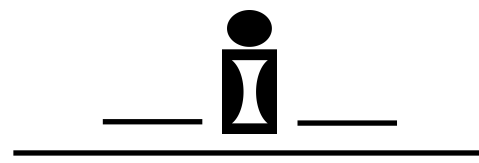


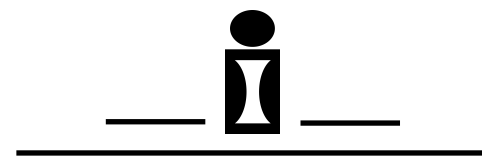
# Military Adoption of Kinetic Metallization™

Howard Gabel, R. Tapphorn, K. Hashimoto, and T. Crowe  
ITSC 2012



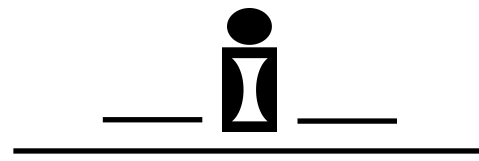


# International Meeting Information



# KM Military Role

- ❖ Market leading needs
  - ❖ Performance and Cost
- ❖ R&D budget

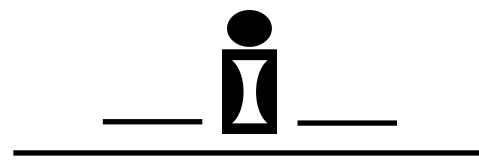


# Kinetic Metallization (KM)

## Process and Equipment

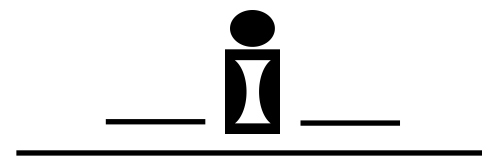






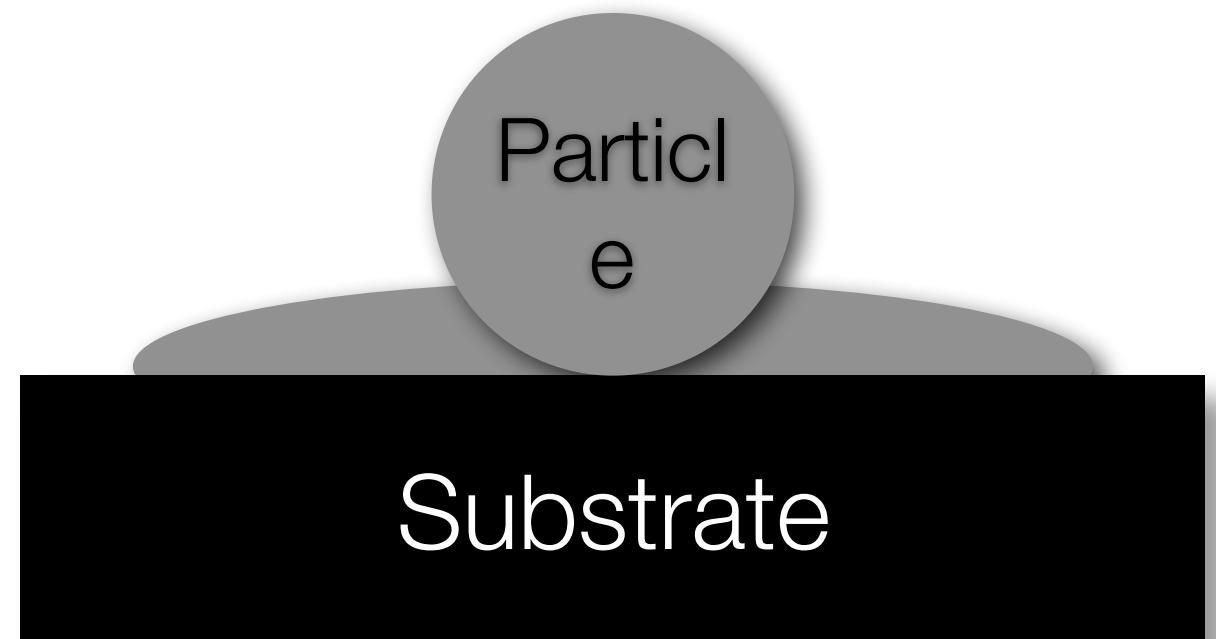
# Introduction to KM

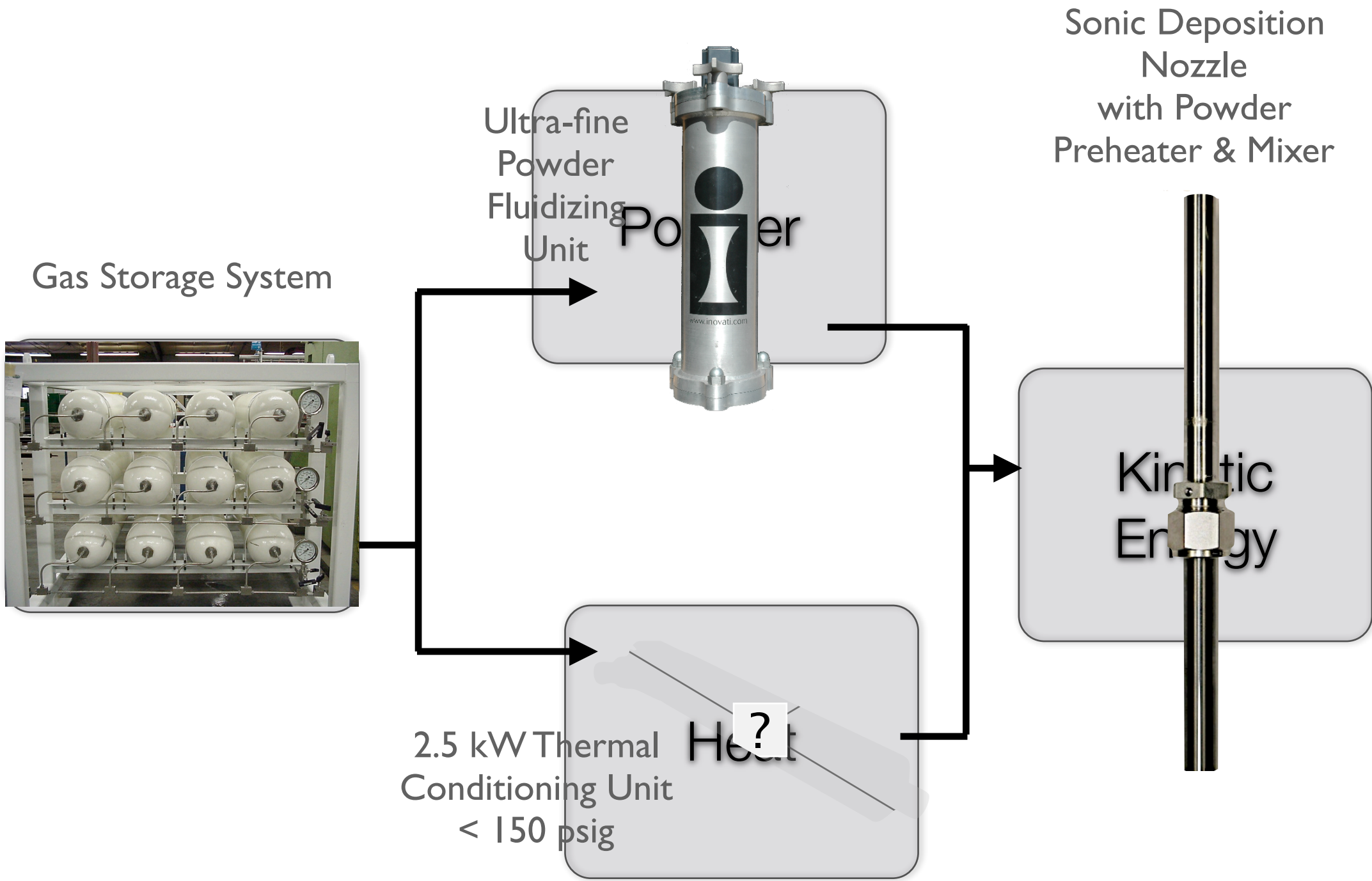
- ❖ Metal deposition through particle impact
- ❖ Low-temperature  $\ll$  melting point
- ❖ Low noise  $< 75$  dBa @ 1 m
- ❖ High quality coatings



