6th SmartRaCon Scientific Seminar 2024

Repair of wheels and rails by additive manufacturing

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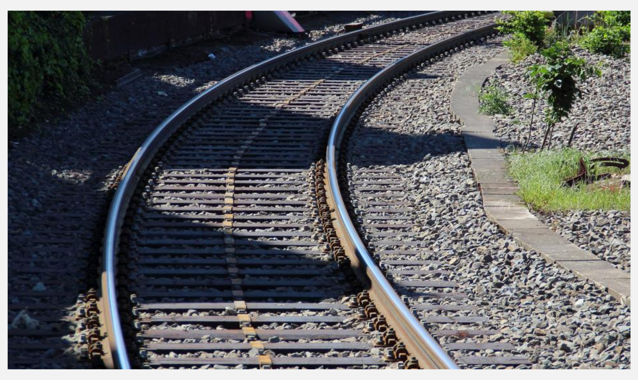
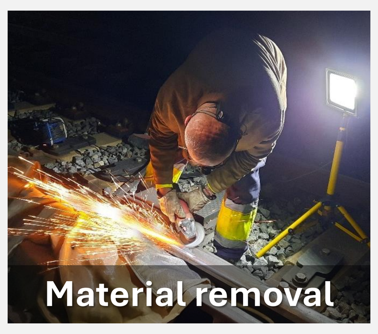
Development of new materials and automated methods for the repair of metal components using laser DED additive manufacturing technology

Problem statement:

The damaged track elements, such as rails and switches, are currently being repaired using manual electric arc welding.
The repeatability and quality of the repairs are particularly susceptible to human errors.





Manual grinding

Manual electric arc welding and torch preheating

In order to recover the wheel, it is often necessary to disassemble and reassemble the axle from the wheel, which frequently leads to secondary and potentially risky operations.

Any failure during this process can result in significant economic and time losses.

Wheel profile reshaping

How does IAM4RAIL address the problem?

QUALITY repairs performed using L-DED → better shape and finish than those done by manual electric arc welding.

NEW MATERIALS specially designed for repairs with L-DED → Improve repair performance.

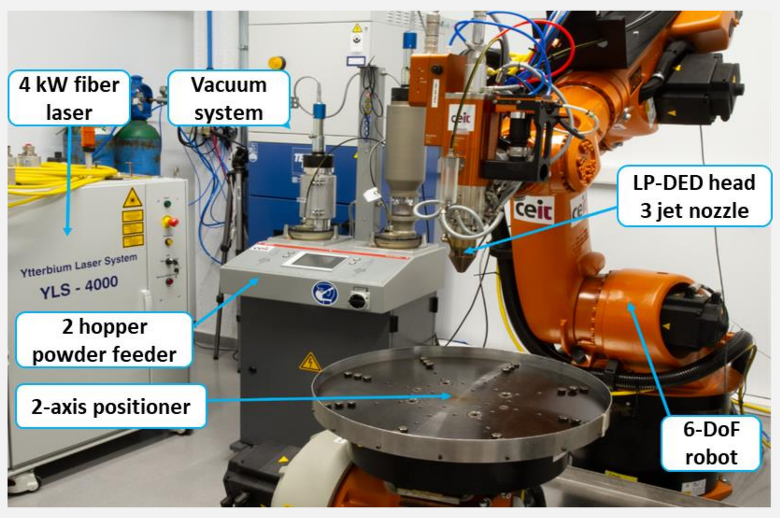
AUTOMATION of manual repair operations: Minimizes errors, increases precision and consistency. More efficient repair process → Extension of the repaired component's service life.

Infrastructure: Repair of rails and turnouts | **Rolling stock: Repair of wheels**

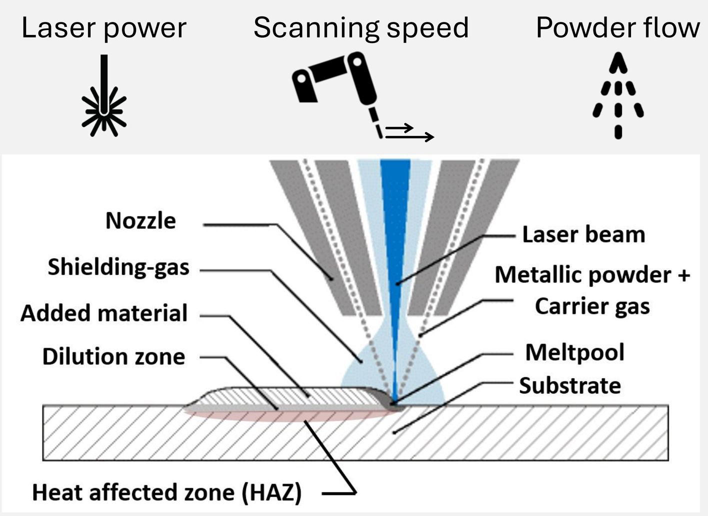
Develop an In-situ L-DED Powder repair machine

