

Innovations and proven equipment at the iaf 2013

At the iaf 2013 Plasser & Theurer will present 16 machines for the maintenance of tracks, turnouts and overhead lines under the motto "Quality cuts costs". Among these there will be some world firsts such as the all-in-one switches & crossings and track maintenance machine, a ballast cleaning machine for turnouts and the mobile rail welding robot.

The 16 machines on show represent only a small part of our production range. They offer cost-efficient solutions for performing the necessary maintenance work on the track and the overhead line system. It is vital for the operator to find the machine that is best suited to his requirements and for the work he has to carry out. Requirements such as the maintenance of high-speed lines or heavy haul lines must be dealt with as well as special cases such as smaller track networks, enclosed track networks (e.g. underground railways), tracks with sharp curves and tight structure gauges, to mention only a few examples. Therefore, for one job there are machines in different output categories which all produce a high quality of work. The innovations being shown offer the infrastructure managers the opportunity to pursue new paths in the maintenance of tracks and turnouts. This includes, for example, continuous-action ballast bed cleaning in turnouts without having to remove them, complete maintenance of turnouts providing ballasting, lifting, lining, tamping, grading, stabilising and measuring in one machine or the mobile rail welding robot with certified welding quality.

Attention is also drawn to the possibility of sound-insulation of the work units on tamping machines or the reduction of emissions when operating a motor tower car.

1 Track and turnout maintenance using mechanised maintenance trains (MDZ)

Restoring the track geometry after a certain traffic load is a scheduled maintenance job that has to be performed quickly and accurately. After the preparatory work, such as establishing the lifting and lining values, checking the ballast profile and commencing the organisational steps, the main work is carried out in a track possession.

This consists of lifting and lining the track or the turnout and fixing the new position by packing ballast under the sleepers. Then the ballast bed is profiled and the stabilising process commences. The integrated measuring system checks the quality of the work performed.

At the end of the track possession a fully operative track must be available. For decades this work has been performed using so-called mechanised maintenance trains, in short MDZ. Today Plasser & Theurer offers MDZ trains in all output categories. They can consist of one, two or three machines.

In the case of the new model (see 1.3) "supplementing the ballast" is also integrated.

1.1 The MDZ 3000

The MDZ 3000 consists of a 4-sleeper tamping machine with integrated track stabilisation and a machine for ballast management. At the present time this is the most productive machine group for track maintenance on the world market. Peak outputs of over 2,500 m/h enable cost-effective utilisation of very short track possessions.

1.1.1 109-4X Dynamic Tamping Express

The machine on show (Fig. 1) comprises 3 sections: the tamping section, the stabilising section and the sweeping section. It was built according to French specifications and is operated by a contracting firm.

The 4-sleeper tamping units are the main features of the machine. The full output capacity is achieved on tracks with regular sleeper spacing. In practical operation this is not always the case. However, due to the crosswise division of the tamping units, it



Ing.
Rudolf Becker

Section Head,
Technical information

Plasser & Theurer
Export von Bahnbaumaschinen
Gesellschaft m.b.H., Wien
export@plassertheurer.com



Fig. 1: The fastest track tamping machine in the world – 109-4X Dynamic Tamping Express (factory photo)
(source of all figures: Plasser & Theurer)



Fig. 2: Tamping machine with split-head technology – Plasser 08-16 SH (factory photo)



Fig. 3: Easy ballast regulating – PBR 500 V (factory photo)

is possible to use the machine also as a 1 or 2 sleeper tamping machine. Therefore, sections with irregular spacing can also be tamped without difficulty.

The tamping vibration frequency of 35 Hz in combination with 4-sleeper tamping produces an outstanding quality of work. After tamping, the track is stabilised immediately which has a homogenising effect on the ballast bed. This raises the track's resistance to lateral displacement and increases the stability of the geometry.

After this, two powerful sweeper units clear ballast stones from the track. At the same time various track parameters are measured and checked. The machine leaves behind a finished track.