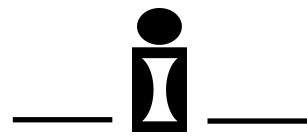
# Sonic Mach 1 Nozzle

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





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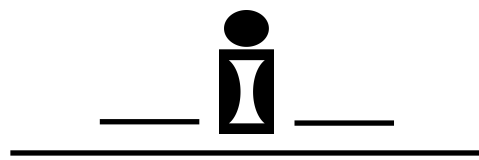


# KM ID Gun

- ❖ Bore Dimensions
  - ❖ 50 mm ID
  - ❖ > 1 meter Length

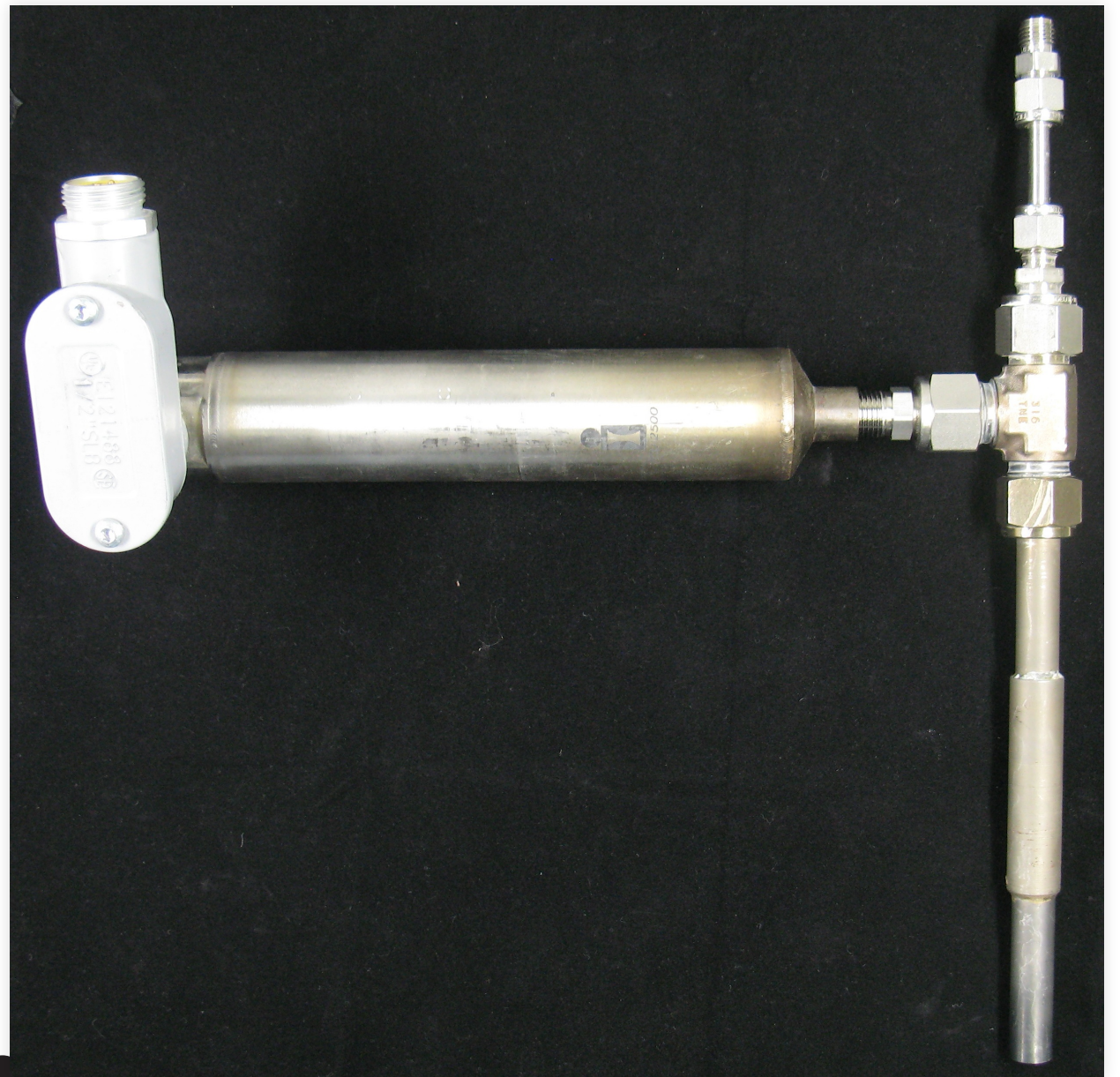


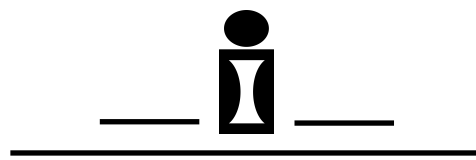




# Raster Gun

- ❖ Robotic rastering & translation
- ❖ Uniform & large area coating repairs
- ❖ Gas blending (He or N<sub>2</sub>)

