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## Future track technology — NOW: the new Plasser & Theurer Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> takes technology to the next level

Multiple innovations installed on a single machine: the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> is a cutting-edge combined tamping and ballast regulating machine for plain track and turnouts that is designed for optimised worksite logistics, in that it combines the functions of several machines: ballasting, tamping, profiling, stabilising, surveying, pre- and post-measuring. Existing ballast resources are used during the tamping process, thus a perfect result is achieved by just a single machine.

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The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> was conceptualised as a versatile tamping machine that uses innovative technology while driving technological innovation. It boasts cutting-edge technologies and adopts features that serve research and development purposes, such as an inertial measuring system, ballast condition measurement, tamping reports, virtual workstations, and preparations for a ground penetration radar (GPR) system. In the following, a number of technological highlights of the new machine is addressed.

### Optimised periodic track maintenance: flexibility and high performance offered by the 8x4 tamping unit

Track possessions available for sections of line and, thus, machine operating times are becoming shorter and shorter due to denser rail traffic, which particularly affects periodic track maintenance. In other words, the sections to be maintained are also becoming shorter and shorter. However, these sections often embrace a variety of track features: plain track, turnouts, cross-over points, and connecting track sections, which all pose different maintenance challenges. Modern track maintenance machines have to be as universal and variable as possible, in order to handle these sections as flexibly as possible. This is precisely where the machine concept of the new Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> comes into play.

Experience gained has shown that a combined machine such as the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> unlocks its full potential when it comes to periodic track maintenance. A single machine takes care of all the necessary work sequences: everything from measuring the track geometry to maintaining the track and the ballast bed, as well as post-work treatment by its dynamic track stabilising unit. The synergy effect that results from using one machine instead of several machines is obvious when it comes to direct costs.

Furthermore, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> has been optimised to simplify servicing, which entails lower machine maintenance costs. Also, the decrease in the number of machine service staff required provides additional economic benefits. Fast and easy machine servicing not only saves time and money but, very importantly, also increases machine availability for productive deployment.

### High-performance 8x4 tamping unit

The core component of the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> is its high-performance 8x4 universal tamping unit, which provides perfect prerequisites for tamping both turnouts and plain track. The machine can tamp a turnout with the same high quality, capacity and speed as the proven 4x4 tamping unit. When working in 2-sleeper mode, the machine can tamp longer sections of connecting track quickly and at high capacity.



Fig. 1: The new Unimat 09-8x4/4S BR Dynamic E<sup>3</sup>: ballasting, tamping, profiling, stabilising, surveying, as well as pre- and post-measuring – all performed by a single machine

The new 8x4 tamping unit features eight tamping unit segments that can work independently of each other, as well as 24 tilting tamping tines. The continuous-action 2-sleeper tamping machine also has a newly developed tamping tine arm design that allows more freedom of movement. The opening width, penetration depth, and squeezing distance can be varied as needed. Also, the machine can switch to 1-sleeper tamping at any time, which is particularly beneficial when tamping twin sleepers or hollow sleepers, where the point machine is located.

Tamping double-slip turnouts and turnouts with a movable point frog is turnout tamping at its finest. The 8x4 tamping unit can easily master this task using its high power reserves and versatility.

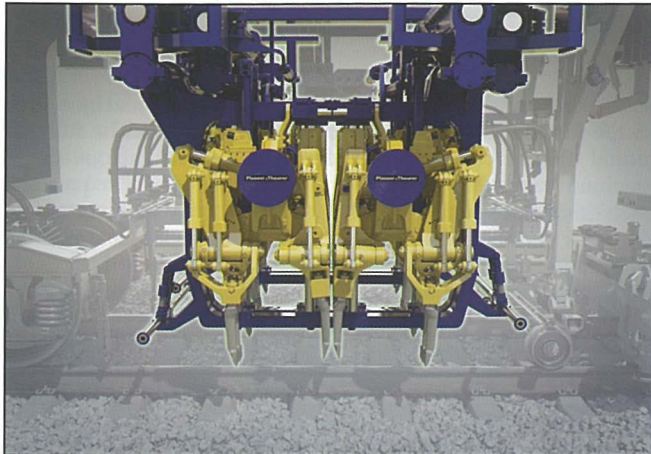


Fig. 2: The 8x4 tamping unit combines performance, precision and flexibility – the tamping unit segments can be lowered independently of one another; the tilting tamping tines allow optimum tamping in the critical turnout area

In short: the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> combines the high performance of 2-sleeper tamping with the maximum flexibility of working in 1-sleeper mode when/where needed.

