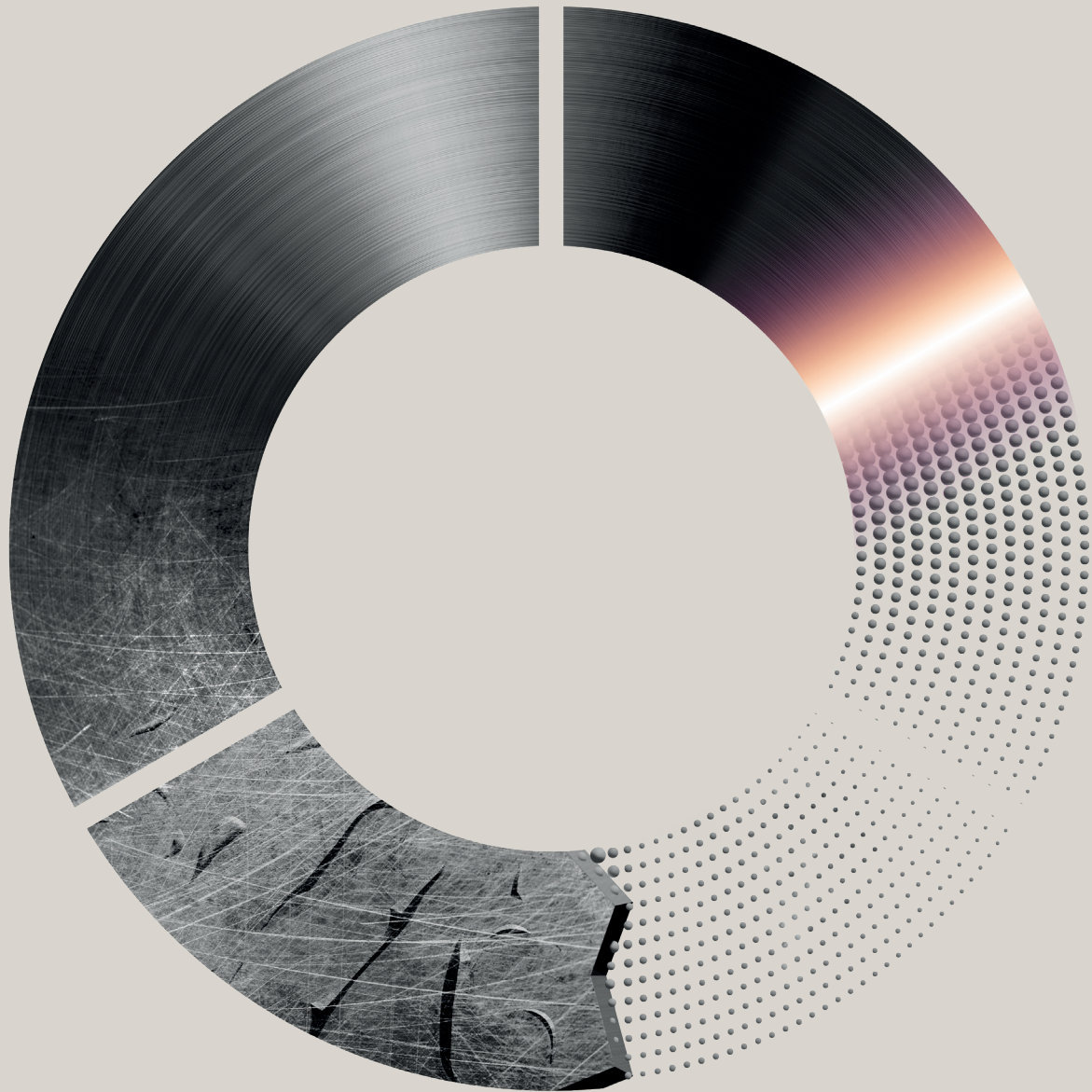


FREEDOM IN METAL AM DEVELOPMENT & PRODUCTION



VALUES WE PROVIDE

Materials and technology for research - scientific cooperation	3
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Any alloy atomized into powder	8
From any feedstock to desired powder	10
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It all started with science

A Ph.D. student needed 200 g of bulk metallic glass powder for his research on alloy design for laser powder bed fusion, but gas atomization services exceeded the project budget by two times. The solution was already out there, but it had been forgotten for 40 years – ultrasonic atomization. Upon rediscovering this technique, it was decided to build a new device and produce the powders in-house.

This is the story of AMAZEMET founder and inventor, Łukasz Żrodowski, and the origin of the company’s core mission: to broaden scientific possibilities in materials science and metal 3D printing by spreading knowledge and delivering novel tools for researchers worldwide.

This mission has grown over time, focusing on values such as sustainability, providing a closed-loop production chain for metal 3D printing, and the development of industrial metal additive manufacturing (AM). Being both a production company and a Warsaw University of Technology spin-off, AMAZEMET combines the understanding of relevant fundamental science and academic environments with industrial processes and needs.



Possibility of scientific cooperation

One of the most important challenges facing the development of science and industry is the formation of partnerships that foster interdisciplinary and international cooperation – for example, research project collaborations between companies and universities. Over the past few years, AMAZEMET has participated in more than 30 consortia involving projects such as EIC Pathfinder, M-ERA.NET, CETP, RFCS, Horizon 2020, and ESA-funded projects. Currently AMAZEMET has been granted 8 international projects.

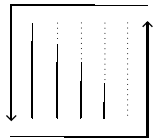
The greatest value for partners who collaborate with AMAZEMET is the scientific support of the Warsaw University of Technology. The specialists involved in these projects have extensive experience in materials engineering, and they understand the need for research and development. Applying these skills while using innovative technologies, such as ultrasonic atomization, makes AMAZEMET a unique contributor to the consortium.

Involving AMAZEMET in project collaboration comes with many benefits, including access to:

- Expertise in fields related to materials science, ultrasonics, and vacuum technologies, and access to additional resources at the Warsaw University of Technology,
- A highly-skilled interdisciplinary team eager to solve complex engineering problems,
- The possibility to atomize metallic powders with tailored chemical compositions,
- Laboratories fully equipped to perform atomization of nearly all alloying systems,
- Laser powder bed fusion (LPBF) system dedicated to optimizing new materials.

