



# ABT7000 Abtus Cyclic Top Measurement Device (CTMD)



## Instruction Manual

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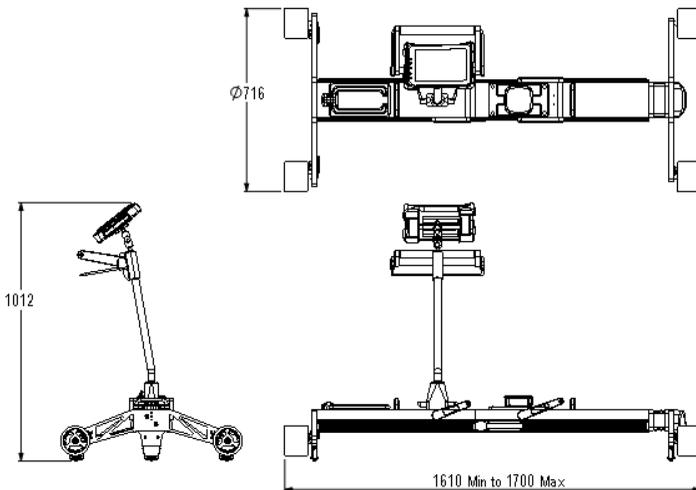
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### 3.0 Specification

Weight	On track(CTMD)	23.5kg
	- Box & Foam	22kg
Physical Dimensions	- Windows Tablet	1kg
	- Chargers & Other In Box	1kg & 1kg
	- On Track (CTMD)	Length: 716mm Height: 1012mm Width: 1700mm(max) 1610mm(min)
	- In Box	Length: 1040 mm Height: 380 mm Width: 950 mm
Operating Temperature	-	-10°C to + 50°C (-4°F to 122°F)
Environmental Rating	-	IP65
Battery Life	- CTMD	Up to 12 hours
	- Windows Tablet	Up to 6 hours
Operating System	-	Must be 64 bit Windows 7, 8 or 10
PC Connectivity	-	Wi-Fi



**Figure 2: Overall Dimensions**

## 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 it is under 25kg the device can be lifted onto and off of the track in a single lift by one user. However if it is to be carried, since the device is more than 20kg it must be broken into its three parts so that it can be carried by two people. The device can be dismantled to fit into a protective transit case for transportation and storage.

Cyclic top track geometry data is transmitted from the measuring device via Wifi to a Windows device supplied with the Cyclic Top Software. The software displays track geometry data including distance, Cant, Twist and Gauge in real time. The cyclic top analysis can be viewed at the end of a measurement. The data is saved as a .csv file containing distance, Cant, Twist and Gauge data and as a pdf containing the cyclic top analysis report. PDF reports can be transferred to other devices by using a USB flash drive.

The ABT7000 is intended to be used for the measurement of cyclic top faults. The software also allows the device to be used to measure track geometry. The operator should refer to the ABT7000 instruction manual for further details.

The CTMD is designed with the following characteristics:

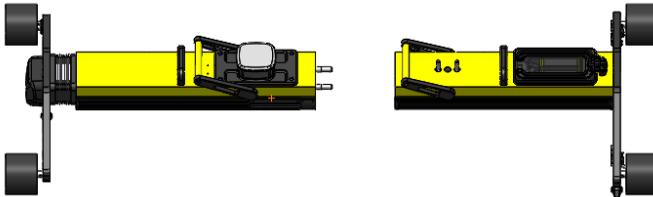
- This product is used to accurately record Gauge, Cant and Cyclic Top depth and cycles for railway maintenance.
- Non-conducting: The gauge is insulated and therefore does not create electrical contact between the two running rails. This is achieved by using plastic wheels and also has protective non-conductive blocks on the top of the contact bearings.
- Lights: The device is fitted with lights on the front and the back. These are to help illuminate the path of the user during times or in areas of low lighting. Filters are available from Abtus for different colour lights if required (for example red).
- Compact: The CTMD breaks down into 3 separate parts to allow it to fit into most vehicle boots.

- Portability: The CTMD is designed to be easily lifted onto and off the track. This is done using the handles provided. The total weight of the system is 25Kg.
- Sturdy: The gauge is designed to be solid in structure especially around the joint.
- Colour: The device is predominantly yellow (RAL1018).
- The unit has been designed to be user-friendly with only limited training required.

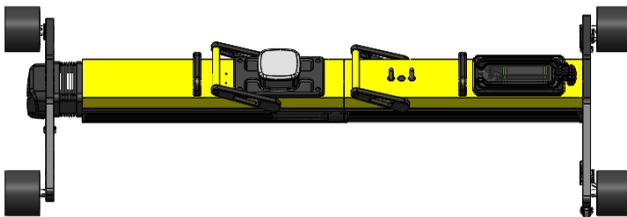
## 4.2 Assembly

Upon receipt of your ABT7000 some assembly is required.

First step: Join the main parts A and B together, see figure 3. Assure the lock lever is in the unlock position before join them. See figure 4.

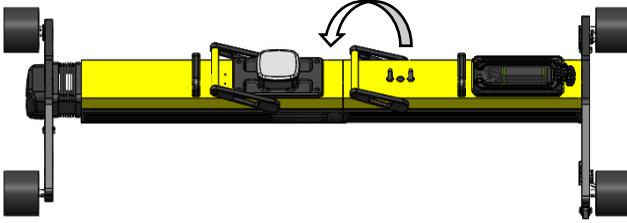


**Figure 3: Join Step 1**



**Figure 4: Join Step 2**

Second step: Lock both parts using the lock lever. Move the lever to the other side and lock them together. See figure 5.



