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ABT-7000 Abtus Cyclic Top Measurement Device (CTMD)

Track Geometry

Static/Kinematic measurement equipment for track alignment and inspection.

Instruction Manual

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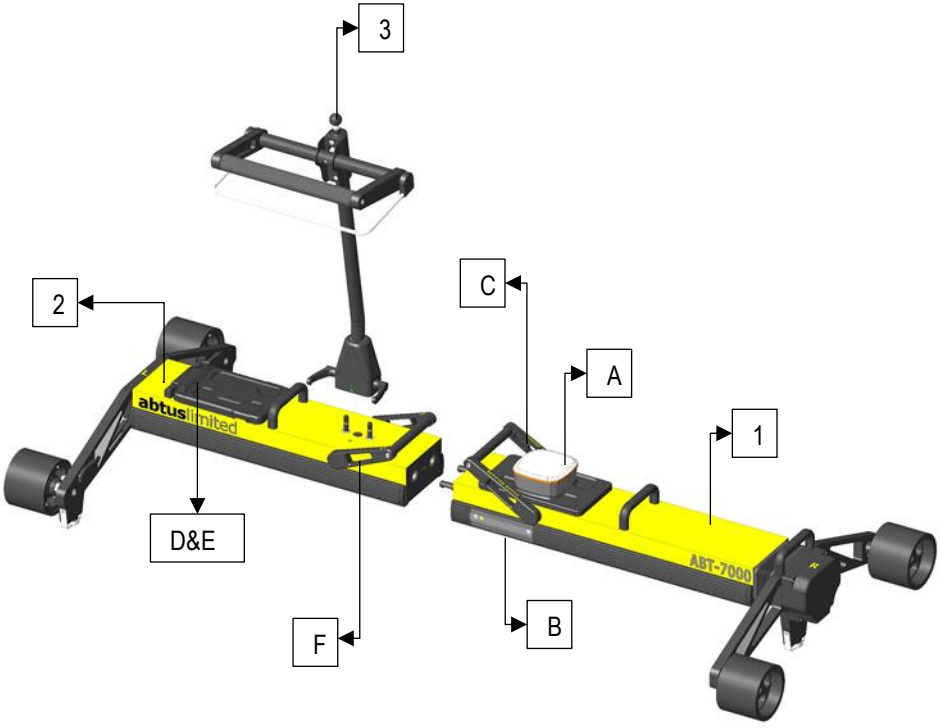
2.0 Item List

1. CTMD = 1 (Right Side) + 2 (Left Side) + 3 (Handle)
   (See assembly section of this manual)
   - (1) (Left Side) contains: GPS (A), Red LED Lights (B), Gauge Retraction Lever (C)
   - (2) (Right Side) contains: 2x Removable 12V Lithium Ion Batteries (D), On/Off Power Button (E) & Locking Lever (F)
2. FZ-G1 Panasonic Tablet + User Manual & Charger
3. FZ-G1 Panasonic Tablet Holder
4. Battery Charger + Accessories
5. CTMD Instruction Manual
6. Transit Cases



3.0 Specification

Weight	- CTMD on Track - Bag 1 & Bag 2 - Panasonic Fz-G1 Tablet - Chargers & Other - CTMD in Bags	25.9 kg 3 kg ea. (Total 6 kg) 1.1 kg 1 kg & 1 kg 35 kg
Physical Dimensions	- CTMD on Track - Bag 1 - Bag 2	Length: 1610 mm to 1700 mm Height: 1000 mm Width: 720 mm Length: 870 mm Height: 300 mm Width: 790 mm Length: 1010 mm Height: 300 mm Width: 790 mm
Operating Temperature	-	-10°C to + 50°C (-4°F to 122°F)
Environmental Rating	-	IP65 Assembled
Battery Life	- CTMD 2x Lithium Ion - Panasonic FZ-G1 Tablet	Up to 6 hours per battery Up to 6 hours
Operating System	-	Windows 64 bit
Trolley Connectivity	-	Wi-Fi

4.0 Getting Started

4.1 Overview

The Abtus ABT7000 is a measuring device which records cyclic top geometry while being pushed by an operator at walking speed.

The device can be assembled by one operator. Since the weight of the trolley weighs 28 kg the trolley should only be lifted in its entirety if the user feels as though they feel fit to do so, otherwise the trolley should be disassembled and carried by two operators. The device can be dismantled to fit into two protective transportation bags.

Cyclic top track geometry data is transmitted from the measuring device via Wi-Fi to a Panasonic FZ-G1 running a Windows 64 bit operating system supplied with the Cyclic Top Software. The software displays track geometry data including Distance, Cant/ SE, Twist and Gauge in real time. The Cyclic Top analysis can be viewed only at the end of a measurement. The data is saved as a .csv file containing distance, Cant/SE, Twist and Gauge data and as a PDF contains the cyclic top analysis report. PDF reports can be transferred to other devices via a USB flash drive.

The trolley is intended to be used for the measurement of cyclic top faults and track geometry measurements.

The CTMD is designed with the following characteristics:

- This product is used to accurately record Distance, Cant/SE, Twist, Gauge, Cyclic Top depth and cycles for railway maintenance.
- Non-conducting: The trolley is insulated and therefore does not create electrical contact between the two running rails. This is achieved by using plastic wheels and also accommodates a non-conductive insulation block between the wheel arm and contact bearings.
- Lights: The trolley is fitted with red LED lights on the front and back to enable other track users and train drivers of the operator's presence on track.
- Compact: The CTMD breaks down into 3 separate parts to allow it to fit into most vehicle.
- Portability: The CTMD is designed to be easily lifted onto and off the track. This is done using the plastic lifting handles provided.
- The unit has been designed to be user-friendly with only limited training required.

4.2 Assembly

- Firstly position the locking lever towards the left as shown in Figure 1.

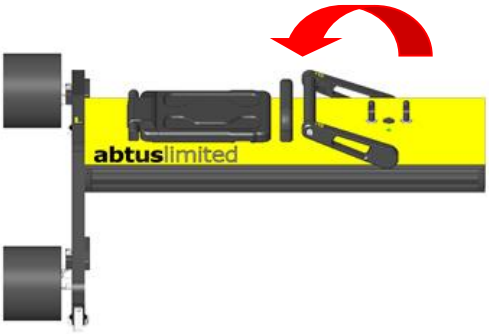


Figure 1 - Initial Locking Position

- Push the two halves together as shown in Figure 2 & Figure 3.

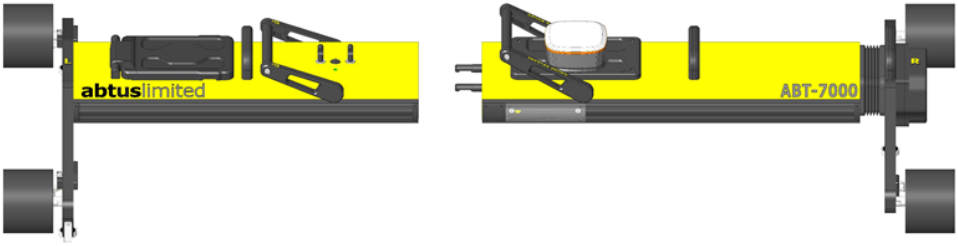


Figure 2 - Joining of the Fixed & Rotating Halves

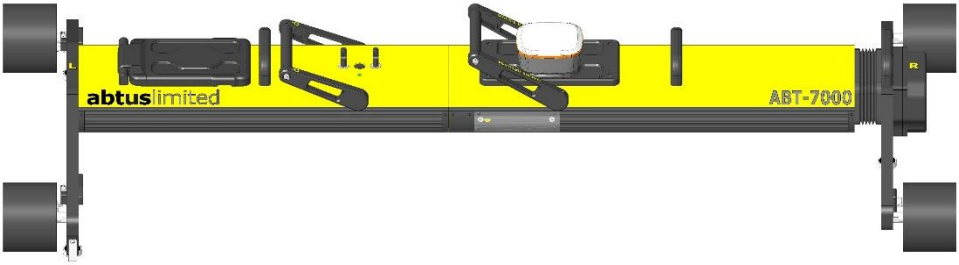


Figure 3 - Two Halves Together

- Lock the two halves together by pushing the locking lever towards the right until it firmly snaps into position.

Figure 4 - Locked Position

- Before attaching the handle, ensure that the locking levers are positioned towards the plunger on the back of the handle block as shown in Figure 5.

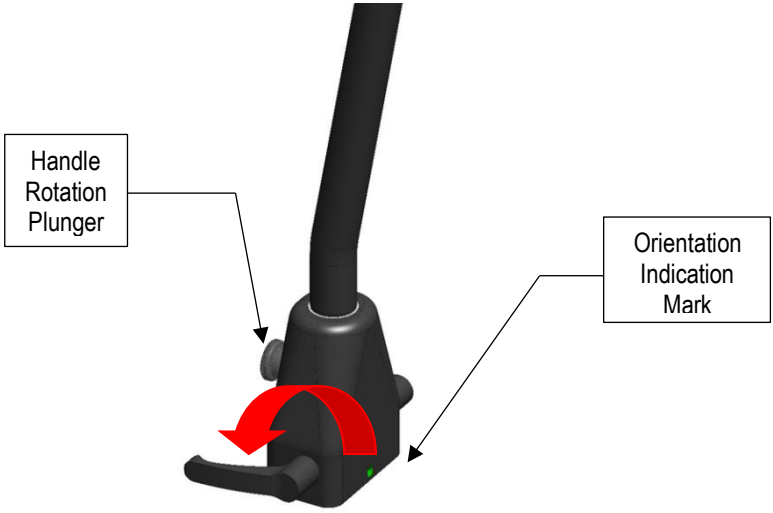


Figure 5 - Handle Locking Lever Position

- Attach the handle to the CTMD ensuring that the indication marks are aligned as shown in Figure 6 & Figure 7.

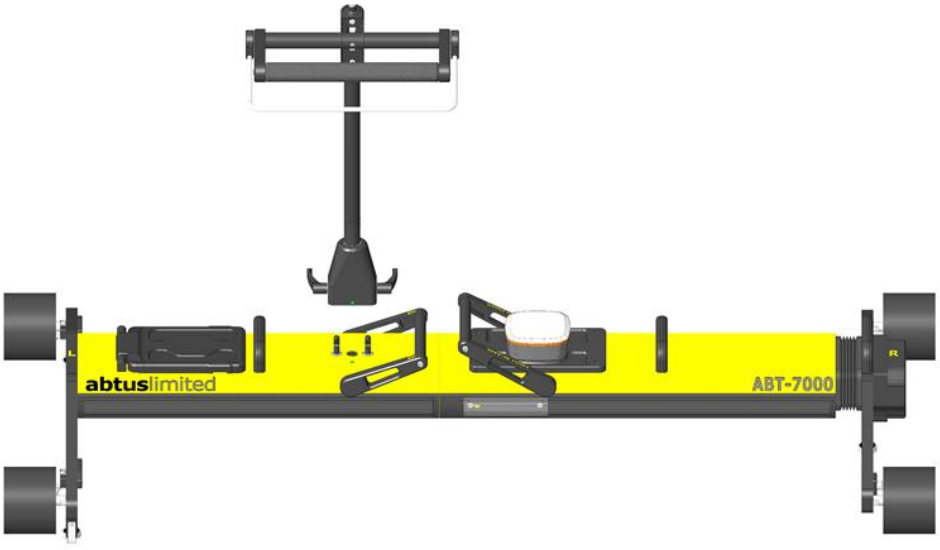


Figure 6 - Attaching the Handle

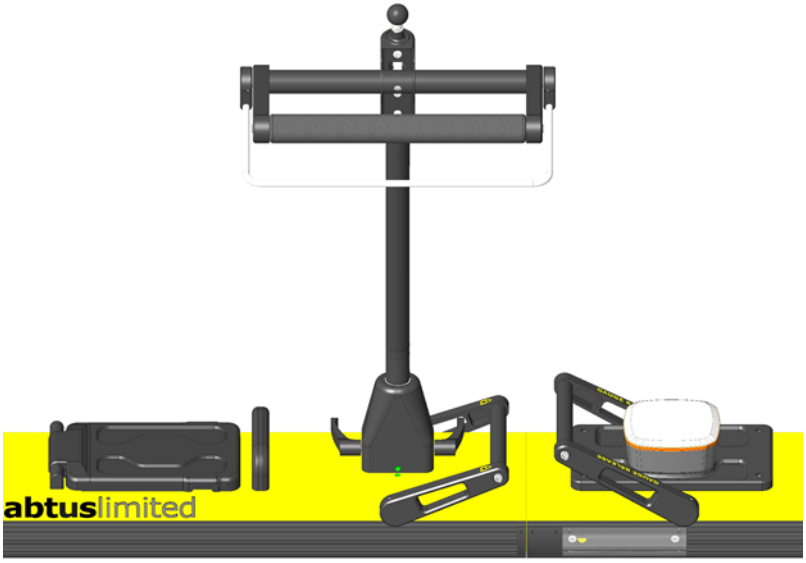


Figure 7 - Handle Before Locked

- To lock the handle into position, rotate the locking levers towards the indication mark.

