Military Adoption of Kinetic Metallization™

Howard Gabel, R. Tapphorn, K. Hashimoto, and T. Crowe

ITSC 2012
International Meeting Information
KM Military Role

- Market leading needs
- Performance and Cost
- R&D budget
Kinetic Metallization (KM)

Process and Equipment
Introduction to KM

- Metal deposition through particle impact
- Low-temperature << melting point
- Low noise < 75 dBA @ 1 m
- High quality coatings
Sonic Mach 1 Nozzle

- High particle velocity $> 750$ m/s
- Pressure $< 1$ MPa (150 psig)
- Temperatures to 1100°C
- Powder preheater & mixer
- Powder injection at nozzle inlet
Potential Energy

Heat

Powder

Kinetic Energy

Gas Storage System

Ultra-fine Powder Fluidizing Unit

Sonic Deposition Nozzle with Powder Preheater & Mixer

2.5 kW Thermal Conditioning Unit < 150 psig
KM ID Gun

- Bore Dimensions
  - 50 mm ID
  - > 1 meter Length
Raster Gun

- Robotic rastering & translation
- Uniform & large area coating repairs
- Gas blending (He or N₂)
KM-Handheld Gun

- Lightweight (< 5 lbs)
- Round or oval nozzles (< 75 dBa)
Three applications
Common Goals

❖ Total refurbishment
❖ Weight sensitive
❖ Time sensitive
Common Issues

- Subject to corrosion and wear
- Limited spares availability
- High spares costs
Dimensional Restoration

Al and Mg Transmission Housings
Aircraft Mounted Accessory Drive

- AMAD Gearbox Housing
- F/A-18 Aircraft
- Naval Fleet Readiness Centers
Oil Passage Repair

- Repaired at Inovati
Hydraulic Pad Repair

❖ Fretting Damage
❖ KM coating
**Pad surface**, post spray with all masks except alignment pin removed.

AMAD housing with extra deposited material machined off to achieve original drawing dimensional requirements.

Alignment pin installed, awaiting NDI, alodine 4 conversion coating and final cleaning prior to completion.

- Post deposition
- Finish machined
- Minimal surface preparation
- Free machining alloy
- Robotic and hand held guns
- Common electronic/gas hardware
Dimensional Restoration
Landing Gear Struts
Commercial Strut

- 3.5” ID
- Proprietary Alloy
- HS Al substrate
- Dimensional restoration
- Ability to fit existing workflow
- Severe mechanical approval
- Mild actual requirements
Dimensional Restoration
Corrosion Resistance
Heavy Military Ground Vehicles
Expeditionary Fighting Vehicle
Joint Light Tactical Vehicle

❖ Thee of many varients
Mobile Coating System
Installation USMC
Common Problems

- Limited production
- Weight sensitive
- Corrosion
Early Adopters

- Dimensional restoration
- Low tech materials
- Chiefly aluminum
Future

- Functionally more complex materials
- WC-Co ID replacement of Hard Cr
- Movement towards structural repairs
- Use in OEM operations
Latest Development

- KM-1373
- Highest temperature available
- Lowest gas flow available
- Highest quality coatings
- Lowest cost coatings