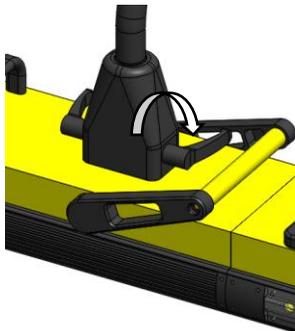
**Figure 5: Join Step 3**

Third Step: Insert the handle in place. See figure 6.



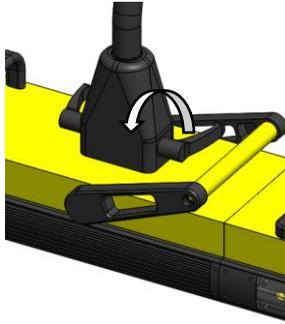
**Figure 6: Handle Assembly Step 1**

Fourth step: Rotate the two handle levers to secure the handle in place. See figure 7.



**Figure 7: Handle Assembly Step 2**

To release the handle rotate the levers in the opposite direction. See figure 8.



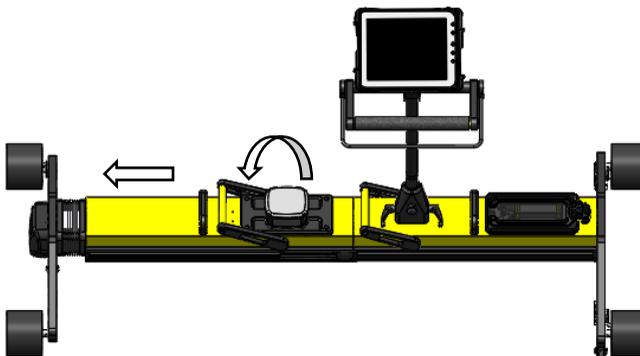
**Figure 8: Handle Disassembly**

Fifth step: Assemble and adjust the tablet holder and the tablet using the ball joints. See figure 9.

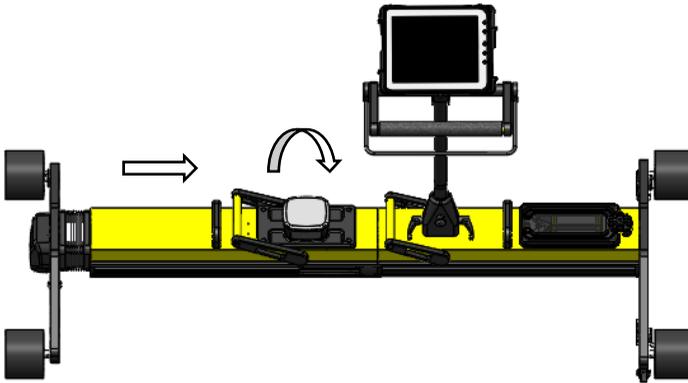


**Figure 9: Ball Join**

Sixth Step: Retract the gauge using the gauge lever to sit the CTMD in place on the track. After that the gauge can be released using the gauge lever again. See figures 10 and 11.



**Figure 10: Gauge Release**



**Figure 11: Gauge Retraction**

Seventh step: Adjust the handle to control the CTMD from a different position – the handle can be orientated towards the side, back or front of the CTMD. Release the knob at the base of the handle and rotate the handle. See figure 12.



**Figure 12: Handle Rotation**

## 5.0 Maintenance

The Measurement Device does not require any lubrication as all the moving parts have sealed bearings. However the following routine checks must be carried out on the gauge:

### 5.1 Before Each Use

- Ensure that wheels rotate freely
- Ensure that there is nothing on the wheels (dried mud, leaves or any other debris)

### 5.2 Every 3 Months

- Visually inspect the CTMD for signs of damage. If necessary, contact your local distributor for help.
- Check all wheels for flats or grooves. If any are found the Measurement Device must be returned to Abtus. Flat spots develop on wheels if the device is pushed along the track while the brakes are engaged. Flat spots develop on bearings when they are unable to rotate freely, and the same side is always in contact with the rail.
- Check that when Measurement Device is assembled, there is no play in the joint.

### 5.3 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 gauge should have at least one trained operator who is responsible for returning the gauge.

The measuring device is marked with a calibration sticker showing the next annual due date and must be returned to Abtus for annual calibration and maintenance. If the ABT7000 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 it 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

### 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	±0.5mm
Resolution	0.1mm

### 6.3 Super-Elevation

Range	±250mm
Accuracy	±0.5mm
Resolution	0.1mm

### 6.4 Twist

Range	±250mm
Accuracy	±0.5mm
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:**

+ **ive** SE is the right rail **lower** than the left rail

- **ive** SE is the right rail **higher** than the left rail

**(Ask to Abtus for setting a different one if you have different sign convention)**

NB. The left side is the fixed end of the device.

NB: The device can be used to measure through switches and crossings but the operator should be aware that the accuracy will be slightly reduced.

### 6.5 Distance

Range for Gauge, SE & Twist	200km
Accuracy	±1%
Resolution	10mm

## **7.0 Transportation and Storage**

The ABT7000 must be transported inside its transit case. The case should be moved by two people following safe manual handling practices. The case should be stored flat to prevent it falling over.

If the Measurement Device is not going to be used for a few weeks, it is strongly recommended that the batteries be fully charged and that the Measurement Device be stored away from direct sunlight in a location of low humidity where the temperature will be between: +20°C and +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 license and any necessary wireless drivers and will check the Wi-Fi connection with the CTMD. If the Windows device does not connect to the CTMD contact Abtus for support.

