

Aviation Power Capability  
and Technology  
2022



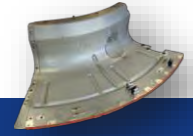
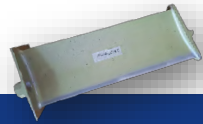
**AERO SPACE POWER**  
by **TUNGSRAM™**

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# Tungram Aero Space Power Current Capabilities and Plans



FAN OGV

Seg HC Seals

Stationary AS

Rotating AS

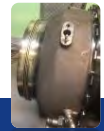
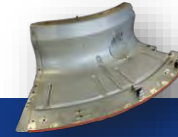
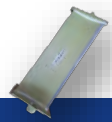
Tubes & Ducts

Heat Shields

CF6-80C2	●	●	●	●	●	●
CF6-80E	●	●	●	●	●	●
GE90-94B	●	●	●	●	●	●
GE90-115B	●	●	●	●	●	●
CF34-3	●	●	●	●	●	●
CF34-8C/-8E	●	●	●	●	●	●
CF34-10E	●	●	●	●	●	●
CFM56-3	●	●	●	●	●	●
CFM56-5B	●	●	●	●	●	●
CFM56-5C	●	●	●	●	●	●
CFM56-7B	●	●	●	●	●	●
V2500	●	●	●	●	●	●
GEnx-1B	●	●	●	●	●	●
GEnx-2B	●	●	●	●	●	●

● TBD ● Planned ● Partial Capability ● Full Capability

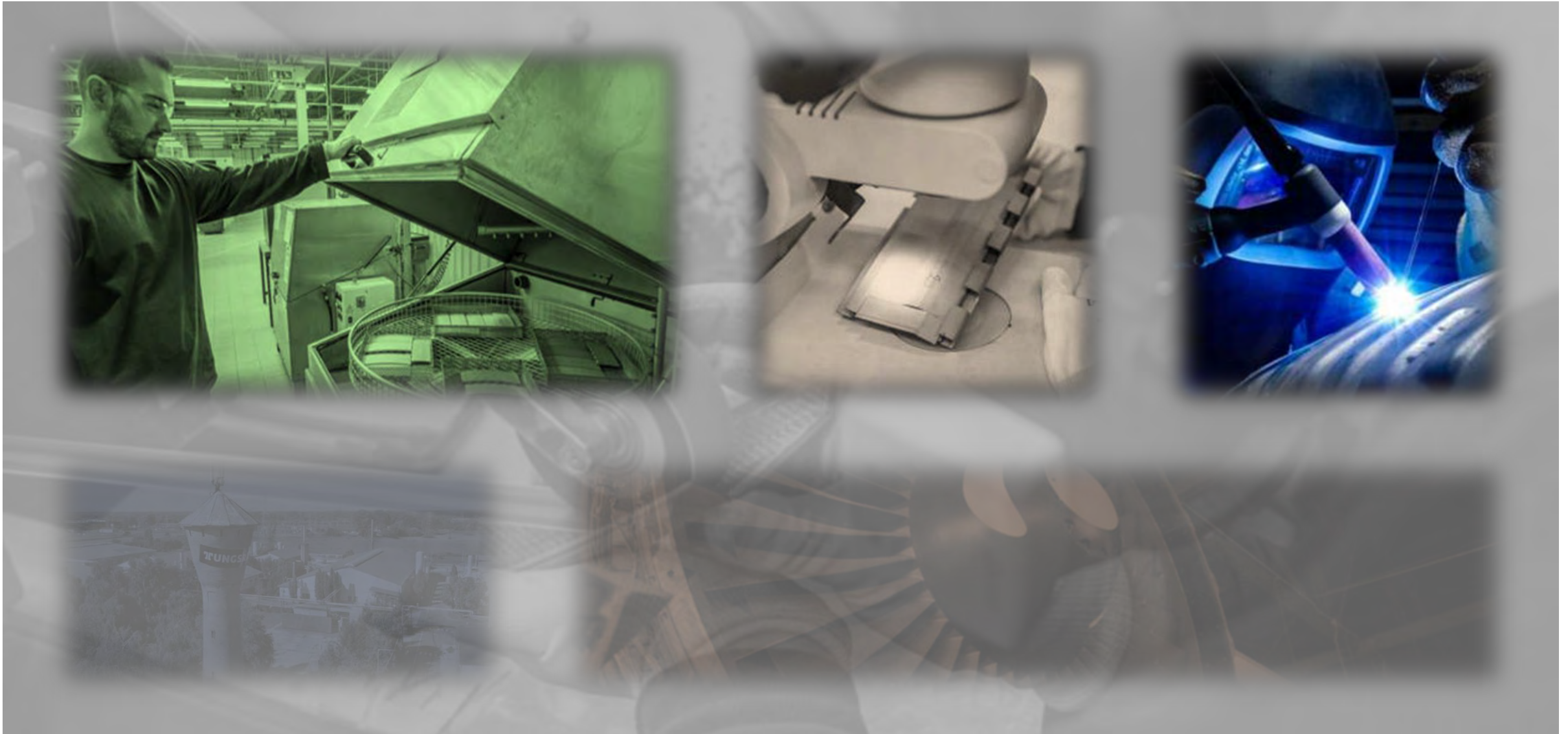
# Tungfram Aero Space Power Future Capabilities