1.1.2 Ballast management system – BDS 2000-4

In the case of large track lifts, it is necessary to dump quantities of ballast corresponding to the lifting value before starting work. This is generally done with the help of hopper cars.

In many cases, however, it is not necessary to dump new ballast in the track because there is already a great quantity of surplus and therefore unused ballast in the track. Modern laser measuring systems with appropriate computer software can determine the quantities of surplus ballast and the areas for each separate half of the track. Now it is up to the machine to utilise this surplus cost-efficiently.

The answer is a powerful ballast plough with a large hopper and that is the BDS 2000-4 ballast management system. The two-part machine, consisting of the ploughing section with a 15 m³ hopper and a sweeping section with three sweeper units, is linked by a connecting rod.

Now it is possible in areas with excess ballast to draw this into the ballast crown area using the ploughs and to distribute

the ballast. Any ballast that is not needed is collected by the front sweeper unit and transported on conveyor belts to the hopper. When there is a shortage of ballast, the stored ballast is distributed in the track via distributor chutes or on two slewing conveyor belts. In the course of track maintenance it is possible to reduce the quantity of new ballast required by up to 60%.

At the present time the BDS 2000-4 is the most efficient ballast regulating machine on the world market. It can keep pace with the fastest 09-4X tamping machine and leaves behind a perfect ballast profile. This machine can also be used in turnouts.

1.2 The MDZ with 1-sleeper tamping machine

As mentioned above, there are mechanised maintenance trains for all performance requirements. In the top performance category there are the groups of tamping machines that work in continuous action and in the lower category those that work in cyclic action.

The following two machines are at the lower end of the performance range. A good addition would be a dynamic track stabilizer such as the DGS 90 N which is unfortunately not on show.

1.2.1 Plasser 08-16 SH tamping machine

This cyclical 1-sleeper tamping machine (Fig. 2) is equipped with two split-head tamping units.

They are in split design and each section can be deployed independently of the other. The work units are also laterally displaceable in pairs. This makes it possible to tamp practically the entire area of turnouts and crossings.

When tamping plain track the pairs of units go into action together and in curves they are centred automatically over the rails. The

combined lifting and lining unit consists of roller lifting clamps, lifting hooks and lining rollers which ensures versatile application in tracks and turnouts.

1.2.2 PBR 500 V ballast profiling machine

The PBR 500 V compact ballast profiling machine (Fig. 3) is equipped with a frontal plough, shoulder ploughs, sweeper unit with a transverse conveyor belt and rail fastening brushes. The frontal plough is designed in divided form and the halves are longitudinally displaceable to each other.

All ballast movements in the vicinity of the ballast crown can be performed in one pass.

The positioning of the three-part shoulder ploughs is carried out hydraulically, operated from the cabin.

The sweeper unit picks up the surplus ballast and throws it onto the left or right hand ballast shoulder using a reversible transverse conveyor belt.

With the help of a turntable, the machine can be turned 180° to change the direction of work.

Buffing and draw gear can be mounted on the ends of the frame at the front and the rear.

1.3 The premium programme for switches & crossings

The development of continuous-action track tamping by Plasser & Theurer made possible for the first time the incorporation of the functions "ballast regulating" and "stabilising" in one machine.

Prior to track maintenance work supplementary ballast had to be distributed in the track using ballast wagons. The premium programme for the turnout (Fig. 4) presented at the iaf 2013 represents a worldwide innovation and includes transport and dis-

