TRACK MEASUREMENT SYSTEMS

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TRACK
MEASUREMENT
SYSTEMS

Table of Contents

STI

DIGITAL GAUGE FOR TRACK AND TURNOUTS

Digital
Reliable
Accurate
Easy-to-use

The STI digital track and turnout gauge measures track and turnout geometry. Values of all parameters are presented in the digital form on large and legible displays. The built-in memory enables the recording of measurements and sending copied data to a PC via a USB Pendrive.

The STI gauge is a lightweight, reliable, easy-to-use and very accurate device featuring a temperature compensation system. Because of its simple design and robust structure, the gauge is both durable and highly reliable.

The gauge is equipped with a solar battery enabling continuous operation and a backlit display legible even in direct sunlight.

The gauge can be supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.
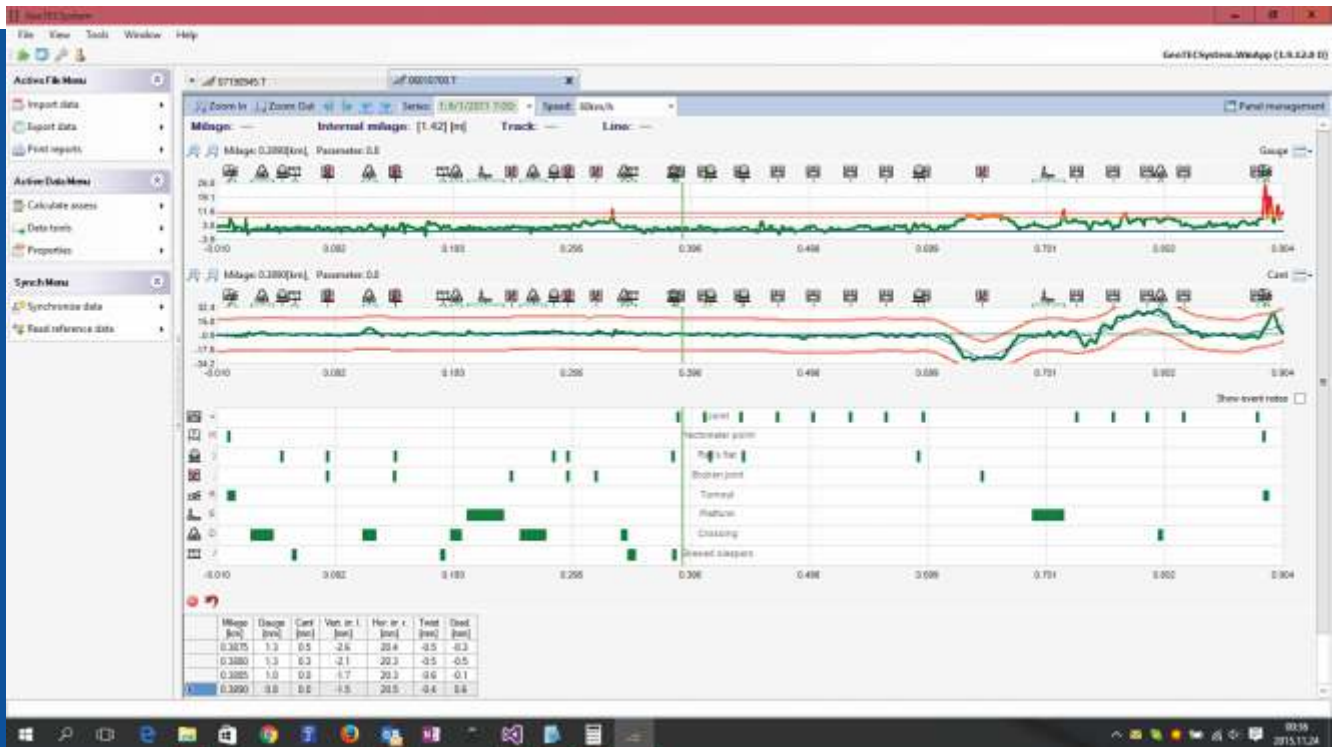
Screenshot of the GeoTEC System software

Specifications:

Measurement increment:	Defined 0.5 m; 1.0 m; 5.0 m and 10.0 m
Measured parameters:	Track gauge, cant, groove widths
Ranges:	Track gauge: -20 ÷ + 45 mm of the nominal gauge Cant: ±250mm Groove width (left and right): 26 ÷ 75 mm
Accuracy:	Track gauge: from ±0.3 mm Cant: ±0.5 mm Groove width: ±0.4 mm
Operating conditions:	Temperature: -20°C ÷ +45C Humidity: 15 ÷ 85%, no condensation
Memory capacity:	8000 measurement files
Weight:	2.8 kg
Operating time:	24 h of continuous work
Availability	all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Data formats:	PDF, MS Word, MS Excel, TXT

DTG

DIGITAL TRACK
ND TURNOUT GAUGE

Turnout measurement

Track measurement

OPCJE WIDOKU POMIARU
Przechyłka nominalna
0.0
Szer. wyśw.
wzgl
Pomiar główny
dynamiczny
Poziom jasności

USTERKI
- ☐ Punkt hektometrowy
- ☐ Most, wiadukt, tunel
- ☐ Rozjazd
- ☐ Przejazd
- ☐ Peron
- ☑ Brak śrub
- ☐ Pęknięta szyna
- ☐ Podkład

The DTG digital track and turnout gauge measures track and turnout geometry. Values of all parameters are presented in the digital form on a large, legible and backlit display. The built-in memory enables the recording of measurements and sending copied data to a PC via a USB Pendrive.

The DTG gauge is a lightweight, reliable, easy-to-use and very accurate device featuring a temperature compensation system. Because of its simple design and robust structure, the gauge is both durable and highly reliable.
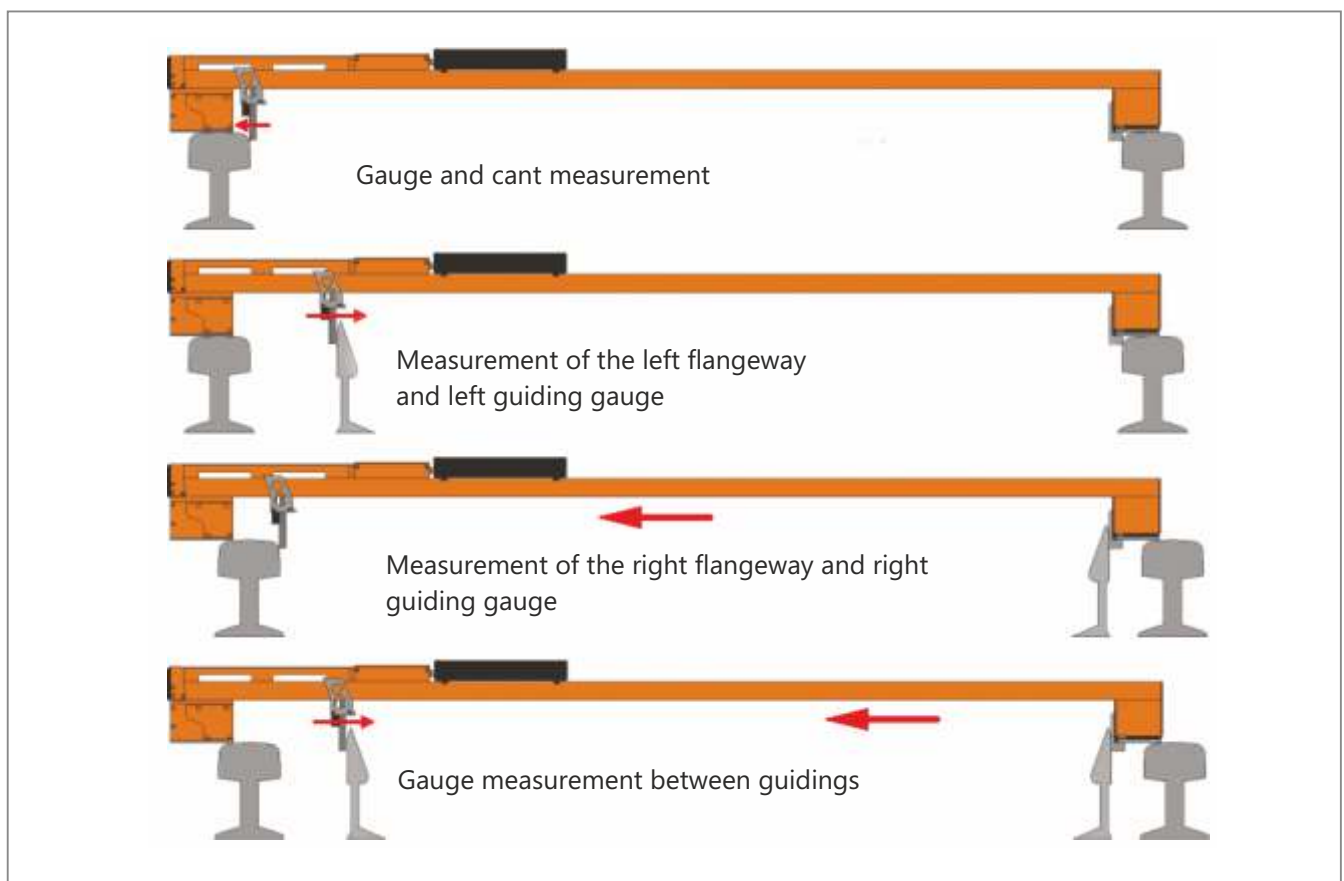
The gauge is supplied with the entire list of sets of characteristic points required by Internal Instruction Id-4.

[During measurements, the control panel is mounted on the gauge, making it possible to perform measurements and enter additional diagnostic information, including visual inspection results. The operator can define tolerances of measured parameters using the control panel keyboard. Values of measured parameters exceeding related tolerances are displayed in red.

In addition, in the turnout mode, the track gauge software prompts the sequence of measurements at characteristic points in accordance with a previously prepared set of measurement points.
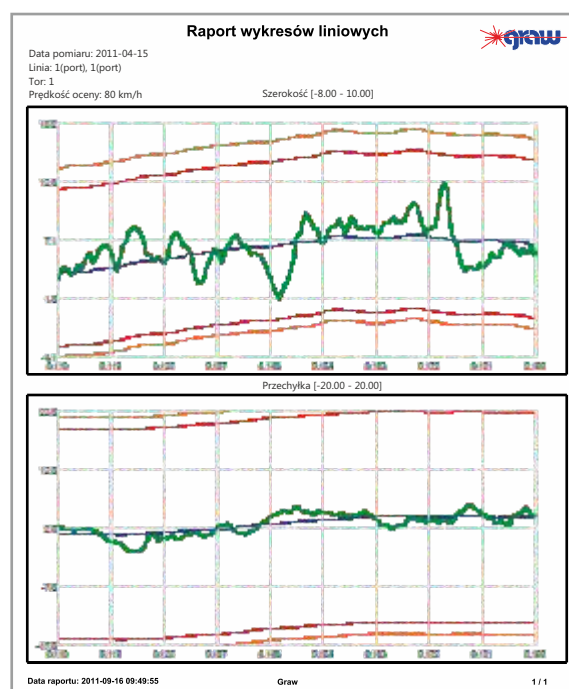
The gauge is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

In addition, the turnout module of the GeoTEC System software can be used to modify and create new sets of characteristic points, including information about measured parameters, nominal values and allowed tolerances in relation to various types of turnouts.
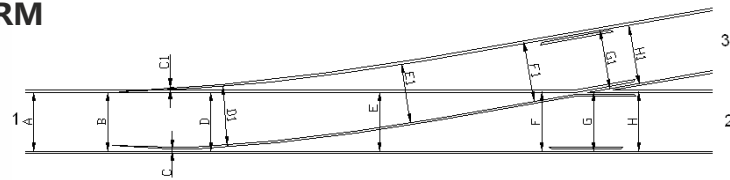
Gauge and cant measurement

Measurement of the left flangeway and left guiding gauge

Measurement of the right flangeway and right guiding gauge

Gauge measurement between guidings

DTG
DIGITAL TRACK
ND TURNOUT GAUGE

Specifications:

Measurement increment:	Defined 0.5 m; 1.0 m; 5.0 m and 10.0 m
Measured parameters:	Track gauge, cant, groove widths
Ranges:	Track gauge: -20 ÷ + 45 mm of the nominal gauge Cant: ±250mm Groove width (left and right): 26 ÷ 75 mm
Accuracy:	Track gauge: from ±0.3 mm Cant: ±0.5 mm Groove width: ±0.4 mm
Operating conditions:	Temperature: -20ºC ÷ +45C Humidity: 15 ÷ 85%, no condensation
Memory capacity:	8000 measurement files
Weight:	2.8 kg
Operating time:	24 h of continuous work
Availability all track gauges, e.g.:	914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Data formats:	PDF, MS Word, MS Excel, TXT

Examples measurements.

