Modular welding offers smoother running

Following service testing with the latest evolution of its proven APT 1500 R flash-butt welding head, Plasser & Theurer is now developing a modular range of carrier vehicles to optimise both design and utilisation.

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At a time when people are becoming more aware of sustainability and the environment, the railway system is on a roll. Rail use for both passenger and freight transport has been increasing steadily, with more frequent and heavier trains. However, this increased traffic load places greater pressure on the infrastructure, requiring regular maintenance and periodic rail replacement, as well as complete track renewals[1].

Throughout Europe, a comprehensive renewal programme is underway across both main lines and secondary routes, to address maintenance backlogs and ensure that rail networks are in good enough condition to cope with the higher demands[2].

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Modern high-capacity railways are generally laid with continuously welded rails, and flash-butt welding has become a tried and tested method for delivering high quality welded rail joints that can meet the infrastructure managers' national regulations and the standards set out in EN 14587-2[3].

However, this requires the use of high-tech mobile equipment able to undertake in-situ welding with a high degree of reproducibility.

Building on more than 45 years of experience in the supply of mobile rail welding machines, Plasser & Theurer has been evolving its successful APT 1500 R flash-butt welding unit, which has been delivered to more than 15 customers in 13 countries since 2008. The work unit is designed to be mounted on different carrier vehicles, including rail vehicles or a road-rail lorry, as well as a self-loading container.

Improved head saves time

Building on extensive customer feedback as well as technical advances, Plasser & Theurer has used its proven APT 1500 R welding head as the basis of an optimised modular design, now rebranded as the Plasser FlashWelder (below).

The entire welding assembly has been redesigned to modularise the work unit, and simplify operator handling, as well

The newly developed Plasser FlashWelder welding head.

The Plasser FlashWelder was trialled in regular service by Swietelsky, mounted on a rail-bound carrier vehicle.

as optimising the overall dimensions and reducing its mass. The total weight of the new head is approximately 3 500 kg, representing a reduction of around 20% compared to the previous generation. As well as reducing the axleload of the carrier vehicle, this weight saving has had a positive effect on the manipulator design and provides an improved operating range.

The clamping mechanism has been fully re-engineered so that clamping is achieved on both sides synchronously and at high clamping pressure. The rotating clamping jaws allow for a more compact design, reducing the width of the entire unit to save space and facilitate welding operations in confined spaces — such as adjacent to third-rail power supplies.

Right: The Plasser FlashWelder is compact enough to be used while trains continue to run on the adjacent track.

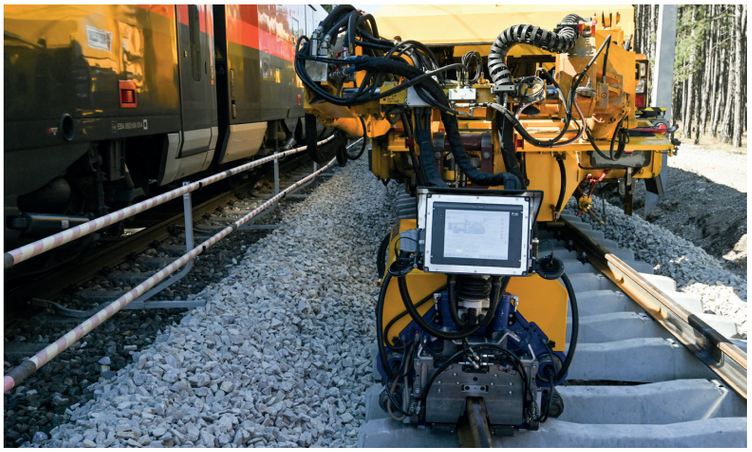
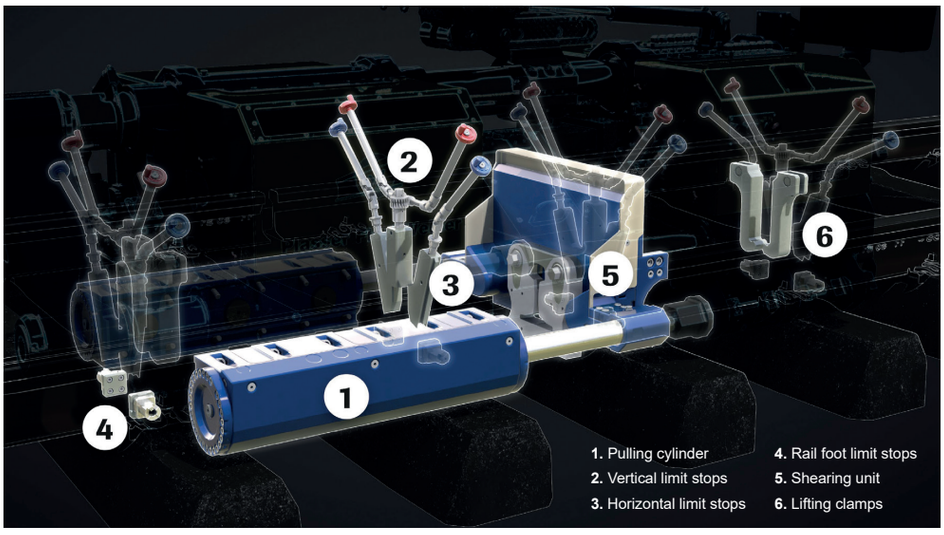


Fig 1. Modular design of the welding head allows individual units to be tailored to meet specific customer requirements.