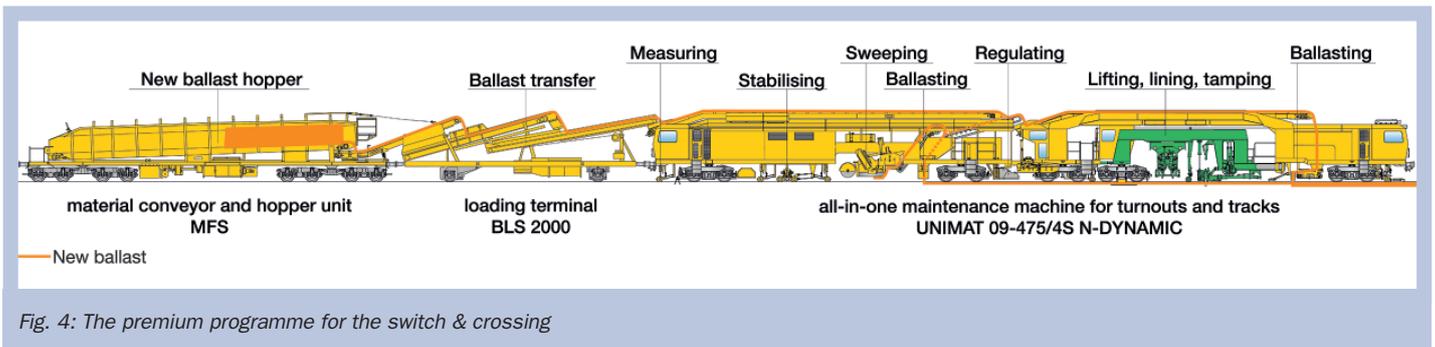


Fig. 4: The premium programme for the switch & crossing

tribution of the supplementary ballast as well as complete and careful maintenance of the turnout. This system produces a finished and fully maintained turnout (and track).

The system comprises the three machine models described in the following.

1.3.1 All-in-one machine
Unimat 09-475/4S N-Dynamic

The two-part maintenance machine Unimat 09-475/4S N-Dynamic (Fig. 5) is the core of the system.

It contains all features of a modern turnout maintenance machine such as split tamping units with tilting tines, four-rail tamping and careful lifting of the turnout with 3-point application.

The incorporation of ballast transport and distributing conveyor belts is new. Before lifting and tamping, the ballast coming from the rear is placed in the turnout or the track in measured quantities by two slewing conveyor belts. After tamping, the ballast bed is profiled using centre plough and shoulder ploughs.

Then surplus ballast is picked up by a

sweeper brush and either deposited to the side via two transverse conveyor belts, or sent to a hopper via a steep conveyor belt, or passed on to the front distributing conveyor belts.

The attached fine sweeper brush cleans the sleeper surfaces once again. The following stabilising unit achieves a homogenisation of the ballast bed, thus increasing the safety and quality of the track geometry.

Finally, the quality of the corrected track geometry is checked by measuring, recording and evaluation of the various geometry parameters. As stipulated by European standard EN 13848, levelling and alignment faults are restricted to the wavelength range D1 (3–25 m) separate for each rail. The limit values for up to five line speeds can be pre-programmed. Reports show the quality of the turnout or the track and any anomalies.

The Unimat 09-475/4S N-Dynamic is equipped with the most up-to-date control and diagnostics technology. The machine enables fast and cost-effective maintenance of the entire track and turnout area with the highest possible quality of work including placement of ballast. It is the first machine in the world that can perform all-in-one track maintenance in turnouts and tracks.

1.3.2 MFS 100 material conveyor and hopper unit

The new ballast is taken to the maintenance area with the help of a self-contained MFS material conveyor and hopper unit. Due to the slow running floor conveyor belt and the faster running transfer conveyor belt, ballast can be deposited as required.

A separate drive unit is installed to supply power to the conveyor belts. The hopper has a storage volume of up to 68 m³.

Basically, other MFS models can also be used. The dimensions and overhang of the transfer conveyor belt are the same on all units.

1.3.3 BLS 2000 loading terminal

The BLS 2000 loading terminal is used to pass on the new ballast from the material conveyor and hopper unit to the ballast conveyor belt at the rear end of the Unimat 09-475/4S N-Dynamic.

Its main function is to provide a transition for the differing heights and widths of the conveyor belts between MFS and Unimat. It also has a separate power supply for the conveyor belts.