Figure 8 - Handle in its Locked Position

- The CTMD comes with a RAM Mount holder for the Panasonic FZ-G1 as shown in Figure 9, which is spring loaded for ease of insertion and removal.

Figure 9 - Panasonic FZ-G1 Holder

- To attach the holder to the CTMD handle, simply insert the two 1” diameter rubber balls into the short double socket arm cups as shown in Figure 10.

Figure 10 - Short Double Socket Arm

- The CTMD has been designed with the user in mind. The trolley has a rotating handle to prevent the user having to lift and rotate the trolley on track. The handle has three locking positions and a position has been added to allow the user to push the trolley in the cess or in areas of limited access. To rotate the handle please see Figure 11.

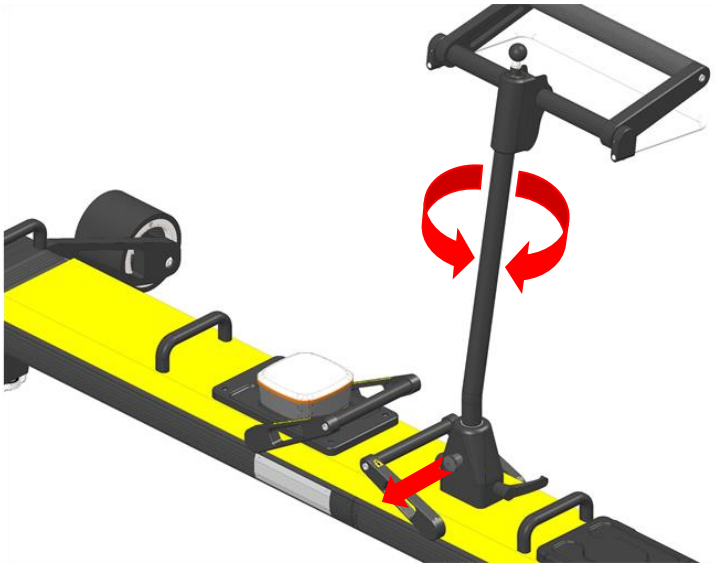


Figure 11 - Handle Rotation

- The CTMD trolley has a retraction lever to allow the user on track to retract the gauge through switch and crossing. The trolley uses a spring to self-align in the running rails, the gauge is in its released position when the lever is towards the right as shown in Figure 12.

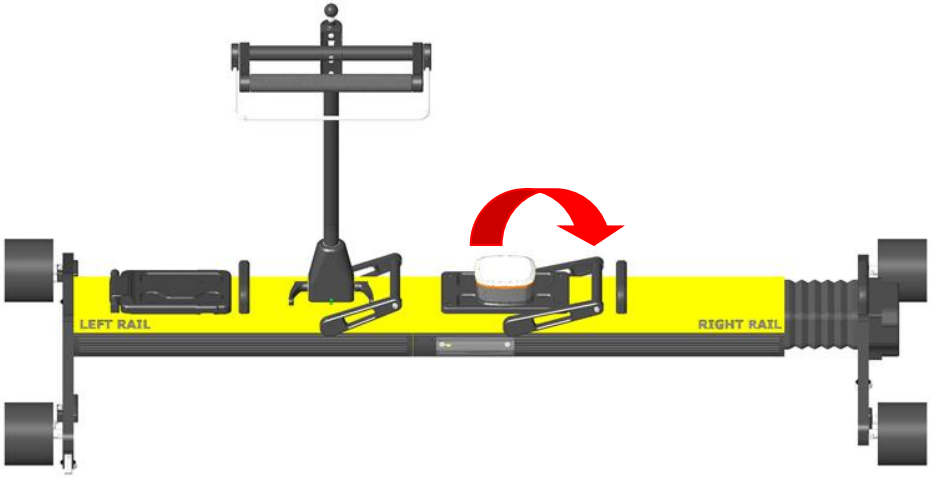


Figure 12 - Fully Extended

- The gauge is in its retracted position when the lever is towards the left as shown below:

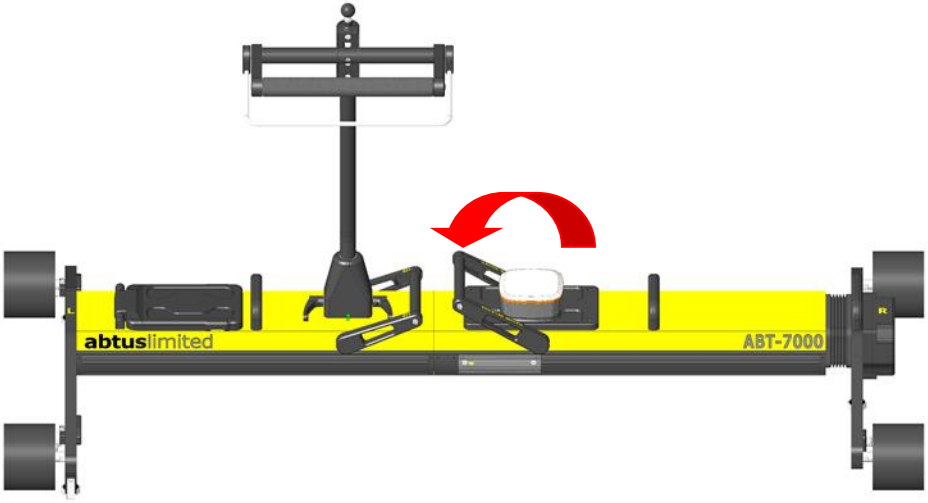


Figure 13 - Fully Retracted

5.0 Maintenance

The CMTD does not require any lubrication as all the moving parts have sealed or dry running bearings. However the following routine checks must be carried out on the trolley:

5.1 Every 3 Months

- Visually inspect the CTMD for signs of damage. If necessary, contact your distributor for help.
- Check that when the trolley is assembled, there is no play in the central joint.

5.2 Annual

The CTMD must be returned to Abtus Ltd annually for re-calibration to ensure measurements are within specification. The condition of all components will be checked at this time and replaced as required. Each trolley should have at least one trained operator who is responsible for returning the trolley.

The trolley is marked with a calibration sticker inside of the battery compartment showing the next annual due date and must be returned to Abtus for annual calibration and maintenance. If the trolley is used beyond the calibration due date the performance may be degraded.

If the equipment becomes defective, or if it has an out of date calibration sticker, a warning notice should be placed on the device to prevent further use and should be returned to Abtus for repair, maintenance and re-calibration.

6.0 Measurement Characteristics

6.1 Cyclic Top Faults

Cyclic Top Distance Range	2 - 200m
Cycle Lengths Detected	4.5m, 6m, 9m, 13m, 18m
Depth Range	0-30mm
Depth Accuracy	±2mm
Depth Resolution	0.1mm

The ABT7000 measures top faults which, when present on the track at a regular interval form Cyclic top.

Top faults are measured by calculating the vertical versine along the length of the track and identifying the peak values. The identified peaks are reported to the user as cycles and are shown on the screen as vertical bars of a height equal with the versine measured in millimetres. The chord length of the versine is selectable by the user between 4.5 m, 6 m, 9 m, 13 m and 18 m and the measurement is carried out every 0.1 m. The measurements are done without loading the track and

thus the results are likely to differ when compared with other measurement methods such as measurement trains.

Top faults of less than 2 mm in depth are not displayed to the user. Top faults have to exceed 5 mm in order for the software to treat them as cycles (count them and report them). The reported cycles, depending on their position along the track, may or may not form a cyclic top fault. The software does not tell the user whether or not the cycles form a cyclic top fault, but the stars displayed on the graph can be used as a guide to see if there are three or more cycles in a regular interval.

The software will show any cycles present on the track, even if just one is present (which is not enough to form a cyclic top fault). Results are likely to differ when compared to other means of measurement such as the measurement train which reports the cycles only if they form a cyclic top fault and exceed other types of thresholds.

6.2 Gauge

Note: This measurement is taken from the internal running edges of the tracks at P-point (usually -14mm) distance from the top of the rail.

Range	-25/+65mm (on nominal)
Accuracy	±1mm
Resolution	0.1mm

6.3 Super-Elevation

Range	±250mm
Accuracy	±1mm
Resolution	0.1mm

Super Elevation (SE) is measured across the running rails and is displayed as height differential between the high and low rail in millimetres

The default sign convention is: Left rail up is positive Cant/SE

During Cyclic Top measurements the software records the trolley half labelled "L" as being the left rail. During geometry measurements the left and right side is determined by the direction of travel.

6.4 Twist

Range	±250mm
Accuracy	±1mm
Resolution	0.1mm

Twist is when one rail has a downward gradient while the other rail has an upward gradient, causing the carriage to twist. Twist is normally calculated over the bogie length (Traditionally 3m) and the bogie centre to centre distance (Normally 12m).

6.5 Distance

Maximum limit on the number of measurements per recording for Gauge, SE & Twist	50,000
Recording Increment	0.1, 0.2, 0.25, 0.5 & 1.0 m
Accuracy	±1%
Resolution	10mm

6.6 *GPS*

Accuracy	±2 m (In sunny clear sky conditions)

The GPS accuracy varies by time and location thus the user should wait 1 – 2 minutes to achieve the best accuracy.

7.0 Transportation and Storage

The CTMD must be transported inside its transportation bags. The bags should be moved by two people following safe manual handling practices. The bags should be stored flat to prevent them falling over.

If the trolley is not going to be used for several weeks, it is strongly recommended that the batteries be fully charged and that the trolley be stored away from direct sunlight in a location of low humidity where the temperature will be between: +15°C & +25°C (68OF to 77OF).

8.0 Software Introduction

8.1 Cyclic Top Measurement Device Software

The Cyclic Top Measurement Device software is installed on the Windows device that comes with the CTMD. This guide explains the important features of the CTMD software that are necessary for measuring and analysing cyclic top faults.

8.2 Initial Setup

No initial setup is required as Abtus will install the CTMD software and any necessary wireless drivers. If the Windows device does not connect to the CTMD contact Abtus for support.