	FAN OGV	SEG HC Seals	Stationary AS	Rotating AS	Tubes & Duct	Heat Shields	Mechanical System	Knife edge Seal
CF6-80C2	●	● 2023	● 2023	● TBD	● 2023	●	●	●
CF6-80E	●	● 2023	● 2023	● TBD	● 2023	●	●	●
GE90-94B	● TBD	● 2023	● 2023	● TBD	● 2023	●	● TBD	● TBD
GE90-115B	● TBD	● 2023	● 2023	● TBD	●	●	● TBD	● TBD
CF34-3	●	●	●	●	●	●	●	●
CF34-8C/-8E	●	●	● TBD	● TBD	●	●	●	●
CF34-10E	●	● TBD	● TBD	● TBD	●	●	●	●
CFM56-3	●	●	●	●	●	●	●	●
CFM56-5A	●	●	●	●	●	●	●	●
CFM56-5B	● 2023	● 2023	● 2023	● 2023	●	●	●	●
CFM56-5C	●	●	●	●	●	●	●	●
CFM56-7B	● 2023	● 2023	● 2023	● 2023	●	●	●	●
V2500	●	●	●	●	● TBD	●	●	●
LEAP-1A	●	●	●	●	●	●	●	●
LEAP-1B	●	●	●	●	●	●	●	●
GEnx-1B	● TBD	●	●	●	●	●	●	●
GEnx-2B	● TBD	●	●	●	●	●	●	●

● TBD ● Full Capability

# Service Technologies





# Inspection and Certifying Area

Fenced area for handling incoming goods and a properly equipped area for incoming inspection and certifying parts





# Heavy-Light Duty Alkaline Cleaner

- Chemical cleaning of metal and rubber parts
- Ardrox 185L / Ardrox 6367
- Tank size: 1500x1500x1500 mm
- 4 heated tanks + 2 cold rinse tanks
- Operation temperature: RT – 98 °C



# Rotating Basket Washer

2 pcs rotating basket for washing metal parts with detergent and rinsing with water

Washing Capacity ( Ø X H ) Ø 98 H 54 cm

Basket Load Capacity 200 kg

Tank 270 lt





# Pressure Tester

Medium: water and air

## Water tester:

- Low pressure: 18-800 PSI
- High pressure: 800-6000 PSI
- Size: 700 x 1800 x 790 mm

