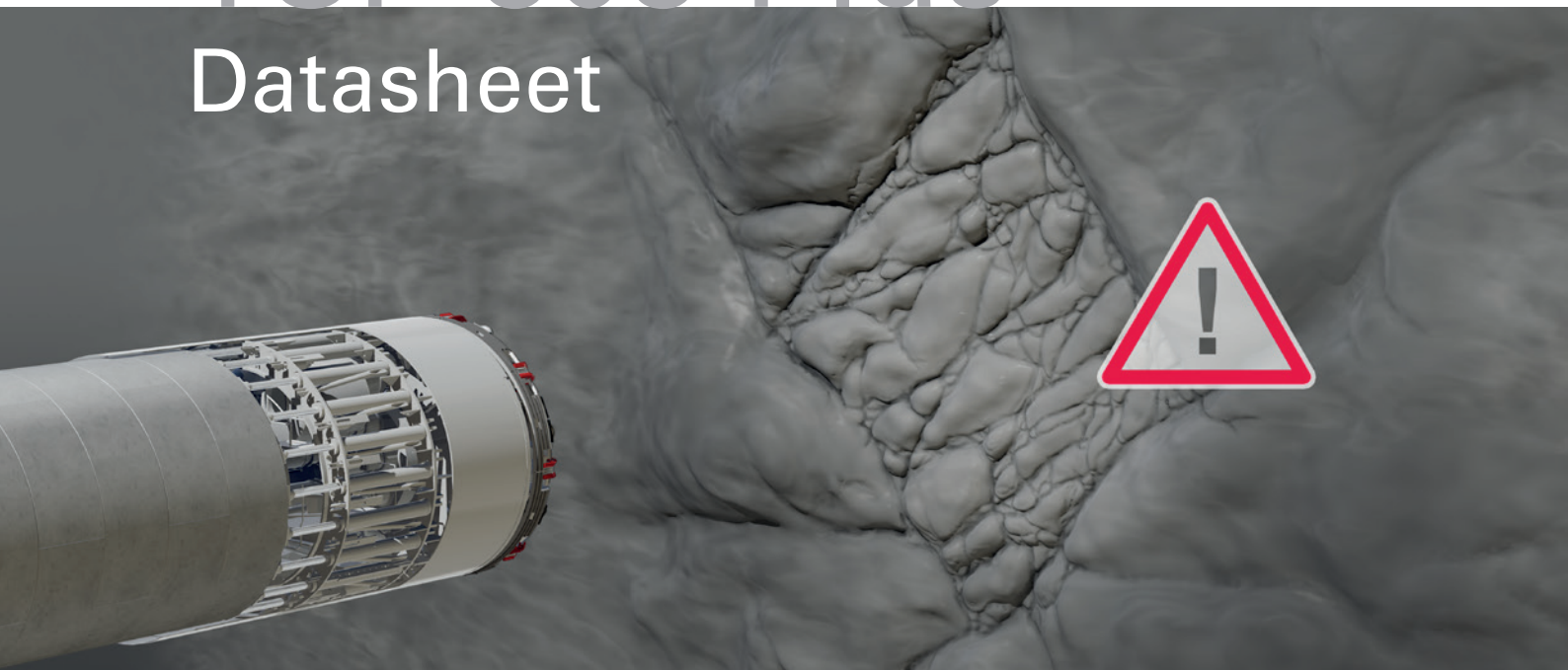


# TSP 303 Plus

## Datasheet



### **TSP Tunnel Seismic Prediction – The proven method**

The TSP 303 Plus is designed for geological prediction in conventional tunnelling methods as well as in gripper & shield TBM headings. Get full 3D geological prediction results and comprehensive reports within a few hours on-site.

Your benefits at a glance:

#### **Performance**

- Investigation range about 150 from face
- Measurement time less than 1.5 h
- Results on site within 3 h

#### **Cost savings**

- Reduction of probe drillings
- Minimised down time

#### **Operational benefits**

- Increased work safety
- Timely planning for countermeasures

#### **System operation**

- “Ready-to-use” system
- Simple installation within 30 min
- Easy to operate by site engineers
- Clear and comprehensive reports and 3D graphics



The TSP 303 Plus comes in easy-to-carry, water and dust proof boxes designed for the conditions of underground construction. The complete system package consists of

- TSP 303 Plus Recording Unit
- TSP 303 Receiver Units
- TSP 303 Accessories
- TSP 303 Consumables

# TSP 303 Plus – System Hardware



## TSP 303 General Specifications

Temperature range operat./storage	0 to +45°C / -10 to +60°C
Protection code operat./storage	IP 64 / IP 67

