

Laser Cladding at Oerlikon Metco

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Metco is now an important part of the Oerlikon group

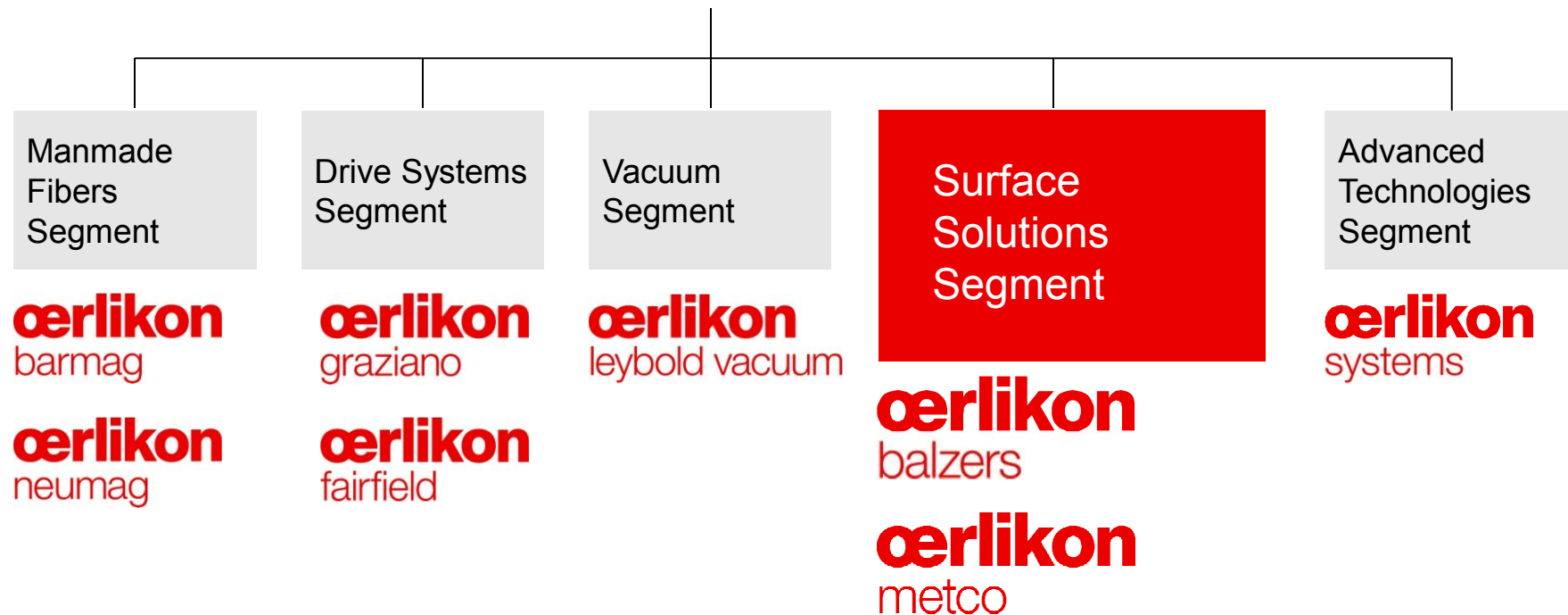


Red is the new Blue – Metco stays Metco

Metco is now an important part of the Oerlikon group



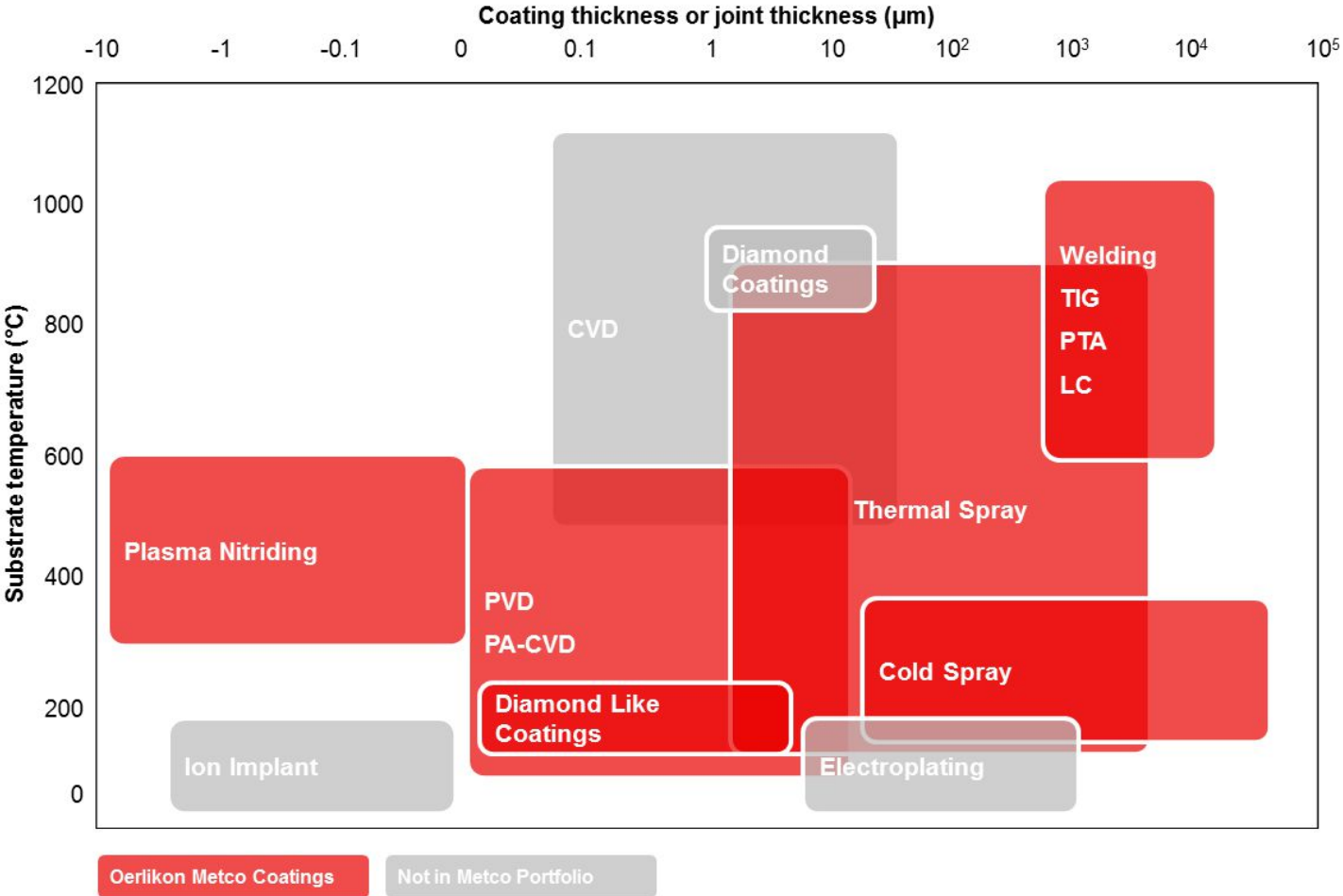
Oerlikon



Key figures Surface Solutions Segment

- Around 6'000 employees
- CHF 1.2 billion in sales