## Air tester:

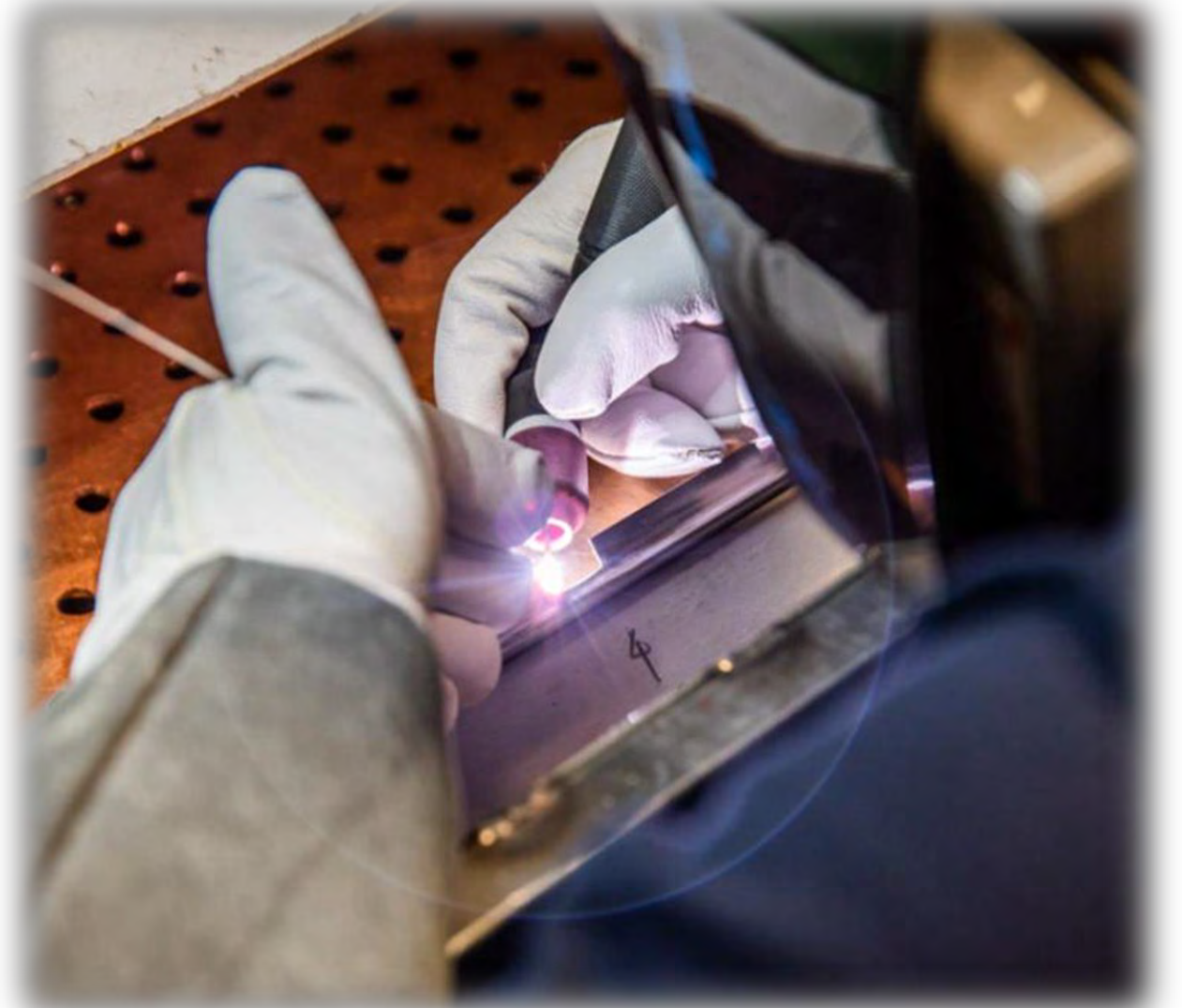
- Pressure: 0-87 PSI
- Size: 600 x 1910 x 490 mm



# Welding Capacity

Each welding position fillet weld, butt weld

- Welding qualification: AWS D17.1
- II.A - Austenitic stainless steel
- III.A - Nickel base alloys
- III.B - Precipitated hardened nickel base alloys
- IV. - Aluminum alloys
- VI. - Titanium alloys
- VII. - Cobalt alloys





# Grit Blasting

- Size: 1280 x 980 x 950 mm

- Blasting cabin type: pressure sand blaster

- Blasting agent:

  - P220 aluminium-oxide

  - Plastic mesh 20-30

  - Glass bead fraction: 70-110





# Chiseling, Grinding Booth

Welding preparation, finishing and removal of residual honeycomb and brazing material from seal segments and ring parts with abrasive grinding wheels

- Pneumatic Air grinders
- Air belt Sanders
- Belt Grinder Booths
- Air chisel tools



# Blending Area

Area with extraction equipment dedicated to incoming damage or in-process grinding, equipped with different types of grinding tools





# Conturing Area

- Recovering original geometry of shroud parts
- Dimensional inspection with contour gages
- On-site design and manufacturing of the desired tools and fixtures





# Drying Oven

Oven used for drying operations with different low heating temperatures, heating for shrink joints

