

25 YEARS
"GUIDED BY VMT"



Latest Innovations

Celebrating 25 Years by Making the 'Best' Better

25

In 2019, VMT will be celebrating its 25th anniversary as a company serving and working with the tunnelling industry to develop the product range it offers today.

ANYONE CONNECTED to the underground construction industry and in particular tunnel and microtunnelling construction knows that the hard work is done by the TBMs and microtunnelling shields, as they cut the ground and remove the muck to create the tunnels. However, there are parts of the tunnelling process that require precision and skilled steering of these mighty tunnelling machines.

VMT is one of the leading global companies able to meet both these requirements – not just with excellent products but also with innovative and forward-looking research and development and a ‘concept to

project’ ethos. This principle also applies to an after-sales back-up and service that others find difficult to match.

Looking at the tunnelling industry, it is obvious that without the best navigation systems holing on target may be missed; without superior management of tunnel lining segment manufacture and delivery production/advance targets may be missed; without the correct collection and management of the construction process data crews will not know when things may be going wrong until it is too late, and outside of the tunnel environment knowing the effects of tunnelling on the surroundings can be vital.

The observation by George Wei Managing Director of VMT Asia subsidiary summarises it nicely: “A guidance system without a machine is useless but a machine without guidance is almost worse than useless. Guidance to the TBM is as eyes are to humans. When we close our eyes we can still walk. However, after not too many meters we feel less and less confident about where we are and where we are heading and desperately want to open our eyes! We are scared of what we might run into, and even though we assume we are walking in a straight line we are surprised how much have deviated from the straight line once our eyes are opened.” VMT provides the TBM with its eyes.

IN A WORLD where tunnelling operations from planning to completion are increasingly integrated and complex, the impetus behind the company’s R&D programme is innovation. This is the key to remaining ahead of the field enabling us to improve the support to our customers whilst offering solutions that meet their demands and solve technically challenging problems. To this end, VMT recently established a dedicated Research & Development division that does nothing else but seek out new systems and provide improvements to VMT’s products across the industry.

Therefore, marking its 25th year in the business, during the course of this anniversary year VMT will unveil the first results of this work and bring a number of its latest developments, additions and upgrades to the global market. These will include products in the areas of tunnel advance and support ring building, which form the core of VMT’s product portfolio, and aspects of tunnelling started 25 years ago and that still represent the foundation of the company’s success. With this new ‘innovation offensive’ VMT will not only establish and launch new navigation technology but also enlarge, improve and fine-tune existing systems to meet the demands of projects for years to come.

The range of novel ideas will include new hardware components that are more robust, functional and flexible, along with the supporting software.

Always following the aim to make the industry’s best system even better.

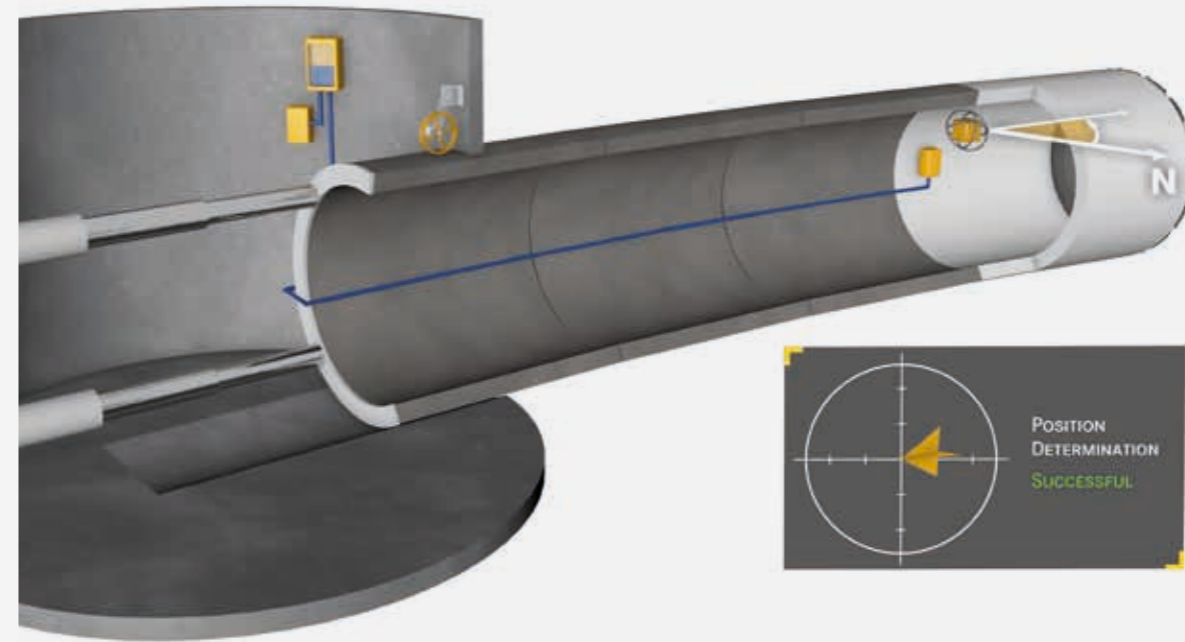
VMT will continuously enhance, advance and refine its product range that delivers appropriate solutions for all kind of mechanised tunnelling: from concept to completion, and from product design to installation and use – as a recognised, well-respected supplier and partner for guidance systems, process data management, production and logistics management for segmental lining, for monitoring and management systems for optimal ring build as well as deformation monitoring.

