UNITED STATES ARMY
AVIATION and MISSILE LIFE CYCLE MANAGEMENT COMMAND

The Evolution of Protective Covers for Army Aviation and Missile Systems

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# The Evolution of Protective Covers for Army Aviation and Missile Systems

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Standard Form 298 (Rev. 8-98)
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Getting Technology to the War Fighter
Why cover?

- Protective covers provide protection from:
  - Environmental effects
  - Particulate intrusion
<table>
<thead>
<tr>
<th>Environment</th>
<th>Principal Effects</th>
<th>Typical Failure Induced</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Relative Humidity</td>
<td>• Corrosion&lt;br&gt; • Electrolysis&lt;br&gt; • Moisture absorption</td>
<td>• Loss of mechanical and electrical strength&lt;br&gt; • Interference with function&lt;br&gt; • Loss of electrical properties&lt;br&gt; • Increased conductivity of insulators</td>
</tr>
<tr>
<td>Rain</td>
<td>• Water absorption and immersion&lt;br&gt; • Erosion&lt;br&gt; • Corrosion</td>
<td>• Increase in weight; electrical failure&lt;br&gt; • Removes protective coatings&lt;br&gt; • Surface deterioration&lt;br&gt; • Enhances chemical reactions</td>
</tr>
<tr>
<td>Wind</td>
<td>• Force application&lt;br&gt; • Deposition of materials&lt;br&gt; • Heat loss or gain</td>
<td>• Loss of mechanical strength&lt;br&gt; • Interference with function&lt;br&gt; • Accelerated abrasion and intrusion&lt;br&gt; • Accelerated high/low temperature effects</td>
</tr>
<tr>
<td>Sand/Dust</td>
<td>• Abrasion&lt;br&gt; • Clogging</td>
<td>• Increased wear&lt;br&gt; • Interference with function&lt;br&gt; • Alteration of electrical properties</td>
</tr>
</tbody>
</table>
The “Old” Way

- Shrink Wrap (Shipping Protection)
- Vinyl Equipment Covers
Shrink Wrap – Total Coverage

- Effective when not compromised and applied under ideal conditions
- Study performed in FY04 found that shrink wrap of current Army aircraft caused more harm than protection
- DA G-4 Issued “Suspension Of Shrink Wrapping Of Army Helicopters” Dec 04 131653Z Message
Vinyl Equipment Covers

- Bulky, heavy and cumbersome to use
- Often not used by soldiers due to difficulty
- Short life due to temperature problems with material
- Provides little to no protection when not used or not used regularly
- Adds burden to the soldier with little benefit
The “New” Way

- Protective covers
New cover requirements

- Covers must now protect
  - Environmental effects
  - Particulate intrusion
  &
  - Contaminate intrusion (Chlorides, etc.)
  - UV degradation
  - Temperature damage
  - Condensation formation (Greenhouse Effect)
## Additional Protection

<table>
<thead>
<tr>
<th>Environment</th>
<th>Principal Effects</th>
<th>Typical Failure Induced</th>
</tr>
</thead>
</table>
| High Temperature | • Thermal aging: oxidation, structural change, chemical reaction  
                      • Softening, melting and sublimination  
                      • Viscosity reduction and evaporation  
                      • Physical expansion  
                      • Decreased MTBF | • Thermal aging: oxidation, structural change, chemical reaction  
                      • Softening, melting and sublimination  
                      • Viscosity reduction and evaporation  
                      • Physical expansion  
                      • Decreased MTBF |
| Chemical Intrusion  | • Corrosion, electrolysis                                                                 | • Surface deterioration and structural weakening  
                      • Alteration of electrical properties  
                      • Interference with function  
                      • Increased conductivity |
| UV Radiation     | • Embrittlement  
                      • Physiochemical reactions                                                                 | • Surface deterioration  
                      • Alteration of electrical properties  
                      • Discoloration of materials |
The “Greenhouse” Effect

- Trapped air within an enclosed space allows condensation to form.
<table>
<thead>
<tr>
<th>Paired Environment</th>
<th>Principal Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity + High Temperature</td>
<td>• High temperature tends to increase the rate of moisture penetration.; the general deterioration effects of humidity are increased by high temperatures</td>
</tr>
<tr>
<td>Humidity + UV Radiation</td>
<td>• Humidity intensifies the deteriorating effects of solar radiation on organic materials</td>
</tr>
<tr>
<td>Humidity + Chemicals</td>
<td>• High humidity may dilute concentrations and could affect the corrosive action by increasing coverage and thereby increasing conductivity and the rate of corrosion.</td>
</tr>
<tr>
<td>Humidity + Particulates</td>
<td>• Particulates have a natural affinity for moisture and this combination increases deterioration</td>
</tr>
<tr>
<td>High Temperature + Chemicals</td>
<td>• High temperature increases the rate of corrosion influenced by chemicals (salts and sulfurs)</td>
</tr>
<tr>
<td>High Temperature + UV Radiation</td>
<td>• High temperature can increase the breakdown of organic materials by UV radiation</td>
</tr>
<tr>
<td>High Temperature + Particulates</td>
<td>• The erosion rate of particulates may be accelerated by high temperature</td>
</tr>
<tr>
<td>UV Radiation + Particulates</td>
<td>• Suspected to result in temperature elevation</td>
</tr>
<tr>
<td>Chemicals + Particulates</td>
<td>• Particulates and chemicals influence the rate of corrosion and enhance deterioration</td>
</tr>
</tbody>
</table>
Cover technology

- A “breathable” cover
  - Allows vapor transfer out while preventing water, contaminatees and particulates from intruding

- A “soft” cover
  - Will not damage or abrade the surface of the asset

- A “lightweight and packable” cover
  - Lightweight and compressible enough to be user friendly

- A “tough” cover
  - Can withstand the daily use of a soldier while still performing all other duties listed
  - Resists damage from UV radiation
Aviation Cover applications
Missile Cover Applications
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