Innovation in track maintenance: Track Maintenance Train

In a trial, DB Netz AG explores the use of the Track Maintenance Train (Fahrbahninstandhaltungszug FIZ) and its opportunities.

Fig. 1: The Track Maintenance Train FIZ Source: DB Netz

References DB Netz AG

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DB Netz AG (DB Netz) starts testing the track maintenance train (FIZ) for maintenance tasks in the section rail track. The new three-part vehicle offers many advantages compared to conventional methods. By spatially separating railway traffic and track construction operations, working on the track becomes safer, more ergonomic and has less of an effect on the train traffic on the adjacent track. For several years, preparatory work run by an interdisciplinary project team has been under way. As soon as the vehicle will get approval, the DB Netz Western region will start field trials. Before the FIZ finally gets its fixed tasks and areas of operation, the employees of DB Netz check in which areas of activity the vehicle brings the maximum benefit for the operator and those involved.

Introduction of the vehicle and maintenance concept

The FIZ, manufactured by Robel in Freilassing with series number 782, is a new and unique vehicle for the DB Netz fleet. The project for developing the track maintenance train has evolved over many years, starting with the closure rail replacement wagon (PaWag), followed by the MMU (Mobile Maintenance Unit). This was not only a development with regard to the name but also as a project with a classic specification. What began with a simple wagon for coupling onto common maintenance vehicles, is today a completely independent unit for maintaining the track. That is precisely why the FIZ has become a matter very close to their hearts for many project members.

The three-part vehicle is state of the art and makes sure that all staff, materials and tools can be brought to the work site together (see Fig. 1). Configured with many innovative features, the FIZ benefits the track maintenance crew, but also the region and the environment. The work in the vehicle is carried out without any combustion engines in machines and equipment. Thanks to sufficient seating, additional journeys will be reduced in comparison with traditional manoeuvring. However, before the FIZ will be allocated its final tasks and areas of deployment, the trials shall determine what it is capable of.

FIZ provides innovation for track maintenance at DB Netz

From DB Netz' viewpoint, the vehicle is truly a revolution in track maintenance. Extending side walls, a covered work area and an integrated rail stressor make working on the track not only safer and more ergonomic but also more efficient. With regard to its environmental credentials, the FIZ delivers huge benefits. As it is possible to move people, materials and tools to the work site, there is no need for additional journeys in (road) vehicles. Several CO2 air conditioning units are operating without the usual environmentally harmful ref-

rigerants. Reduced noise and exhaust emissions, less light coming through from the work area - these advantages will not only benefit the staff in the vehicle but also local residents. Therefore, the need for obligatory night shift permits will be reviewed as part of the trial. The FIZ makes full use of its advantages not only in urban areas but also when working in places that are difficult to access from outside (e.g. in tunnels, on bridges etc.).
Drive engine and power supply are equipped with the latest, cleanest generation of engines and meet all current requirements for vehicle acceptance. Furthermore, combustion engines have been fully done away with in hand-guided machinery and equipment, opening up a completely new way of working on the track. Changing to electric, battery powered and hydraulic drives for the machines is made possible by the power supply in the vehicle and reduces noise and exhaust emissions. Advance planning that includes charging the batteries for the subsequent shift ensures smooth operations. Table 1 lists the hand-guided machines and equipment that have been selected for the FIZ . By the way, the FIZ is not the first of its kind. The railways of neighbouring countries, e.g. the Austrian ÖBB, are using similar vehicles [1, pp. 56ff].

A three-part vehicle - from the depot to the work site and beyond

The FIZ consists of three wagons in a formation: the Traction and Supply Unit (TSU), the Intermediate Car (IC) and the Mobile Maintenance Unit (MMU) (see Fig. 2). In addition to the main cab with two seats and a cross passage with the steps, the TSU accommodates a mess room for a further 8 persons. This has a kitchenette with sink, fridge, toilet etc. You then move to the technology section of the TSU, followed by the workshop and battery cabinet. The passageway to the next wagon, the IC, is divided by a door.
In the IC, the space opens up - this stores all the materials and tools. Directly at the transition to the TSU, two loading platforms are installed at opposite ends. Two ceiling cranes can lift up to 2.5 tonnes each and reach the whole storage area of the IC and the MMU work area as they can move lengthways and crossways. To the left and right along the side walls are pallet boxes with appropriate retaining devices. The floor of the centre corridor consists of flaps and an underfloor compartment for rails. The rails are picked up from the work area in the MMU by crane and deposited in the underfloor compartment (see Fig. 3).
The transition to the MMU is open, allowing a view of the covered work area without a floor. At the front end are rail stressors that keep the rails in their original position. You see the rails, ballast and sleepers as well as the side walls on the left and right that accommodate electric sockets as well as pneumatic and hydraulic connections for the power supply (see Fig. 4). They also have roller shutters that shut out the bottom open area down to the ballast in working mode as well as LED strips for glare-free lighting. There is also additional storage space for rails, machines and tools. At the rear end of the work area, the side walls have two integrated sliding doors on either side that allow access to point mechanisms, for example. At the rear face end of the work area is an identical structure consisting of steps, handrails and rail stressors, behind that an auxiliary cab (operator's desk). From there, operators can control working mode drives, e.g. to accurately position the FIZ on the work site. Furthermore, they can operate the side walls including roller shutters and blinds or unlock sliding doors and cranes. The crane is then controlled remotely. The last section of the MMU accommodates another open platform with steps and the second cab of the FIZ, allowing for travel in both directions.
The FIZ is approx. 74 m long with a 17.5 m long work area in the MMU. The work area has a width of 2.6 m or 4.2 m when the side walls