Discover our Latest Innovations for Making the ‘Best’ Better

Navigation Systems

TUnIS Navigation TBM^{Gyro}

The measurement method of this navigation system is based on a gyroscope (gyro compass) and is particularly suitable for tight alignment radii and where there is no laser window on TBMs with only a small diameter. TUnIS Navigation TBM^{Gyro} determines the current advance position related to the planned tunnel axis with millimetre accuracy and in real-time using a gyro compass and the dead reckoning method. It is suitable for all tunnel boring machines – irrespective of a specific machine type (EPB, mixshield, hard rock).



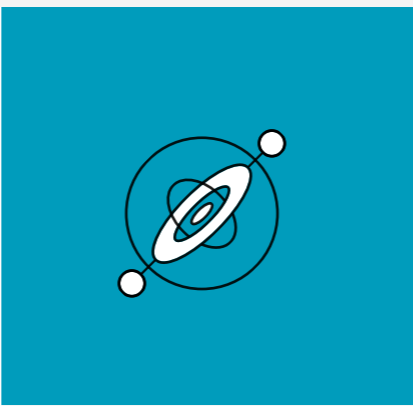
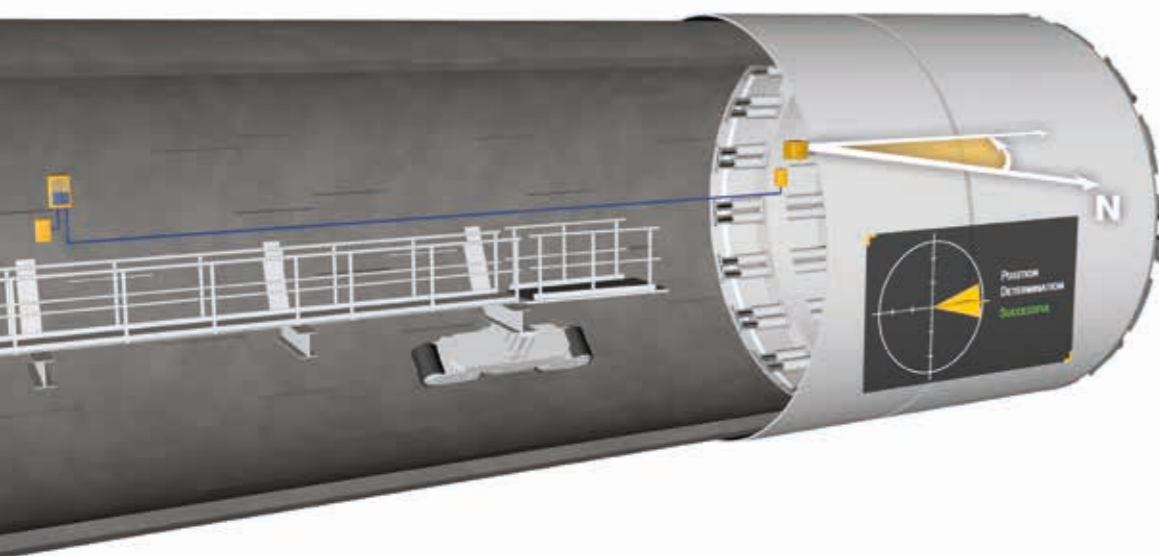
FEATURES

- ▣ Display of deviations for the actual machine axis or for the drift-corrected drive direction to the tunnel axis
- ▣ Calculation of a correction curve in the case of inaccurate driving and display of the TBM deviation to the correction curve
- ▣ Manual drift and chainage correction
- ▣ User-specific display of the navigation screen
- ▣ Continuous display of the position data, also when affected by vibration and during the advance

BENEFITS

- ▣ Universal use:
 - for very tight curve radii
 - machines without a laser window
 - TBMs with small diameter
- ▣ Easy to use software thanks to wizards
- ▣ Compact, space-saving system

universal use



TUnIS Navigation MT

TUnIS Navigation MT is a universal navigation platform for micro tunnelling advances. In its various operating modes, it supports all common navigation principles and thus forms the core of a complete system family. Due to the free choice of navigation technology, TUnIS Navigation MT meets almost all requirements for every machine size and all imaginable alignment geometries. Regardless of which tunnelling method is currently being used and how an alignment runs, the system provides the exact position of the tunnelling machine at all times, calculates deviations from the target alignment and displays them to the shield operator.

