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Problem based learning - Advanced Manufacturing

practical cases, methodology & flow

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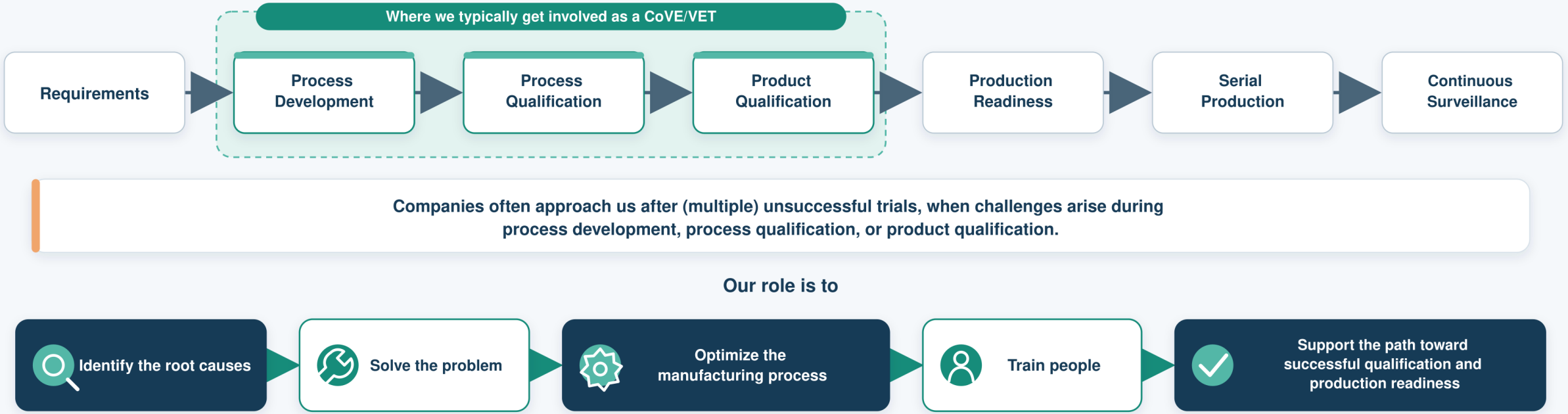
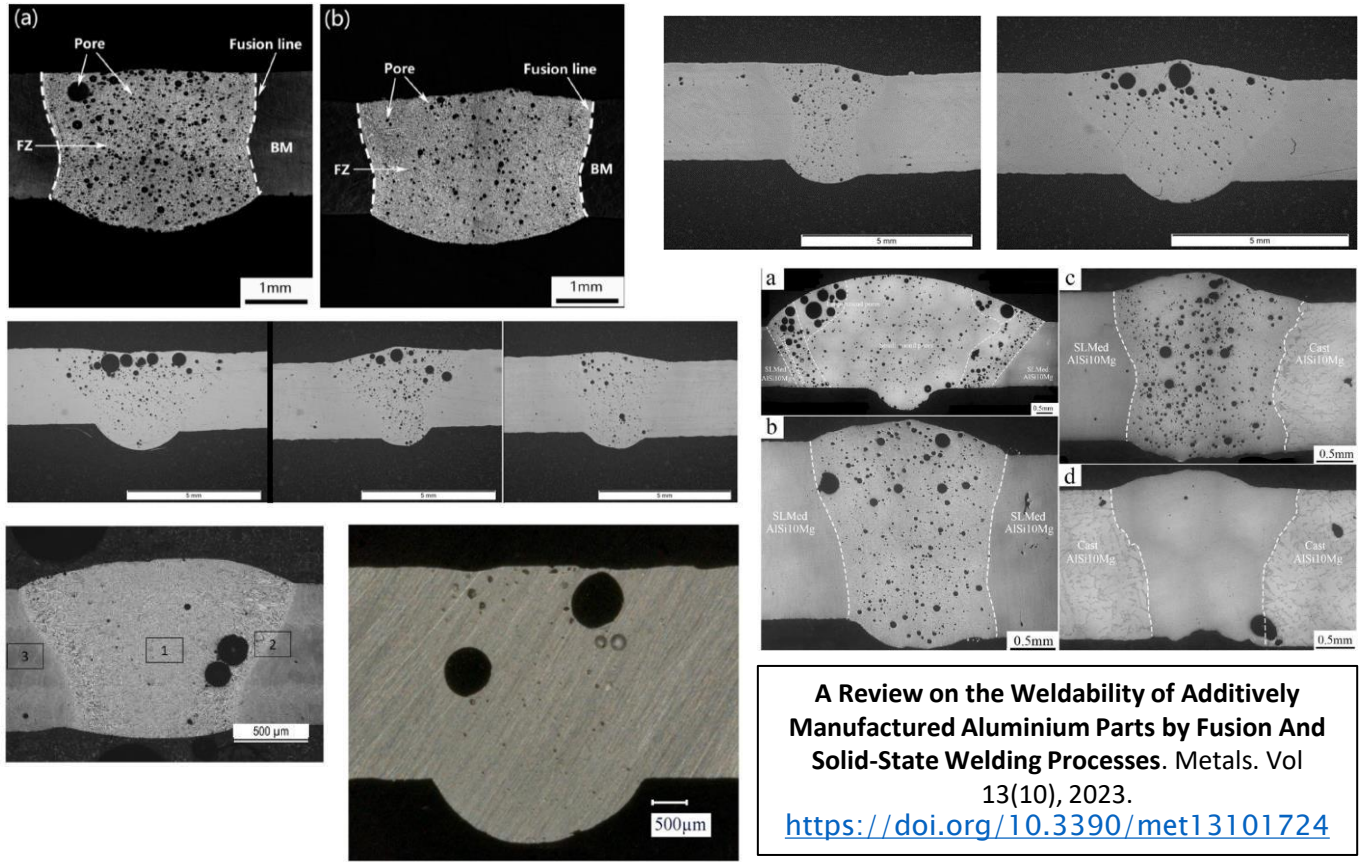
Co-funded by the European Union