Battery Operated	Electric	Hydraulic
Rail band saw	Wooden sleeper drilling machine	Weld trimmer
Impact wrench	Grinding machine	Rail stressor
Vertical tamper	Battery charger	
Rail web drilling machine	Torque wrench	

Table 1: **Compilation of hand-guided machines and equipment**

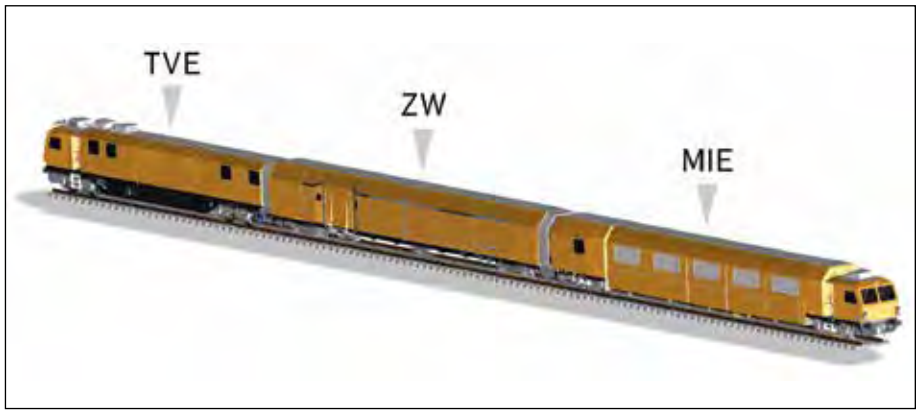

Fig. 2: The three parts of the FIZ *Source ROBEL*

Fig. 3: Intermediate car with loading platform Source: DB Netz *Source DB Netz*

Fig. 4: Work area in the Mobile Maintenance Unit *Source DB Netz*

are extended by 0.8 m maximum each (see Fig. 5). Work on a trial site showed that a lateral side wall extension of 0.4 metres is sufficient to perform a rail replacement. This is of great benefit since the full extension width of the side walls cannot be utilised on some line sections of the DB network due to existing track centre distances. The FIZ will work on lines from class B2 upwards. This will ensure that travelling and working will be possible on a large proportion of the DB network. With an output of 1,200 kW, the FIZ with its 180 tonnes unladen weight and payload can accelerate to a speed of up to 100 km/h.

Initial maintenance concept specified

The focus will be on rail replacement which has shown in an evaluation early on to be the most promising intervention for DB that can be carried out using the FIZ. Apart from rail replacement, other maintenance interventions will include:

- Replacement of switch assemblies
- Track and superstructure welding
- Work outside the track (control command and signalling, electronics and construction engineering)

The trials will show if these tasks can be performed in an economically efficient manner. In addition, occupational health and safety and environmental protection as well as deviations from conventional work processes will be looked at. Thus, in the first place, experience of working with the vehicle on the DB network will be gathered in order to identify future optimum deployment options for the vehicle, infrastructure and staff.

Expected benefits for staff and processes

The expectations are particularly high with regard to occupational health and safety and working conditions. After all, the FIZ presents an unrivalled next level in track maintenance. Due to working in an enclosed space, the maintenance crew benefits from protection against adverse weather, such as rain and wind, but above all from the increased occu-