L-DED Powder

L-DED Powder EQUIPMENT



MAIN PROCESS PARAMETERS:



MAIN ADVANTAGES:

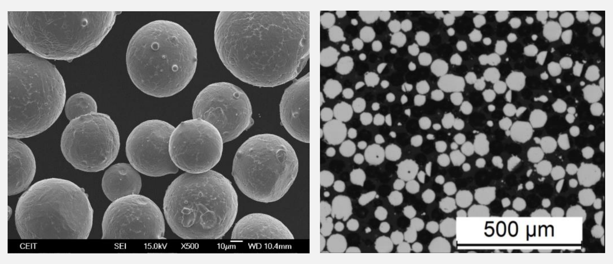
- ✓ Very localised heat input, minimum heat affected area in base material
- ✓ High accuracy and better process control
- ✓ High adaptability to different materials and geometries

MATERIALS DEVELOPMENT

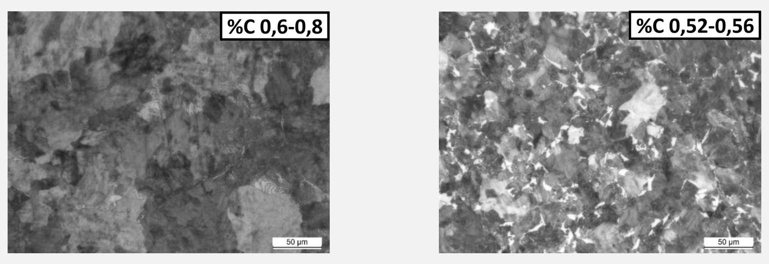
Alloy development and atomisation process

- Alloys Carbon compatible with steels
- Gas atomisation

Characterization of initial materials:



Addition material:
- Low porosity (<0,1 %)
- Sphericity and few satellites
- Particles between 45-106 µm
- Good fluidity 15,8 (50 g/s)