- More than 130 facilities with over 110 coating centers in 35 countries

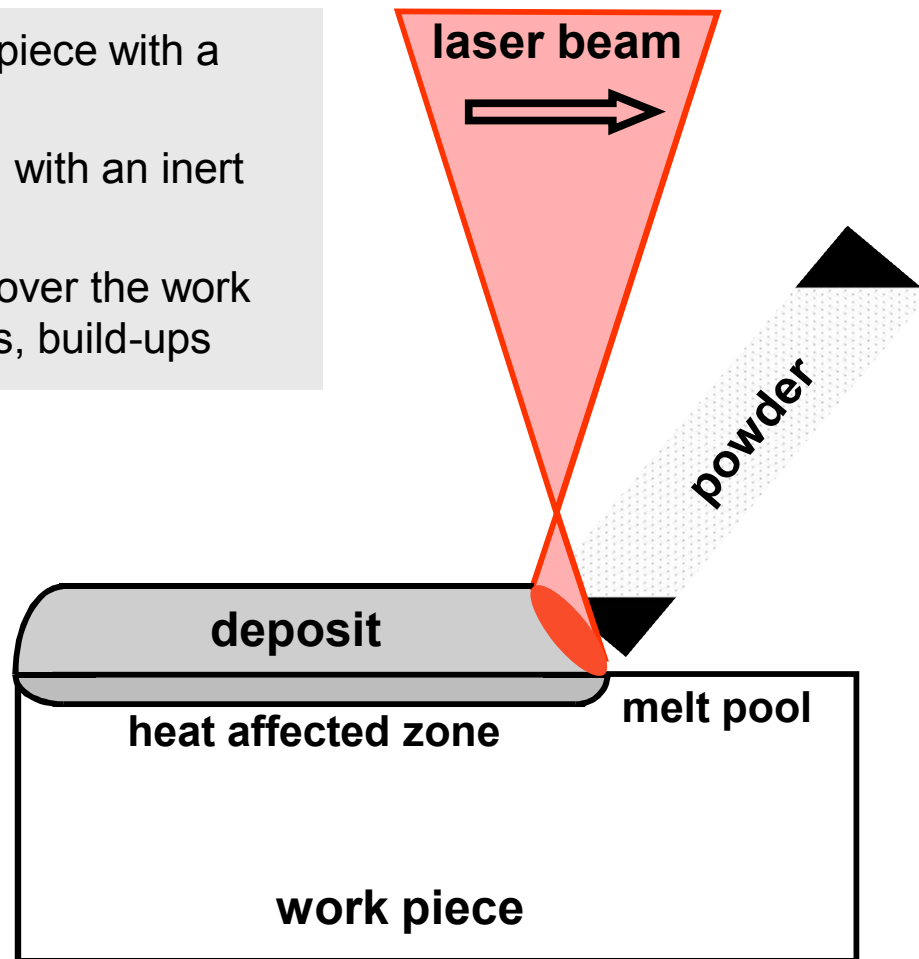
Laser Cladding is a welding technology



Laser Cladding (LC) means **laser build-up welding**, also known as Laser Metal Forming (LMF), Laser Metal Deposition (LMD), Direct Metal Deposition (DMD™), Laser Engineered Net Shaping (LENS™) or Direct Energy Deposition (DED)

Laser Cladding – how does it work?

