

# Aerospace New Trends: Saving with the Cold Spray Process



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1. **Company Overview**
2. **Cold Spray in the Aerospace Industry**
3. **Case study: Repair of Integrated Drive Generators**
4. **Repair Procedure Development**
5. **Validation**
6. **Optimized Procedure**
7. **Cost Savings**
8. **Summary**



- Private company established in 1953
- Located in Livermore, California
- Over 60 years in Aviation Business
- Staff of 70 employees including skilled technicians, machinists, support staff, and onsite Engineer/FAA-DMIR
- Provides test, repair and overhaul service on Commercial, Military aircrafts, and Helicopters Class I, II, III components
- Provide 24/7 AOG Service
- Provides unique special DER repairs using the cold spray process



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# Repairing in the Aerospace Industry

- ✓ Aluminum and Magnesium Alloys materials of choice for non-structural and structural components
- ✓ The life span of an aircraft often surpasses the commercial availability of standard replacement components
- ✓ Obsolescence makes replacement components increasingly expensive or simply impossible to obtain
- ✓ Ability to economically and reliably restore damaged components becomes an important necessity of aircraft maintenance
- ✓ Traditional thermal spray processes produce excessive heat, porosity, distortion, oxide inclusions
- ✓ Traditional thermal Spray requires labor-intensive masking to protect areas from overspray. Masking often represents a sizeable portion of the repair costs

# Cold Spray in the Aerospace Industry

- Thermal spray shops serving the aerospace industry have developed numerous cold spray repair specifications to bring back to service hundreds of high value aircraft components
- The ability to restore these components to the same quality standards as original OEM using cold spray is saving the aerospace industry millions of dollars



# Cold Spray in Aerospace



VAC AERO  
INTERNATIONAL INC.



AEROSPACE SERVICES  
A Textron Company

Honeywell



Hamilton Sundstrand  
A United Technologies Company



Concurrent  
Technologies  
Corporation



Triumph Group, Inc.



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## Typical Housings

- Tight tolerance Housings made of cast Magnesium and/or Aluminum which do not tolerate thermal distortion
- After years of service, the housing becomes worn or damaged beyond normal repair