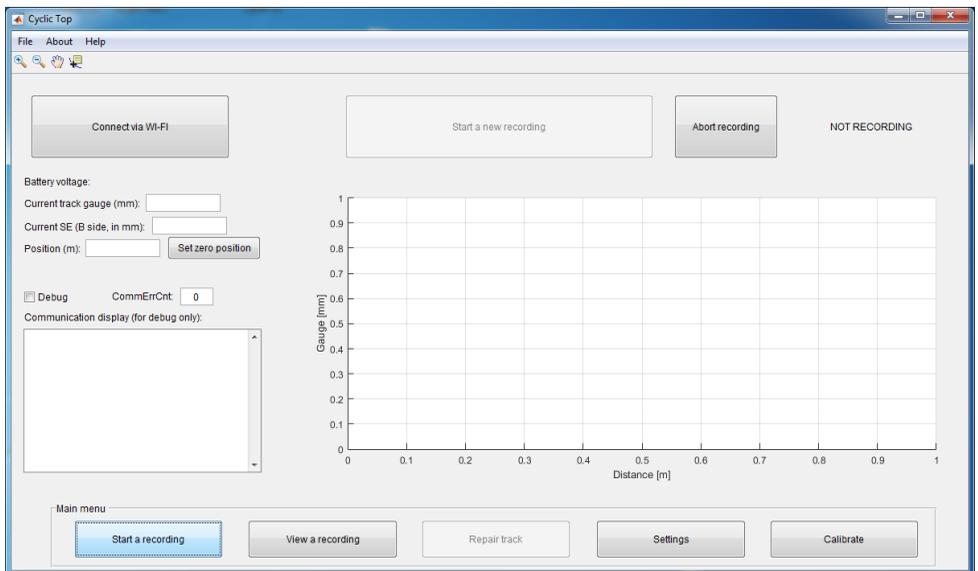
## 9.0 Before going on track

### 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. Check the battery levels of the Panasonic Tablet.

### 9.2 Check Wireless Connection

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



**Figure 14: Home screen for the CTMD software**

### 9.3 Pre-Use Checks

The following checks should be carried out in an office or depot before taking the ABT7000 onto the track.

- The condition of the ABT7000 should be checked by the operator before it is used. The measuring device must be in good condition with no loose or broken components.

- The ABT7000 must be marked with a valid calibration sticker showing the next annual due date. The device should not be used after the calibration due date.
- The batteries should have sufficient charge before the measuring device is taken onto the track. This is shown by pressing the battery indicator button on each battery.
- The safety brakes should be functioning correctly. The brakes are applied to two of the wheels. They should be tested by releasing the brake handle, and turning the two wheels by hand to check that they cannot move.
- The wheels and bearings should be clean and turn freely.
- The electrical connection pins between the three parts of the device should be clean.
- An appropriate and adequate safe system of work must be in place before the ABT7000 is used.

## 9.4 Training and responsibilities

Only trained and competent people should use the ABT7000.

- All users must have received adequate training for the use of the ABT7000.
- A trained person will be responsible for the gauge 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 ABT7000 and have access to it for reference.
- Operators should understand the accuracy levels of the ABT7000.
- The trained operator is responsible for using the ABT7000 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 reasonable practical. They are responsible for informing any other staff of safety requirements relating to the ABT7000 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 Obtain Measuring Train Data

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, D with I being the most severe and D being the least severe. Normally, at a minimum categories I, A & B require speed restrictions.

The direction of the measuring train is shown by the mileage information. The GPS position gives the start of the fault when travelling in the direction of the measuring train.

#### Track Geometry Fault Report

<b>Date:</b>	18/07/2016	<b>Route:</b>	Anglia
<b>Train:</b>	PLPR2	<b>MDU:</b>	HT8 Tottenham MDU
<b>Desc:</b>	SYSTON NORTH JN TO ELY	<b>TME:</b>	TME Ely
<b>RST:</b>	0239/2	<b>TSM:</b>	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
			<b>Wavelength:</b> 13m	<b>Rail:</b> Right	<b>Cycles:</b> 3		<b>Cat:</b> D	
EMP	1100	074.0556 (25) - 074.0489 (22)	5226.0160N:0016.1616E	075	Cyclic	21.23	20.00	(Correct :60d)
			<b>Wavelength:</b> 13m	<b>Rail:</b> Left	<b>Cycles:</b> 4		<b>Cat:</b> C	
EMP	1100	074.0556 (25) - 074.0489 (22)	5226.0160N:0016.1616E	075	Cyclic	39.77	38.00	Corr:maintenance
			<b>Wavelength:</b> 13m	<b>Rail:</b> Both	<b>Cycles:</b> 7		<b>Cat:</b> D	

**Figure 15: Measuring Train fault report**

## 9.6 Tools

It is recommended to take spray paint to mark the start position of the cyclic top fault so that recordings done before and after maintenance can begin from the same location. The GPS accuracy varies by time and location and may not repeatably give the starting point to the exact sleeper.

