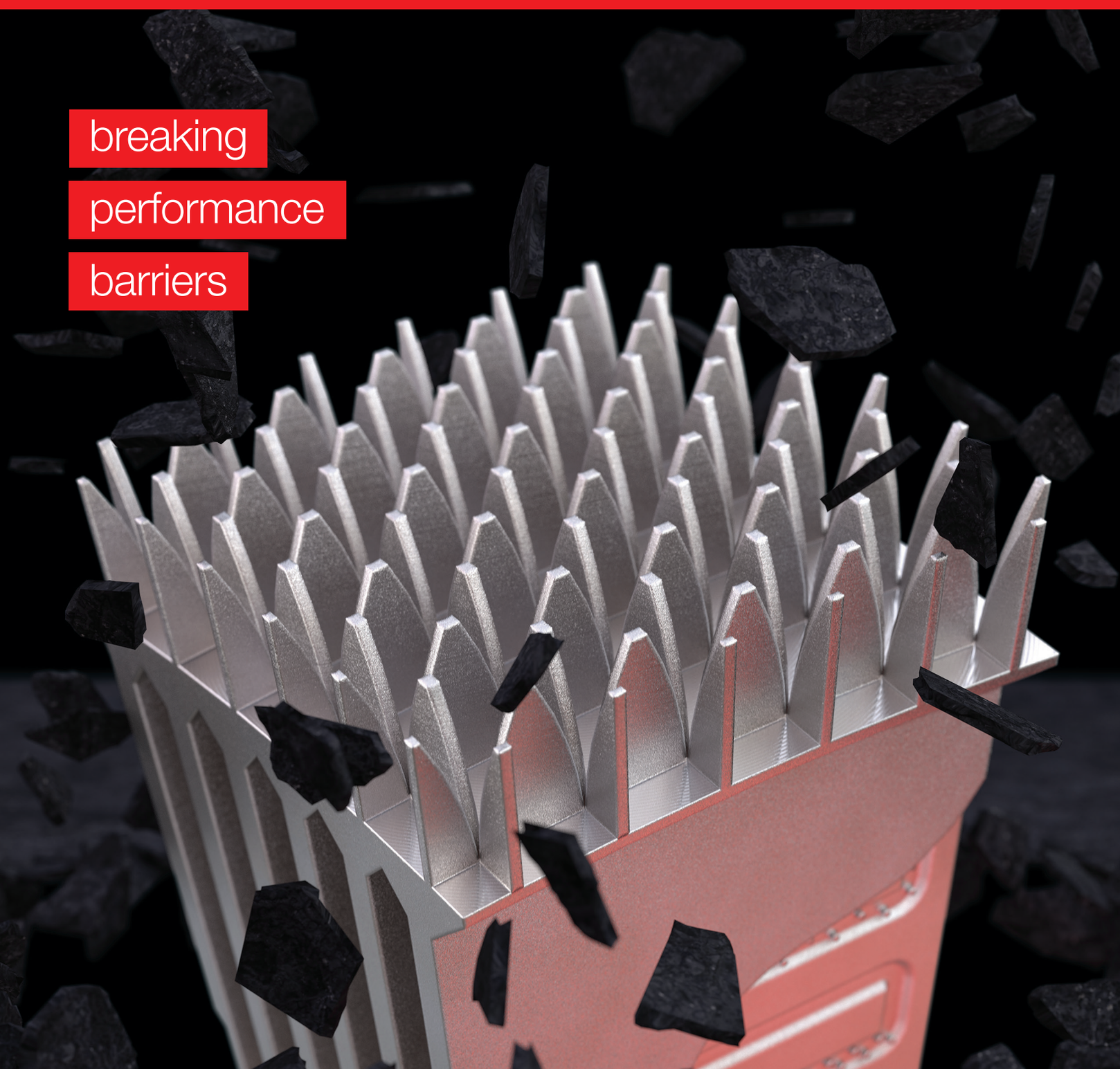
oerlikon
am

Metal Additive Manufacturing and Product Development Partner

breaking
performance
barriers

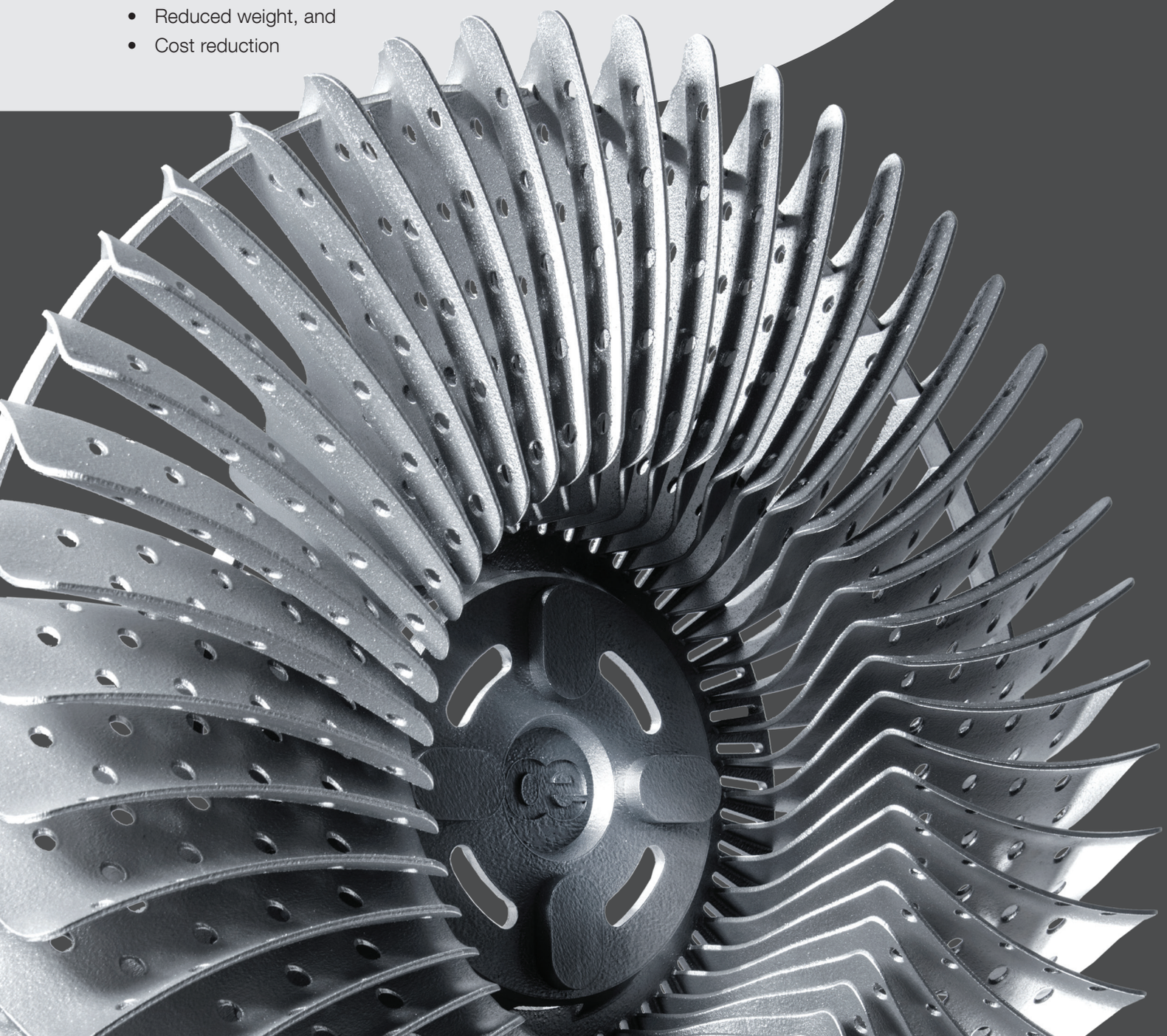


Solutions for your greatest challenges

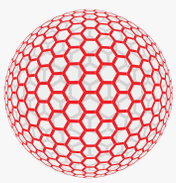
Increasingly complex product designs coupled with pressure to minimize energy, raw materials and cost pose challenges for manufacturing companies. AM's sustainable, cost-effective manufacturing process replaces traditional solutions like casting, welding, machining and opens up new manufacturing possibilities in the demanding power generation, aerospace and automotive sectors, amongst others.

Additive Manufacturing addresses increasing end-user demands for:

- Quality
- Durability
- Performance
- Reduced weight, and
- Cost reduction



Additive Manufacturing benefits



Enhanced geometric freedom

Formerly complex or impossible geometry becomes simple when design for AM principles guide you in new designs.