SWITCH ASSESSMENT RESULT FORM

Station _____

Area _-_____

Switch ID _411A_____

Design _Standaard Wissel_____

Type _NP. 46-1:5L_____

Manufacturer _____

Built in _1982_____

Taken out _2012_____

Overzicht Links Wissel

1	2														3	4
	Gauge nominal value and limits [mm]															
	A	B	C	C1	D	D1	E	E1	F	F1	G	G1	H	H1	Defects, parts for replacement and additional remarks	Signature
	1435	1435	45	45	1435	1435	1435	1435	1435	1435	1435	1435	1435	1435		
Measurement date	+15	+12	+99	+99	+15	+10	+15	+15	+8	+8	+8	+5	+8	+8		
	-5	-4	-8	-8	-4	-6	-5	-6	-5	-5	-4	-4	-5	-5		
	Cant nominal value and limits [mm]															
	0	0			0	0	0	0	0	0	0	0	0	0		
	+10	+10			+10	+10	+10	+10	+10	+10	+10	+10	+10	+10		
	-10	-10			-10	-10	-10	-10	-10	-10	-10	-10	-10	-10		
	Checked dimensions [mm]															
Meas. date 2008-03-07	1437	1434	17	56	1443	1441	1437	1438	1436	1435	1432	1434	1433	1432	Temperatuur meting: 9.9℃	
	0	-1			0	5	-6	0	-10	-3	-15	-2	-15	-3		

Screenshot of the GeoTEC System software

TEC

TRACK GEOMETRY TROLLEY

The trolley meets requirements of the EN 13848-4 standard

The trolley measures track geometry and records results of track condition visual inspections. The trolley is easy to use and has a modular design enabling its transport by one person and fixing on a track in less than 5 minutes.
In addition, the possibility of using the trolley on any track gauge significantly increases work productivity.

Measurement results such as values of width, cant, horizontal and vertical irregularities, covered distances and GPS positions are recorded in the device memory on a real-time basis. The trolley can be easily and quickly (ca. 24 kg in weight) removed from a track to allow the safe passage of trains. Measurements can be instantly resumed without calibration or zeroing.
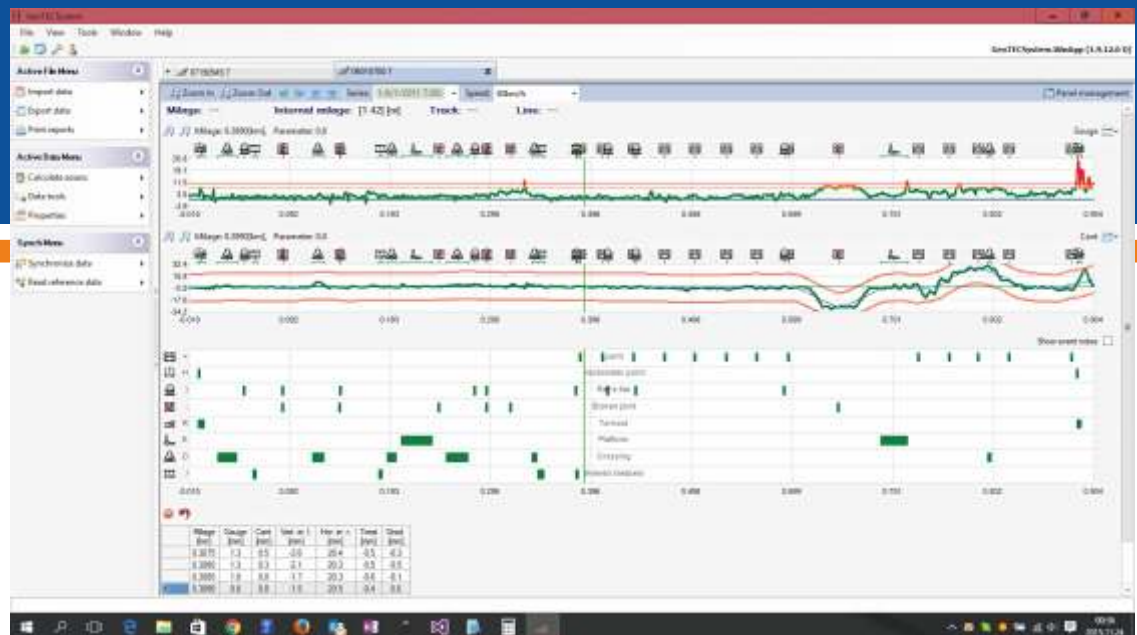
The TEC trolley meets the requirements of the EN 13848-4 standard. Measurement results generated by the trolley are consistent with the requirements of the Polish Railway Lines (PKP PLK).

The trolley is provided with a colourful backlit display and a comfortable keyboard (typical of other GRAW products). Measurement results and information about exceedings of allowed values are perfectly visible even at night. Dedicated keys of typical defects facilitate the recording and annotation of cracks in welds or rails, missing bolts, sleepers requiring replacement etc.

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

Screenshot of the GeoTEC System software

Measurement route map

TEC TRACK GEOMETRY TROLLEY

Trolley specifications:

Measured parameters	Track gauge, cant, vertical irregularities, horizontal irregularities
Measurement increment	0.5 m; 0.25 m
Ranges	Track gauge: -15 ÷ +50 mm of the nominal value Cant: ±200 mm Vertical irregularities: ±2 mm Horizontal irregularities: ±5 mm
Accuracy	Track gauge: from ±0.5 mm Cant: ±1.5 mm Vertical irregularities: ±0.2 mm Horizontal irregularities: ±0.2 mm
Operating conditions	Temperature: -20 ÷45 C Humidity: 15 ÷ 85%, no condensation
Memory capacity	60 000 km
Weight	23.6 kg
Functionality	• Trolley records the measurement route using the on-board GPS receiver • Display legible even in direct sunlight, as well as in the tunnel; visual signalling of exceedings • Durable battery lasting up to 10 hours of continuous operation (optionally, the trolley may be equipped with the hot swappable external batteries) • Transferring of the measurement data to the PC via a USB Pendrive • Software for printing measurement reports, archiving and comparing measurement results
Optionally available	replaceable batteries making continuous operation possible
Availability	The trolley is available for all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Calculated parameters	Width gradient Track twist Horizontal and vertical irregularities on a chord of up to 20 m
Data formats	PDF, MS Word, MS Excel

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

Numeric data report

Measurement date: 6/1/2017 7:48:09 AM
Line: 1 (wilczak - murawa)
Track: t2
Assessment speed: 80km/h

Parameter tolerances:
-8 < Gauge < 10
-20 < Cant < 20
-18 < Vertical irregularities left < 18
-17 < Horizontal irregularities right < 17
-16 < Twist < 16
-2 < Gradient < 2

= - Joint	H - Hectometer point	) - Rail s flat	; - Broken joint
R - Turnout	E - Platform	D - Crossing	/ - Skewed sleepers
Z - Side wear			

Milage [km]	Gauge [mm]	Cant [mm]	Vert. irr. l. [mm]	Hor. irr. r. [mm]	Twist [mm]	Grad. [mm]
0.0000	5.0	-1.7	---	---	---	0.3
0.0005	5.0	-1.8	---	---	---	0.1
0.0010	5.3	-2.1	---	---	---	-0.6
0.0015	5.1	-2.6	---	---	---	-0.9
0.0070	7.5	-1.9	-11.6	11.2	8.4	-0.8
0.0075	7.1	-0.7	-13.3	14.0	9.0	-0.3
0.0080	6.7	1.0	-14.4	15.7	10.5	1.5
#0.0085	6.8	2.5	-15.6	14.0	12.1	5.4 #
#0.0090	8.2	4.0	-16.1	13.5	12.5	11.4 #
#0.0095	12.2 #	4.2	-17.7 #	16.6	12.2	10.0 #
#0.0100	19.6 #	5.1	-19.7 #	22.5	12.6	8.8 #
#0.0105	22.2 #	7.3	-18.5 #	26.5	11.6	-0.8
#0.0110	28.4 #	9.3	-13.9	32.5 #	11.7	-11.0 #
#0.0115	21.4 #	10.0	-6.3	31.0 #	11.8	-8.7 #
#0.0120	17.4 #	10.3	-0.4	26.9	14.0	-8.8 #
#0.0125	12.7 #	11.9	5.2	21.0	15.4	0.4
#0.0130	8.6	12.6	9.8	16.7	15.2	8.7 #
#0.0135	13.1 #	14.2	13.9	18.9	14.0	6.1 #
#0.0140	17.3 #	15.8	16.0	19.2	13.5	2.0
#0.0145	19.2 #	18.2	20.1 #	15.2	13.9	-0.8
#0.0150	19.3 #	20.5	24.6 #	8.1	12.7	-2.2 #
#0.0155	18.4 #	22.5	26.4 #	1.1	12.1	-5.0 #
#0.0235	6.7	7.1	-8.0	51.0 #	-12.8	3.0 #
#0.0240	8.4	5.1	-5.5	42.7 #	-12.2	1.8

Report date: 2/22/2016 9:57:49 AM **GRAW** **1/40**

Measurement results may be viewed and reported in graphical and tabular formats.

TEE

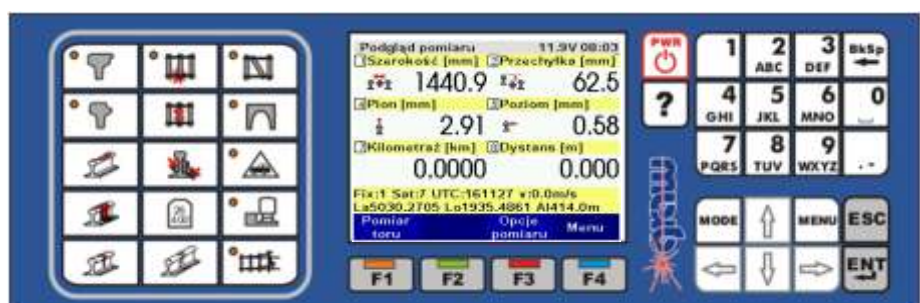## TROLLEY FOR TRACK AND TURNOUT GEOMETRY

The trolley meets requirements of the EN 13848-4 standard

The trolley measures track and turnout geometry as well as records results of track condition visual inspections. The trolley is easy to use and has a modular design enabling its transport by one person and fixing on a track in less than 5 minutes. In addition, the possibility of using the trolley on any track gauge significantly increases work productivity.

Measurement results such as values of width, cant, horizontal and vertical irregularities, covered distances and GPS positions are recorded in the device memory on a real-time basis. During turnout measurements, operator activates the turnout mode enabling the recording of measurement results related to groove widths and check-rail gauges. All measured parameters are recorded using a measurement increment of 30 mm. In addition, at each characteristic point the operator can stop the trolley and save values of all parameters required in accordance with a previously prepared set of characteristic points.