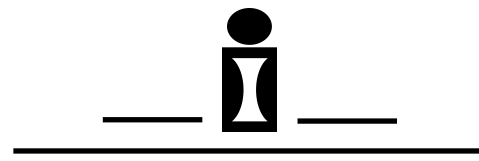




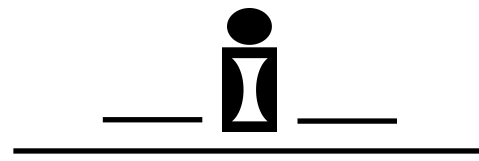
# KM-Handheld Gun

- ❖ Lightweight (< 5 lbs)
- ❖ Round or oval nozzles (< 75 dBa)





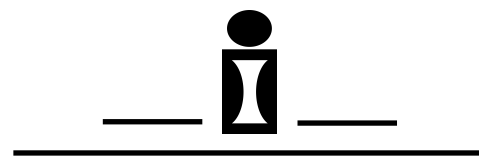
# Three applications



# Common Goals

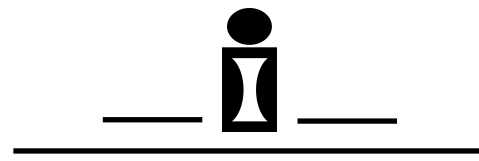
- ❖ Total refurbishment
- ❖ Weight sensitive
- ❖ Time sensitive





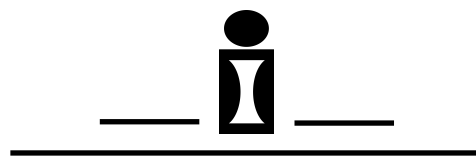
# Common Issues

- ❖ Subject to corrosion and wear
- ❖ Limited spares availability
- ❖ High spares costs



# Dimensional Restoration

## Al and Mg Transmission Housings



# Aircraft Mounted Accessory Drive

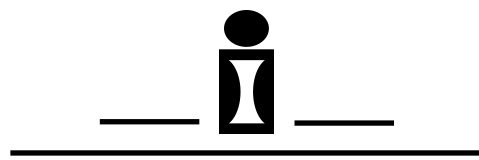
- ❖ AMAD Gearbox Housing
- ❖ F/A-18 Aircraft
- ❖ Naval Fleet Readiness Centers





