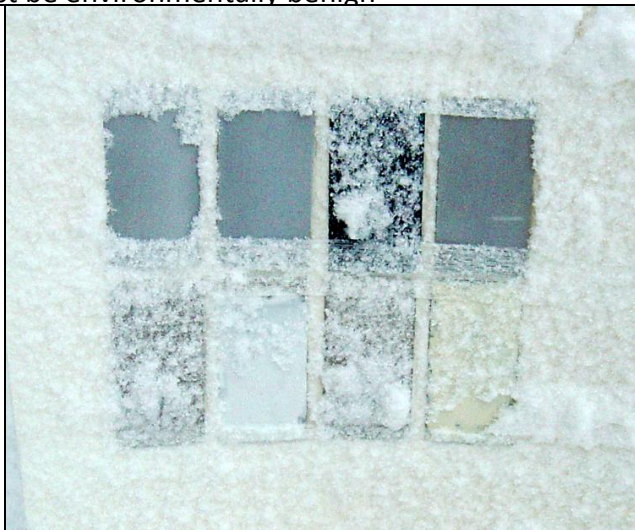
- Creation and testing of novel nanocomposite coatings that minimize both ice accretion and adherence to military topcoat surfaces
  - Approach uses ultrahydrophobic additives in coatings and be compatible with existing A/C topcoats (MIL-PRF-85285)
- Demonstrate effectiveness of novel ultrahydrophobic coating formulation for icephobic activity in collaboration with industrial partner (The Goodrich Corporation)
- Must not alter existing A/C topcoat/coating system properties (i.e. optical props, color, surface smoothness)
- Must be environmentally benign

## Benefits/Impacts:

- Reduce aircraft surface ice accretion and adhesion due to the “Lotus effect”
- Compatible with MIL-PRF-85285 topcoat
- Does not increase drag.
- Does not add substantial weight and easily removed.
- Does not alter paint colors or alter optical properties.
- Is cleanable and repairable.
- Environmentally friendly – reduces need for propylene glycol & other hazardous solvents.

**Customer:** ALCs, all weapons systems

**USAF POC:** Dr. Elizabeth Berman





U.S. AIR FORCE

# Ice-Phobic Clearcoat to Improve Aircraft and Pilot Safety – ePaint



## Objective:

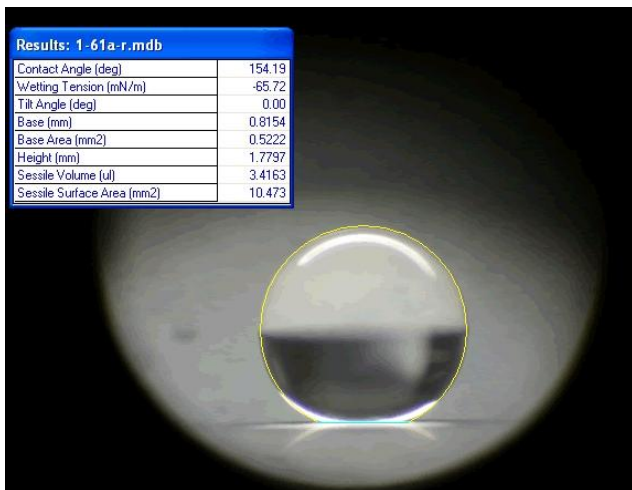
- Develop a novel icephobic topcoat for inhibiting the attachment of ice
  - The system is compatible with current military topcoats (MIL-PRF-85285), and currently used military aircraft colors and optical properties.
- Develop Phase Change Material (PCMs) encapsulated within a thin, flexible, hydrophobic polymer topcoat.
- Formulate PCMs into no-VOC resins for anti-icing application.
- Determine anti-ice and ice adhesion characteristics of test coatings and determine optical transparency of clearcoat.

## Benefits/Impacts:

- Reduce current untreated aircraft surface ice formation
- Be easily strippable and be a clear coat
- Elimination of potential runoff from environmentally harmful deicing operations
- Reduction in overall fluid use by 90%
- Elimination of costs associated with capturing runoff
  - \$10K - \$200K per location (varies depending on local wastewater discharge limitations)