The trolley can be easily and quickly (ca. 26 kg in weight) removed from a track to allow the safe passage of trains. Measurements can be instantly resumed without calibration or zeroing.

The TEC trolley meets the requirements of the EN 13848-4 standard. Measurement results generated by the trolley are consistent with the requirements of the Polish Railway Lines (PKP PLK). The trolley is supplied with the entire list of sets of characteristic points required by Internal Instruction Id-4.
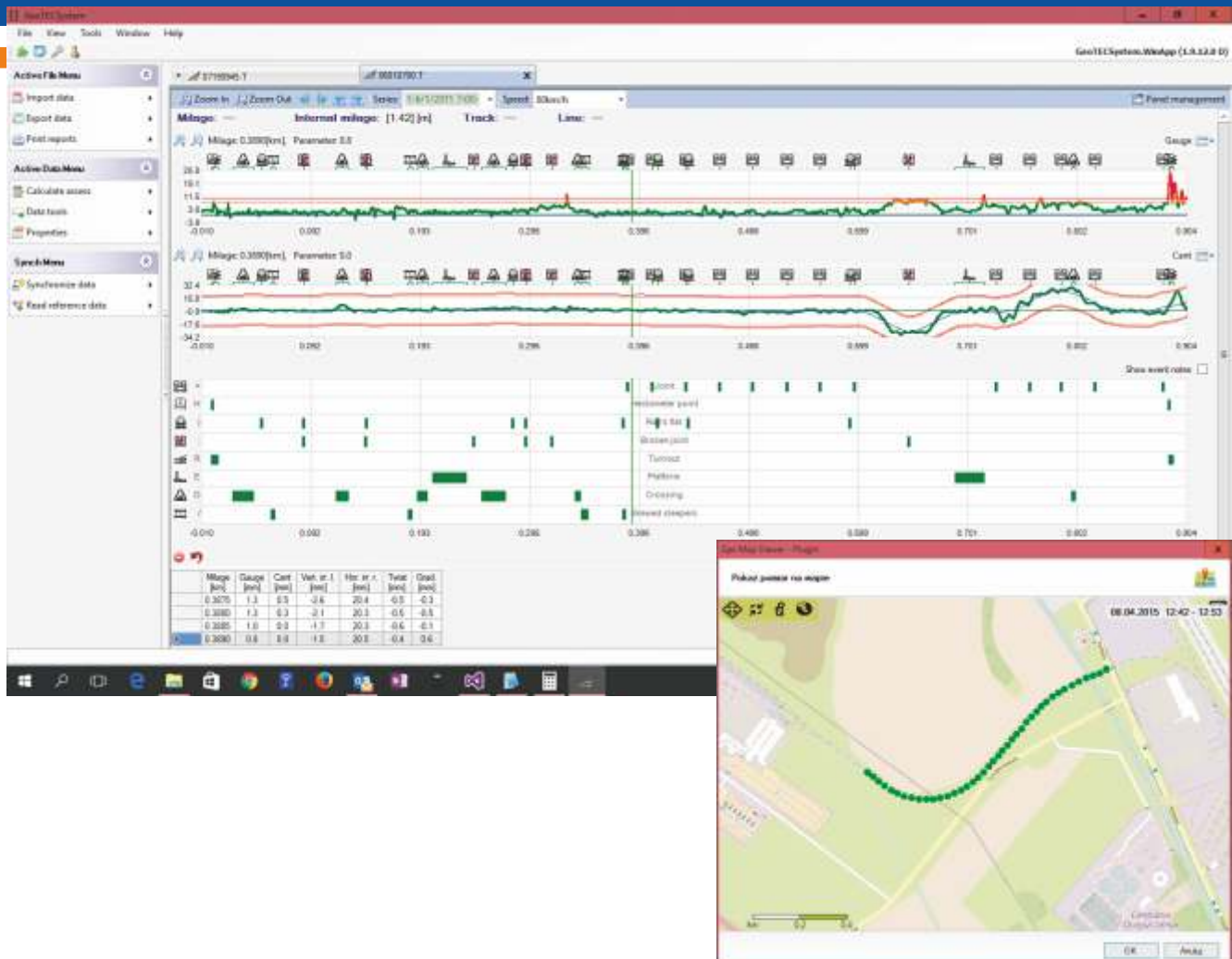
The trolley is provided with a colourful backlit display and a comfortable keyboard (typical of other GRAW products). Measurement results and information about exceedings of allowed values are perfectly visible even at night. Dedicated keys of typical defects facilitate the recording and annotation of cracks in welds or rails, missing bolts, sleepers requiring replacement, etc.

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

In addition, the turnout module of the GeoTEC System software can be used to modify and create new sets of characteristic points, including information about measured parameters, nominal values and allowed tolerances in relation to various types of turnouts.

Measurement route map

www.graw.com

TEE

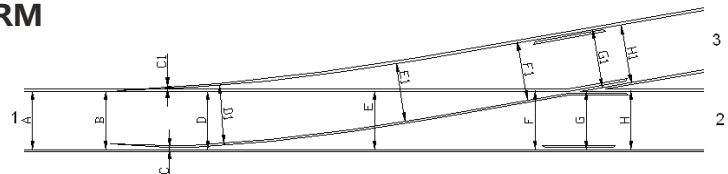## TROLLEY FOR TRACK AND TURNOUT GEOMETRY

Trolley specifications:

Measured parameters:	Track gauge, cant, vertical irregularities, horizontal irregularities grooves
Measurement increment:	0.5 m; 0.25 m (31 mm in the turnouts)
Ranges:	Track gauge: -15 ÷ +50 mm of the nominal value Cant: ±200 mm Vertical irregularities: ±2 mm Horizontal irregularities: ±5 mm Grooves: 35 ÷ 110 mm
Accuracy:	Track gauge: from ±0.5 mm Cant: ±1.5 mm Vertical irregularities: ±0.2 mm Horizontal irregularities: ±0.2 mm Grooves: ±0.5mm
Operating conditions:	Temperature: -20 ÷45 C Humidity: 15 ÷ 85%, no condensation
Memory capacity:	60 000 km (2500 km in the turnout)
Weight:	25,60 kg
Functionality:	• Trolley records the measurement route using the on-board GPS receiver • Display legible even in direct sunlight, as well as in the tunnel; visual signalling of exceedings • Durable battery lasting up to 10 hours of continuous operation (optionally, the trolley may be equipped with the hot swappable external batteries) • Transferring of the measurement data to the PC via a USB Pendrive • Software for printing measurement reports, archiving and comparing measurement results
Optionally available:	replaceable batteries making continuous operation possible
Availability:	The trolley is available for all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Calculated parameters:	Width gradient Track twist Horizontal and vertical irregularities on a chord of up to 20 m
Data formats:	PDF, MS Word, MS Excel

SWITCH ASSESSMENT RESULT FORM

Station _____

Area - _____

Switch ID _____ *411A* _____

Design _____ *Standaard Wissel* _____

Type _____ *NP. 46-1:5L* _____

Manufacturer _____

Built in _____ *1982* _____

Taken out _____ *2012* _____

Overzicht Links Wissel

1	2														3	4
	Gauge nominal value and limits [mm]															
	A	B	C	C1	D	D1	E	E1	F	F1	G	G1	H	H1		
	1435	1435	45	45	1435	1435	1435	1435	1435	1435	1435	1435	1435	1435		
Measurement date	+15	+12	+99	+99	+15	+10	+15	+15	+8	+8	+8	+5	+8	+8	Defects, parts for replacement and additional remarks	Signature
	-5	-4	-8	-8	-4	-6	-5	-6	-5	-5	-4	-4	-5	-5		
	Cant nominal value and limits [mm]															
	0	0			0	0	0	0	0	0	0	0	0	0		
	+10	+10			+10	+10	+10	+10	+10	+10	+10	+10	+10	+10		
	-10	-10			-10	-10	-10	-10	-10	-10	-10	-10	-10	-10		
	Checked dimensions [mm]															
Meas. date 2008-03-07	1437	1434	17	56	1443	1441	1437	1438	1436	1435	1432	1434	1433	1432	Temperatuur meting: 9.9℃	
	0	-1			0	5	-6	0	-10	-3	-15	-2	-15	-3		

Screenshot of the GeoTEC System software

Laser-TEC

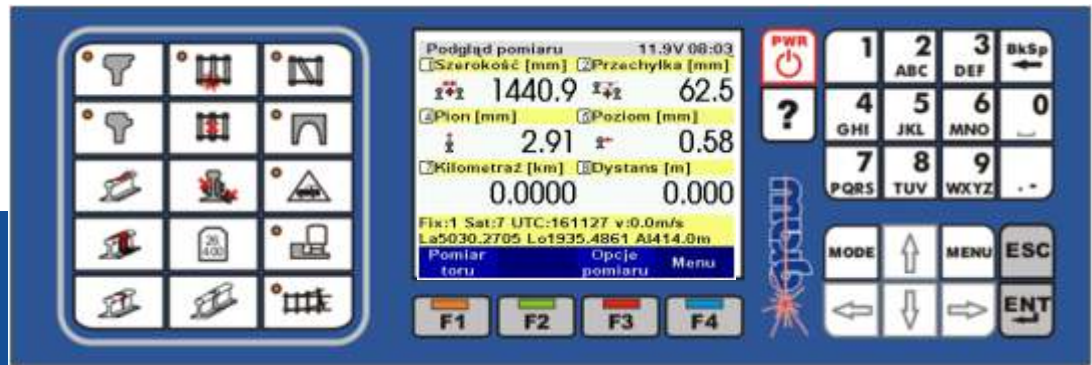## LASER TRACK AND CLEARANCE GEOMETRY TROLLEY

The trolley measures clearance and track geometry as well as records results of track condition visual inspections. The add-on provided with a laser range finder and mounted on the trolley enables measurements of structures and objects having sizes in excess of 10 mm, including, light signals, tunnels, platforms, intertrack spaces as well as the height of the contact wire, poles and other elements located within 7 metres away from the track axis. The trolley is easy to use and has a modular design enabling its transport by one person and fixing on a track in less than 5 minutes. In addition, the possibility of using the trolley on any track gauge significantly increases work productivity.

Measurement results such as values of width, cant, horizontal and vertical irregularities, covered distances and GPS positions are recorded in the device memory on a real-time basis. Clearance measurements are performed by the operator aiming the laser beam at a selected point (after stopping the trolley). After a measurement, the trolley control panel display presents the position of a point being measured in relation to the track axis. Measurement results along with locations of related objects are saved in the device memory.

The trolley can be easily and quickly (ca. 26 kg in weight) removed from a track to allow the safe passage of trains. Measurements can be instantly resumed without calibration or zeroing.

The trolley meets the requirements of the EN 13848-4 standard. Measurement results generated by the trolley are consistent with the requirements of the Polish Railway Lines (PKP PLK).

The trolley is provided with a colourful backlit display and a comfortable keyboard (typical of other GRAW products). Measurement results and information about exceedings of allowed values are perfectly visible even at night. Dedicated keys of typical defects facilitate the recording and annotation of cracks in welds or rails, missing bolts, sleepers requiring replacement etc.

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

In addition, the software makes it possible to save clearance measurement results in the DXF format, compare objects with the track clearance, automatically identify points of collision and print reports concerning rail profiles.