Fully optimized performance

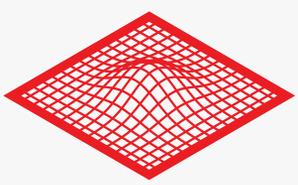
Manufacture designs with fewer components, lower mass and additional features to optimize performance for each application.

Shorter innovation cycles

Design, develop and test innovative products more quickly by eliminating expensive tooling and prototype fabrication.

Simpler supply chain

Streamline production by cutting out supplier, transportation and warehousing costs.



Easy customization

Customize manufacturing at lower unit cost, whether small production batches or mass component customization.

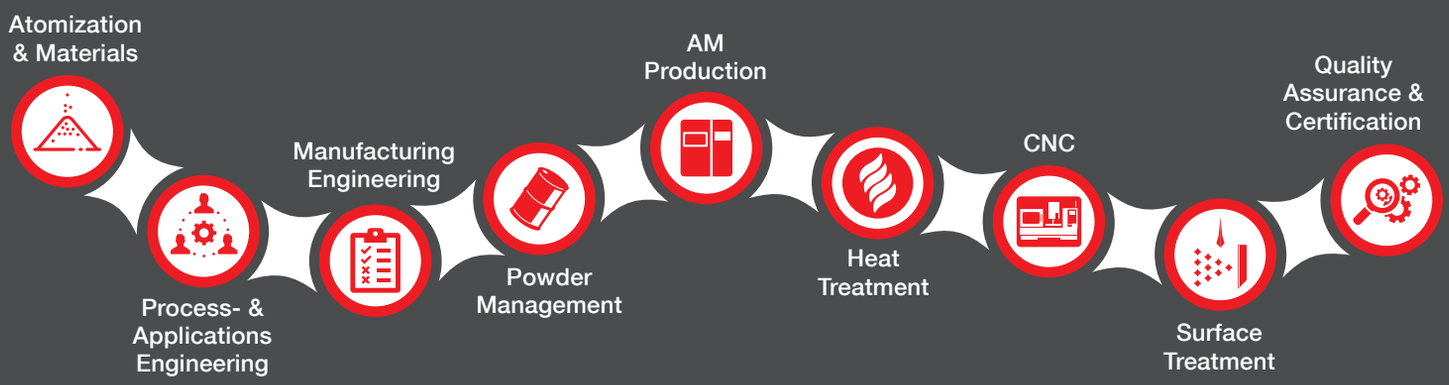
Competitive business models

Build on demand anywhere in the development cycle, enabling shorter time to market and more competitive business models.

Industrialized AM is today

At Oerlikon AM, we're integrating and scaling the entire AM value chain to handle your project from beginning to end.

By offering materials and surface technologies, design, production and testing of industrial metal-based components, Oerlikon AM and its global service network across the entire Oerlikon group is uniquely positioned to advance the industrialization of Additive Manufacturing.



Metal Powders

We have high-quality production facilities, a growing portfolio of alloys, and a R&D team committed to developing new alloys that are ideally suited to the manufacturing process.

Design & Application Engineering

We help our customers overcome design challenges, whatever their industry or application requires. Our design and R&D teams can help turn concepts into a qualified production reality.

Additive Component Manufacturing

We have helped AM go from a prototyping tool to a mainstream manufacturing process. We act as the leading AM research hub for academic and industrial partnerships in the EU and the US. We are experienced in Powder Bed Fusion and Direct Energy Deposition technologies.

Post-Processing Expertise

Our global AM centers combine on demand a full scale of post-processing technologies to modify printed surfaces, HIP and/or heat treatment or coat the printed components prior to delivery.

Key Sector Experience

We work in power generation, aerospace, automotive, tooling and general industry - all sectors where precision and quality are vital.

80+ years of materials and engineering experience

We provide the world's leading metal powder portfolio, offering superior quality, traceability and production performance.

We have a broad range of alloys and are continuously developing more. We know that current solutions in AM cannot answer every production need. Our R&D teams can rapidly design, optimize, and produce new and custom alloy chemistries for pilot atomization and AM validation in our production facilities.