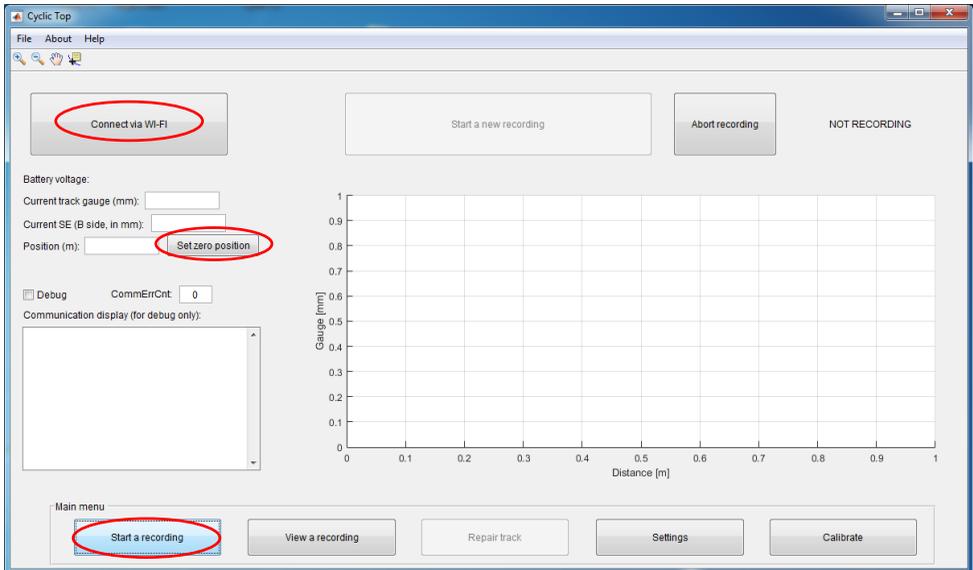
## 10.0 Step by Step Guide to Recording Cyclic Top Measurements on Track

### STEP 1. Put the CTMD on the track

The CTMD should be positioned near to the cyclic top fault with the fixed side on the left and the sprung side on the right, facing in the direction of travel of the measuring 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 Measurement Device begins to send real time data to the Windows device. The current gauge, SE and position given by the distance encoder are displayed below the 'Connect to Wi-Fi' button, but they are not recorded.



**Figure 16: Home Screen for the CTMD software**

The screenshot shows a window titled "Start a new recording" with the following fields and buttons:

- Operator: Default operator
- Filename: untitled1
- Date and time: 05-May-2017 13:50:02
- Current GPS loc. (highlighted with a red circle)
- Fault GPS loc (please enter) (highlighted with a red circle)
- Distance to fault: -
- Start recording button
- Cancel button (highlighted with a red circle)

**Figure 17: Start 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 measuring 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 '0'. 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'**. Move the CTMD backwards to -20m. Double check that the CTMD has the fixed side on the left and the sprung side on the right.

### STEP 4. Calculate Distance to Measure

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. Multiply the number of yards between the start and end positions by 0.9 to give the number of metres to the end of the fault from the zero position.

### STEP 5. Record a Cyclic Top Fault

Press **'Start new recording'** again. Input the **Operator** name, the **Filename** would typically include the name of the nearest depot and whether the recording is before or after maintenance. Click **'Start recording'** and let go of the CTMD handle.

Start a new recording

Operator: Default operator

Filename: untitled1

Date and time: 05-May-2017 13:50:02

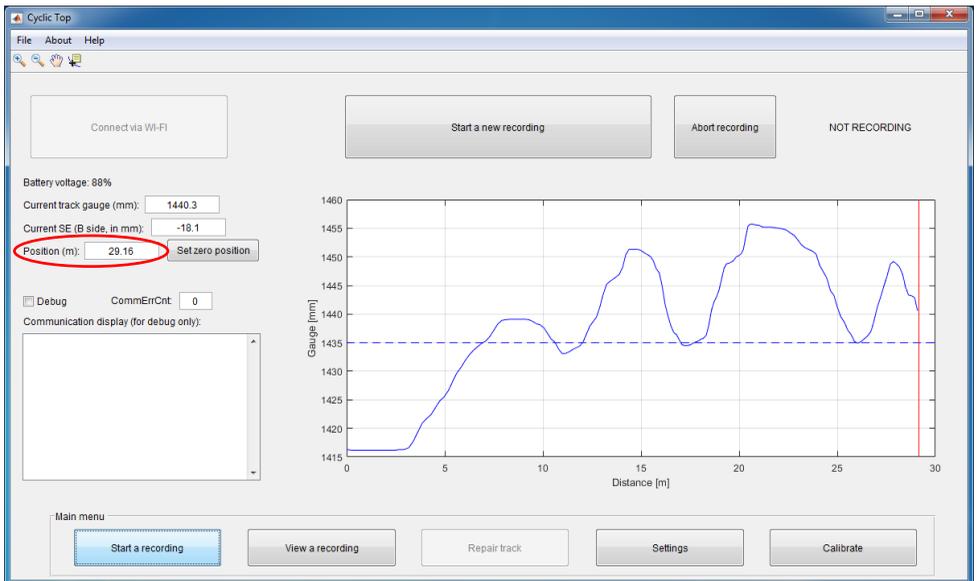
Current GPS loc:

Fault GPS loc (please enter):

