

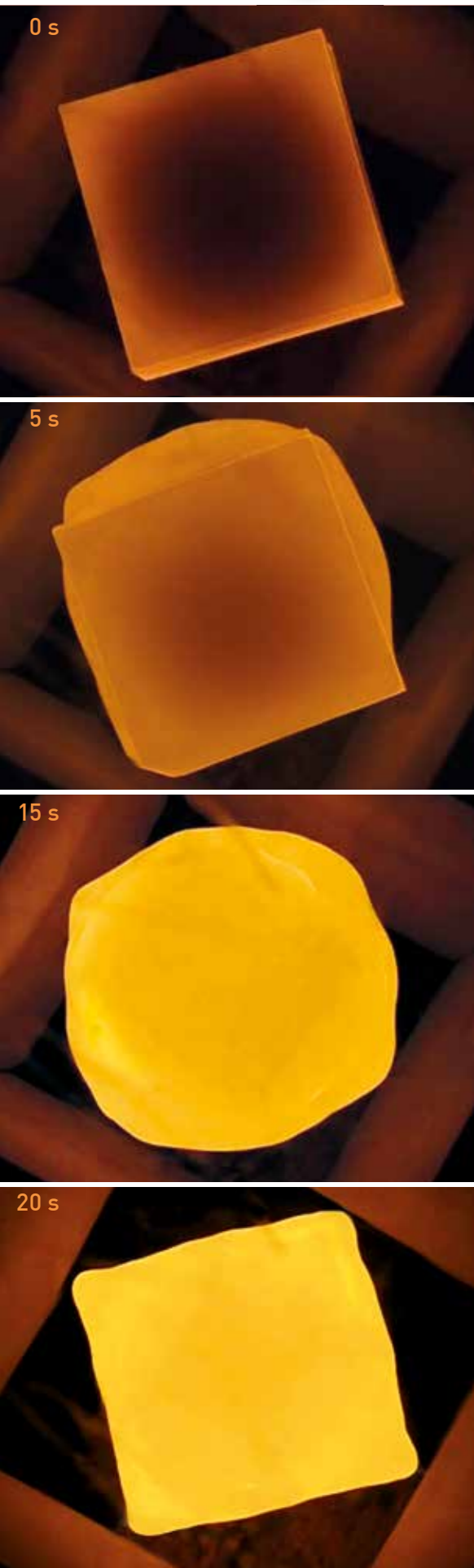
ALD Vacuum Technologies
High Tech is our Business

***FAST*Cast** INDUSTRIAL-SCALE
LEVITATION MELTING





LEVITATION MELTING | INDUSTRIAL-SCALE



FASTCast – Birth of the new Casting Technology

A NOVEL MELTING TECHNIQUE

- ▶ ALD's motivation to overcome limitations of conventional casting methods with crucibles (ceramic and copper)
- ▶ FASTCast was born to revolutionize casting market
- ▶ Pilot system (Demonstrator) was designed and installed to prove levitation melting technology in industrial scale
- ▶ Experiences were used to draft a continuous production system
- ▶ Patents approved

BENEFITS OF FASTCast

The levitation process is able to superheat the melt to a high degree in a very short time frame without interactions with ceramic crucibles:

