

# **COLD SPRAY**

## Repair Technology within AFLCMC



**U.S. AIR FORCE**



University of Dayton  
Research Institute

23 Jun 2020

Briefed by JR Groenewegen (UDRI)

Contract: GS05Q17BMD0005



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# Implementing Cold Spray Repair Technology for the Air Force



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## MISSION

Qualify state-of-the-art advanced technologies for the sustainment enterprise while providing training for engineers and technicians through a collaborative environment



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# *Cold Spray Repair Technology Innovation Across the Air Force*



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**COLD SPRAY  
TECHNOLOGY  
for the AIR FORCE:**  
development locations

## **ATTC – Dayton**

Dayton, OH  
Near Wright Patterson AFB



## **ATTC – Middle GA**

Warner Robins, GA  
Near Robins AFB

**CO-LOCATED WITH CENTERS OF ENGINEERING EXPERIENCE**



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# Cold Spray Repair Technology Innovation Across the Air Force



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## ATTC – Dayton

**Current Focus Areas:** Testing, Validation and Verification, and Qualification

**Technologies:** AM, Cold Spray, Corrosion (paint/powder coat and testing), machining, heat treatment



## ATTC – Middle Georgia

**Current Focus Areas:** Testing, Validation and Verification, and Qualification

**Technologies:** AM, Cold Spray, Corrosion (e-coat and testing), machining, heat treatment



FOUNDED ON INNOVATION AND COLLABORATION



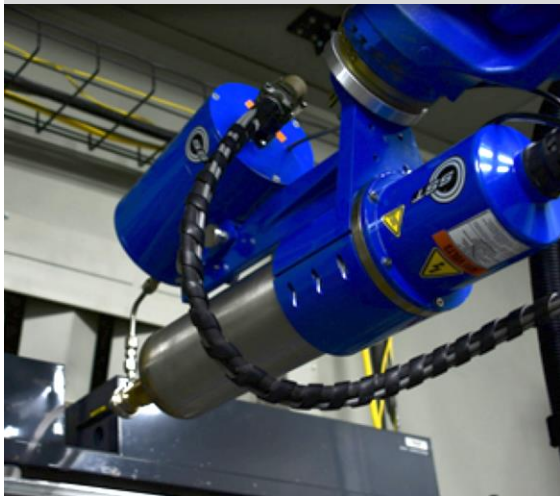


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# CS Equipment Currently in Service at ATTCs for Development Work



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## Centerline EP Low Pressure CS System

- 34 Bar, 500°C
- Pure aluminum, aluminum alloys, blended/matrix coatings
- Focus on low cost coatings with nitrogen
- HiWatch HR laser diagnostics unit



## VRC Gen III High Pressure CS System

- 70 Bar, 460°C
- Aluminum alloys, stainless steel, copper, and titanium
- Focus on high adhesion strength and harder coatings with nitrogen or helium