FEATURES

- ▣ Supported operating modes (also alternately):
 - Laser in the launch shaft + electronic laser target on machine
 - Laser in the launch shaft + electronic laser target on machine + electronic hydrostatic level
 - Travelling total station + electronic laser target on the machine (from DN 1200)
 - Gyro compass (gyroscope) + electronic hydrostatic level
 - Multi-station systems
 - Special application for E-Power Pipe method

BENEFITS

- ▣ Optimum control of the machine position by continuous monitoring of machine movements
- ▣ Increase in efficiency due to the selection of the optimum navigation technology, tailored in each case to the advance method and the alignment
- ▣ Change of navigation technology also possible in the course of an approach without problems
- ▣ Reduction of navigation-related downtimes
- ▣ Uniform operation independent of the navigation technology currently in use

maximum flexibility



TUnIS Navigation Rockbolter

The total station and sensor-based navigation system enables the precise positioning of anchors in the tunnel arch for rock reinforcement. The system determines the exact position of the drill rod and visualises it for the machine operator in real time. In combination with the specified anchor pattern, the machine operator can use it not only to start each anchor at exactly the right position without manual measurement work, but also to set the drill rod at precisely the planned angle.



FEATURES

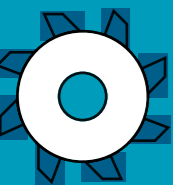
- ▣ Total station-based position determination of the machine and sensor-based alignment of the drill rod
- ▣ Module for configuration of the anchor patterns based on the tunnel profile and evaluation of the anchors set in TUnIS CT Office
- ▣ Wireless data transfer to the machine
- ▣ Display of the deviations between planned and actual position of the drill rod both graphically and numerically



BENEFITS

- ▣ Precise, 3-dimensional positioning and alignment of the drill rod in relation to the planned target anchor
- ▣ When using TUnIS Navigation Roadheader at the same time, use the installed once tachymeter for both systems
- ▣ When TUnIS Navigation Roadheader is used at the same time, data from both systems can be merged
- ▣ Can also be used under poor visibility conditions

maximum efficiency



TUnIS Navigation Roadheader

The navigation system ensures exact measurement accuracy, high performance and high efficiency in conventional tunnelling for roadheader excavation, while at the same time ensuring greater work safety for personnel. The system combines robust hardware proven under harsh conditions with modern analysis software. TUnIS Navigation Roadheader has been developed with the objective of maximising the advance rate by making the machine operator able to conduct the excavation faster under adverse conditions and exactly in accordance with the design profile.



FEATURES

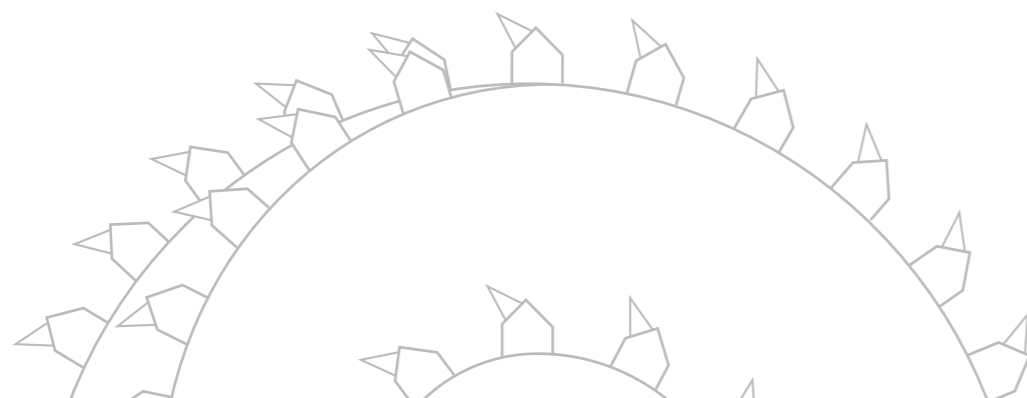
- ▣ Determination of position of machine and cutting arm using tachymeters and sensors
- ▣ Proven and robust hardware (IP65-compliant)
- ▣ Data transmission between total station and TUnIS PC by radio
- ▣ System components that can be used independent of machine manufacturer
- ▣ Data archiving for later analysis



BENEFITS

- ▣ Precise roadheader position information – even with high dust loads at the tunnel face and poor visibility
- ▣ Optimum data basis for machine control due to an ongoing comparison of the actual and the design profile
- ▣ Precise excavation of the design profile with reduced reworking for fast advance and reduced shotcrete use

