Magnesium Finishing for OEM And Overhaul
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19a. NAME OF RESPONSIBLE PERSON

Standard Form 298 (Rev. 8-98)  
Prescribed by ANSI Std Z39-18
Finishing Options
Typical for Magnesium

Conversion Coatings - Used Most Commonly During Overhaul
- Dow 7, created in the 1940’s
- Dow 9, created in the 1940’s
- Chrome Manganese, created in the 1940’s

Anodize Coatings Used Most Commonly for New Build
- Dow 17, created 1942
- HAE, created 1955
- TAGNITE®, created 1992
- Keronite®, created ?
HAE

HAE, named after inventor Harry A. Evangelides, was patented in 1952. The very high alkaline solution has a pH of approximately 14 and should be operated between 70 and 86°F Fahrenheit.

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>Concentration (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxide (extremely caustic)</td>
<td>120</td>
</tr>
<tr>
<td>Fluoride</td>
<td>35</td>
</tr>
<tr>
<td>Potassium Permanganate (strong oxidizer)</td>
<td>20</td>
</tr>
<tr>
<td>Aluminum Hydroxide</td>
<td>34</td>
</tr>
<tr>
<td>Sodium Phosphate</td>
<td>35</td>
</tr>
</tbody>
</table>
Dow 17

The Dow Chemical Company invented Dow 17 in the mid-1940’s. The electrolyte has a pH of approximately 5 and should be operated at or above 160°Fahrenheit.

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>Concentration g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium BiFluroide</td>
<td>360</td>
</tr>
<tr>
<td>Sodium Dichromate (hazardous chemical)</td>
<td>100</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>97</td>
</tr>
</tbody>
</table>
Developed in the 1990’s with the Clean Air & Clean Water Act in mind, Tagnite® was designed as a replacement coating for Dow 17 and HAE. The electrolyte’s pH range is 12.8-13.2 and operates below room temperature (40-60°F)

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>Concentration (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxide</td>
<td>4 - 8</td>
</tr>
<tr>
<td>Fluoride</td>
<td>5 - 10</td>
</tr>
<tr>
<td>Silicate</td>
<td>15 - 25</td>
</tr>
</tbody>
</table>

No Chromates or Heavy Metals
Chemical Composition as a Percentage of Water

5% * chemical concentration
25%* chemical concentration
56% * chemical concentration

HAE contains heavy metals;  Dow 17 contains heavy metals and chromium

*Approximations
Coating Morphology

Dow 17

HAE

TAGNITE®

All photos shown at 500x magnification.
Corrosion Testing
Superior Corrosion Resistance

*TAGNITE®, HAE & Dow 17 (Type I) on magnesium alloy ZE41 after 168 hours in salt spray*

*Only Tagnite Provides Inherent Corrosion Resistance*
Superior Galvanic Corrosion Resistance

AZ91E sand cast magnesium test plates assembled using cadmium plated steel bolt/washer & placed in salt spray (ASTM B117) for 1000 hours.

TAGNITE® 8200

HAE

DOW 17
Galvanic Corrosion - HAE

Cadmium-Plated Steel Bolt

Cadmium-Plated Steel Washer

AZ91E Test Panel Coated with HAE
Galvanic Corrosion – Dow 17

Cadmium-Plated Steel Bolt

Cadmium-Plated Steel Washer

AZ91E Test Panel Coated with TAGNITE®
Galvanic Corrosion – TAGNITE

Cadmium-Plated Steel Bolt

Cadmium-Plated Steel Washer

AZ91E Test Panel Coated with TAGNITE
Tagnite has been carefully studied and reviewed and by the EPA’s Design for the Environment Program and has been granted the status of Partner Formulator

Tagnite Contains

- No Chromium(VI)
- No Heavy Metals
- No Sulfuric Acid
- No Nitric Acid
- No Hydrofluoric Acid

Environmentally Clean
View of Magnesium Intermediate Case For a Jet Engine – Approximately 75 Square Feet of Surface Area
CH-53
AH-6
F-35 Fighter
F-22 Fighter
MD 500/600
USMC EFV
AH-64 Apache
KC-135 Tanker
B-52 Bomber

Widely Specified
Magnesium Transmission Housing

Magnesium Oil Pan

Magnesium Gearbox

Magnesium Jet Engine Gearbox
• Last B-52 was built in 1962
• Air Force wants to keep them going until 2040
• The B-52 utilizes many magnesium components including several in the pilot yoke/Steering column
• The majority of these 48 year old castings are still serviceable
• By selecting Tagnite the Air Force was able to eliminate hexavalent chromium and attain corrosion resistance superior to standard chromate conversion coatings typically used during overhaul
• Tagnite has been employed now on 11 different part numbers on the B-52 Bomber and 7 more part numbers are in the approval process
Tagnite is regularly applied to used magnesium castings on the B-52
48 Year Old+ Magnesium Castings

Better Protected in 2011 Than When They Were Factory New
48 Year Old+ Magnesium Castings
48 Year Old+ Magnesium Castings

Better Protected in 2011 Than When They Were Factory New
• Last KC-135 Was built in 1965
• Air Force wants to keep them going until 2040
• The KC-135 utilizes many magnesium components including several in flap drive system
• The majority of these 45+ year old castings look good and are still serviceable
• By selecting Tagnite, the Air Force was able to eliminate hexavalent chromium and attain corrosion resistance superior to standard chromate conversion coatings typically used during overhaul
• Tagnite has been employed now on 15 different part numbers on the KC-135 approval process
Magnesium Housings Used For Flap Drive Gearboxes
Do these look like 49 year old magnesium castings?

Old magnesium castings cleaned (above), and then Tagnite anodized (right).
45 Year Old+ Magnesium Castings Re-Coated with Tagnite and Paint and Ready to Return to Service
45 Year Old+
Magnesium Castings Ready to Return to Service
Why Invest in the Added Time & Cost to Mask Ferrous Metal Inserts and Tagnite vs. Quick Inexpensive Chromate Conversion Coatings?

TAGNITE® 168 Hours of Salt Spray

Dow 7 9 Hours of Salt Spray

DOW 19 9 Hours of Salt Spray
Jet Engine Gearbox

Successfully Tagnite Coated After Masking:

6 Steel Bearing Liners
42 Helicoils
52 Studs
3 of the 6 Bearing Liners had Core Passageways Going Through Them Which Would Allow Electrolyte to Penetrate to The Steel Liner.
Extreme Masking Challenges Have Been Dealt With Successfully
New Casting in Production
Requiring Extensive Masking of Ferrous and Magnesium Prior to Tagnite Anodize

Bearing Liner is flush with magnesium on one side
And raised above magnesium on other side. On raised side
a core passage way comes directly to bearing liner.

Multiple Pressed in Steel Bushing
Jet Engine Intermediate Housing

Successfully Tagnite Coated After Masking:

121 Ferrous Inserts
Approved by Many Aerospace and Defense Companies, Brush Tagnite is an Effective Method to Touch-up Magnesium Castings Without Using Hexavalent Chromium
Thank You For Your Time