



28th Bomb Wing



AFGSC.... Deter...Assure...Strike!

Win the Fight - Strengthen the Team - Prepare for the Future

Cold Spray Transition for Ellsworth Air Force Base

MSgt Jeremy Horstman

28 MXS Chief (AMRRF)

25 June 2019

Brian L. James

28 MXG Engineering

- Prepare for the Future -

***Purpose:** To discuss Implementation of Ellsworth Additive Manufacturing Facility (AMRRF) for cold spray repair*



Overview



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- Additive Manufacturing Rapid Repair Facility (AMRRF)**

Mission Statement

- AFMC**

DLA MICAP Data (2011-2015)

DLA MICAP Data (2015-2018)

- AMRRF Facility**

Facility & Equipment

Operational Requirements

- AMRRF Personnel**

Operational Requirements

- AMRRF Projects**

Tubing, FEB panels, Ejector Racks, C-5 Panel, PLA sprays

- New Parts qualification**

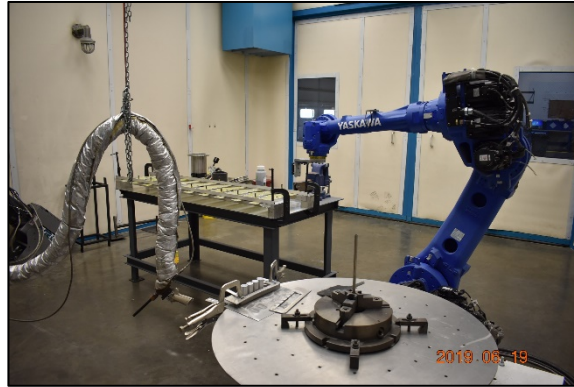




28 MXS Additive Manufacturing Rapid Repair Facility



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AMRRF Facility



Mission Statement

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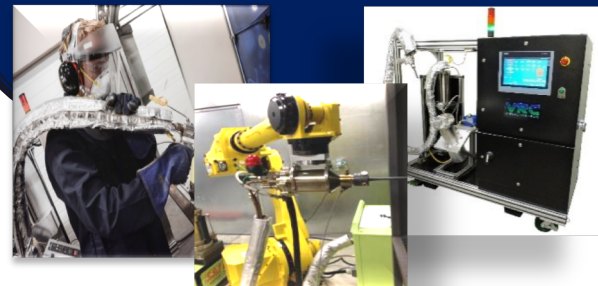
Mission Statement

Utilize advanced Additive Technologies to Provide Rapid Repair of Weapon Systems Components To Enhance Combat Readiness and Reduce Costs



Vision Statement

Leverage advances in Additive Manufacturing Technologies to improve weapon system maintenance and repair capabilities