## Yaskawa/Motoman

- MH50 robotic arm and MotoPOS rotary/tilt table

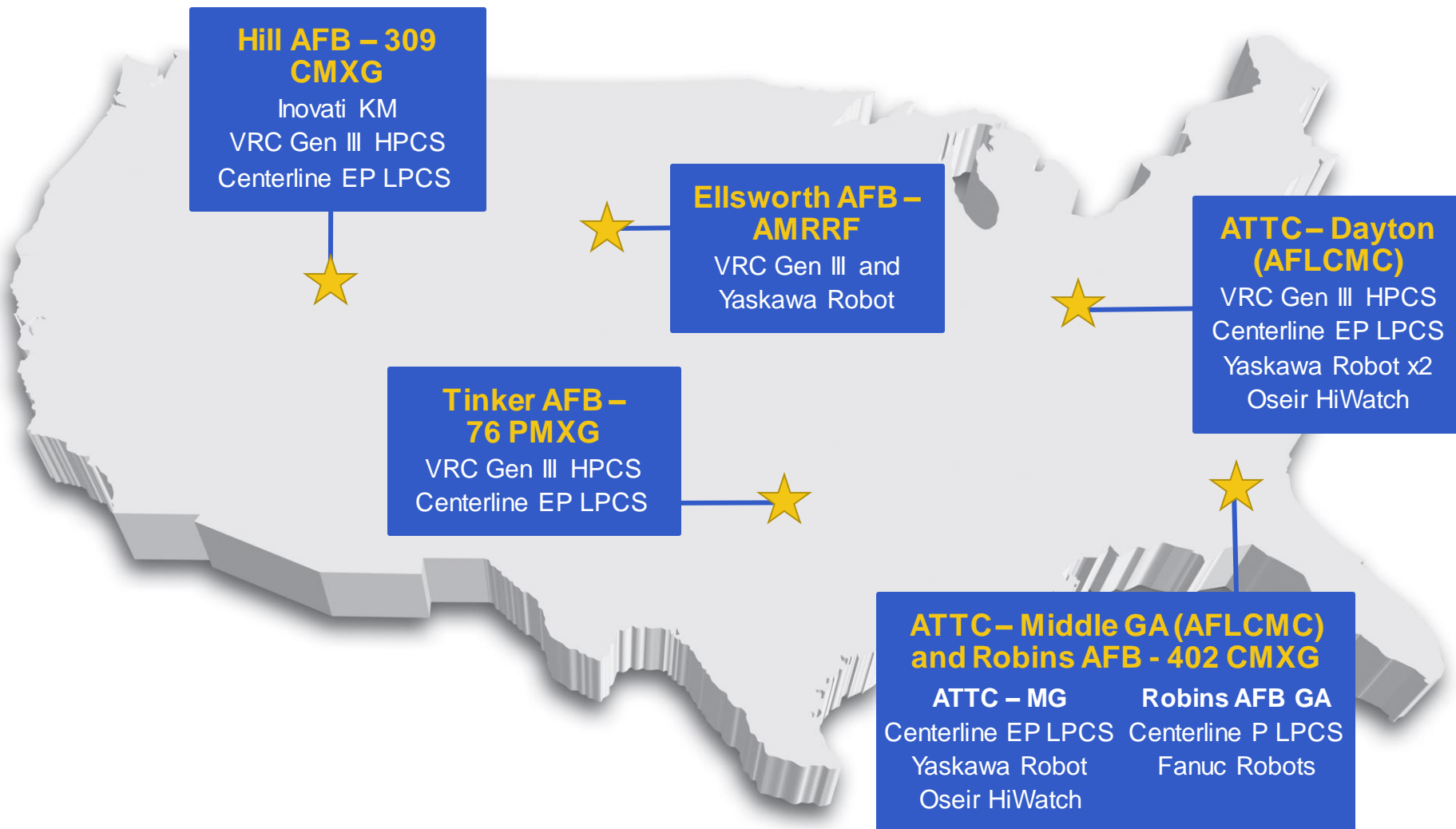


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# Cold Spray Equipment Across the AF



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# Cold Spray Repair Technology Innovation Across the Air Force



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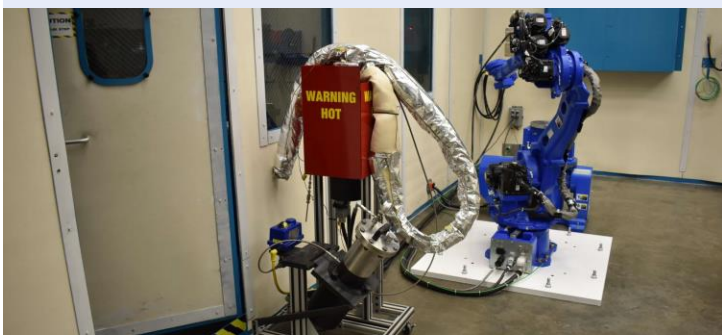
## Ellsworth Additive Manufacturing Rapid Repair Facility (AMRRF)

AFGSC 28 MXS/AMRRF

**Current Focus Areas:** Dimensional restoration on B-1B panels

**Equipment:** VRC Gen III, Yaskawa Robotics

**POC's:** TSgt Lance Liverman, Mr. Brian James, Mr. Dave Darling



## Tinker AFB – 76 PMXG

AFMC 76 PMXG/MXDEKA

**Current Focus Areas:** Gearbox repair

**Equipment:** VRC Gen III, Fanuc Robotics, Centerline EP (coming soon)

**POC's:** Mr. Glen Drebes, Mr. Stehvin Olson



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# Cold Spray Production Facilities



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## Robins AFB CS

AFMC 402 CMXG/MXDED

**Current Focus Areas:** Slat track repair

**Equipment:** Centerline P, VRC Gen III, Fanuc Robotics

**POC's:** Mr. Scott Swartz



## Hill AFB CS

AFMC 309 CMXG/OO-ALC/EN

**Current Focus Areas:** Gearbox repair

**Equipment:** Upcoming – Inovati KM, VRC Gen III, Centerline

**POC's:** Mr. Rik Crowther



Inovati KM



VRC Gen III



Centerline EP





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# Cold Spray Major Steps 2017 – 2020



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- Cold Spray capabilities ready at both Dayton, OH (Spring 17) and Warner Robins, GA (Fall 18) ATTCs
- Approval achieved on cold spray repairs for:
  - B-1B Forward Equipment Bay panels (2018)
  - B-1B hydraulic tubing (2018)
  - A-10 Constant Speed Drive (2019)
  - TF33-P103 and P100 Rear Gearbox Housings (2019)
  - F-16 Accessory Drive Gearbox (2019)
- Provided training for cold spray personnel from Tinker AFB and Ellsworth AFB
- Book form drawing of "Standard Practices and Procedures for Repair Using Cold Spray" to be published Q3 2020 by USAF Metals Technology Office (MTO)



