

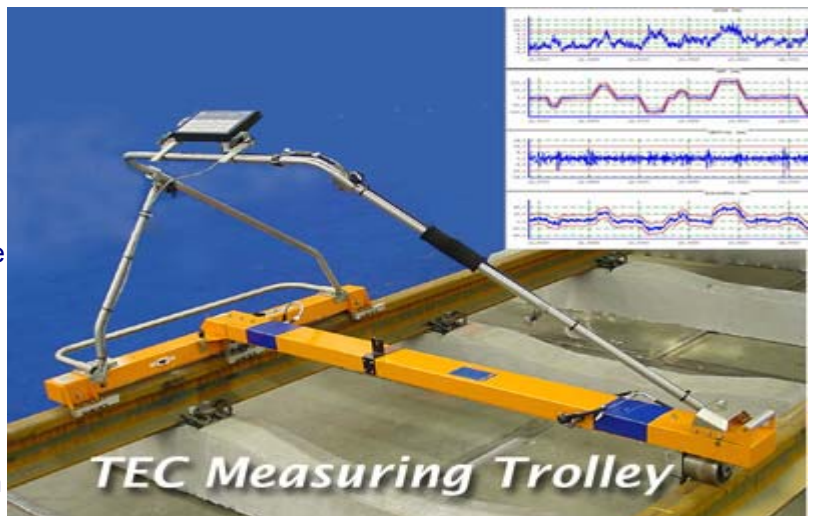
TRACK RECORDING TROLLEY TEC-1435

The trolley is designed for measurements of track geometry. The readings are recorded automatically in an electronic memory in real time, as the trolley travels along the track. The operator can see the measured values of the track gauge, cant, and the actual mileage on the display during the measurements. The large size foil keyboard makes it possible to enter information on track faults found. One can mark locations, e.g., of the broken weld or rail, the need to replace the sleeper or missing bolts.



1. Main specifications of the track gauge:

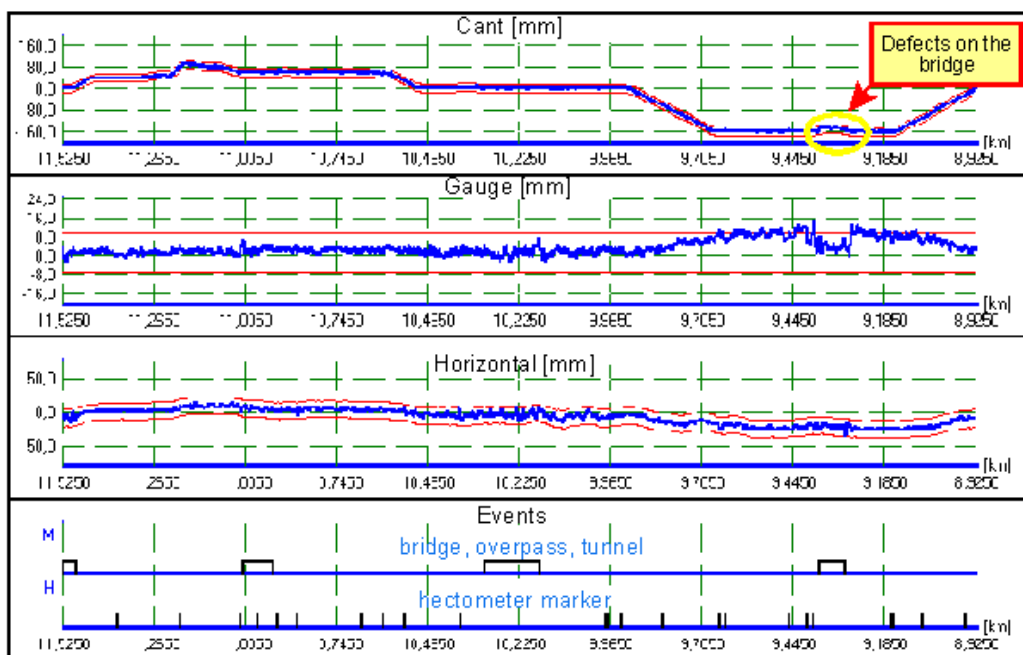
- Mileage measurement: 0.5 m, 1 m, 2.5 m, 5 m; resolution 0.1 m
- Track gauge: range 1420 – 1485; resolution 0.1 mm (the device with other track gauge measurement range may be delivered on request)
- Track cant: range ± 200 mm; resolution 0.1 mm
- Track vertical irregularities: range ± 4 mm / 1 m; resolution 0.1 mm
- Track horizontal irregularities: range ± 5 mm / 1 m; resolution 0.1 mm