- The laser beam is (de)focused on the work piece with a selected spot size
- Metal powder as filler material is transferred with an inert carrier gas into the melt pool
- Laser beam and powder nozzle are moved over the work piece surface producing single tracks, layers, build-ups



Small beam focus and high power density mean highly localized part treatment

Laser Cladding – the growing niche between Thermal Spray and PTA



Source: Fraunhofer IWS, 2011

	PTA Welding	Laser Cladding	Thermal Spray
Bonding strength [MPa]	Metallurgical bond ≤800	Metallurgical bond ≤800	Physical bond ≤80
Density [%]	100%	100%	95+%
Build-up rate [kg/h]	≤12	≤6 ↗	≤20
Typical thickness [mm]	0.5 - 4	0.2 - 2+	0.05 - 0.5
Heat input	High	Medium	Low
Dilution [%]	8-18	<5	0

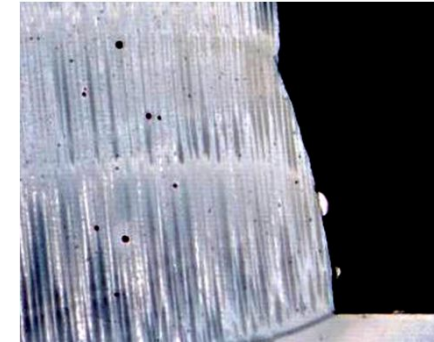
- Perfect metallurgical bonding, fully dense coatings vs TS
- Small heat affected zone, low dilution between substrate and filler material vs PTA
- Extended weldability of sensitive materials like C-rich steels or Ni super alloys vs PTA
- Near net-shape weld build-up, less finishing effort vs PTA
- Surface coating as well as weld build-up on edges possible vs TS
- Fine, homogeneous microstructure due to the high solidification rate

- **LC is a complementing technology to thermal spray**
- **LC becomes more and more competitive against PTA welding**
- **In advanced weld repair application LC outperforms conventional TIG welding**

Laser Cladding and Oerlikon



- 1988 Sulzer: CO₂-laser system in operation for R&D purpose
- 1998 Single-Crystal laser cladding patent filed (granted in 2000)
- 2001 Laser Cladding as a coating service in Switzerland
- 2006 Fiber-laser system in operation
- 2012 Metco provides Laser Cladding services, materials and equipment
- 2014 Metco becomes part of Oerlikon



Metco has more than 25 years experience in Laser Cladding applications

Oerlikon Metco Laser Cladding services

- 3 large LC-systems in Winterthur (former Sulzer Innotec) and Wohlen
- LC service provider in several different business areas – from general industry to gas turbine components
- Experience with a broad range of materials – from Titanium to Steel to Co- and Ni-based super alloys, carbides, ...



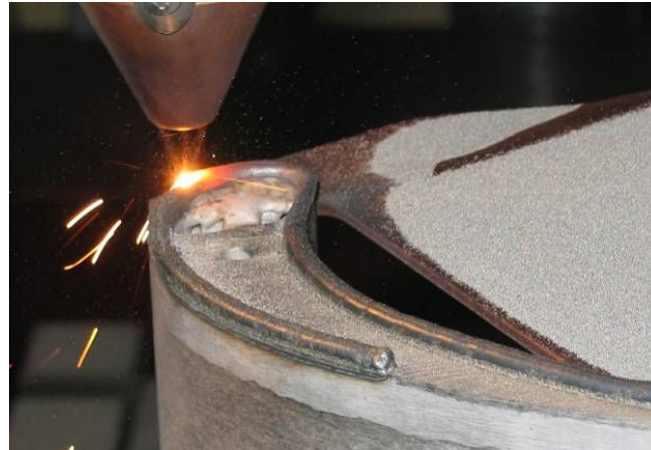
Our service business is the nucleus for our application know-how

