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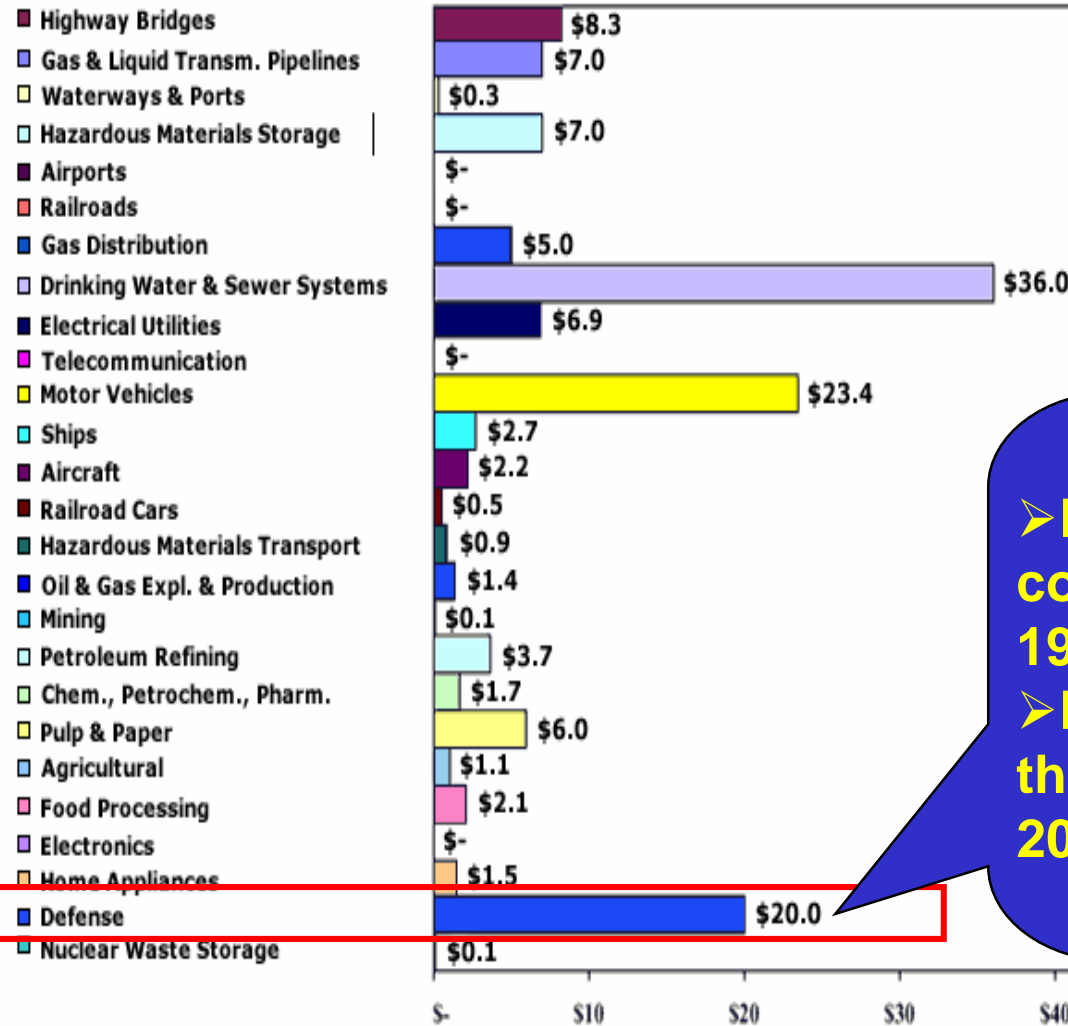
Great Ideas Competition
Kinetic Spray for Corrosion
Protection
and Metal Part Restoration

Wally Birtch
General Manager
Supersonic Spray Technologies Div.



Corrosion Cost

Cost of Corrosion Per Analyzed Economic Sector, (\$ x billion)



1997 Total U.S. Corrosion cost of \$279 billion/year or 3.2% of GDP

➤ DoD Corrosion mitigation cost were 20 billion/year in 1997
 ➤ Based on 3.2% of the GDP this would be 26.5 billion in 2007

Corrosion



Technology History

First US Cold Spray Patent
1902

→ Samuel H Thurston

1914

→ Max U Schoop

1958

→ Charles F Rocheville

Obninsk Center for Powder Spraying (OCPS)

DYMET®

Kashirin (Russian)