Distance to fault: -

Start recording Cancel

**Figure 18: Start a new recording**



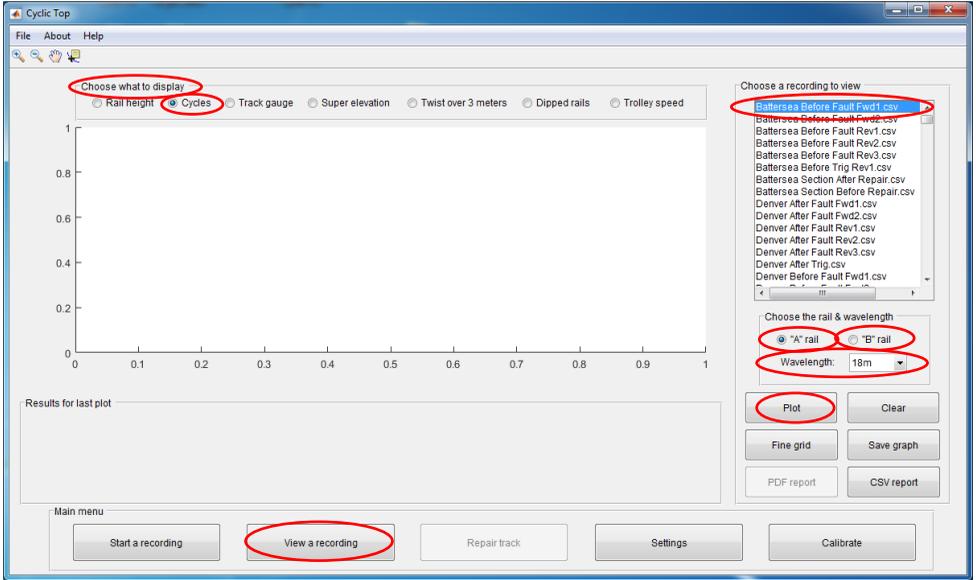
**Figure 19: Making a recording**

The software begins a 15 second countdown during which time the operator must not touch the handle. Push the CTMD at a walking pace the 20m to the start of the fault, then the length of the fault, and then a further 20m. The distance from the zero position is shown in the box labelled 'Position (m)'. At the end of the run, gradually stop the CTMD and let go of it. A 15 second countdown

automatically begins when the CTMD stops moving. Not touching the device lets the sensors stabilise. After 15 seconds the record is saved automatically, the 'Start a new recording button' becomes enabled and the 'Recording in progress' message disappears. Only one recording is necessary. The CTMD is ready to measure a different location or for the user to view the recording.

# 11.0 Step by Step Guide to Viewing Recordings

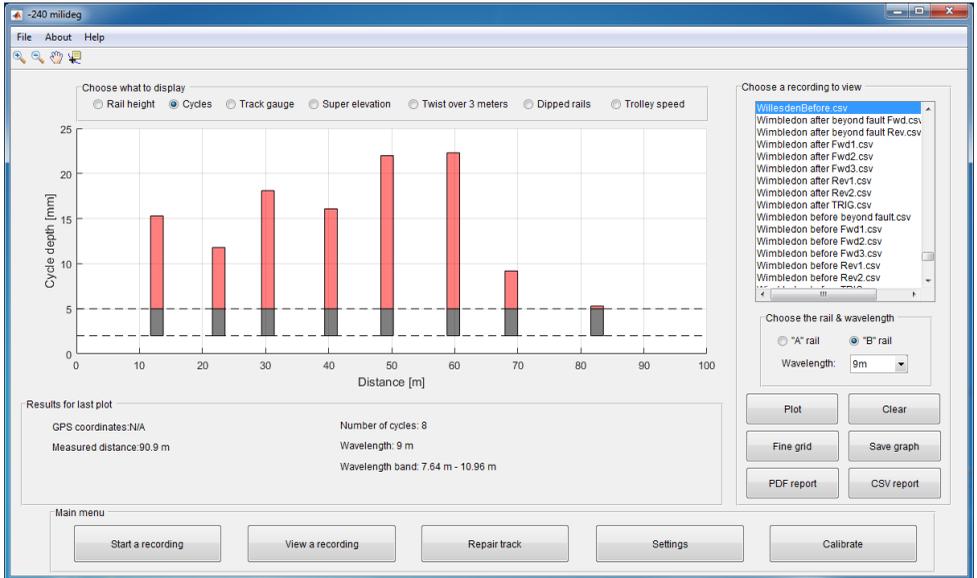
## Step 1: View Cyclic Top Faults for a specific wavelength



**Figure 20: View a recording**

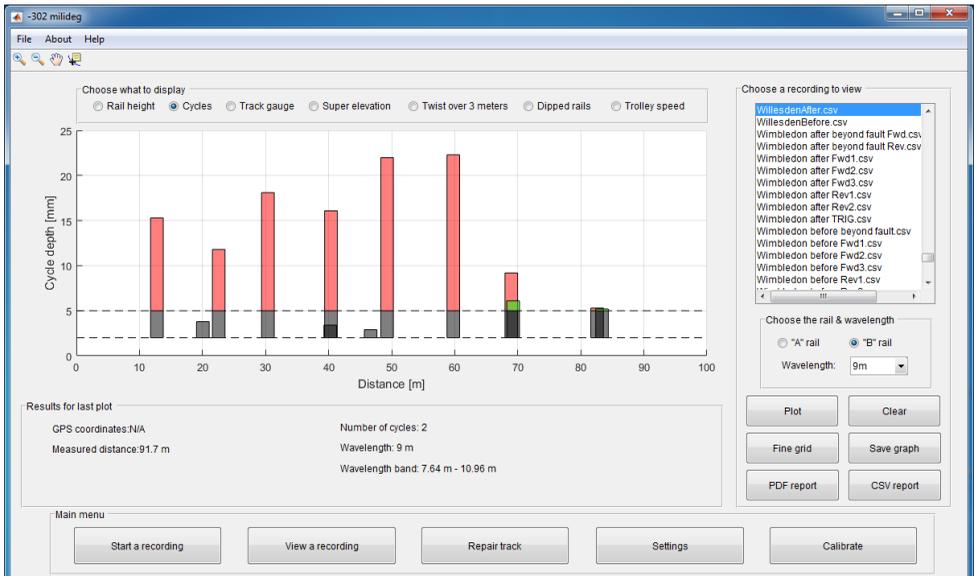
Click the 'View a recording' button at the bottom of the screen. In the 'Choose what to display' options at the top of the screen select 'Cycles'. The top right of the screen shows a list of recordings saved on the Windows device. Each recording stores data for the fixed end of the Measurement Device called the 'left' or 'A' rail, and the sprung end called the 'right' or 'B' rail. Select the rail and wavelength of cyclic top you want to analyse and click 'Plot'. For example if the measuring train report has found an 18m cyclic top fault on the right rail, then select those options.

