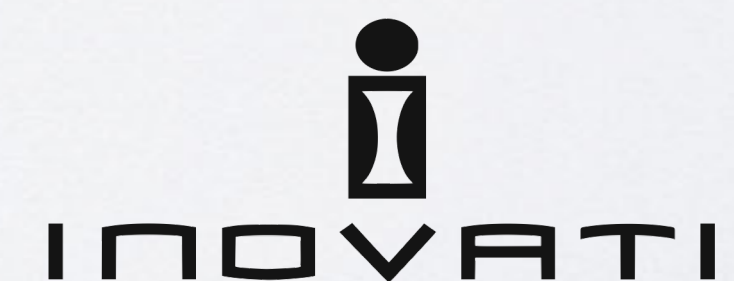


# MILITARY APPLICATIONS OF KINETIC METALLIZATION™

Howard Gabel, R. Tapphorn, and T. Crowe  
ITSC 2015 Presentation

# MILITARY NEED

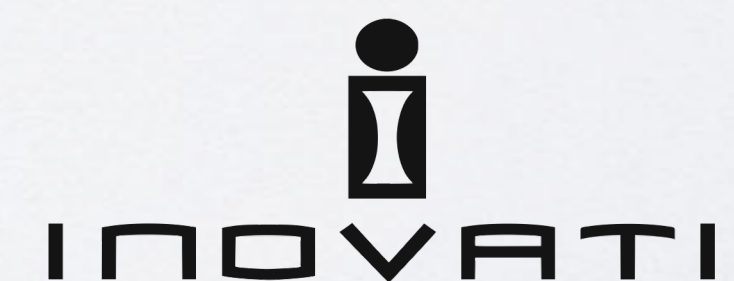
- Corrosion and Wear Protection.
- Safe alternative to toxic heavy metals.
- Dimensional Restoration of damaged or corroded parts.



# THE SOLUTION

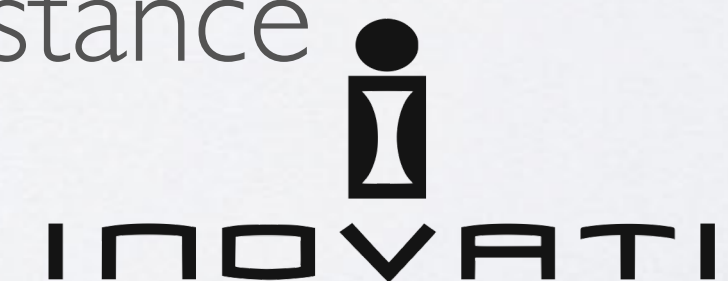
## ***Kinetic Metallization***

- Reclaim High-Value Long-Lead Components
  - Deposit corrosion / wear resistant coatings
  - Replace Toxic Heavy Metals with
  - Non hazardous by products.