Fig. 5: The all-in-one machine – Unimat 09-475/4S N-Dynamic (factory photo)

2 09-2X/SD tamping machine with sound insulation

An 09-2X/SD continuous action track tamping machine was built for a contracting firm in Japan. This machine will be used only on the Tokaido Shinkansen line.

The 2-sleeper tamping units are divided lengthwise to the sleeper (Fig. 6). This enables the machine to be used alternatively as a 1 or 2 sleeper tamping machine.

Apart from the high quality technology, great importance is placed on noise protection in Japan. This is required for the operators in the cabins as well as for reducing the working noise emitted into the surrounding area. The machine is equipped not only with sound-insulated cabins and engine compartment, but also with sound protection panels at the sides. This achieves a sub-

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Fig. 6: 1 or 2-sleeper tamping at the push of a button – 09-2X/SD (factory photo, without sound protection panels)



Fig. 7: By road to the worksite – UST 79 S tamping machine

stantial reduction of working noise, caused mainly during the tamping process, for the surrounding area.

To counteract possible generation of dust during the tamping process and to provide the operator with good visibility, a water spray system is installed in the vicinity of the tamping units. It is activated when the tamping units are lowered and switched off when they are lifted.

Apart from the three bogies, two more running axles are mounted in order to comply with the maximum permissible axle load of 14 t laid down by the railway administration.

3 Unimat 09-4x4/4S Dynamic universal tamping machine

The extremely complex regulations of the UK Railway Group Standards GM/RT 2400 were applied for the design and construction of this machine. It combines the advantages of a continuous action track tamping machine with the functions of a turnout tamping machine of the latest generation.

The machine carries four independent, laterally displaceable, 1-sleeper tamping units. Each tamping unit carries four tines and the outer ones can be tilted to the side. The tamping units can be turned together by $\pm 7^\circ$ to guarantee optimum tamping of the slanting sleepers in the turnout. This produces 100% tamping of the turnout.

The stress in the rail fastenings is kept low due to the application of the three-rail lifting unit in the area of the crossing and is far below the permissible range. The stabilising units and the sweeper unit are mounted in the rear section.

In addition to the standard measuring systems, the machine is equipped with a CAL levelling and alignment laser. This is used to extend the measuring base for levelling and lining and can be deployed not only on straight track but also in curves. A non-contacting sleeper detection system allows fully automatic operation when working on plain line track.

4 UST 79 S tamping machine with road chassis

High-quality maintenance work has to be carried out regularly even on small rail networks (e.g. on the rails of urban transport authorities) with ballasted track which can only be reached via the tracks of the main railways or sometimes have no connecting track at all.

The UST 79 S universal tamping machine (Fig. 7) was developed and built for easy access to these work sites. It is designed as a semi-trailer for transport by road. The rear end of the frame was extended for the support on the semi-trailer truck and a three-axle road chassis was installed that can be lifted and lowered hydraulically.

Dimensions and weight of the machine were chosen so that no special permits or special accompanying vehicles are necessary for transport by road. Without additional aids, the machine can be on or off-tracked in the depot or at a suitable level crossing. Two lifting cylinders behind the tamping units are used to uncouple or attach the machine to the semi-trailer truck.

The machine is also equipped with two bogies for working mode on the track. Despite the compact dimensions the machine is equipped with the necessary work units: heavy-duty tamping units, lifting and lining unit, measuring systems, sleeper-end consolidators, levelling and alignment laser, recording unit, etc. The machine can be used in tracks and turnouts.

5 Ballast cleaning machines for every requirement

Regular cleaning of the ballast is one of the mainstays for low maintenance costs of tracks and turnouts and a long service life of the track material. Basically, the working principle of a ballast cleaning machine is always the same: the ballast material is excavated, the material is screened to separate ballast from spoil, the cleaned ballast is returned to the track and the spoil is taken away.

However, there is a wide spectrum of operating conditions which influence the choice of the machine best suited for the job. This includes the size of the track network, operation in long-term possessions or short intervals between trains, cleaning in tracks, cleaning in turnouts and on-track cleaning or cleaning where the tracks or the turnouts have been removed.