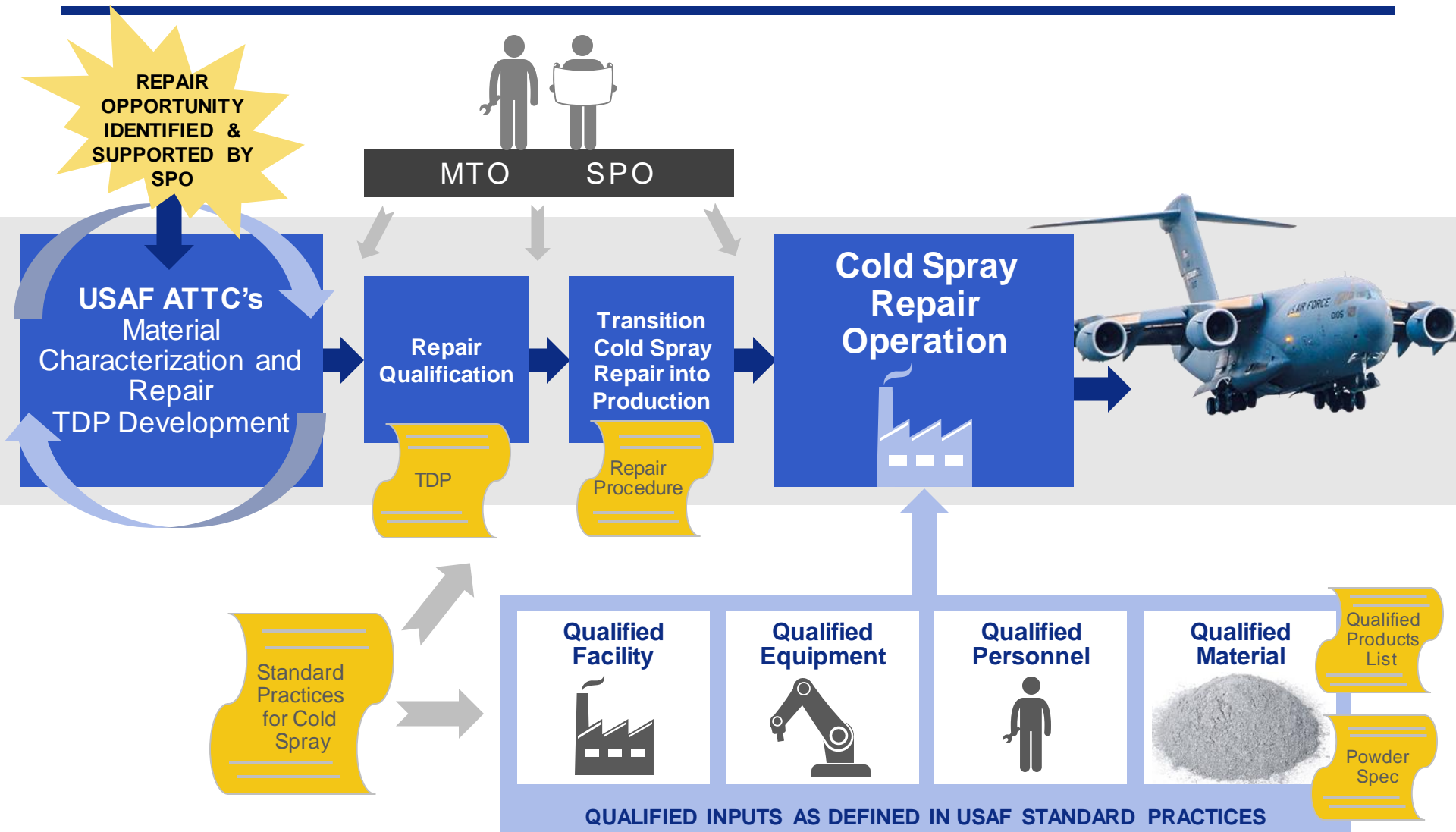


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## ***Documentation – Qualification Process***



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# Summary of Approved Repairs



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## Repair: F-16 Accessory Drive Gearbox

**Repair type:** Gearbox inner diameter – 6061Al

**Material combination:** 6061 Al on ZE41A Mg

**CS equipment:** VRC Gen III with helium

**Production facilities:** Tinker AFB and Hill AFB

**Approval Authority:** Airworthiness Change Evaluation Team (CET)



## Repair: TF-33 P100/P103 Rear Gearbox Housing

**Repair type:** Gearbox inner diameter

**Material combination:** 6061 Al on EZ33A and AZ92A Mg

**CS equipment:** VRC Gen III with helium

**Production facilities:** Tinker AFB

**Approval Authority:** Airworthiness CET



## Repair type: A-10 CSD Safety Wire Lug

**Material combination:** Matrix powder  
(Centerline SST-A0082) on EZ33A-T5 Mg

**CS equipment:** Centerline EP with nitrogen

**Production facilities:** Tinker AFB

**Approval Authority:** Program Office



## Repair type: B-1B Fastener Hole Countersinks Repair

**Material combination:** 6061 Al on 2024 Al

**CS equipment:** VRC Gen III with helium

**Production facilities:** Ellsworth AFB

**Approval Authority:** Airworthiness CET





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## *Summary*



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**AM and Cold Spray**  
are critical technologies  
able to help address maintenance  
and sustainment challenges





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# Questions?

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