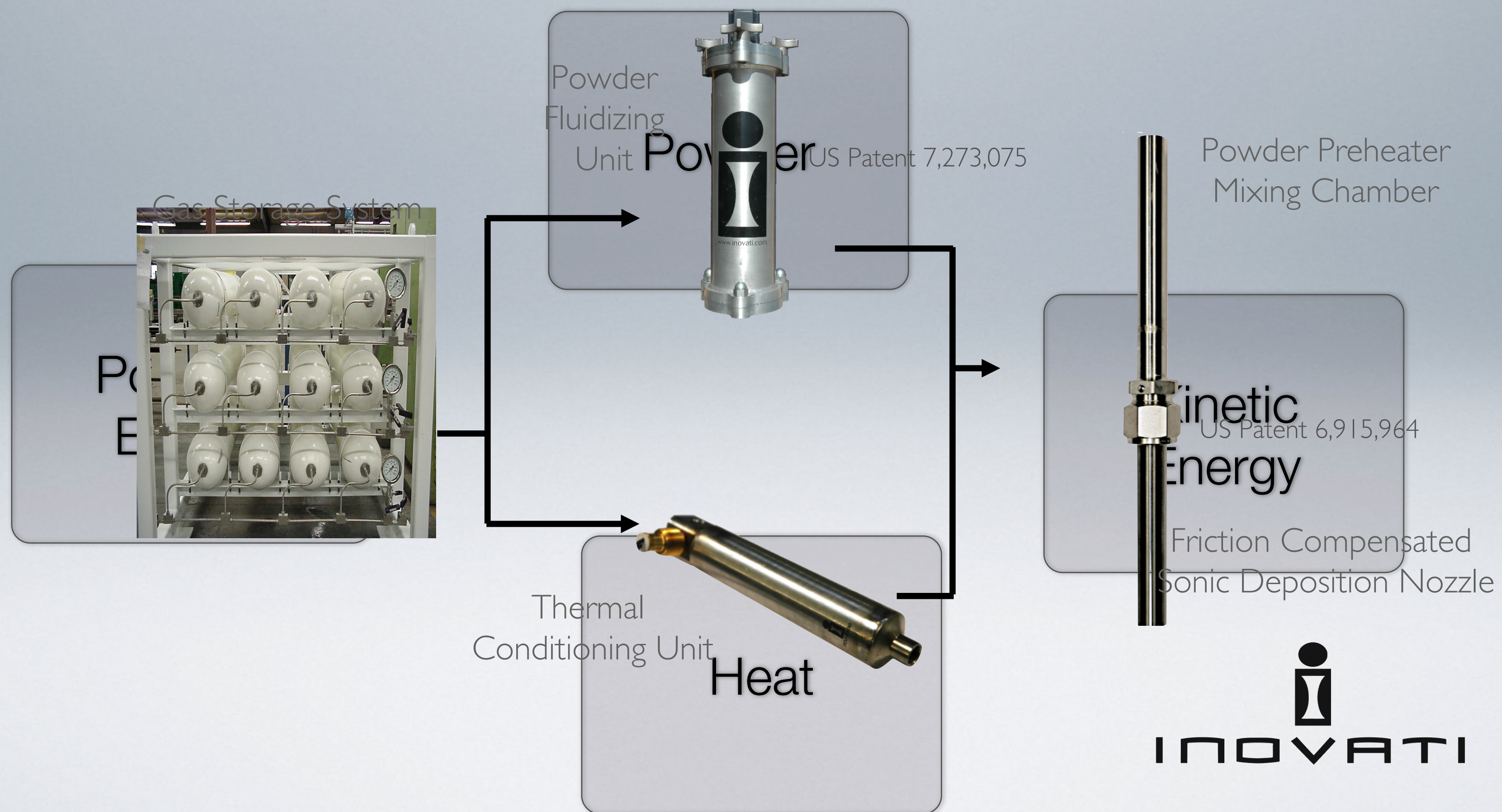


# KINETIC METALLIZATION

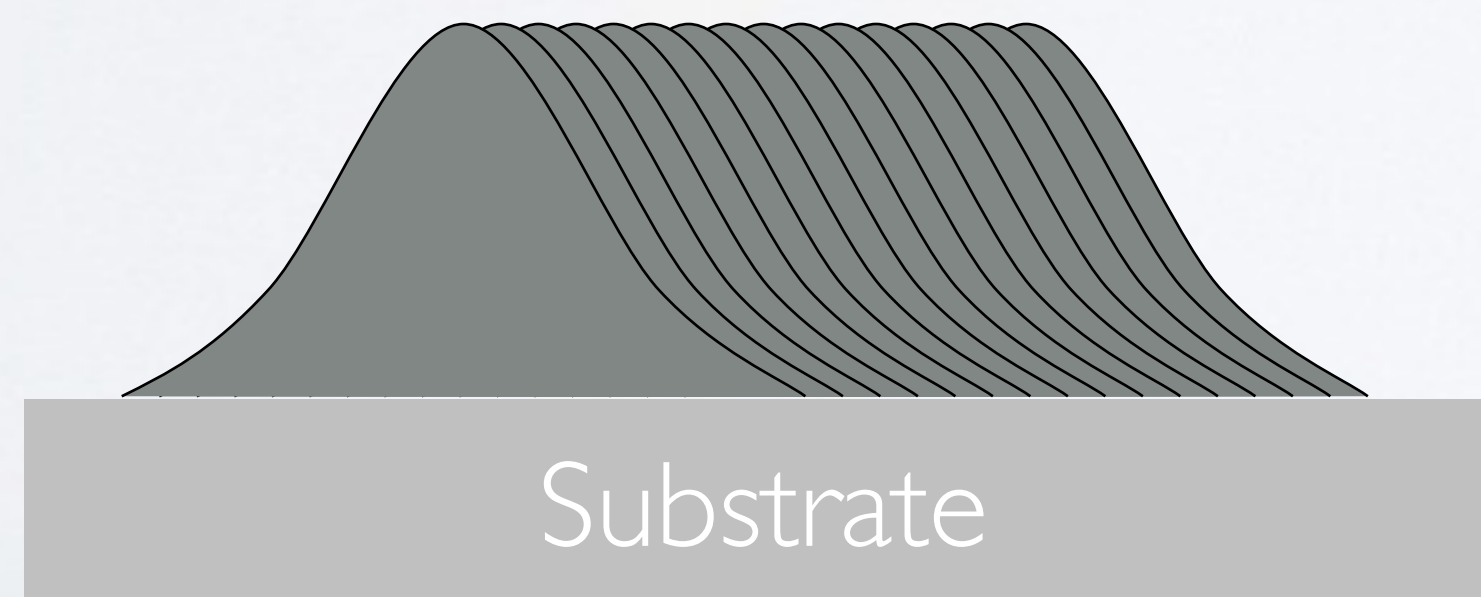
- Solid-state spray deposition process
- Patented sonic nozzle
  - Accelerate particles to high speeds
- Low temperature
- Low pressure
- Low cost
- Metallurgical bond
- Optimized feedstock
  - Machinability
  - Corrosion resistance
  - Wear resistance