To facilitate rerailing operations with limited track access, the unit is narrow enough to weld rails prepositioned in the centre of the track. Rails prepositioned outside the track can be welded within the working mode gauge without exceeding the structure gauge. This means that the adjacent line can remain in service (above).

Another novel feature of the welding head is the mechanism which aligns the rail ends to be welded. The rails are aligned both vertically and horizontally at the rail head and horizontally at the rail foot. Two limit stops on each side of the welding head are mechanically adjustable via a spindle drive with a

position display, allowing the rail ends to be aligned easily and quickly. These position settings can be preset, meaning that the welding head can be rapidly adjusted to suit different rail cross-sections, without the need for complex measuring systems and sensors.

An extended design of lifting clamps allows prepositioned rails to be lifted from a low position ready for welding, without the need to lift the rails and pack them temporarily. This mechanism also facilitates retraction near rail fastenings, so the rail fastenings do not need to be removed completely in order to grab the rails. Together, these efficiencies can significantly reduce the time needed for preparation ahead of welding.

Shear improvements

Once a weld has been made, it needs to be cleaned up ready for use, removing any upset protruding from the running surface. A built-in weld shearing unit can be controlled manually or automatically, when fitted with the appropriate blade for the rail cross-section. The shearing unit opens or closes automatically using hydraulic actuation.

In routine plain line maintenance, it is frequently necessary to weld new and worn rails of varying condition, and the mix of cross-sections increases the strain on the cutting edge of the weld shear blade. Instead of using an integrated blade, the new model allows an external split shearing blade to be fitted manually in front of the area to be welded. The shearing unit then presses the blade over the upset after welding. If a cutting edge becomes damaged, the external mounting of the split shearing blade means that it can be replaced immediately without any time-consuming dismantling and reassembly of the welding head.

> ‘It is possible to configure one welding head specifically for production welding with a reduced amount of equipment, while another could be fitted with a full range of functions’

Modular configuration

The new generation of welding head has been designed to be as modular as possible, allowing the range of functions to be tailored to individual customers’ requirements. For example, it is possible to configure one welding head specifically for production welding with a reduced amount of equipment, while another could be fitted with a full range of functions including closure welding. Fig 1 shows the main modules: the pulling cylinder, with or without a closure welding function, the adjustable limit stops at the rail head and foot, the shearing unit and the lifting clamps. The welding heads can also be customised to work with specific rail cross-sections and rail steel grades.

The Plasser FlashWelder is designed to operate in conjunction with the manufacturer’s Datamatic fleet management system, allowing additional control options. For example, it becomes possible to record set values at the alignment limit stops or to upload the welding report automatically for immediate online availability. The report also includes GPS location data, the chainage of the area to be welded and general vehicle information.

Below: The Plasser FlashWelder was deployed on a wide variety of application scenarios during the field trials with Swietelsky.

Field trials successful

As an established track maintenance contractor, Swietelsky has extensive experience in using Plasser & Theurer products, and the company’s welding specialists were invited to collaborate

Table I. Technical details of the Plasser FlashWelder

Length *mm*	2565
Width *mm*	927
Approximate weight *kg*	3500
Minimum curve radius for production welding *m*	250
Minimum curve radius for closure welding *m*	1000
Maximum stroke of the lifting clamp *mm*	100
Permissible temperature range for working ℃	-10 to +45

in the development of the Plasser FlashWelder. Swietelsky was then invited to undertake field tests with the new welding head under real conditions between March and December 2022. For use at a range of construction sites, the prototype unit was mounted on an existing railborne maintenance vehicle (p37).

With the support of the Plasser & Theurer service engineering team, the operators did not take long to learn how to use the new unit, including the retraction of rails using the lifting clamps and alignment of rail ends by means of manually adjustable limit stops.

Different application scenarios were tested, ranging from rail replacement to complete rehabilitation with track renewal, in a variety of locations including some very tight curves with a high degree of cant. Prepositioned rails were welded both within and outside the track.

Over the course of the trial, the machine was deployed for 42 shifts across 25 projects. It completed 752 welding operations with three different rail profiles — 60 E1, 54 E2, and 49 E1 — with both standard R260 grade steel and the heat-treated R350HT.

Following these trials, the Swietelsky team worked with Plasser & Theurer engineers to examine the results. This confirmed the accuracy and geometry of the welded joints, as well as the easy handing of the welding unit compared to earlier versions. The two parties suggested further improvements to the design, and various adjustments were made to help optimise the performance of the production welding head.

Swietelsky is now planning to deploy the pre-production welding head in its regular operations, mounted on one of the company's own carrier vehicles.