#### So much more than tamping

In all areas, such as machine concept, technology, and ergonomic design, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> combines time-tested, state-of-the-art, and future-proof components. This combined tamping and ballast regulating machine for turnouts and plain track is the successor to the time-tested Unimat 09-475/4S N-Dynamic. Like its predecessor, the new machine completes all the necessary work sequences for maintenance of plain track and turnouts in the technologically correct order in a single pass. The major difference, which is immediately recognisable, is that the new machine features the pioneering Plasser & Theurer E<sup>3</sup> hybrid drive technology.

#### “Economic – Ecologic – Ergonomic”: the power of E<sup>3</sup> hybrid drive technology

The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> features the revolutionary new E<sup>3</sup> hybrid drive technology. In addition to the conventional drive system, the machine can be powered fully electrically in both running and working mode. All rotating movements (drive in both running and working mode, tamping units, etc.) are powered fully electrically. All linear movements remain powered hydraulically. This means that, in addition to the purely electric drive unit, the E<sup>3</sup> machine concept also allows for a decentralised electro-hydraulic drive system for both the main and auxiliary work units of the machine, entailing a significant decrease in the amount of hydraulic oil required.

In particular when in running mode, the consumption of fossil fuels (diesel) can be decreased to a large extent thanks to the use of energy supplied from the overhead line system, which is mostly carbon neutral and less expensive. There is also less exhaust-gas and noise emission (no diesel engine operation) which, especially in urban areas, is very much welcomed by line-side residents.

#### Innovative cab concept: a single work cab gets the job done

Owing to the E<sup>3</sup> drive system, the machine would normally be comparatively long which, particularly when tamping turnouts, could pose potential disadvantages. For this reason, attempts were made to make the overall length of the machine as short as possible. A newly developed single-cab design was the result – the first of its kind, which also impacts machine operation. The single cab provides enough space for both the co-tamping operator (who operates the lifting and lining unit) and the tamping unit operator. Both operators, despite their varied functions, can perform their work at ease and in a well laid-out environment.

A new feature that is part of the single-cab design is that there is a fully virtual workstation for the co-tamping operator, who now also works on the continuously moving part of the machine, and sits with his back to the tamping unit operator. Thanks to six high-resolution screens, there is a digital overview of machine operations, which offers various advantages. Twenty-four high-resolution cameras provide a better view of the work units than can be had from an “analogue” workstation.

Furthermore, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> has an ultra-modern crew room that provides space for six people and features all the necessary amenities: WC, kitchenette, seating area, heated lockers, as well as a “digital workplace”. The latter allows machine personnel located in the seating area to see what is happening during machine operation, which can be used for quality monitoring or for training purposes. The new crew room complies with occupational health and safety regulations. Further, there is a workbench for performing minor repairs.

#### Efficient and systematic ballast management

The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> ensures the highest tamping quality and a long-lasting work result by using proven technologies from the Plasser & Theurer BR (Ballast Regulator) portfolio, comprising ploughing, sweeping, profiling, and ballast management. Surplus ballast is collected, stored (12 m<sup>3</sup> hopper capacity), distributed, and inserted into the track using the plough, sweeper, and profiling units of the machine. Thanks to the combined tamping and ballast regulating machine concept, ballast resources are used in a sustainable manner and ballast is systematically placed in front of the 8x4 tamping unit. As existing ballast is used, the machine can perform tamping of long sections of track, including turnouts, without the need for any external ballast trains.