# KM-PCS North Island FRC



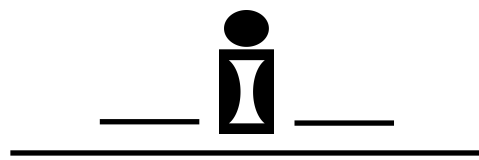


# Oil Passage Repair



❖ Repaired at Inovati

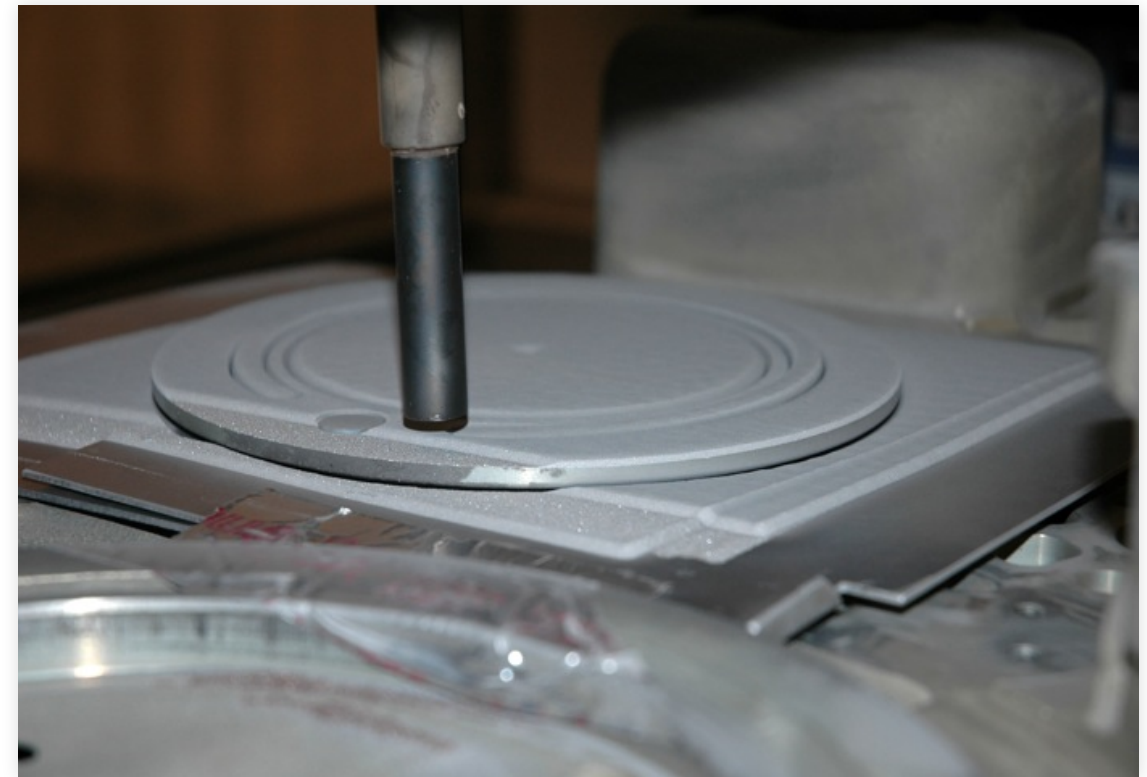




# Hydraulic Pad Repair



❖ Fretting Damage



❖ KM coating



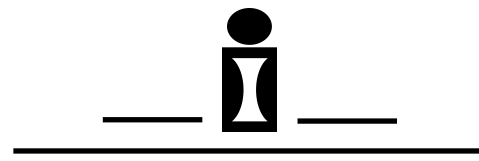
❖ Post deposition



❖ Finish machined

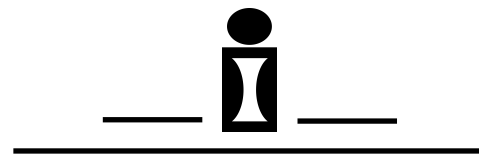


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- ❖ Minimal surface preparation
- ❖ Free machining alloy
- ❖ Robotic and hand held guns
  - ❖ Common electronic/gas hardware





# Dimensional Restoration

## Landing Gear Struts

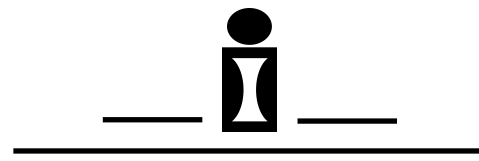


# Commercial Strut

- ❖ 3.5" ID
- ❖ Proprietary Alloy
- ❖ HS Al substrate
- ❖ Dimensional restoration
- ❖ Ability to fit existing workflow
- ❖ Sever mechanical approval
- ❖ Mild actual requirements



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Dimensional Restoration  
Corrosion Resistance  
Heavy Military Ground Vehicles