- Capacity (Liters) 400Max
- Temperature (°F) 527Max
- Temperature (°C) 275



# Ball Mandrell

Hydraulic expansion repair of damaged and dented pipe sections and pipe ends

Mandrel diameters: 17, 20, 22, 24, 34, 37, 41, 47, 52, 58, 70, 80 mm



# Tube Bending

## Jutec 4800 mandrel bending device

- Bending capacity  $\varnothing$  6 to 50 mm
- Max. tube length: 2840mm
- multi functional machine control setting of bending angle ( $0.1^\circ$ )





# Etching Area

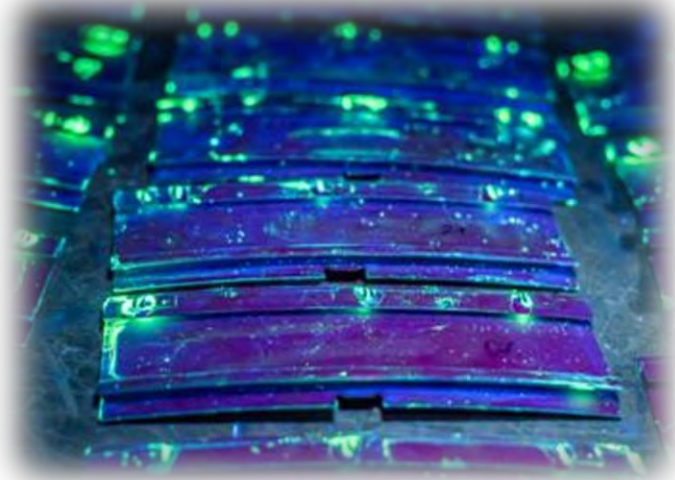
- Swab etching booth for preliminary step before fluorescent-penetrant inspection that is used to permit revealing local indications in the metal surface
- Workbench size 1500 x 900