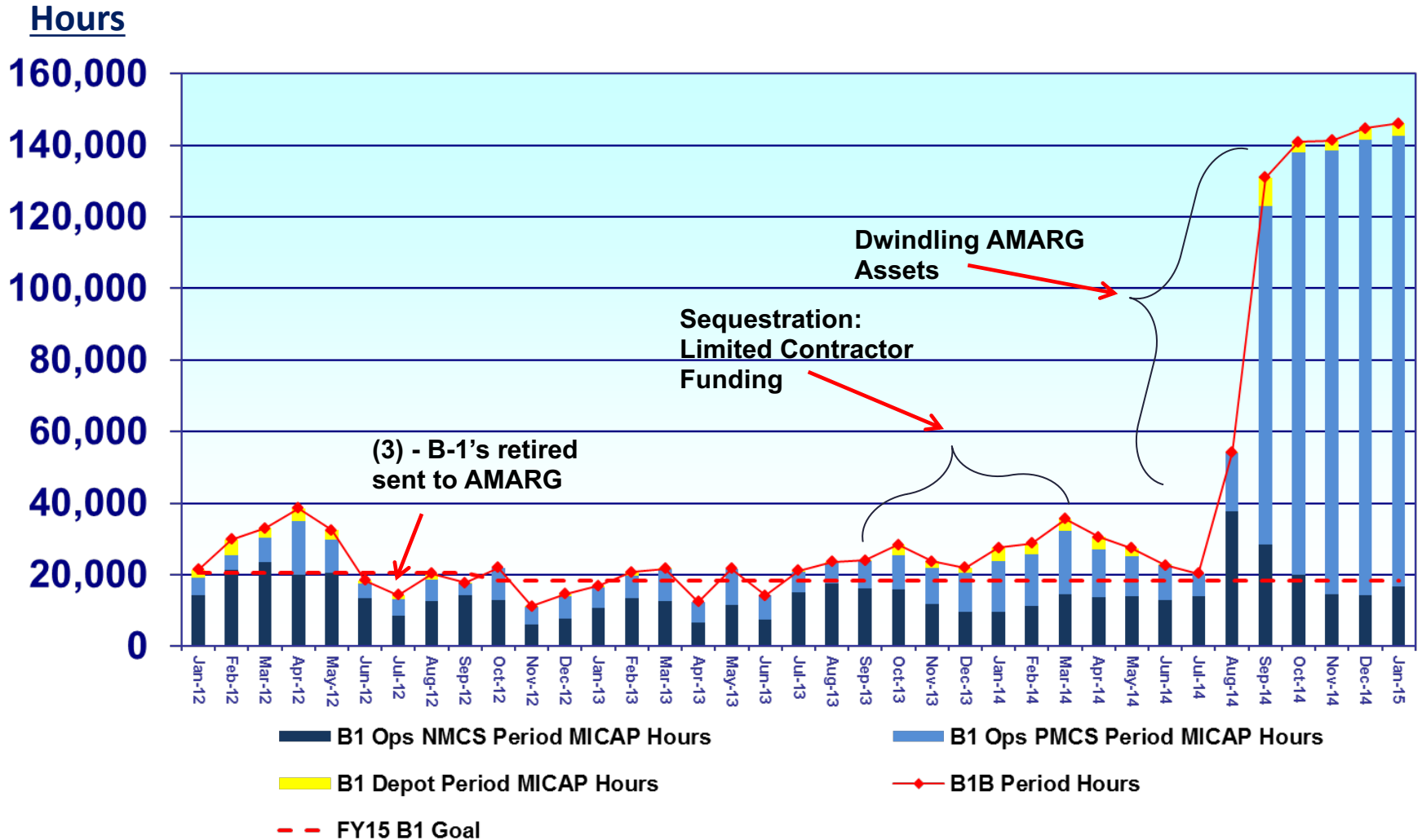


B-1 (WSDC - 56F)



Weapon System MICAP Data

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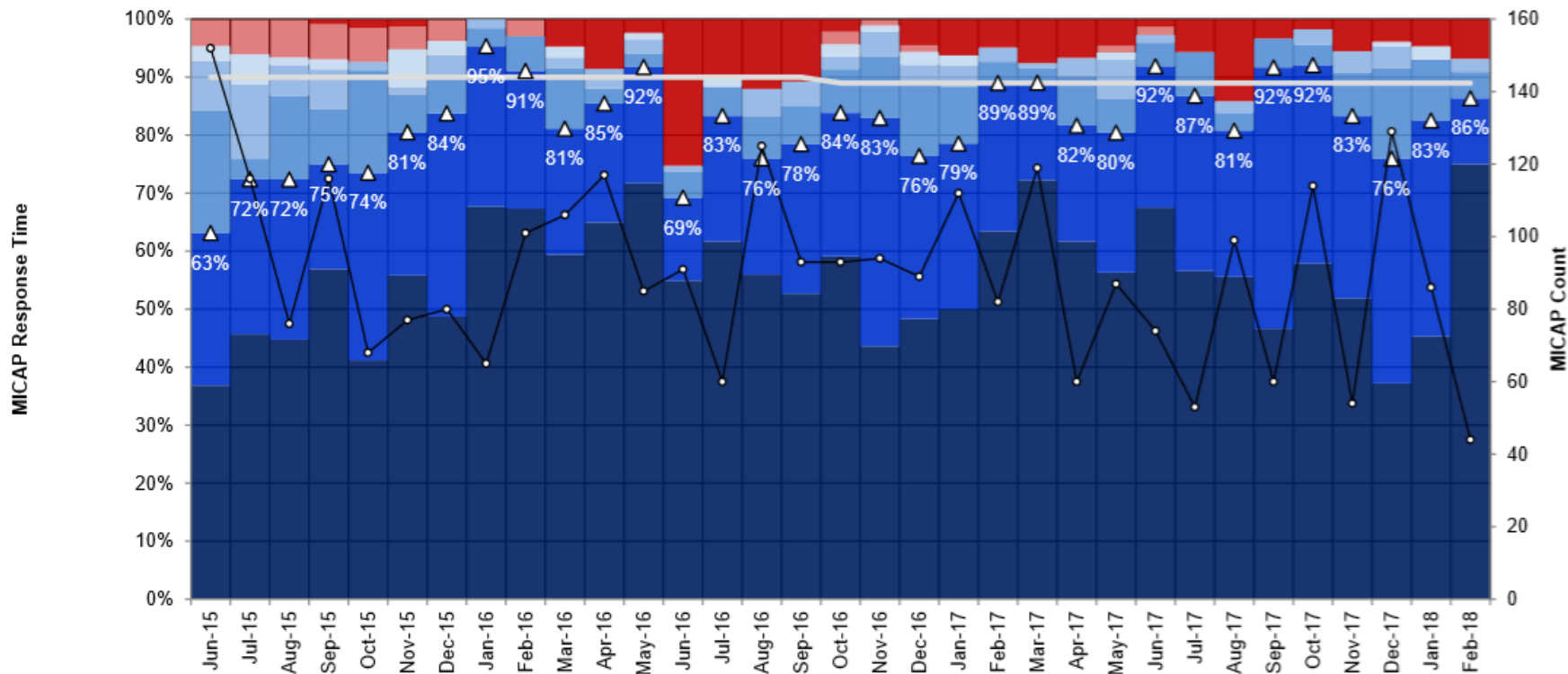