Measurement results

Laser-TEC
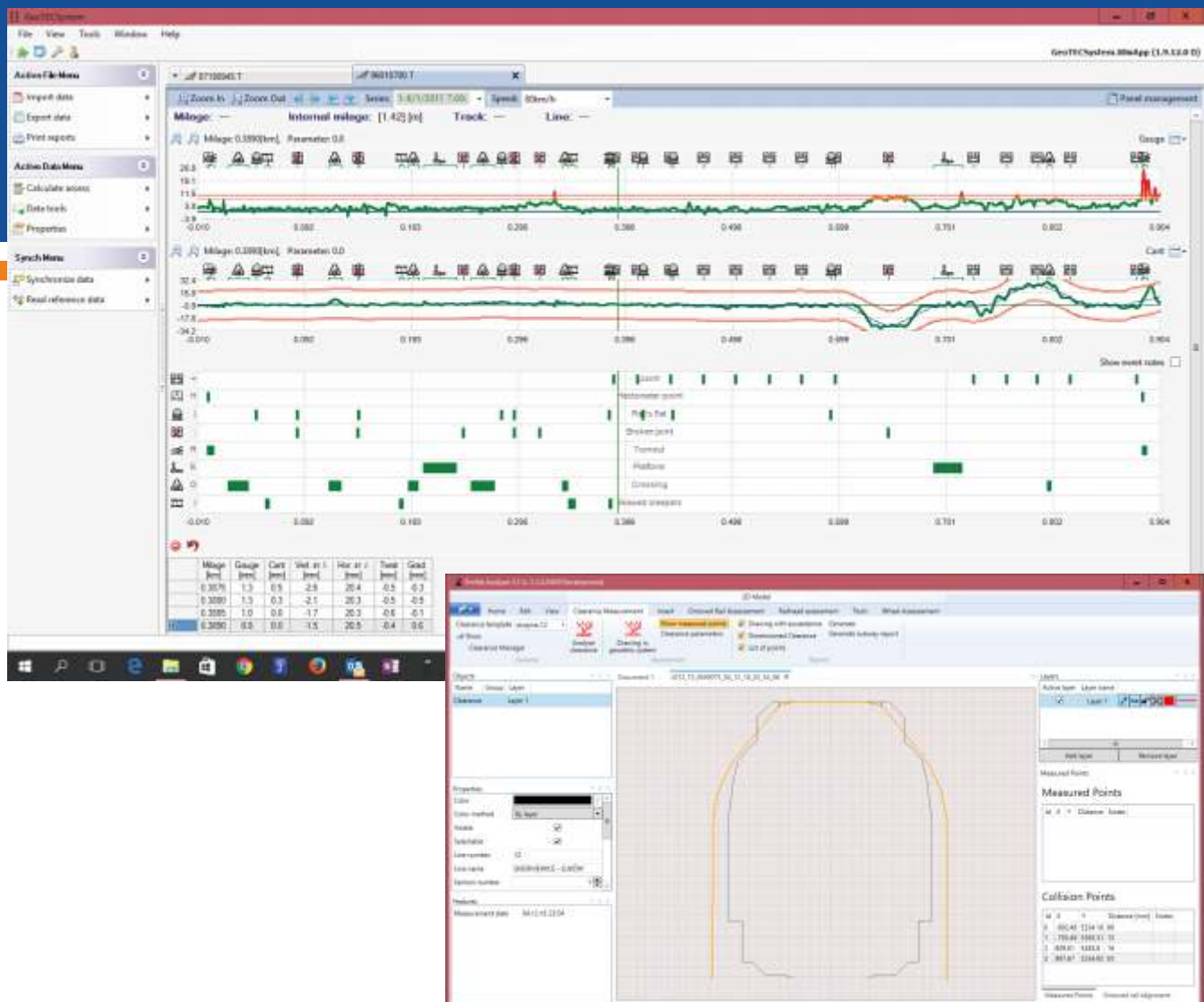
Sheet of inventory of building gauges 10.12.2016

Place and date of measurement			
Line	12 -		
Section	1		
Trail	0		
Track	2	Kilometer	75,628
Object name	Transmission bridge	Date	04.12.16 23:54
Description of the object	Gauge parameters		
Vehivle location		Cant	8,3
Bow	0		

5 km/h

clearance gauge dimension

Specyfications:

Measured parameters:	Track gauge, cant, vertical irregularities, horizontal irregularities, track clearance measurement
Measurement increment	0.5m, 0.25m
Ranges:	Track gauge: -15 ÷ +50 mm of the nominal value Cant: ±200 mm Vertical irregularities: ±2 mm Horizontal irregularities: ±5 mm Track clearance: up to 8 m
Accuracy:	Track gauge: from ±0.5 mm Cant: ±1.5 mm Vertical irregularities: ±0.2 mm Horizontal irregularities: ±0.2 mm Track clearance: ±5 mm
Operating conditions:	Temperature: -20 ÷45 C Humidity: 15 ÷ 85%, no condensation
Memory capacity:	60 000 km or 36 millions of clearance measurement points
Weight:	23.6 kg
Functionality:	• Trolley records the measurement route using the on-board GPS receiver • Display legible even in direct sunlight, as well as in the tunnel; visual signalling of exceedings • Durable battery lasting up to 10 hours of continuous operation (optionally, the trolley may be equipped with the hot swappable external batteries) • Transferring of the measurement data to the PC via a USB Pendrive • Software for printing measurement reports, archiving and comparing measurement results
Clearance measurement technology:	Laser range finder with two degrees of freedom – makes measurement possible of thin elements (even below 5 mm), like elements of railway signalisation
Optionally available:	replaceable batteries making continuous operation possible
Continuous work:	For 10 hours with fully charged battery
Availability:	The trolley is available for all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Calculated parameters:	Width gradient Track twist Horizontal and vertical irregularities on a chord of up to 20 m
Data formats:	PDF, MS Word, MS Excel, DXF

TEP TROLLEY FOR TRACK GEOMETRY MEASUREMENTS WITH LASER CAMERAS

The trolley measures track geometry as well as railway and tramway rail head profiles and records results of track condition visual inspections. The trolley is easy to use and has a modular design enabling its transport by one person and fixing on a track in less than 5 minutes. In addition, the possibility of using the trolley on any track gauge significantly increases work productivity.

The TEP trolley has the entire functionality of the TEC trolley. In addition, equipped with laser measurement head, the TEP trolley enables:

TEP trolley meets requirements of EN 13848-4 standard

o   measurements and recording of rail profiles with a measurement increment of 0.5 m,

o   overview of profiles during measurements,

o   rail profile measurements with an accuracy of ±0.3 mm

o   determination of rail wear parameters with an accuracy of ±0.3 mm

o   automatic assessment of the rail profile in the track.

The trolley is available in two versions, i.e. with one (TEP2.1) or two (TEP2.2) laser probes for rail profile measurements.

The trolley can be easily and quickly (weight ca. 30 kg) removed from a track to allow the safe passage of trains. Measurements can be instantly resumed without calibration or zeroing.

The TEC trolley meets the requirements of the EN 13848-4 standard. Measurement results generated by the trolley are consistent with the requirements of the Polish Railway Lines (PKP PLK).

The trolley is provided with a colourful backlit display and a comfortable keyboard (typical of other GRAW products). Measurement results and information about exceedings of allowed values are perfectly visible even at night. Dedicated keys of typical defects facilitate the recording and annotation of cracks in welds or rails, missing bolts, sleepers requiring replacement, etc.

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

In addition, the software enables the saving of measured profiles in the DXF format, comparing measured profiles with model profiles, automatic sizing and printing of rail profile-related reports.

Measurement route map

TEP

TROLLEY FOR TRACK GEOMETRY MEASUREMENTS WITH LASER CAMERAS

Trolley specifications:

Measured parameters:	Track gauge, cant, vertical irregularities, horizontal irregularities, horizontal and vertical rail head wear
Measurement increment:	0.5 m; 0.25 m
Ranges	Track gauge: -15 ÷ +50 mm of the nominal value Cant: ±200 mm Vertical irregularities: ±2 mm Horizontal irregularities: ±5 mm Rail profile: full rail profile
Accuracy	Track gauge: from ±0.5 mm Cant: ±1.5 mm Vertical irregularities: ±0.2 mm Horizontal irregularities: ±0.2 mm Rail profile: ±0.3mm
Operating conditions	Temperature: -20 ÷45 C Humidity: 15 ÷ 85%, no condensation
Memory capacity	1 400 km (TEP2.2) or 2 800 km (TEP2.1)
Weight	30 kg
Functionality	• Trolley records the measurement route using the on-board GPS receiver • Display legible even in direct sunlight, as well as in the tunnel; visual signalling of exceedings • Transferring of the measurement data to the PC via a USB Pendrive • Software for printing measurement reports, archiving and comparing measurement results
Profile measurement technology	Non-contact optical measurement method
Rail types:	Rails: Vignoles type, grooved, turnout elements
Continuous operation:	Replaceable batteries making continuous operation possible (about 3 hours with one set of batteries)
Availability:	The trolley is available for all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Calculated parameters:	Width gradient Track twist Horizontal and vertical irregularities on a chord of up to 20 m
Data formats:	PDF, MS Word, MS Excel, DXF

Numeric data report

Measurement date: 6/1/2017 7:48:09 AM
Line: 1 (wilczak - murawa)
Track: t2
Assessment speed: 80km/h

Parameter tolerances:
-8 < Gauge < 10
-20 < Cant < 20
-18 < Vertical irregularities left < 18
-17 < Horizontal irregularities right < 17
-16 < Twist < 16
-2 < Gradient < 2

= - Joint	**H - Hectometer point**	**) - Rail s flat**	**; - Broken joint**
R - Turnout	**E - Platform**	**D - Crossing**	**/ - Skewed sleepers**
Z - Side wear			

Milage [km]	Gauge [mm]	Cant [mm]	Vert. irr. l. [mm]	Hor. irr. r. [mm]	Twist [mm]	Grad. [mm]
0.0000	5.0	-1.7	---	---	---	0.3
0.0005	5.0	-1.8	---	---	---	0.1
0.0010	5.3	-2.1	---	---	---	-0.6
0.0015	5.1	-2.6	---	---	---	-0.9
0.0070	7.5	-1.9	-11.6	11.2	8.4	-0.8
0.0075	7.1	-0.7	-13.3	14.0	9.0	-0.3
0.0080	6.7	1.0	-14.4	15.7	10.5	1.5
#0.0085	6.8	2.5	-15.6	14.0	12.1	5.4 #
#0.0090	8.2	4.0	-16.1	13.5	12.5	11.4 #
#0.0095	12.2 #	4.2	-17.7 #	16.6	12.2	10.0 #
#0.0100	19.6 #	5.1	-19.7 #	22.5	12.6	8.8 #
#0.0105	22.2 #	7.3	-18.5 #	26.5	11.6	-0.8
#0.0110	28.4 #	9.3	-13.9	32.5 #	11.7	-11.0 #
#0.0115	21.4 #	10.0	-6.3	31.0 #	11.8	-8.7 #
#0.0120	17.4 #	10.3	-0.4	26.9	14.0	-8.8 #
#0.0125	12.7 #	11.9	5.2	21.0	15.4	0.4
#0.0130	8.6	12.6	9.8	16.7	15.2	8.7 #
#0.0135	13.1 #	14.2	13.9	18.9	14.0	6.1 #
#0.0140	17.3 #	15.8	16.0	19.2	13.5	2.0
#0.0145	19.2 #	18.2	20.1 #	15.2	13.9	-0.8
#0.0150	19.3 #	20.5	24.6 #	8.1	12.7	-2.2 #
#0.0155	18.4 #	22.5	26.4 #	1.1	12.1	-5.0 #
#0.0235	6.7	7.1	-8.0	51.0 #	-12.8	3.0 #
#0.0240	8.4	5.1	-5.5	42.7 #	-12.2	1.8

iTEC

INERTIAL TRACK GEOMETRY TROLLEY

The trolley measures track geometry and records results of track condition visual inspections. Irregularities in two planes (horizontal and vertical versines) in relation to both rails are measured using an innovative inert system consisting of cutting-edge semiconductor gyroscopes and accelerometers. A new method for measuring horizontal and vertical irregularities enables the obtainment of highly repeatable measurement results.
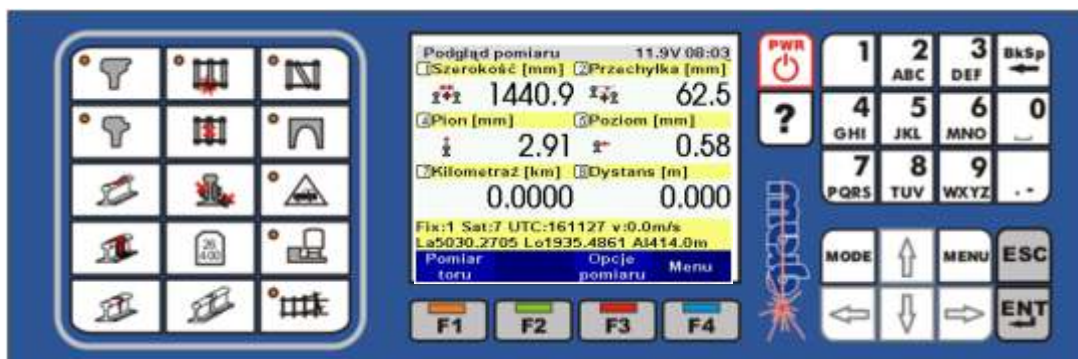

iTEC trolley meets requirements of EN 13848-4 standard.