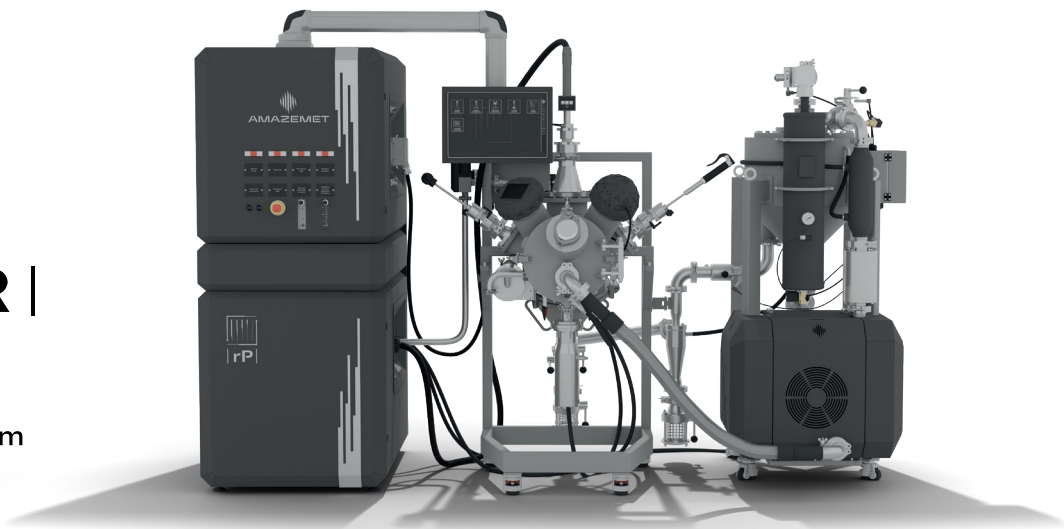
Projects in which we participate



| rePOWDER |

Ultrasonic powder atomizer
and alloy prototyping platform



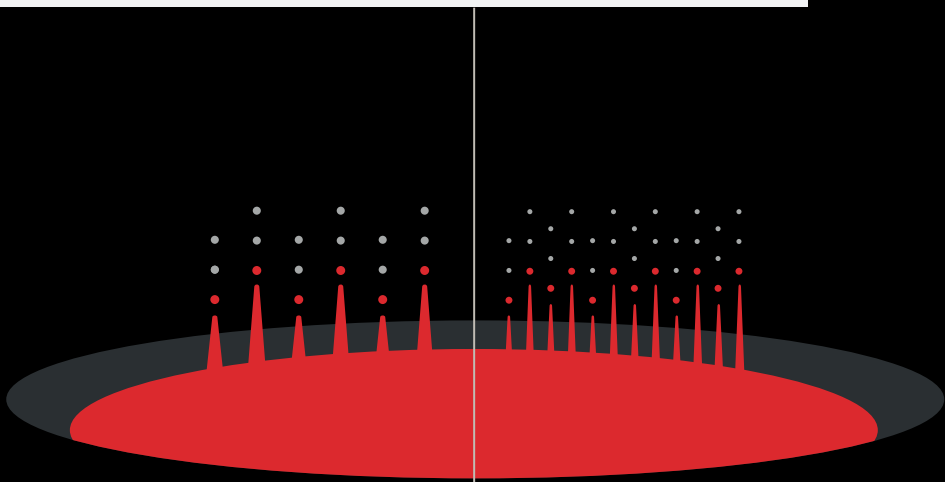
Ultrasonic atomization is a liquid-to-solid type of process, where ultrasonic vibrations are used to create powders. The main principles of this technology are based on amplitude and surface wettability. When the threshold vibrational amplitude in the liquid layer wetted to the sonotrode is exceeded, standing capillary waves are generated (Lierke et al., 1967). Further increasing the amplitude disrupts the internal forces of the liquid, thereby ejecting small droplets from the melt.

The size of the produced particles depends primarily on the ultrasonic frequency, although it is also influenced by the physical properties of the liquid material like density.

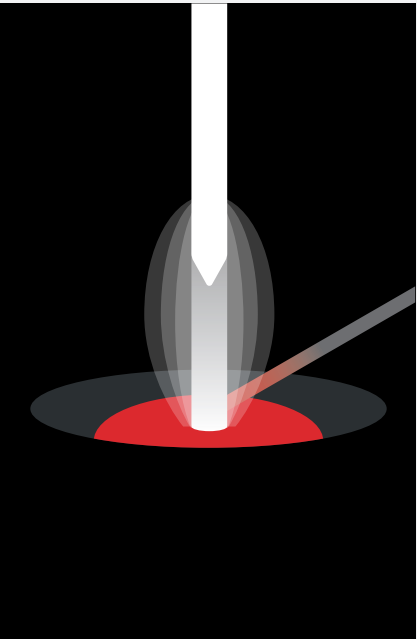
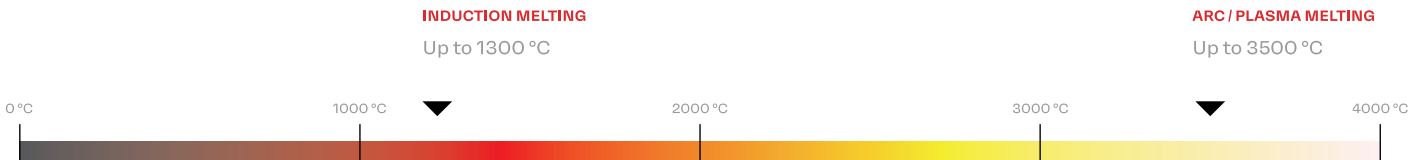
The PSD can be modulated by using different frequencies:

- 20 kHz is most suitable for electron beam melting (EBM) and direct energy deposition (DED), leading to a d50 between 80–100 µm, depending on the atomized material,
- 40 kHz is most suitable for LPBF and sintering technologies, leading to a d50 between 45–60 µm,
- 60 kHz is most suitable for LPBF, binder jetting (BJ), thermal spraying and sintering technologies leading to a d50 between 30–45 µm.