US patent 1999

Univ. of Windsor

Maev, Strumban

Centerline - SST

-Low-Pressure Downstream Powder Injection feeder

Novosibirsk – Inst. of Theory. & Appl. Mechanics

ongoing work

Alkhimov, Papyrin (Russian) US patent 1990

NCMS Demo Program (1994-1997)

Penn State/ Navy ARL Programs

GM- Research → Delphi – “Kinetic Spray”

J. Browning
"impact fusion"

Sandia Labs – Smith, Neiser

ASB Industries

Innovati

-High-Pressure Upstream Powder Injection feeder-

Ktech - ARL

1980's

1990's

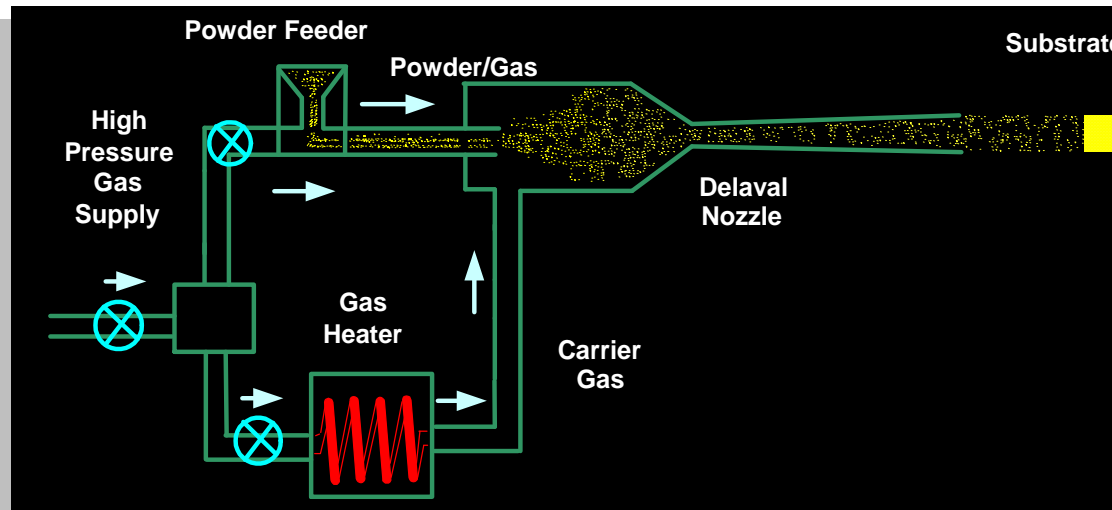
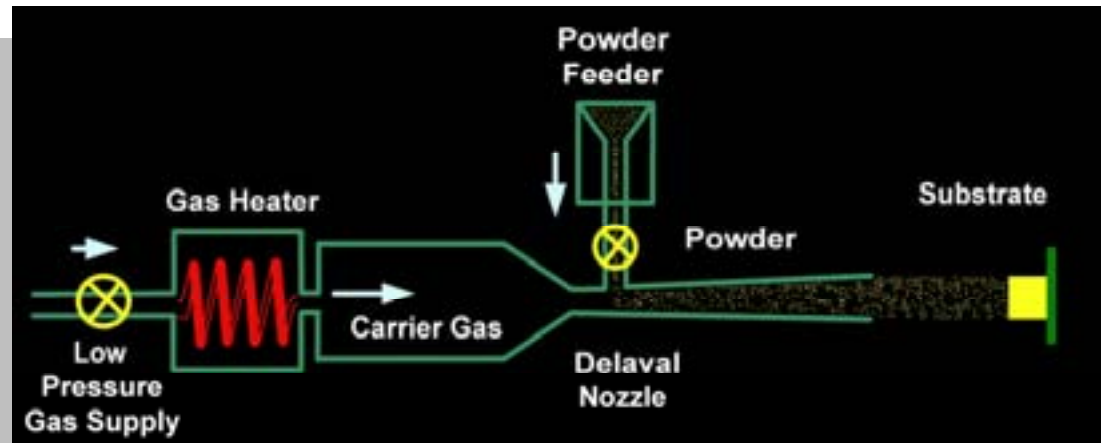
2000's

Present

Kinetic Spray Technology

Low Pressure Down Stream Radial Powder Feeding

- 85-150psi Air or Nitrogen
- Flow rate 12 – 20 cfm
- Low-Pressure Downstream Powder Injection feeder
- Close couple gas-preheater (Ambient – 550 Deg C)