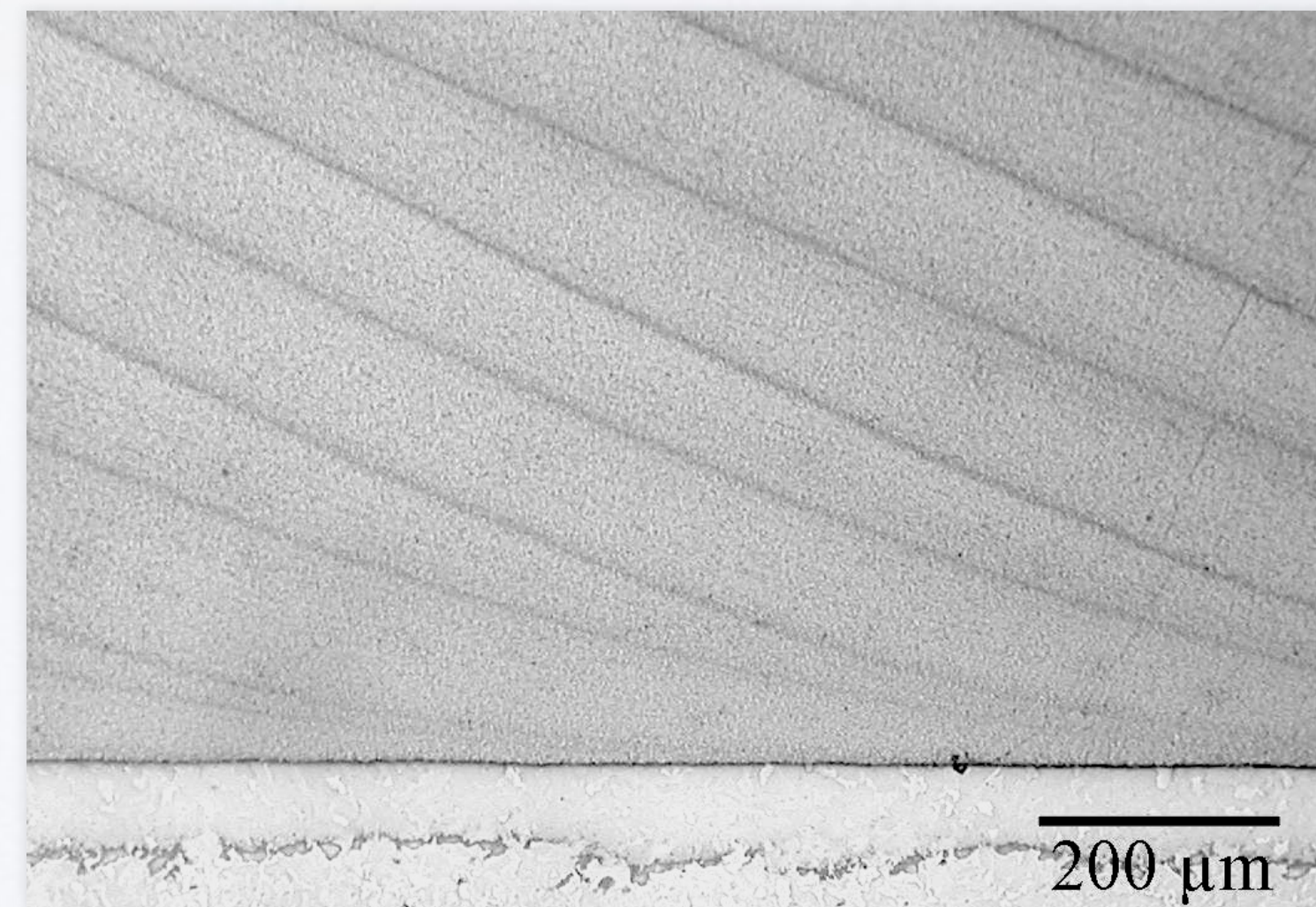
# KINETIC METALLIZATION™ PROCESS



- Impact Consolidation Process
  - Feed-stock: fine powder,
  - Accelerant: inert light gas
- Solid-state Consolidation
  - No Melting
  - No Liquid Chemicals



- Environmentally Innocuous
  - No Particle release
  - No Chromate formation
  - No Hazardous Gas Emission
- Enhanced worker safety






# POWDER FLUIDIZING UNITS

- Large Capacity - 4 hour run time
- Patented Brush-Sieve Design
- Light-weight pressure vessel
- Powder/ Gas flow rate independent
- Gas flow independent of feed rate
- Powder Size: 500nm - 50 $\mu$ m
- Feed Rate: 0-100g/min



  
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# KM QUALITY REPORT



## Run Details

Operator	tcrowe	Customer	INOVATI
Date	1/16/15	Project	WC-Co Demo
Time	12:36:03	Task	Sample Coupon

## Substrate

Material Group	Steel	Bond Coat	none
Alloy	4130	Preheat Temp	0
Surface Prep	Al2O3 Grit Blast	Thickness (in)	0.04
Surface Roughness	124		
Substrate Comment	3"Wx4"Lx0.40"		

## Powder 1

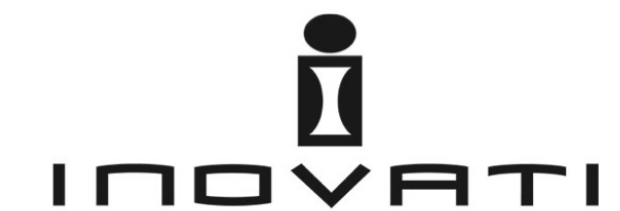
Material Group	Tungsten	Drying Method	None
Alloy	KM HF-10-10	Preblend?	No
Powder ID	0104-67	Set Point (%)	55
Sieve	35	Feed Rate (g/min)	30
Powder 1 Comment	-----		

## Powder 2

Material Group	-----	Drying Method	-----
Alloy	-----	Preblend?	---
Powder ID	-----	Set Point (%)	0
Sieve	---	Feed Rate (g/min)	0
Powder 2 Comment	-----		

## Nozzle

Type	Straight	Serial Number	1501
Throat Diameter (in)	0.059		
Nozzle Comment	-----		



