



Alloyed Ltd.

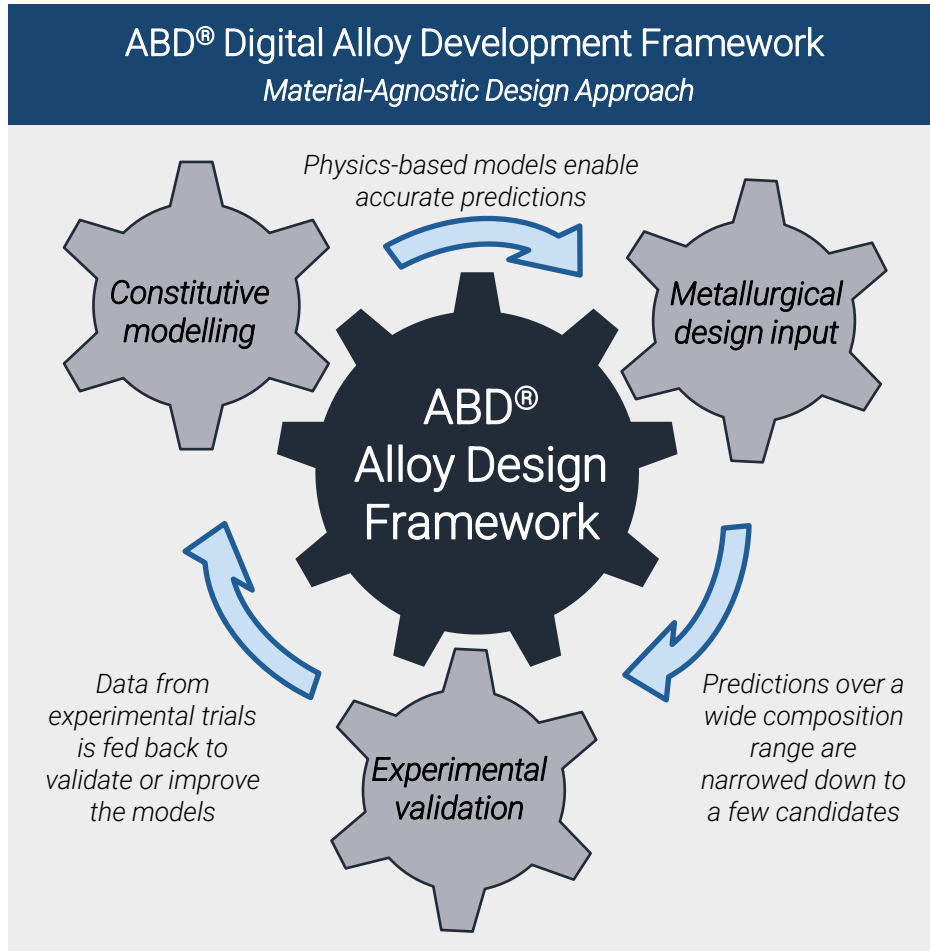
Nickel-based Superalloys for Additive Manufacturing

Manufacturing & Engineering Week
8th – 9th June 2022

John W. G. Clark, MPhys, EngD

Alloyed – Nickel-based Superalloys for Additive Manufacturing

Alloy Development Platforms



Alloys for Demanding Applications
e.g. Nickel Superalloys, Titanium Alloys

Conventional Castings
(e.g. turbine wheels)