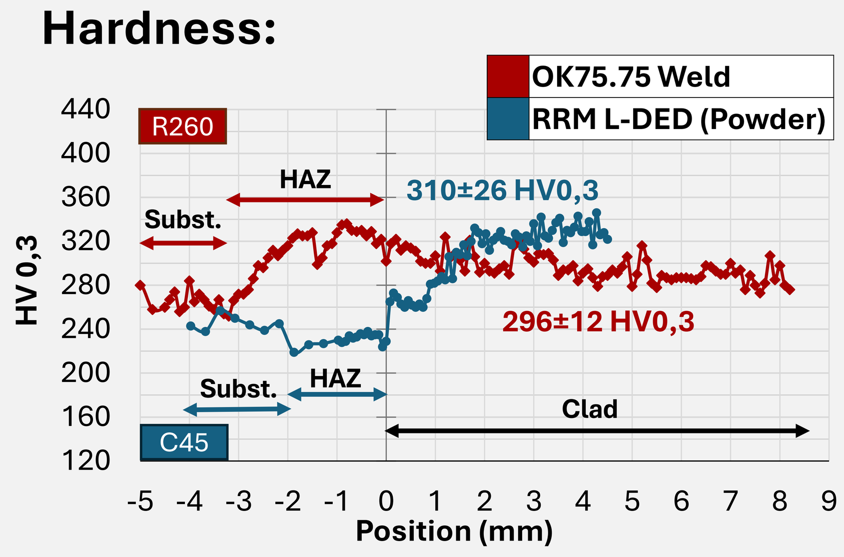


R260 grade Rail steel
- Pearlitic structure
- Hardness 274 HV10

ER8 grade Wheel steel
- Ferritic-pearlitic structure
- Hardness 263 HV10

REPAIR OF RAILS

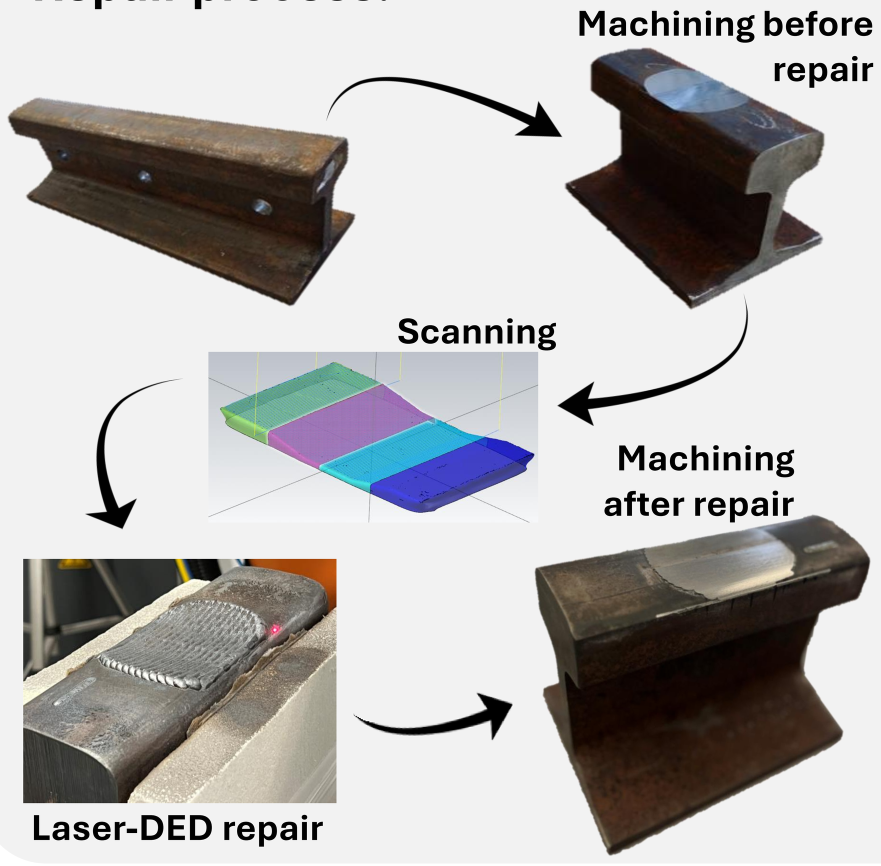
Hardness:



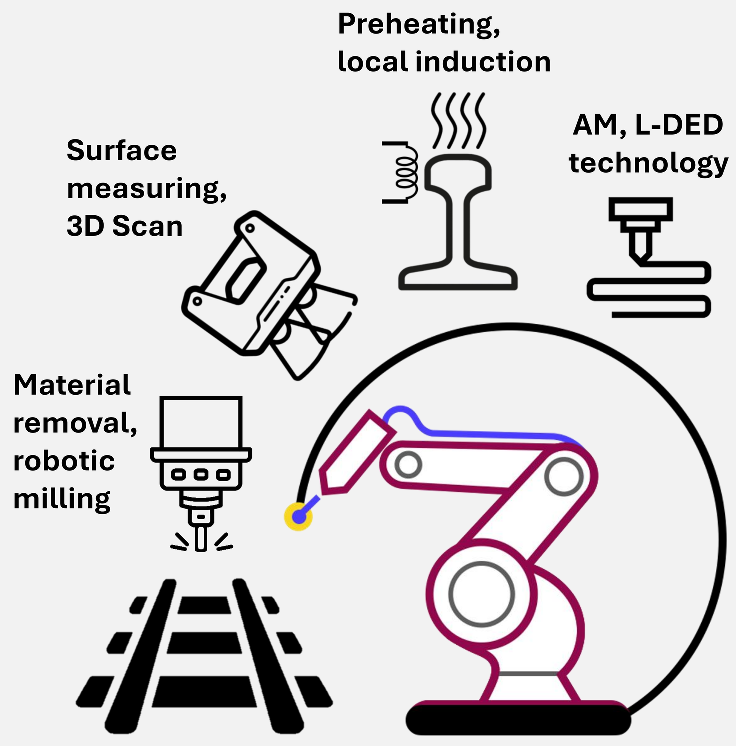
Standard: UNE-EN 15594

	Position	Standard (R260)	RRM L-DED (powder)	OK7575 Welding	
Multi-layer	Surface	305-358	315	301	HV10
	Internal	max. 400	305	296	
			✓	✗	

Repair process:

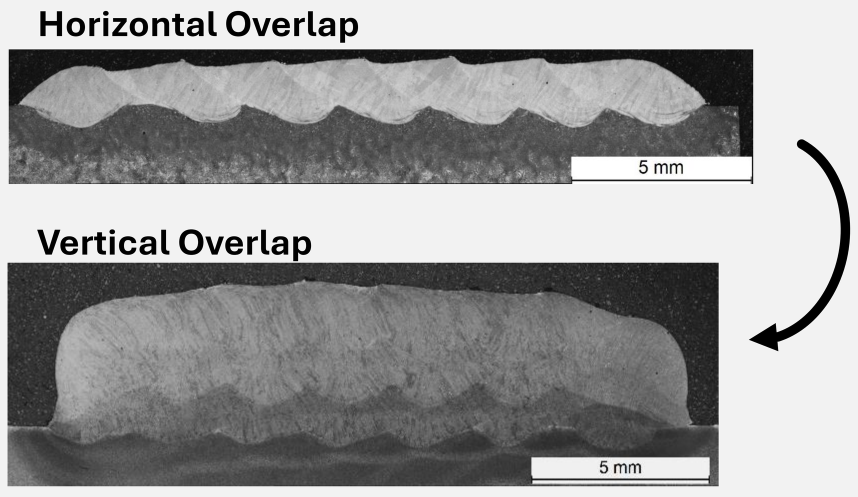


Integrated solution:

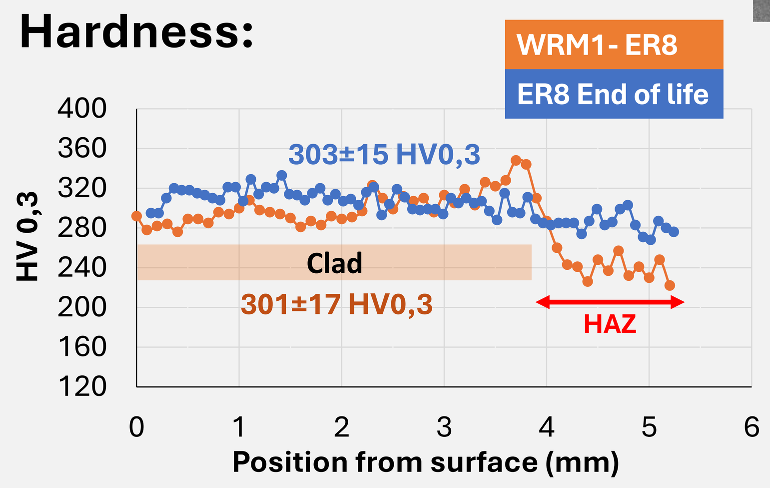


REPAIR OF WHEELS

ER8 WHEEL



Hardness:



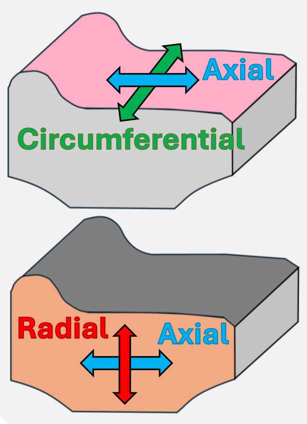
Measurements in HV10
- Added material **270-310** HV10
- ER8 Wheel **260-290** HV10

Standard: UNE-EN 13262

Steel Grade	Vickers Hardness HV10*
ER8	≥ 258

* Standard: 245 HB

Residual stresses:

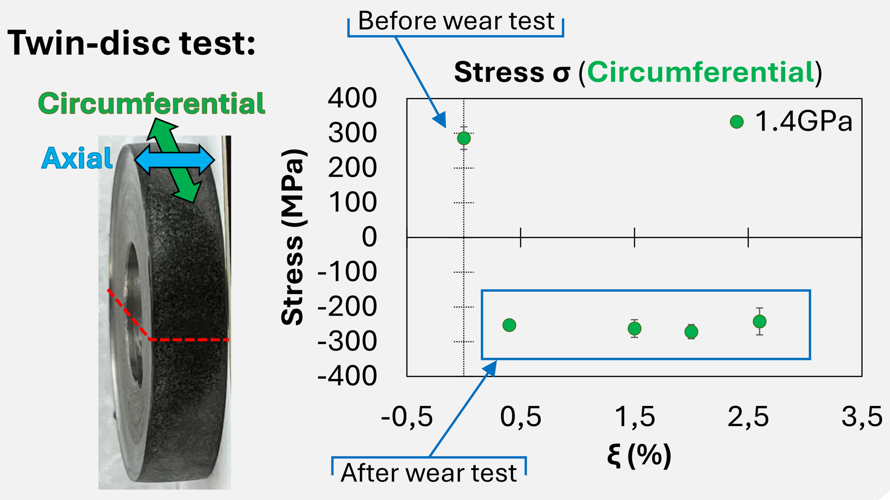


- CIRCUMFERENTIAL
- RADIAL

COMPRESSIVE $\sigma_{crs} \geq -80$ MPa

Standard: UNE-EN 13262

Twin-disc test:



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