## Step 2: Comparing results before and after maintenance



**Figure 21: Plot of recording applying 18m wavelength**

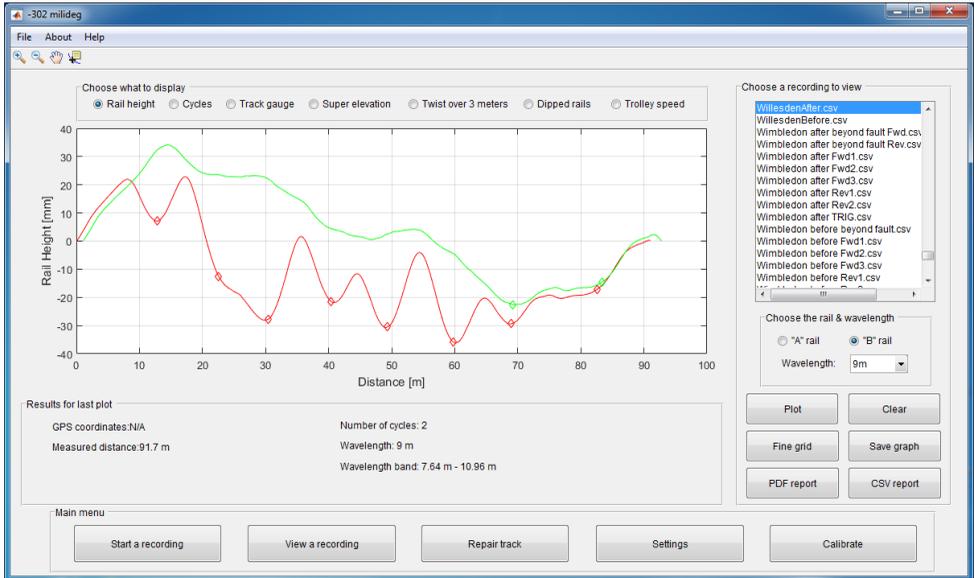
The bar chart above shows the result of clicking 'Plot' to show a bar chart showing the positions of the cycle depths for a 9m cyclic top fault before maintenance has occurred. The graph shows eight cycles. The cut off for requiring maintenance has been set at 5mm in this example.



**Figure 22: Plot of a recording after maintenance shown**

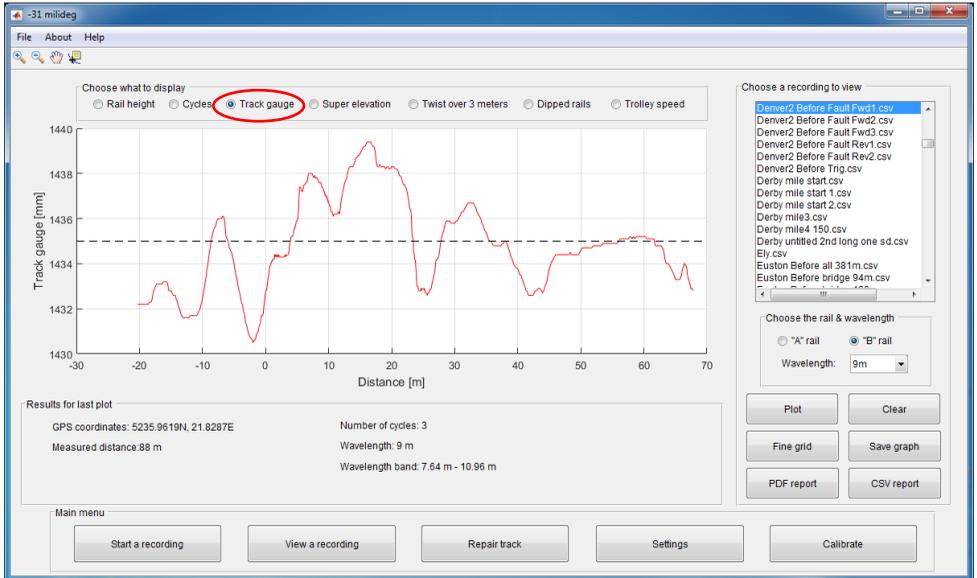
## ***transparently over the recording before maintenance***

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, one cycle shown the maintenance removed all but one of the cycles.