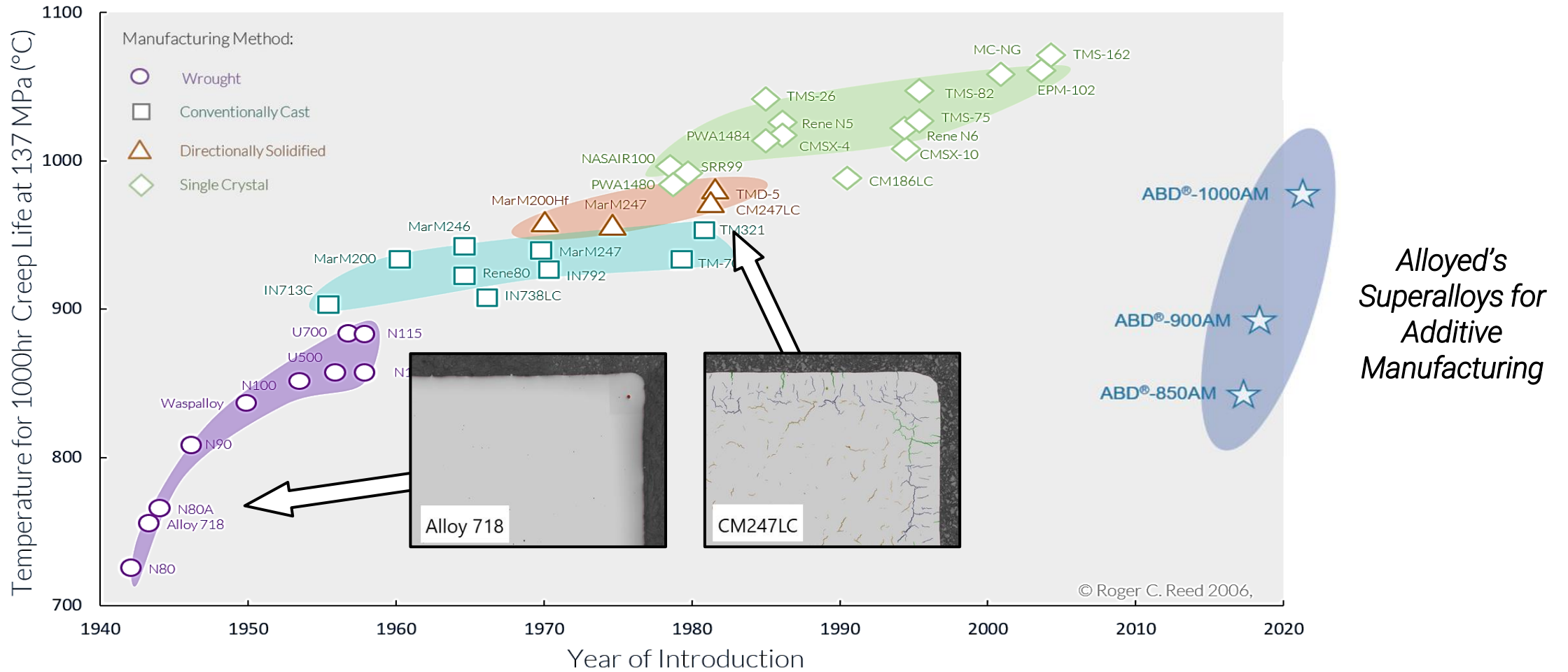
Single-crystal Castings
(e.g. turbine blades)

Super-plastic Forming
(e.g. fan blades)

Additive Manufacturing
(e.g. lattices, complex shapes)