- Software for the PC platform, supplied with the track gauge makes it possible, among others, calculation of the track gauge gradient, track twist, and recalculation of the measured vertical and horizontal irregularities to 10 m long chords. Tabular printout of the measurement results is possible, with marking the mileage values where faults observed by the operator occurred, printout of the measurement results as plots, and also calculation of the synthetic indices according to regulations of the Polish State Railways, Hungarian State Railways or Dutch Railways – for evaluation of the track geometry quality. Delivery of the software for processing the track gauge measurement results according to requirements of other railways is also possible.

The main advantage of the TEC-1435 track gauge system is its capability for evaluation and visualization the measurement results in a similar way to the one employed by geometry vehicles. The gauge has many operational advantages. Low weight (about 20 kg) makes fast removal from the track possible to let the train pass, next, immediate continuation of the measurements is possible without any calibration. The track gauge may be folded easily and transported even in a small car. The gauge's electronic memory can store up to 15 km of the track length measurement results, which is equivalent to the single shift measuring capability of the gauge.

Software for the PC platform, supplied with the track gauge makes it possible, among others, calculation of the track gauge gradient, track twist, and recalculation of the measured vertical and horizontal irregularities to 10 m long chords. Tabular printout of the measurement results is possible, with marking the mileage values where faults observed by the operator occurred, printout of the measurement results as plots, and also calculation of the synthetic indices according to regulations of the Polish State Railways, Hungarian State Railways or Dutch Railways – for evaluation of the track geometry quality – see figs 3÷5. The main advantage of the TEC-1435 track gauge system is its capability for evaluation and visualization the measurement results in a way similar to the one employed by geometry vehicles.



The track gauge user can select parameters, at his discretion, which plots should appear on the same page (max four plots). The plot demonstrating occurrences of events (e.g., switch, semaphore, bridge, etc.) and track defects (e.g., missing bolts, flash, skewed sleepers. etc.) is very important, as it is a precondition for the rational interpretation of the measured track geometrical parameters.

Example

An example is show below of the track geometry measurement made with the TEC-1435 track gauge. Assessment of the track quality has been done according to the Polish State Railways (PKP) regulations for the line speed of 120 km/h. The complete set of the measurement results' documentation consists of:

1. Listing of numerical values.

Page 1

Measurement data file of: 25.10.2001r., Route: HDR-HWD, Track: 1

Limits: -7.0mm < Gauge < 9.0mm
 -1.0mm < Gradient < 1.0mm
 -12.0mm < Cant < 12.0mm
 -12.0mm < Twist < 12.0mm
 -10.0mm < Vertical < 10.0mm
 -9.0mm < Horizontal < 9.0mm

Event and defect filter: DE WLS)

H - hectometer marker
 M - bridge, flyover, tunnel
 R - crossover
 D - crossing
 E - platform
 F - precise measurement
 B - sleeper fixing bolts missing
 P - broken rail

W - sleeper replacement necessary
 L - fish bar bolts missing
 S - flash
) - rail's flat
 Y - burr
 / - skewed sleepers
 Z - side wear
 ; - broken weld joint