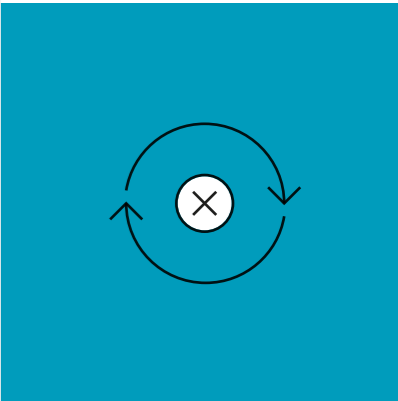
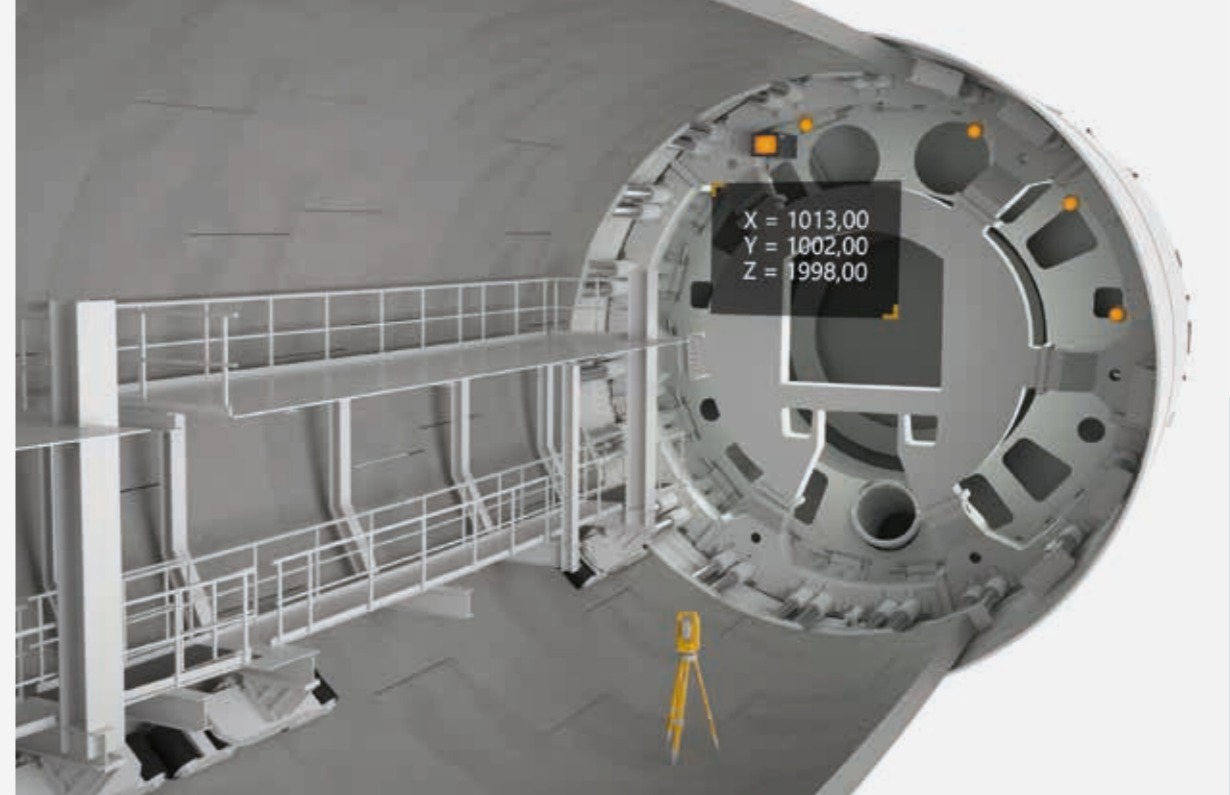
unique analysis software



Complementary Systems

TUnIS.moving station

The assistance system enhances a laser target-based navigation system in large diameter tunnelling. With TUnIS.moving station, the total station is not mounted on the tunnel wall, but travels on the gantry of the TBM. Prisms on the tunnel wall and an electronic laser target in the TBM shield are used for precise position determination. First, the current position of the total station is determined via the prisms, then the position of the laser target and thereby the TBM position. During ring building, the system determines the coordinates of the total station (free stationing).