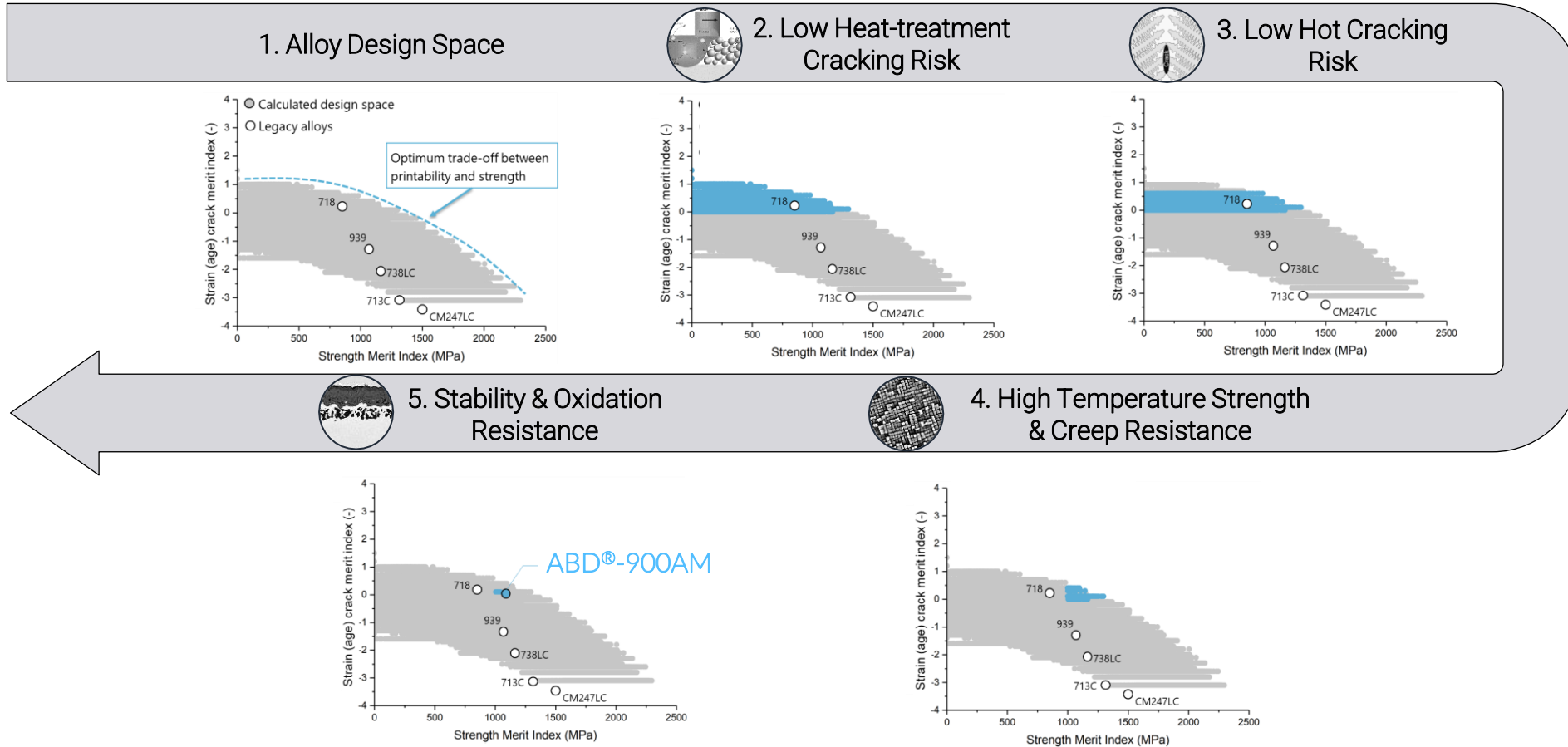
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Alloy Development Roadmap



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Alloy Design for Additive Manufacturing