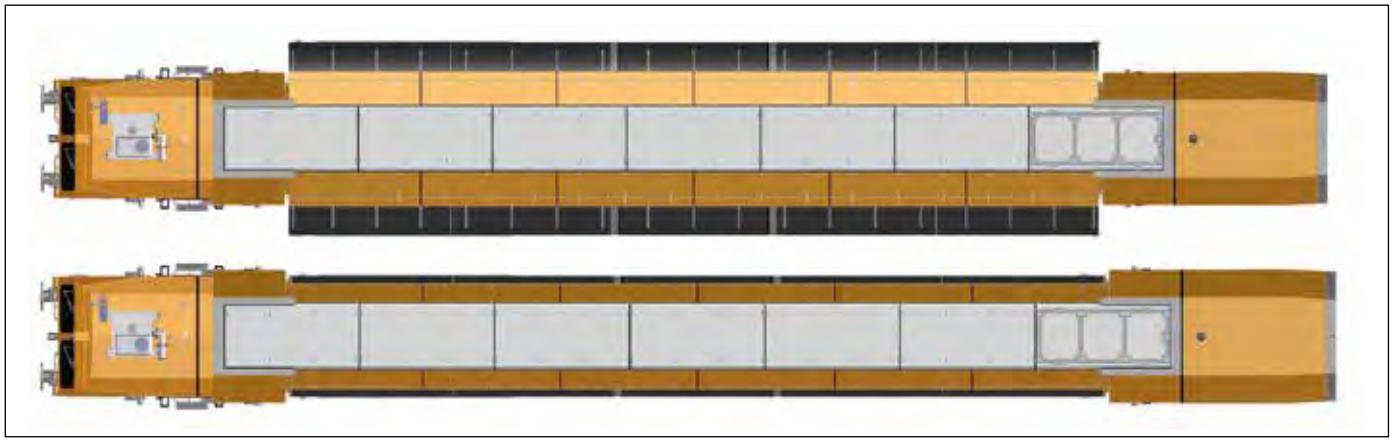

Fig. 5: Top view of MMU - side walls extended and retracted *Source ROBEL*

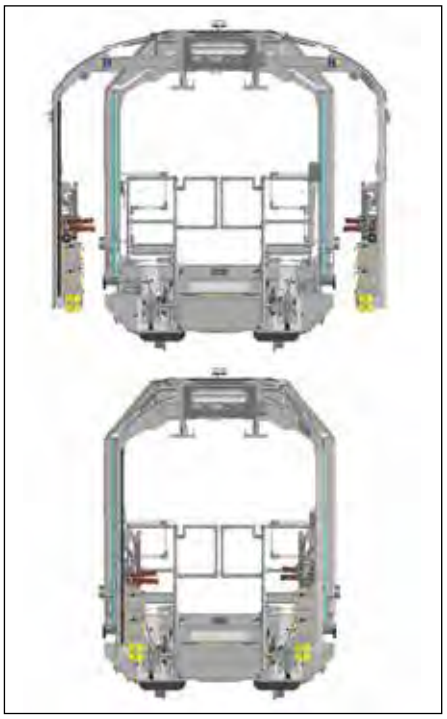

Fig. 6: Cross section of MMU - side walls extended and retracted *Source ROBEL*

pational safety.
Working in a protected space allows train traffic on adjacent tracks to continue operating. Furthermore, work with the FIZ can in future be scheduled as train journeys, offering additional operational benefits. A high degree of shift and capacity utilisation will be the prerequisite for economically efficient deployment. This can benefit all stakeholders due to shorter possessions, better conditions and higher outputs per shift.

Fig. 7: Rail joint grinding at the trial work site *Source DB Netz*

Improved occupational health and safety and working conditions

The maintenance staff working on the FIZ particularly benefit from the vehicle that has been manufactured specifically for track maintenance. The extensive facilities in the mess rooms allow for site briefings to be conducted during transiting and for comfortable break times. Safety mechanisms such as video cameras ensure focused and uninterrupted working on the track [1, pp. 58f]. Adapted work ergonomics and lighting, a “roof” and ventilation not only allow for better working but also for improved quality of work. An extraction unit for welding work and associated measurements of air quality are included in the project. It is to be expected that emission loads can be reduced, especially when working in tunnels. When the FIZ enters a track, an occupied signal will prevent other vehicles entering that track. Only when the FIZ leaves the track, the occupied signal will be cancelled, thus providing a reliable protection for securing the work site. In order to be able to make the most of these benefits, roles and responsibilities will need to be clearly defined when working with the FIZ and the staff instructed accordingly.