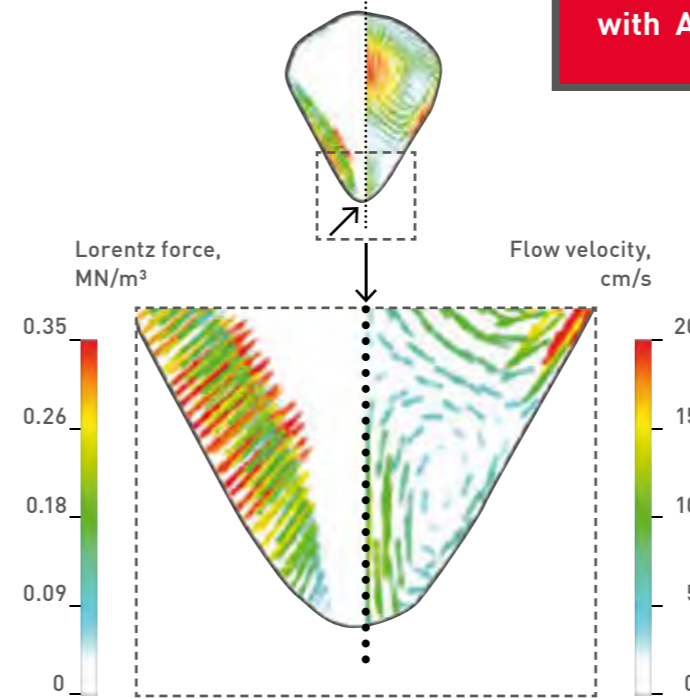
- ▶ This combination prevents any significant alloy element losses or melt contaminations
- ▶ The high superheat opens new ways for mold design and thus for thin-walled and complex casting components



Melting sequence of 500 g Ti-6Al-4V, ASTM Grade 5



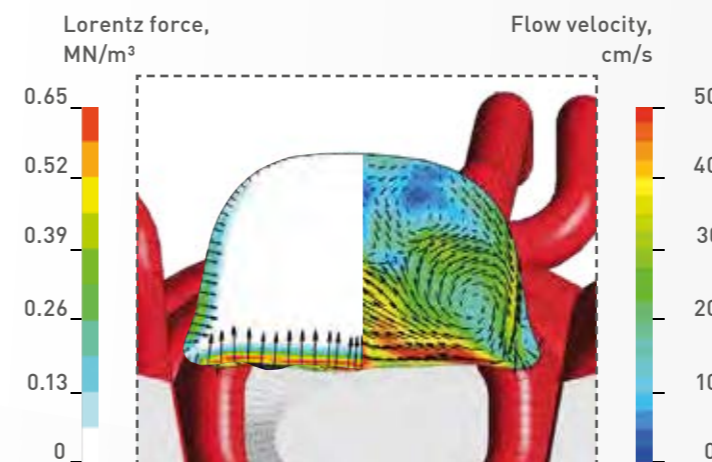
From theory into reality with ALD's engineering



The Physics of Levitation Melting

ORIGIN OF LEVITATION MELTING

- ▶ Melt weights of a few grams were realized with conventional axisymmetric EM levitation technology
- ▶ Lack of Lorentz force at the bottom of the charge limits weight
- ▶ ALD's sophisticated numerical simulations optimize the EM levitation technology



TRANSITION INTO INDUSTRIAL SCALE

- ▶ ALD developed a novel levitation technology with **two separate EM fields** enabling melt charges of 500 g Ti64
- ▶ Horizontal EM field lines exert EM lifting force, even in axis of levitated charge
- ▶ Resulting charge weights increase to practical industrial scales, free of drips and leakages



by courtesy of Access e. V.