Advanced manufacturing & CoVE/VET: Qualification framework – role as a Cove/VET



Aerospace/defence application – joining of 3D printed aluminium with conventional aluminium (COAMWELD)



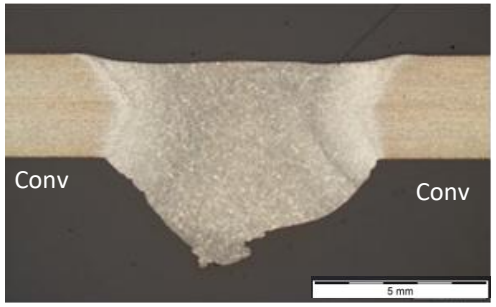
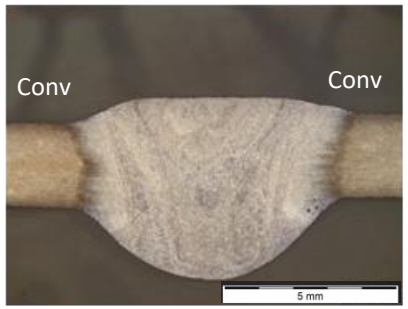
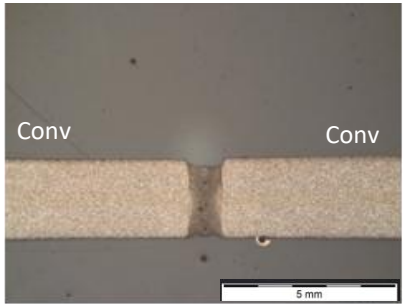
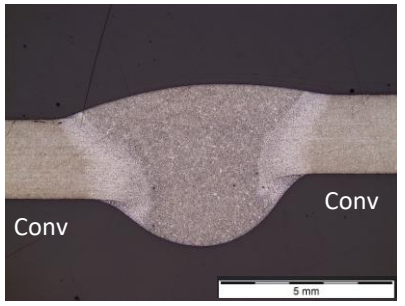
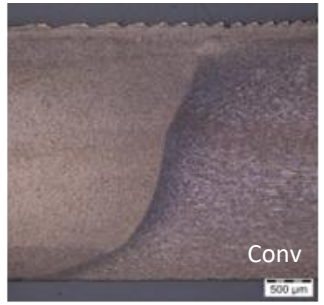
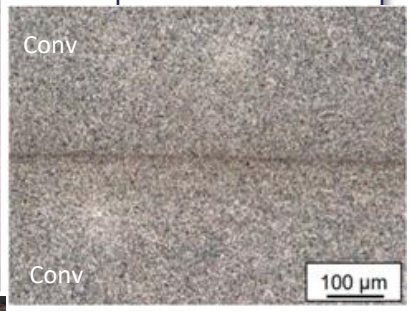
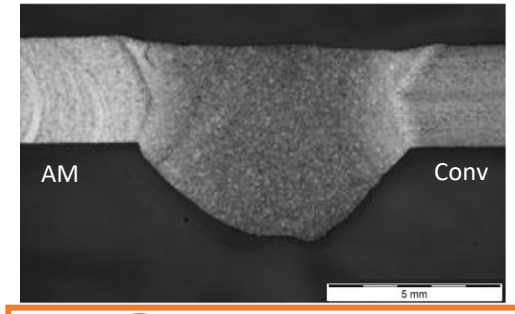
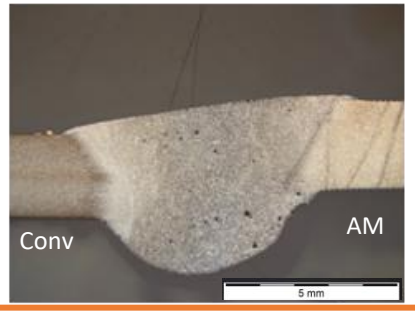