The shoulder ploughs of the machine, which have slewing limitation to prevent any infringement of the clearance gauge of the adjacent track, profile the ballast shoulders and draw the ballast into the sleeper-end area and towards the ballast crown. The centre plough of the machine rearranges the ballast in the crown area. The sweeper unit then clears any ballast that may have been left behind on the sleepers. The sweeper brush no longer needs to be adjusted manually for work on wooden and concrete sleepers – on this machine, it is adjusted at the push of a button. Because of its pantograph, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> does not place new ballast (it is not required for the intended machine application scenarios).

#### Dynamic track stabilisation optimises track geometry durability

Dynamic track stabilisation has become indispensable to sustainable track maintenance. This is all the more important as traffic loading increases. High-speed lines are particularly affected. By means of the dynamic track stabilising unit of the machine, the ballast stones are rearranged homogeneously and an even consolidation of the ballast bed is effected, which ensures that the dynamic forces resulting from rail traffic are more evenly distributed onto the track formation. A controlled settling of the track not only ensures that the track panel is firmly established in the ballast bed, but also considerably increases its resistance to lateral displacement, which obviates the need for any speed restrictions following tamping. For an even more homogenous track quality, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> offers the option for the dynamic track stabilising unit to apply a variable impact force, steplessly adjustable from 0 to 100 percent.



### **Inertial Measurement Trolley: on the fast track to track geometry**

In addition to the conventional chord measuring system, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> is equipped with future-proof technology for precise and comprehensive measuring results: an inertial measuring unit (IMU) mounted on a compact two-axle trolley. The IMU records a space curve that is assigned a relationship to the rails via mechanical track gauge measuring. The compact system set-up enables complete post-measuring, requiring only a little space. Further, the IMU can survey the track geometry prior to correction at speeds of up to 60 km/h – this saves a significant amount of time in daily operations. Further, the system enables a precise recording of long-wave track geometry faults (longitudinal level and alignment faults) for the wavelength ranges D1 and D2.

### **Quality at a glance thanks to Plasser TampingReport: a high level of transparency provided by detailed reports**

Plasser & Theurer currently offers two SmartTamping options: the intelligent tamping assistance system “PlasserSmartTamping – The Assistant”, and “Plasser TampingReport”. The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> is equipped with the Plasser TampingReport system. In addition to the work result report provided by the electronic DRP data recording processor, TampingReport gives detailed information on the work sequences. When these tamping reports provide proof of technologically correct maintenance, this can serve as a basis for future strategic decision-making. The reports provide detailed information that helps to optimise and expand the planning of future maintenance work. Highly customisable display options are available for both the back office and on-board the machine. Individual tamping positions, lifting and lining positions, corresponding values, as well as any obstacles detected, can be displayed or hidden, and be viewed using the stepless zoom function.

### **The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> at a glance – goals, economic aspects, benefits:**

- this combined tamping and ballast regulating machine for turnouts and plain track has a high capacity thanks to its 8x4 tamping unit. Its profiling, ploughing and sweeping unit, as well as its ballast hopper (up to 12 m<sup>3</sup> capacity), allow ballast to be used in a sustainable manner. Ballast can be placed directly in front of the tamping unit, thus obviating the need for any external ballast trains;
- this efficient machine is very suitable for periodic maintenance of track sections, including turnouts and connecting track, for which short track possessions are available. Only a single machine is needed, which also offers clear advantages in terms of cost efficiency;
- as it concerns a combined machine there is only one drive unit, which entails cost savings as regards procurement, operation and, in particular, servicing;
- as work sequences are performed in a uniform, coordinated manner this saves time and planning efforts;
- this combined machine requires only five operators, two of them located in the single cab of the machine. As expertise is pooled on just one machine, this mitigates skilled staff shortages.

*The Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> combined tamping and ballast regulating machine for turnouts and plain track offers various advantages*

### **Conclusion**

In all areas, such as machine concept, technology, and ergonomic design, the Unimat 09-8x4/4S BR Dynamic E<sup>3</sup> combines time-tested, state-of-the-art, and future-proof components. With more than eight technological highlights, the machine embodies “future track technology – NOW”.

