



Kinetic Metallization™

A Repair Process for
Damaged IVD-Al Coatings,
Mg, and Al Alloy Components

NAVAIR Ph II SBIR Briefing

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Problem - Field Repair of Damaged IVD Aluminum Coatings

- Used on Landing Gear and HS Steel Aircraft Components
 - No Al coating field repairs
 - Brush plating of cadmium
- Naval Aviation Depot (NADEP)
 - F/A-18, E-6B, H-1, V-22, F-35
- Air Force Depot Facilities
 - Tinker and Hill AFB Depots





Aircraft -Dimensional Restoration Mg and Al Alloy Parts

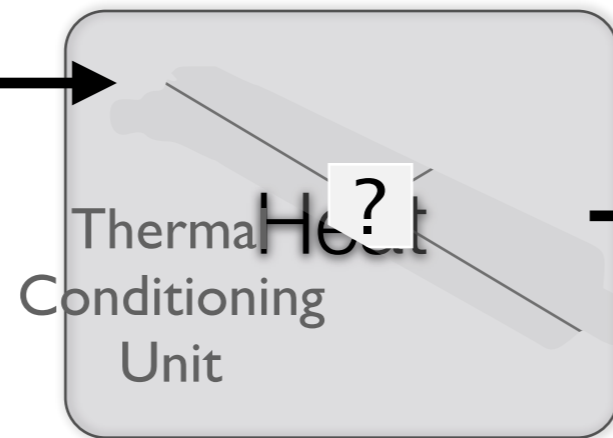
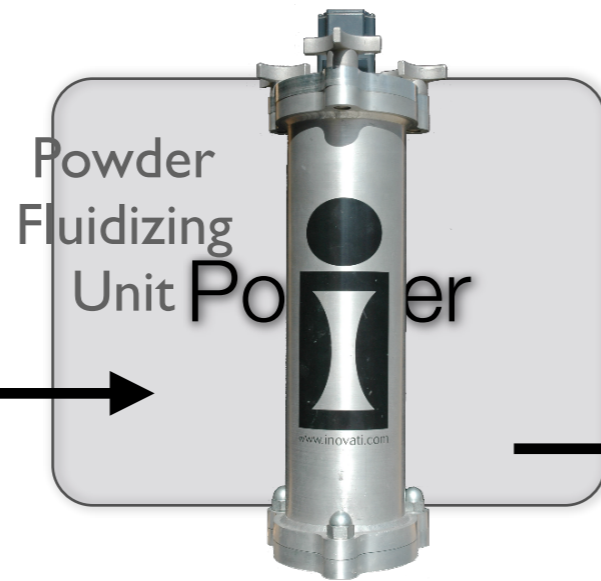
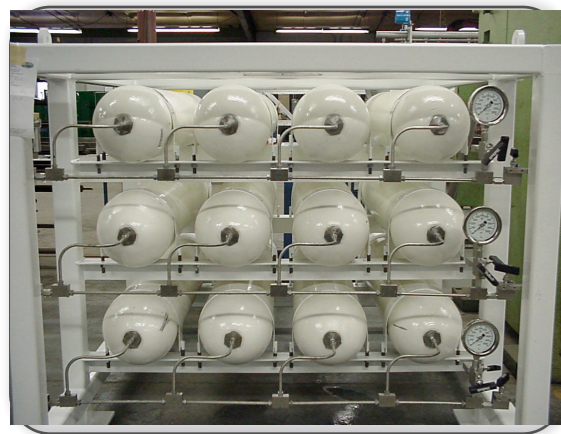
- Transmission Gearboxes, Housings, Generators
 - Rotary Aircraft (AH-64, AH-1W, AH-1Z, CH-53, HH-1N, MH-53E, SH-60, UH-60)
 - Fixed Wing Aircraft (P-3, F-35)
- Mg Alloys (AZ80A, AZ91C, AZ91E, ZE41, AEZ33A, WE43B-T6, AZ92-T6, HC32A-T5, QE22A-T6)
- Al Alloys (7075, 7050)