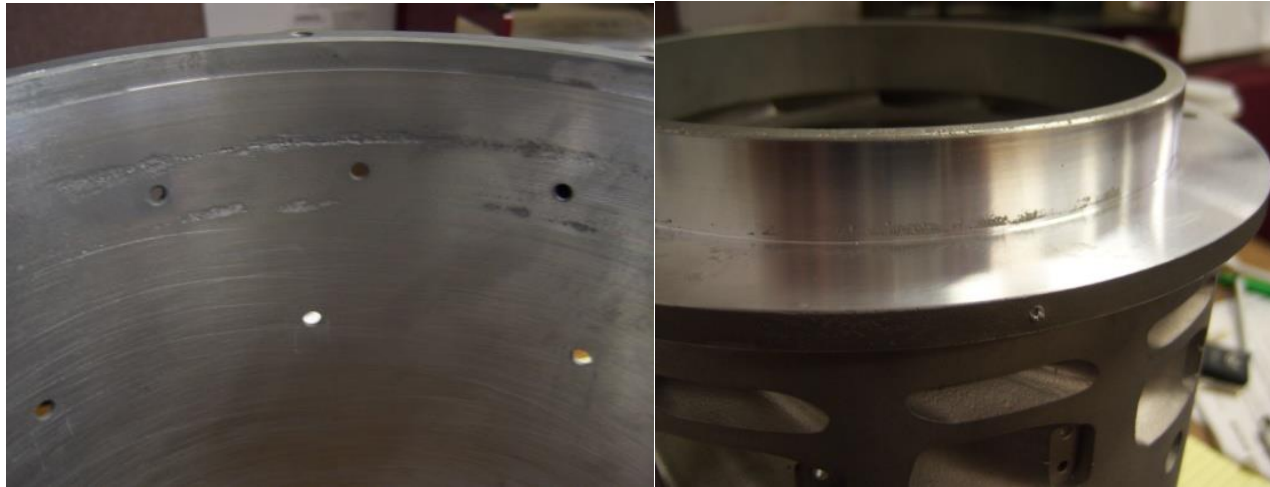
APU Generator Endcap-Boeing 777



IDG End Housing-Boeing 747/757/767

## Component Failure

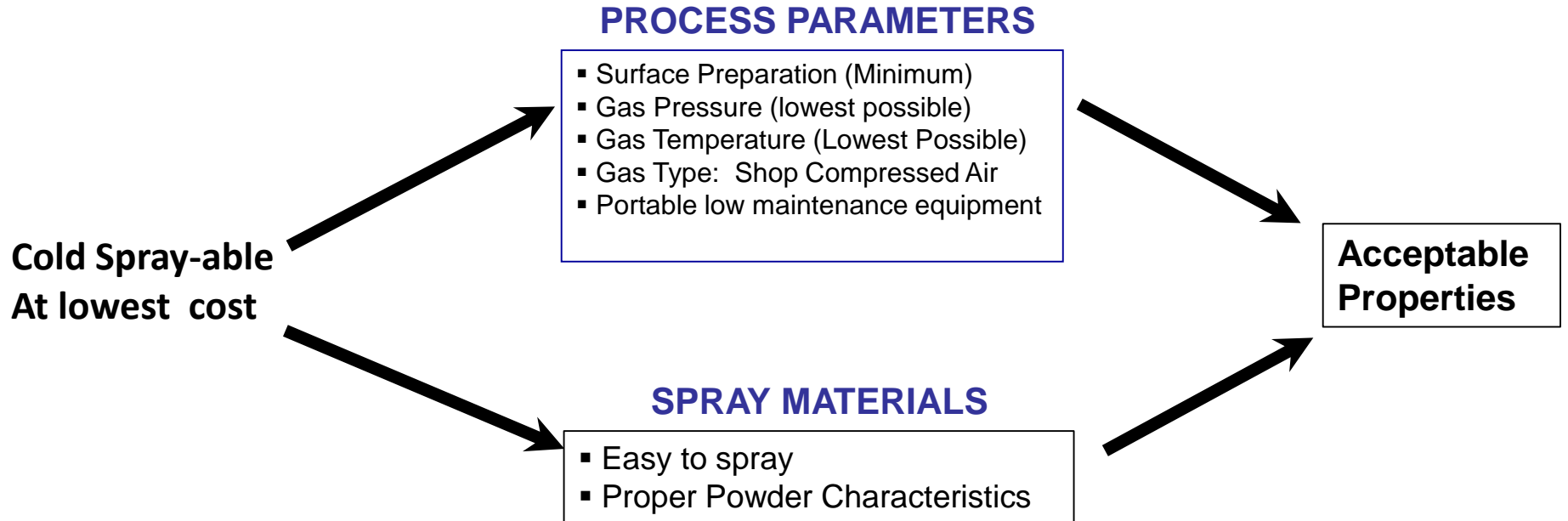
- ✓ Pitting Corrosion
- ✓ Failures are located at tight tolerance heat-sensitive areas such as stator bores, exciter bores, pilots, mounting pads and mating faces...



APU Generator Stator Housing-Boeing 747

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# Repair Procedure Development and Specification



# Repair Procedure Development and Specification

## MATERIAL

SST A0050 / Al-Al<sub>2</sub>O<sub>3</sub> mix



## PROCESS OPTIMIZATION

### SST SERIES P System

Pressure, Temperature, Air -Manual/Robotic Operation

## VALIDATION TO OEM SPEC

- ✓ ASTM C633 bond strength
- ✓ Metallographic Inspection
- ✓ Hamilton Sundstrand SPR52 90° bend