KILOMETER [km]	GAUGE [mm]	GRADIENT [mm]	CANT [mm]	TWIST [mm]	VERTICAL [mm]	HORIZONTAL [mm]	EVENTS HMRDEFBPWLS) Y/Z;
15.1000	-1.0	0.1	4.7	0.3	0.2	-8.3	
15.1005	-0.9	0.0	5.4	0.2	-0.2	-7.5	
15.1010	-1.0	0.4	4.2	0.6	-0.4	-6.6	
15.1015	-0.9	0.3	5.7	0.5	-0.4	-5.5	
15.1020	-0.6	-0.1	5.0	1.2	-0.4	-4.4	
15.1025	-0.6	-0.3	4.6	0.8	-0.3	-3.6	
15.1030	-0.7	-0.2	4.9	1.6	-0.1	-3.2	
15.1035	-0.9	0.2	4.9	2.2	0.0	-2.9	
15.1040	-0.9	0.2	5.2	1.4	0.0	-2.7	
15.1045	-0.7	0.2	6.3	1.7	0.0	-2.9	
15.1050	-0.7	0.2	5.4	1.8	0.0	-3.3	
15.1055	-0.5	0.2	7.0	2.4	0.2	-3.6	
15.1060	-0.5	0.5	6.4	2.5	0.3	-4.0	
15.1065	-0.3	0.5	7.1	2.0	0.5	-4.5	
15.1070	0.0	0.3	6.7	1.6	0.8	-5.1	
15.1075	0.1	-0.1	6.4	0.6	1.2	-5.4	
15.1080	0.2	-0.7	7.3	0.1	1.5	-5.5	
15.1085	0.0	-0.4	7.5	0.2	2.0	-5.7	
15.1090	-0.4	0.2	7.2	-0.4	2.4	-5.8	
15.1095	-0.4	0.3	7.8	-0.1	2.8	-5.4	
15.1100	-0.3	0.1	6.0	-0.4	3.1	-4.9	
15.1105	-0.1	-0.1	7.0	-0.2	3.1	-4.6	
15.1110	-0.1	0.3	6.6	-0.9	3.2	-4.3	
15.1115	-0.2	0.5	6.7	-0.9	3.0	-4.0	
15.1120	0.2	0.4	6.6	-1.7	2.8	-3.6	
15.1125	0.3	-0.1	6.0	0.2	2.5	-3.3	
15.1130	0.5	-0.8	7.1	-0.7	2.2	-2.9	
15.1135	0.2	-0.6	6.5	-0.6	1.8	-2.7	
15.1140	-0.3	-0.2	6.3	-0.7	1.4	-2.5	
15.1145	-0.5	0.1	6.1	-1.3	0.9	-2.8	
15.1150	-0.5	0.3	6.2	-0.3	0.4	-3.2	
15.1155	-0.3	0.4	6.4	-1.1	0.0	-3.4	
15.1160	-0.2	0.5	6.0	-0.6	-0.3	-3.6	
15.1165	0.0	0.5	6.0	-0.5	-0.5	-3.7	
15.1170	0.0	0.5	6.0	-0.5	-0.5	-3.7	