## Gas

PFU Gas	He
TCU Gas	He

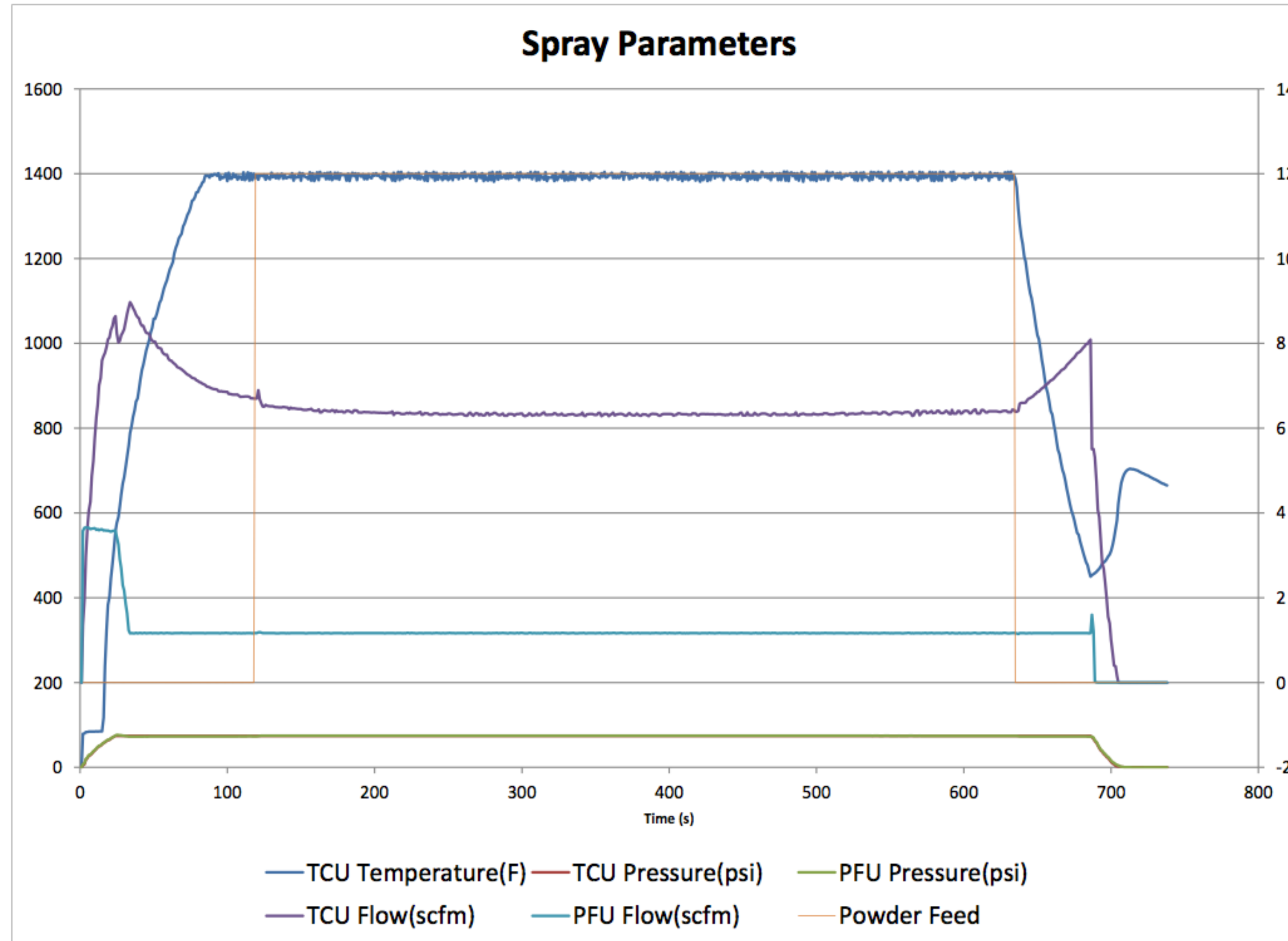
## Spray Parameters

	Units	Set Point	Min	Max	Average	Standard Deviation
Temperature	F	1600	1585.00	1603.00	1,594.46	5.36
Pressure	psig	75	73.77	74.29	73.93	0.07
TCU Flow	SCFM	-----	5.69	6.64	5.82	0.14
PFU Flow	SCFM	-----	1.16	1.18	1.16	0.00
PFU Motor 1	%	55	0.00	55.00	54.69	0.60
PFU Motor 2	%	0	0.00	0.00	0.00	0.00