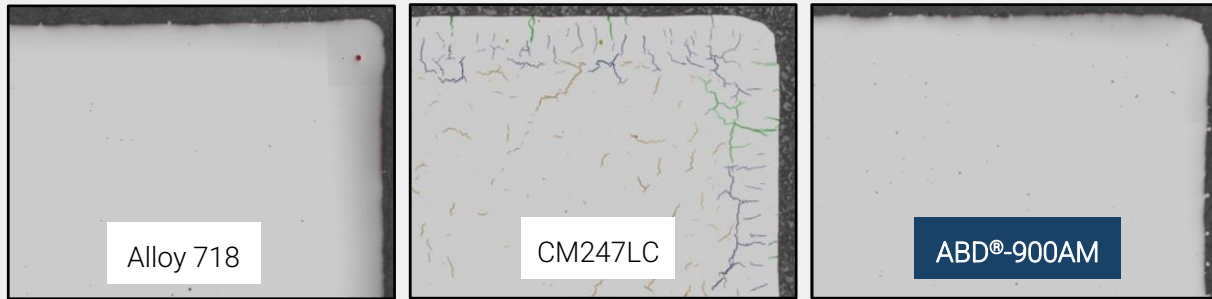


ABD® framework enables 'right first time' alloy design

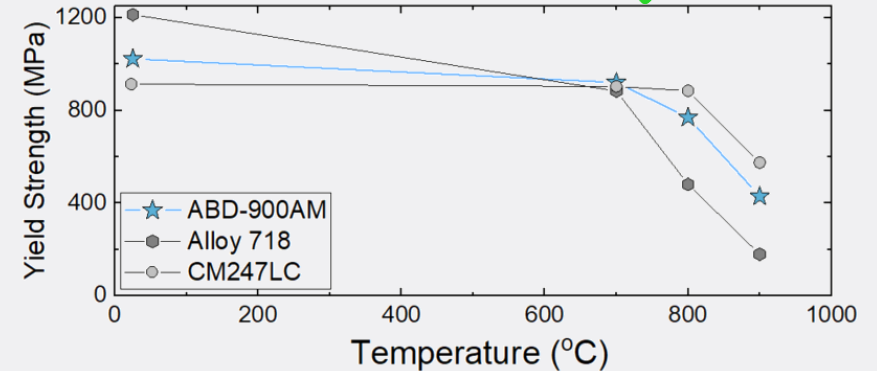
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Alloy Development: ABD[®]-900AM Design Criteria

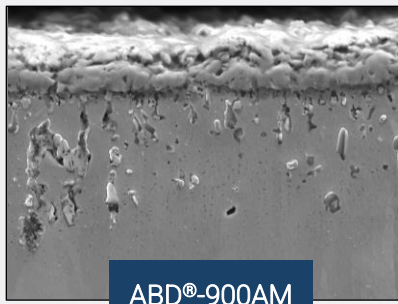
Processability by Additive Manufacturing