Calculated values correspond to measurements performed using a wire versine meter or measurements made by state-of-the-art measurement cars. The trolley is easy to use and has a modular design enabling its transport by one person and fixing on a track in less than 5 minutes. In addition, the possibility of using the trolley on any track gauge significantly increases work productivity.

Track geometry measurement results such as values of width, cant, horizontal and vertical irregularities, covered distances and GPS positions are recorded in the device memory on a real-time basis. The trolley can be easily and quickly (ca. 26 kg in weight) removed from a track to allow the safe passage of trains. Measurements can be instantly resumed without calibration or zeroing.

The TEC trolley meets the requirements of the EN 13848-4 standard. Measurement results generated by the trolley are consistent with the requirements of the Polish Railway Lines (PKP PLK).

The trolley is provided with a colourful backlit display and a comfortable keyboard (typical of other GRAW products). Measurement results and information about exceedings of allowed values are perfectly visible even at night. Dedicated keys of typical defects facilitate the recording and annotation of cracks in welds or rails, missing bolts, sleepers requiring replacement etc.

The trolley control panel can be removed, facilitating the overview of results after the completion of measurements. The transfer of data to a PC is performed via a USB Pendrive.

The trolley is supplied with the GeoTEC System software (for PCs) enabling, among other things, the graphic presentation and comparison of measurement results as well as the printing of measurement reports or calculating typical track quality factors. Measurement results are also available in the tabular form containing track defect locations. Measurement data can be exported in MS Word, MS Excel and PDF formats.

Screenshot of the GeoTEC System software

iTEC

INERTIAL TRACK GEOMETRY TROLLEY

Trolley specifications:

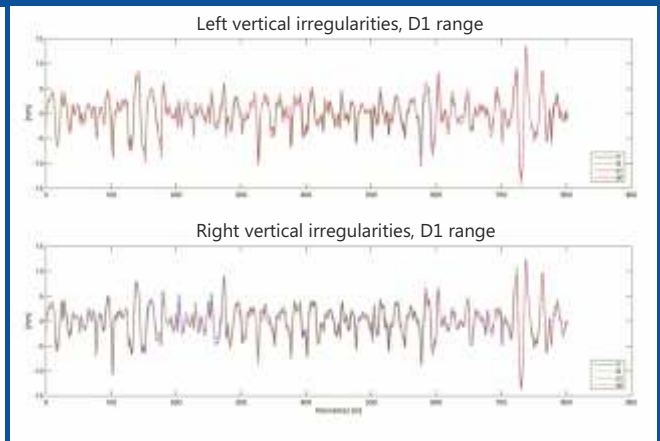|	
Measured parameters	Track gauge, cant, vertical irregularities, horizontal irregularities
Measurement increment	0.25 m
Ranges	Track gauge: -15 ÷ +50 mm of the nominal value Cant: ±200 mm Horizontal and vertical irregularities: full range
Accuracy	Track gauge: from ±0.5 mm Cant: ±1.5 mm Vertical irregularities: ±1 mm /10 m Horizontal irregularities: ±1 mm /10 m
Operating conditions	Temperature: -20 ÷45 C Humidity: 15 ÷ 85%, no condensation
Memory capacity	430 km (measurement speed 1.5 m/s)
Weight	26 kg
Functionality	• Trolley records the measurement route using the on • board GPS receiver • Display legible even in direct sunlight, as well as in the tunnel; visual signalling of exceedings • Transferring of the measurement data to the PC via a USB Pendrive • Software for printing measurement reports, archiving and comparing measurement results
Optionally available	replaceable batteries making continuous operation possible
Availability	The trolley is available for all track gauges, e.g.: 914, 1000, 1067, 1435, 1520, 1524, 1600, 1668, 1676 mm
Calculated parameters	Width gradient Track twist Horizontal and vertical irregularities on a chord of up to 25 m Alignment in D1 range Longitudinal Level in D1 range
Continuous work	replaceable batteries making continuous operation possible (about 3 hours for one set of batteries)
Data formats	PDF, MS Word, MS Excel

versines for 10 m long base

— left rail — right rail

Screenshot of PC data processing software delivered with the trolley

Left horizontal irregularities, D1 range

Right horizontal irregularities, D1 range

Left vertical irregularities, D1 range
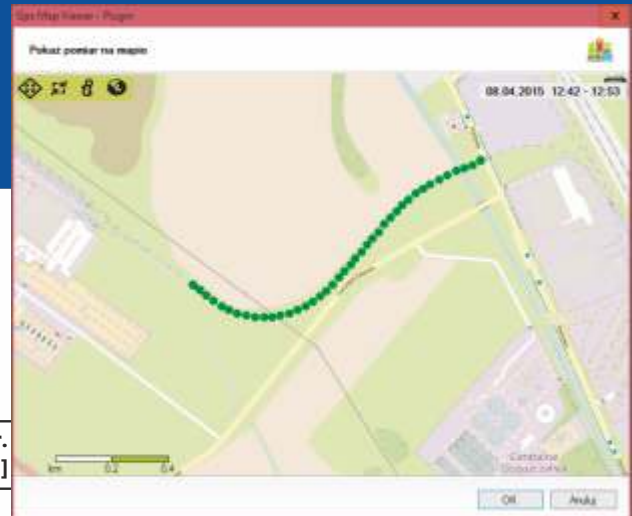
Right vertical irregularities, D1 range
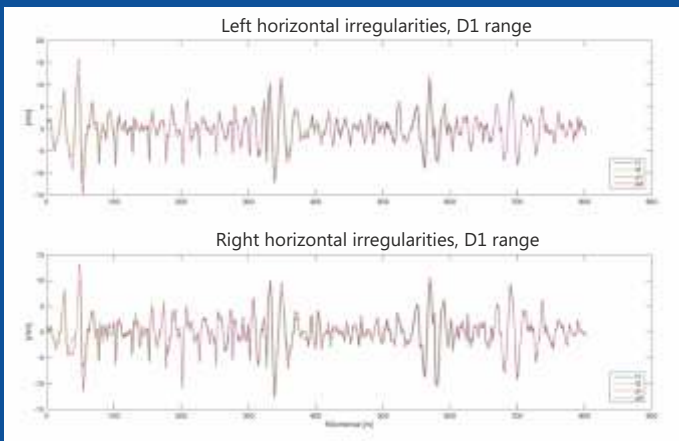
Horizontal irregularities - range D1

Vertical irregularities - range D1

Numeric data report

Measurement data: 09.06.2015 09:11:34
Line: 1 (1)
Track: 1
Parameter tolerances: 80 km/h

Mileage [km]	Gauge [mm]	Cant [mm]	Twist [mm]	Gradient [mm]	Hor. irr. L. [mm]	Hor. irr. R. [mm]						
0.0123	-1.5	5.3	-1.8	1.8	-1.3	-1.0	2.1	2.0	3.7	-1.7	4.6	-1.8
0.0125	-0.7	5.0	-0.8	1.1	-0.6	-0.7	2.2	2.0	3.9	-1.1	4.2	-1.7
0.0178	1.7	4.4	-0.7	-0.1	2.7	0.3	3.8	3.7	5.0	3.3	4.9	1.6
0.0180	1.6	4.1	-0.5	-0.2	2.6	0.3	3.9	3.7	5.0	3.3	4.6	1.4
0.0183	1.5	3.5	-0.4	-0.6	2.2	0.3	3.9	3.8	4.6	3.1	3.8	1.1
0.0185	1.6	3.0	-0.3	-1.6	1.8	0.3	4.0	3.9	4.0	2.7	3.0	0.7
#0.0188	1.6	2.9	-0.8	-2.5 #	1.2	0.4	4.0	3.9	3.3	2.0	2.7	0.4
#0.0190	1.4	2.8	-1.0	-3.3 #	0.6	0.4	4.1	4.0	2.9	1.3	3.1	0.4
#0.0193	0.9	2.6	-1.4	-3.2 #	0.0	0.4	4.1	4.1	2.9	0.4	3.7	0.7
#0.0195	0.0	2.6	-1.3	-2.2 #	-0.5	0.3	4.2	4.1	3.3	-0.3	4.4	1.1
0.0198	-0.9	2.7	-1.9	-0.7	-0.9	0.2	4.2	4.2	3.6	-0.8	4.5	1.2
0.0200	-1.9	2.9	-2.2	0.8	-1.2	0.1	4.2	4.2	3.5	-1.0	4.0	0.4

The trolley was examined by the independent railway scientific research body:
Railway Institute, Railway Track and Operation Division in Warsaw.

CIK INSTYTUT KOLEJNICTWA

X-Y

SWITCH AND RAIL PROFILE GAUGE

The X-Y Switch Profile Measurement Gauge is used for measurement of the transverse sections of switch elements in the characteristic points of frogs and half of a pair of switches. The gauge is based on the track during the measurement cycle, using the special beam as the datum. Having located the gauge in the required position, the operator guides manually the spherical measuring tip along the inspected surface and its trajectory is stored in the electronic memory that is large enough to store 30,000 measured profiles.

Digital
Lightweight
Accurate
Reliable
Rain and frost resistant

Specifications:

Operating temperature:: -20°C ÷ +45°C	Humidity: 15 + 85% (no condensation)
Weight; gauge 3.6 kg, datum beam 3.0 kg, control panel 0.8 kg	20 hours' non-stop operation with fully charged battery
Dimensions (HxWxL): gauge 240x75x685 mm; beam 165x225x1910 mm	Measurement accuracy: ±0.1 mm

The X-Y gauge makes it possible to measure virtually any switch element in the following measuring range:
X axis = 575 mm; Y axis = 110 mm with the accuracy of ±0.1 mm in each axis.