FEATURES

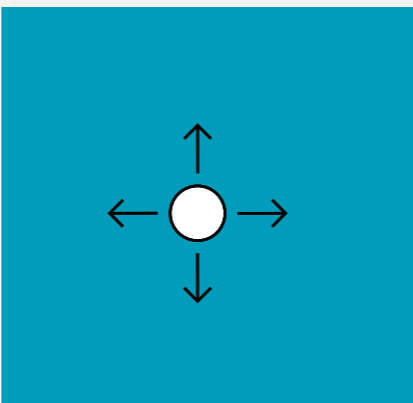
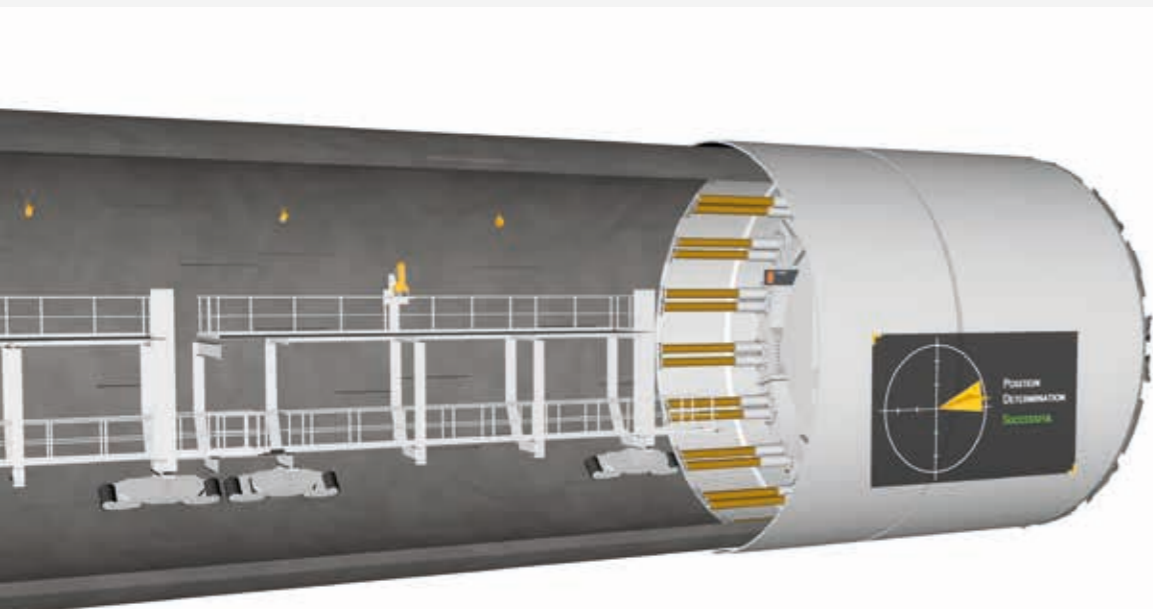
- ▣ Precise, automatic measurement with the laser tachymeter during ring building
- ▣ Determination of the current position during the advance using stroke measurement of the thrust cylinders and the VMT Track Assistant system
- ▣ Continuous calculation and display of the TBM position



BENEFITS

- ▣ Time and cost savings, particularly when cornering: no rearrangement of the total station, rebuilding of prisms by site personnel possible
- ▣ Good visibility also in tight curves, due to short spacing between total station and laser target
- ▣ High reliability: if the laser beam is interrupted, navigation can be temporarily performed via the Track Assistant thrust cylinder

efficient & reliable



TUnIS.pulse

TUnIS.pulse is a multiple-redundancy system for laser-based VMT navigation systems in large diameter tunnelling. The system intervenes in all situations where the functioning of the primary, laser-supported navigation system is interrupted:

- in the case of exceptional environmental conditions that interfere with the laser of the navigation system, such as extreme dust, vapour or mist formation
- in the case of exceptional, temporary events that temporarily interrupt the laser, such as work on the machine
- in the case of hardware failures in the navigation system



FEATURES

- ▣ Temporary determination of position based on additional sensors
- ▣ Manual measurement possibility using control points with direct manual data entry into the navigation system
- ▣ Measurement via prisms if the electronic laser target fails
- ▣ If necessary, the navigation computer can be replaced with the TUnIS Navigation Office computer
- ▣ On-site database restore from the TUnIS Navigation Office computer