AM Metal Powder Portfolio

	Product	Nominal Chemistry	Nominal Particle Size Distribution [µm]
Nickel	MetcoAdd 718C	Ni 18Cr 18Fe 5(Nb+Ta) 3Mo 1Ti 0.6Al	-45 +15
	MetcoAdd 718E		-63 +20
	MetcoAdd 718F		-106 +45
	MetcoAdd 718 API C	Fe 53Ni 18Cr 5(Nb+Ta) 3Mo 1Ti 0.5Al	-63 +16
	MetcoAdd 718 API F		-106 +45
	MetcoAdd 738LC-A	Ni 16Cr 7(Al+Ti) 9Co 4 Fe 3W 2Mo 2Ta 0.1C	-45 +15
	MetcoAdd 625A	Ni 21Cr 9Mo 4Fe 4(Nb+Ta) 0.4Al 0.4Ti	-45 +15
	MetcoAdd HX-D	Ni 21Cr 18Fe 9Mo	-45 +15
	MetcoAdd HX-L		-53 +20
	MetcoAdd H23X-A	Ni 22Cr 2Mo 14W 0.35Al 0.03La	-45 +15
	MetcoAdd 6022A	Ni 22Cr 14Mo 3Fe 3W 2.4Co 0.5Mn	-53 +20
Cobalt	MetcoAdd 75A	Co 28Cr 6Mo	-45 +10
	MetcoAdd 76A-1		-45 +15
	MetcoAdd MM509-A	Co 10Ni 24Cr 7W	-45 +15
Iron	MetcoAdd 316L-A	Fe 18Cr 12Ni 2Mo 0.02C	-45 +15
	MetcoAdd 316L-D		-106 +45
	MetcoAdd 415F	Fe 13Cr 4Ni 0.8Mn 0.6Mo 0.5Si 0.03C	-45 +15
	MetcoAdd 415G		-106 +45
	MetcoAdd 17-4PH-A	Fe 17Cr 4.5Ni 4Cu 0.3(Nb+Ta) 0.07C	-45 +15
	MetcoAdd 17-4PH-D		-106 +45
	MetcoAdd 15-5PH-A	Fe 15Cr 4.5Ni 3.5Cu 0.3Nb 0.07C	-45 +15
	MetcoAdd 15-5PH-B		-90 +45
	MetcoAdd C300-A	Fe 18Ni 9Co 5Mo	-45 +15
	MetcoAdd H11-A	Fe 5Cr 1Mo 1Si 0.5V 0.4C	-45 +15
	MetcoAdd H13-A	Fe 5Cr 1Mo 1Si 1V 0.4C	-45 +15
	MetcoAdd H13-B		-90 +45
Titanium	MetcoAdd Ti-64 G23-A	Ti 6Al 4V	-45 +15
	MetcoAdd Ti-64 G23-E		-106 +45
	MetcoAdd Ti-64 G5-B		-63 +20

Production Technology and Capabilities

Our custom metal powder development and production is located in two facilities in Michigan, US.

Troy

- Inert Gas Atomizers (IGA) for Ni, Co and Fe-based powders (argon atomization gases)
- NADCAP certified QA facility
- Proprietary labeling / packaging capabilities

Plymouth

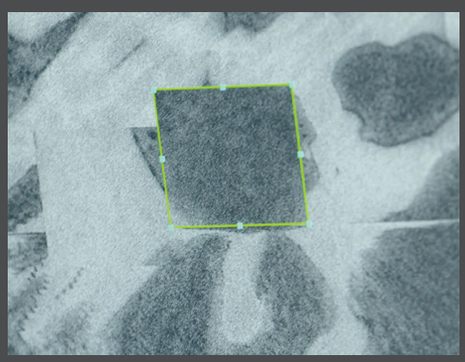
- Vacuum Inert Gas Atomizer (VIGA) for Ni, Co and Fe powders (nitrogen & argon atomization gases)
- EIGA for titanium powders - Grades 5 and 23 (argon only)
- Dedicated R&D Atomizer: up to 250 kg heat sizes (argon only)
- Onsite QA capabilities, packaging and R&D development

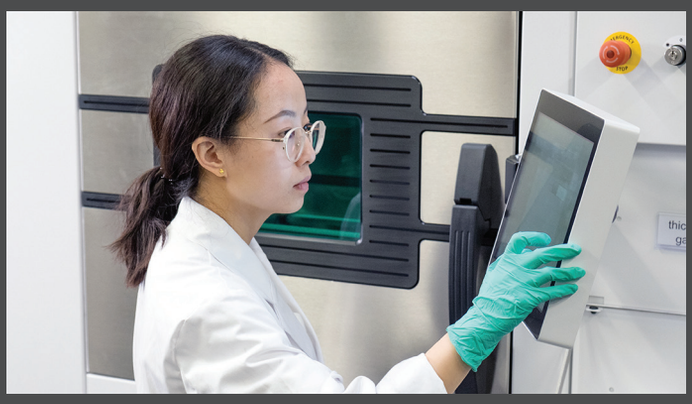
Distribution Centers

- Regionally positioned (USA, Germany, Singapore, Australia, China and Japan)
- ISO, OHS certified
- Over 6 million units moved through network