## Robot Parameters

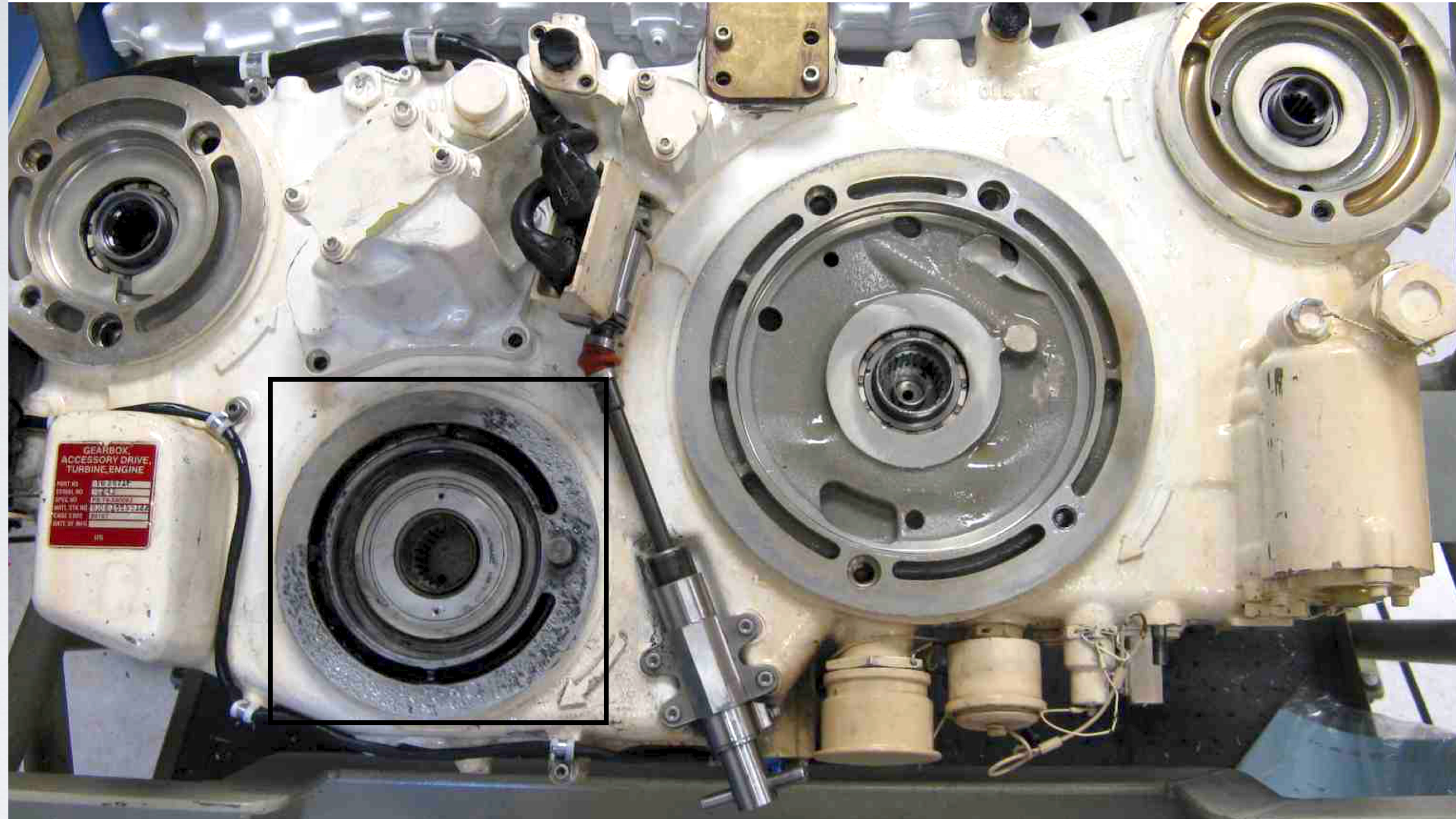
	Units	Set Point
Length	in	4.2
Width	in	1
Substrate Thickness	in	2.02
Standoff	in	0.45
Speed	in/sec	5
Step Size	in	0.01
Strokes	---	1
Layers	---	1
Turn Table Rotation Speed	rpm	0