Laser Cladding in the MRO business

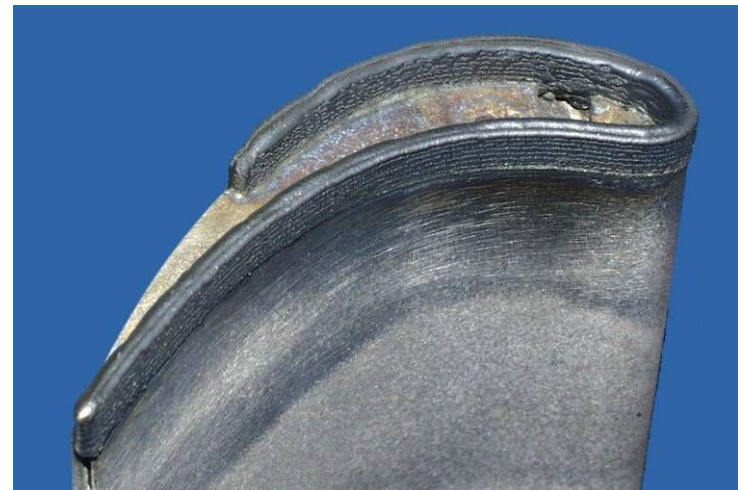
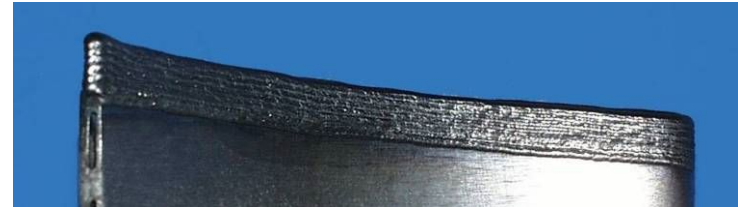


Industrial Gas Turbines

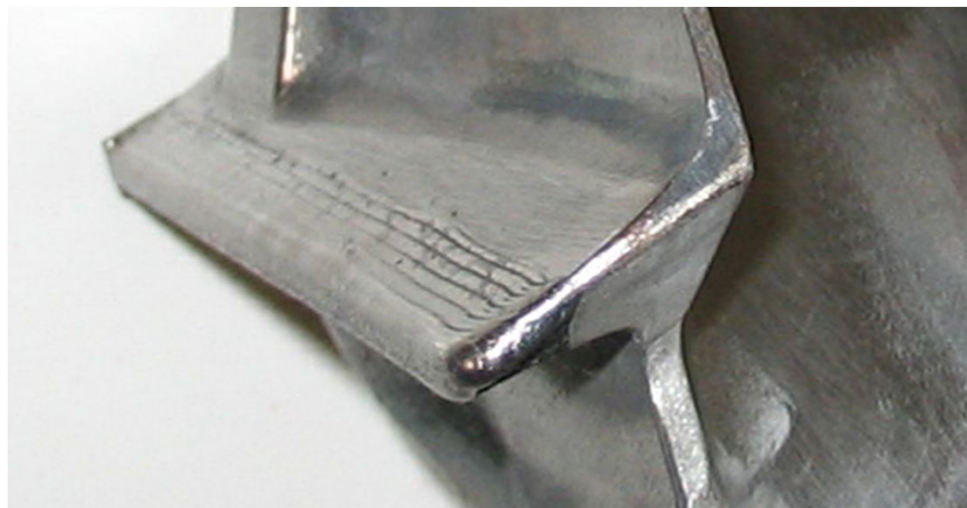
- component repair and modification



Welding process



Blade tip repair, 6mm weld build-up, MetcoClad™ 625 on In738



Knife edge repair, up to 12mm high

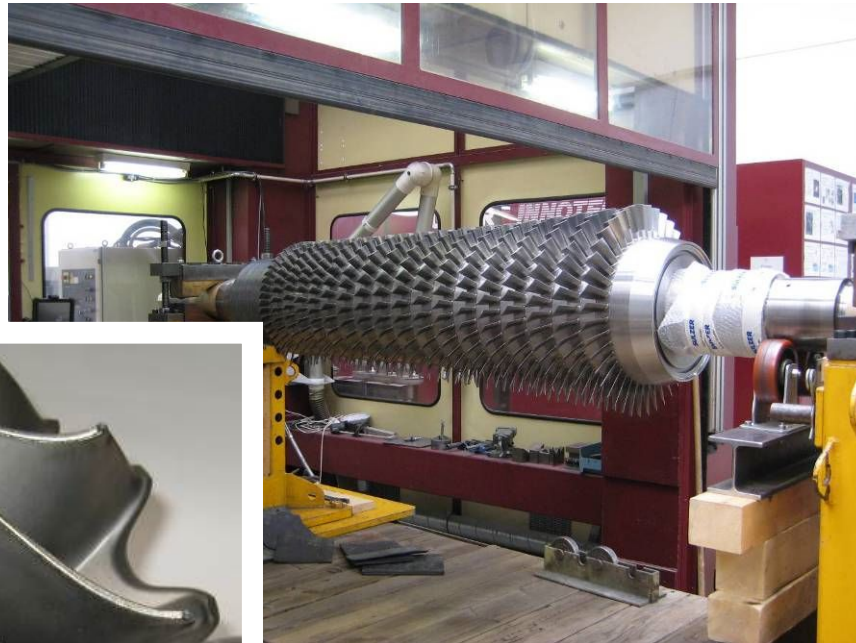
- Challenging materials
- Small heat-affected zone
- Near net-shape weld build-up, minimum finishing effort