Metal Powder R&D

- R&D centers in Munich (Germany) & Charlotte, North Carolina, (USA) for testing and process parameter optimization on a variety of metal AM machines.
- Pilot atomizers available for R&D powder development / analysis with up to 500 lb. maximum melt capacities. Oerlikon Scoperta provides computational Rapid Alloy Development (RAD) tools to create new alloys and improve existing ones.





If you can imagine it, we can build it

Our expertise and extensive AM equipment options allow us to serve you in any advanced way you need: prototyping, pre-series and volume production, integrated full-service provider or product development partner. We can help you achieve the functionality, geometric accuracy and mechanical characteristics your application demands.

Our Europe and US-based application engineers provide swift in-house design and can work with a wide range of design files and equipment. Their capabilities and the experience of our R&D team allow us to advise you on the best possible combination of materials, design, production methods and post-processing for your project.

Prototyping

We provide a broad range of material and machine options to suit the needs of each prototyping application. We specialize in rapid prototyping of end-use components in metals. Furthermore we have experience and equipment to cover your polymer prototyping needs.

Series Production

We make series production components for many industries, including aerospace, power generation and automotive. We can help you move from prototyping to production.

Design & Applications Engineering

We can help our customers overcome even the most demanding design challenge, regardless of industry or application. We select the right process, machine and material to make parts manufacturable.

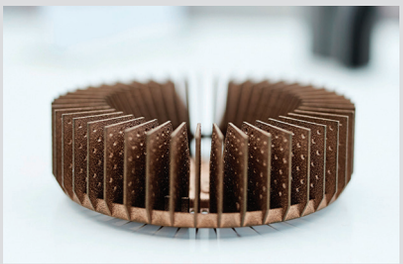
Post-Processing

We can provide finished parts using our in-house post-processing capabilities and expertise in surface engineering. Offerings include hot isostatic pressing, vacuum heat treatment, CNC machining and coating.

AM Metal Component Manufacturing

EU / USA

	Materials
Al	AlSi9Cu3(EU), AlSi7Mg(EU), AlSi10Mg, AlMgSc (Scalmalloy) (EU), 6061 RAM 2(US), A205(US)
Ni	Alloy 718 (2.4668), Alloy 625 (2.4856), Alloy X (2.4665), Alloy 230(US) Haynes 282, C22(EU)
Co	CoCrMo (F75), Mar-M509
Fe	18 Ni Maraging Steel (1.2709), 316L (1.4404), 1.4859(EU), 1.4308(EU) (CF8), H11 (1.2343)(US), H13 (1.2344)(EU)
Ti	Ti-6Al-4V
Cu	CuNi2SiCr(EU), CuCr1Zr(EU), CuCp(EU)

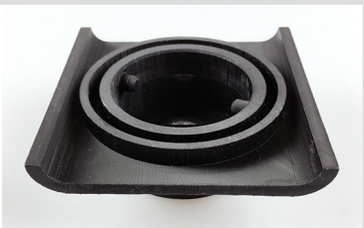


Laser Powder Bed Fusion of Metals (PBF-LB/M), also known as SLM

Concept Laser	1x Concept Laser M2 (1kW)	5x Concept Laser M2 Dual UP1 (2x 400W)		
EOS	1x EOS M270 (200W)	3x EOS M280 (400W)	11x EOS M290 (400W)	8x EOS M400 (1kW)
Renishaw	1x RenAM 500Q (4x 500W)			
Trumpf	3x Trumpf TruPrint 1000 (200W)	2x Trumpf TruPrint 3000 (500W)	1x Trumpf TruPrint 3000 Dual (2x 500W)	5x Trumpf TruPrint 5000 (3x 500W)
3D Systems + GF	3x DMP Factory 500 (3x 500W)			

AM Polymer Production

EU only



Laser Powder Bed Fusion of Polymers (PBF-LB/P) also known as SLS

EOS 1x EOS P100 1x EOS P110 2x EOS P396

Materials: PA12, PA12-GB, PA12-CF and TPU

Vat Photopolymerization (VPP) also known as CLIP

2x Carbon M2 MPU 100

Materials: EPU40 (similar to TPU), RPU70 (similar to ABS), CE221 (similar to glass filled nylon), SIL30 (similar to TPE), EPX82 (similar to 20% glass filled PBT), EPX86 FR (flame resistant) and IND405 (transparent)