**Customer:** ALCs, all weapons systems

**USAF POC:** Dr. Elizabeth S. Berman



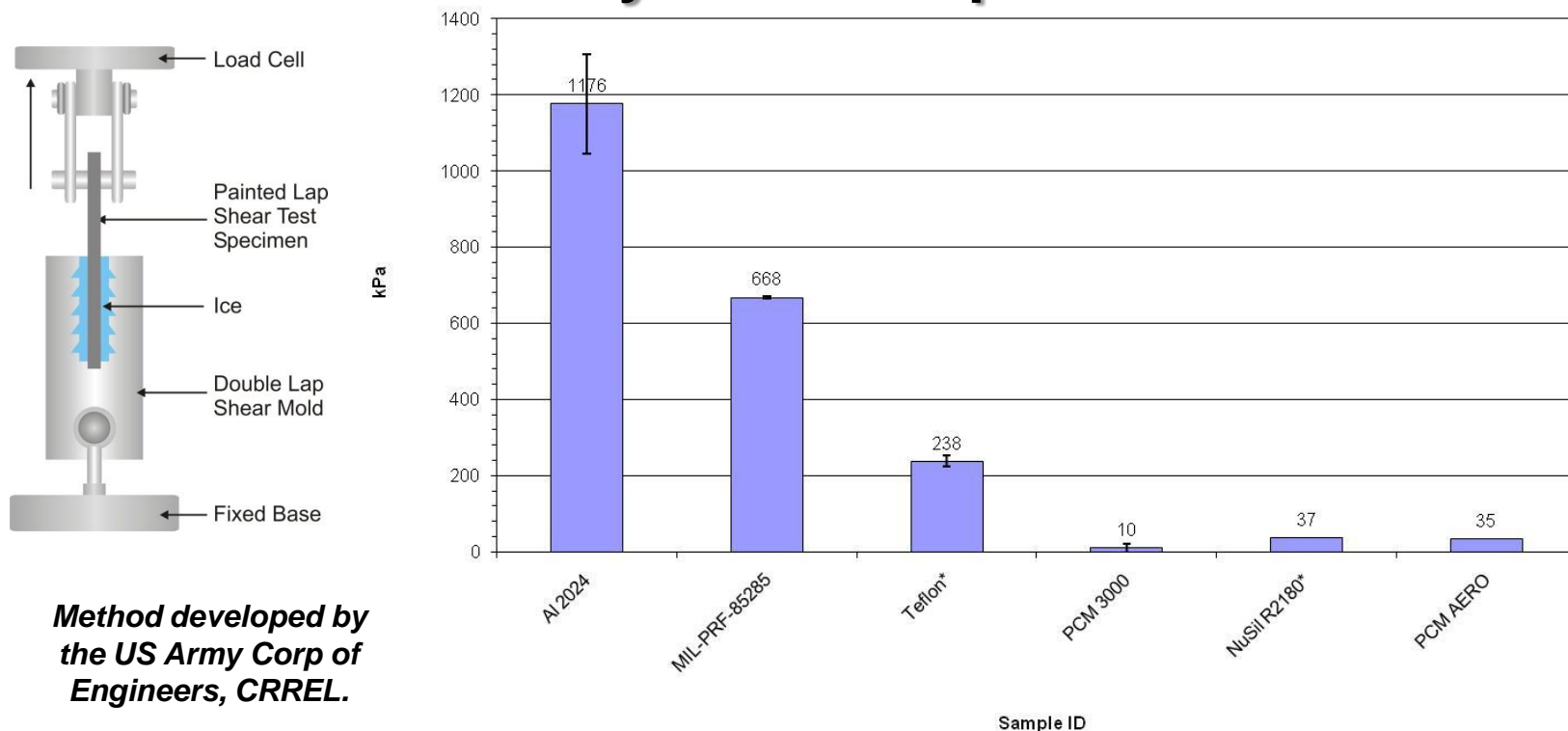


U.S. AIR FORCE

# Ice-phobic Clearcoat to Improve Aircraft and Pilot Safety



## Minimal Ice Adhesion to PCM Coating Technology Determined by Double Lap Shear Test



**Method developed by the US Army Corp of Engineers, CRREL.**

**\*Laboratory Ice Adhesion Test Results for Commercial Ice-phobic Coatings for Pratt & Whitney, May 2004, CRREL.**



# ***Environmentally Benign Aircraft Anti-Icing and Deicing Fluids Based on Cost-Effective, Bio-Based Ingredients***



- Partnership with Battelle Memorial Institute (lead agency), AFRL/ ASC, Army (CRREL), Navy (NAVAIR), Octagon, AMIL (University of Quebec)
- Maximize use of bio-based ingredients
  - Typically less persistent in environment, less corrosive, and less toxic
  - Reduction in carbon footprint based primarily on replacing petroleum-based PG as FPD
  - Battelle patents and experience with use of bio-based polyols along with other polyols, as needed, for freezing point depression
- Use of superior, multi-functional additives
  - Minimizes the number of additives and therefore corrosivity and toxicity
  - Simplifies overall formulation chemistry
  - Reduces manufacturing costs



U.S. AIR FORCE

# *Environmentally Advantaged Aircraft Deicing Fluid Demonstration*



- **Field demonstration of environmentally advantaged aircraft deicing fluid (ADF), “EcoFlo II”**
  - **Winter of 2011-2012**
  - **Deice KC-135 aircraft, fly mission, observe aircraft**
  - **Observe aircraft surface for ADF properties, such as slipperiness, fish eyes, foaming, etc.**
- **Evaluate environmental properties**
  - **Non-toxic additives**
  - **Low chemical oxygen demand (COD), biochemical oxygen demand (BOD) compared to currently used ADFs**



U.S. AIR FORCE

# *Environmentally Advantaged Aircraft Deicing Fluid Demonstration*



- **Material compatibility testing beyond SAE AMS 1424J Type I deicing fluid requirements**
  - **Military Test Method Standard, included in draft DoD Deicing Joint Test Protocol**
  - **Tested for compatibility with a cross section of military specific materials:**
    - **Metallics**
    - **Polymer Matrix Composites**
    - **Elastomerics**
    - **Aircraft Wire Insulation**
    - **Carbon/Carbon Brakes**
    - **Infrared Windows**