Three ballast cleaning machines for different fields of application are presented in the following.

5.1 Non-stop through the switch & crossing using the URM 700

Continuous-action, rail-mounted ballast bed cleaning in tracks has been performed since the beginning of mechanisation. Now continuous-action ballast bed cleaning in turnouts, on-track and fully mechanised, has been achieved through the development and construction of the URM 700 universal ballast cleaning machine. The system also incorporates a screening car and material conveyor and hopper units (Fig. 8).

The core component of the URM 700 is its excavating unit in the form of a sword with a horizontally circuiting excavating chain. The excavating width of the sword can be varied infinitely and without manual operation up to a width of 6100 mm. It can be used on the left or the right and is supported at the other end when slewed inwards. The ex-

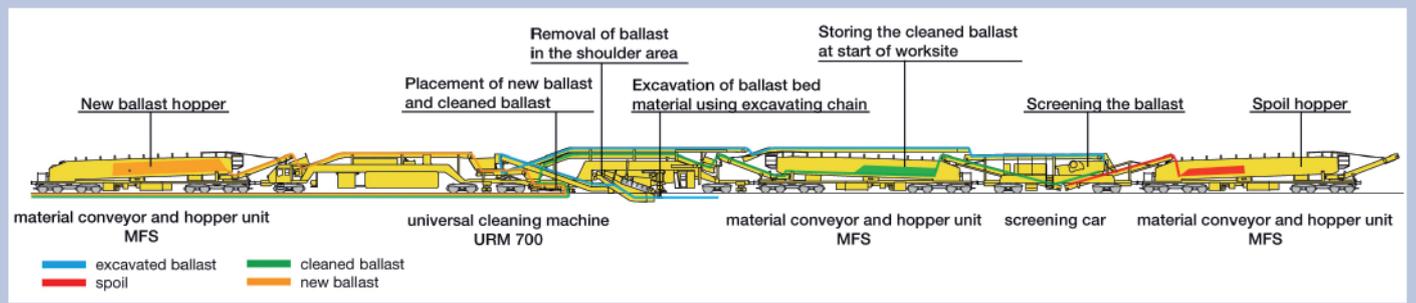


Fig. 8: Non-stop through the switch & crossing

cavating unit works without support only in short transition areas.

The excavating depth is variable and the formation crossfall can be adjusted. Special lifting jacks hold the turnout in position until it is filled with ballast from the slewing conveyor belts. Shoulder excavating units first clear the area at the sleeper ends. After the return run the sword is slewed in and the ballast bed material is sent to the shoulder excavating unit (Fig. 9). If necessary, new ballast can be added to the cleaned ballast. Complete exchange of ballast is also possible.

Naturally the machine can also be used for ballast cleaning in tracks or for shoulder cleaning alone.



Fig. 9: Excavating unit of the URM 700

5.2 High output when cleaning ballast in tracks – HRM 2004 CH

Due to the dense frequency of trains on tracks of the China Railways Corp (CRC), the track possession lasts for only 3 hours. Ballast cleaning at high output with excellent quality is therefore a basic requirement. The HRM 2004 CH three-part ballast cleaning machine fulfils the demands with the help of a powerful excavating chain and two screening units. If required, new ballast can be added from the material conveyor and hopper units coupled at the end.

The machine is equipped not only with a rail undercarriage but also with two crawler tracks that can be lifted and lowered hydraulically. Since the crawler tracks should not travel over the formation, cleaned ballast is returned ahead of the crawler tracks. Another option for ballast placement is located behind the second crawler track. New ballast can be added if required. After the track has been filled with ballast, spiral conveyors regulate the material.

which is clearly superior to other rail welding processes. The European welding standard EN 14587-2 was also a driving force behind the development of the new welding robot which meets the requirements and even surpasses them.

The new welding robot boasts a whole range of innovative features. Highest geometry quality and a 100% reproducible welding quality is guaranteed thanks to the fully automatic centring of the rail top and running edges which are measured and documented using special measuring equipment.