The gauge has many advantageous operational features. Its low weight (ca. 7 kg) and magnetic fixing to the track or switch elements make its quick removal from the track possible to let the train pass.

www.graw.com

The device may be used for planning the maintenance scope of switches; it is possible to work out its detailed documentation and the graphical representation of each switch wear, as well as introduction of this information to the tender documents. Results of measurements carried out with the gauge may be used for commissioning the scope and quality of repairs done by the service providers - one can illustrate the condition before and after repair with the reference profile in the background. Moreover, a possibility of presenting many profiles measured in the same transverse section of the switch during its operation makes it possible to follow its wear out developing in time.
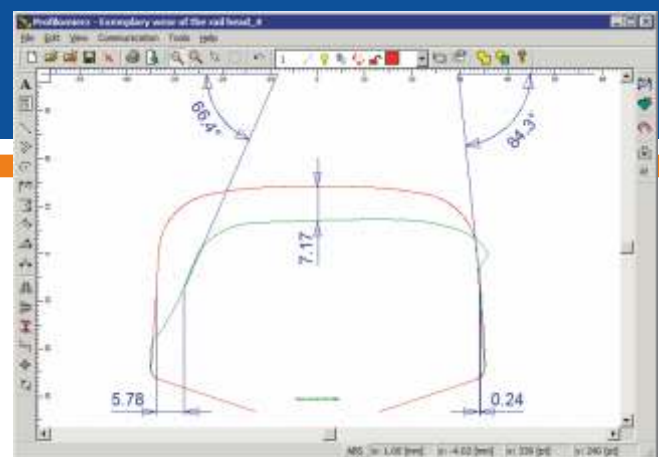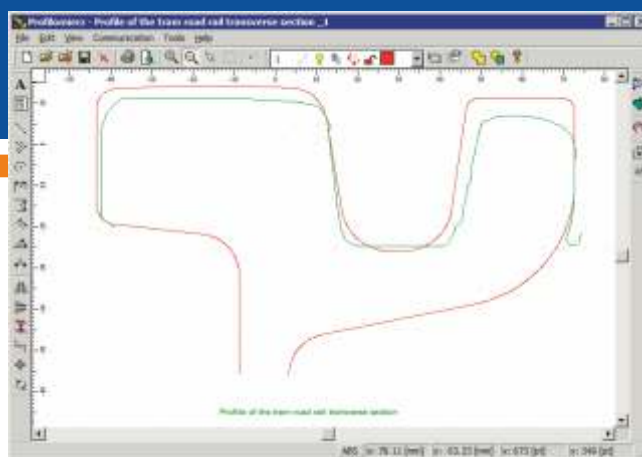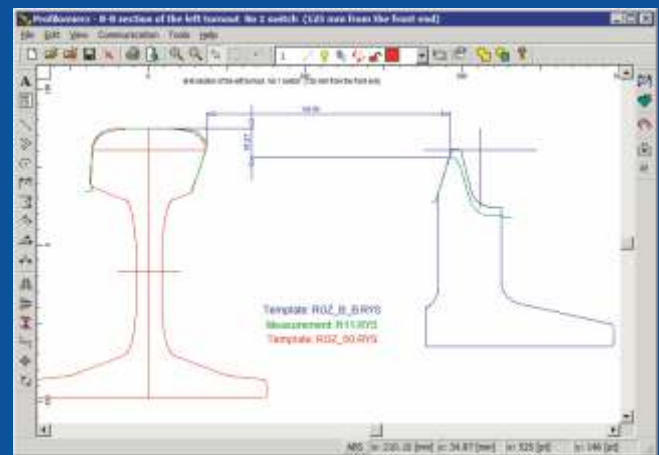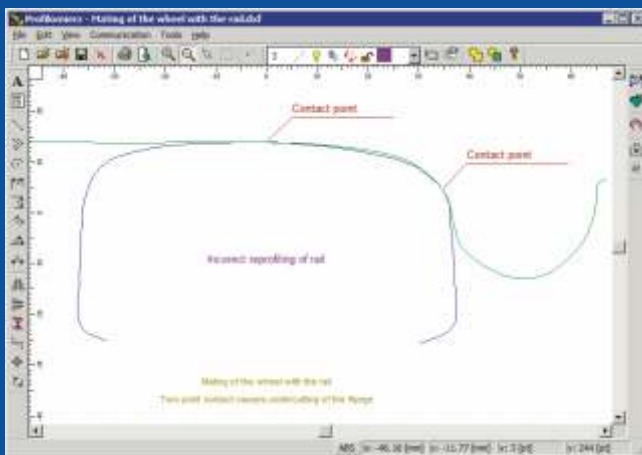
The PC software supplied with the gauge makes it possible to create the theoretical profiles for each cross sections of the switch elements, comparing the measured profiles with the theoretical ones, and comparing the profiles measured at different times. Graphical software provide features like adding dimensioning to the drawings, annotations, zooming, and many other. Measurement data upload to the PC is possible using the USB PenDrive; measured profiles may be exported as files in TXT and DXF formats.

SCORPION

LASER SCANNING SYSTEM FOR RAIL ND TURNOUTS PROFILE MEASUREMENT
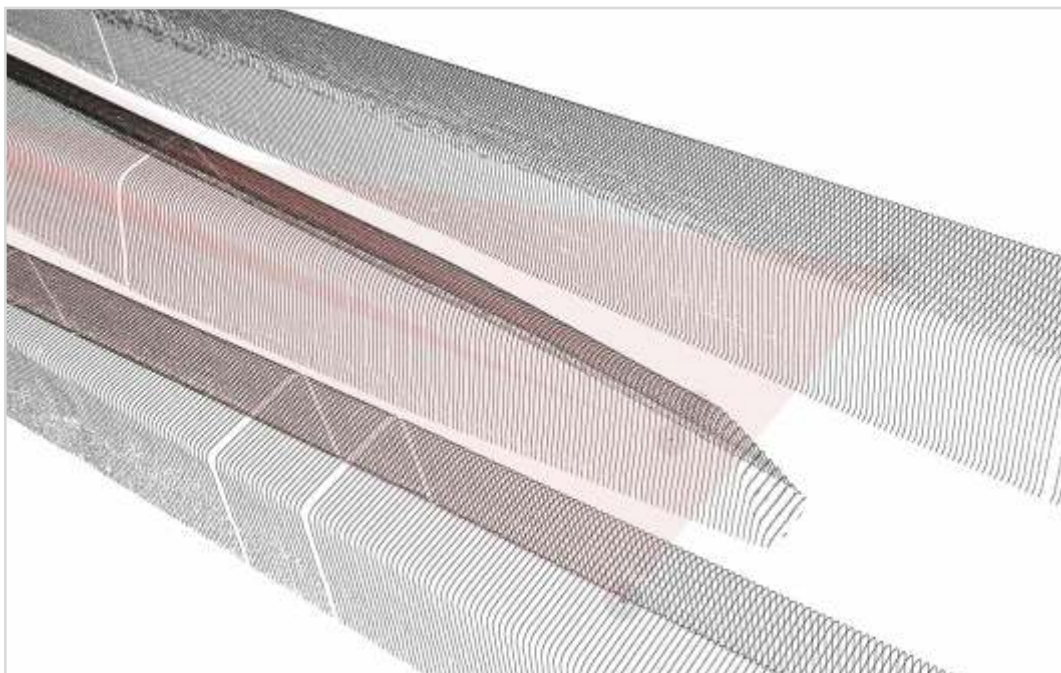
Specifications:

Description:

This laser measurement device is designed for periodic measurements of rail and turnouts profiles. The device is composed from the frame, featuring the rigid datum base, laser measurement head, measuring the shape of the inspected object, and drive system making the automatic transition of the measurement head over the inspected object possible. The measurement is carried out automatically after placing the device on the inspected element. The device control unit has the keyboard and the LCD display. Measurement results are saved in the internal memory of the device and may be transferred to the PC using the USB pen drives. The measurement result is the 3D model of the measured object, that is exact representation of the measured object both in the lateral and transverse directions. The device is delivered with the PC software making processing of the measurement results possible, including: merging of multiple measurements into one object, generating of the arbitrarily selected 2D profiles, calculation of the longitudinal profiles, generating measurement reports.

Specifications:

The device can be transported in the passenger car	Operating temperature: -10° C to 50° C
The device requires two operators	Mounting: placed freely in the inspected area, no mechanical or magnetic fixtures
Measurement range in one pass (WxHxL): 160 x 70 x 1300 mm	Operating time with one set of batteries: 2.5 h -hot swapping of batteries possible, which is equivalent to 6 - 8 complete frog measurements
One may carry out partial measurements and then merge them into a single object	
Measurement accuracy: ±0.1 mm	Memory capacity: 100 measurements
Measurement increment: 1-10mm	Data file format: DXF, CSV, ASC
Duration of a single measurement: 2min	Software: application for MS Windows - XP or newer version
Mass: frame 29 kg, measurement head 13 kg	One may enter information about the measured object location
Dimensions (WxHxL): frame 1800 x 610 x 240 mm, measurement head 560 x 300 x 320 mm	

Exemplary measurement of the crossing frog. The drawing below shows the model of the measured crossing developed with 1 mm measurement increment.