The resulting narrow particle size distribution (PSD) allows up to 80% of the manufactured powder to be used for dedicated technology.



2 types of heat source



Arc / Plasma Melting

Heating can be carried under an inert or reactive gas atmosphere using an electric arc (TIG generator) or focused plasma. Material is fed and melted directly to the top of the sonotrode. It is crucial to have an appropriate sonotrode material with good wettability to the melted material to achieve an efficient atomization process and minimize the possibility of contamination.

Suitable for working with all medium and high-melting materials including:

- Fe-based alloys,
- Ti, Ni, Pt, Ir based alloys,
- High Entropy Alloys,
- Refractory materials such as W, Ta, V, Mo, Nb, Re, etc.
- Metal Matrix Composite powders.



Induction Melting

Induction Melting is usually used to process alloys with melting points up to 1300 °C, for example:

- Relatively low melting point and volatile elements that tend to evaporate in the plasma, such as Sn, Zn, Mg, Pb, and Al alloys,
- Materials with high thermal capacities and conductivities, like Cu and precious metals such as Ag, and Au alloys.

The material in any shape and form can be placed into the crucible, including final alloy, master alloys, or pure elements.

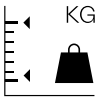
All materials are easily alloyed thanks to the magnetic stirring effect.

Core benefits & features



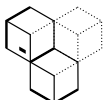
Processing of any elements or alloys

Ultrasonic atomization can be carried out on a wide range of pure elements (e.g., Zn, Mg to Pt, Mo, Ta), as well as any alloy composition (e.g., Mg-Li, CuSn6, TiTaZrRuCu, MoRe).



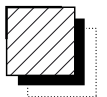
Various capacities depending on specific needs

The ability to produce powder from a few grams (e.g. for small amounts of an alloy or rare and expensive elements) up to several kg per day (when processing wire material or using induction module).



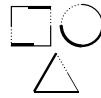
Modularity and openness

The rePowder platform has a modular design. New modules can be added at any time. All connections in the device follow current standards (e.g., ISO-KF), so each customer can create and connect their modules as needed.



Multiple alloys in one day

The device is laboratory-scale, easy to clean, and allows for rapid material changeover. Several atomization processes can be carried out for different alloys on different ultrasonic systems in the course of one day.



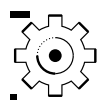
Any form of feedstock

The ability to atomize chips, failed AM prints, damaged samples, rods, wire, powder, and more.



Automated operation

A variety of automated feeders (e.g. powder, rod, wire) and automated plasma torch to make the operation as easy as possible.



One device - many possibilities

The rePowder platform was designed to enable many different types of processes to be performed using a single device, including the preparation of a new composition, alloy homogenization, ultrasonic atomization, suction casting, and further options in development.



Multiple applications

The obtained powder can be used in a variety of technologies, including additive manufacturing, sintering, thermal spraying, catalysis etc.



Recycling

The device allows reprocessing of printed parts or scraps material into powder for further use in the desired application.

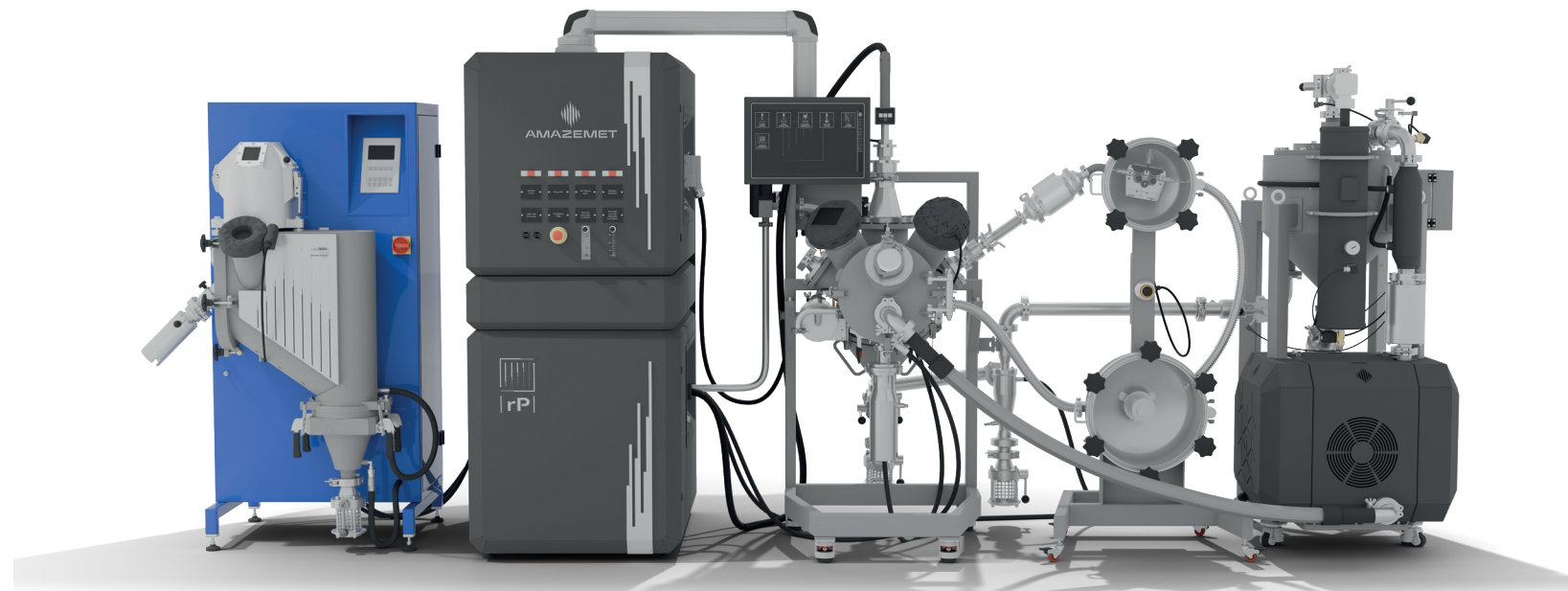


Low maintenance costs

The device uses minimal amounts of noble gases (~10 L/min). The cost of a single atomization process is minuscule.