5.3 Cleaning with or without track – ZRM 350

The ZRM 350 (Fig. 10) can clean ballast bed material even in sections without track.

6 The APT 1500 R rail welding robot

The development of the new APT 1500 R rail welding robot (Fig. 11) is based on many years of experience gained by Plasser & Theurer in flash-butt welding technology

A rail connection with optimum metallurgical qualities is obtained due to the minimum residual ripple of the welding current that is obtained by the supply of alternating current with a frequency of 1000 Hz which

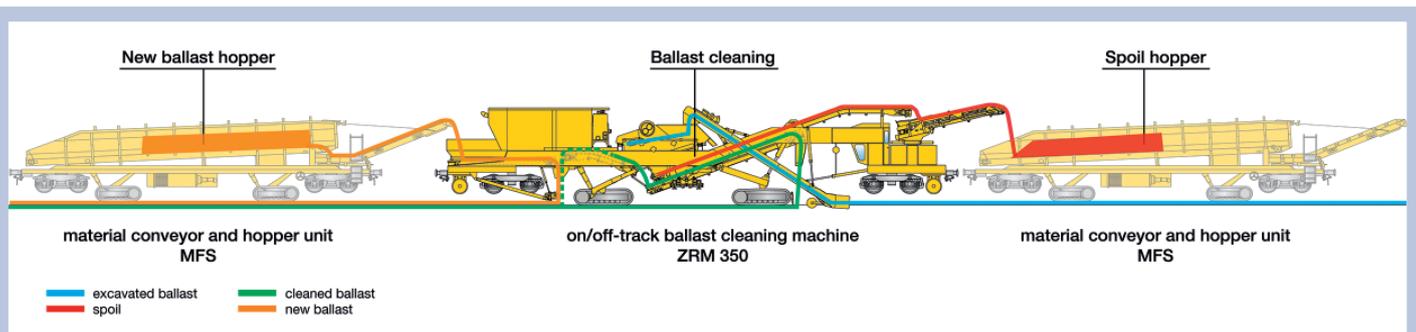


Fig. 10: Ballast cleaning with and without track – ZRM 350

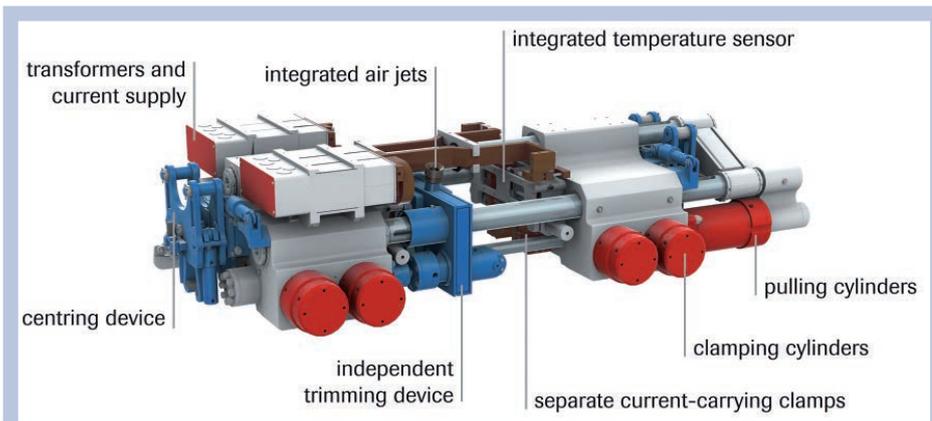
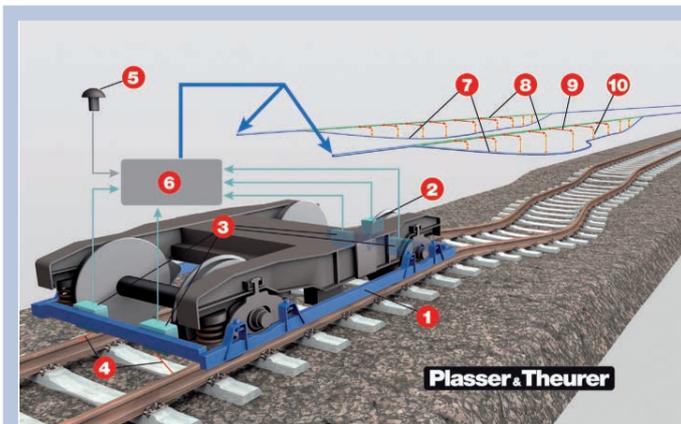