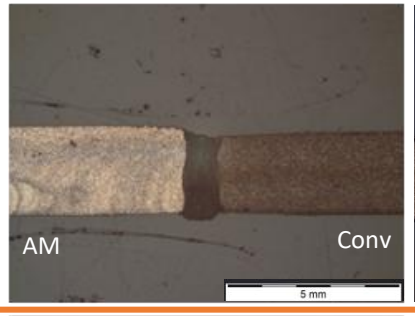
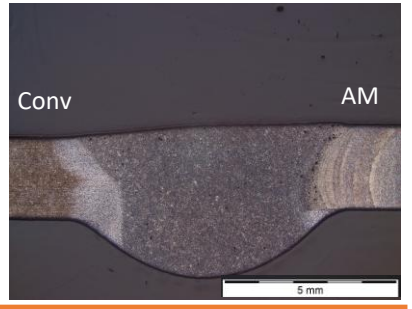
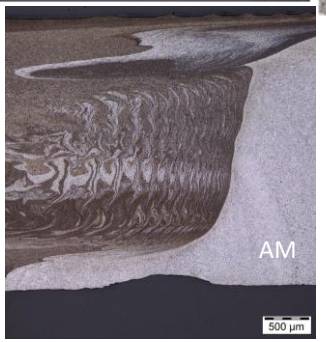
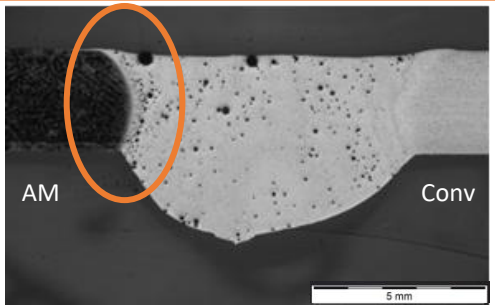
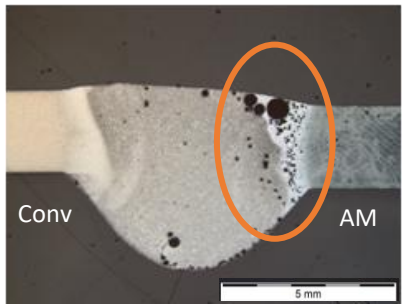
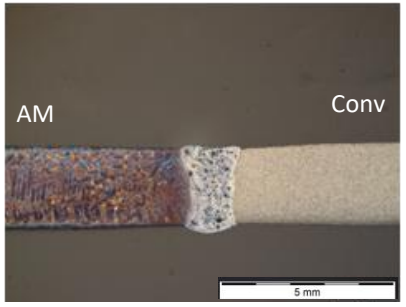
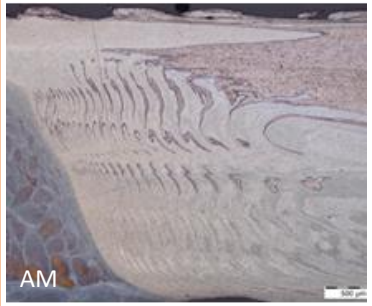
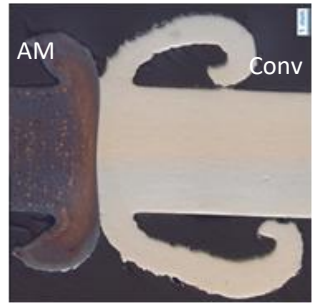
A Review on the Weldability of Additively Manufactured Aluminium Parts by Fusion And Solid-State Welding Processes. Metals. Vol 13(10), 2023. https://doi.org/10.3390/met13101724