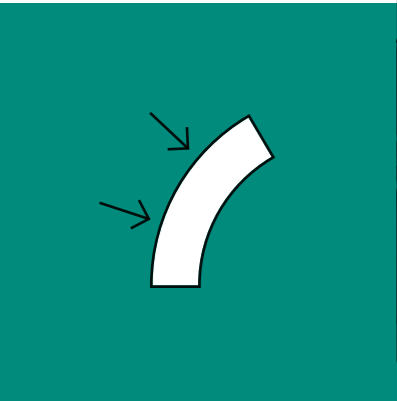
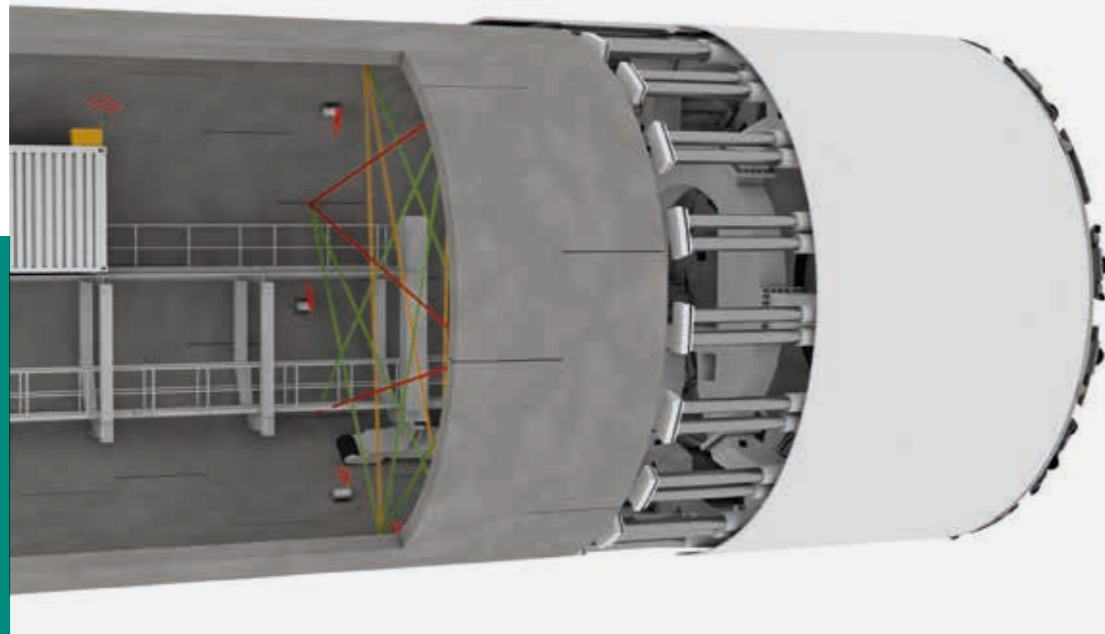


BENEFITS

- ▣ Minimisation of downtimes
- ▣ Continuous availability of current TBM position data
- ▣ Saves troubleshooting and repair time
- ▣ More flexibility for the modification of the tachymeter

complete operational redundancy





RCMS

The automatic ring convergence measuring system, RCMS, continuously and reliably determines the deformation of the rings caused by environmental forces in tunnel construction. RCMS combines all the necessary hardware and software components and, unlike other comparable systems, is specially optimised for tunnelling projects with segmental lining. Thanks to small, lightweight, reusable sensors that are easy to install and wireless operation, RCMS is quick and extremely space-saving to install.

FEATURES

- Significant precision of ± 1 mm
- Recording both of convergences and relative deformations of a ring in the form of movement vectors
- Software with comprehensive evaluation and display options
- Automatic logging and archiving of the data
- Interfaces for data evaluation and archiving in external systems

BENEFITS

- Minimisation of possible damage to the ring building by early recognition of deformations
- Minimal personnel costs due to automatic data acquisition, monitoring, logging and archiving
- Minimal cost for installation and deinstallation due to wireless communication of system components and reversible adhesion of the sensors without drilling
- Efficient performance of contractual obligations for convergence measurement and documentation, even in tight time intervals

simple & wireless

Multi Station

The Multi Station system automates the necessary control measurements for readjustment of the navigation systems. The system consists of a chain of total stations installed inside the pipeline measuring an automated polygonal line, starting from the station in the starting shaft integrated into the local fixed point network. This results in the exact position of the tunnelling machine, which is then used to readjust the navigation system.

FEATURES

- Can also be used for small diameters (less than or equal to DN 800)
- Can use already existing hardware of other VMT systems, especially the navigation computer and the data link
- Interface for data exchange with TUnIS Navigation MT

BENEFITS

- Reduction of the downtimes for control surveys
- Carrying out control surveys also possible for small diameters, in inaccessible pipes
- Significant time and cost advantages due to tunnelling larger approach lengths and curves
- Control surveys in tight time intervals increase the precision of the navigation

effective & precise

TUnIS.mono cam

The assistance system extends the possible applications of a laser-supported navigation system for controlling double shield machines. TUnIS.mono cam works photogrammetrically: a camera is installed in the gripper shield, special markers are mounted in the front shield. During operation, the system recognises the markers in the camera image and uses them to calculate the 3D position of the front shield in relation to the known position of the gripper shield.