Strength

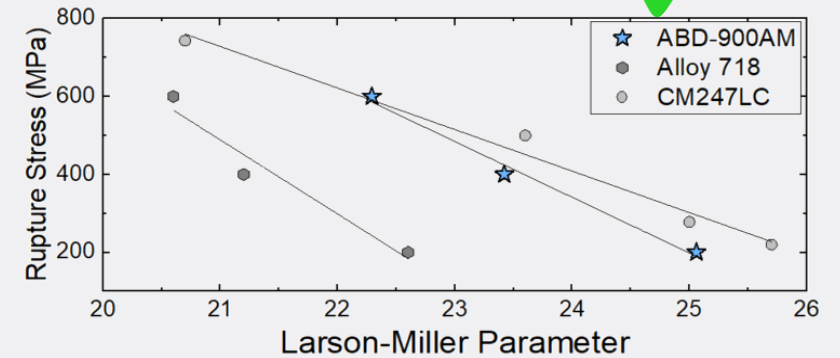


Oxidation Resistance



Stable and consistent chromia scale, protecting against further oxidation

Creep Resistance

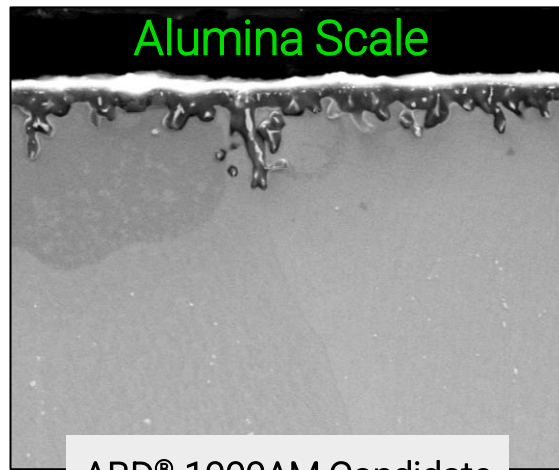
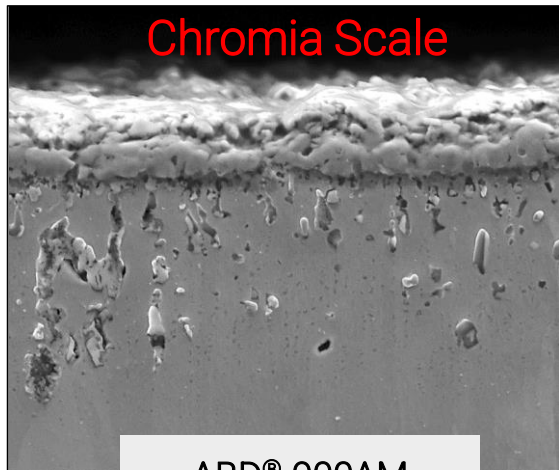


Computationally-designed ABD[®]-900AM alloy meets all of the design criteria

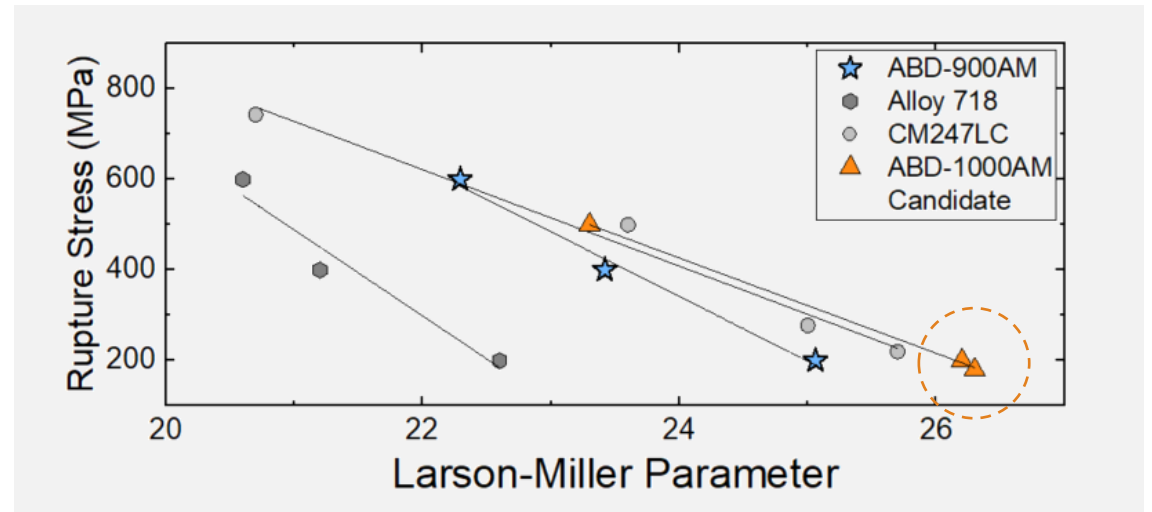
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Alloy Development: ABD[®]-1000AM Design Criteria

Oxidation Resistance at 1000°C



Creep Resistance in High-Temperature Regime



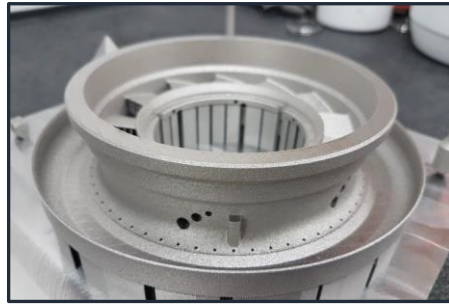
ABD[®]-1000AM alloy designed specifically to match the 1000°C challenges