How to eliminate or mitigate persistent porosity defects in the fusion/joining of 3D-printed parts, given that traditional parameter optimization is insufficient

Main Theory: High porosity levels in PBF-LB joints are formed due to the hydrogen porosity in the PBF-LB base material.

- Higher surface area to volume ratio compared to wire filler material
- Most powder have included porosity
- Most commercial equipment control is based on O_2 content (not by creating a vacuum and then filling it with Ar)
- Common to recycle powder in the PBF-LB process.

Aerospace application – joining of 3D printed aluminium with conventional aluminium (COAMWELD)

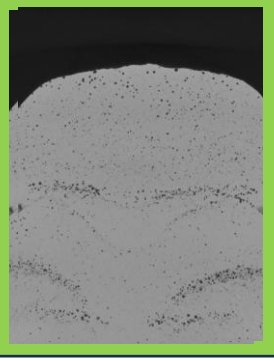
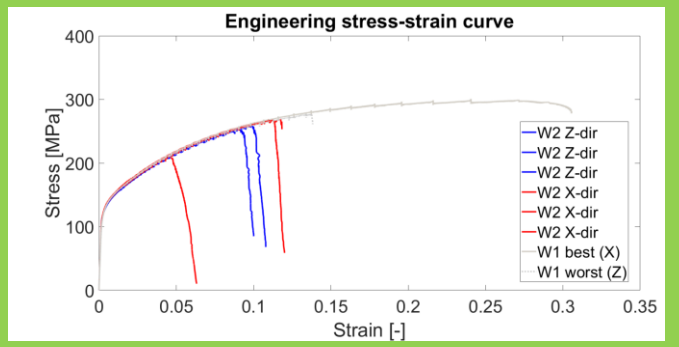
	GMAW - MAG	GTAW - TIG	Lase Beam Welding	Plasma Arc Welding	Friction Stir Welding	RFW Rotational Friction
Conv AW EN-5083 Conv AW EN-5083						
Conv AW EN-5083 WAAM ER 5183						
Conv AW EN-5083 PBF-LB AlSi10Mg						