2. Synthetic assessment of the track geometry.

Page 1

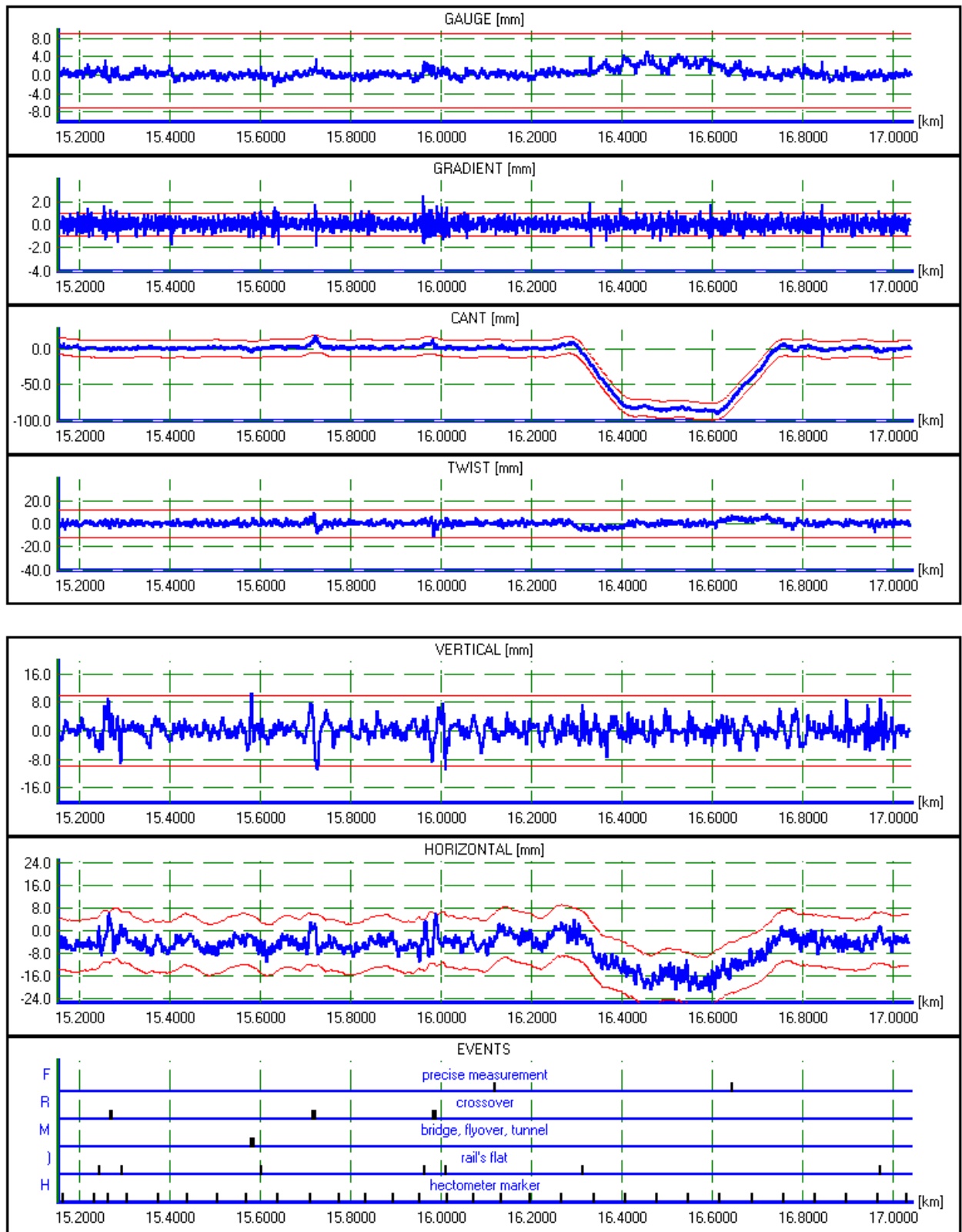
Measurement data file of: 25.10.2001r., Route: HDR-HWD, Track: 1
Synthetic assessment of track condition calculated for 100 [m]