| rePOWDER |

Ultrasonic powder atomizer and alloy prototyping platform



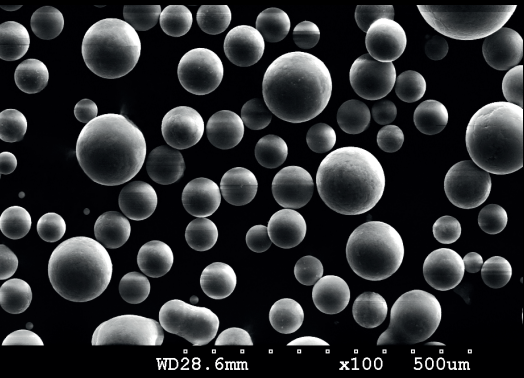
In-house processed materials

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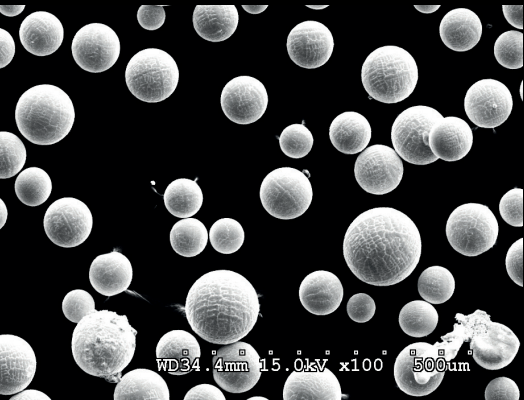
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| rePOWDER |



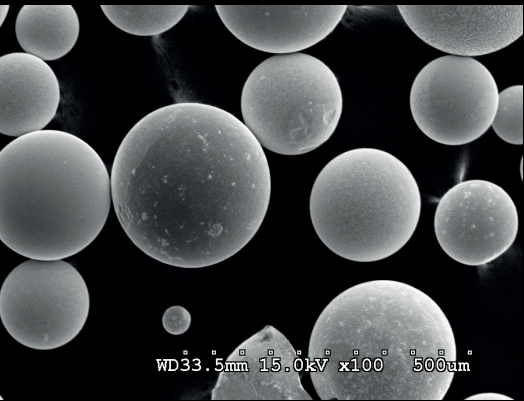
MgLi

HEAT SOURCE
Induction
TEMPERATURE [°C]
750
ULTRASONIC FREQUENCY [KHZ]
40
SONOTRODE MATERIAL
Refractory plate
FEEDSTOCK FORM
Cast



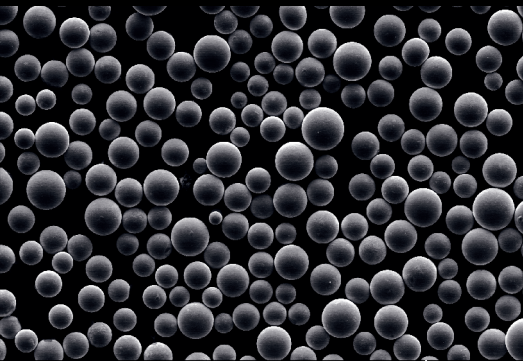
PtRh

HEAT SOURCE
Arc
ARC CURRENT [A]
300
ULTRASONIC FREQUENCY [KHZ]
40
SONOTRODE MATERIAL
W-refractory alloy
FEEDSTOCK FORM
Rod



AMZ4 metallic glass

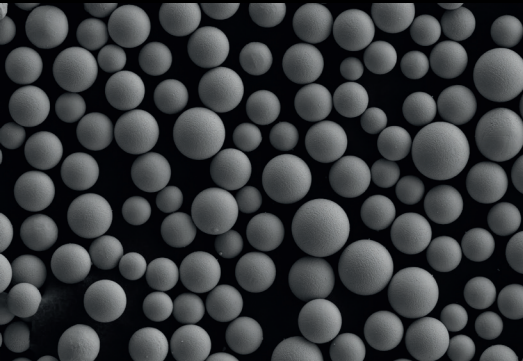
HEAT SOURCE
Arc
ARC CURRENT [A]
300
ULTRASONIC FREQUENCY [KHZ]
40
SONOTRODE MATERIAL
Cu-alloy
FEEDSTOCK FORM
Rod



WUT_SU8000 15.0kV 14.8mm x100 LM(L)

WTaVTi HEA

HEAT SOURCE
Arc
ARC CURRENT [A]
300
ULTRASONIC FREQUENCY [KHZ]
40
SONOTRODE MATERIAL
W-refractory alloy
FEEDSTOCK FORM
Raw elements