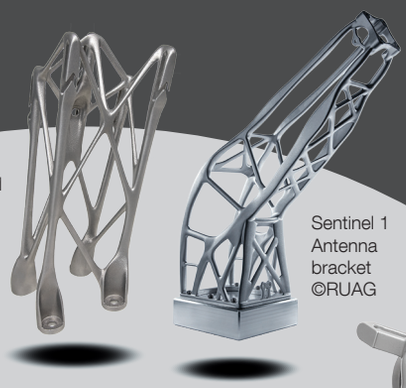
Aerospace & Space

Making aircraft safer, lighter and more efficient

The aerospace industry requires quality, traceability, affordability, reliability, and optimized weight and performance. AM can deliver on all these metrics in a cost-competitive framework.

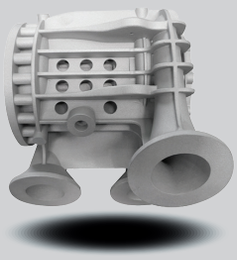
Applications

- **RF antenna**
- **Heat exchanger**
- **Bracket**
- **Pump housings**
- **Rocket nozzle**
- **Impeller**



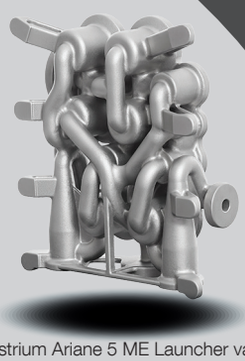
ALM PUSM bracket ©RUAG

Sentinel 1 Antenna bracket ©RUAG



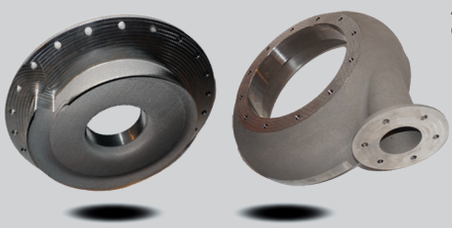
Turbopump ©Rocket Factory Augsburg

LENA Space nozzles for rocket steam turbine

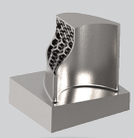


Astrium Ariane 5 ME Launcher valve ©Airbus Defence & Space

LENA Space stator vane section



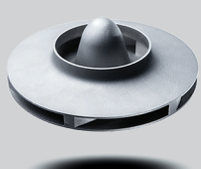
LENA Space casing for rocket turbopump



LENA Space stator vanes for rocket steam turbine

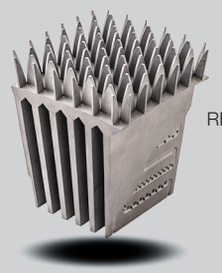
Aero engine boroscope boss made from Ni-based alloy 718 @MTU Aero Engines AG

LENA Space rocket nozzle



LENA Space impeller for rocket turbopump

LENA Space rotor for steam turbine



RF horn

Choose us as your aerospace partner

Our AM specialists have extensive expertise in aerospace and defense.

- AS9100, ITAR registered, full spectrum AM capabilities for quality control and traceability, and affordability
- Powder atomization, R&D and production are delivered in-house
- Aerospace-specific applications engineering in areas like generative design/light weighting, highly customized parts, weld elimination, reverse engineering and replacement of obsolete parts
- Support for material and component qualification
- Collaboration opportunities: Material development, data set/design allowables, R&D, application engineering, series production and prototypes
- Aerospace partnership examples:
  Boeing partnership to create standard processes for 3D-printed structural titanium aerospace parts
  Lufthansa Technik partnership to establish replicable AM processes and standards for MRO applications

Choose us as your automotive partner

The Oerlikon AM's team has extensive expertise in automotive engineering.