Coefficient J limit: 4.0

Section	J	Standard deviations						Quality levels						W5	
		Gauge	Grad.	Cant	Twist	Vert.	Horiz.	Gauge	Grad.	Cant	Twist	Vert.	Horiz.		
12.9890	13.0000	1.3	0.9	0.5	1.4	1.5	2.2	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.0000	13.1000	2.3	0.6	0.4	1.1	1.4	3.9	2.4	0.00	0.04	0.00	0.00	0.03	0.00	0.03
13.1000	13.2000	1.5	0.5	0.3	1.1	1.5	2.2	1.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.2000	13.3000	1.5	0.6	0.3	1.1	1.4	2.3	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.3000	13.4000	1.8	0.6	0.3	1.2	1.5	2.8	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.4000	13.5000	2.1	0.5	0.3	1.6	1.9	3.3	2.0	0.00	0.01	0.00	0.00	0.00	0.00	0.00
13.5000	13.6000	2.2	0.5	0.3	1.3	1.5	4.2	1.6	0.00	0.00	0.00	0.00	0.03	0.00	0.03
13.6000	13.7000	1.7	0.6	0.3	1.0	1.4	2.1	2.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.7000	13.8000	1.6	0.6	0.3	1.0	1.4	2.1	2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.8000	13.9000	2.0	0.5	0.4	1.1	1.5	3.9	1.4	0.00	0.02	0.00	0.00	0.05	0.00	0.05
13.9000	14.0000	1.8	0.5	0.4	1.3	1.5	2.6	2.0	0.00	0.01	0.00	0.00	0.00	0.00	0.00
14.0000	14.1000	2.0	0.6	0.4	1.3	1.5	3.4	1.8	0.00	0.03	0.00	0.00	0.03	0.00	0.03
14.1000	14.2000	1.9	0.5	0.5	1.2	1.5	3.4	1.5	0.00	0.05	0.00	0.00	0.00	0.00	0.00
14.2000	14.3000	1.7	0.7	0.5	0.9	1.2	2.8	1.6	0.00	0.04	0.00	0.00	0.00	0.00	0.00
14.3000	14.4000	2.0	0.6	0.3	1.5	1.8	3.0	2.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.4000	14.5000	1.6	0.5	0.4	1.1	1.3	2.8	1.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.5000	14.6000	1.6	0.6	0.3	1.0	1.4	2.0	2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.6000	14.7000	1.4	0.6	0.3	0.9	1.4	1.5	1.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.7000	14.8000	1.4	0.6	0.4	1.1	1.5	1.7	1.5	0.00	0.01	0.00	0.00	0.00	0.00	0.00
14.8000	14.9000	1.6	0.5	0.3	1.7	1.8	1.6	1.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14.9000	15.0000	1.8	0.5	0.3	1.3	1.4	2.5	2.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.0000	15.1000	2.2	0.5	0.3	1.3	1.5	3.6	2.4	0.00	0.00	0.00	0.00	0.05	0.00	0.05
15.1000	15.2000	1.4	0.5	0.4	1.3	1.5	1.9	1.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.2000	15.3000	2.3	0.8	0.5	1.1	1.5	3.3	3.0	0.00	0.06	0.00	0.00	0.00	0.00	0.00
15.3000	15.4000	1.5	0.6	0.4	0.9	1.2	1.9	1.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.4000	15.5000	1.3	0.6	0.4	1.0	1.5	1.5	1.3	0.00	0.01	0.00	0.00	0.00	0.00	0.00
15.5000	15.6000	1.7	0.5	0.4	1.3	1.6	2.6	1.3	0.00	0.01	0.00	0.00	0.01	0.00	0.01
15.6000	15.7000	1.4	0.7	0.4	1.3	1.5	1.6	1.5	0.00	0.04	0.00	0.00	0.00	0.00	0.00
15.7000	15.8000	2.8	0.7	0.4	2.6	2.8	4.0	2.6	0.00	0.01	0.00	0.00	0.04	0.00	0.04
15.8000	15.9000	1.3	0.5	0.4	1.2	1.2	1.9	1.3	0.00	0.01	0.00	0.00	0.00	0.00	0.00
15.9000	16.0000	2.7	0.9	0.5	1.9	2.4	2.9	3.6	0.00	0.07	0.00	0.00	0.00	0.00	0.00
16.0000	16.1000	1.9	0.7	0.4	1.1	1.6	3.0	1.7	0.00	0.05	0.00	0.00	0.00	0.00	0.00
16.1000	16.2000	1.5	0.5	0.3	1.0	1.4	1.9	1.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.2000	16.3000	1.5	0.5	0.3	1.4	1.3	2.2	1.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.3000	16.4000	1.8	0.8	0.5	1.2	1.3	2.8	1.7	0.00	0.05	0.00	0.00	0.00	0.00	0.00
16.4000	16.5000	1.7	1.0	0.4	1.2	1.4	2.3	1.8	0.00	0.02	0.00	0.00	0.00	0.00	0.00
16.5000	16.6000	1.7	1.0	0.5	1.0	1.4	1.9	2.1	0.00	0.03	0.00	0.00	0.00	0.00	0.00
16.6000	16.7000	1.9	0.9	0.4	1.2	1.9	2.5	2.0	0.00	0.02	0.00	0.00	0.00	0.00	0.00
16.7000	16.8000	2.1	0.6	0.4	1.9	2.6	2.7	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.8000	16.9000	1.8	0.8	0.5	1.2	1.5	2.5	1.8	0.00	0.02	0.00	0.00	0.00	0.00	0.00
16.9000	17.0000	1.9	0.5	0.4	1.3	1.7	3.0	1.6	0.00	0.01	0.00	0.00	0.00	0.00	0.00
17.0000	17.0405	1.2	0.4	0.4	0.9	1.3	1.6	0.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3. Plots of the measured parameters. Their closer analysis reveals the following conclusions:

- a. Crossings located between 15.200 and 16.000 km affect significantly the quality assessment.
- b. Track geometry errors are visible in the plots at both ends of the transition curve.
- c. Side wear of rail heads is visible in the curve.