In line with the new Plasser FlashWelder branding, the company has decided to rebrand its portfolio of related applications (Fig 2):

- Plasser FlashCrafter — a self-propelled rail vehicle with running mode drive;
- Plasser FlashCar — a hauled rail vehicle with working mode drive;
- Plasser FlashContainer — a containerised module with hydraulic supports for self-loading onto a road lorry, semi-trailer or trailer;
- Plasser FlashTruck — a road-rail lorry mounted welding unit;
- Plasser FlashStation — a stationary unit for production welding of rails in a depot.

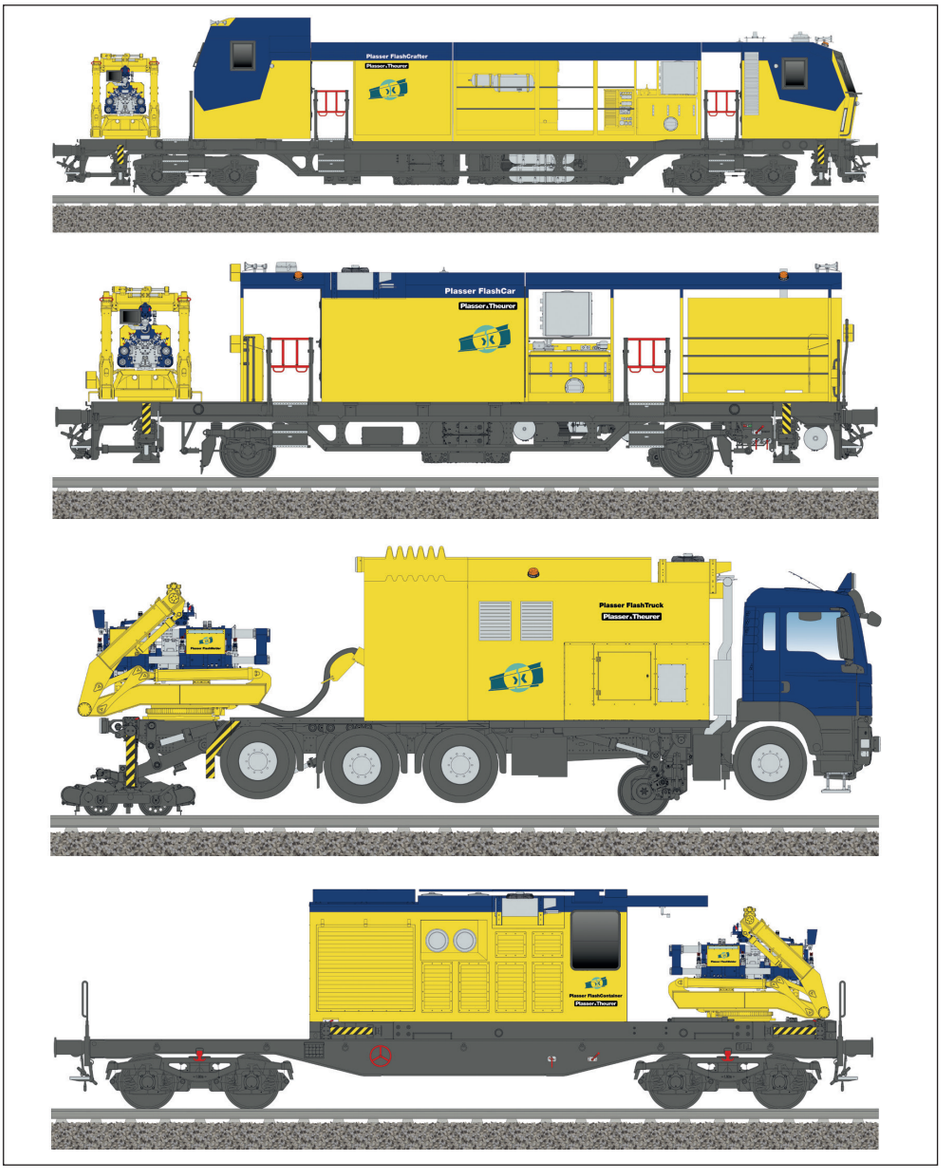


Fig 2. The Plasser FlashWelder can be mounted on a modular range of carrier vehicles.

Modular carriers next

The next step will be the modularisation of the tried and tested carrier vehicles, using identical modules for different applications to reduce the overall number of components. This will build on the range of modular track and catenary inspection and maintenance vehicles that Plasser & Theurer is already supplying to major customers such as DB Netz and ÖBB Infrastruktur. The company suggests that greater modularisation offers a wide range of benefits for customers.

Flash-butt welding requires a great deal of energy, and Plasser & Theurer is currently testing a hybrid approach to powering the welding operations. By using a central battery pack in conjunction with the usual generator set, it is possible to reduce the rated output of the generator significantly. The batteries can absorb peak loads, or alternatively supply energy for the entire welding process in locations where the generator cannot be used. This means the welding process does not depend on an energy supply from the carrier vehicle.

In addition to the mobile applications of flash-butt welding for making joints in-situ, the core technology is also suitable for stationary installations such as rail welding depots.

References

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2. Council of the European Union. Building the single European railway area, 2022.
3. EN 14587-2: 2021-07-15 Railway applications – Infrastructure – Flash-butt welding of rails.