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## **Plasser & Theurer in the run-up to InnoTrans 2022, Berlin, Germany — technologies for increasing the capacity of railway infrastructure**

On 20-23 September 2022, the 13th International Trade Fair for Transport Technology (InnoTrans 2022), will be held in Berlin, Germany. Plasser & Theurer will also partake in this event and present various innovations that address the topics of digitalisation, greening, and automation, opening up new paths into the future of rail and making this most environmentally-friendly mode of transport even more economical, efficient, and sustainable. In the run-up to InnoTrans 2022, Plasser & Theurer has been able to chalk up successes that were made possible by innovations of precisely this kind, as alluded to in this article.

### **Largest single order in the company's history: the supply of 56 zero-emission maintenance vehicles**

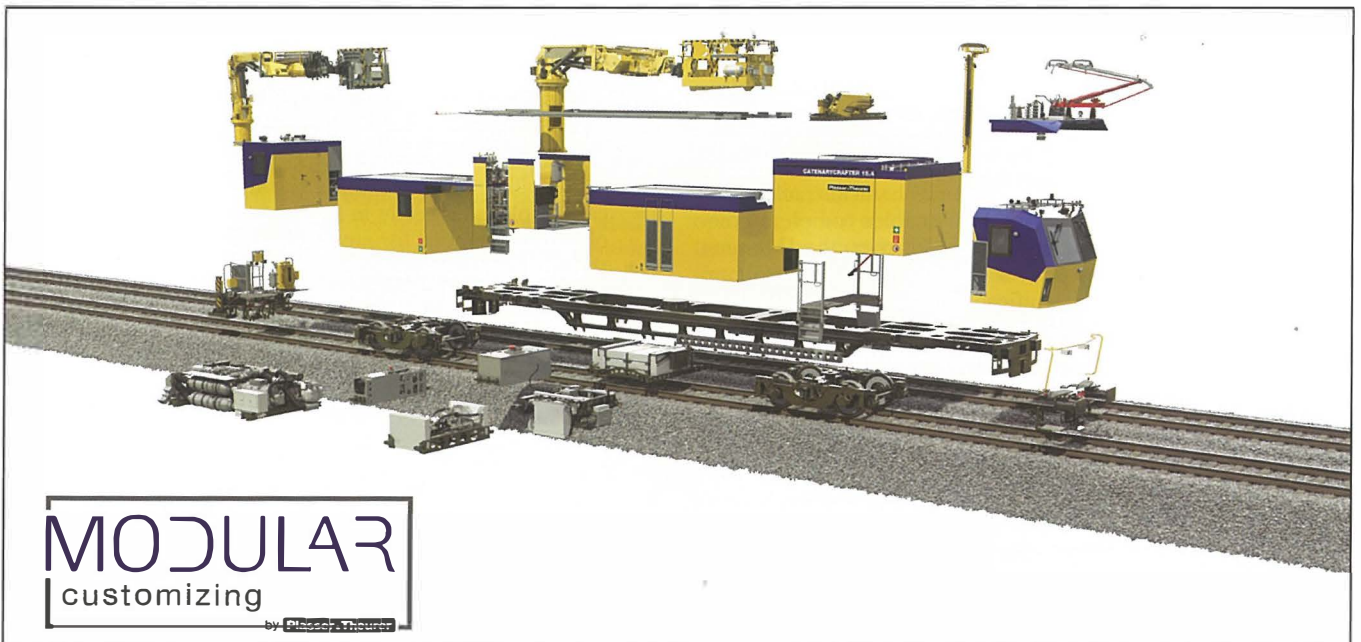
At the end of a two-stage EU-wide tendering process, ÖBB-Infrastruktur, Austria, has awarded a contract to Plasser & Theurer for the supply of 56 zero-emission high-performance maintenance vehicles (21 Plasser MultiCrafters, 29 Plasser CatenaryCrafters for work on overhead line (OHL) systems, and six Plasser TransportUnits) worth almost EUR 250 million, with a procurement option for an additional 46 vehicles. The environmentally-friendly E<sup>3</sup> hybrid drive technology adopted by these vehicles convinced them, as well as the crucial fact that these vehicles are fit for future technologies, such as the ETCS train control system.