B-1 (WSDC - 56F) Weapon System MICAP Data



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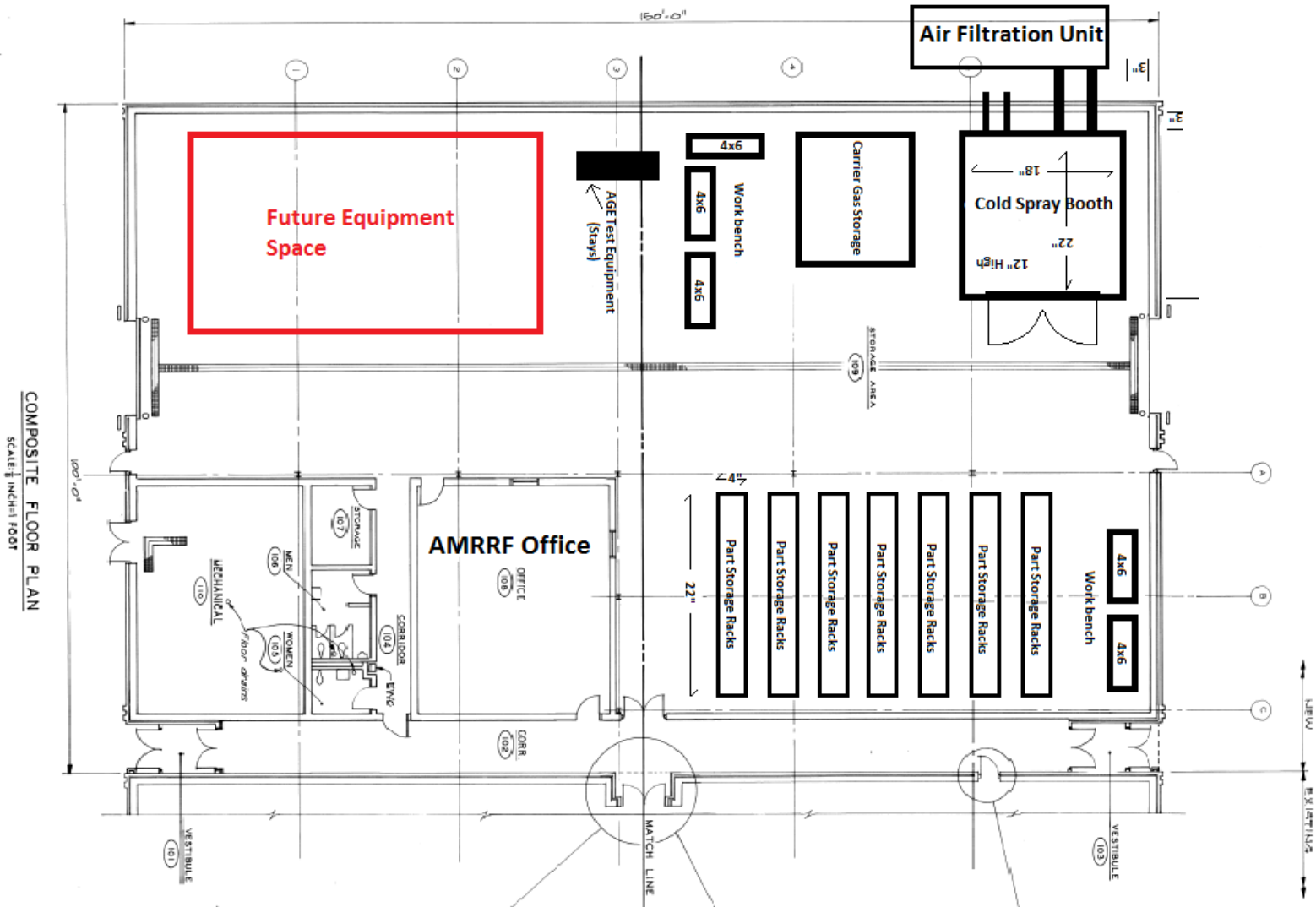


	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	
Open	0	0	0	1	1	1	0	0	0	5	10	2	23	6	15	10	2	0	4	7	4	9	4	4	1	3	14	2	2	3	5	4	3	
> 4 wks	7	7	5	7	4	3	3	0	3	0	0	0	0	0	0	0	2	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
4 wks	4	6	1	2	0	5	2	0	0	2	0	1	0	1	0	0	2	1	2	2	0	0	0	1	0	0	0	0	0	0	0	1	2	0
3 wks	13	15	4	8	1	1	3	1	0	2	4	2	1	0	6	4	2	4	3	4	2	1	2	6	1	0	2	0	3	2	5	0	1	
2 wks	32	4	11	11	12	5	5	2	6	11	3	2	4	3	9	6	7	10	11	11	3	3	5	5	3	4	3	3	4	4	20	9	2	
4-7 days	40	31	21	21	22	19	28	18	24	23	24	17	13	13	25	24	23	37	25	32	21	20	12	21	18	16	25	27	39	17	50	32	5	
0-3 days	56	53	34	66	28	43	39	44	68	63	76	61	50	37	70	49	55	41	43	56	52	86	37	49	50	30	55	28	66	28	48	39	33	
Δ % 0-7 days	63.1	72.4	72.3	75.0	73.5	80.5	83.7	95.3	91.0	81.1	85.4	91.7	69.2	83.3	76.0	78.4	83.8	82.9	76.4	78.5	89.0	89.0	81.6	80.4	91.8	86.7	80.8	91.6	92.1	83.3	75.9	82.5	86.3	
Goal	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	89.0	
○ Total MICAPs	152	116	76	116	68	77	80	65	101	106	117	85	91	60	125	93	93	94	89	112	82	119	60	87	74	53	99	60	114	54	129	86	44	