9.0 Before going on track

9.1 Check Battery Levels

The CTMD has two removable batteries which are accessed from the lid in the top of the Measurement Device. Press the battery indicator button to check the charge of the batteries and charge them if necessary, you can also see the battery voltage in the start a recording screen. Check the battery levels on the Panasonic FZ-G1 Tablet by clicking on the battery icon bottom right of the tablet.

9.2 Check Wireless Connection

Switch on the CTMD and 'Cyclic Top' should appear in the list of wireless networks available and windows should automatically connect to it. Open the CTMD software on the Windows tablet and click 'Connect via Wi-Fi' to check that the connection is working between the tablet and the trolley.

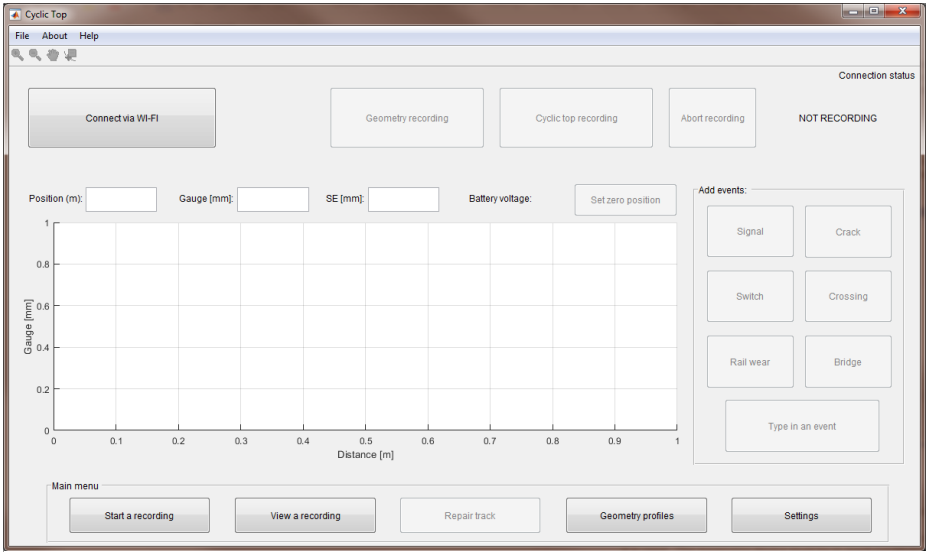


Figure 14 - CTMD Software Home Screen

9.3 Before Each Use

The following checks should be carried out in the office or depot before taking the trolley onto the track.

- The condition of the trolley should be checked by the operator before it is used. The trolley must be in good condition with no loose or broken components.

- The trolley must be marked with a valid calibration sticker showing the next annual due date located inside of the battery compartment. The trolley should not be used after the calibration due date.

- The batteries should have sufficient charge before the trolley is taken onto track. This is shown by pressing the battery indicator button on each battery.
- The electrical connection pins between the two parts of the device should be clean.
- An appropriate and adequate safe system of work must be in place before the trolley is used.
- Ensure that all wheels rotate freely.
- Ensure that there is nothing on the wheels. (dried mud, leaves or any other debris)
- It is possible around the guide bearing shroud for dirt and grease build up, ensure this is clear to allow the bearings to run freely.
- The trolley is fitted with a dead man brake which can cause flat spots on the wheels if the brakes are engaged whilst pushing the trolley. Check all wheels for flats or grooves. If any are found, the trolley must be returned to Abtus as this can result in inaccuracies.
- The safety brakes should be functioning correctly. The brakes are applied to two of the wheels which can be tested by spinning the wheels and releasing the brake lever on the main handle ensuring that both wheels lock firmly.

9.4 Training and responsibilities

Only trained and competent people should use the trolley.

- All users must have received adequate training for the use of the trolley.
- A trained person will be responsible for the trolley during the work shift. This includes carrying out the safety and performance related checks described in the user manual.
- Operators should have read the instruction manual for the CTMD and have access to it for reference.
- Operators should understand the accuracy levels of the trolley.
- The trained operator is responsible for using the trolley safely in accordance with the safety guidelines in the ABT7000 HAZOP Safety Risk Assessment and for ensuring that any risks identified are kept as low as reasonably practical. They are responsible for informing any other staff of safety requirements relating to the trolley that affect the planning of the work to

be carried out. The trained operator should challenge any instruction that compromises safe use of the equipment and is responsible for communicating the risks involved.

9.5 Cyclic Top Fault Report from Measurement Train

The CTMD is designed to measure track sections which the measuring train has identified as having cyclic top faults. The CTMD can be used before, during and after maintenance.

The measuring train produces a fault report showing the GPS position, wavelength, number of cycles of the cyclic top fault and the category of severity on a scale I, A, B, C, and D. The direction of the measuring train can be identified by checking the mileage data. The GPS position gives the start of the fault.

Track Geometry Fault Report

Date:	18/07/2016	**Route:**	Anglia
Train:	PLPR2	**MDU:**	HT8 Tottenham MDU
Desc:	SYSTON NORTH JN TO ELY	**TME:**	TME Ely
RST:	0239/2	**TSM:**	TSM March

ELR	TID	Mileage	GPS	Linespeed	Channel	Peak	Threshold	Action
EMP	1100	085.0526 (24)	5233.3260N:0006.1944E	060	AL35	-17.69	-16.00	Correct 14 days
EMP	1100	085.0512 (23)	5233.3200N:0006.2004E	060	AL35	20.60	16.00	Correct 14 days
EMP	1100	074.0542 (25) - 074.0490 (22)	5226.0110N:0016.1688E	075	Cyclic	18.54	18.00	Corr:maintenance
			Wavelength: 13m	**Rail:** Right	**Cycles:** 3		**Cat:** D	
EMP	1100	074.0556 (25) - 074.0489 (22)	5226.0160N:0016.1616E	075	Cyclic	21.23	20.00	(Correct :60d)
			Wavelength: 13m	**Rail:** Left	**Cycles:** 4		**Cat:** C	
EMP	1100	074.0556 (25) - 074.0489 (22)	5226.0160N:0016.1616E	075	Cyclic	39.77	38.00	Corr:maintenance
			Wavelength: 13m	**Rail:** Both	**Cycles:** 7		**Cat:** D	

Figure 15 - Measure Train Fault Report Example

9.6 Tools

It is recommended to take spray paint to mark the start & end position of the cyclic top fault so that recordings done before and after maintenance at the same location.

10.0 Step by Step Guide to Recording Cyclic Top Measurements on Track

STEP 1. Put the CTMD on the track

The CTMD should be positioned near to the cyclic top fault with the fixed side (marked L) on the left rail, facing the direction of travel of the measurement train.

STEP 2. Connect the Windows device to the CTMD

- Turn on the CTMD and the Windows device.

- Open the CTMD software to see the home screen.

- Click 'Connect to Wi-Fi' in the top left corner of the screen.

- The trolley begins to send real time data to the Windows device. The Gauge, Cant/SE are displayed below the 'Connect to Wi-Fi' button, but they are not recorded.

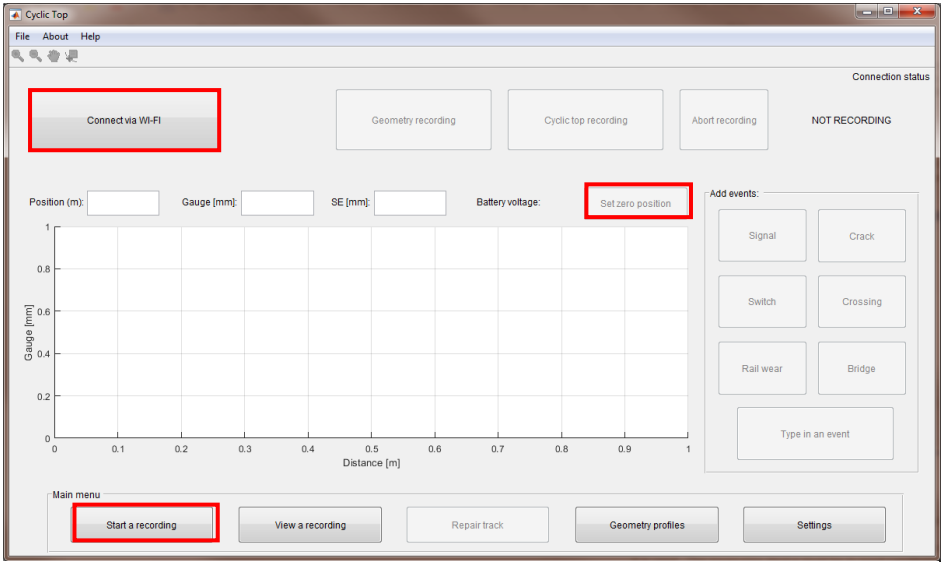


Figure 16 - CTMD Software Connecting

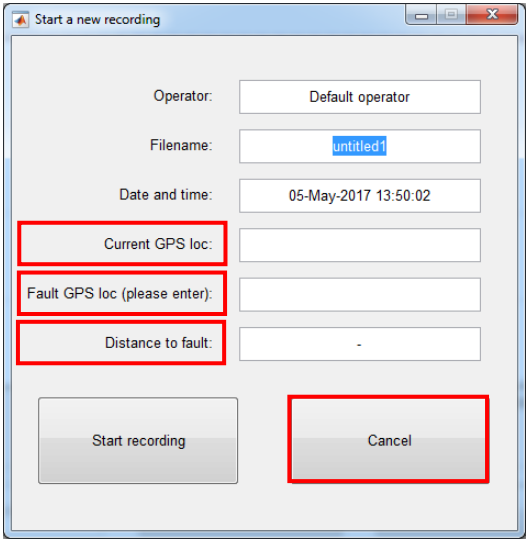


Figure 17 - Starting a New Recording

Step 3: Move to GPS location of Cyclic Top Fault

- Click 'Start a new recording' in the bottom left of the screen.

- In the 'Start a new recording' pop-up window, input the GPS position of the fault given by the measurement train into the 'Fault GPS loc' text box. The current GPS location is displayed in 'Current GPS loc' as well as the distance to the fault.

- Move the CTMD until it is at the GPS position of the cyclic top fault - this is when the 'Distance to fault' box displays less than 1 – 2 m.

- Mark the zero position with spray paint on the nearest sleeper to the GPS position (the spray paint will allow post maintenance measurements to start from the same position).

- Press 'Cancel' to close the pop-up window.

- On the home screen click 'Set zero position'.

STEP 4. Calculate Measurement Distance & Position CTMD on Track

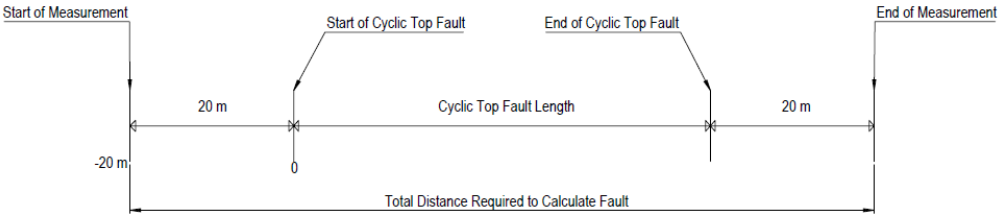


Figure 18 - Calculate Distance to Measure Diagram

- Move the trolley backwards to -20m from the start of the Cyclic Top fault. (Double check that the CTMD has the fixed side (marked L) on the left rail)

- The length of the fault is found on the measuring train fault report. The cyclic top fault has a start and end position shown in miles and yards. Subtract the start yards from the ending yards and multiply the difference by 0.91 to give the length of the fault in metres.