## TSP 303 Plus Recording Unit

# receiver input sockets	8
# channels	24
Sample frequency	16 / 24 / 48 kHz
Baseband bandwidth	8000 Hz
Record length	500 / 1000 ms
A/D conversion	24 bit/channel
Max. input signal / dynamic range	10 Vpp / 120 dB
Power supply (removable for air flights)	Li-Ion 11.1 VDC, 4.7 Ah
Power charger	230/110 VAC, 50/60 Hz
Operation time	>5 h
Dimensions and weight	486 x 392 x 192 mm, 8.3 kg
Laptop computer	Panasonic Toughbook CF-31 w / 8 GB RAM
Operation time and weight	approx. 12 h, 3.7 kg

## TSP 303 Receiver Units

4 tri-axial sensors	
▪ Sensitivity	1000 mV/g
▪ Frequency range	0.5 to 5000 Hz ± 5%
▪ Resonance frequency	> 20 kHz
▪ Transverse sensitivity	≤ 5 %
▪ Overload limit (shock)	± 5000 g pk
▪ Temperature range (operat.)	-29 to +77°C
2 transport boxes incl. 2 receiver units & cable drums & setting tools each	
Box dimensions and weight	524 x 429 x 206 mm, 16.5 kg
2 transport bags incl. protective tubes & installation tubes for 2 receiver units	
Bag dimensions and weight	900 x 200 x 110 mm, 5.5 kg

## TSP 303 Accessories

Trigger box with test resistor	
▪ Ignition current sensitivity/accuracy	10 A / 10 µs
Trigger cable on drum	length 10 m
Shooting wire on drum	length 50 m
Leica DISTO™ laser distance meter	up to 200 m / accuracy ±1 mm
SwissLevel digital slope meter	0-90 degree / accuracy 0.1 degree
LED Lenser torch	200 lm / lighting duration > 60 h
Victorinox SwissTool Plus	multifunction tool kit, 38 functions
Folding meter	range 3 m
Transport box incl. above mentioned items & electrical chargers	
Dimensions and weight	524 x 429 x 206 mm, 11.5 kg

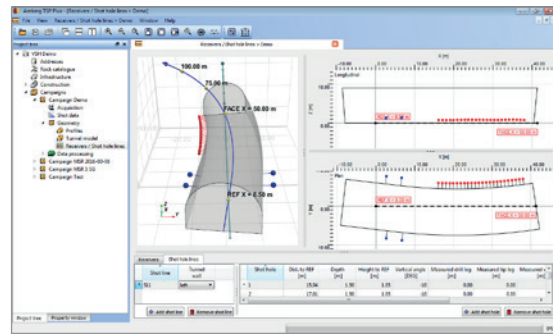
## TSP 303 Consumables

SeisBond	
▪ special-purpose rapid-setting cement bag (setting time <10 min.)	size ø35 x 300 mm, weight 280 g
TSPdowel	
▪ thermoplastic of utmost precision with high stiffness for excellent sensor coupling with rock mass	size ø40 x 175 mm weight 80 g

# TSP 303 Plus– System Software

## TSP 303 Project Setup & Geometry

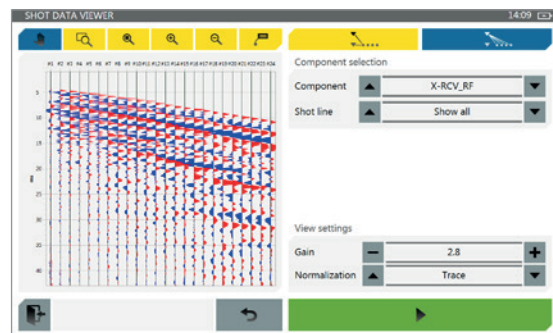
- State-of-the-art framework
- Multiple document interface with drag-and-drop positioning of sub-windows
- Clear project tree layout
- Multiple tunnel profiles (full face, top/bench heading, etc.)
  - Multiple tunnel and tunnel axes as built
  - Campaign set-up consisting of multiple surveys



Geometry setup screen

## TSP 303 Data Acquisition

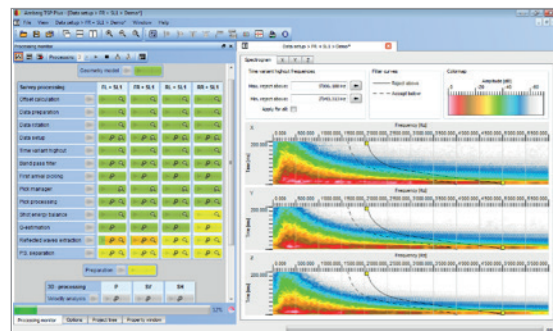
- User guided wizard for simple operation in the tunnel
- Selection of data acquisition parameters:  
48/24/16 kHz; 500/1,000 ms
- Sensor self-test
- Multiple shot line definition & assignment
- Borehole-shot assignment
- Flexible shot charge entry
- Easy noise control with indicated db-values
- Instant replay and quality check of recorded data
- Recorded data in shot or tri-axial component view