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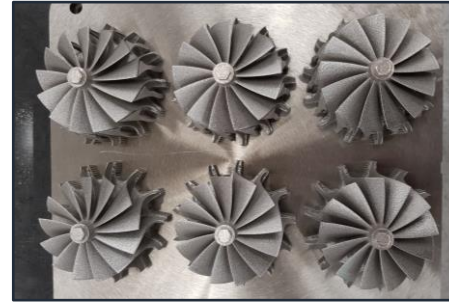
ABD[®]-900AM and ABD[®]-1000AM Aerospace Applications



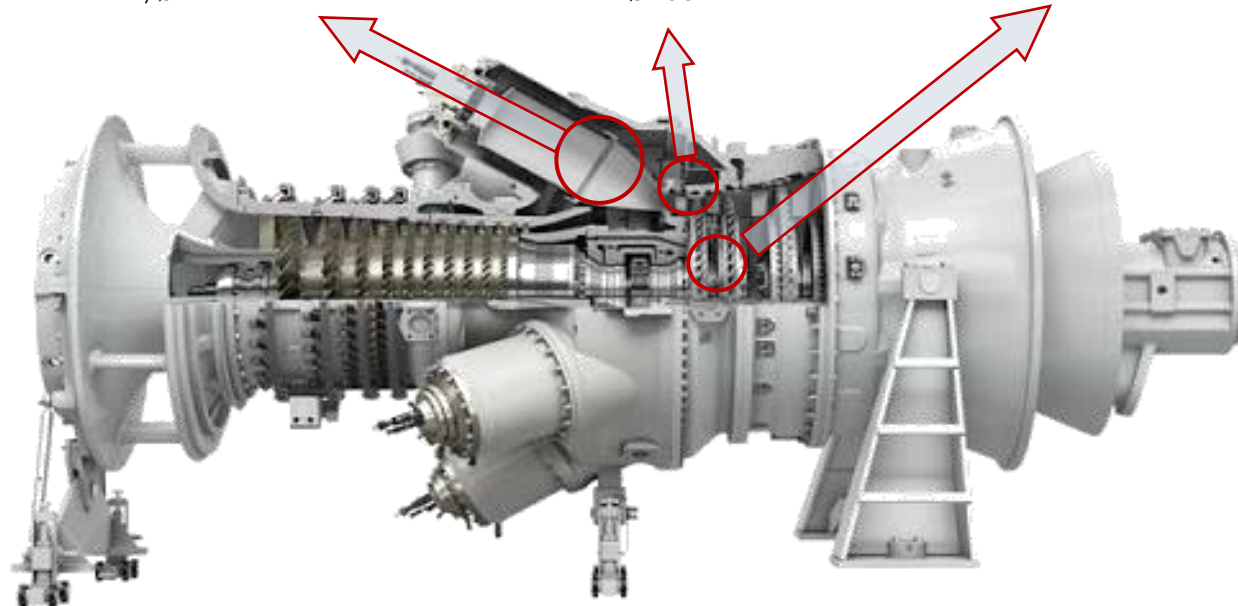
Combustion Chambers
291 mm, Ø147 mm



Static Guide Vanes
Ø200 mm



Rotating Turbine Wheels
Ø76 mm



Typical Aeroderivative Gas Turbine

ABD[®]-XAM Alloys Enable:

- Higher temperature capability
- More efficient engines
- Lighter parts
- Intricate geometries
- Reduced scrap rate
- Part repair