AMRRF Facility



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AMRRF Facility

Key Requirements



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Facility & Installation:

- Operational - 1 July 2017
- PHA NFPA Compliant
- Robot and Pedestal Integrated Into VRC GEN III CS Equipment
- Establish AFGSC Operational Funding FY19/20

Equipment Maintenance & Repair:

- Develop Maintenance Manuals
- Develop Training Procedures
 - Provided by equipment vendors according to 28 BW Operating Instruction



AMRRF Facility

Key Requirements



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Operation Requirements:

- Hazardous Communication Program
- Hazardous Waste Program
- Housekeeping Plans
- Machine Maintenance and Inspections (PCAMS)
- Safety and Occupational Health requirements
- Environmental Programs (EPA Requirements)
- Respiratory Protection*
 - 3M Full Face vs. PAPR (Powered air Purifying Respirator)





AMRRF Personnel Key Requirements

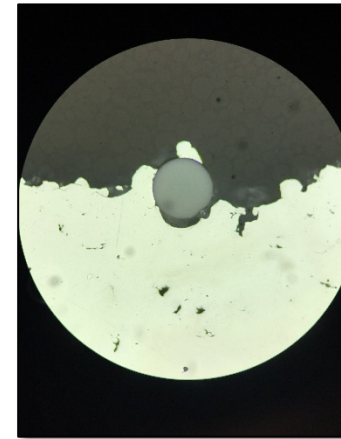


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Operational Requirements:

- Training required
 - Yaskawa Academy
 - Advanced Technical Training Center
 - On the Job Training
- Training documentation (TBA)



TBA - MTP - Query

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Hood, Robert G - Workcenter Supervisor

Suspenses Scheduling Courses ITP MTP Products Reports & Queries Administration Change Role Logout Help

28th MXS/MXMFs - Aircraft Structural Maintenance (28th MXS MXMF Fabrications Flight) Select a Work Center

Original Display By: Display by Products Display by Task Groups

Product Types To Display: CFETP AF JCS Command JCS Work Center JCS

Filter Options: Tasks Assigned to Groups Tasks Not Assigned to Groups Deployment Task Associated UTC Numbers None

Results Per Page: 100

View Group	5 LEVEL CORE Core Tasks (5)	View Group	5 LEVEL Local/Qualification Tasks	View Group	7 LEVEL LOCAL/Qualification Tasks	View Group	7 LEVEL TASKS / Inst Tasks	View Group	SUPPORT SECTION local Tasks
CFETP 2A7X3 - 006.1000 and EQUIPMENT									
Training Reference - TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, and applicable -32, -33, -34 series TOs, and equipment manuals									
CFETP 2A7X3 - 006.001 Composite Tool Kits (CTKs)									
CFETP 2A7X3 - 006.001.001 Inventory	Core Indicator: 5	Certification Indicator: <input type="checkbox"/>	Minimum Coverage: 5	Deployment Task: N	Duration in Days: 60				
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)									
Special Instructions: N									
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, and applicable -32, -33, -34 series TOs, and equipment manuals. 12 MONTH MILESTONE									
CFETP 2A7X3 - 006.002 Use hand tools									
Training Reference - TO 32-1-101									
Core Indicator: 5	Certification Indicator: <input type="checkbox"/>	Minimum Coverage: 5	Deployment Task: N	Duration in Days: 60					
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)									
Special Instructions: N									
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TO 32-1-101. 12 MONTH MILESTONE									
CFETP 2A7X3 - 006.003 Maintain tools									
Training Reference - TO 32-1-101									
Core Indicator: 5	Certification Indicator: <input type="checkbox"/>	Minimum Coverage: 5	Deployment Task: N	Duration in Days: 90					

CFETP 2A7X3 - 011	REPAIR, MODIFY and FABRICATE METAL PARTS and ASSEMBLIES of AIRFRAME STRUCTURES	Training Reference - TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691 / applicable structural repair and corrosion control TOs
CFETP 2A7X3 - 011.001 Identify metals	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.003 Interpret drawings	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.005 Develop layout for repairs	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.006 Develop layout for parts	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.008 Cut sheet metal	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.009 Form metal parts		
CFETP 2A7X3 - 011.009.001 Machine form parts	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90
Remarks: Method of training: Demonstration performance, lecture, and reading. Evaluation method: performance based. Training Aid/Resources: TOs 1-1A-9, 1-1A-1, 1-1A-8, 1-1-691, applicable structural repair and corrosion control TOs. 12 MONTH MILESTONE		
CFETP 2A7X3 - 011.009.002 Hand form parts	Core Indicator: 5	Certification Indicator: <input type="checkbox"/> Minimum Coverage: 5
Task Groups Assigned: 5 LEVEL CORE Core Tasks (5)		Deployment Task: N
Special Instructions: N		Duration in Days: 90