# KM QUALITY CHART



# DIMENSIONAL RESTORATION





F18 SUPER HORNET AMAD





FRETTING HYDRAULIC PAD





MASK



GUN RASTER



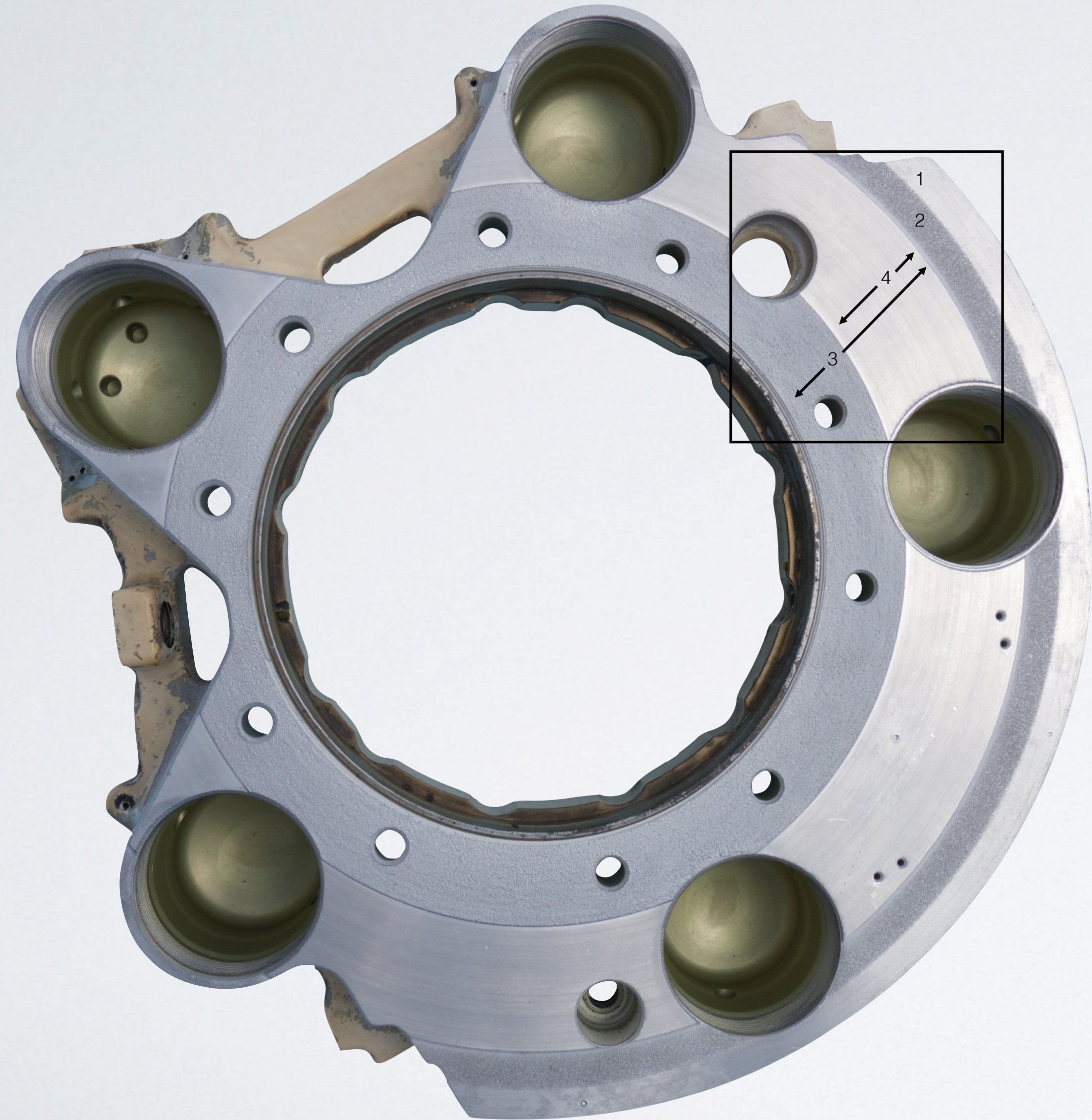
POST DEPOSITION



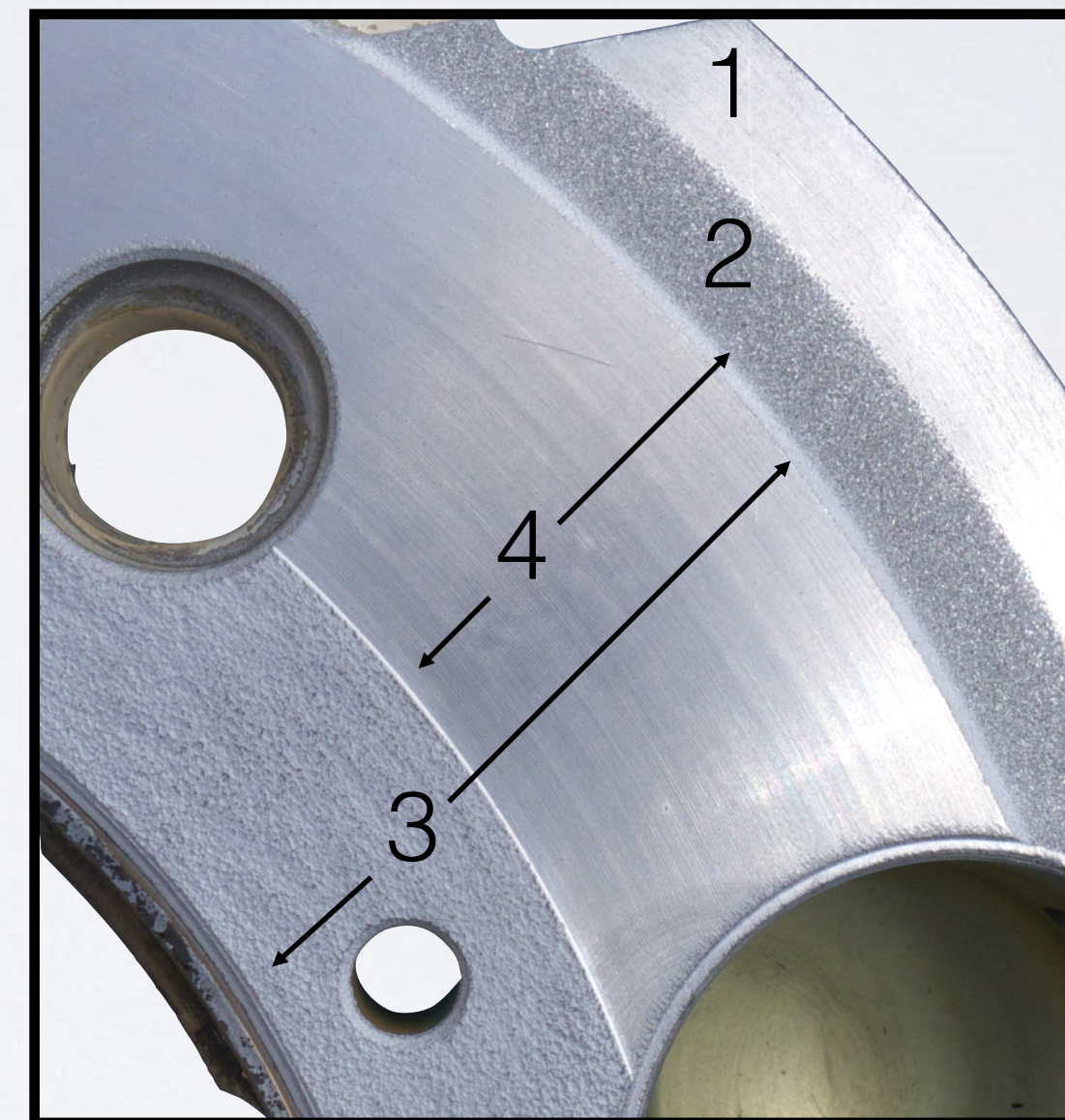
MACHINED



# KM Repair F/A-18E/F Brake Carrier



1. Corroded and damaged surface machined down.
2. Surface prepared by grit-blast for KM Repair.
3. Kinetic Metallization repair as deposited.
4. KM repair as machined.