For example, for the below mileage:

074.0556 (25)
074.0489 (22)

The length of the fault in yards is 556-489=67 yards and thus in meters 60.97 m.

The end of the measurement is at the length of the fault + 20 m thus in this example is 80.97 m.

STEP 5. Record a Cyclic Top Fault

- Press 'Start new recording'.

- Input the Operator name.

- Input the Filename.

- Click 'Start recording' and leave the trolley in a static position. (The software will guide the user on the necessary waiting time)

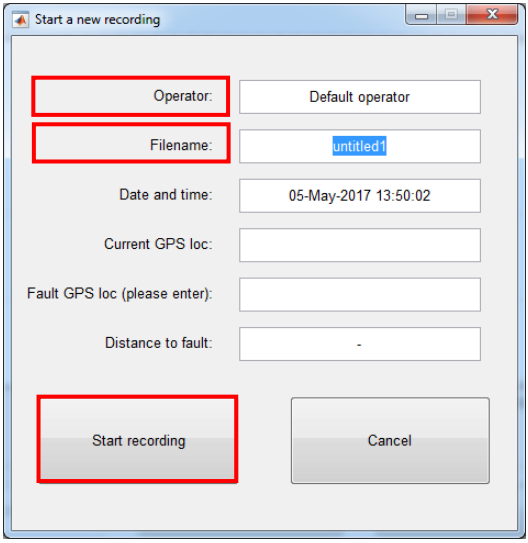


Figure 19 - Operator & Filename

- Position (m) is shown below in Figure 20.

- Push the trolley over the cyclic top fault. In this example push the trolley from - 20 m to + 80.97 m. When finished, gradually stop the trolley and let go of it. (This message can be seen below underneath the geometry and cyclic top recording buttons)

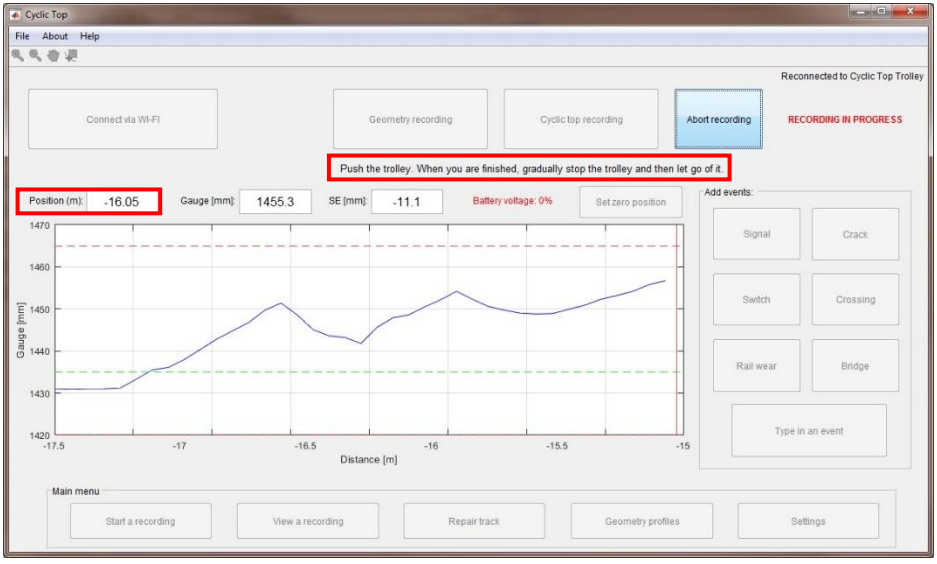


Figure 20 - Making a Recording

At any point whilst recording you can add predefined events such as Signal, Crack, Bridge etc. as well as custom events which may happen during the recording. These buttons are positioned on the right hand side of the screen below. CTMD software will record the position of the event and the type of event when such a button is pressed. Pressing the “Type in an event” button will open a window as shown below where you are able to type a custom event name and add it to the recording. Please be aware that if you stop the trolley completely it will automatically end measurement, we recommend you keep moving the trolley very slowly when adding a specific event.

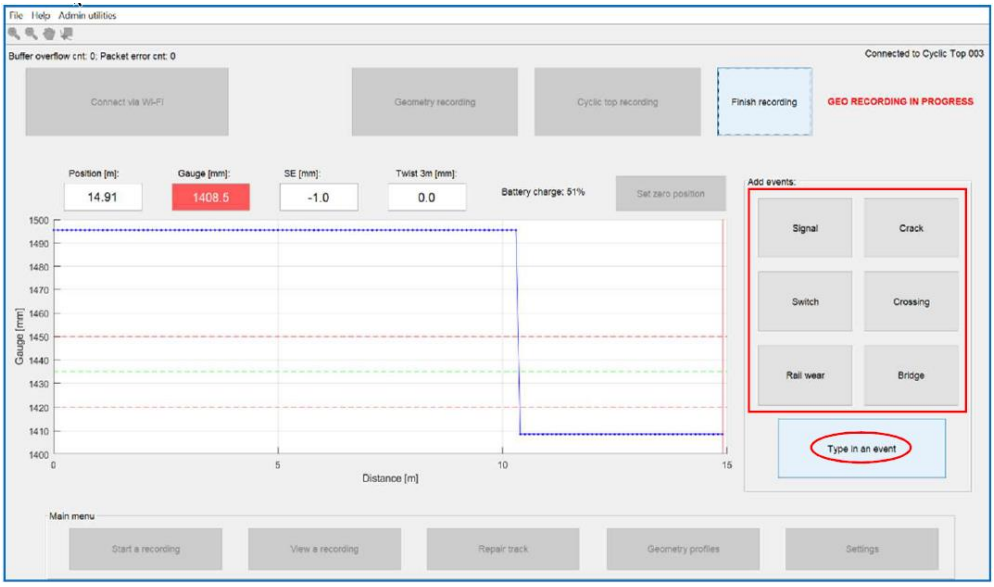
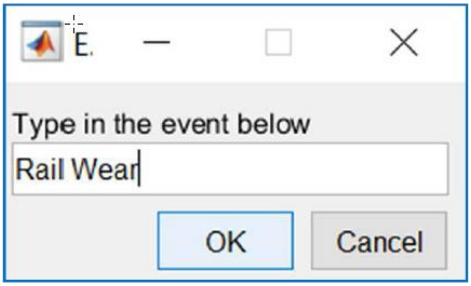


Figure 21 Adding events



- Once the trolley is in a stationary position a message underneath the geometry and cyclic top recording button will display a message that will tell the user how many seconds the trolley needs to be stationary for.

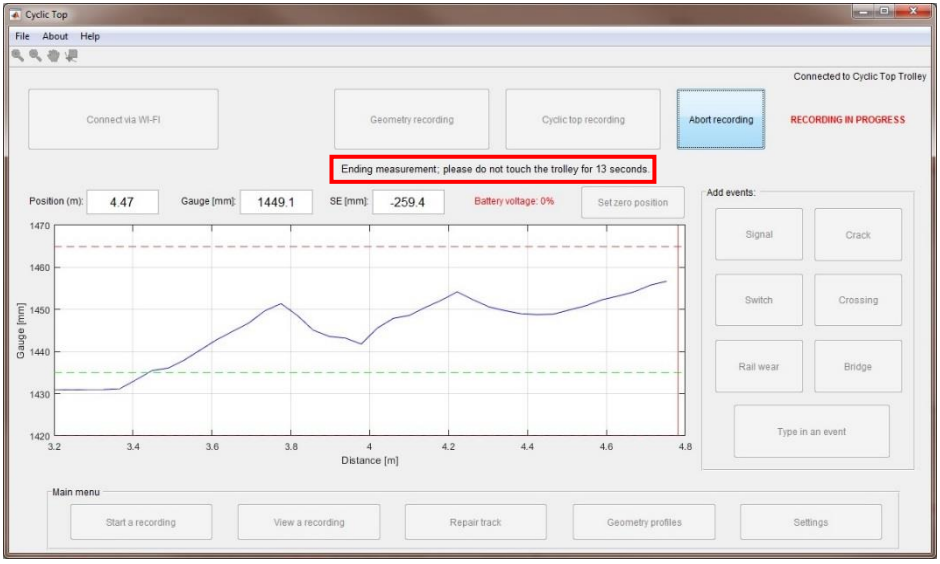


Figure 22 - Ending a Cyclic Top Recording

- When the trolley has been stationary for the required time the recording will automatically save.

- The trolley is ready to measure a different location or for the user to view the recording.

11.0 Viewing a Recording

Step 1: View Cyclic Top Faults for a specific wavelength

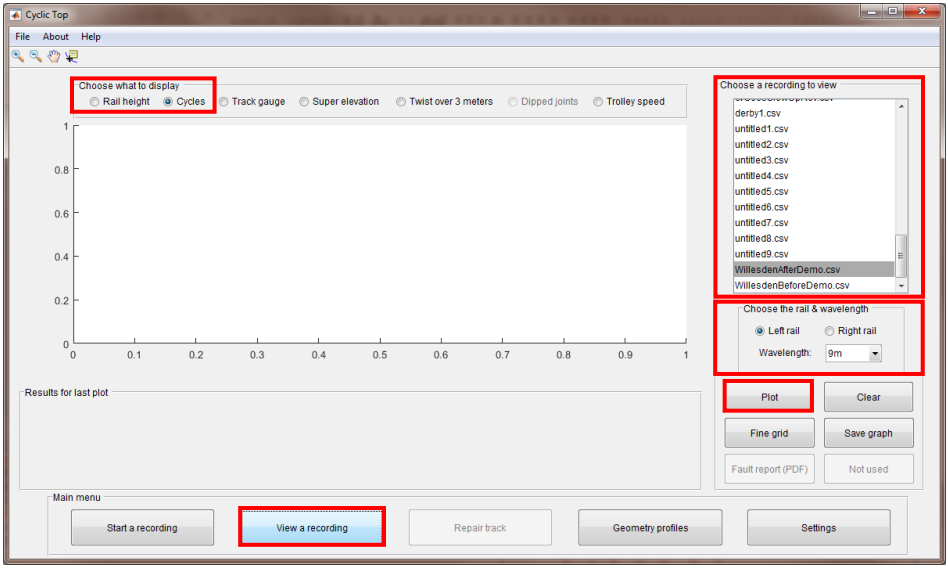


Figure 23 - View a Recording

- Click the 'View a recording' button at the bottom of the screen.

- In the 'Choose what to display' options at the top of the screen select 'Cycles'.

- The top right of the screen shows a list of recordings saved on the Windows device.

- Select the rail and wavelength of the cyclic top fault to analyse.

- Click 'Plot'. For example if the measuring train report has found an 18 m cyclic top fault on the right rail, then select those options.

Step 2: Comparing results before and after maintenance

- The below figure shows the cycle depths & locations for a fault of 9 m on the right rail before maintenance.