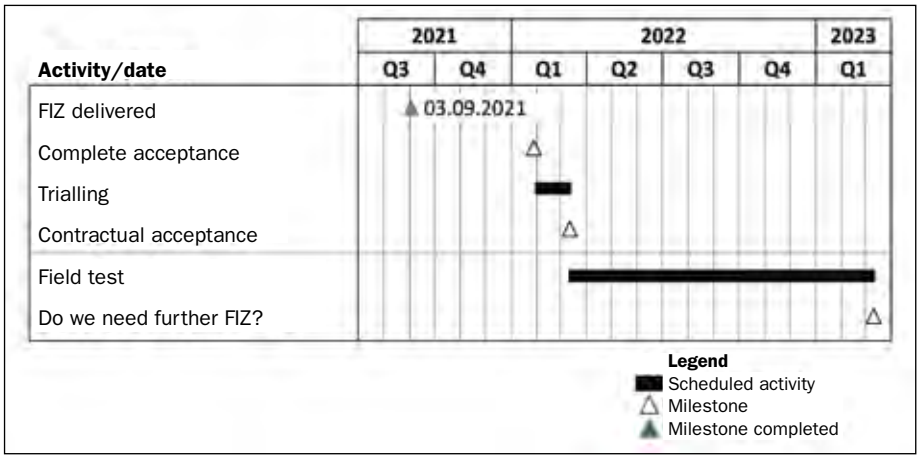

Fig. 8: Timeline FIZ trial and testing

Operational issues can be managed

In contrast to conventional methods, restricted speed sections are no longer necessary, thanks to the closed side walls in the work area (see Fig. 6). Traffic on the adjacent track can travel at the locally permitted speeds. The work site is secured by the presence of the FIZ. This also reduces the set-up times considerably. The duration of possessions can also be reduced, line closures are not necessary. Another benefit of the enclosed workspace is that the overhead line does not need to be switched off. This saves time, and since only one vehicle is required for the transport of materials and crew, the logistical effort is also reduced considerably.

The standard workflows of the operations and constructions guidelines are expected to be affected only to a small extent by the extending side walls. The maintenance staff is expected to stay within the FIZ during working. The safety plan mandatory at DB will be adapted to these new circumstances.

Use of the FIZ requires optimised planning process

In conventional methods, rail replacement is often an intervention at short notice following test or measuring runs. When working with the FIZ, a new approach needs to be taken. In order to be economically efficient, it requires carefully planned shifts with several rail replacements or a combination of rail replacement and clustered interventions. It should also be possible to schedule short maintenance interventions in between two regular trains. This is what the vehicle is designed for: For a complete shift, personnel and vehicle are equipped with everything they need to work on several work sites. This will of course require more preparation and communication between the involved parties. It means that solid and proactive planning are crucial for deploying the FIZ. Developments in recent years have shown that sufficient interventions are available within a selected area and period of deployment to achieve the required utilisation.

Procedure and results

On a trial work site valuable insights were gained on the use and handling of hand-guided machines and equipment. Once the FIZ is approved, it is expected to go through a short phase of trial operations followed by a field test. The final step will be to refine the scenario of deployment in relation to the infrastructure.

First practical findings

In the first week of May 2021, the FIZ was trialled at a work site in Freilassing. There, the operational capability of the FIZ was tested for the first time. Although the work was carried out on Robel's factory sidings in Freilassing, it was possible to create real conditions to simulate the focus on rail replacement. Indeed, several runs were carried out successfully (see Fig. 7).

In addition to working with the vehicle, work on the trial site also had the purpose of training the maintenance staff in the use of the new machines. The staff tested new hand-guided machines in order to fully optimise their potential.

Unfortunately, due to the pandemic, only the staff required for the individual tasks could participate. This included staff for measuring the air pollution during thermite welding. Occupational safety experts were also present to observe the workers' safety. The vehicle manufacturer Robel ensured the smooth running of the trial. The feedback of all parties involved was positive throughout. The results contain important information for the future use of the FIZ. Some improvements have already been implemented on the vehicle and the hand-guided machines. However, the most important point is that the parties involved have been passing on their experience with the vehicle.

Trialling the vehicle in and with the Western Region

At the beginning of September, the FIZ arrived in the Western Region and will remain there until its approval. After the approval by the European Union Agency for Railways (ERA) at the beginning of November, the vehicle will start working in trial operations for 30 days to test its operational capability. There, all networks participating in the first year will start working with the FIZ in preparation. The trial period will be concluded with the acceptance of the vehicle, when the responsibility for the FIZ will be taken over by DB Netz (see Fig. 8).

Field testing which is due to last a year will start at the end of the year and will take place in the Western region of DB Netz AG. This will gather numerous findings, including both objective and subjective factors. On the one hand, the profitability calculation will need to be validated. On the other hand, not all factors can be evaluated based on budgetary figures. For example, it is difficult to put a value on employee satisfaction and the increase in safety. Until this stage has been reached, all parties involved drive the FIZ project forward in order to get off to a good start. The regulatory conditions will need to be established, shifts have to be planned, carried out and evaluated. Findings have to be gathered, processed and distributed to the relevant bodies. If we succeed in doing this, the FIZ will not only generate efficiencies but also make work on the ground more ergonomic and safer. In the end, the question will be about the weighting of economic efficiency versus soft factors and, finally, if we need more vehicles like the FIZ.

REFERENCES

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