Introduction to Kinetic Metallization™ (KM)

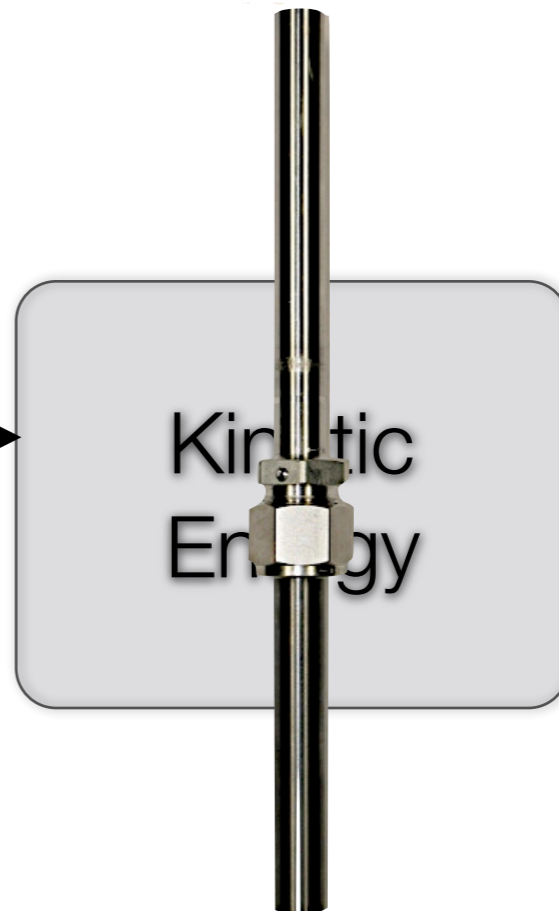
- Metal deposition through particle impact
- low-temperature \ll melting point
- high particle velocity > 500 m/s
- gas velocity below Mach 1
 - He, 300K, 980 m/s
 - GN2, 300K, 330 m/s



Gas Storage System



Deposition Nozzle





KM-MCS

IVD-AI Repair

- KM-Mobile Coating System
 - Handheld KM Spray Gun
 - Portable cart
 - Brush-sieve powder fluidizing unit
- Al-Trans[®] Coatings
 - Aluminum-Transition Metal
 - Corrosion resistant transition metal blend (Cr or Ni Alloys)

Al-Trans[®] HSS Alloy Development

Dimensional Restoration
HSS Alloy Components \longrightarrow Amorphous Powder

Corrosion Control
HSS Alloy Components \longrightarrow CP-Al $\begin{cases} \longrightarrow \text{Cr-Based Admixture} \\ \longrightarrow \text{Ni-Based Admixture} \end{cases}$



Qualification Panels Brush-Cd and Al-Trans[®]



KM Repair Sequence for IVD-AI

IVD-AI Removed

Feather Edges

KM AI-Trans[®] Repair



Brush Cd Control Samples

KM Al-Trans® Repair Specimens

ASTM B-117 Salt Fog Testing



Brush Cd control specimens

KM Al-Trans[®] repair specimens

Scribed Salt Fog Testing ASTM B-117



Brush Cd Repair Specimens
168 Hours

KM Al-Trans® Repair Specimens
504 Hours

Scribed Cyclic SO₂ Salt Fog
(ASTM G85 annex 4, B117/SO₂)

JTP-2003

Performance Specifications

General & Galvanic Test	JTP	Acceptance Criteria	Pass/Fail
Strip-ability	3.1.3	Removal with 2 Hrs MIL-S-5002D	Pass
Open Circuit Potential	3.1.4	OCP Steady State < 1 Day	Pass
EIS/Tafel Analysis	3.1.4	Steady State Corrosion Rate	Pass
Visual Exam	3.1.4	No pitting/crevice corrosion	Pass