Laser Cladding in the MRO business

Compressors and Pumps

- bearings, blades

Turbocharger blade tip repair



Compressor shaft repair

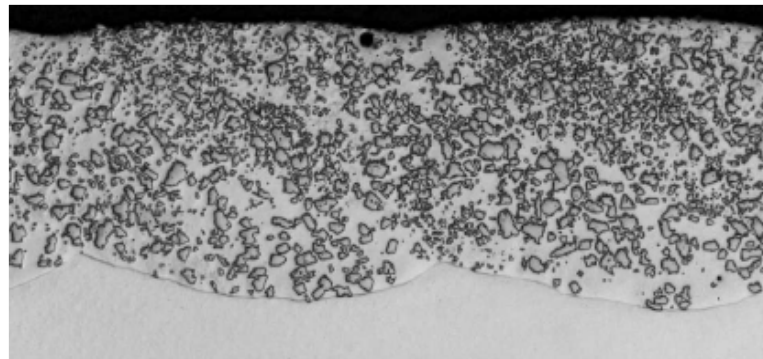
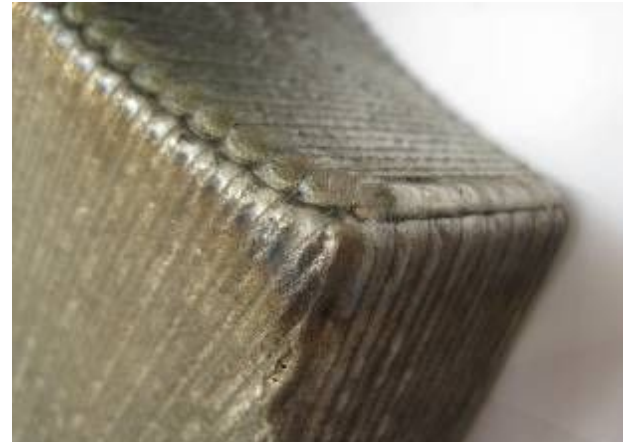
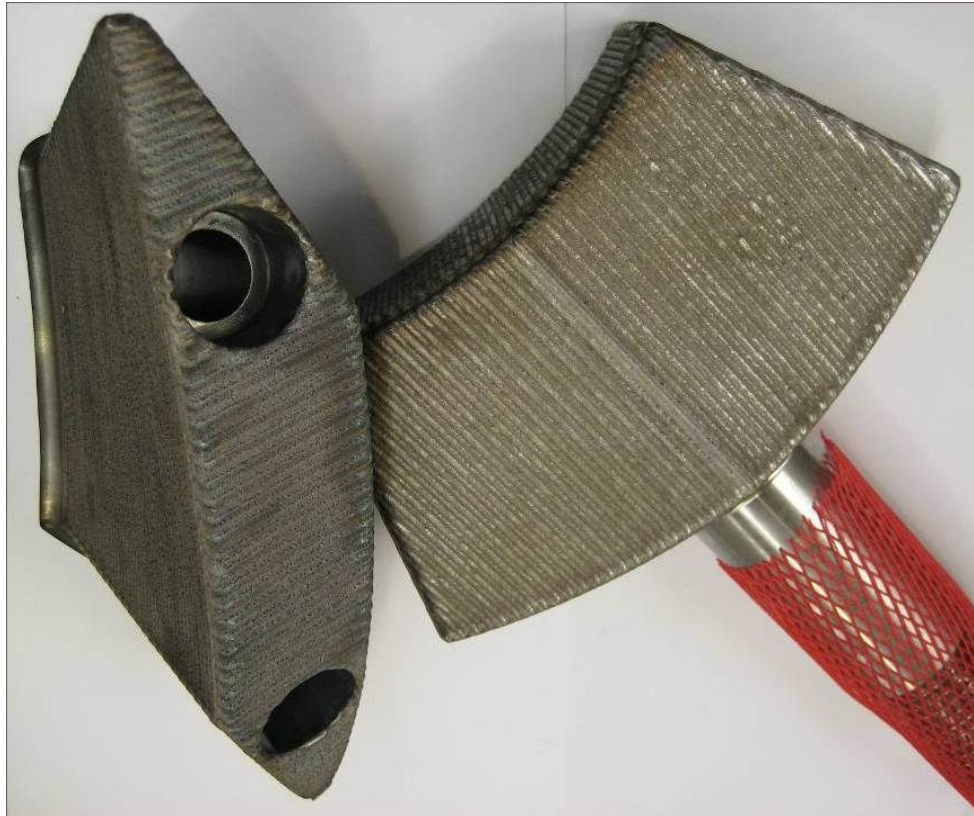
- No post-weld heat treatment possible
- Qualified processes



Compressor shaft repair

(all Oerlikon Metco)

Laser Cladding hardfacing examples



Knader teeth, fully covered with PlasmaDur™ 51302

- WC-coating with hardness 1500+ HV
- Homogeneous distribution of the WC particles
- significantly improved wear resistance, several times increased service lifetime