Mr. Johannes Max-Theurer, CEO of Plasser & Theurer, on being awarded this major contract, noted that: “Orders like this prove that with our machines we not only promote economical track maintenance, but also sustainably achieve the

climate goals of the rail transport system with the innovative, environmentally-friendly drive and work technology.”

### **ModularCustomizing – shorter delivery times and lower costs**

Not to be underestimated in winning the aforementioned largest single order in the company's history was the concept of ModularCustomizing, on the basis of which the vehicles are designed and manufactured. The development of this concept began about 10 years ago with the construction of 48 maintenance vehicles for German Rail (DB) and has been consistently pursued ever since. Today, different machines can be built from modules with a 100% level of detail and precisely defined interfaces in less time and at lower costs. The advantages of ModularCustomizing become effective during the entire service life of the machines, as it not only significantly facilitates maintenance, but also repairs and refurbishments.



**MODULAR**  
customizing  
by Plasser & Theurer

*Plasser CatenaryCrafter 15.4 E<sup>3</sup> – all vehicles for ÖBB have a completely new design concept based on ModularCustomizing*

**A speed-up for spare and wear parts**

Over the past two years, the Customer Services division of Plasser & Theurer has developed very dynamically, with the focus always being on meeting customer and market requirements in a professional and sustainable manner. Life-cycle enhancement, eco-retrofitting, and used machines can serve as examples in this context.

The company’s European Distribution Center in Linz, Austria, will start test operation in the summer of this year. This is the beginning of a new era for Plasser & Theurer spare and wear parts provision. The goal is to have all frequently ordered parts in stock, and to enhance customer satisfaction with shorter delivery times. An improved supply chain is key to reducing delivery times and optimising the cost of parts.

**“Economic – Ecologic – Ergonomic”:  
the power of E<sup>3</sup> hybrid drive technology**

At the outdoor area of InnoTrans, Plasser & Theurer will present a highlight of its current product range: the Unimat 09-4x4/4S Dynamic E<sup>3</sup> with the revolutionary E<sup>3</sup> hybrid drive technology. This universal tamping machine for plain track and turnouts is the first hybrid machine for DB Bahnbau Gruppe GmbH (a German Rail (DB AG) company), which – with this machine – is equipping itself to meet a number of current challenges in the areas of climate protection, occupational safety, urban working operations, and reduction of equipment and resources.

In addition to the conventional drive system, the machine can be powered fully electrically in both running and working mode. All rotating movements are powered fully electrically. Only the few linear movements remain powered hydraulically.



*The Unimat 09-4x4/4S Dynamic E<sup>3</sup> with hybrid drive technology*

**Machine, Fleet & Infrastructure  
remain at the top of the agenda**

Plasser & Theurer is dedicated to providing precise answers to current market needs with new technologies, and remains true to its objectives in the Machine, Fleet and Infrastructure segments:

- *Machine*: in this segment, ModularCustomizing provides an individualised machine fleet with high standards;
- *Fleet*: in this segment, the focus remains on providing support throughout the entire service life of the machine;
- *Infrastructure*: in this segment, digital solutions for maintaining railway infrastructure and complementary services continue to be the main topics of interest.

The E<sup>3</sup> hybrid drive technology reduces hydraulic oil consumption by 80%. When using carbon-neutral traction current supplied from the overhead line (OHL) system when in running mode, this substantially lowers diesel consumption. Furthermore, as the E<sup>3</sup> hybrid drive technology significantly reduces exhaust-gas and noise emissions (no diesel engine operation), this will be of great benefit to line-side residents, especially in urban areas.

**Conclusion**

Plasser & Theurer aims to provide innovative contributions that strengthen rail as the most environmentally-friendly mode of transport, the capacity enhancement of which is becoming increasingly important for future mobility sustainability.