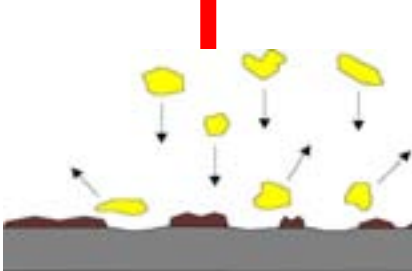
High-pressure Up Stream Axial Powder Feeding

- 100-500 psi Nitrogen or Helium/ Nitrogen
- Flow rate 30 – 100 cfm
- High-Pressure Upstream Powder Injection feeder
- Separate Gas preheater (Ambient – 550 Deg C)

Kinetic Spray Technology

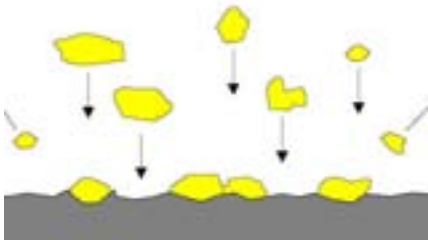
Stages of Materials Attachment

Supersonic Flow



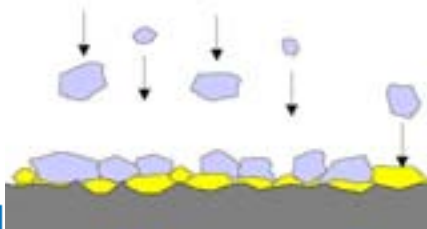
Surface Cleaning
and Activation

1



Formation of a
Coating on Substrate

2



Formation and Densification
of the Layers by Flow
of High-Velocity Particles

3

Project Award



Problems

CORROSION OF STEEL PANELS AND PARTS



Coupon 55, 60 cycles



IVD Aluminum - Control



Problems

Corrosion and Wear Damaged Magnesium Castings for Aircraft



Solutions

Corrosion Protection of Ferrous Materials using Cold Spray



Centerline Zn, 60 cycles



Centerline Zn-Al, 60 cycles



Centerline Al, 60 cycles



ARL C.S. Aluminum
60 cycles



Delphi



Centerline



ARL

All of the test specimens passed the inspection after 1000 hours

Corrosion MIL-DTL-83488

Solutions

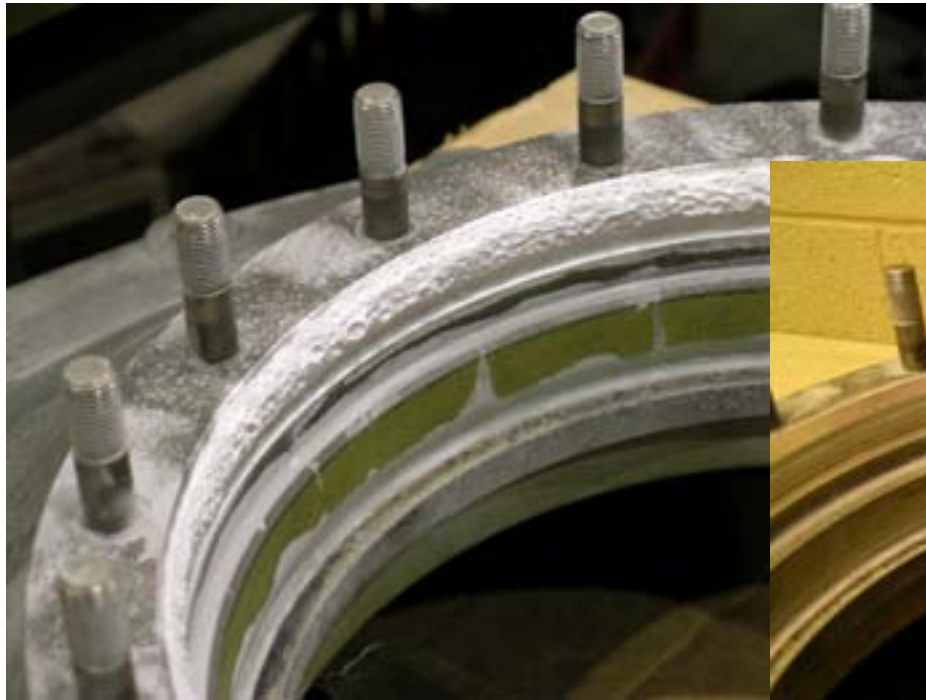
Corrosion Protection of Ferrous Materials using Cold Spray