JTP-2003

Performance Specifications

Reparability Test	JTP	Acceptance Criteria	Pass/Fail
Appearance	3.1.1 3.7.1	Smooth Continuous Coating	Pass
Bend Adhesion	3.2.1 3.7.1	No loss of adhesion per MIL-STD-870B	Pass
Paint Adhesion Solvent Primer	3.2.2 3.7.1	ASTM D 3359 MIL-PRF-85582	Pass

JTP-2003

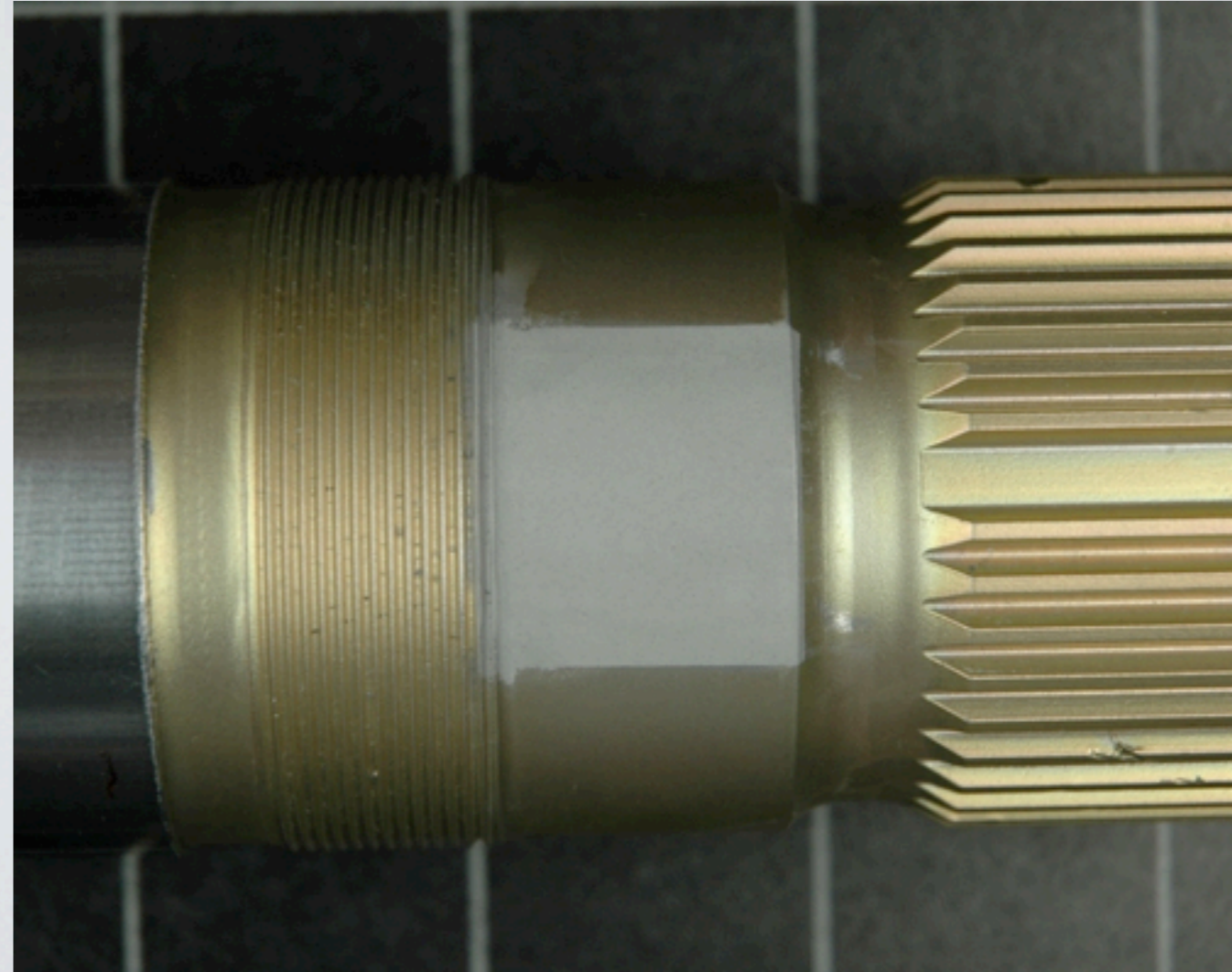
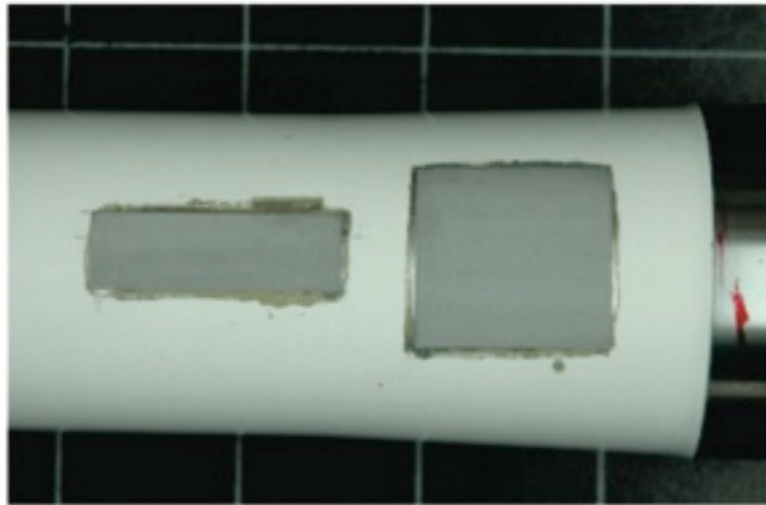
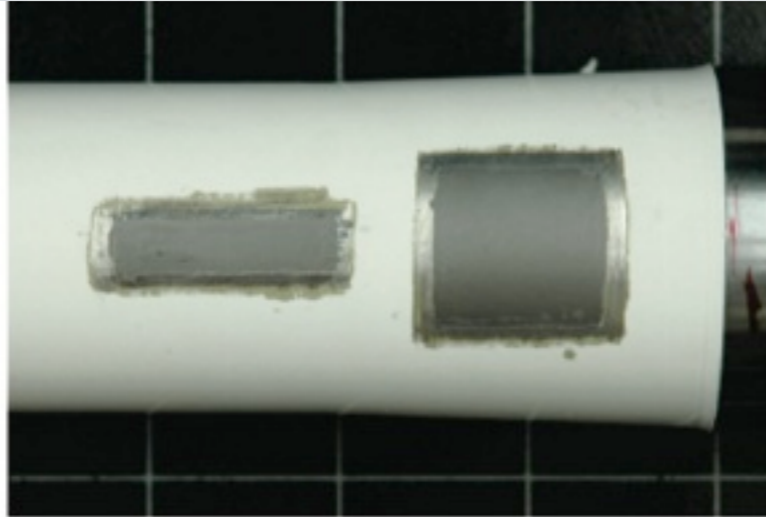
Performance Specifications