Cold Spray Activities

Future Parts Qualification Plans



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Class 3

*Continue Class 3
Repair approvals
Based on similar
criteria with
different Material
Requirements*



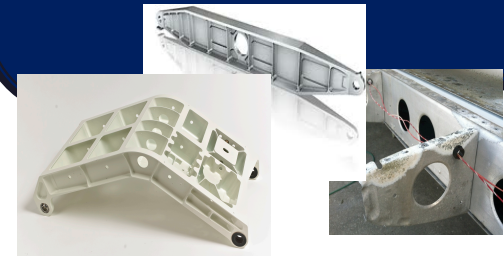
Class 2

*Initial development
Trials for Class 2
Components
through the CET
Process*



Class 1

*Initial development
of Class 1 Structural
Part induction
through the CET
Process*



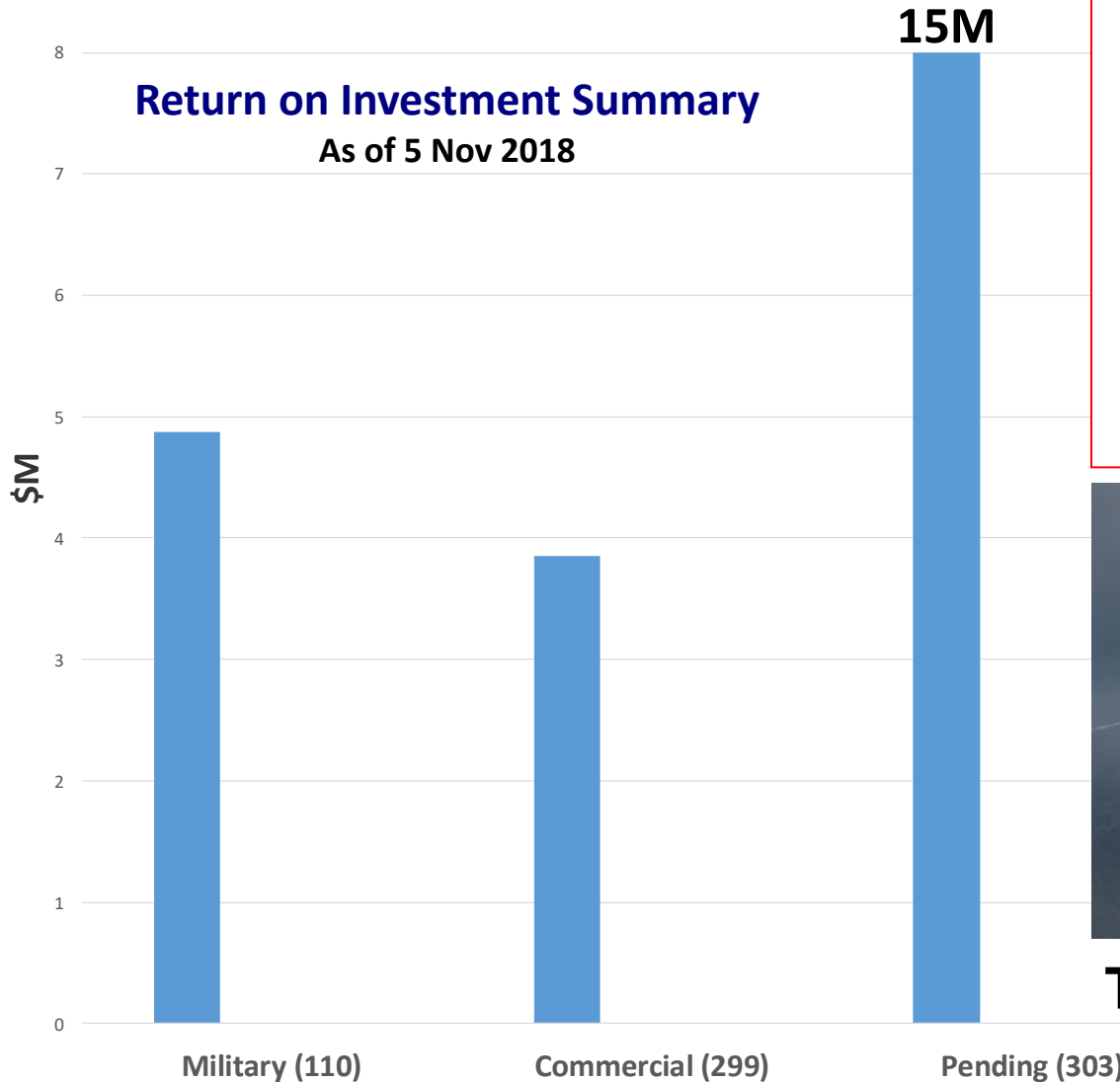


OSD ManTech



Cold Spray Repair & Rebuild Technology

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Total Savings to Date

\$8.7M