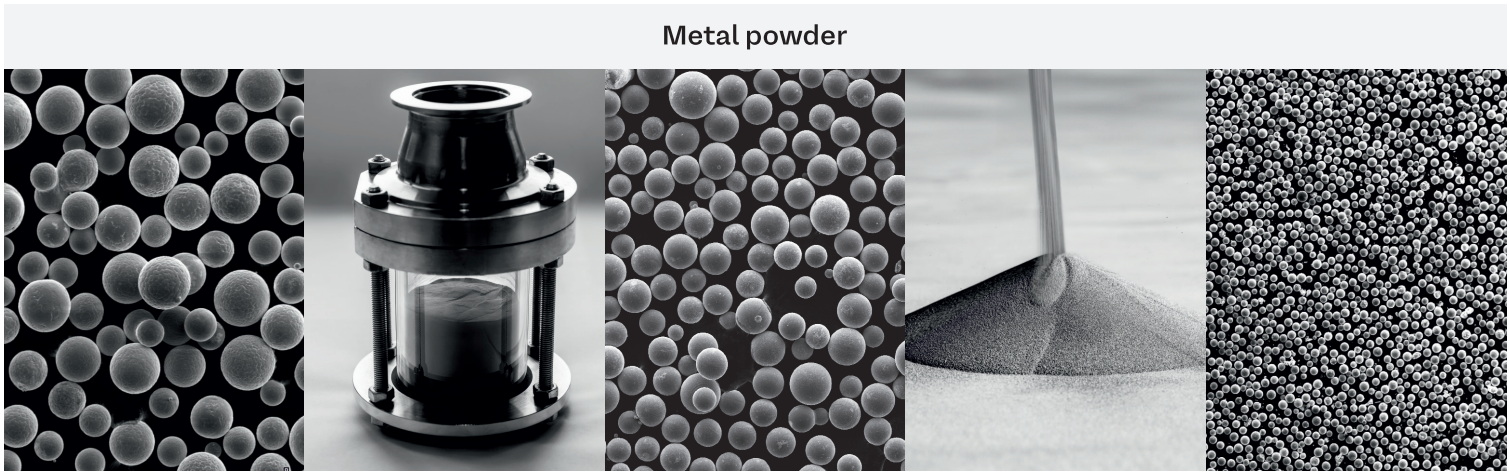
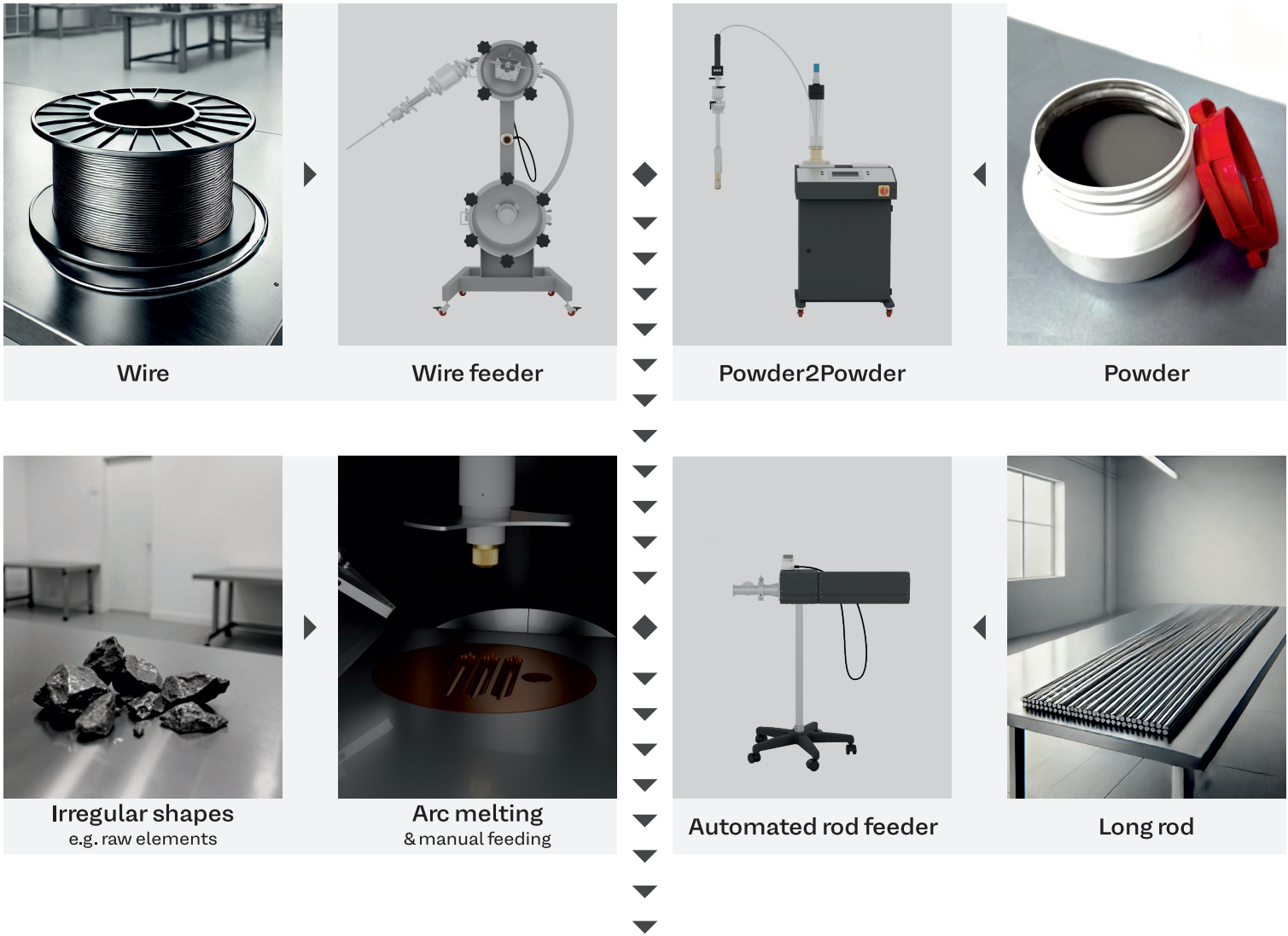


WUT_SU8000 15.0kV 15.0mm x200 SE(L)

C103 niobium alloy

HEAT SOURCE
Plasma
ARC CURRENT [A]
240
ULTRASONIC FREQUENCY [KHZ]
40
SONOTRODE MATERIAL
W-refractory alloy
FEEDSTOCK FORM
Metal sheet