Reparability Test	JTP	Acceptance Criteria	Pass/Fail
Unscribed Salt Fog	3.3.1 3.7.1	3000 Hrs ASTM B117-94	Pass
Scribed Salt Fog	3.3.2 3.7.1	1000 Hrs ASTM B117 94	Pass
Unscribed SO2 Salt Fog	4.1.1	500 Hrs ASTM G85	Pass
Scribed SO2 Salt Fog	4.1.2	500 Hrs ASTM G85	Pass
Unscribed Salt Fog	3.1.4	3000 Hr ASTM B117-94	Pass

JTP-2003

Performance Specifications

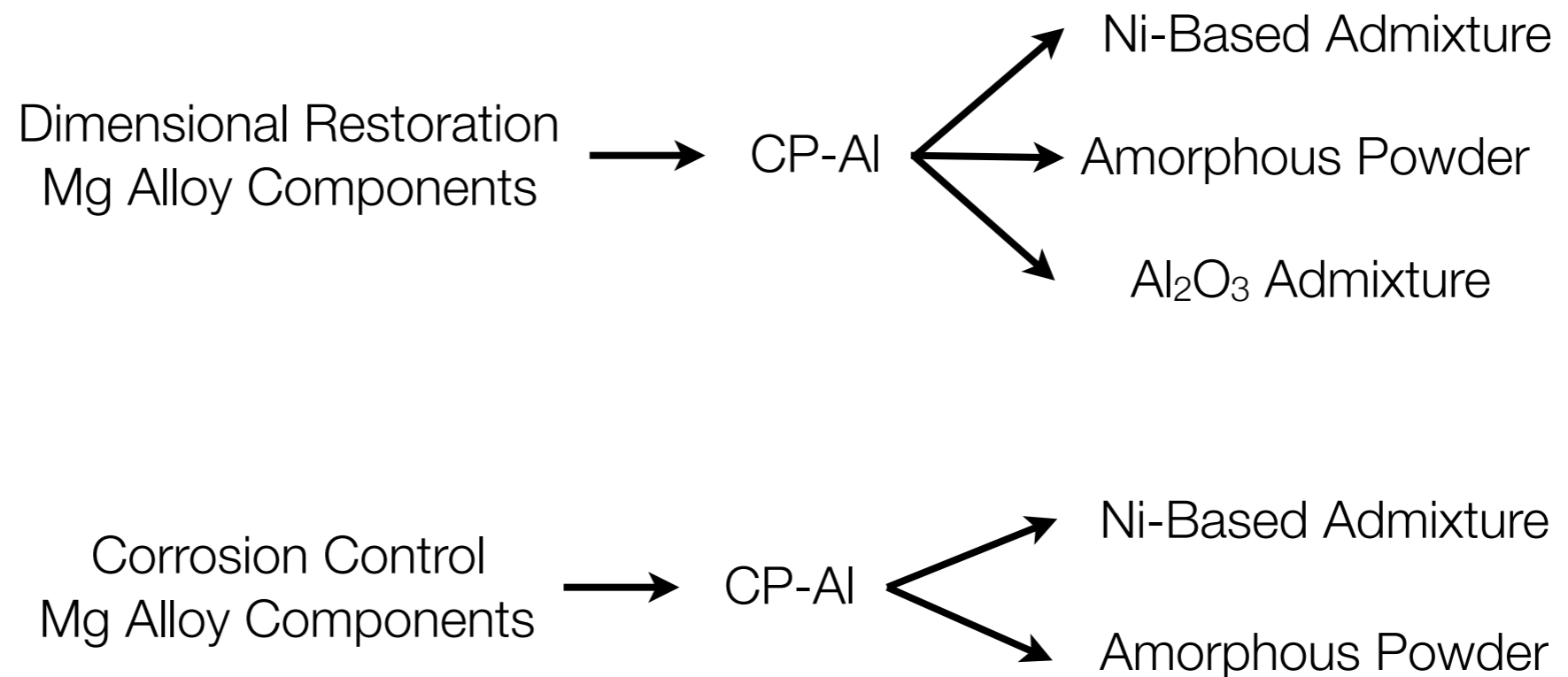
Reparability Test	JTP	Acceptance Criteria	Pass/Fail
Hydrogen Embrittlement	3.6.1	200 Hr/75%	Pass
	3.7.1	ASTM F519	
Hydrogen Re-Embrittlement	3.6.1	200 Hr/75%	Pass
	3.7.1	ASTM F519	
Corrosion Resistance 14 Fluids	3.3.4	No Coat Degradation Compared to Brush Cd	Pass
Stress Corrosion Cracking	4.3	SEM Fractography	Pass
Scribed Painted Coating	3.3.5	3000 Hrs ASTM B117 - 94	Pass



F-18 Axle
IVD-AI Repair
KM AI-Trans[®] Coating

Al-Trans[®]