Fig. 11: APT 1500 R mobile rail welding robot

The welding robot is offered as a rail-mounted model or as a road-rail flash-butt welding machine. Both models are designed with jacks to lift the machine on one side which enables a free longitudinal movement of the rails during closure welding.

7 Perfect measuring for your safety - the electronic track recording car EM80H

The EM80H electronic track recording car built for the Gabon railway operator SETRAG is equipped with a non-contacting track geometry measuring system. This system consists of an inertial measuring unit, two optical gauge measuring systems and the navigation unit (Fig. 12). Measuring can be performed at speeds up to 100 km/h and is only limited by the travel drive. The track is measured under load and the inertial measuring system requires no minimum speed. The measurements are evaluated in real time. The self-propelled track recording car is compliant with EN 13848 – 1 and 2.



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|---|---|
| <p>1 Measuring frame with fixed vertical distance to the rail surfaces</p> <p>2 Inertial measuring unit (IMU)</p> <p>3 Sensors of the track gauge measurement</p> <p>4 Laser beams to scan the track gauge</p> <p>5 GPS data acquisition</p> <p>6 Navigation computer</p> | <p>7 Blue curves: space curves of both rails derived from the measurements along the track, synchronised with GPS data</p> <p>8 Green lines: track design line</p> <p>9 Red arrows (horizontal): alignment defects, calculated from the space curve</p> <p>10 Orange arrows (vertical): longitudinal profile defects, calculated from the space curve</p> |
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Fig. 12: Working principle of the track geometry measuring system – EM80H

8 Safe access to catenary using the MTW 100.216 motor tower car

Safe and efficient operation is of course also important for the necessary work on the overhead catenary system.

The motor tower car on show is equipped with a three-part lifting platform. This enables work to be performed simultaneously at three different heights and in different areas, namely up to 4.5 m to the side and 9 m in height and in the centreline of the track up to 6 m in height (Fig. 13).



Fig. 13: Safety at the top – MTW 100.216 (symbolic photo)

is a world first. The welding current is transmitted by using separate current-carrying clamps which means that it is no longer necessary to grind off the welding marks on the rails.

With the new welding head we can produce the optimum rail connection on high-alloy rails and head-hardened rails. When welding high-alloy rails, the temperature sensor incorporated in the welding head monitors the post-heating produced by current pulses in order to ensure that the rail cools down slowly. It is possible to achieve any metallurgically specified cooling-off curve. The temperature is also monitored after welding head-hardened rails. By using integrated air jets the cooling of the weld is accelerated.

Thanks to the special constructional features of our welding robot, it is also possible to perform closure welds without an additional pulling device. The upset metal is removed immediately after the welding process without opening the clamping jaws. It is this independent-action trimming device that enables closure welding.

Other features of this design include a PKR loading crane with a self-levelling work basket, a pantograph, holding devices for contact wire and carrying cable and a static contact wire measuring unit.

The MTW 100.216 motor tower car is equipped with two low-emission diesel engines with particle filters. Every engine is equipped with the complete drive hydraulics for the work units. With an output of 440 kW engine 1 is used primarily for the hydrostatic transfer drive – up to 100 km/h – and serves as a reserve in the event of a failure of engine 2. Engine 2 has an output of 200 kW and is normally used for working operation. Engine 1 is then not in operation. This ensures minimum pollutant emission and high operating reliability at the same time.

The machine is also prepared for the installation of an ETCS unit.