**Expeditionary Fighting Vehicle**



# Joint Light Tactical Vehicle



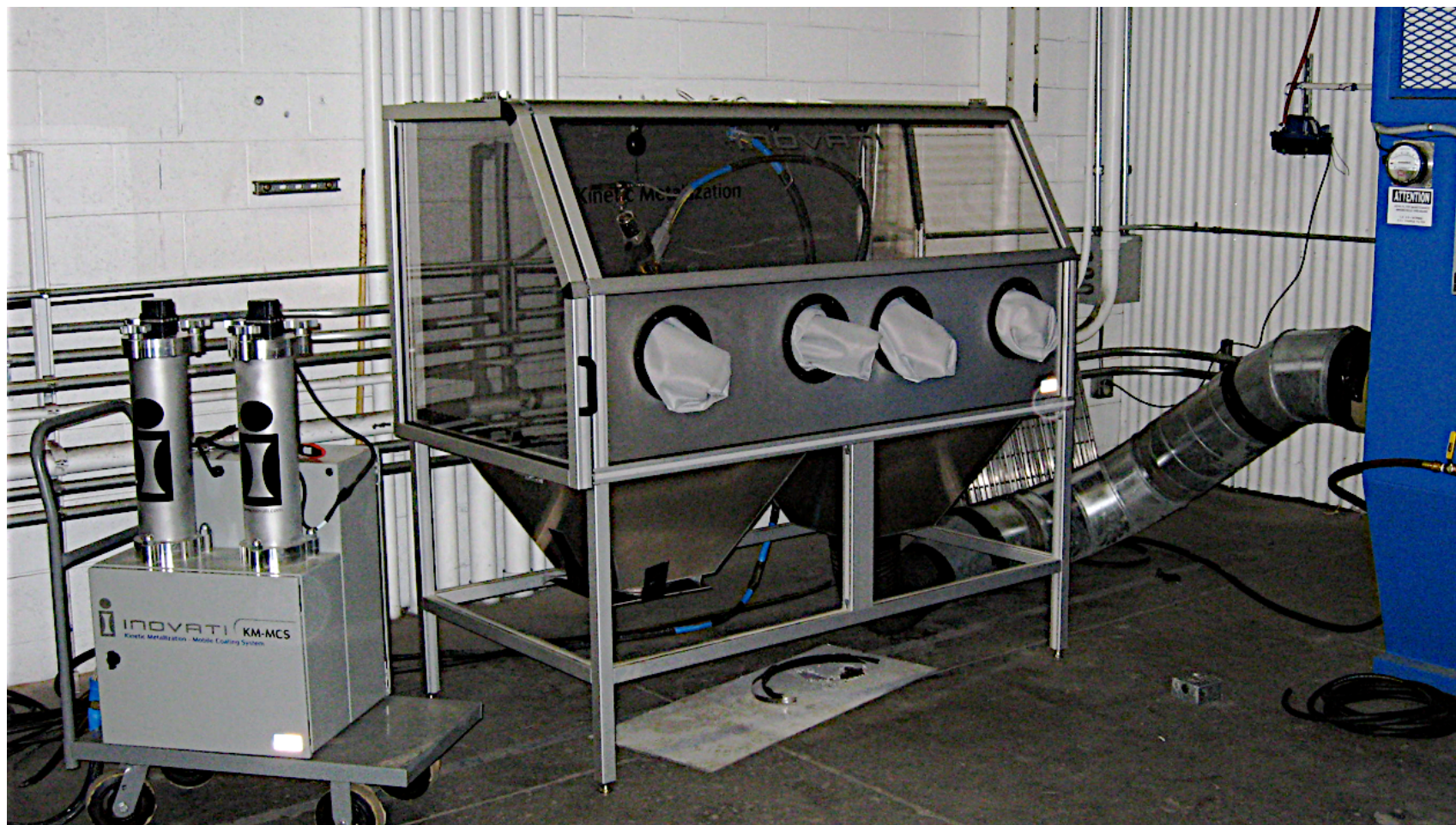
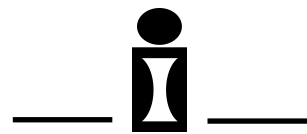
- ❖ Thee of many varients





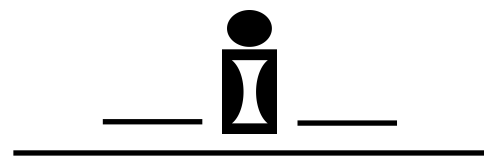
# Mobile Coating System





# Installation USMC

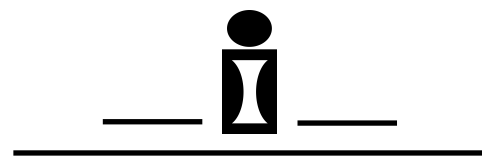




# Common Problems

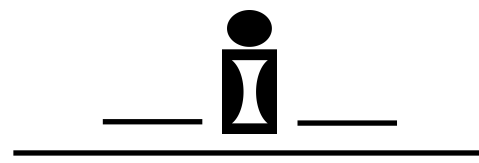
- ❖ Limited production
- ❖ Weight sensitive
- ❖ Corrosion





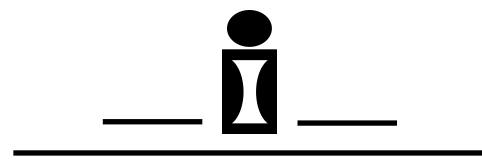
# Early Adopters

- ❖ 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