Savings with Pending Contract Items

\$23.7M



Total DMS&T Investment

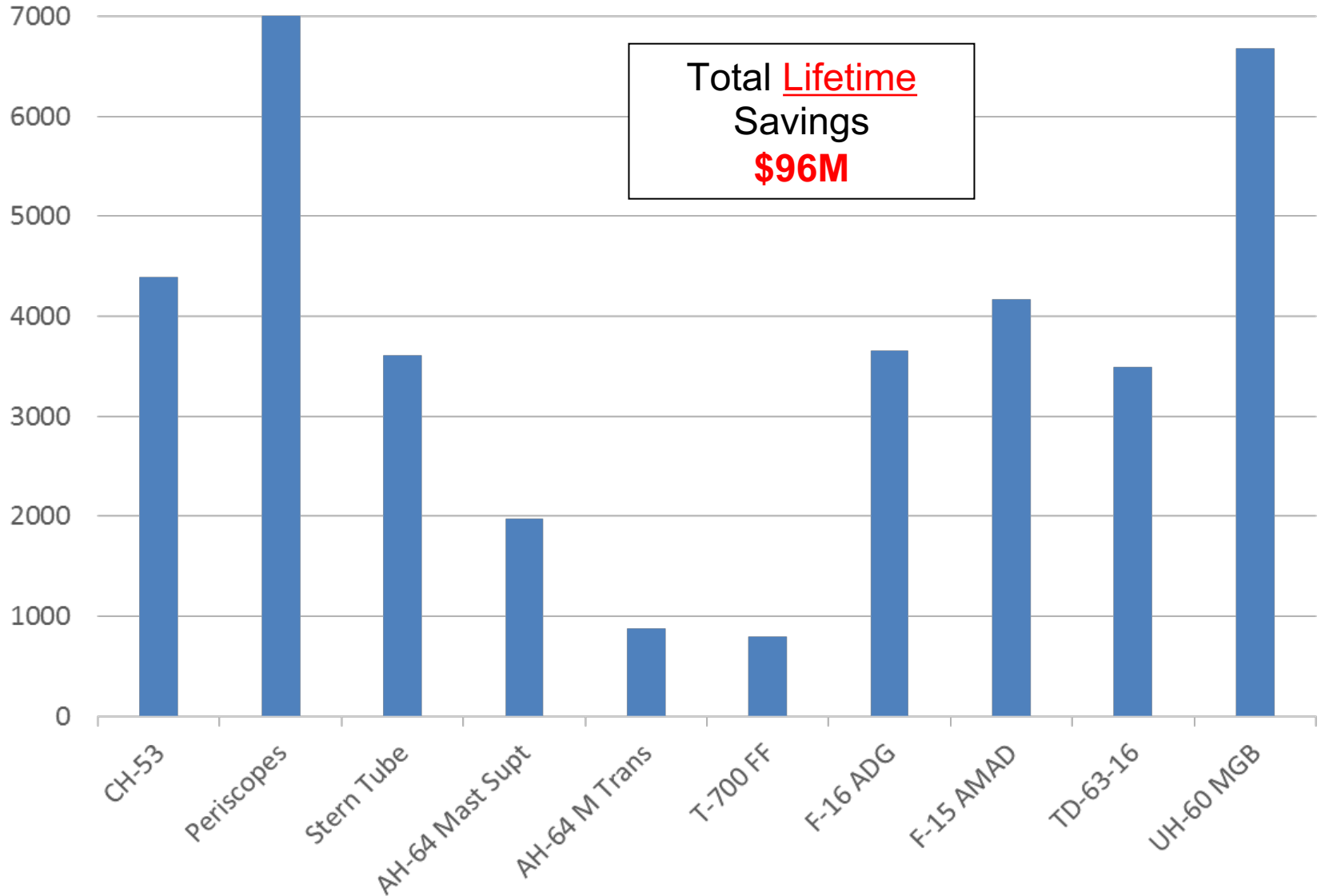
\$5.1M



Cold Spray Repair & Rebuild Lifetime ROI



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Implementation Strategy



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3 Phase Implementation Plan

Phase 1 – Facility Start up

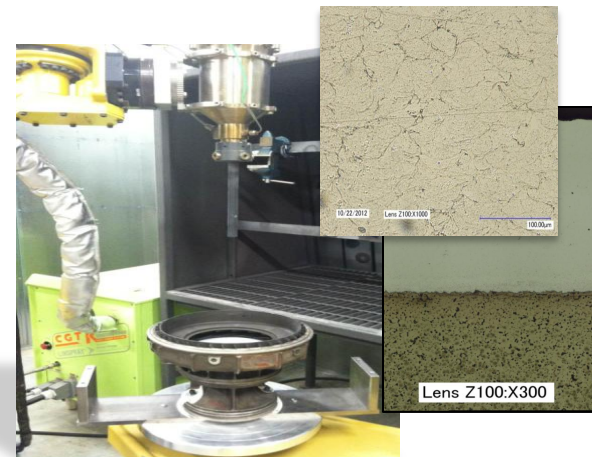
- Utilize existing Contractor procedures and processes for operating the facility until AF personnel system authorizes the manpower slots and AFSCs for trained Air Force personnel.
- Ensures Equipment and Process are fully Debugged and Operational