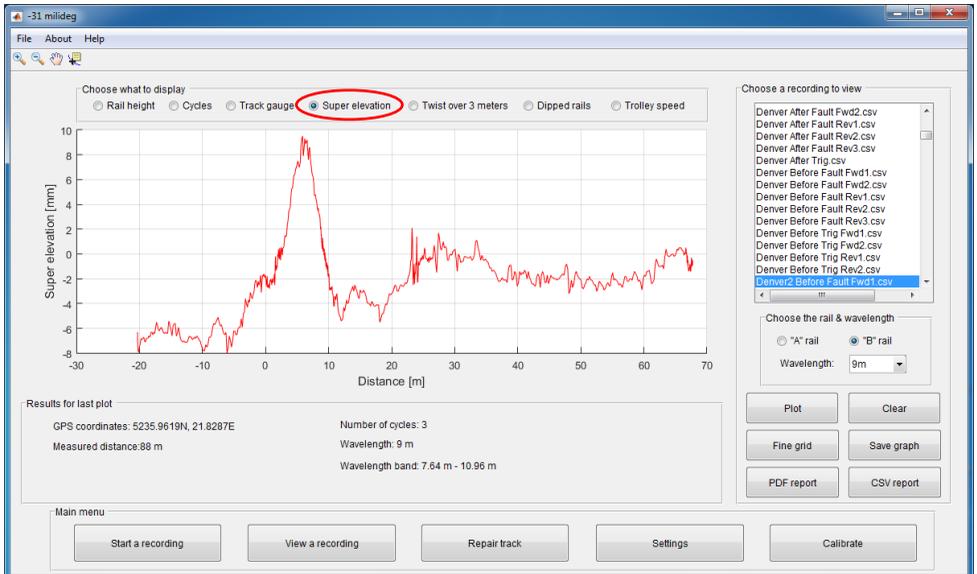
**Figure 23: Plot of a rail height before and after maintenance**

Along the top of the graph are options to view other data in the recording such as rail height track gauge, super elevation, twist, dipped rails and Measurement Device speed. The plot of rail height can be used to compare the rail profile before and after maintenance.

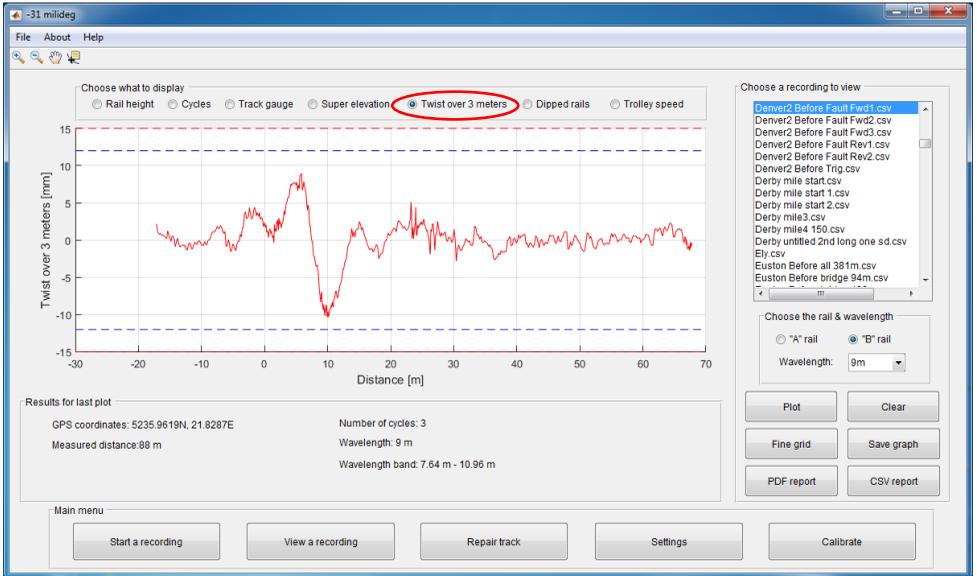


**Figure 24: Plot of a track gauge**

The **Track gauge** and **Super elevation** of the track can be shown.