Solutions

Corrosion Protection and Restoration of Magnesium

Gear box housing supplied by NAVAIR Depot Cherry Point



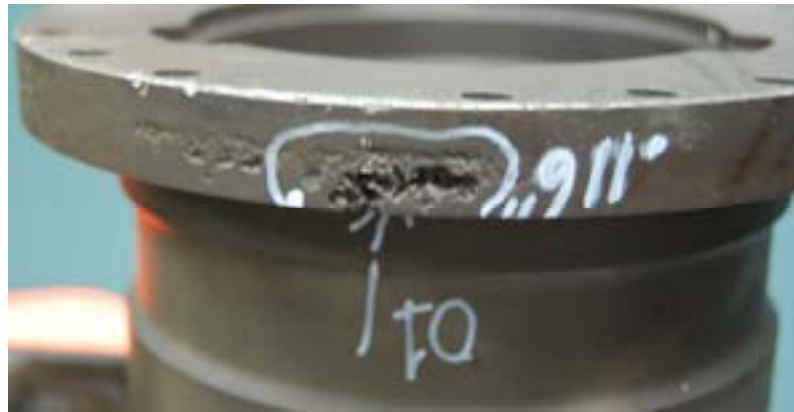
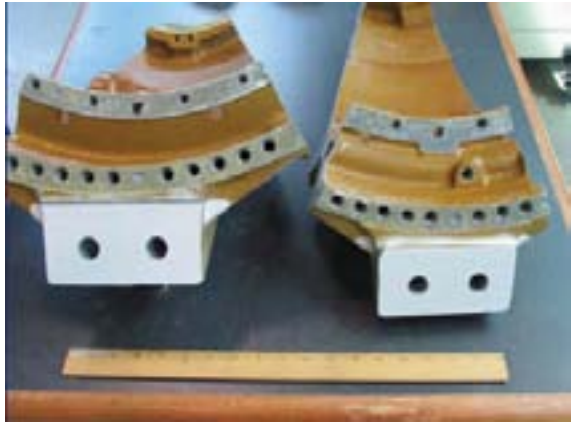
Part sprayed by CenterLine

Part machined after spraying



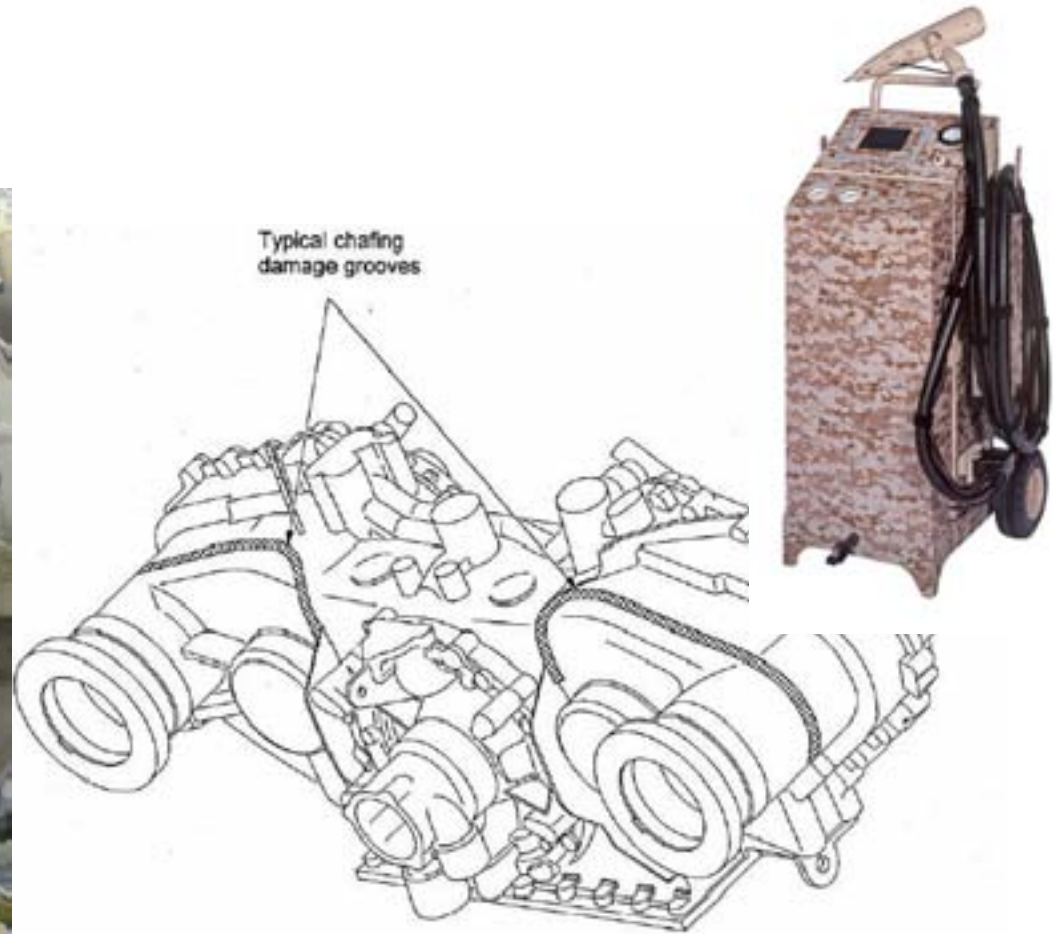
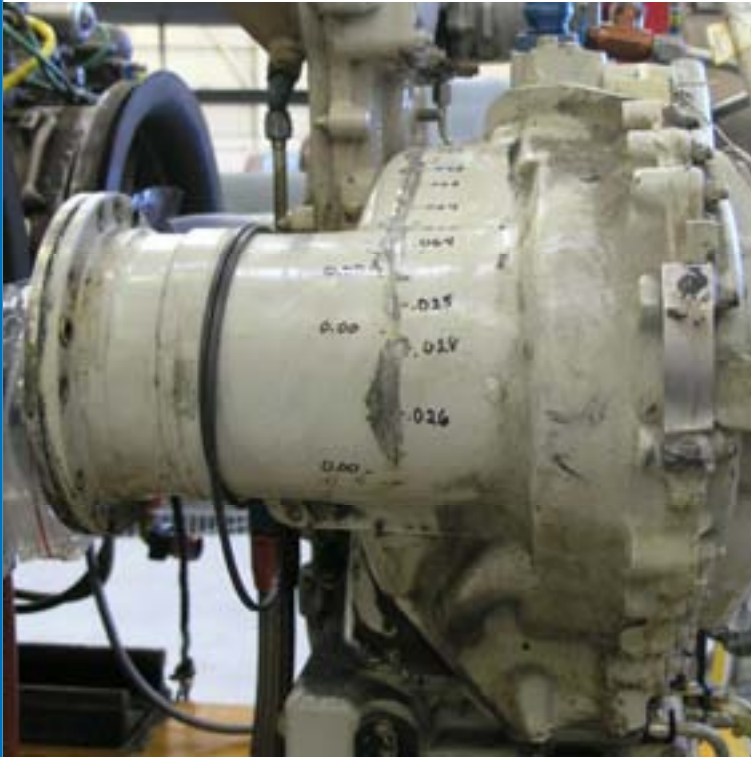
Solutions