From any feedstock



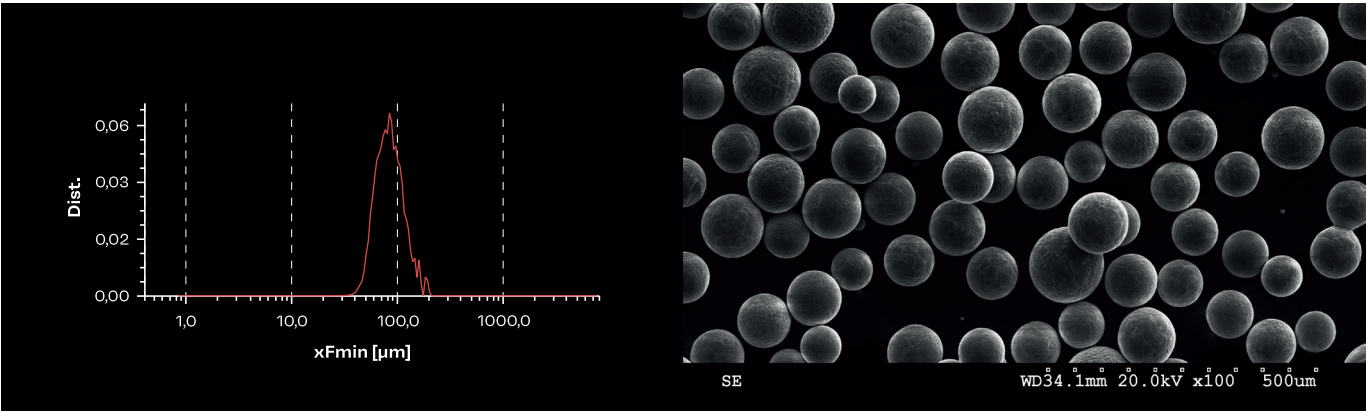
To desired powder

Powder quality
Morphology

Flowability (hall flow): 4-5 g/s
Sphericity (aspect ratio): d50 > 0.90

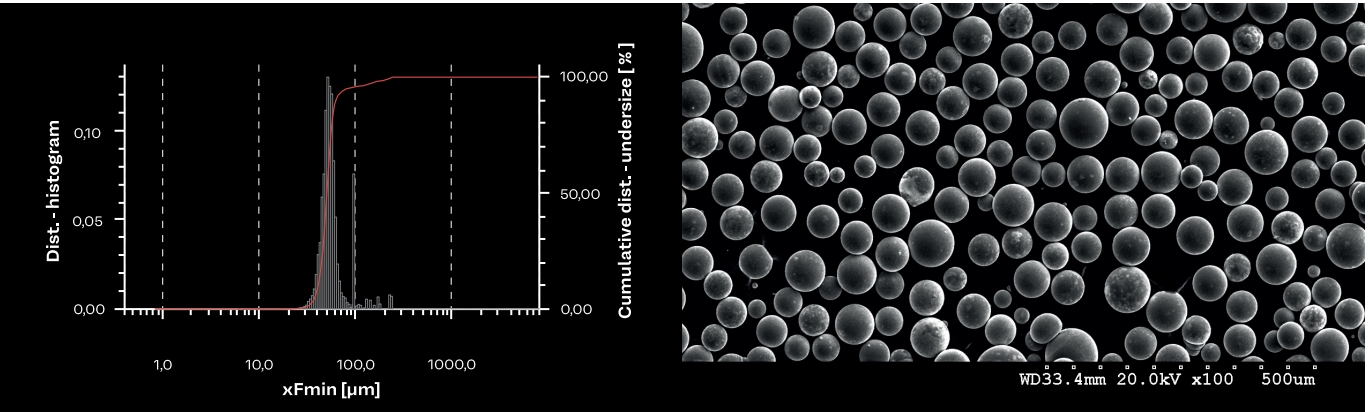
Frequency: 20kHz

d50: 80-100 [μm]



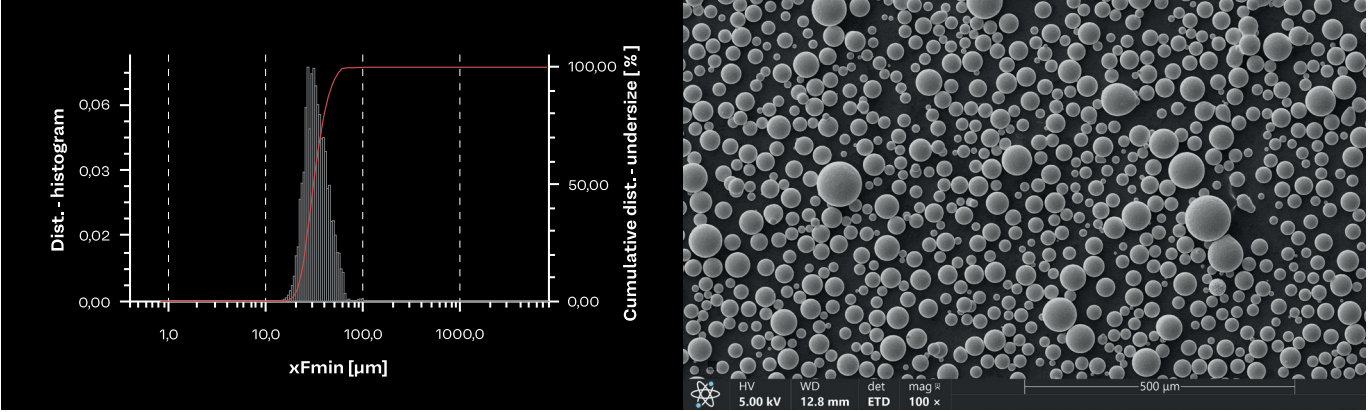
Frequency: 40kHz

d50: 45-60 [μm]



Frequency: 60kHz

d50: 35-45 [μm]



Powder2Powder

► **Reduced powder costs and purchase procedures**

Buy powder once and reuse it until it's fully consumed, cutting expenses and increasing operational efficiency.

► **Reduced powder waste disposal**

Reuse powder instead of disposing it, minimizing waste and environmental impact.

► **Metal research multitool**

Single device for metal powder production from various feedstock forms, now including also high-efficiency atomization of metal powder.

► **Custom powders from the scrap you already have**

Mix unused powder to get new alloy composition with homogeneous powder particles.

► **Closed-loop production chain**

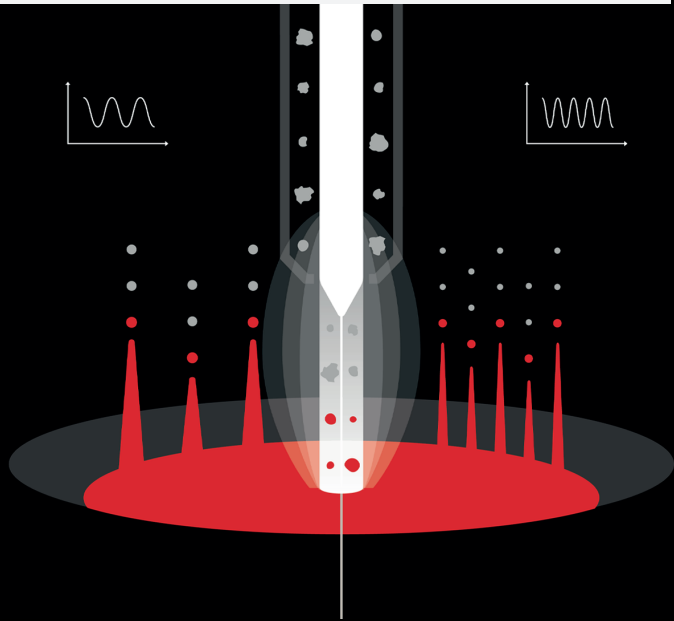
Integrate recycling and reuse into your production process for a sustainable, cost-effective solution.