Defence application - customer specs - high strength aluminium (7075) – DED-arc printing: part 1 “feasibility 5183” (WAALU)

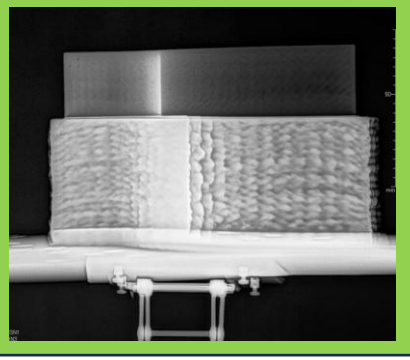
FEASABILITY STUDY
with good printable filler material (5183) – no PWHT: few iterations for parameters & print strategy

simple geometry – material (5183)

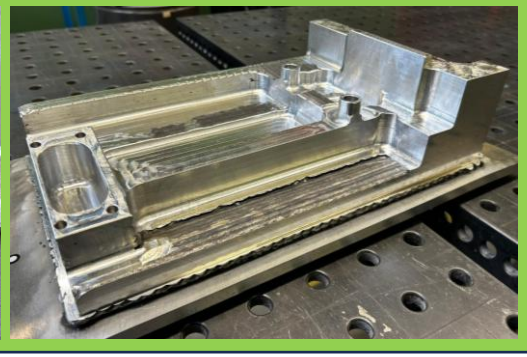


Basic demonstrator: material (5183)

complex demonstrator – material (5183)

Defence application - customer specs - high strength aluminium (7075) – DED-arc printing: part 2 “advanced” (WAALU)

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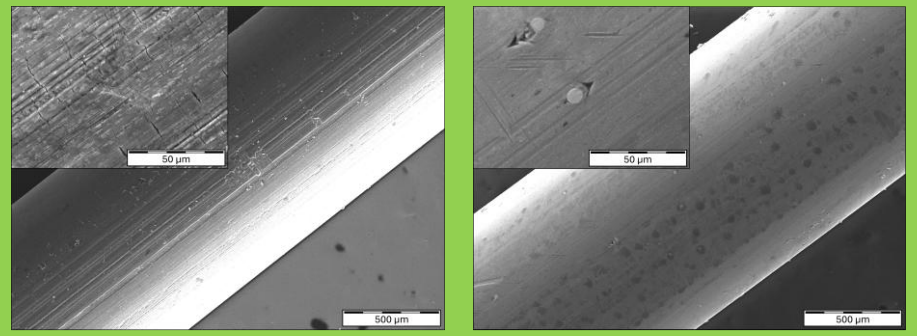
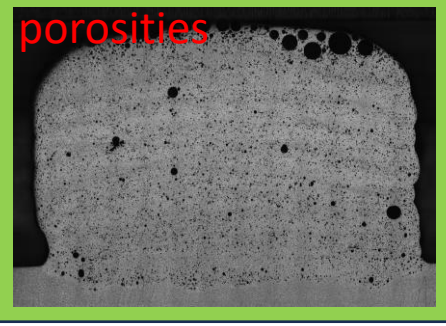
Customer specs = the same as conventional plate 7075 material

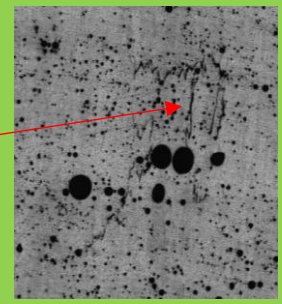
Filler metal choice (not standardized)



Printing strategy & welding parameters + preheat
(a lot of iterative optimization)