FEATURES

- Automatic marker recognition and image evaluation
- Synchronous recording of all measurement data with high precision
- Check of roll difference between gripper and front shields
- High flexibility for installation: in or against the direction of advance

BENEFITS

- Complete 3D measurement system: easy, quick, space saving set-up
- Reduction of maintenance costs by dispensing with sensitive, expensive sensors
- Use also in tight curves possible due to the increased field of vision in comparison with laser-based systems

easy set-up

Sensors & Infrastructure

Aim.X

Aim.X is an active, electronic laser target (target unit) for determination of the position of a TBM. The laser target is mounted on a bracket on the body of the TBM; then its position is determined precisely. During operation, a sensor receives the laser beam and determines the point of incidence in the horizontal and vertical directions. In addition, using a two-axis inclinometer, the roll and inclination measurements are performed. The spatial position of the TBM ultimately results from this.



BENEFITS

- ▣ Can also be used for very tight alignment radii due to the large working range of the yaw angle
- ▣ Also suitable for small TBMs due to narrow laser window and space-saving bracket
- ▣ Modular design ensures cost-effective maintenance
- ▣ LED status indicator makes fault clearance easier

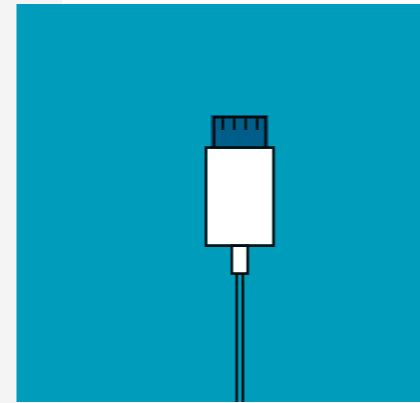
VMT Anti-Vibration bracket

This anti-vibration bracket is a base plate for a total station equipped with vibration damping elements: several damping elements connected in parallel and in series reduce the vibrations transmitted to the total station. As a result, the total station has a stable position with correspondingly high measurement accuracy. Replaceable damping elements with specific characteristics allow use for many different types of vibration.



BENEFITS

- ▣ Quick, easy mounting thanks to appropriate wall bracket
- ▣ Damping of vibrations to a minimum increases measurement accuracy to a maximum
- ▣ High advance speed due to small measurement tolerances



VMT.connect

VMT.connect is a uniform hardware platform that can be used with all VMT navigation systems. It connects the VMT hardware with the VMT software:

- The VMT.connect main board provides interfaces for the connection of all VMT products
- The special embedded Linux operating system ensures stable connection of hardware and software



BENEFITS

- ▣ High level of reuse due to compatibility with all VMT components
- ▣ Maximum compatibility of all VMT components guaranteed
- ▣ Simplified installation, configuration and maintenance
- ▣ Simple status query with TUnIS app (Healthdata)
- ▣ Use of current industry standards: ready for Industry 4.0 communication

TSX.connect

TSX.connect is a wireless communication unit between the total station installed on the tunnel wall and an access point – usually the VMT.connect switch box directly on the TBM.

TSX.connect provides the connection between the total station and a software application – mainly the VMT software TUnIS. In addition to the transmission of the commands and responses between total station and the software, the TSX.connect unit also provides the power supply for the total station.