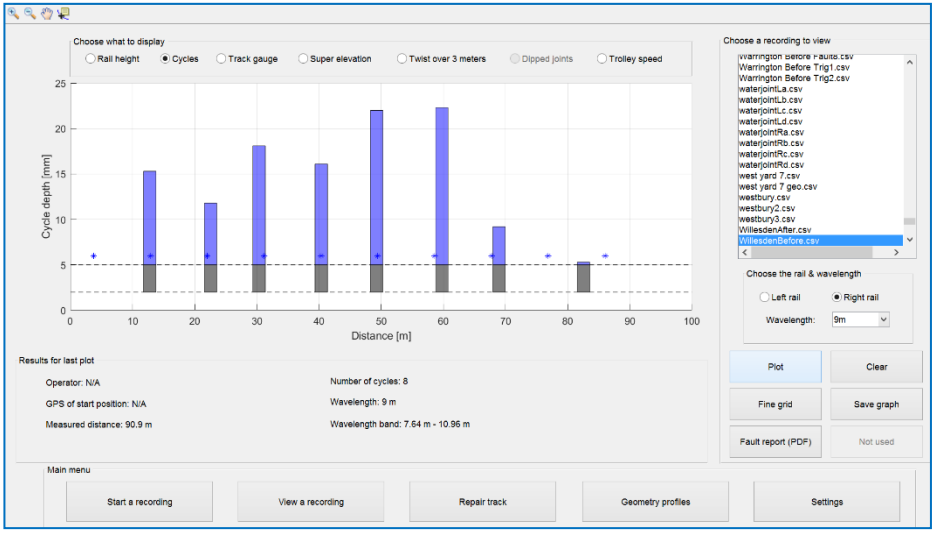


Figure 24 - Plotting a Recording

- The bar chart above shows the result of clicking 'Plot' to display the positions of the cycle depths for a 9 m cyclic top fault beofre maintenance has occurred.

- The graph shows eight cycles & the fault treshold is 5 mm (everything black is below 5mm)

- Another recording can be plotted over the top of the first recording. This can be used to compare a rail before and after maintenance. In the example shown, the maintenance removed all but two of the cycles.

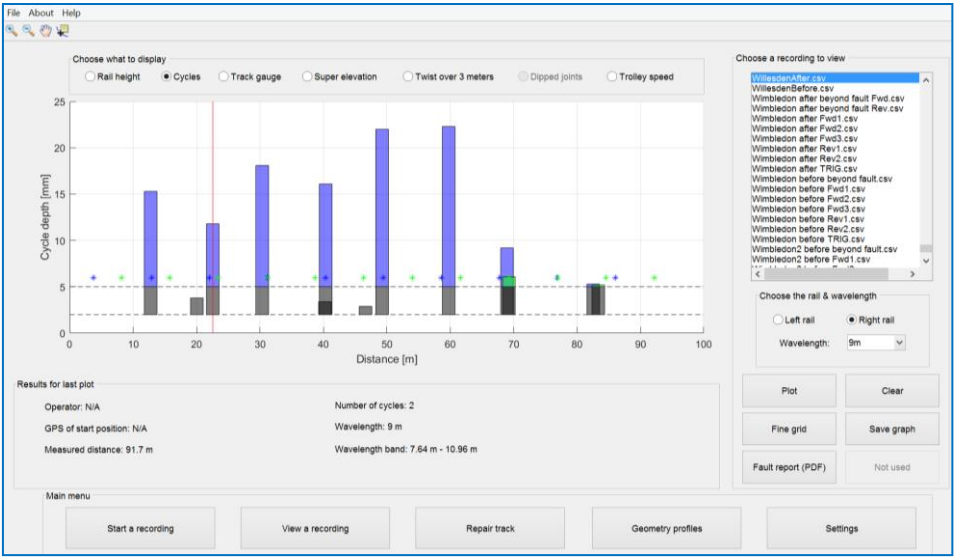


Figure 25 - Plotted Recording Before & After

- Along the top of the graph are options to view other data in the recording such as rail height track gauge, super elevation, twist, and Measurement Device speed. The plot of rail height can be used to compare the rail profile before and after maintenance. The plot of rail height shows the height of the rail relative to a straight line that intersects the starting position and the ending position of the trolley as it was used to measure the rail.

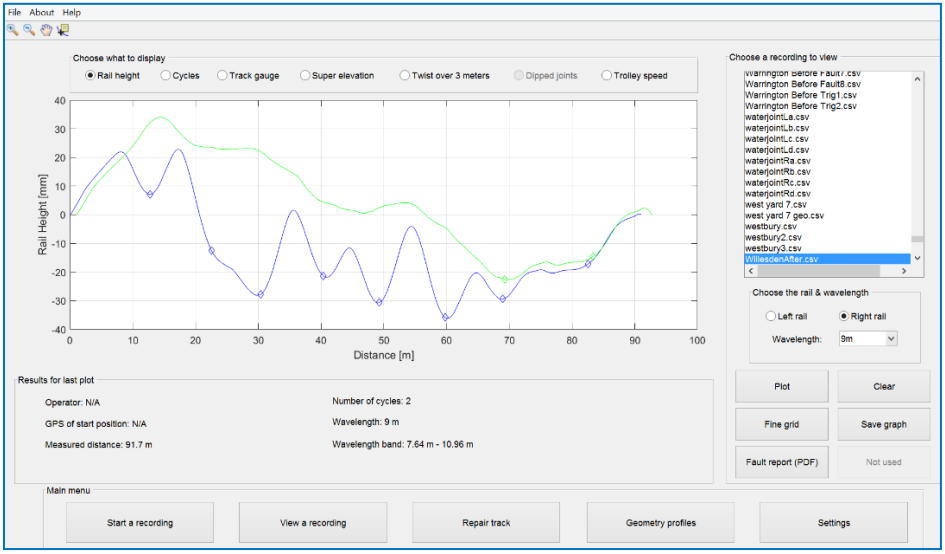


Figure 26 - Rail Height Before & After

The Track gauge, Super elevation and their limits of the track can be shown.

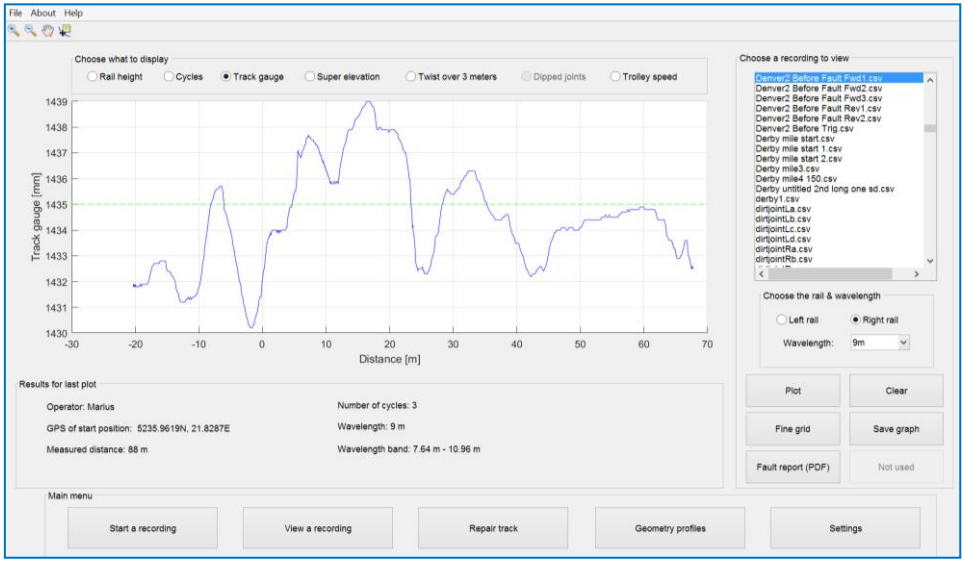


Figure 27 - Track Gauge

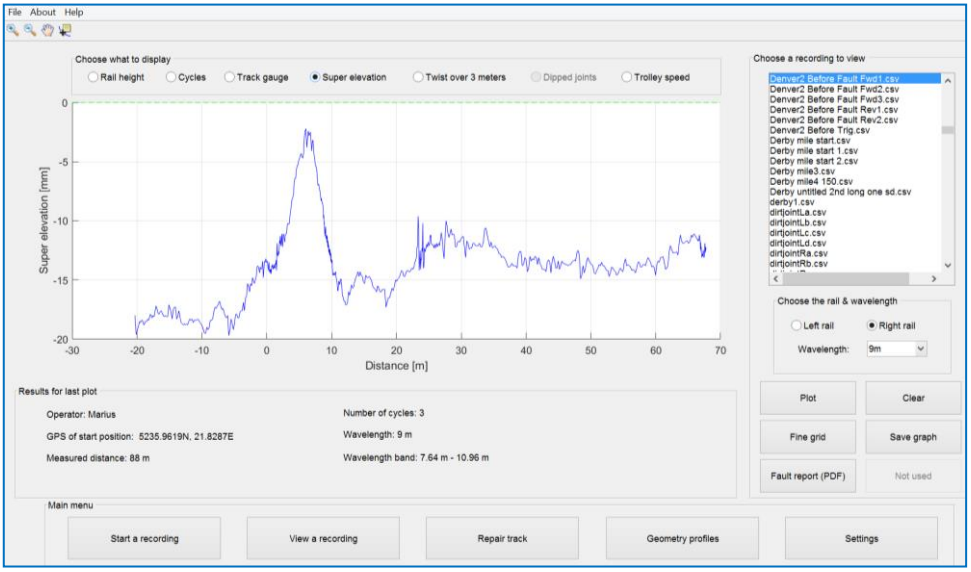


Figure 28 - Super Elevation (Cant)

- The Twist can be shown along with whether it is within allowable limits (shown by dotted horizontal blue and red lines).

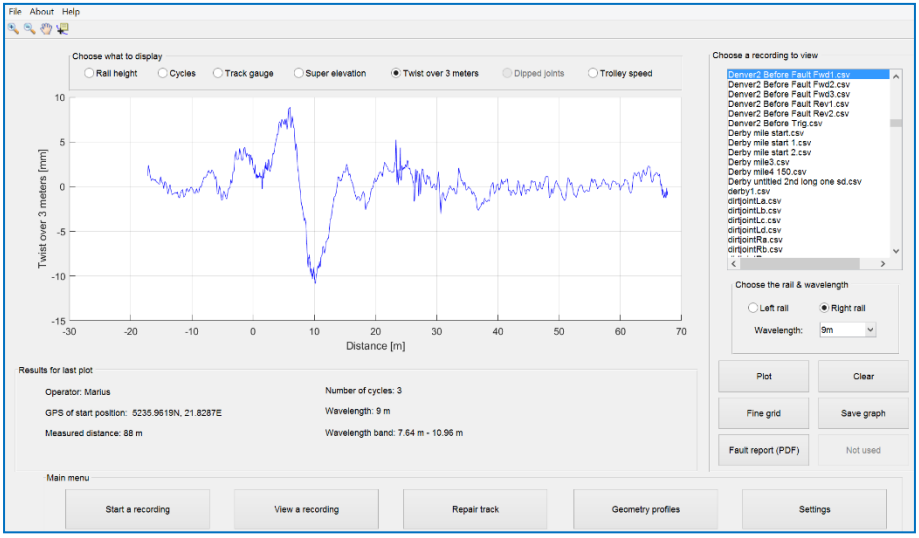


Figure 29 - Twist Over 3 Meters

- The Trolley speed can also be shown.