- Integrated services, from prototyping to production, delivering AM solutions for mass-market automotive applications
- Components with properties superior to conventional solutions
- Designs previously impossible to manufacture
- Consolidation of multiple parts, reducing weight and simplify the supply chain
- Expertise in materials – from metal alloys to plastics
- New powder development – tailored and custom alloys designed and atomized in-house for tooling and component manufacturing
- R&D facilities to support your product development

Automotive

Increasing performance and efficiency for the automotive industry

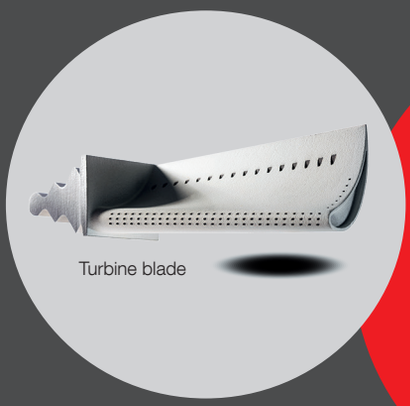
AM offers the perfect balance of unique part construction and ergonomics, dynamic mass reduction, enhanced cooling, part count reduction and fast delivery.

It helps car manufacturers meet new efficiency targets and to ramp up innovative technologies.

Applications

- **Fuel cell systems**
- **E-axle components**
- **Battery systems**
- **Thermal management**
- **Exhaust components**

Power Generation & Oil/Gas


Turbine blade

Applications

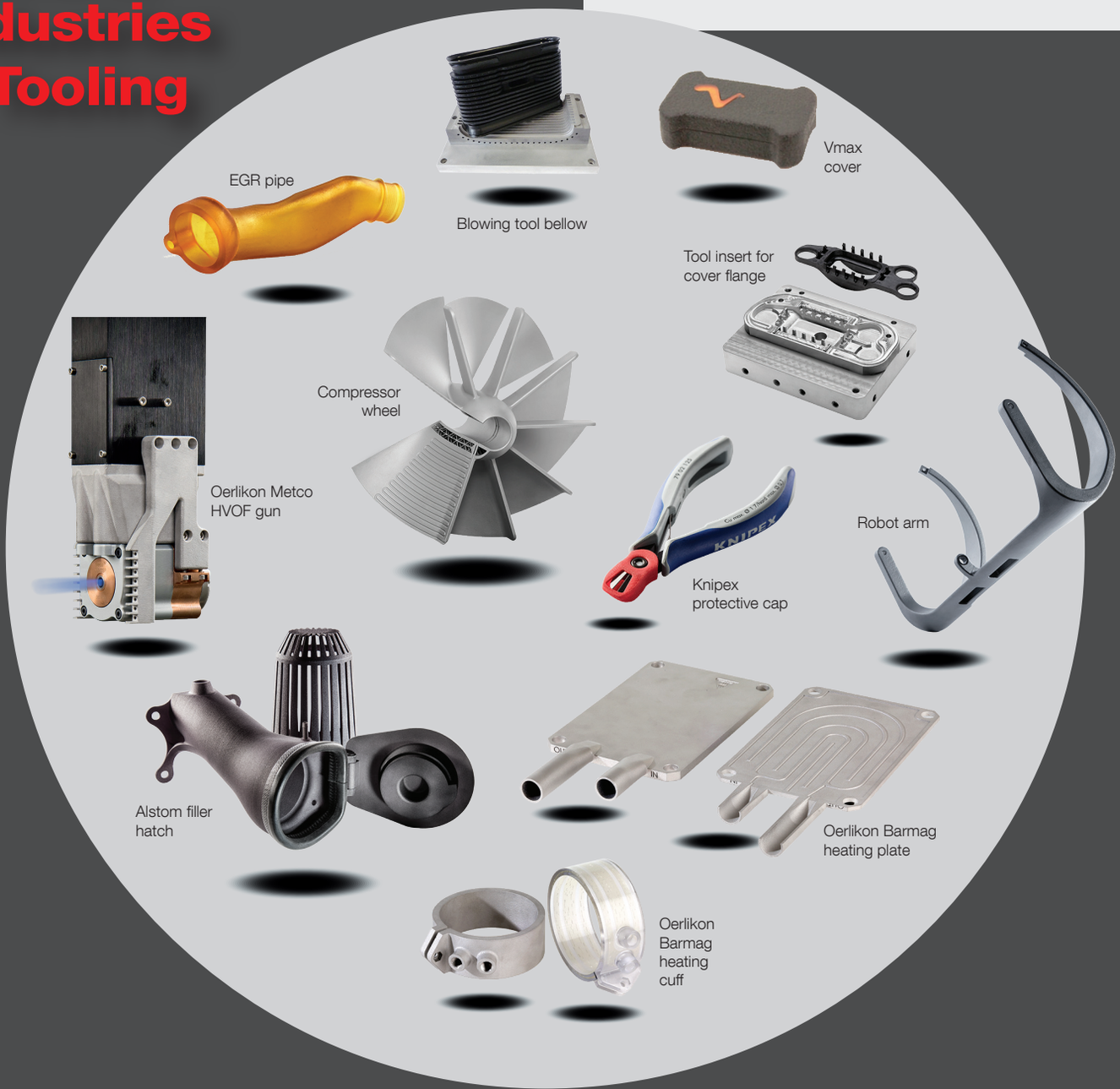
- **Burners, swirlers**
- **Compressor**
- **Turbine blades**
- **Impellers**
- **Micro combustion chambers**
- **Drill bits**