► **New research possibilities**

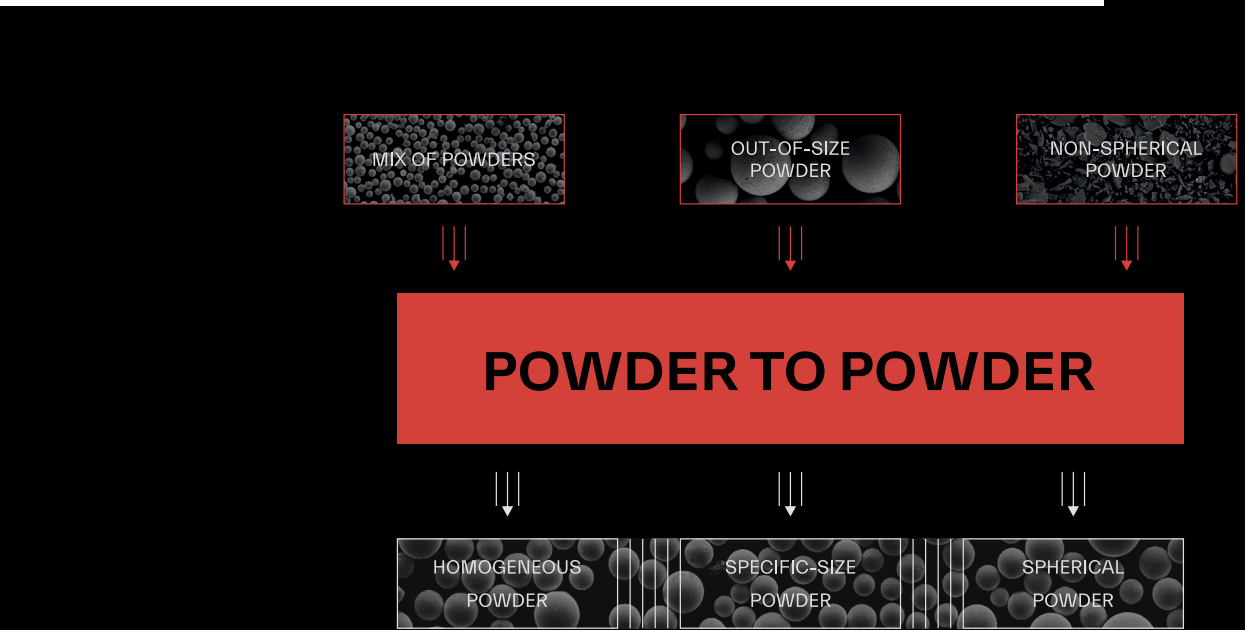
Take your research to next level by utilizing recycled materials and exploring innovative applications.

Powder2Powder (P2P) technology combines plasma processing and ultrasonic atomization to transform irregular or oversized particles into highly spherical, satellite-free powders optimized for additive manufacturing (AM). The feedstock powder is fed through the plasma torch into the melt pool. This step allows to completely remelt and rehomogenize the feedstock powder particles. Then the ultrasonic atomization takes place and new powder particles are ejected from the standing wave formed in the melt pool.

Unlike plasma spheroidization, the P2P technology allows powder size to be independent of the initial feedstock, making it the only technology capable of direct atomization of pulverized Ti-feedstock. Additionally, the P2P system can process blends of elemental powders, creating pre-alloyed materials tailored to exact chemical compositions.

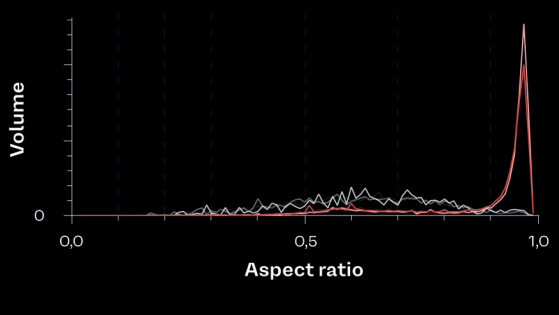
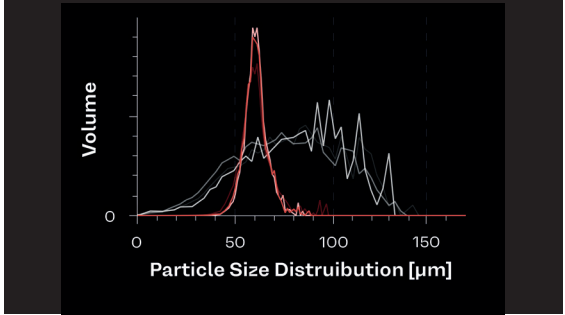
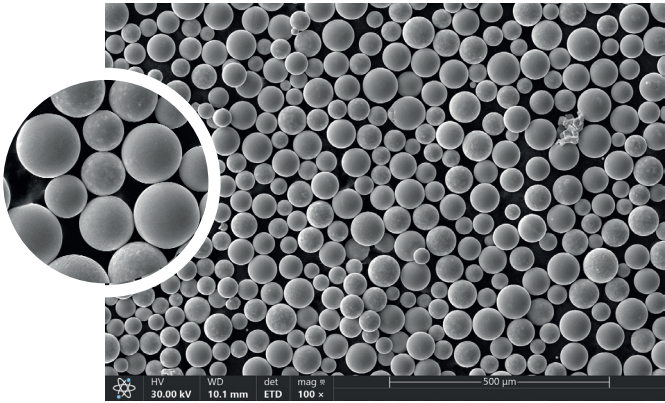
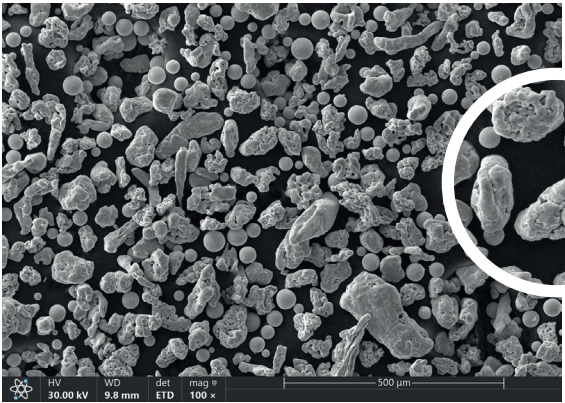