Magnesium Alloy Development



Al-Trans[®] Screening Tests

Powder Alloy Development

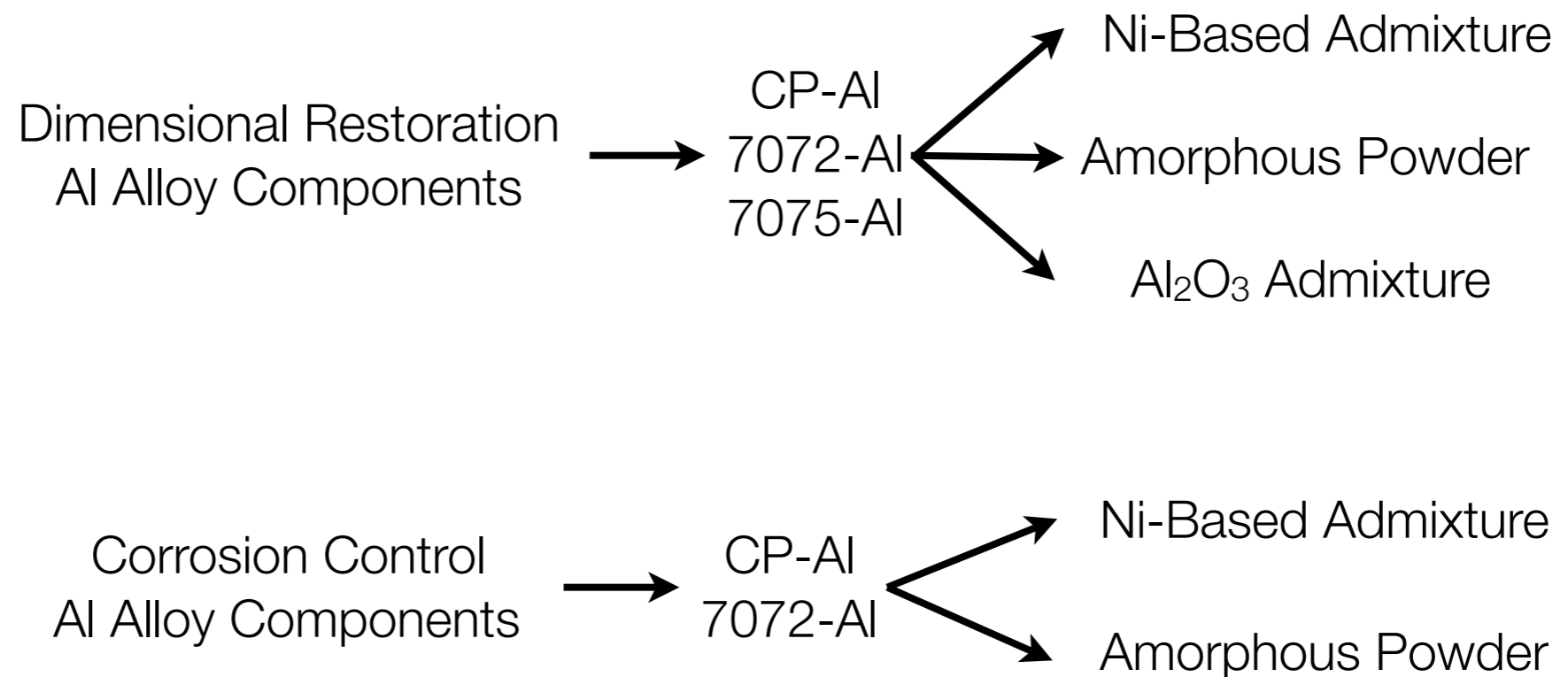
Requirement	Property
Microhardness	> 62 R _b
Residual Stress	Compressive
Interface/Coating Cracks	None
Bond Strength	> 10 ksi
Porosity	< 1%
Tensile UTS/YLD	32/23 Ksi (min)
Strain-to-fracture	> 0.5%