NEXT GENERATION



LEVITATION MELTING | INDUSTRIAL-SCALE

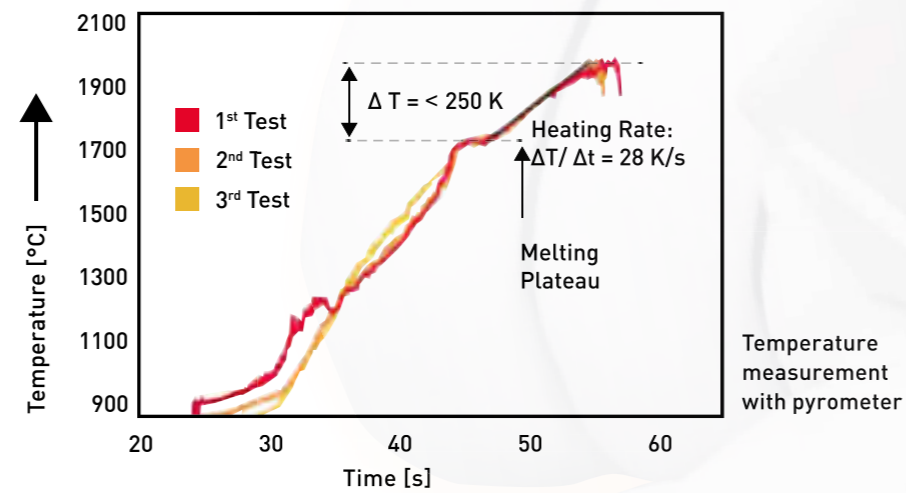
Pilot System to Prove Capabilities

FROM CONCEPT TO DEVELOPMENT

- ▶ Extensive series of experiments were conducted to verify capabilities of *FastCast*
- ▶ Successful casting trials with various alloys confirmed the reliability of the process with premium quality

The Pilot System includes:

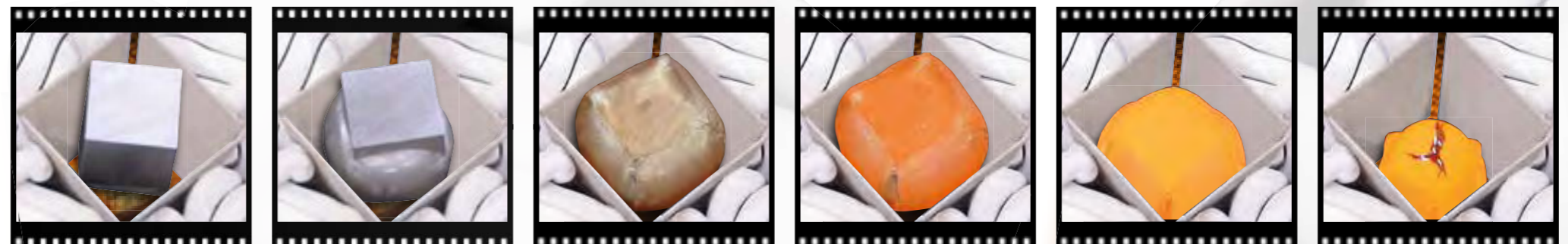
- ▶ Mold pre-heating furnace
- ▶ Mold centrifuge
- ▶ Mold withdrawal unit
- ▶ Vacuum/Argon operation mode