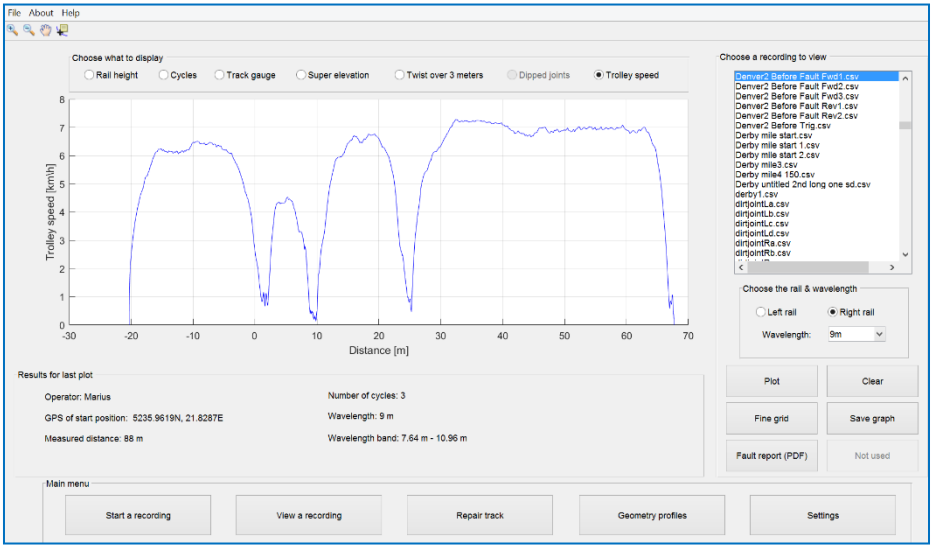


Figure 30 - Trolley Speed

11.1 PDF Recording Report

- Click ‘PDF report’ to view a summary of the results as a pdf report for the filename and cyclic top wavelength selected. For each of the rails ‘left’ and ‘right’ the PDF report produces three graphs:

- Firstly the PDF report shows the rail height profile and details about the recording such as the operator, file name, date and time, GPS of start position, length of track measured, which rail was measured, the number of cycles and the tested wavelength.

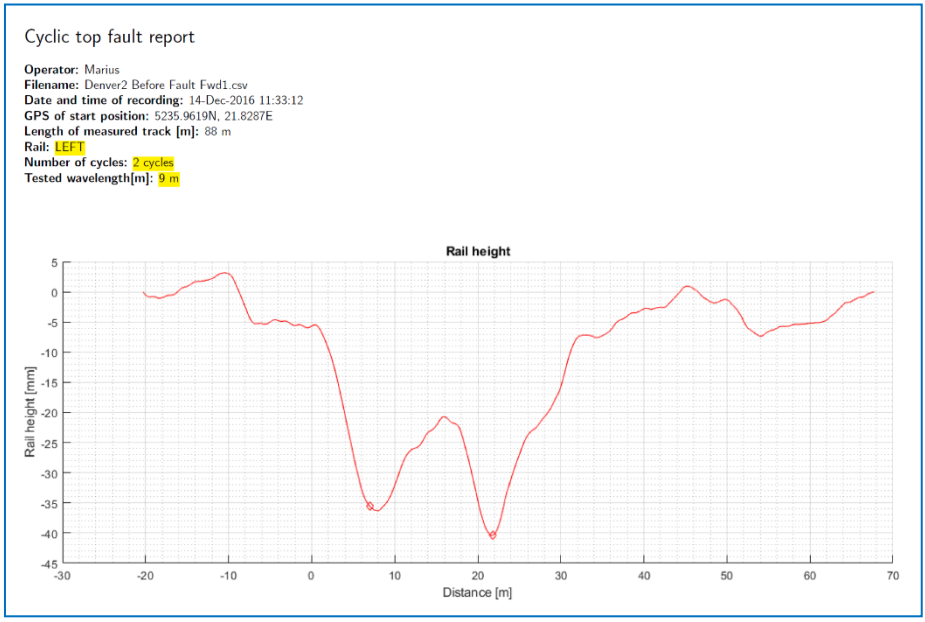


Figure 31 - PDF Report - Rail Height Profile

- Secondly the PDF report shows a graph of the identified cycles and a table showing the trough location and cycle depth.

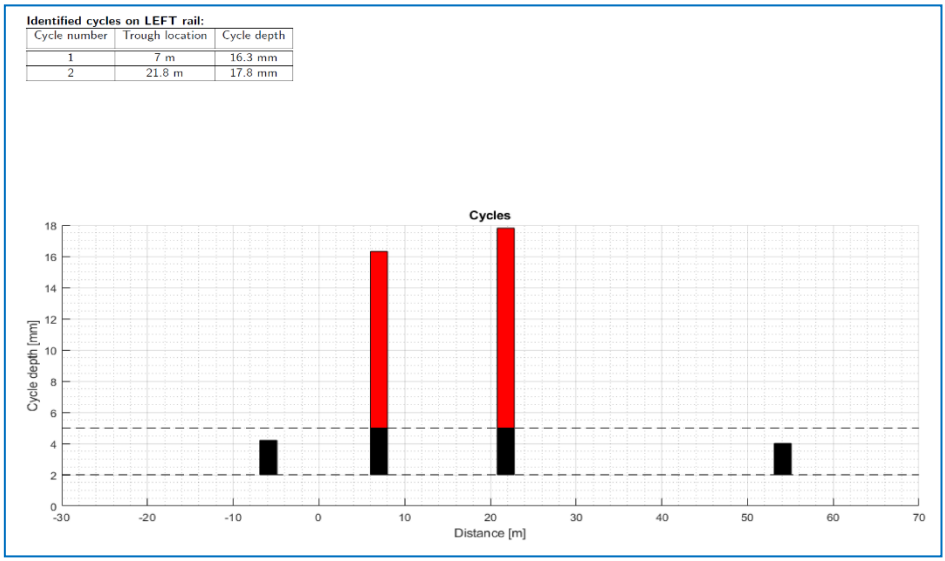


Figure 32 - PDF Report - Cycle Identification

- Thirdly the PDF report shows the recommended rail height and lift.

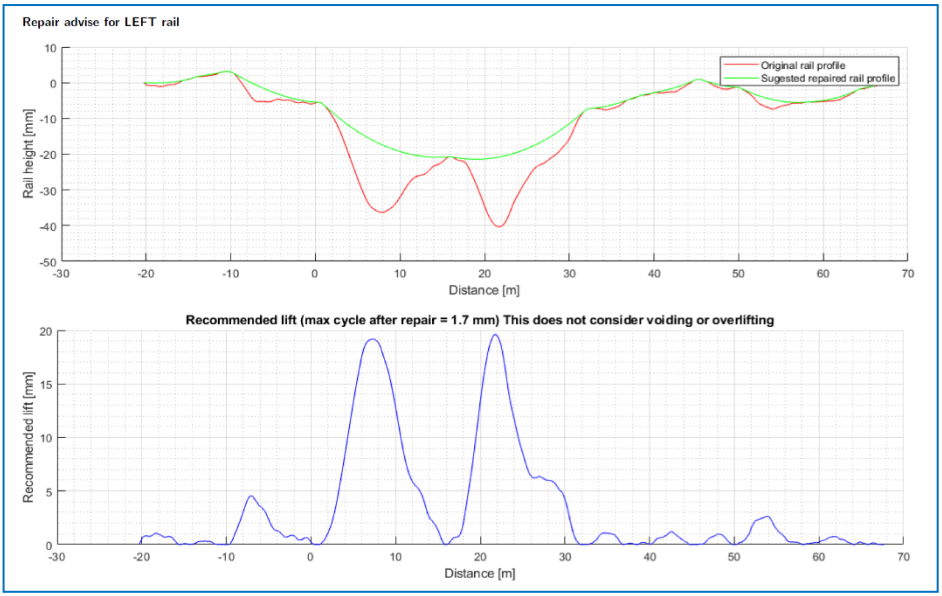


Figure 33 - PDF Report - Rail Height & Lift

- All parts of the report are then repeated for the other rail.

12.0 Track Repairs

12.1 'Repair Track' Screen

- The CTMD software makes recommendations for the lift required in track repair. The top graph shows the profile of the Rail height, the middle graph shows the position and Cycle depth of the identified cycles & the lower graph shows the recommended lift.

- In the top graph, the recommended rail height is shown in one colour (blue in the example shown) as well as the recommended rail height and the recommended repair height. The recommended repair height may be higher than the recommended rail height based on the overlift selected by the user.

- The user can click 'Increase' or 'Decrease' to change the 'Overlift'.

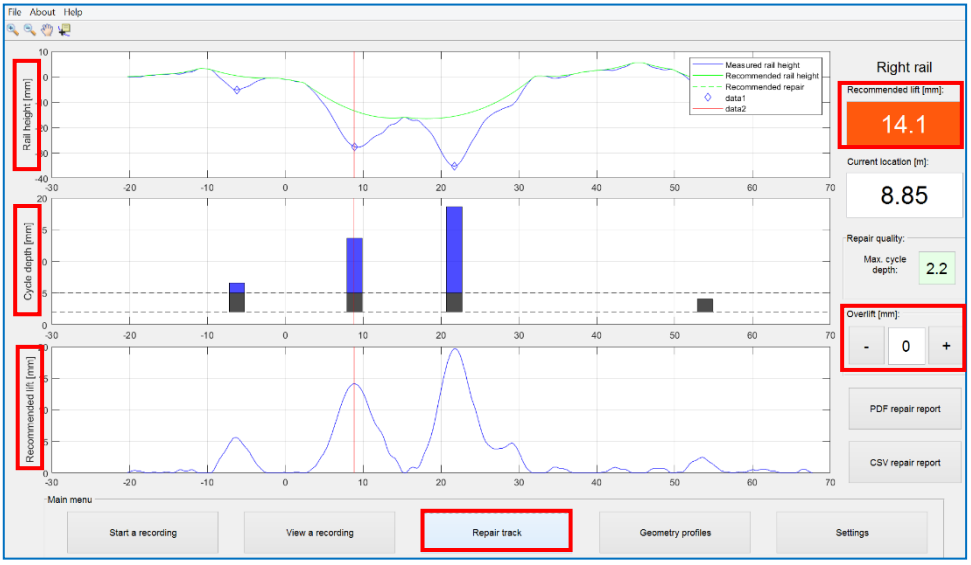
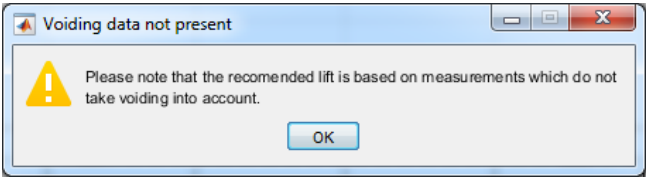


Figure 34 - Repair Track

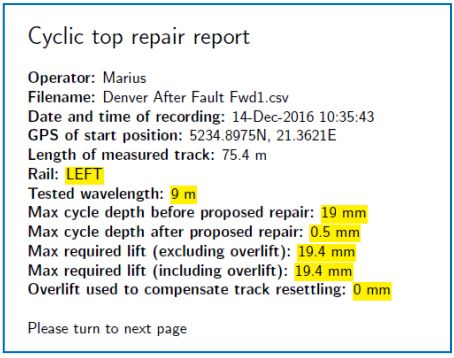
- The recommended rail height and recommended lift height are based on measurements that do not include voiding. Use of void meters can help to determine the amount of overlift required – the user is warned of this by a notification window.



- The dotted lines in the graphs of rail height and recommended lift include overlift. If the amount of overlift is changed, the dotted lines extend up and down. A red line moves as the user walks and the colour of the recommended lift box changes colour when the user reaches the peak of the lift.

12.2 Repair Report PDF

- Click on 'Repair report (PDF) to view a repair report.