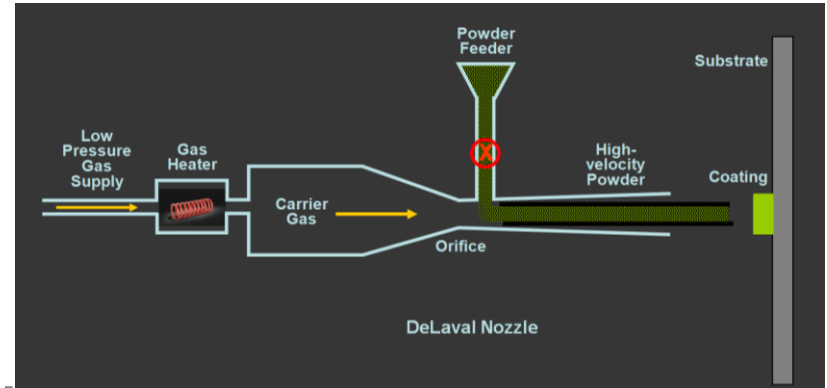
# Downstream Injection Cold Spray (SST)

**Gas:** Air , Nitrogen / Helium

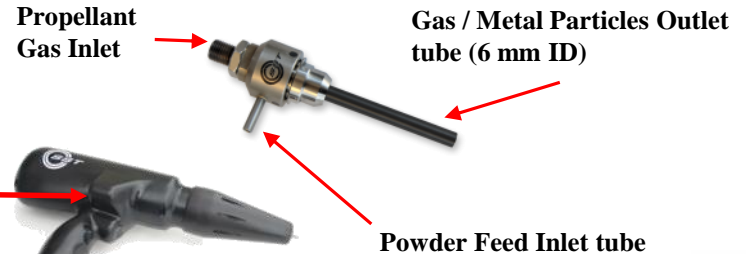
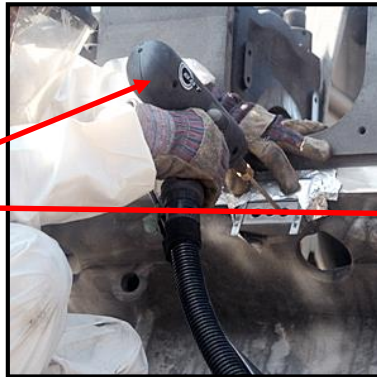
**Gas Pressure:** 60 -500 psi (4-34 bar)