The software delivered makes it possible to recognize the particular crossing elements, i.e„ point, left and right wing rails. Based on these elements, the mathematical point of the crossing is calculated.
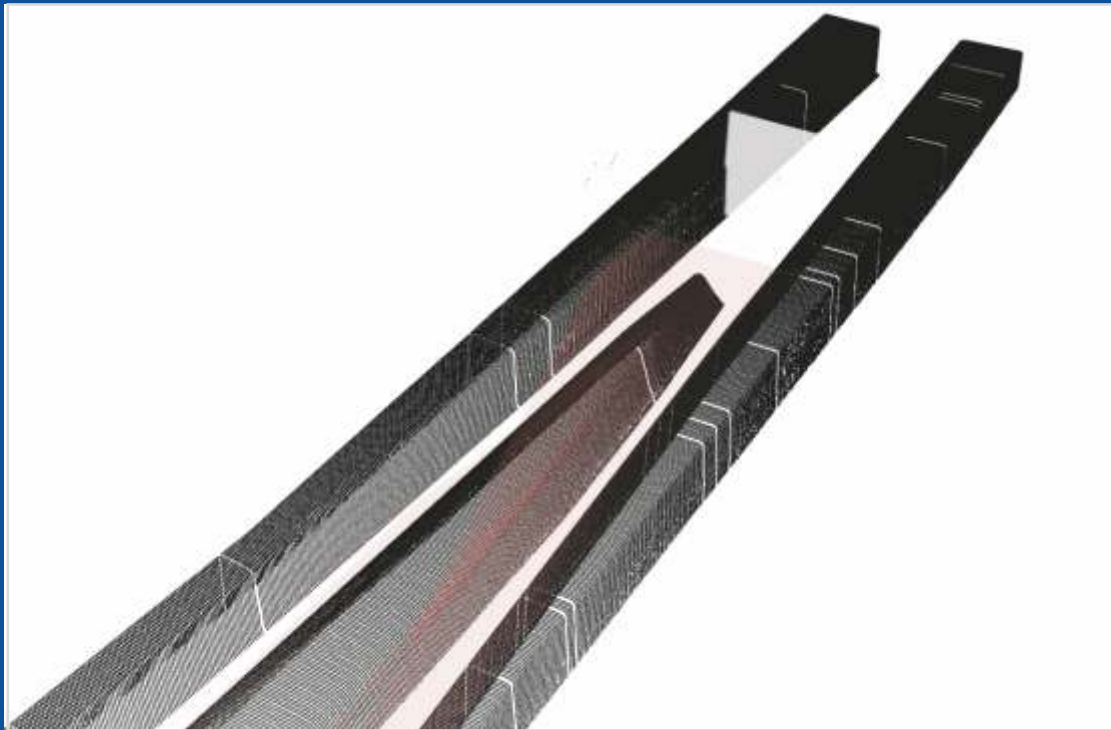
Using the 3D model, the user can acquire any transverse section profile. The section direction may be defined manually or a series of transverse sections may be generated with the particular increment along the selected virtual axis. The drawing below shows an example of the generated transverse section profile.
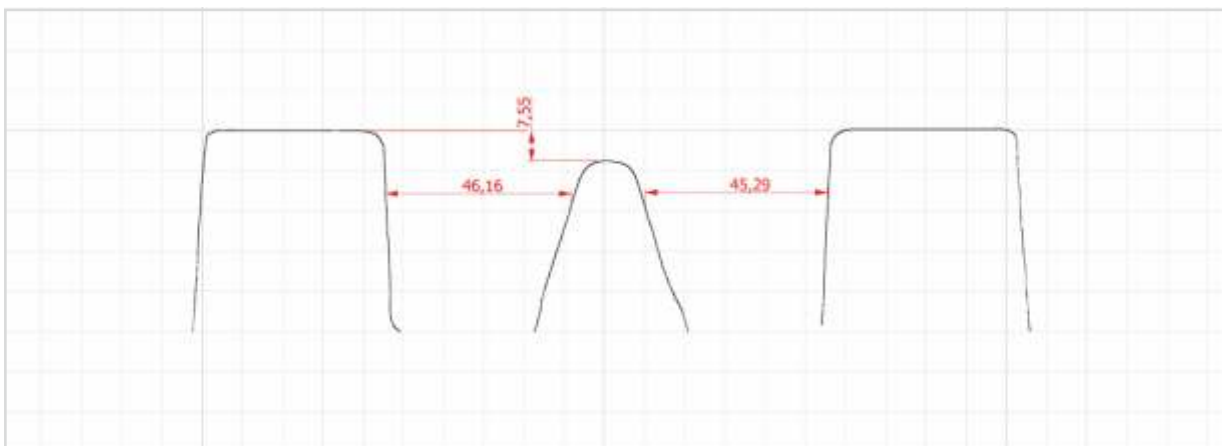
To determine the longitudinal wear of the measured elements the user may define a section (blue line below), along which the software will calculate the shape of the inspected element. This way it is possible, e.g., to determined crossing point wear in the vertical- or horizontal direction. The drawing below shows an example of the frog shape analysis.
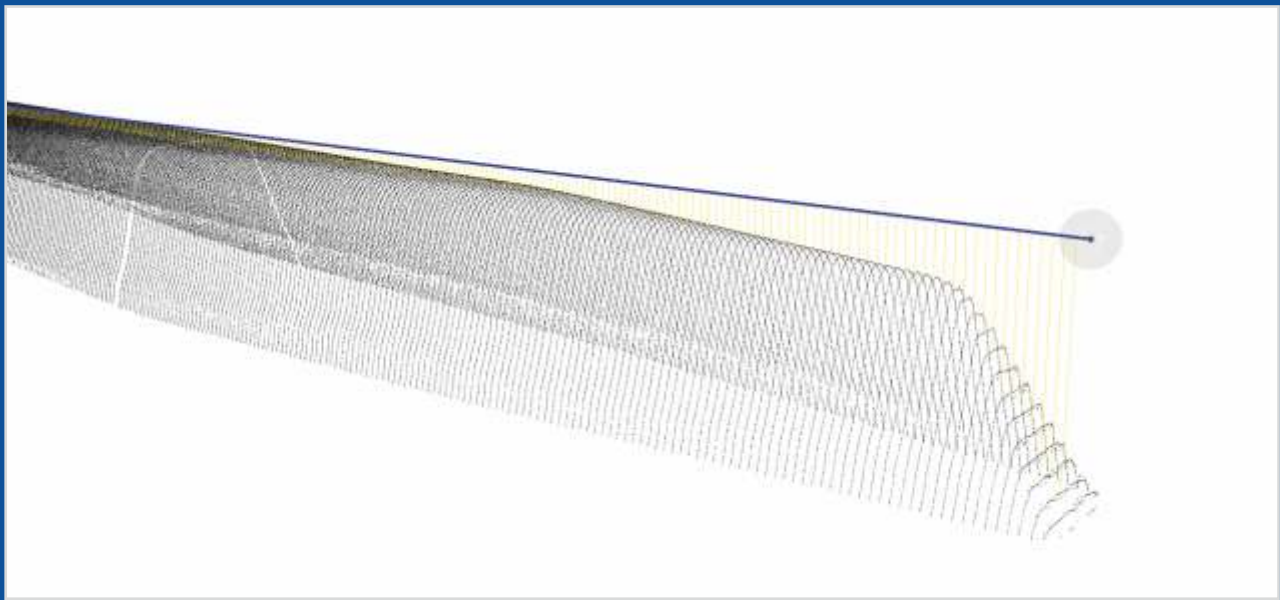
The shape calculated this way may be presented as a drawing showing the frog point profile.

TMS TURNOUT MEASUREMENT SYSTEM

Turnout geometry measurement in motion

The efficient and detailed inspection of track condition is carried out since many decades using the track recording cars with instrumentation on-board that generates an efficient, quantitative statement of known track conditions. Their equipment changed with time, reflecting the new data collection systems available - from the purely mechanical contact systems to the contemporary non-contact systems with the real time computer measurement data analysis.

TMS vehicle

The state-of-the-art inspection cars are equipped with the on-board measurement and geographic reference data systems being the main and productive tool for safety inspectors. Measuring the track geometry provides information about their current condition, yet direct access to historical data is needed to make efficient detection of potential accident-causing hazards possible. However, no geometry car could take measurements of the turnout geometry so far, and usually the readings collected by the geometry cars passing the turnout zones were masked and not taken into account in the track assessment procedure, as they would reduce the track condition evaluation results. Therefore, the important permanent way elements - turnouts - highly affecting train operation safety, were not measured automatically so far, and the safety inspectors had to rely on manual measurements in selected characteristic points only. Yet - "a switch is a track" (J. Tiecken, Volker Rail), so its detailed measurements at points located as densely as possible along the turnout appears to be the novel approach to improvement of train operation safety. GRAW, Poland, responded to this need, developing in cooperation with Volker Rail (The Netherlands) and LAP GmbH (Germany) the self propelled inspection vehicle with the following systems:

- optical laser measuring system for track and turnouts
- navigation - Differential Global Positioning System (DGPS) to determine precisely location of turnouts, track defects and other reference points
  visual track inspection

The autonomous TMS system is capable to take measurements in the turnout zone at 60 km/h with the measuring increment of 3 cm, as required by pertinent regulations. Rail types are automatically recognised, which makes it possible to evaluate their wear. Turnout types are read from the GeoTEC database, according to the actual vehicle position.

Laser optical measurement module

Turnout geometry condition is assessed according to the approach already in use in The Netherlands since 2002, based on GRAW TEE-1435 track and turnout trolleys implemented at that time; moreover, measurement of profiles is carried out now also using the virtual templates with the shapes specified by the pertinent local regulations.

Common crossing

Common crossing as measured and analysed by TMS

TMS system switches automatically from its track- to turnout measurement mode based on GPS reading. All measurement data is stored in the on-board database, from which it is uploaded to the main GRAW GeoTEC database accessible to the infrastructure maintenance engineers.


On-board visual inspection system stores images of tracks and turnouts

TMS

TURNOUT MEASUREMENT SYSTEM

TMS system measures the following parameters:

Measured parameters	Switch	Track	Crossing
Rail slope			
Profile measurement			
Vertical wear			
Horizontal wear			
Percentage of the rail head wear			
Gauge			
Stock rail wea			
Blade wear			
Measurement of flangeways			
Gap between open blade and stock rail			
Check rail gauge			
Cant			

Nearly entire Dutch railway network definition is stored in GeoTEC system, so new measurement data can be automatically assigned to the track segments or turnouts identified by their geographical position. Remote access over GPRS/EDGE/UMTS to the vehicle's measurement system supports remote software maintenance and/or access to themeasurements currently carried out. The system operation is fully automatic, as it finds its location after turning power supply on and next it begins measurements switching between the measurement modes.


0.003375|−15.342721 [km] 3.8.2008
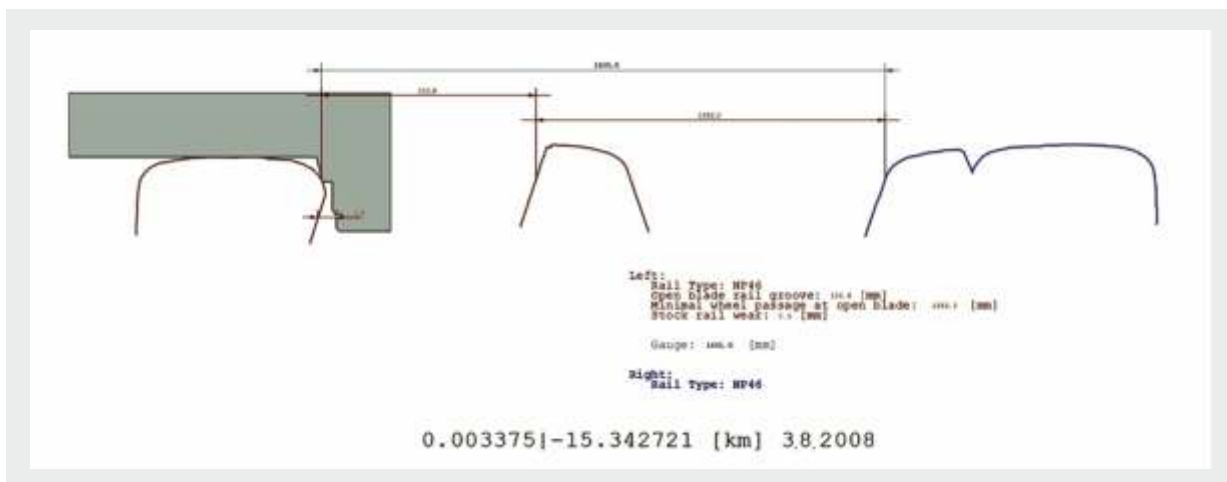
Example of turnout geometry analysis using MAL-1 template
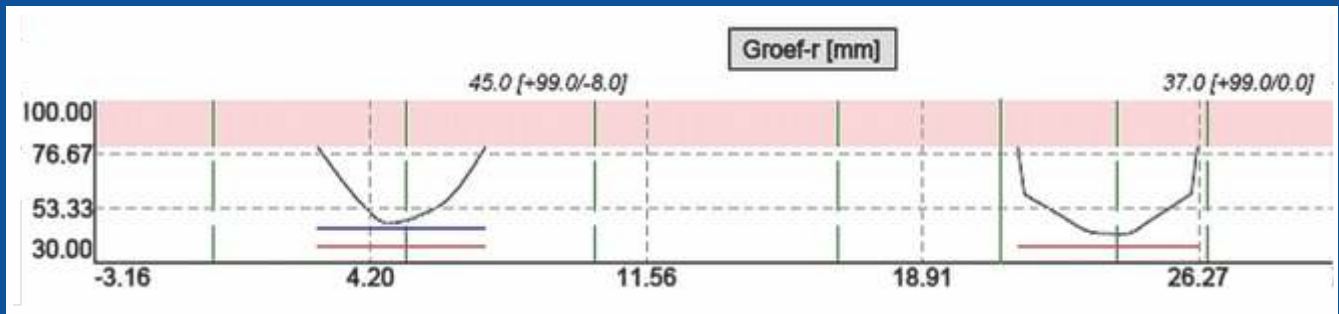
Example of the measured turnout geometry analysis made with TMS software