Max product size: 850x850x500mm

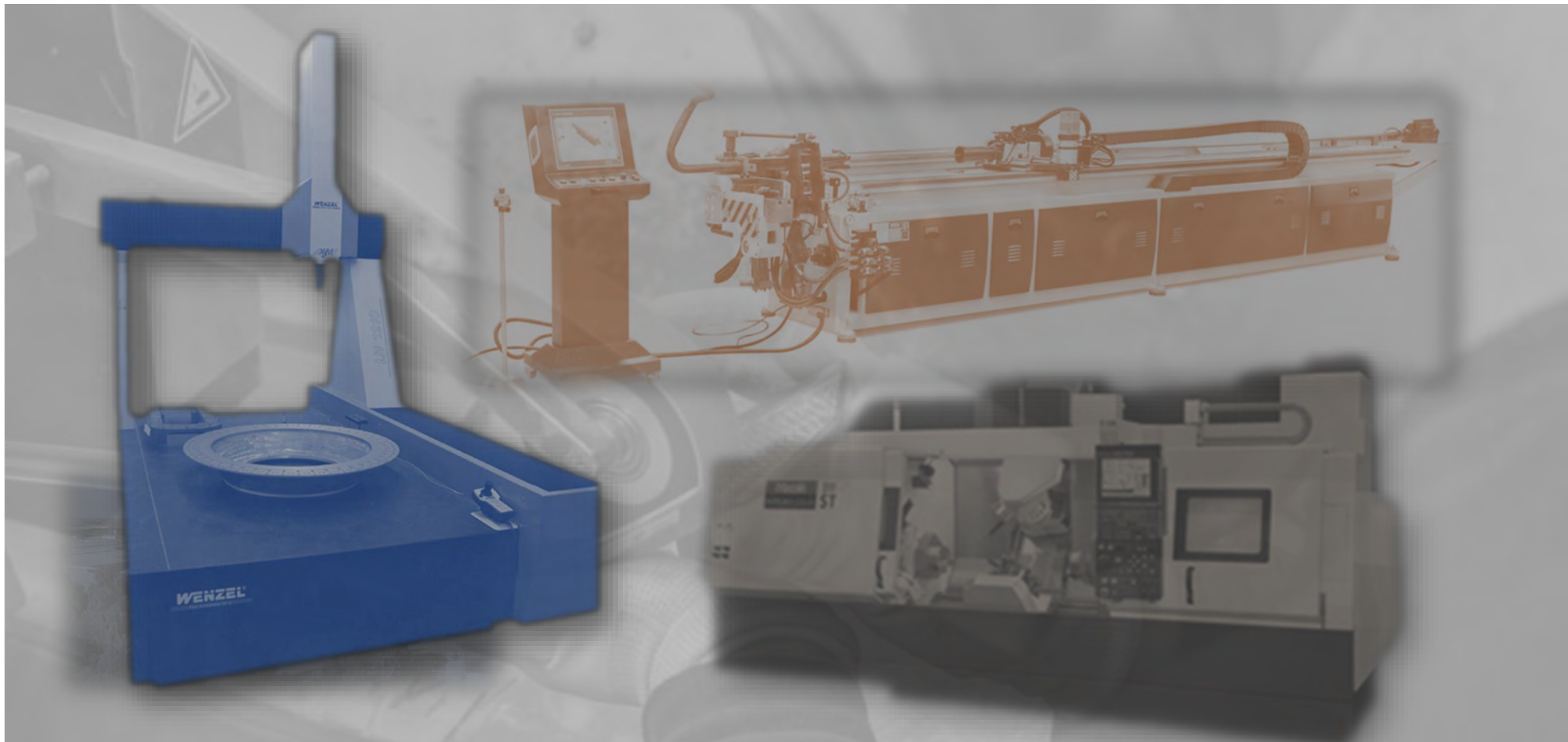
Consist of 8 main elements

- 1. immersion tank (Ardrox 970P25E level 3 sensitivity penetrant liquid)
- 2. immersion tank (Ardrox 9814 level 4 sensitivity peneration liquid)
- Darkened examination station
  - 2 washing \ rinsing tanks
  - Emulsification tank (Ardrox 9881 emulsifier)
- Air dryer station
- Developer station (Ardrox 9D4A)
- Spot FPI station (Ardrox 9814 and Ardrox 9D1B)
- Staff qualifications per OEM SPM, AMS2644, ISO9712





# Machining Technologies



# CNC Turning Integrex 300 ST, QTN 200

Max mfg size (mm)

Accuracy (mm)

X: 200-760

0,005-0,02

Z: 300-1530





# CNC Milling VCN 510 C, NCT MM-850

Max mfg size (mm)

Accuracy (mm)

X: 400-1050

0,01 - 0,05

Y: 300-500

Z: 200-600



# MAZAK QTC 100 / MAZAK VTC 800 / Citizen L20

Max mfg size (mm)

X: 2000

X: 25

X: 340

Y: 800

Y: 300

Y: 500

Z: 720





# ABM 76 CNC I

Max mfg size (mm)

Dia.: 76

Len.: 6000



# High Pressure Water Jet Cutting

## PTV WJ3020B-1Z-D (X-Y CNC TABLE)

X, Y Travel	3050 x 2050 mm
Accuracy of positioning	+/- 0,05 mm
Precision [mm]	+/- 0,05 mm
Max. of depth (calibrated)	100 mm
Best surface roughness	Ra 3,2
Width over set (jet stream)	1,2 mm
Max. bleed (booster made in USA)	4100 bar
Maximum working speed	12 mm/min