Cyclic top repair report

Operator: Marius
Filename: Denver After Fault Fwd1.csv
Date and time of recording: 14-Dec-2016 10:35:43
GPS of start position: 5234.8975N, 21.3621E
Length of measured track: 75.4 m
Rail: LEFT
Tested wavelength: 9 m
Max cycle depth before proposed repair: 19 mm
Max cycle depth after proposed repair: 0.5 mm
Max required lift (excluding overlift): 19.4 mm
Max required lift (including overlift): 19.4 mm
Overlift used to compensate track resettling: 0 mm

Please turn to next page

Figure 35 - Repair Report Details

- The repair report shows the same details as the fault report of a recording with additional details showing the maximum cycle depth before and expected after the repair, the lift required with and without overlift and the overlift that was set.

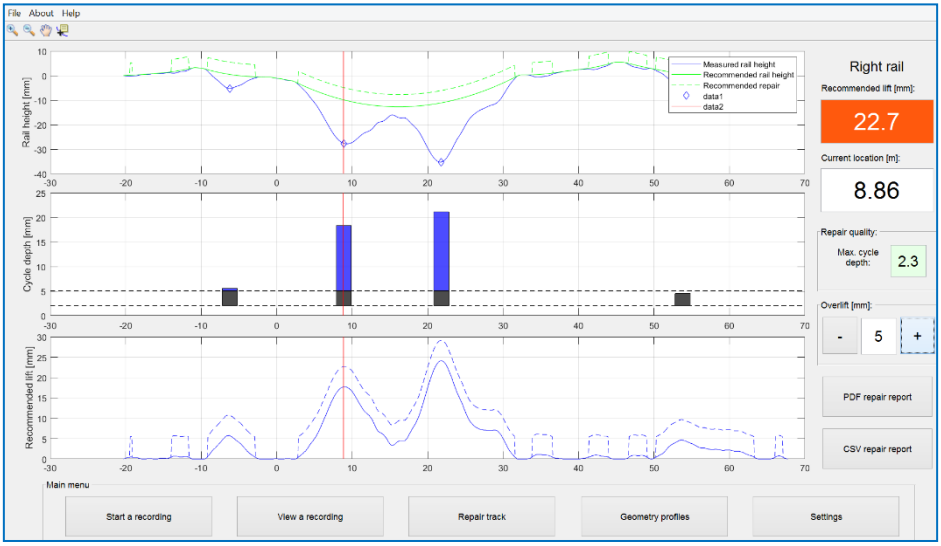


Figure 36 - Repair Report Graphs

- The report contains a print screen of the repair track page.

Required lift (including overlift):

Dist [m]	Lift [mm]	Dist [m]	Lift [mm]
-20	0	10	0
-19	0	11	0
-18	0	12	1
-17	1	13	4
-16	2	14	3
-15	2	15	3
-14	1	16	1
-13	0	17	0
-12	0	18	0
-11	0	19	0
-10	0	20	0
-9	0	21	0
-8	0	22	0
-7	0	23	0
-6	0	24	0
-5	1	25	0
-4	4	26	0
-3	9	27	0
-2	12	28	0
-1	6	29	0
0	2	30	0
1	0	31	0
2	0	32	0
3	0	33	0
4	0	34	0
5	0	35	0
6	0	36	0
7	1	37	0
8	3	38	0
9	1	39	0

Dist [m]	Lift [mm]
40	0
41	0
42	0
43	0
44	0
45	0
46	1
47	2
48	1
49	0
50	0
51	0
52	0
53	0
54	0

Figure 37 - Repair Report - Required Lift at Each Metre

- Lastly the Repair Report PDF shows the required lift including overlift at each metre of the track.

If a repair is carried out using the advised lift reported by the software (plus any user selectable over-lift), it is very important to repair both rails in order to ensure that twist faults are not introduced into the track. If following the repair advice for both rails, no twist faults will be introduced.
It is also important to identify and resolve any voiding issues the track may have as these are not measured by the ABT7000.

13.0 Step by Step Guide to Recording Geometry Measurements on Track

Step 1 Setting New Geometry Profiles

Open CTMD software on the windows tablet and click "Geometry Profiles" to set the tolerance parameters (Figure 38).

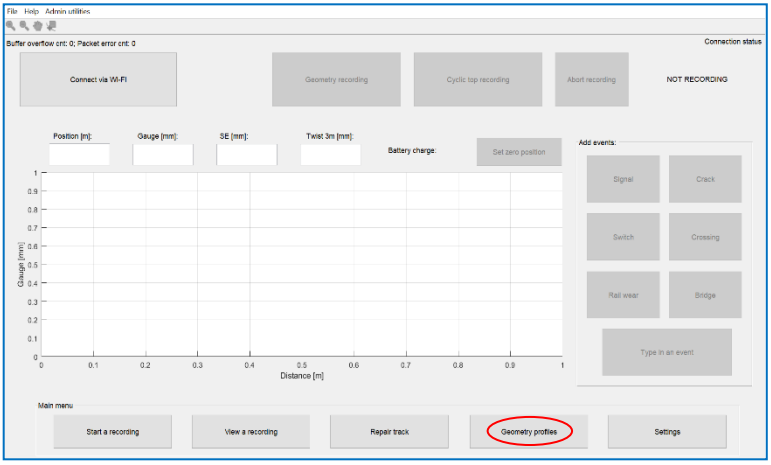


Figure 38 Chaining Geometry Profile

You can create a new profile by clicking on the "Create New Profile", which will open the window shown in Figure 39. Enter the required details and click "OK" to create the new geometry profile.

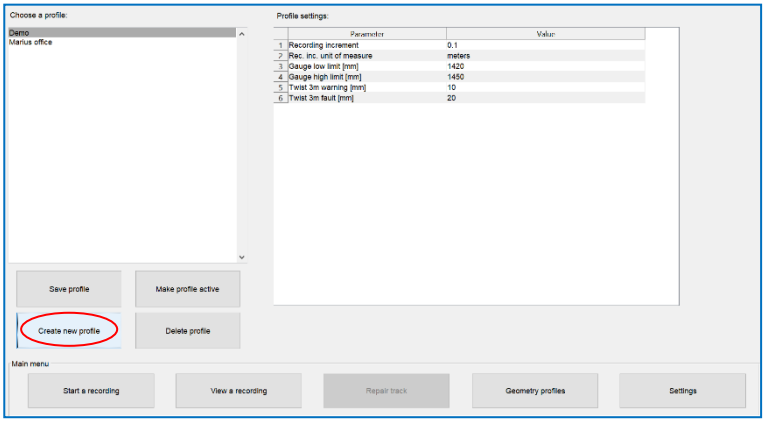


Figure 39 Creating new profile

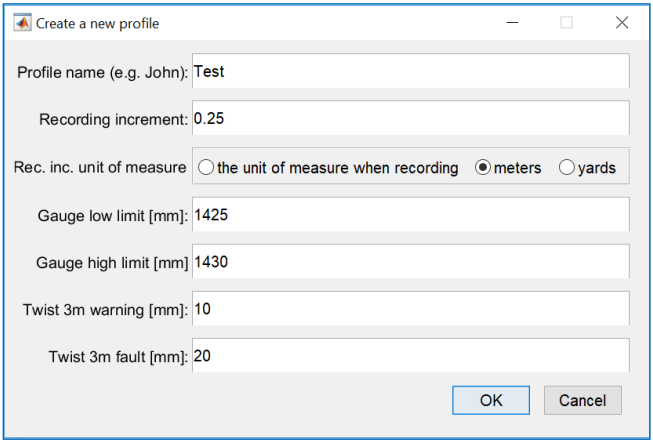


Figure 40 Profile settings

Figure 41 shows the newly created Geometry Profile. Pressing the "Make profile active" button will make this profile active until someone changes the settings in the future.

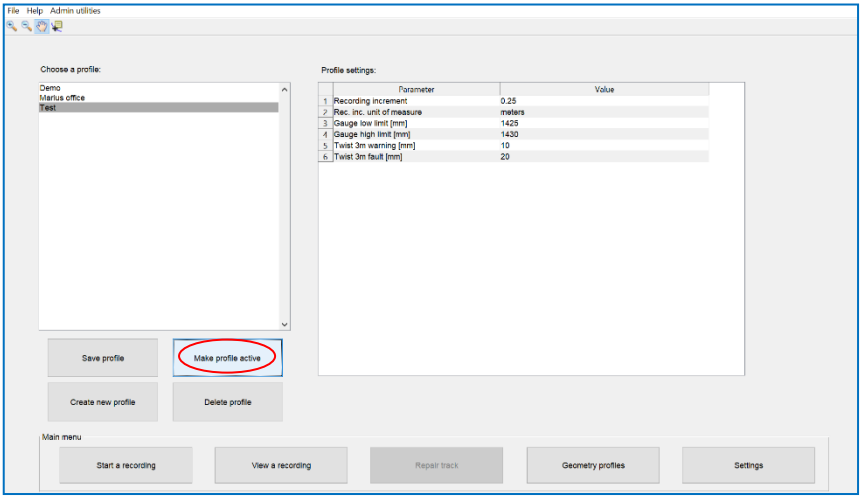


Figure 41 Activating the profile

STEP 2. Put the ABT7000 on the track

The CTMD should be positioned on the track with the fixed side (marked L) on the left rail, facing the desired direction of travel.

STEP 3. Connect the Windows device to the CTMD

- Turn on the CTMD and the Windows device.

- Open the CTMD software to see the home screen.

- Click 'Connect to Wi-Fi' in the top left corner of the screen.

- The trolley begins to send real time data to the Windows device. The Gauge, Cant/SE are displayed below the 'Connect to Wi-Fi' button, but they are not recorded.

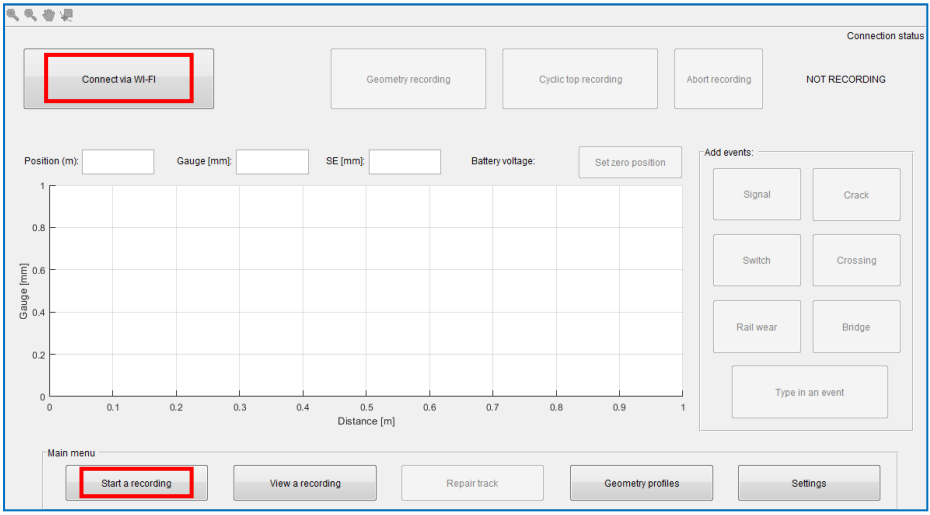


Figure 42 Connecting to CTMD

STEP 4: Start Geometry Recording

Once the CTMD is ready to start a recording, press the “Set Zero Position” to reset the position reading to zero.