FastCast Pilot System proven capability with 500 g of Ti64

- Applicable alloys:
- ▶ Titanium & γ -TiAl
 - ▶ Superalloys
 - ▶ and many more

R&D plant is available for customer trials



Melting sequence of 500 g aluminium in air





LEVITATION MELTING | INDUSTRIAL-SCALE



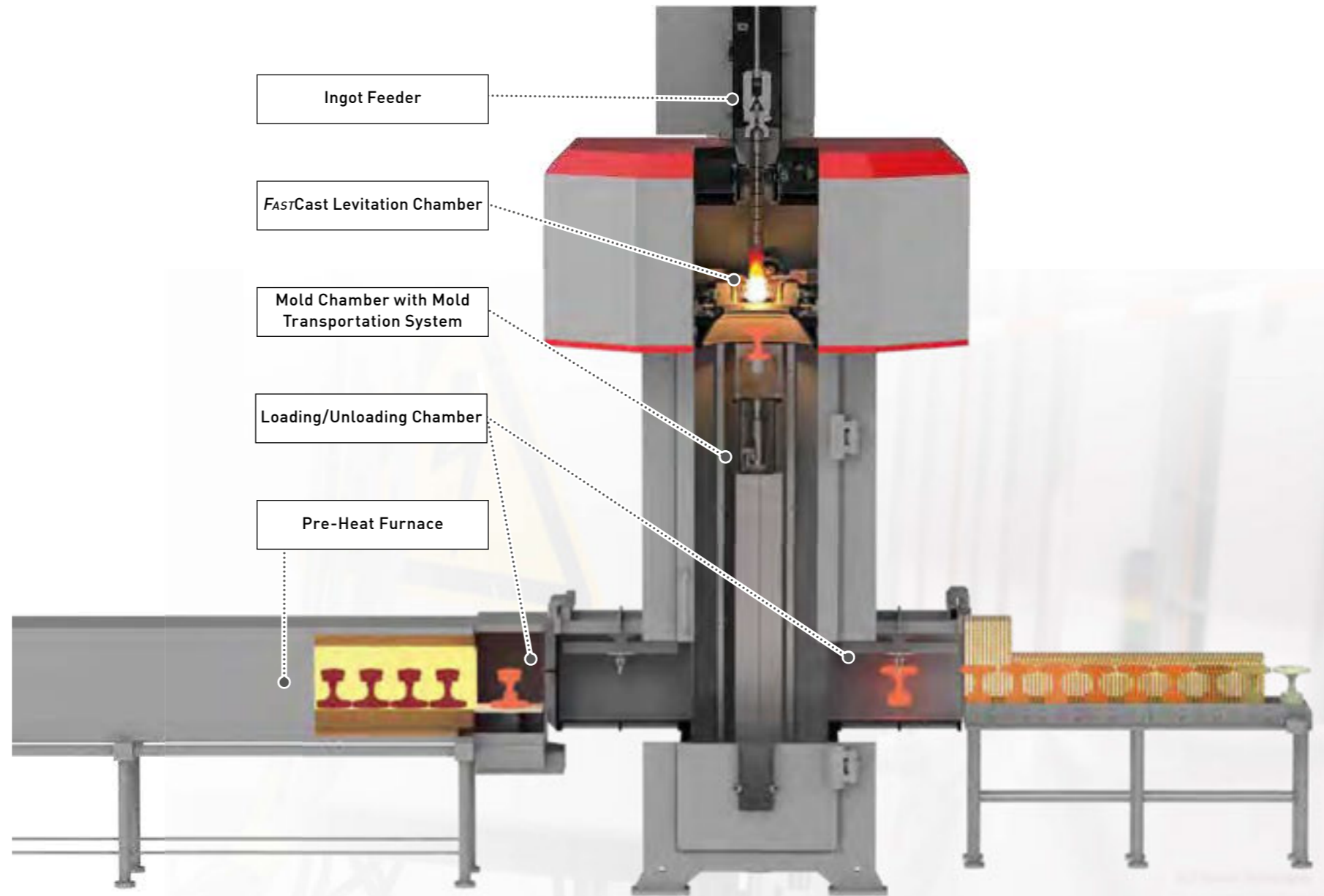
Concept of Continuous Production System

NEW LEVEL OF TITANIUM CASTING

- ▶ Melting and casting system is identical to Pilot System
- ▶ Mold loading and unloading chamber are attached to the side of the casting chamber
- ▶ High throughput is achieved by automated and fast melting and material handling (molds and ingots)

OUR FEATURES

- ▶ Contact-free melting
- ▶ High purity of melt
- ▶ Melt rates of approx. 40 K/s
- ▶ Short cycle times of < 60 s
- ▶ Excellent reproducibility
- ▶ Continuous and automated single batch production line
- ▶ Vacuum and inert gas atmosphere possible
- ▶ Industry 4.0 capable with single part tracability



PROCESS SEQUENCE

1. Preheated mold is locked in through loading chamber and is positioned onto the mold plate of the lift.
2. Lift moves the mold to top position and starts fast mold rotation.
3. Superheated melt is dropped. Simultaneously the mold accelerates downwards.
4. Melt approaches and enters mold with little relative speed difference.
5. Mold spinning can be applied to support mold filling with thin edges.
6. Lift decelerates to achieve mold filling.
7. Mold exits through unloading chamber.



**Outlook:
Larger melt weights**





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