The Oerlikon MetcoClad™ System in Wohlen

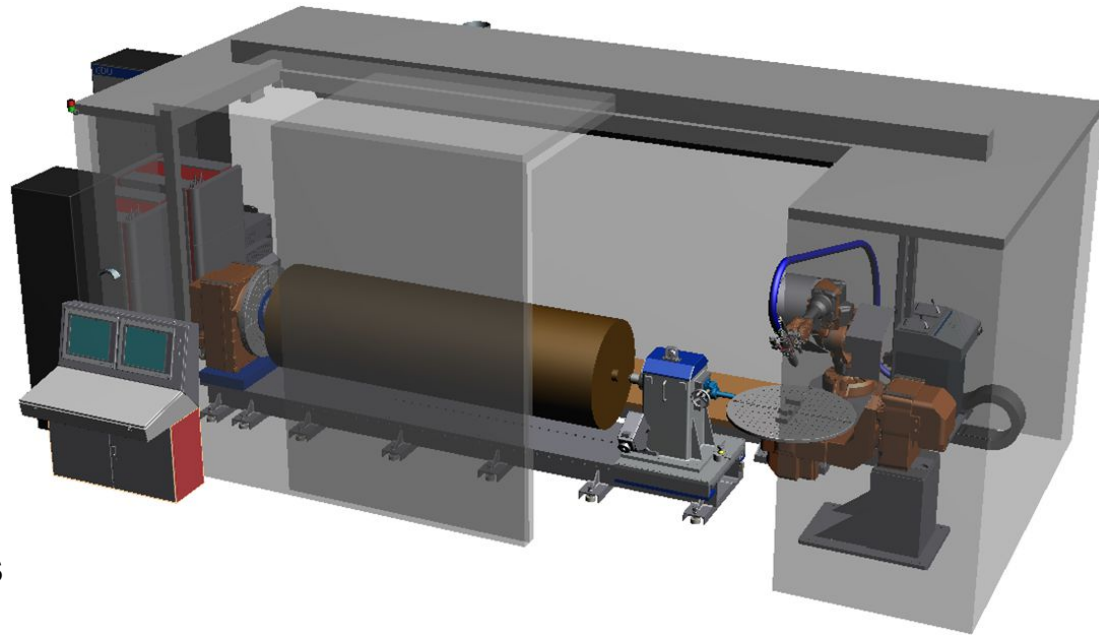


First system in Switzerland

- Application support and development
- Customer demonstration
- **Laser Cladding services**

Design features

- Oerlikon Metco LC Controller
- Oerlikon Metco Powder Feeder
- Oerlikon Metco Powder Nozzles
- 6 kW Diode Laser
- 10 axes handling system: track-mounted robot, tilting turn-table, lathe



Customer solutions will be tailored according to customer needs and may require less laser power, less robot-controlled axes, a smaller or larger or probably no lathe, ...

The MetcoClad™ system is the consistent enhancement of Metco's available thermal spray coating equipment.