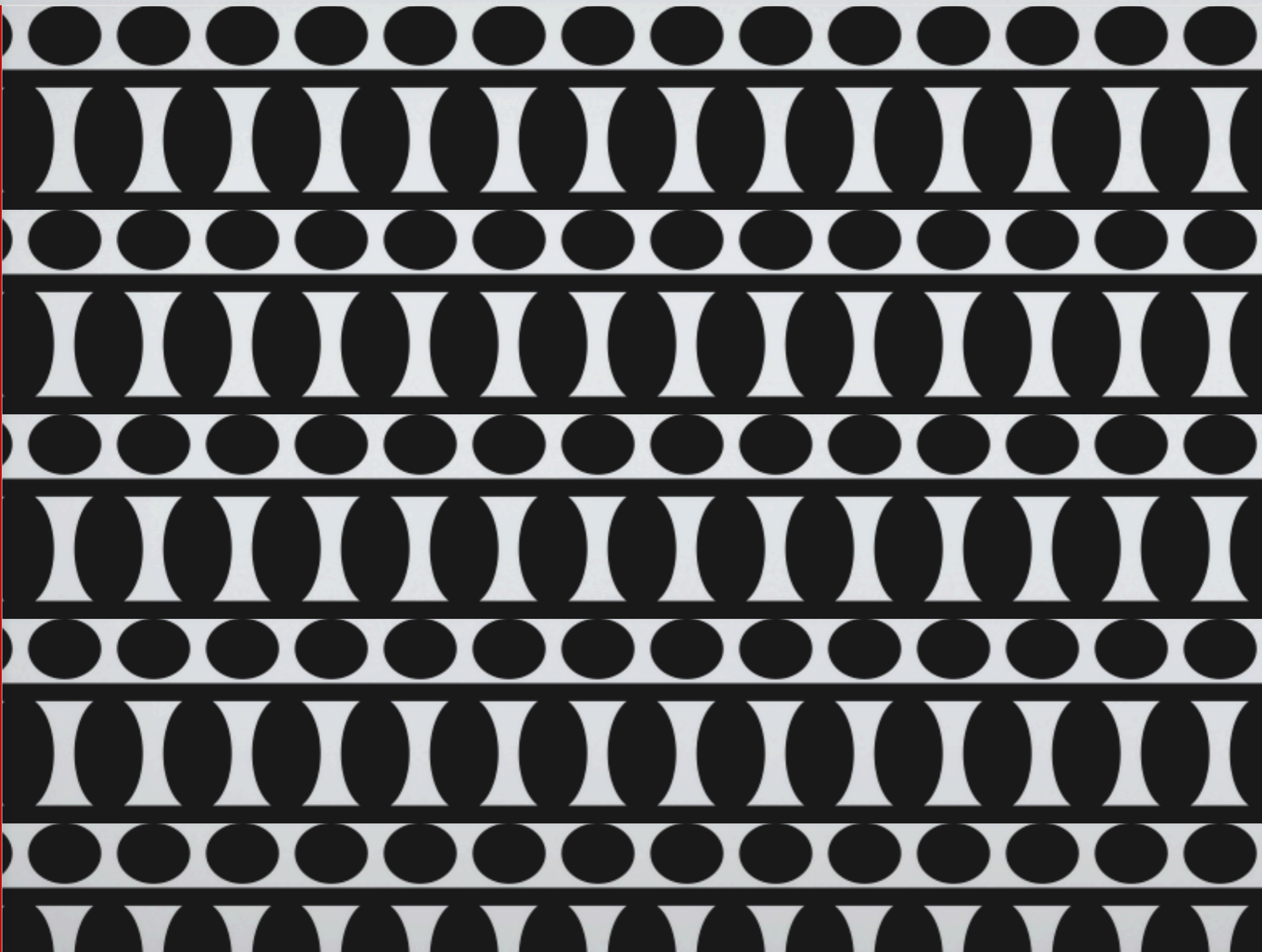
KM Dimensional Restoration

- KM Portable System
 - Handheld KM Spray Gun
- Aircraft Alloy Components
 - Mg gearboxes & transmissions
 - Al stanchions & hinges
- Current NAVAIR Ph II SBIR
 - Alloy powder development
 - Portable KM System development



Al-Trans[®] Aluminum Alloy Development





For more
information,
please visit our
booth #319