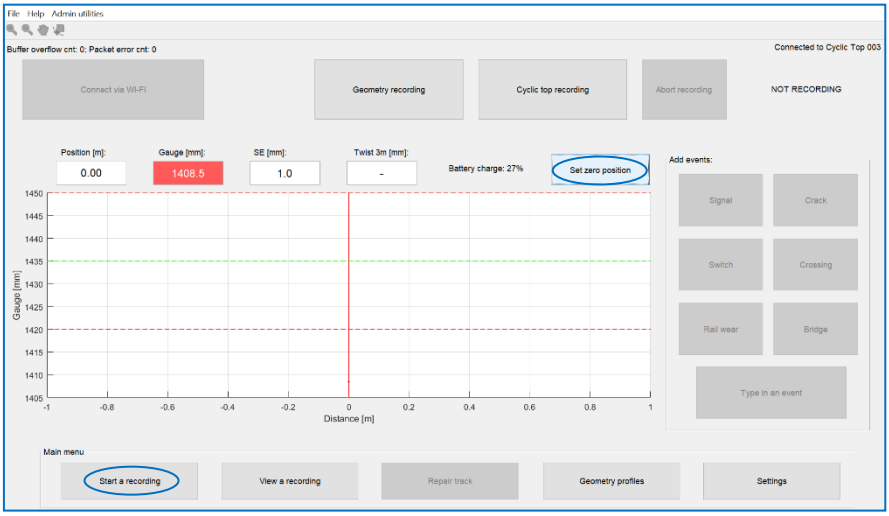


Figure 43 Setting zero position

Press “Geometry Recording” to open the window shown in Figure XX.

- Input the Operator name.

- Input the Filename.

- Click ‘Start recording’

The other fields in the window are optional. The “Counting” can be “Up” or “Down” depending on the direction of travel and will change the on-screen position of the trolley when it is moved.

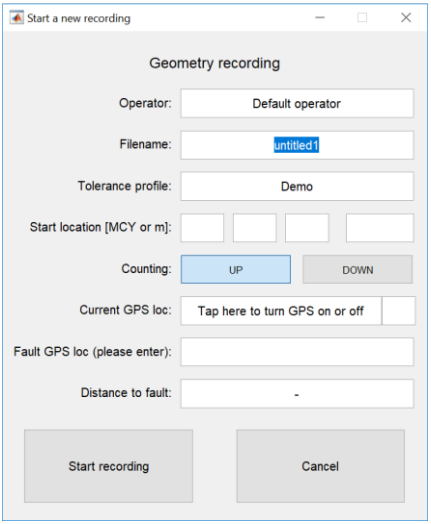


Figure 44 New geometry recording settings

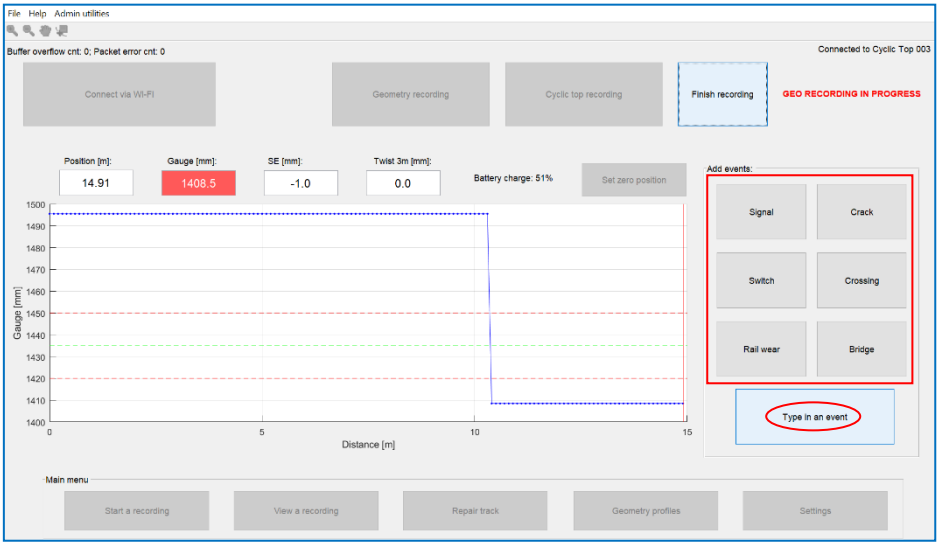


Figure 45 Geometry Recording in progress

Push the CTMD along the track, you can tap on the live graph to change which measurement to view (Gauge, SE and Twist).

You can add events such as Signal, Crack, Bridge etc. as well as custom text evens which may happen during the recording by pressing the corresponding buttons on the right side of the screen as shown in Figure 45. CTMD software will record the position of the event and the type of event when such a button is pressed. Pressing the "Type in an event" button will open a window as shown in Figure 46 where you are able to type a custom event name and add it to the recording.

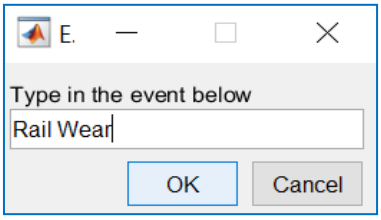


Figure 46 Adding Custom Event

When the recording is finished, press "Finish Recording" to stop the measurement and save the data.

STEP 5: Start Geometry Recording

Press "View a recording" to open the results screen which is shown in Figure XX.

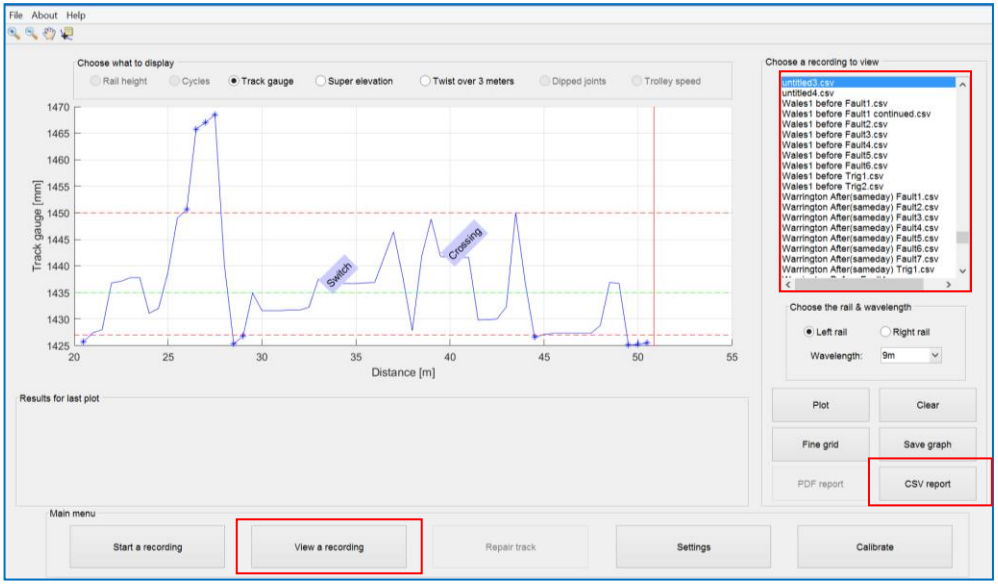


Figure 47 - Viewing track gauge results with events

Figure 47 shows the Results screen. Similar to Cyclic Top measurements, you can choose to plot Track gauge, Super elevation or Twist over 3 metres. Choose the recording by clicking on the name and press "Plot" to see the recording graphically. This will also show the events that were added during the recording.

STEP 6: Opening CSV report

Pressing "CSV report" button on Figure 47 will create a tabulated version of the recorded results. Figure 48 shows an example of such a report. The user is able to view the position at which faults, such as Gauge and twist faults occurred.

	A	B	C	D	E	F	G	H
1	ABT7000 geometry measurement file							
2	File version: 2							
3	Operator: Default operator							
4	Filename: 181005-CTT3-10KGS-001							
5	Profile: Marius test track							
6	Gauge low limit: 1420							
7	Gauge high limit: 1460							
8	Twist 3m warning limit: 12							
9	Twist 3m fault limit: 15							
10	Start location:							
11	Counting: up							
12	Date and time of recording: 05-Nov-2018 11:15:10							
13	GPS of start position:							
14	Length of measured track [m]: 140							
15	End of header							
16	Distance [m]	Gauge [mm]	SE [mm]	Twist 3m [mm]	Gauge fault [mm]	Twist 3m warning [mm]	Twist 3m fault [mm]	Event
1048	103.1	1432.9	34	14.5		2.5		
1049	103.2	1433.3	35.3	15		3		
1050	103.3	1433.5	36.5	15.5		3.5	0.5	
1051	103.4	1433.8	36.8	15.3		3.3	0.3	
1052	103.5	1433.8	36.8	15.1		3.1	0.1	
1053	103.6	1433.7	36.9	14.9		2.9		
1054	103.7	1434	36.9	14.3		2.3		
1055	103.8	1434	37.7	14.4		2.4		
1056	103.9	1434.2	38.4	14.3		2.3		
1057	104	1434.6	38.8	13.5		1.5		
1058	104.1	1434.9	38.8	12.7		0.7		
1059	104.2	1435.1	38.7	12		3.5527e-15		
1060	104.3	1435.2	38.8	11.8				

Figure 48 – CSV Report

14.0 Troubleshooting

Cyclic Top Software not working The software does not work as expected, for example graphs do not show or buttons in the user interface do not work.	Close the program, turn off the trolley, wait 3 seconds and try to turn the trolley on. Open the software and try to connect to the trolley.
No Wi-Fi connection The CTMD and Windows device are not connected.	Check in the Wi-Fi connection on the right side of the Windows taskbar that the device is connected to the trolley Wi-Fi. Try restarting the trolley and if problem persists try and restart the tablet & app.
Negative distance During a recording the current distance displayed is negative.	When measuring a cyclic top fault, negative distance is shown when the trolley is pushed the wrong way round. The trolley should be positioned with the fixed side marked (L) to the left facing in the direction of travel of the measurement train.
Cannot get a GPS signal The current GPS location will give a message saying 'No GPS signal'	The location may have too much shielding due to being next to high buildings, in a confined space or in a tunnel. Identify the correct location using mileage and chainage information and/or user knowledge of the cyclic top fault.
No GPS Coordinates show up	- Check that the Geode GPS unit is turned on. (green light solid or blinking) - If the Geode GPS unit does not turn on the try to manually turn it on via its power button.

15.0 Using the Geode GPS as a stand-alone product.

15.1 When used as part of the CTMD

- The Geode GPS is automatically turned on when GPS coordinates are required by the software.

- If the user presses the Geode power button, it will turn on/off.

- The Geode only measures the GPS position at the start position, and only draws power when the user has the 'Start new recording' pop-up open.

15.2 To use the Geode GPS as a stand-alone product

- Turn off the cyclic top measuring device.

- Turn on the Geode.

- Connect to the Geode via Bluetooth from a device using dedicated surveying software or the Geode Android app and IOS.

- Use the Geode according to the Geode user manual.

- The Geode contains its own battery. The Geode can be re-charged using its own charger or alternatively using a good quality micro USB charger.

16.0 Directive and standards

The equipment has been tested and found to comply with the relevant sections of the below referenced specifications.
The unit complies with all relevant essential requirements of the following directives and the design has been made in accordance with the following standards.

CE Marking

CE

In order to fulfil the requirements of CE marking the CTMD meets the following requirements:

Conforms with the essential performance requirements of the Electromagnetic Compatibility Directive (EMC Directive) and it's amending directives. Standard **EN50121-4**

Conforms with the essential performance requirements of the Radio Equipment Directive (RED Directive) and it's amending directives. Standard **EN300 328**

The CTMD also meets the following additional requirements:

Conforms with the essential performance requirements of the Electromagnetic Fields Directive (EMF Directive) and it's amending directives. Standard **EN62479**