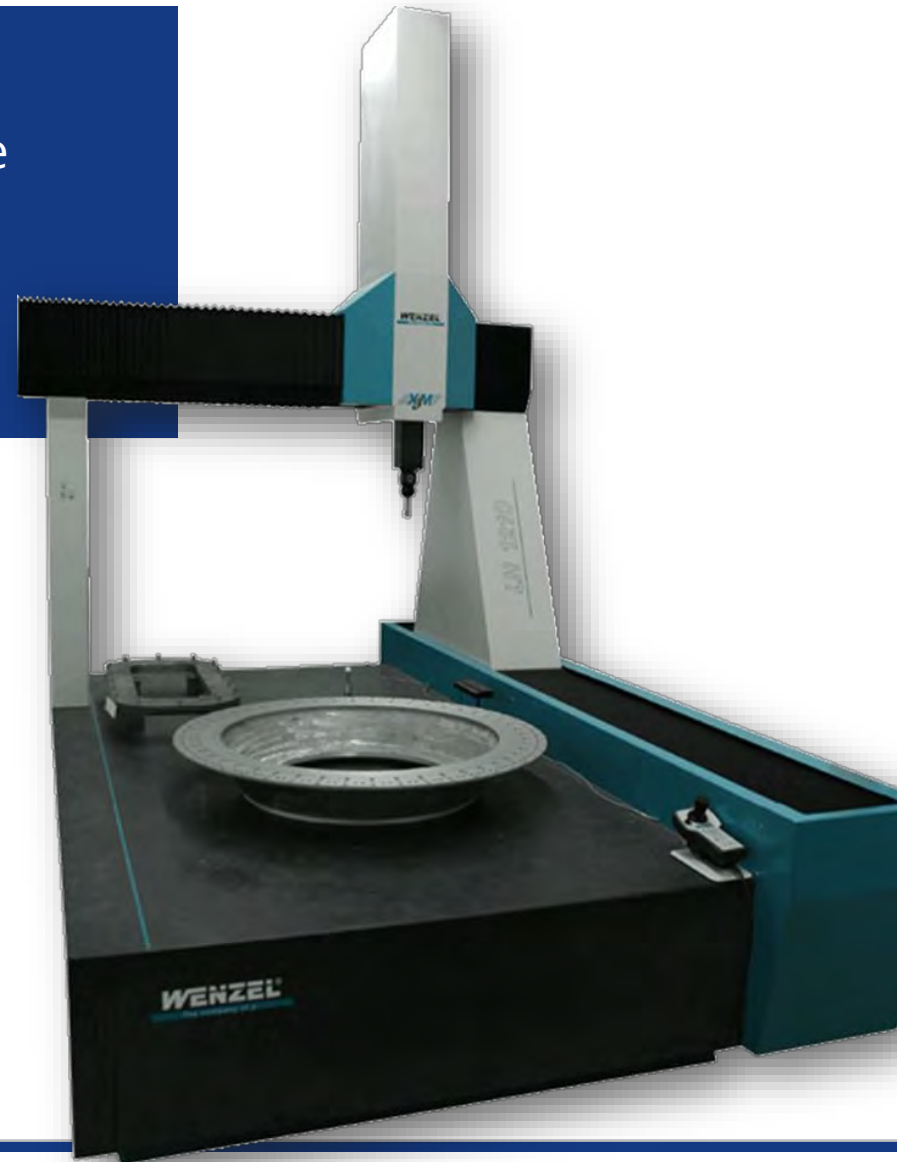


# CNC 3D-Measuring Equipment

## WENZEL LH 1210

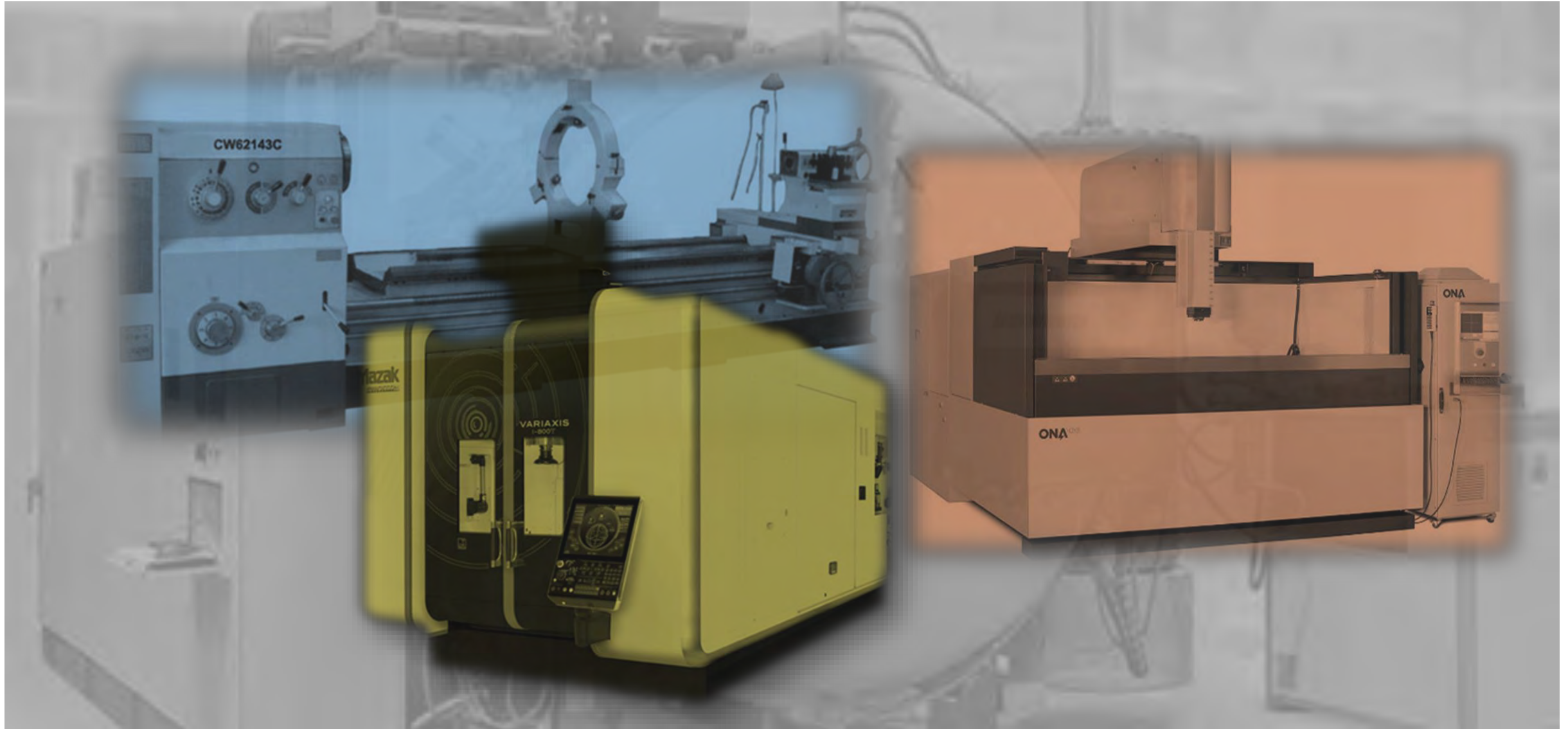
### CNC Portal Design Coordinate Measuring Machine