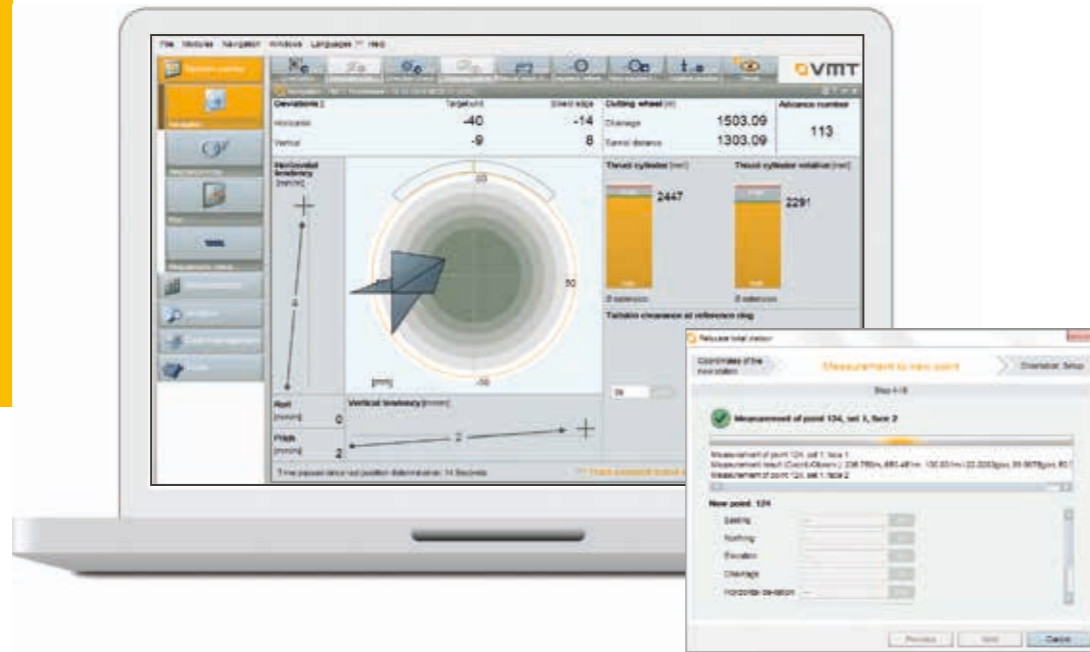
BENEFITS

- ▣ No cabling necessary between total station and TBM
- ▣ Low weight, simplified installation when moving the total station
- ▣ Uniform, simple status query with mobile app (Healthdata)
- ▣ Integration of new features via firmware updates without hardware adjustments

Service & Support

TUnIS.training center

The TUnIS.training centre is a version of the TUnIS navigation software specially adapted for training purposes for how it is used on single shield TBMs. It allows comprehensive training in any training room with an individual workplace for each participant. In its latest version, the training software can now fully simulate the functions of a connected total station. The participants can train all navigation assistants far away from tunnel and TBM without connected hardware: Orientation, direction check, total station relocation, measuring segment reference prisms. A simulator creates plausible measured values and applies small measurement errors to them. By “playing” with the tolerances for the respective actions, the training participants can successfully run through the individual Assistants for the respective actions or consciously let them fail, hence collecting practical experience before the actual tunnelling even begins.



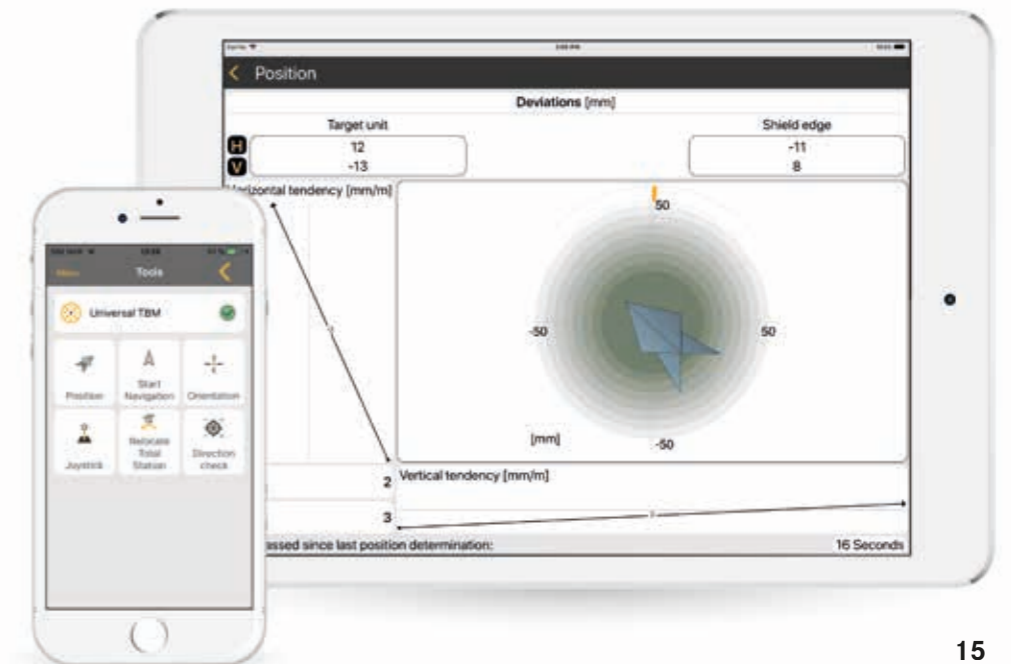
TUnIS.mobile app

This app has been developed for tablets and smartphones for operation of the TUnIS navigation systems in large diameter tunnelling away from the control cabin. With the TUnIS.mobile app, the operator can perform all important routine work on the total station directly on site and from the ground, without having to repeatedly return to the control cabin or climb to the total station. This means significant time saving and increased work safety. The tablet or smartphone with the app (iOS and Android) must be in the WLAN of the navigation system and have been registered once on the navigation system. As with operation on a PC, all measured data are stored directly in the TUnIS database.



Our Customer Service: As near and local as possible

VMT recognised the potential significance of the Asia-Pacific region more than 10 years ago and reacted with the establishment of its subsidiaries in Shanghai and Melbourne. In order to optimally support current and future projects and to support customers locally with the accustomed VMT service, VMT has now also opened permanent agencies in Singapore and New Delhi. Our competent local employees actively promote VMT in their respective regions. They can rely on the support and assistance of the headquarters in Germany anytime.



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