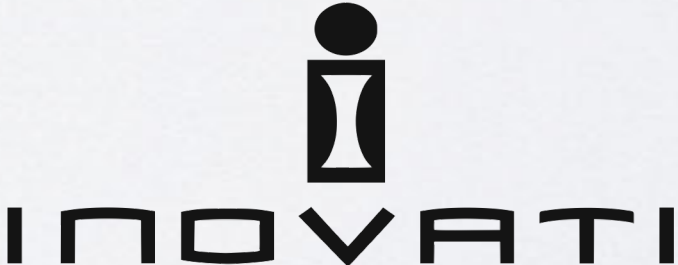


# KM Repair F/A-18E/F Hydraulic Pump Gear Shaft

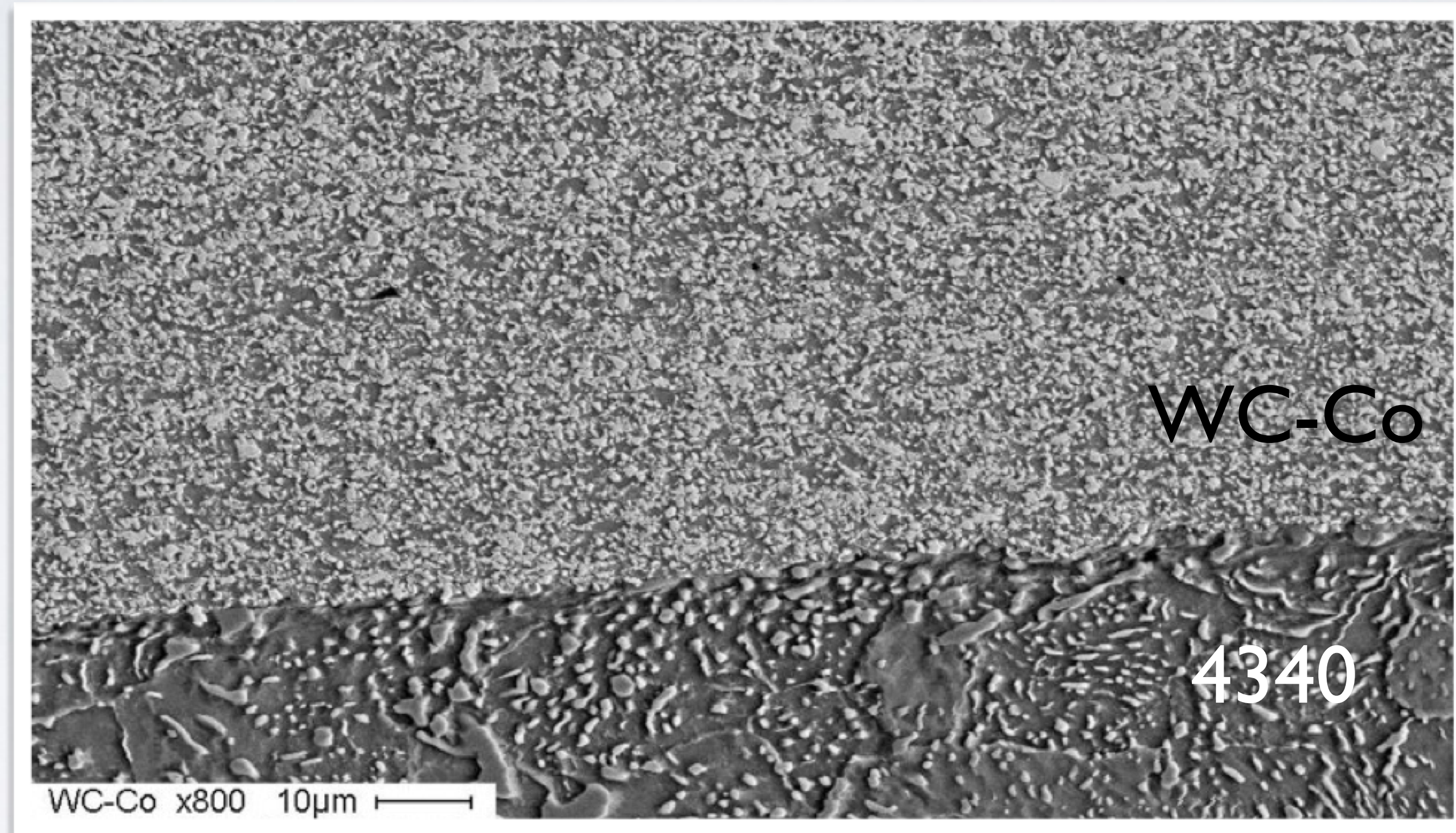
AMS 6265  
Hv = 384

WC-Co  
Hv = 1,000

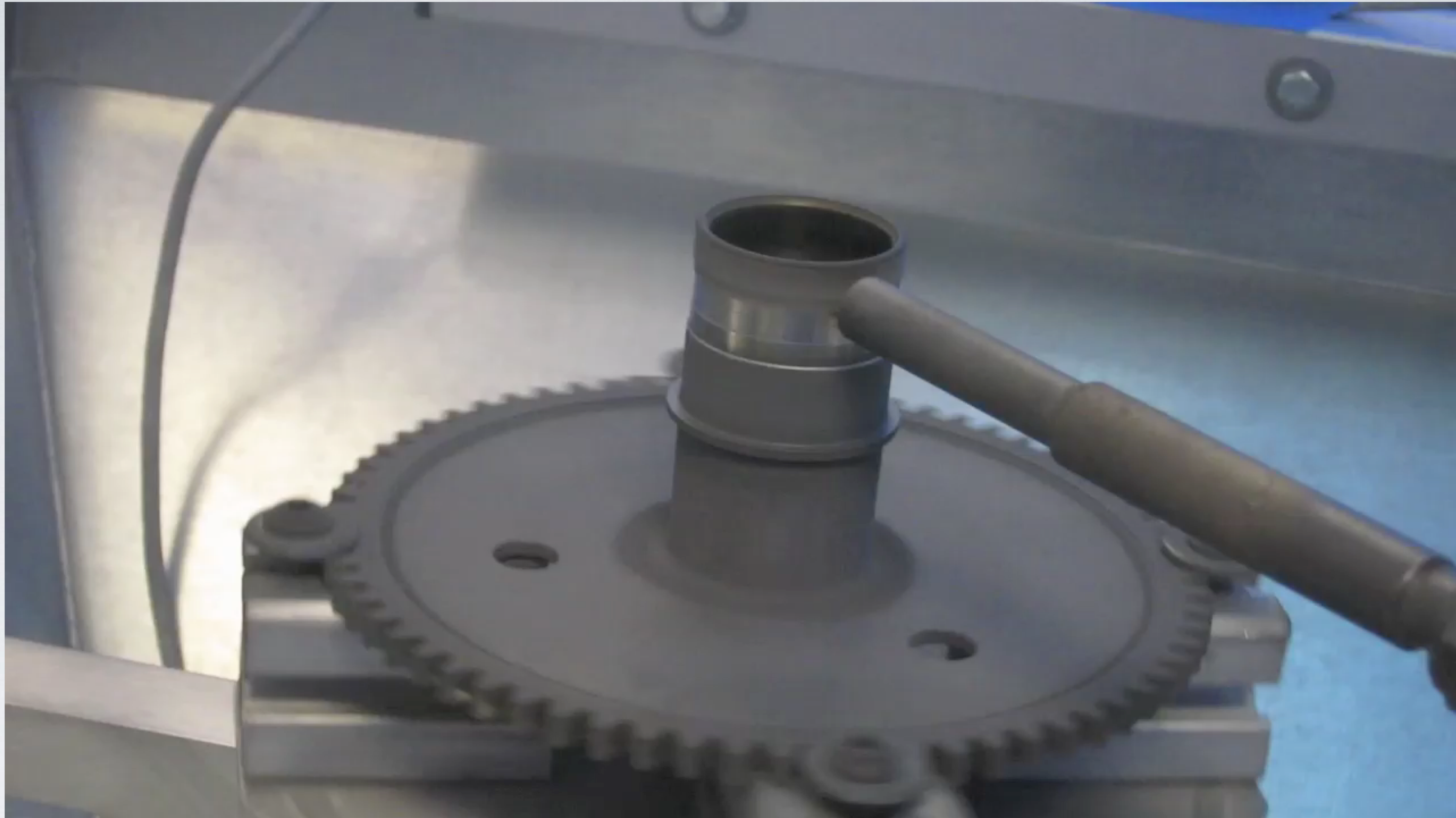
Wear damage removed and replaced  
with Tungsten Carbide-Cobalt using  
Kinetic Metallization™



# KM WC-CO



- Fine grain structure
- 99.9% Dense
- Tunable hardness

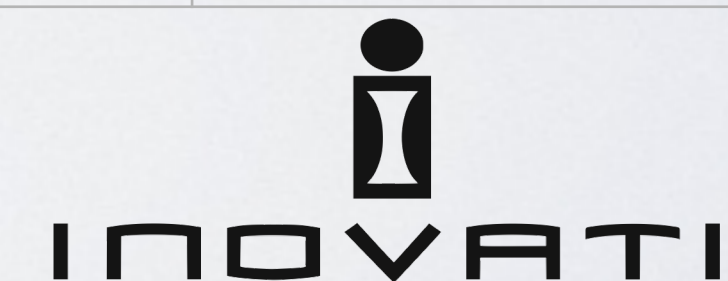


  
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# FRCSW ANNUAL SAVINGS

## \$3,369,200

Nomenclature	Part Number	Replacement cost	Qty per year
AMAD Main Housing	764035B	\$171,000	2
AMAD Cover Side Housing	764033	\$98,900	2
Spur Gear Shaft	764123	\$8,400	10
C/D AMAD Gearbox Housing	42312-231	\$32,200	4
E/F GCU Rotor	FH30007G3	\$289,900	4
Pivot Connecting Link	74A481616-1001	\$59,500	6



# UPCOMING DEVELOPMENT



# E2C - ROTODOME