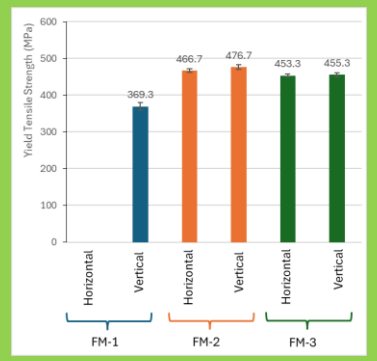


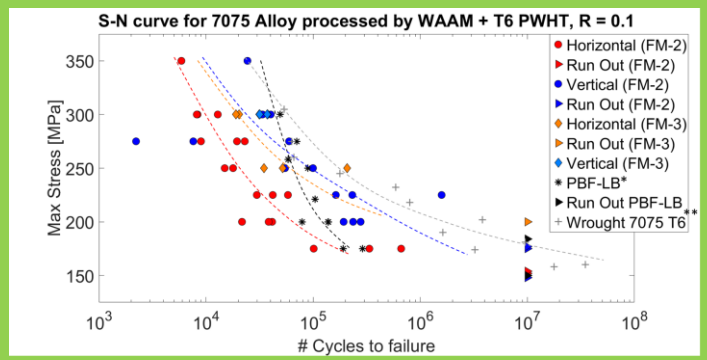
cracks



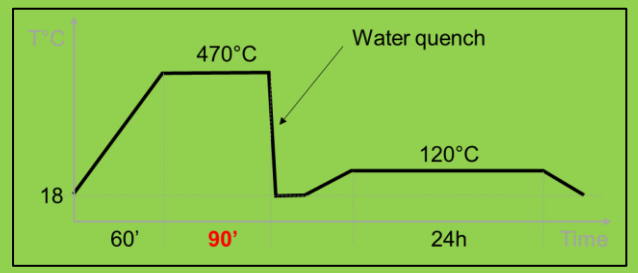


Extensive testing: static & fatigue





Post Welded Heat Treatment: T6 (optimization)



Hardness: ±115 HV0,3 => ±170 HV0,3
Ultimate strength: ± 325 MPa => ± 500 MPa

European Space Agency – Martensitic stainless steel – DED-arc printing (joined research with Guaranteed)

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GOAL: Derisking the printing of large scale component

ENGINEERING: determine material (choice 17-4PH) and mechanical properties

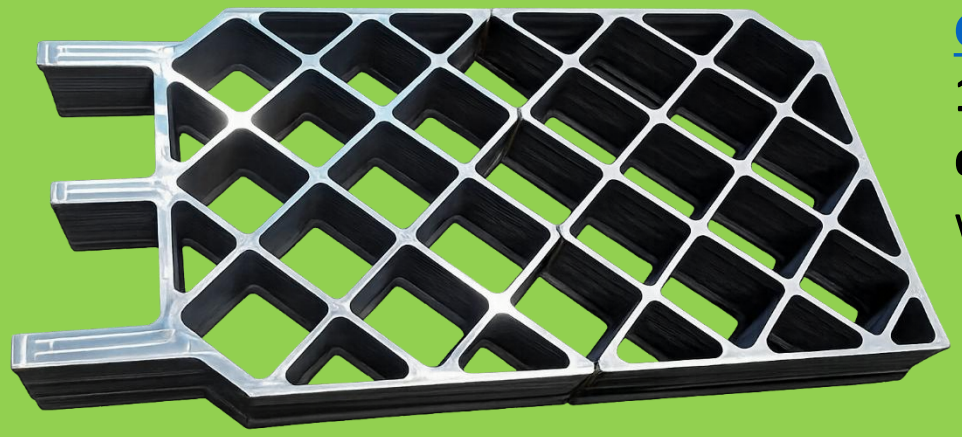
CHOICE FILLER METAL BRAND

INITIAL TEST: optimize welding parameters, print strategy, PWHT (H900 or H1100), NDT testing & material characterisation (tensile, hardness, microstructure, …)



COMPLEX NODE PRINTING & TESTING





[Guaranteed B.V.](#) printed a full-scale **17-4 PH stainless steel grid fin demonstrator** with a deposited weight of approximately **940 kg**.

Guaranteed

TO REMEMBER: Problem-Based Learning (PBL) has no fixed path - it evolves with the problem.



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