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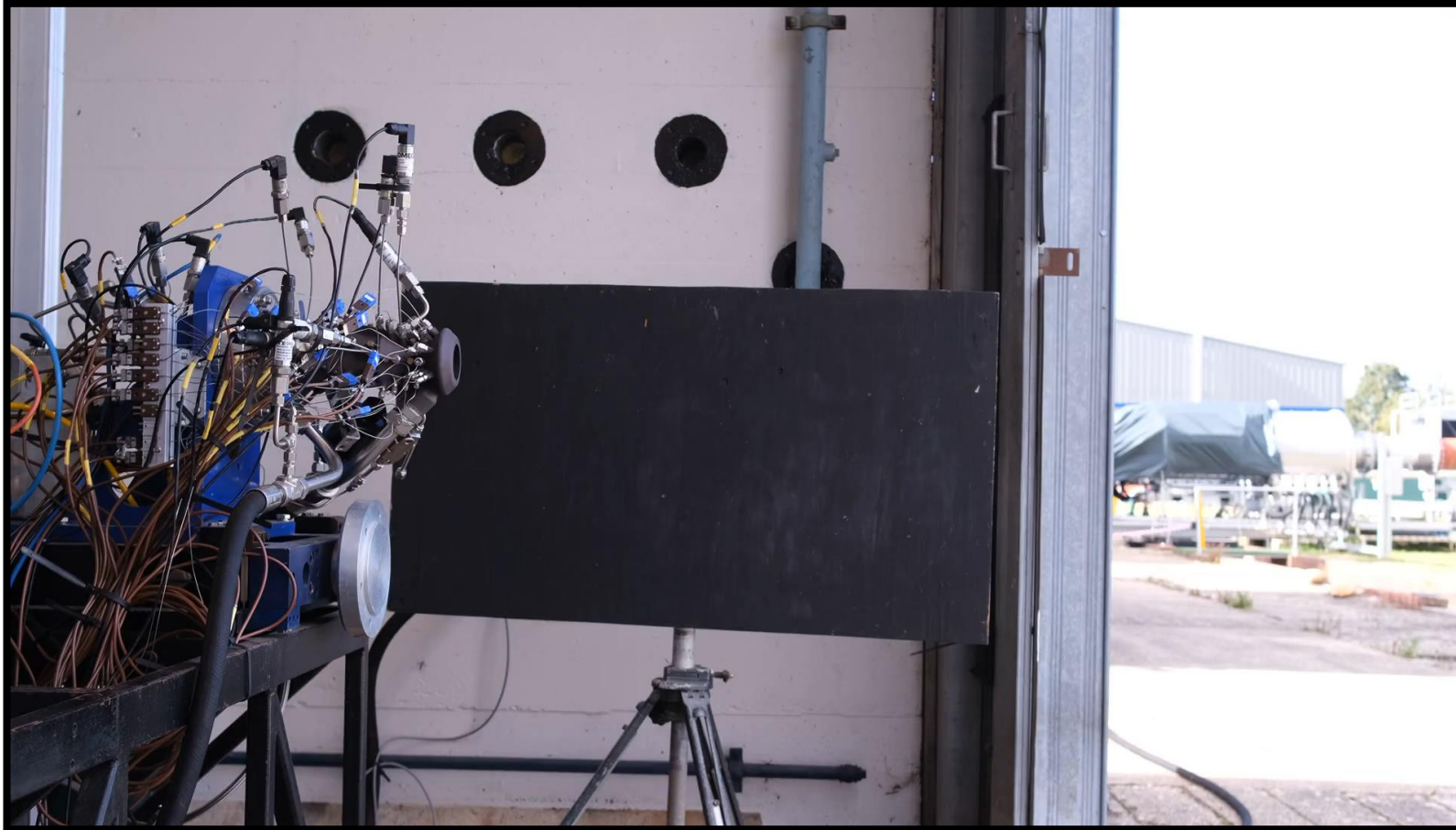
ABD[®]-900AM Example Application: Combustion Chamber



Intricate thin-walled cooling channels only possible through AM process.

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ABD[®]-900AM Example Application: Combustion Chamber



ABD[®]-900AM enables a 70-100°C temperature increase in this part over IN718.

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Acknowledgements

- InnovateUK (funding body for ABD[®]-900AM development)
- NATEP (ATI program) (funding body for ABD[®]-1000AM development)
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- Airbourne Engineering & Renishaw (partners on combustion chamber application)
- Engineering Expo