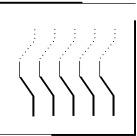
Make use of any metal powder



BEFORE

AFTER





| inFURNER |

Compact high vacuum furnace



Distortion is one of the main problems in AM process. Proper heat treatment is an obligatory step for high-quality products. High vacuum provides reliable heat treatment conditions in every process.

Heaters and thermal screens material vary depending on the maximum temperature option:

- 1200 °C – molybdenum heaters and thermal screens – process example: Ti-based alloys stress relief,
- 1600 °C – tantalum heaters and tungsten thermal screens – process example: sintering of refractory alloys.

For both temperature options there are two hot zone sizes available:

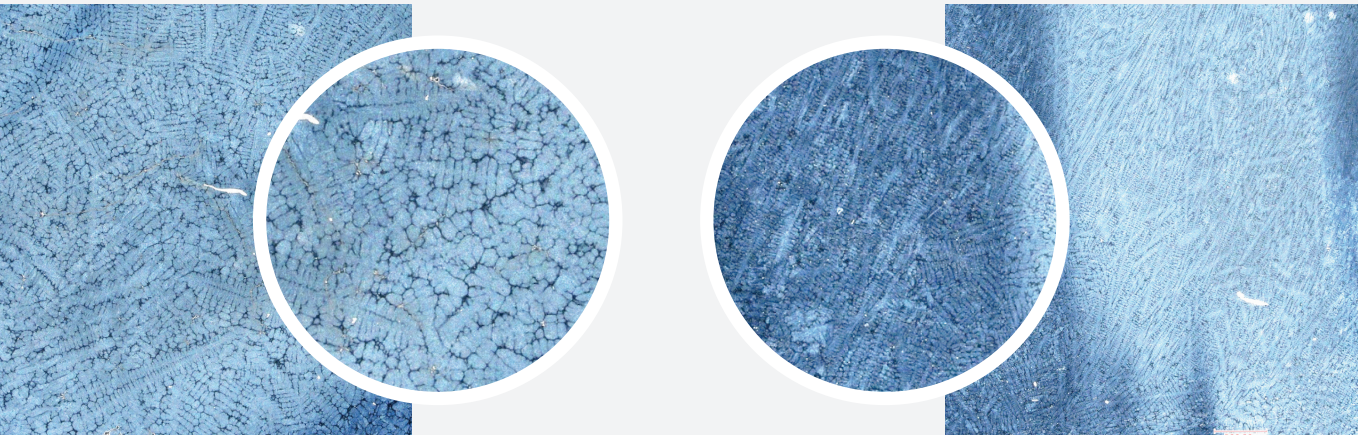
- Ø120 mm x 100 mm height – compatible with small build plate 3D printers,
- Ø200 mm x 200 mm height – compatible with popular medium-sized build plate 3D printers.

In all setups vacuum down to 10⁻² mbar is reached with the preliminary pump. Then, the high-vacuum pump takes over to reach a vacuum of 2×10⁻⁷ mbar (with a turbomolecular pump) or 3×10⁻⁹ mbar (with an ionization pump).

BEFORE



AFTER



Core benefits & features



Laboratory-size device

Total dimensions of 1200 × 800 mm with a cylindrical working chamber. Hot zone dimensions range from 120–200 mm in diameter and 100–200 mm in height.



High vacuum

The furnace is adaptable with diffusion, turbomolecular, or ion vacuum pumps to provide a maximum vacuum ranging from 3×10⁻⁶ to 3×10⁻⁹ mbar.



Data collection

The unit collects and stores all processing data necessary for validating parts for medical and aerospace applications and scientific research.



Maximum temperature

Depending on specific needs, two options are available: up to 1200 °C (ideal for titanium heat treatment in LPBF brazing) or up to 1600 °C (sintering of refractory metals).



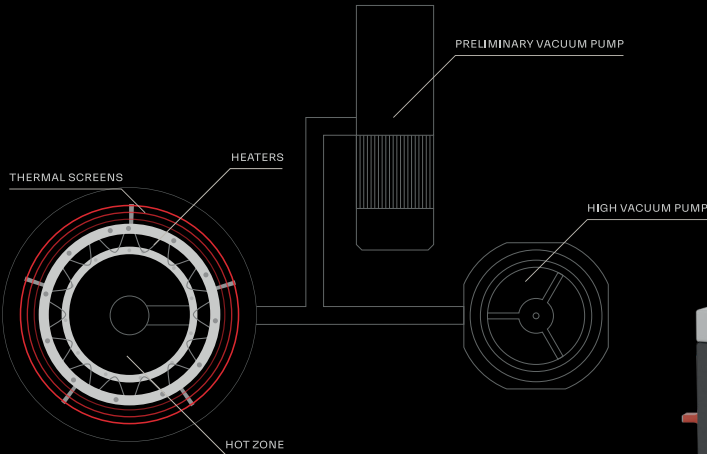
High-pressure gas quenching

This option offers unprecedented part cleanliness, faster furnace cooling, and less overall dimensional change. Common quench gases include nitrogen, argon, and helium.



Various applications

The furnace is ideal for the heat treatment of LPBF-titanium, brazing, sintering, or other scientific and R&D projects.





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