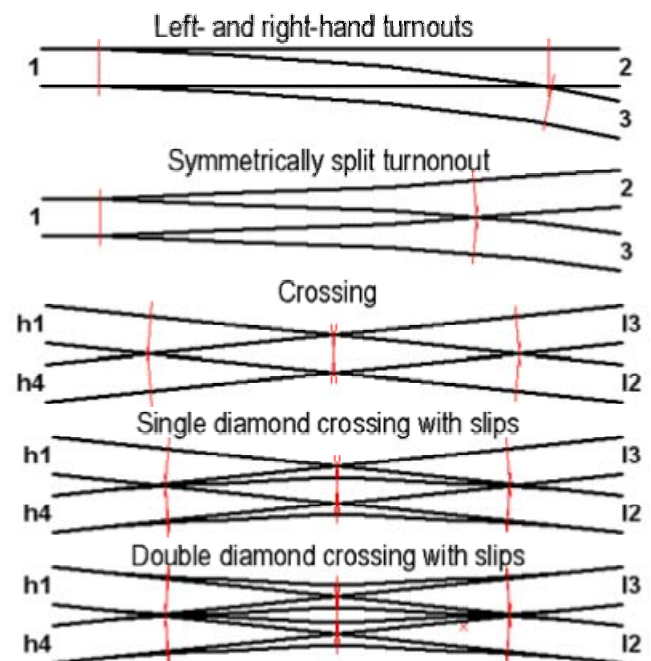
SWITCH GEOMETRY RECORDING TROLLEY TEE-1435

The TEE-1435 track gauge has been developed for track and switch geometry measurements. The trolley offers all functions of the TEC-1435 track gauge and, in addition, makes it possible to make measurements of all geometrical parameters of switches included in the pertinent regulations. The measurement results are registered continuously along the measurement path and, moreover, one can in addition make readings of the parameters at the user-defined switch characteristic points. System software of the track gauge controls the integrity of all measurements made for the particular switch type.



1. Basic technical specification of the track gauge in the switch measurement mode:

- Measurement of all switch types used in Poland and The Netherlands
- Mileage measurement increment 31 mm
- Measurement of groove widths: left and right
- Gauge - range: 1420÷1485; resolution: 0.1 mm
- Cant range: ± 200 mm; resolution: 0.1 mm
- Vertical irregularities range: ± 4 mm / 1 m; resolution 0.1 mm
- Horizontal irregularities - range: ± 5 mm / 1 m; resolution 0.1 mm
- Measurement system calculates twist of the track, gradient of the track gauge, twist of the switch, and location of the left and right check rails.