Data acquisition screen

## TSP 303 Data Processing

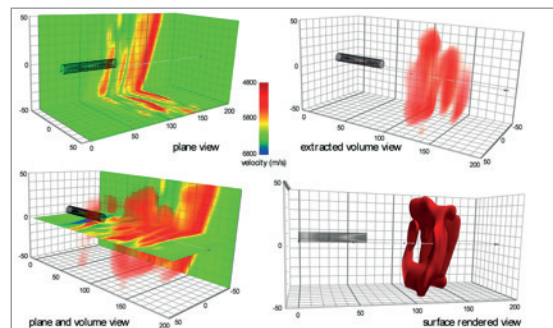
- Easy user-guided automatic processing
- Multiple processing runs for same campaign possible
- Parallel multi-core processing for simultaneous survey of all receiver-shot line combinations
- Clear and user guided processing flow chart for multiple surveys
- Real 3D offset calculation
- 3-component data rotation by inclination & azimuth
- ANR technology for airborne wave noise reduction
- Easy band pass filter parameter setting
- Signal/noise ratio computation
- Sophisticated Q-factor computation
- Adjustable Q-filtering
- State-of-the-art 3D velocity analysis
- 3D VMR technology: Automatic 3D velocity based migration & reflector extraction



Data processing screen

## TSP 303 Visualisation

- Multiple “before and after” displays of seismic data
- Flexible spectrum display at all processing steps
- Interactive 3D result presentation
- Selective longitudinal, plan or cross slice from cuboid of
  - velocity distribution
  - migration section
  - reflector extraction section
- User definable colour mapping histogram

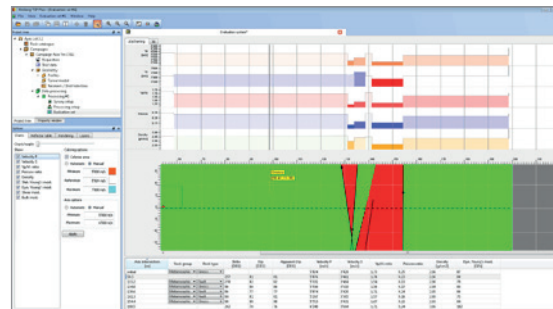


3D velocity image



## TSP 303 Evaluation

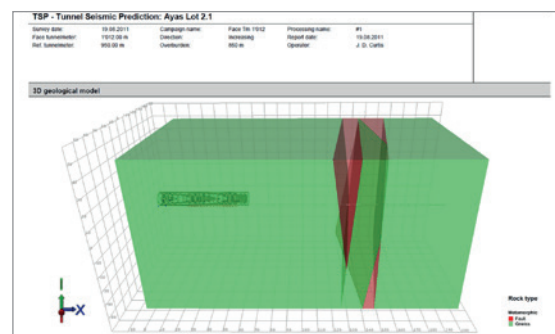
- All-in-one evaluation result for all employed receivers
- Rock catalogue:
  - comprehensive, pre-defined rock groups and rock types available
  - user-definable rock types
  - user-definable density formulas
  - user-definable rock formation assignment
- Elastic and static moduli computed in relation to actual overburden
- Rock density assignment to user-defined rock zone



Evaluation set

## TSP 303 Reporting

- Comprehensive graphical 2D and 3D result presentations of geological model and rock properties with reference to tunnel axis
- Comprehensive rock property chart:
  - Strike and Dip angles
  - Velocity P/Velocity S
  - Vp/Vs ratio
  - Poisson ratio
  - Density
  - Stat. Young's mod./Dyn. Young's modulus
  - Shear modulus
  - Bulk modulus
- Tabular presentation of rock zones with mechanical properties & geological designations within the prediction range



3D geological model



Rock properties chart

Axis intersection [m]	Rock group	Rock type	Strike [DGR]	Dip [DGR]	Velocity P [m/s]	Velocity S [m/s]	Vp/Vs ratio	Poisson ratio	Density [kg/m³]
1100	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
1101	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
1102	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
1103	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
1104	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
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1109	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90
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1200	Metamorphic	Gneiss	257.2	81.4	5104	3429	1.73	0.25	2.90

Rock properties table

Amberg Technologies has been developing specialised system solutions for the infrastructure industry for more than 35 years. The unique combination of systems development experience and industry know-how results in measurement systems characterised by precision instruments, practical system design and powerful software. Last but not least, Amberg Technologies' products have gained the trust and recognition of tunnelling and railway industry experts thanks to a worldwide service and support network.