The Oerlikon MetcoClad™ System



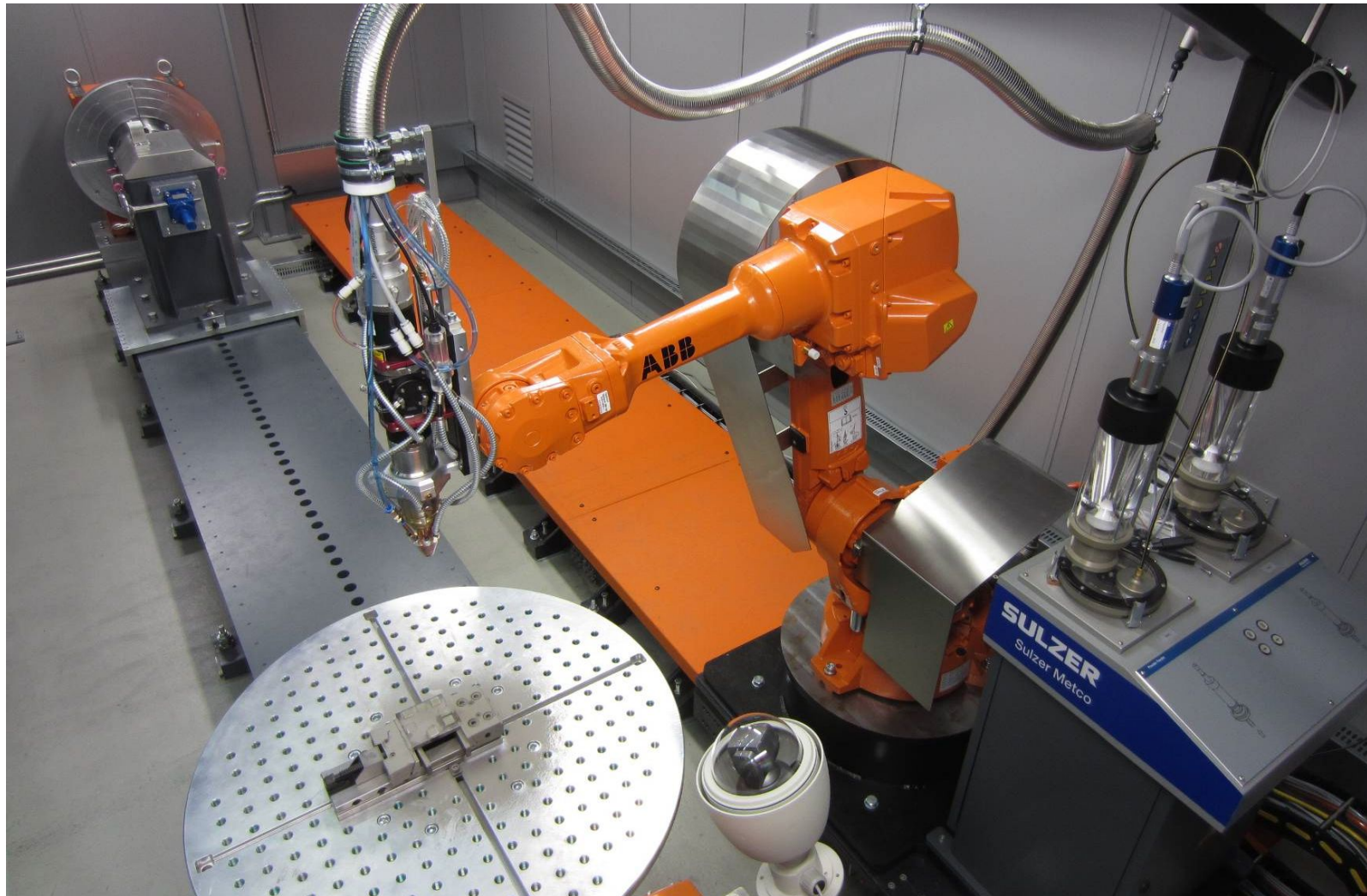
Cabin 7.5 m long, 3.5 m wide, 3 m high

The Oerlikon MetcoClad™ System



Operator desk with LC-Controller, offline programming system, camera surveillance and device monitoring tools

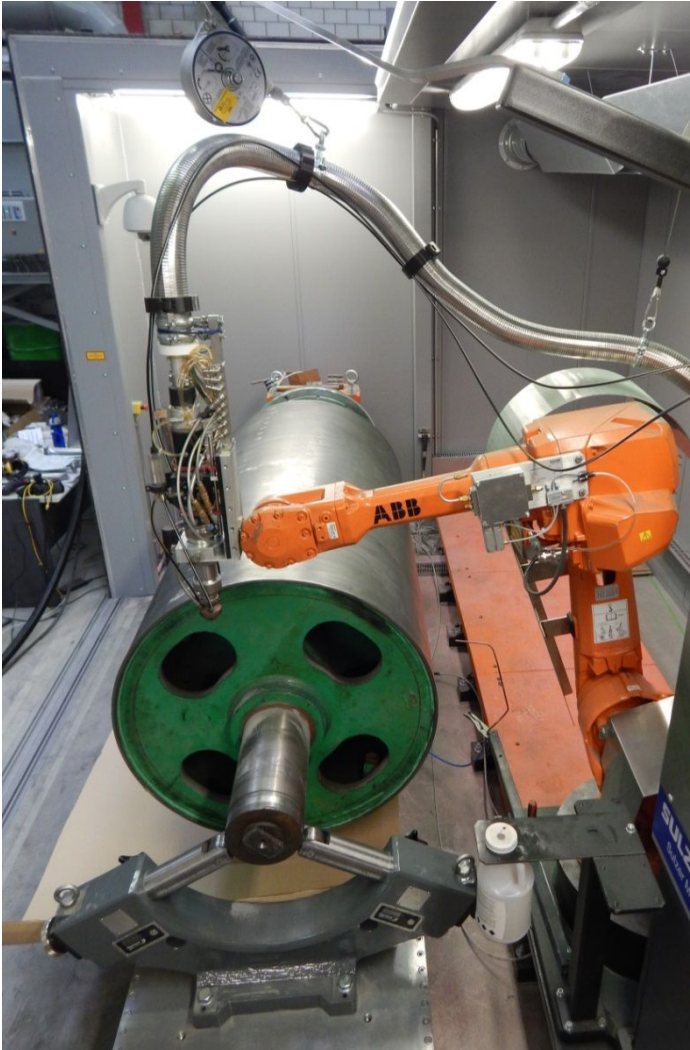
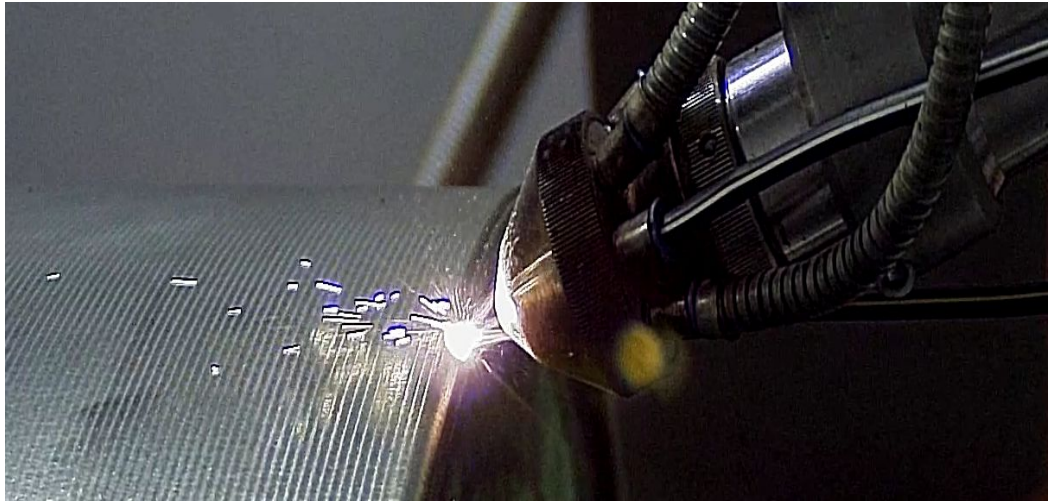
The Oerlikon MetcoClad™ System