**Gas Temperature:** 20 – 550°C (68 - 1022 °F)

**Particle Velocities:** 300 - 900 m/s

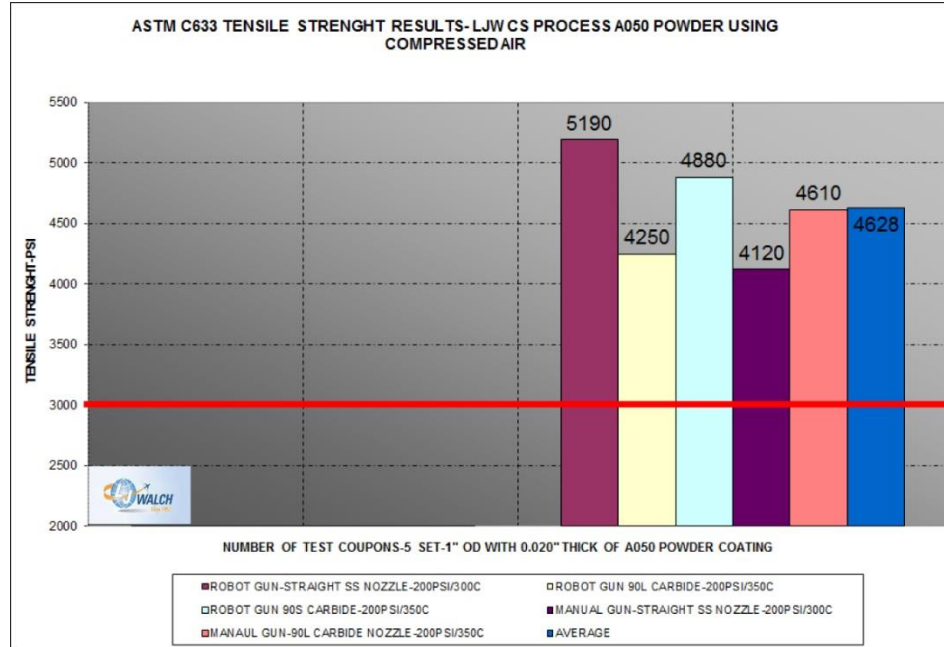


**Handheld SST  
Manual Gun with  
Thumb and  
Forefinger controls**

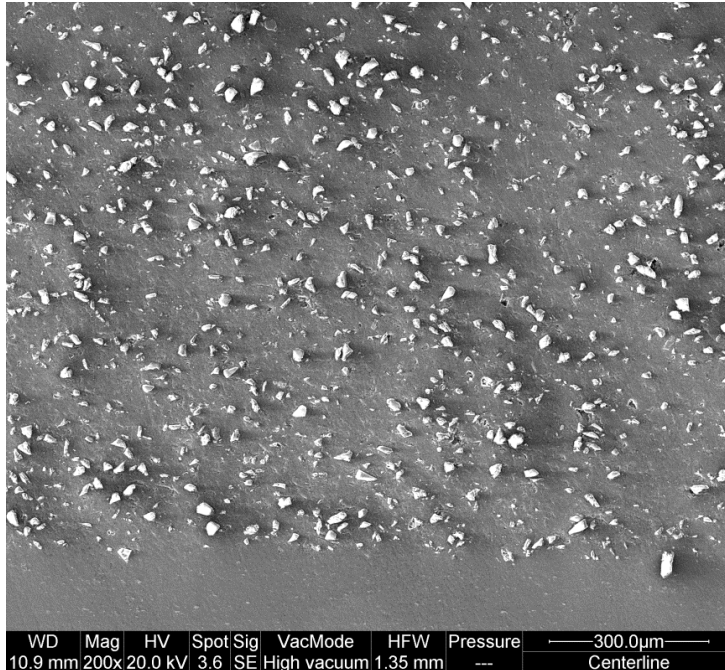


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# ASTM C633 Bond Strength Testing

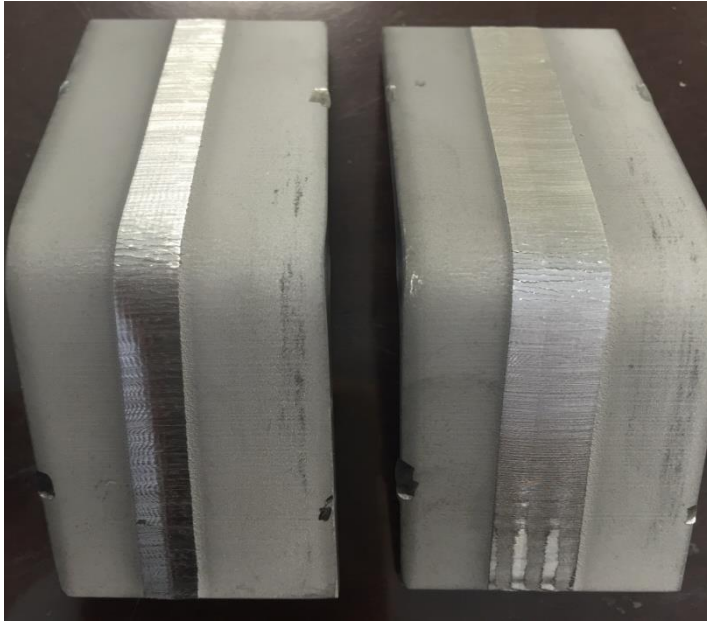


# Metallographic Inspection



- ✓ Porosity less than 2%
- ✓ No cracking
- ✓ No lack of bonding

## Hamilton Sundstrand SPR52 Bending



**90-Degree bend tests with the coating in tension bent around a 0.25” radius showed no spalling or chipping**

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## Optimized Repair Procedure

- ✓ Removal of existing corroded and/or damaged surfaces
- ✓ Pre-machining as necessary to facilitate spray deposition
- ✓ Surface preparation
- ✓ Cold spraying using manual or robotic gun
- ✓ Post machining of the repair per OEM/LJW approved engineering specifications
- ✓ Visual and dimensional inspection
- ✓ Non destructive examination per ASTM-1417
- ✓ Corrosion protection of repaired areas using applicable solutions