- 1200 mm x 2000 mm x 1000 mm
- 0,0026 mm + (L/300mm) mm



# New Investments

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# SECO WARWICK Horizontal Vacuum Furnace

Furnace meets requirements of the norm AMS 2750F, class 2, type B.

- Working zone: 1300x1500x1000 mm
- Max load gross weight: 2000 kg
- Max temperature: 1300 °C
- Temperature uniformity: ±5 °C
- Operating vacuum:  $1 \times 10^{-4}$  Torr
- Quenching gas: Nitrogen, Argon
- Max quenching pressure: 1,5 bar abs.



2023 Q1 Realization



# MAZAK Variaxis I-800 Vertical Machining Center

- Handles parts up to 1000 mm diameter and 375mm high / 800 mm diameter and 500 mm high
- XYZ axis travel: 730 x 850 x 650 mm
- Max. load parts weight: 1000 kg
- 5-axis capabilities



2023 Q1 Realization

# ONA IRIS6+ EDM

- XYZ axis travel: 1000x750x500 mm
- XYZ Positioning resolution: 0,0001 mm
- Max. product weight: 4000 kg



2023 Q1 Realization

# CW62143C, Lathe

- Max. swing over bed: dia. 1400 mm
- Max. swing over cross side: dia. 1060 mm
- Distance between centers: 2000 mm
- Tolerance grade: IT6