Phase 2 – Facility Operation and Training Program Development

- AF Personnel Running facility and developing the training plan
- Train first Round of AF Personnel

Phase 3 – Facility Operation

- Organic Air Force Operation





Ellsworth AMRRF Operating Budget



Annually

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Projected on-going support requirements and costs – Labor, Equipment and tools, Material and consumables

(Monthly Recurring Costs)

Testing & Evaluation	RDH Inputs	\$2,000
Prototyping		\$6,000
Qualification Testing		\$6,000
Fixtures/Materials		\$6,000
Machining		\$5,000
1-Tech/1-Engineer		\$15,000
Powder Inventory		\$1,000
Training		\$2,000
Gen III Operating Costs		\$3,000
Consumables (Hoses, Nozzles, Connectors, etc)		\$2,000
Helium		\$20,000
Nitrogen		\$4,000
Tooling		\$3,500
G&A		\$6,000
Misc. (Shipping & Handling)		\$2,500
	Total	\$24,000
		Per Month



Annual Operations Costs

Total

FY19/20 Broken Glass Funding Request - Support Contract will be for ~\$150K per Fiscal Year



AMRRF Projects

Tubing repair



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Ti-3Al-2.5V Hydraulic Tubing Repair

1. Damaged Tubes
2. Burst test to 8 KSI
3. Cold Spray 10 damaged Tubes
4. Pressurize and hold at 13 KSI





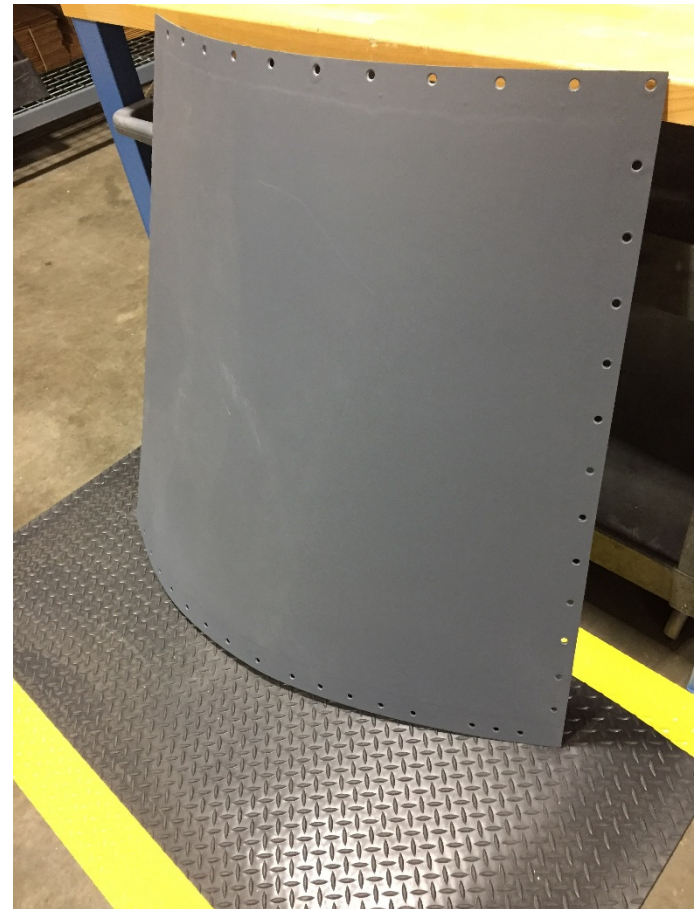
AMRRF Projects

B-1 Forward Equipment Bay Panel



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2024 Panel sprayed with 6061 Powder





AMRRF Projects

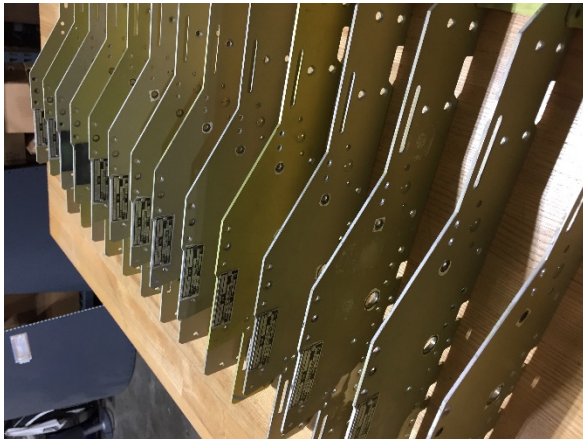
14 inch Ejector Rack



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7075 Panel sprayed with 7075 Powder