The system can generate measurement reports, lists of defects to repair, and verify quality of maintenance work carried out. Employment of the TMS system is a breakthrough in turnouts condition assessment cutting time between consecutive measurements, their analyses and upload their results to the main database for use in track and turnouts improvements and repairs.
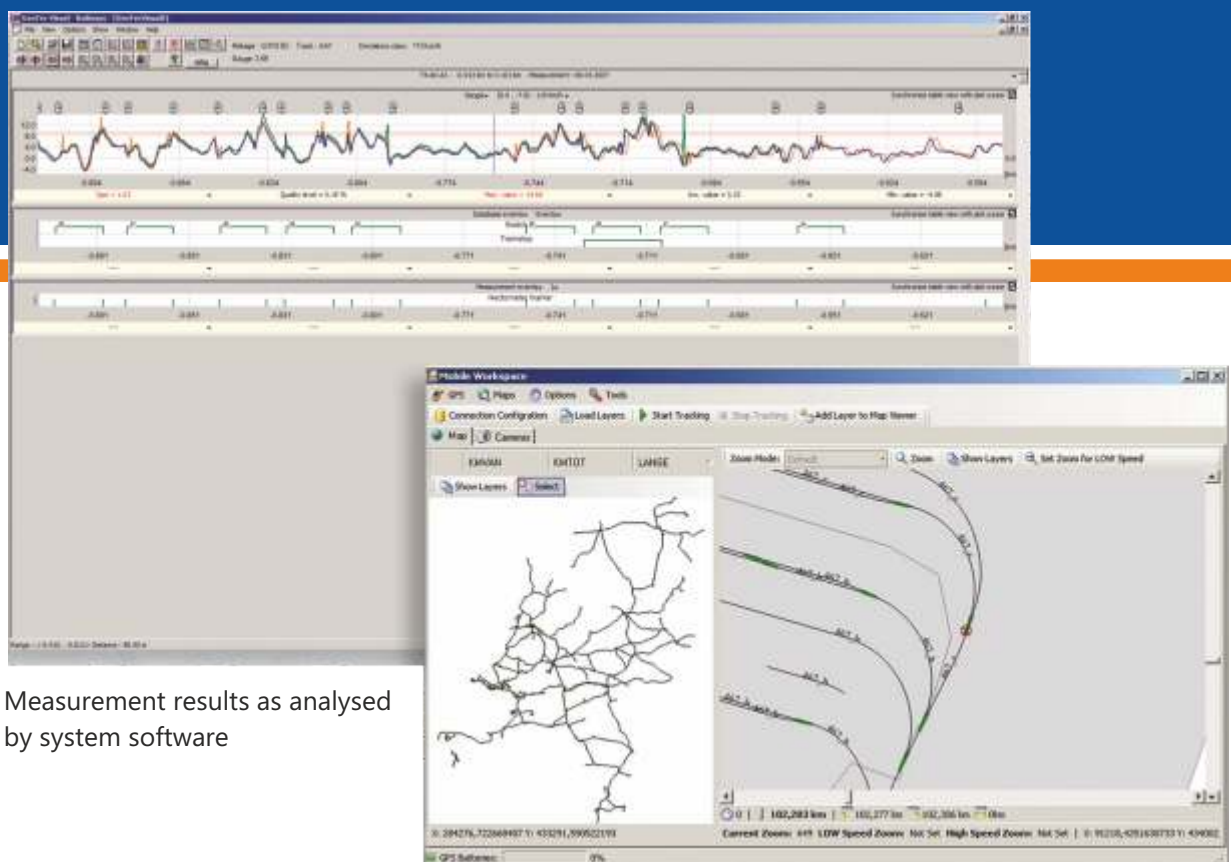
Measurement results as analysed by system software

Dutch Railways network schema parsed by moving TMS in service

Video Inspection

The video systems inspection allow to record the infrastructure condition during the passage of a train and then to carry out inspections of the track in the office. Such an approach is equivalent to the standard inspections, except that the train can record data at high speeds, without disturbing the typical traffic of trains and without affecting the railway line safety systems. Collecting the results by the inspection train and subsequent image processing in the office makes the inspection much more efficient and eliminates the need to maintain a significant amount of staff in the infrastructure. One of the most important aspects of the implementation of video inspection is implementation of such system into the structure and processes of the company. Many years of experience show clearly that in addition to the efficient train on-board computer system, it is important to implement the efficient IT system, making it possible to control and process efficiently the huge amount of the collected measurement data.

The main functionality of such system is provided by the following modules:

» checking the inspection agenda

» checking of passage over the planned routes

» automatic splitting of the images into the predefined infrastructure elements

» quick inspection results viewer

» marking and annotating the detected defects

» reporting

» data archiving

» data backup

Inspection vehicle delivered to VolkerRail

The video inspection module makes continuous image registration possible, both for the illustrative purposes and for the automatic rail condition assessment. The video inspection module is composed of cameras with the high power LED illuminators making image registration possible in similar lighting conditions during the day or at night, at speeds of up to 90 km/h.

The registered images are saved in AVI format with the possibility to export the arbitrarily selected image file in either BMP or JPG format. Information like line number, track ID, actual mileage, data, and time may be applied to each registered video frame (or exported image).

Registration of the illustrative view of the route

The vehicle route is registered as the pictorial view every 0.5 to 4.0 m. The registration is carried out by two sets of panoramic cameras at both vehicle ends, which ensures easy orientation in the field and provides a preview of the inspection location. The automatic adjustment of exposure parameters and switching between the day and night modes makes obtaining high quality images possible, so one can even read signs and inscriptions.

Vehicle route view

Detection of surface defects

The detection module for the rail head surface defects may detect the HCH type defects automatically. To this end, the set of cameras registers images encompassing both rails head running and inner surfaces with the high resolution required in by the defect recognition process. Employment of the unique illumination system eliminates glare and saturation of image fragments.
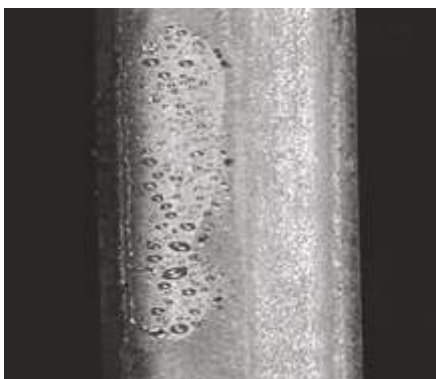
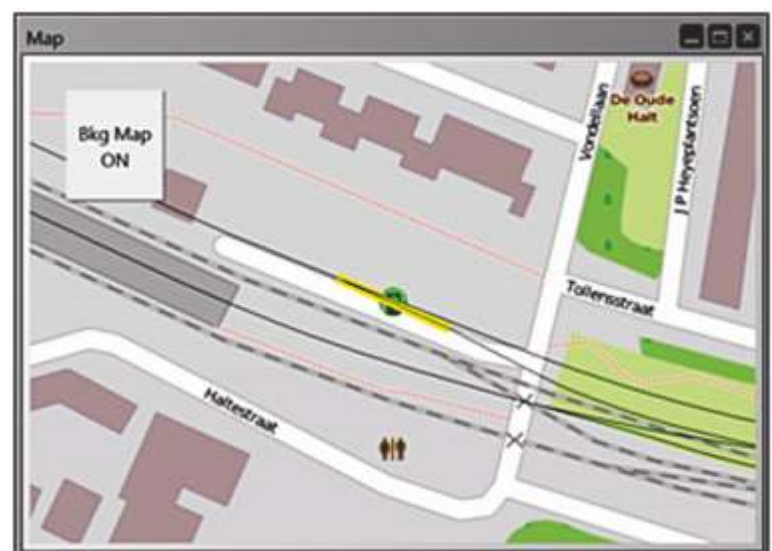Exemplary images of the detected rail head surface defects

Side rail images

Registration of the side views of both rails makes visual inspection of the rail condition possible, as well as of its joints, fixtures, and defects. The registered image includes: rail head, web, rail foot, fastening and makes it possible to read information on the rail web, and also observation of joints, including the welded ones.
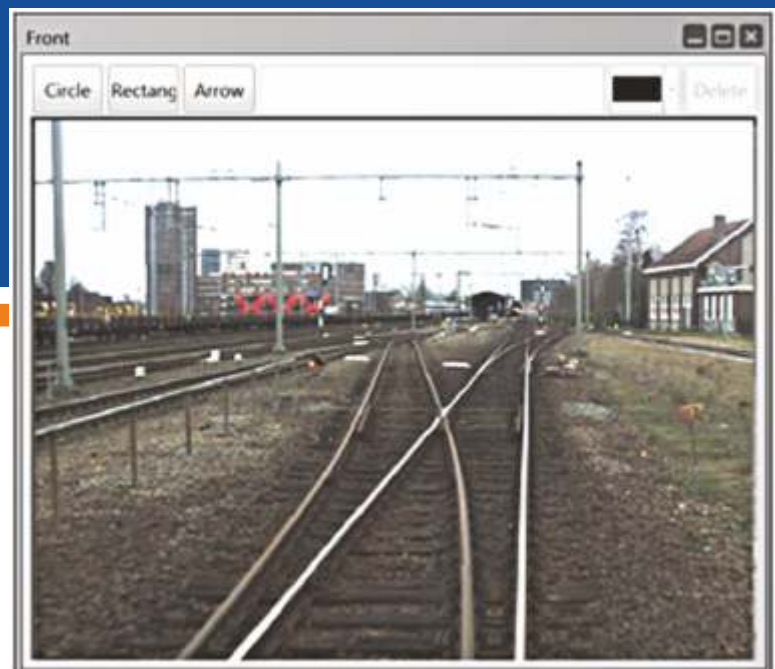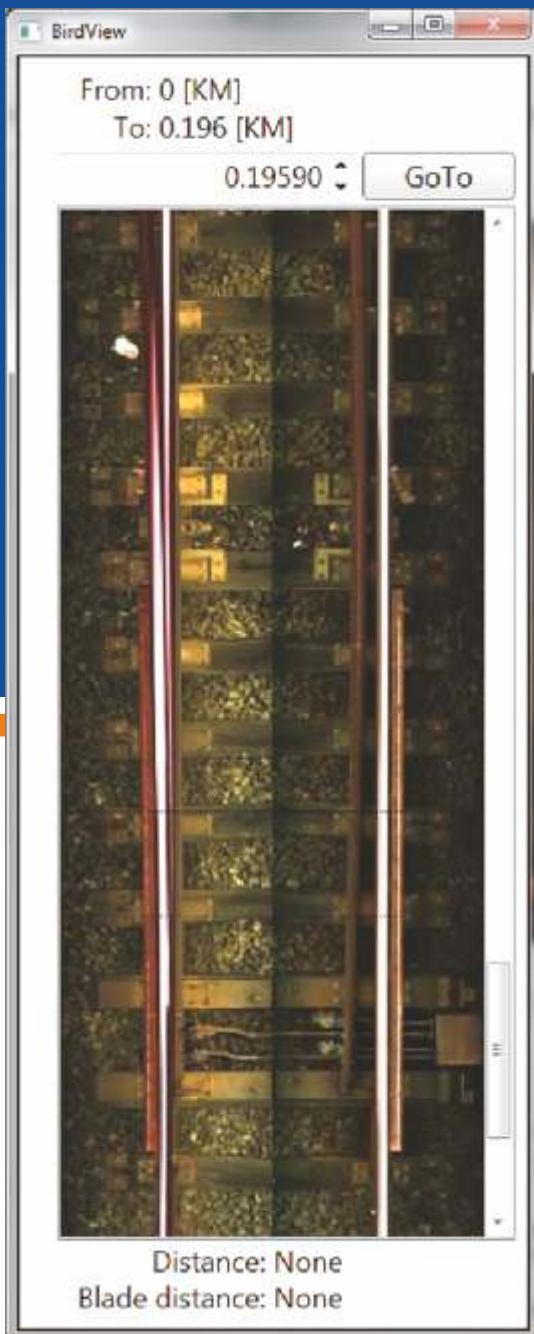

Exemplary rai

Side rail images

Registration of the side views of both rails makes visual inspection of the rail condition possible, as well as of its joints, fixtures, and defects. The registered image includes: rail head, web, rail foot, fastening and makes it possible to read information on the rail web, and also observation of joints, including the welded ones.

Exemplary bird's views of the track

BirdView

From: 0 [KM]
To: 0.196 [KM]

0.19590 ↕ | GoTo

Distance: None
Blade distance: None

Front

Circle | Rectang | Arrow

Map

Bkg Map
ON

Exemplary elements of the system operator
(diagnostician) interface

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