Handling system with robot on track, tilting turn-table, lathe and powder feeder

Laser Cladding of large parts

Water-cooled roll



1 layer with MetcoClad™ C-276, ~1.2mm

Laser Cladding Services around the world



Application selection

- Dies
 - Molds
 - Wear / corrosion-resistant weld overlays
- Other general industry**



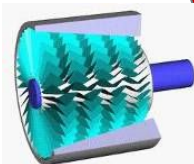
Heavy machinery

- Grader blades
- Scraper blades
- Cutting edges hardfacing
- Wear / corrosion-resistant weld overlays



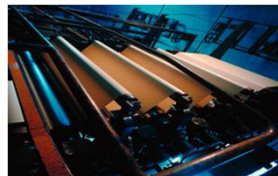
Compressors & Pumps

- Impellers
- Bearings
- Shafts



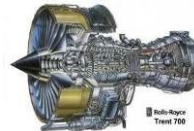
Steel, Pulp & Paper

- Rollers
- Shafts
- Knives
- Saws



Aero

Turbine blade, vane and drum repair
New-part hardfacing



IGT



- Turbine blade, vane and shaft repair
- New-part hardfacing

APPLICATIONS

Advanced weld repairs
(well known for a long time)

Tailored surfaces with improved wear/corrosion resistance

(increasingly popular)

Additive manufacturing
(an emerging application)

Oil & Gas



- Drill collars
- Drilling tools
- Downhole tools
- Stabilizer
- Bearings
- Impellers
- Rollers
- Pump parts
- Excavators

Mining



Piston engines

(from automotive to ship)



- Valve seats
- Camshafts
- Piston ring grooves
- Cylinder liners
- Crankshafts
- Gears

Laser Additive Manufacturing LAM by Direct Energy Deposition DED (= LC)

Advantages

- Material can be added to existing geometries
- Large work pieces possible
- Different materials applicable
- Higher laser power (=productivity) applicable

Limitations

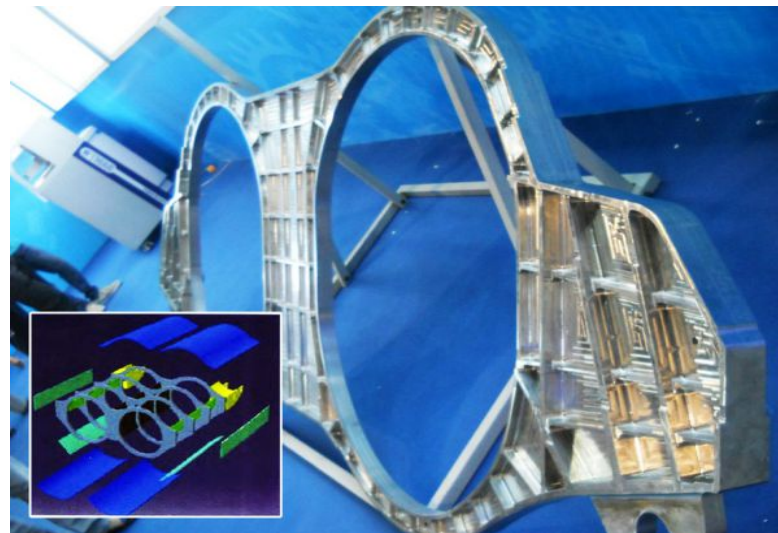
- Limited geometrical freedom vs SLM
- LAM CAM-tools for DED with limited functionality only vs SLM
- «First time right» does not work
- Materials must be weldable

Challenges – Food for thoughts

- Tailored materials that benefit from rapid solidification
- Improved simulation and related CAM-tools
- Improved process monitoring for quality control i.e. absence of welding defects

Laser Additive Manufacturing by Direct Energy Deposition DED (= LC)

- Laser Additive Manufacturing in China



(internet resources)

Summary



- Metco has 25 years experience with laser cladding
- Metco Laser Cladding services is active in several industries, from gas turbine component repair to hardfacing in new part manufacturing
- Metco offers a complete portfolio of laser cladding powders for wear resistance, corrosion resistance and general surface build-up and restoration
- Metco offers dedicated laser cladding systems, based on the long-standing experience with thermal spray equipment and laser cladding applications

Oerlikon Metco can combine material, equipment and application know-how like nobody else in the market