# Optimized Repair Procedure

ROBOTIC COLD SPRAYING



POST MACHINING



# Finished Products

IDG Stator  
Housing-  
747/757/767



APU  
Generator  
Endcap-  
Boeing 777



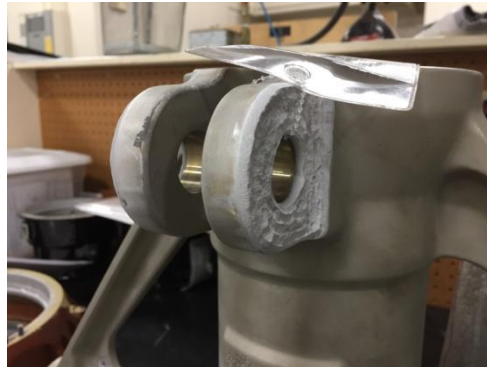
IDG Stator  
Housing-A320  
classic



IDG Stator  
Housing-  
MD11/777



## Repaired Parts using cold spray process

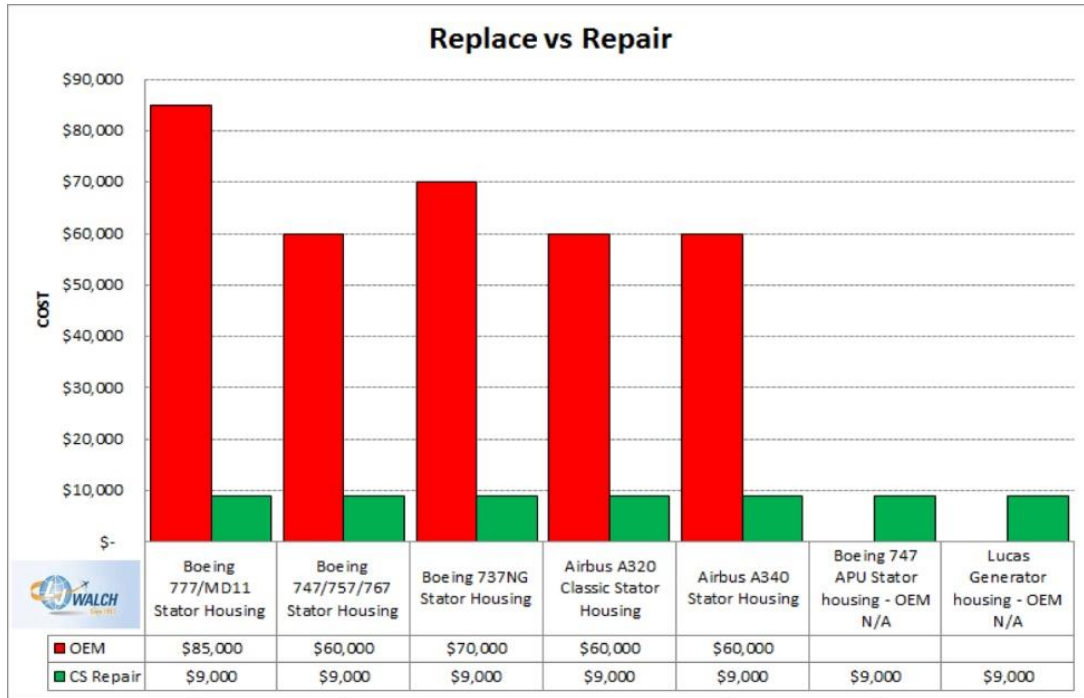


- L1649A Lockheed Constellation heating ducting
- Pneumatic Valve Housing
- Landing Gear Steering Colum
- Helicopter case housing

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# Cost Savings



- Ability to recover these components at a fraction of their OEM replacement cost – this is assuming that the part is commercially available
- In many instances the component is simply no longer available thus making an even stronger economic sense for cold spray restoration



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# Summary

The Cold spray process has become an essential tool that complements thermal spray processes for repair and restoration of high value housings used in commercial aircraft

Cold spray enables the aerospace industry to recover high value and/or irreplaceable components- that otherwise would be scrapped, at a fraction of their replacement cost, thus maximizing profitability

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