

metal JOINing

## Metal JOINing

### K-Projekt Network

**Programme: COMET – Competence Centers for Excellent Technologies**

**Programme line: K-Projects**

**COMET-subproject, duration and type of project:**

**P2 – High Performance Welding of Rails, 09/2014 – 09/2018, multi-firm**

## Magnetically optimized arc-welding of railway rails

With the help of an externally applied magnetic field the arc of a new gas metal arc (GMA) welding procedure for railway rails could be successfully optimized. This has led to an improved geometry of the weld root and the microstructure in the heat affected zone. For the first time this technology is applied for the purpose of optimizing a rail welding process. As a result, improved weldability enables the application of modern rail steel grades of high wear resistance, and thus an essential part to improve the cost efficiency of modern railways as an environmental friendly and sustainable means of transport was realized.



### Weldability, an important decision-making factor for rails

Demands in railway tracks have steadily increased throughout the last decades. In order to meet their customer's higher demands for efficient rail tracks project lead partner voestalpine Schienen GmbH in Leoben/ Donawitz in Austria successfully develops and produces high quality rails. The suitable technology for in track welding and for joining those rails at sufficiently reliable quality is indispensable for the competitiveness in the market.

Currently used aluminothermic welding is essentially a manual casting process with its inherent disadvantages for what regards the quality and mechanical properties of the joints.



### GMA- welding as a new procedure alternative for in the track joining of rails

In comparison to the existing technologies for in track joining of rails GMA-welding offers advantages, such as the possibility of automatization and also layer-by-layer individually adjusta-

ble properties of the joint. However, the requirements for admittance, such as fatigue strength, of a new welding process are comparably high in the sector, as rails represent safety relevant components of the track.



**Fig. 1: Experimental setup used for rail welding with magnetic optimization of the arc at the laboratory of the Institute of Material Science, Joining and Forming (IMAT) at Graz University of Technology 1... Welding torch 2... magnetic yoke 3... rail foot samples.**

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For the metalJOINing P2-project the overall goal is to overcome these challenges and develop a completely new GMA-welding based process for joining rails in the track.

A decisive criterion to be successful in this development is the flawless welding of the root layer at the foot of the rail. This aspect is very hard to accomplish, because of the reduced single sided accessibility in the narrow gap under the given circumstances in the track. Certain geometrical aspects are intolerable as they directly determine the mechanical properties of the joint.

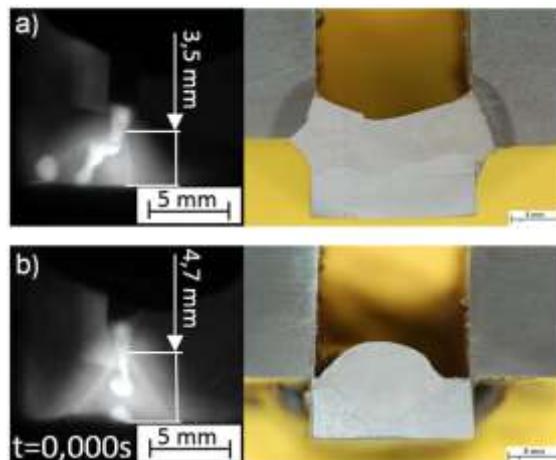
Through the application of an external directed magnetic field the GMW welding arc can be stabilized and moreover, together with detached droplets of filler material intendedly deflected sidewise. In the course of the project this technology could be successfully setup on a testing rig of the laboratory of IMAT at Graz University of Technology and then optimized for root welds on rail samples. As it can be seen in Fig. 2 very promising results were accomplished. The geometry of the weld root, as well as the side-wise penetration were improved by systematic parameter optimizations. Thus, prevailing deficiencies from other, also tried arc controlling mechanisms could be overcome.



### Impact and effects

The introduction of the technology denoted an important step in the metalJOINing P2 project and its goal to develop a GMA welding process for joining of rails. Improved process control and thus weldability will enable the admittance as new procedure for joining modern rail steel grades in the track. Based on this advancement,

gained advantages from these materials' better resistance to wear and other damage mechanisms can be maintained at the weld joint and inside the heat affected zone. Thus track maintenance becomes less and operation costs are reduced.



**Fig. 2: Deflection of the arc and droplet transfer during the developed GMA rail welding process and corresponding cross sections of the root layer of the weld joint. (a)... with and (b) without optimization by an external magnetic field.**

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The research project has helped voestalpine Schienen GmbH to be another step ahead in rail market based on broadened know-how for welding of modern rails steel grades. Through the results an important strategic advantage in the rail market was gained.

In general advancements in the rail sector as one of the most important and environment friendly means of transport represents a sustainable contribution to our society, not only in Austria but again also worldwide.

### Contact und information

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