Corrosion Protection and Restoration of Magnesium



Solutions

Corrosion Protection and Restoration of Magnesium



Implementation

Corrosion Protection of Ferrous Materials using Cold Spray

- **USMC**
The use of cold spray for the repair of LAV'S is being evaluated
- **US Space Command**
Currently there are 2 tests on going for spot corrosion repair on launch facilities.
- **Boeing Intergraded Defense Systems and Wright -Patterson AFB** are continuing to qualify the repair of IVD Aluminum coated parts including landing gear.
- **Qualification and procedures complete by 2nd Quarter 2009**

Implementation

Corrosion Protection and Restoration of Magnesium

- **Navair Cherry Point is continuing the study of cold spray properties to qualify repairs.**
- **Tinker AFB in conjunction with General Dynamics has also purchased a portable system to qualify magnesium casting repairs**
- **Fort Hood will be implementing repair to Apache casting after ARL qualify the repair procedures**

Benefits

Corrosion Protection of Ferrous Materials using Cold Spray

- **Cold Spray offers spot repairs of corrosion that could be at Depot or in Theater.**
- **The repair procedure for Aluminum IVD is stripe and recoat at this time which means disassemble and recoat.**
- **Cold Spray repair will negate the stripe and recoat procedure and allow spot repair on new components as well as in the field repairs.**
- **This will reduce component lead times and increase Aircraft up time**



Benefits

Corrosion Protection and Restoration of Magnesium

- **Sikorsky Aircraft Corporation - 40% of the H-60 main and tail rotor transmission housings that are currently replaced in overhaul would remain in service if coated with SPD aluminum alloys.**
- **This represents an annual savings of approximately \$250,000 on those specific components alone.**
- **The annual cost of acquiring new magnesium alloy components throughout the Army is approx. \$8 million.**
- **Estimating to all components in the entire fleet of Army helicopters indicates that annual savings of several million dollars.**

Acknowledgments

I would like to thank all the team members for there assistance in putting this presentation together.



SOLIDICA

DELPHI



NAV  AIR





Questions

Thank you