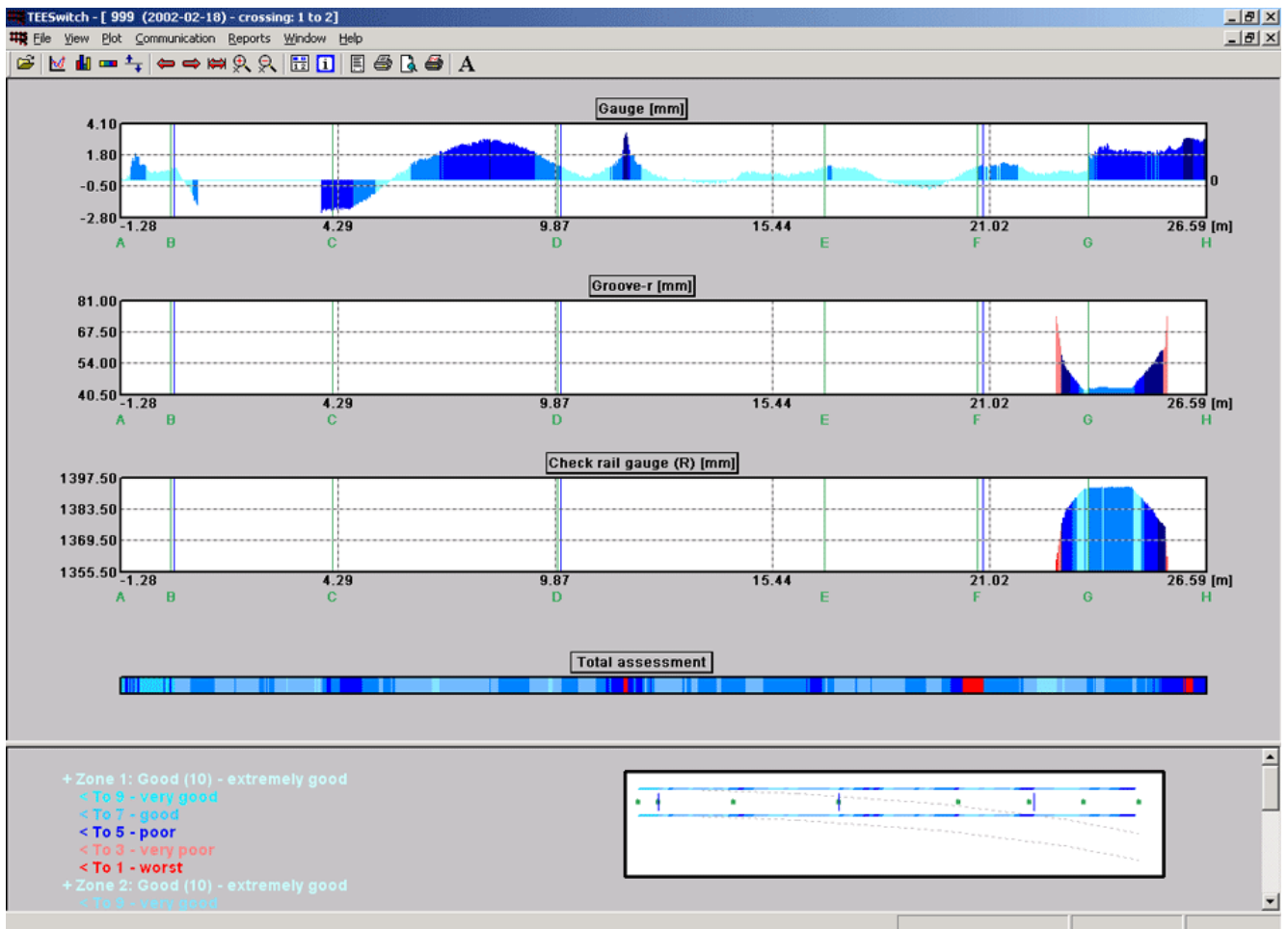


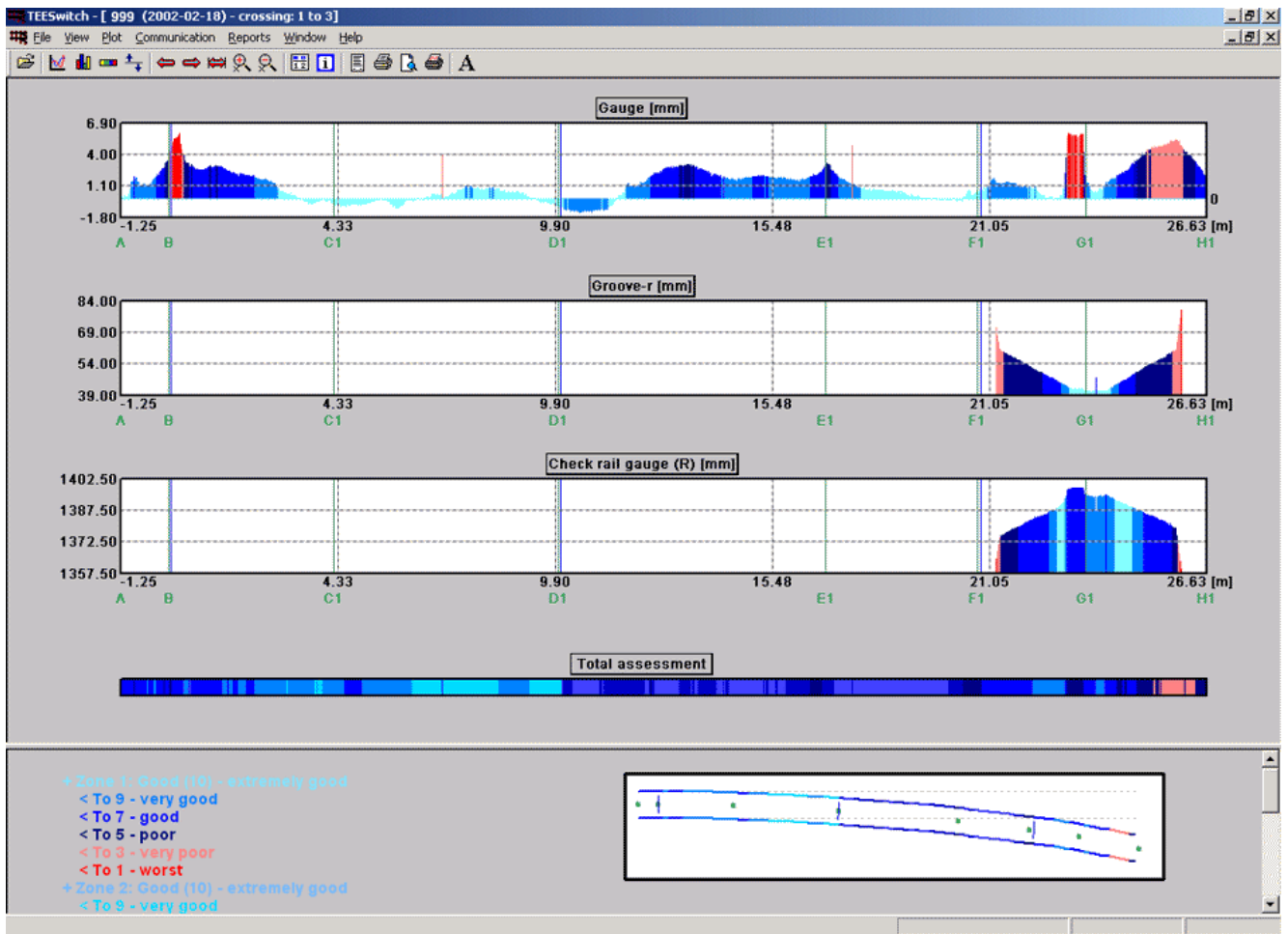
2. The PC software delivered along with the device makes it possible, among others, in addition to options offered by the TEC-1435 device, generating the detailed measurement reports for the switches. Switch condition quality assessment is also carried out.

The gauge has many operational advantages. Low weight (about 20 kg) makes fast removal from the track possible to let the train pass, next, immediate continuation of the measurements is possible without any calibration. The track gauge may be folded easily and transported even in a small car.

EXAMPLES OF SWITCH MEASUREMENT RESULTS

Switch condition assessment can be done by using measurement data at characteristic points, specified in the leaflets. However, real life experience calls for more detailed information - that can be obtained by continuous measurement of the switch geometrical parameters like in plain track. It happens that a switch - apparently in a good shape - is no longer considered as such when its geometry is measured in more detail - every ca 30 mm. The plots below show the continuous measurement results of a switch. Please note the ribbon plot at the screen bottom - it is a summary switch geometry assessment made automatically by the system. The user is free to select geometrical parameters and their tolerances that will be taken into account for the quality evaluation. Tolerances for any parameter may vary for different switch zones, such detailed specifications can be named and saved by the user. Two screens below show measurement results for two different routes through the switch.





The main goal of the TEE-1435 software is to assist in generating the measurement reports for the assessment of the geometrical switch quality level. The switch quality is evaluated using the synthetic switch quality coefficients in a 1-10 scale, and is presented in a concise [Measurement Reports](#) (PDF file - 158 KB).

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