Choose us as your partner

We provide:

- AM design for higher functional integration within components (manifolds, cooling ducts, molds with conformal cooling, semiconductor equipment and heat exchangers)
- AM design for structural, heat-resistant and high-performance components (swirlers, burners and fuel supply systems)
- Complete component manufacturing in our facilities: material manufacturing, part printing, heat treating, stress relief, HIP, machining and finishing – providing you with complete control of all processes
- Expertise in materials – from metal alloys to plastics and new powder development – tailored and custom alloys designed and atomized in-house for tooling and component manufacturing
- R&D facilities to support your own product development

General Industries & Tooling



Case Study

URWAHN oerlikon am

Collaboration between bicycle maker Urwahn and Oerlikon AM

Turning dreams into reality

What happens when you introduce a visionary creator of bicycles in Germany to Oerlikon's creative and passionate additive manufacturing team? You come up with a one-of-a-kind bicycle unmatched by any competitor and a dream for bicycle enthusiasts who want a comfortable and safe bike while riding in nature.

Urwahn and Oerlikon worked together from concept creation to materials selection to product development and engineering, to final 3-D printing of a unique bicycle.

Oerlikon's Balzer's group added a protective BALINIT CROMA PLUS coating in the color rainbow, because cool bikes need to look cool too.

Mobility and transportation is an innovative and rapidly developing industry well suited for additive manufacturing, which can print complex metal components.

Watch the full story behind:

1	Fast re-design, fast production of housings
2	Production on-demand within days
3	Robust materials
4	Comfortable riding qualities
5	Excentric in lightweight design
6	Integrated range of functions and modular design
7	Corrosion protection, scratch resistance and ultra-individualization
8	Reduced weight
9	Organic form language with integrated functions

Our AM offering extends across the globe

We provide end-to-end AM services from facilities in the US, Europe and China.

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Oerlikon's unique offering for manufacturing and coatings

1 Materials

Delivery of coating materials

- **Full range of Oerlikon Standards and customized Coating Materials**
- **In-house R&D and manufacturing**

2 Additive Manufacturing

AM industrialization

- **Metal Powders**
- **Material Innovation**
- **Co-engineering/part development**
- **Additive Component Manufacturing**
  - Laser Powder Bed Fusion
  - Direct Energy Deposition

3 Component Manufacturing

Production of turbine components

- **State of the art facilities with conventional and non-conventional machining capabilities and sheet metal fabrication**

4 Equipment

Delivery of coating equipment for thin and medium thickness coatings

- **Turnkey equipment solutions**
- **Upgrades of existing machines**
- **Comprehensive range of thermal spray and other advanced surface technology equipment**

5 Coating Services

Coating facilities for PVD, CVD and thermal spray

- **Targeted Process Development**
- **Widest range of coating technology**
- **Application of coating solutions on an industrial scale (in-house)**

Oerlikon is a global innovation powerhouse for surface engineering, polymer processing and additive manufacturing. The Group's solutions and comprehensive services, together with its advanced materials, improve and maximize the performance, function, design and sustainability of its customers' products and manufacturing processes in key industries. Pioneering technology for decades, everything Oerlikon invents and does is guided by its passion to support customers' goals and foster a sustainable world. Headquartered in Pfäffikon, Switzerland, the Group operates its business in two Divisions – Surface Solutions and Polymer Processing Solutions. It has a global footprint of more than 12 000 employees at 202 locations in 37 countries and generated sales of CHF 2.65 billion in 2021.

We'll never stop expanding our capabilities

When you're an industry disruptor, you can never rest on your laurels. We're constantly developing our innovation and production sites to serve you with the latest technology.

Why not see what our experience and expertise in application-tailored solutions and materials developments could do for your business?

If you can imagine it, we can build it.

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