Ejector Racks yielded \$6700 per panel \$160,800 in AFREP funds returned to Wing





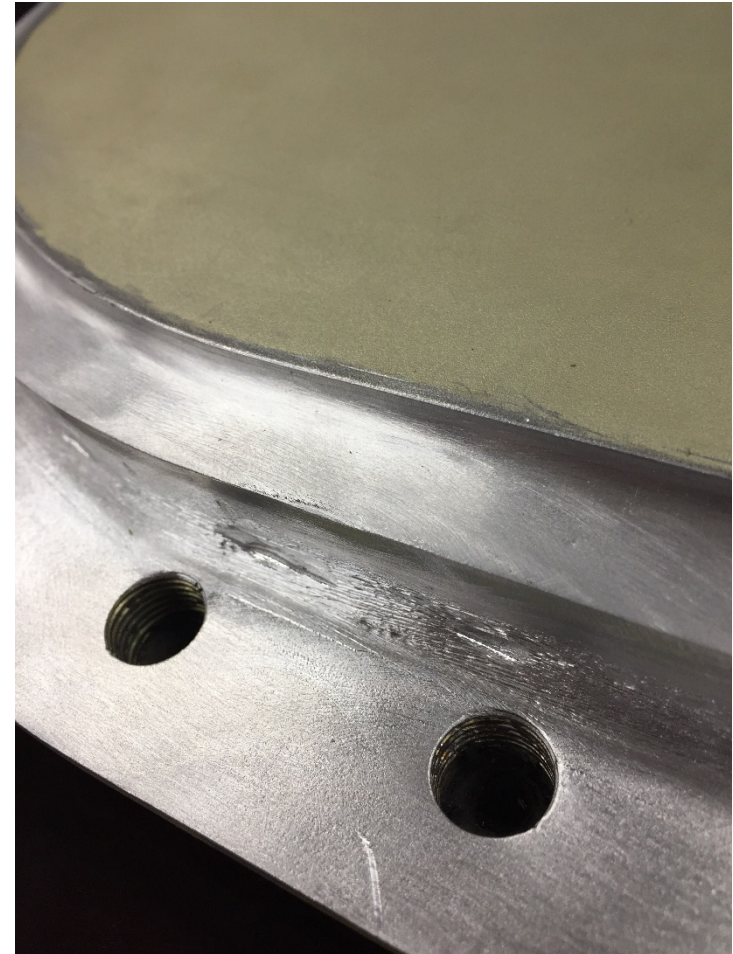
AMRRF Projects

C-5 Fuel Cell Panel (Testing)



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7075 Panel sprayed with 7075 Powder





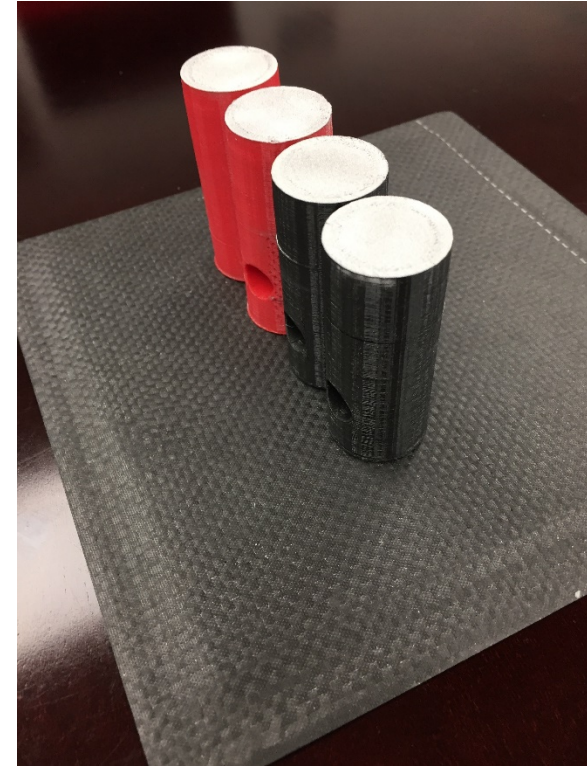
AMRRF Projects

Cold Spray on 3D Printed PLA



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3D Printed C633 Coupons



AMRRF Projects

5R Tank Wing Access Panel(future candidate)

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How do we qualify new parts?

Requirements

- **Tech Order (TO) – method for qualifying new Cold Spray Repair**
 - **Cold Spray TO “Cold Spray Repair” will first be released as USAF drawing X201961304 (example)**
 - **Includes qualifying facility, equipment, material, operator, and process**
 - **Training required for operator to be qualified**
 - **Facility, equipment, material, and process to be qualified initially at repair facility**

***Lock down Tech Data Packages (TDP)**

*From 784th Supply Chain Management Group F-16 Accessory Drive Gearbox Cold Spray ERB





AMRRF



5R Tank Wing Access Panel (future candidate)

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How do we qualify new parts?

Metallurgical match to FEB Panel (2024 panel w/6061 powder)





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Questions