2023 Q1 Realization



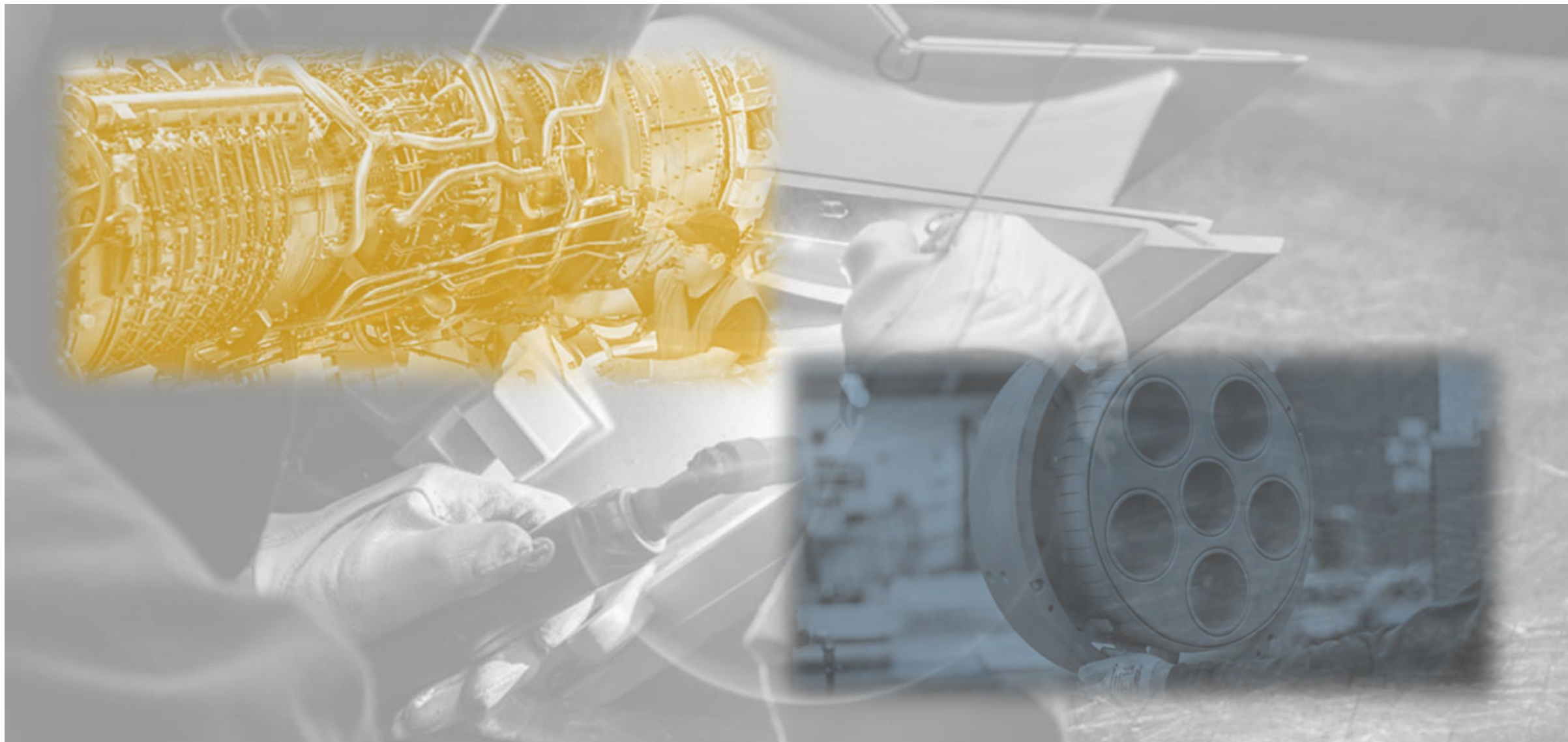
# OERLIKON METCO Multicoat System

- Atmospheric Plasma Spray Process
- Combustion Powder Flame Process
- HVOF-GF Process
- Max work-piece diameter: 1500mm
- Max loading capacity: 1000kg
- Gravimetric powder feeding



2023 Q1 Realization

# Gas Turbine Technologies





# Transition Piece Maintenance

Thorough grinding or grit blast cleaning is essential before the maintenance process for both visual and red dye penetrant inspection to clearly map the damaged areas. Beyond the cleaning and inspection processes, Tungfram performs TIG weld repair on certain areas. Due to the high heat effect of welding, the geometric control of the pieces and the performance of other measurements require great expertise and practice.





# Power Nozzle Maintenance

- Based on the volume of the damage, medium or heavy work scope is determined during the inspection process.
- Usually, heavily cracked and oxidized zones require weld repair. The number of welded areas will determine the scope of work as medium or heavy.
- The majority of cracks, detected by red dye penetrant inspection, can be repaired by TIG welding. Due to the special geometry of the parts, welding and machining require exceptional attention and expertise.



# CAP & LINER Maintenance

- As a non-standard test method, Eddy current is used to identify discontinuities in certain interfaces.
- The documentation of repair characteristics shall be managed in a well-structured manner with high-resolution photos attached.
- During the maintenance workshop visit, the parts must be thoroughly cleaned, and TBC coating removed by grit blasting before inspection so that the scope of repair work can be clearly identified. Disassembly, red paint penetration, sizing, and visual inspection are also performed as part of the service / repair inspection.



Thank You For  
Your Attention!

**AERO SPACE POWER**  
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