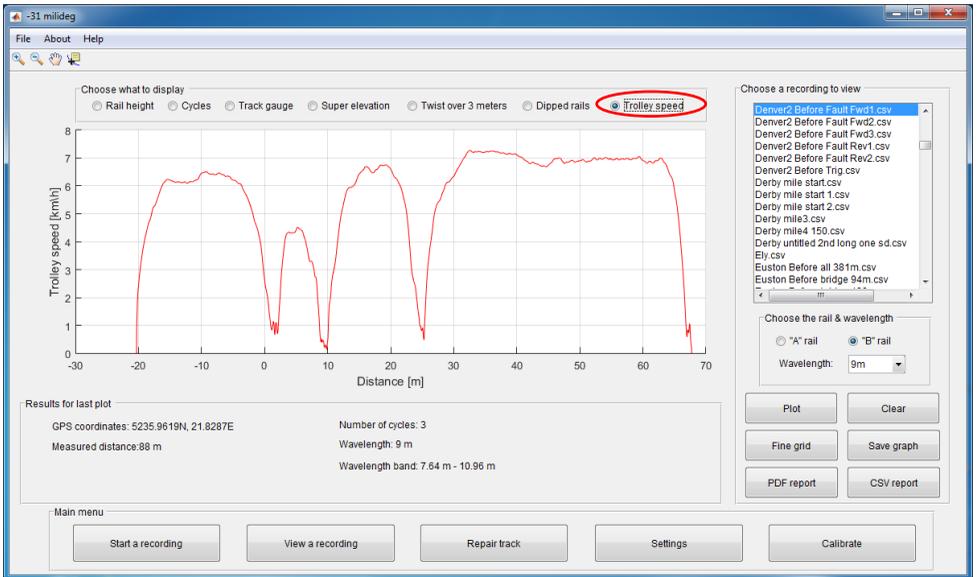


**Figure 25: Plot of super elevation**



**Figure 26: Plot of twist over 3 meters**

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



**Figure 27: Plot of Measurement Device speed**

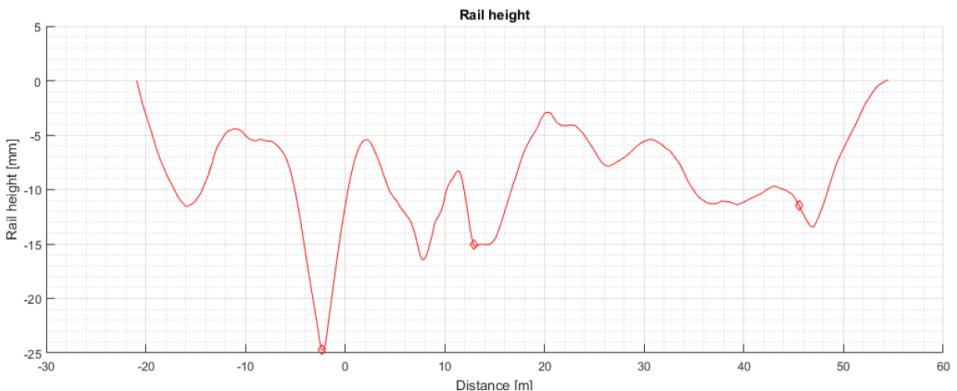
## 11.1 PDF Report of Recording

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 zero position, length of track measured, the rail measured, the number of cycles and the tested wavelength.

### Cyclic top fault report

Operator: Marius  
 Filename: Denver After Fault Fwd1.csv  
 Date and time of recording: 14-Dec-2016 10:35:43  
 GPS of zero position: 5234.8975N, 21.3621E  
 Length of measured track [m]: 75.4 m  
 Rail: A rail  
 Number of cycles: 3 cycles  
 Tested wavelength[m]: 18 m

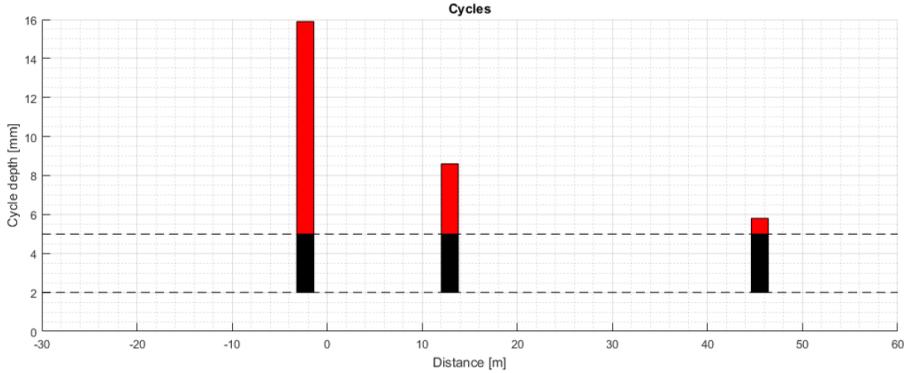


**Figure 28: PDF report – Rail Height Profile**

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

Identified cycles on A rail:

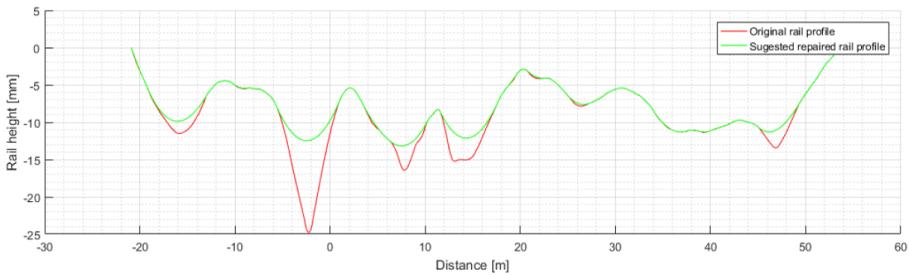
Cycle number	Trough location	Cycle depth
1	-2.3 m	15.9 mm
2	12.9 m	8.6 mm
3	45.5 m	5.8 mm



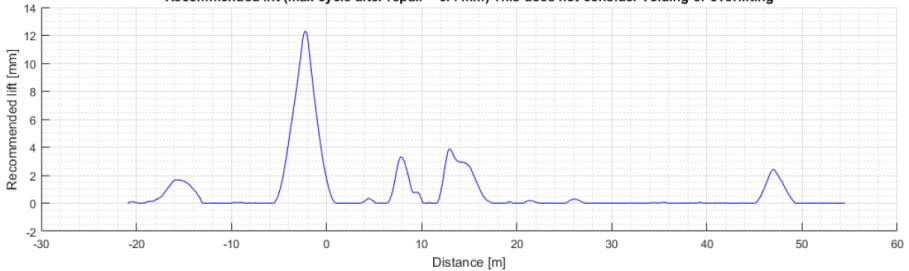
**Figure 29: PDF report – Identified Cycles**

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

Repair advise for A rail



Recommended lift (max cycle after repair = 5.4 mm) This does not consider voiding or overlifting



**Figure 30: PDF report – Rail Height and 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 and 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 percentage of overlift selected by the user. The user can click '**Increase**' or '**Decrease**' to change the overlift percentage.



**Figure 31: Repair Track - Overlift at 30%**

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.



**Figure 32: Voiding data warning**



**Figure 33: Repair Track - Overlift at 10%**

The dotted lines in the graphs of rail height and recommended lift include overlift. If the amount of overlift percentage 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 fault.

## 12.2 Repair Report PDF

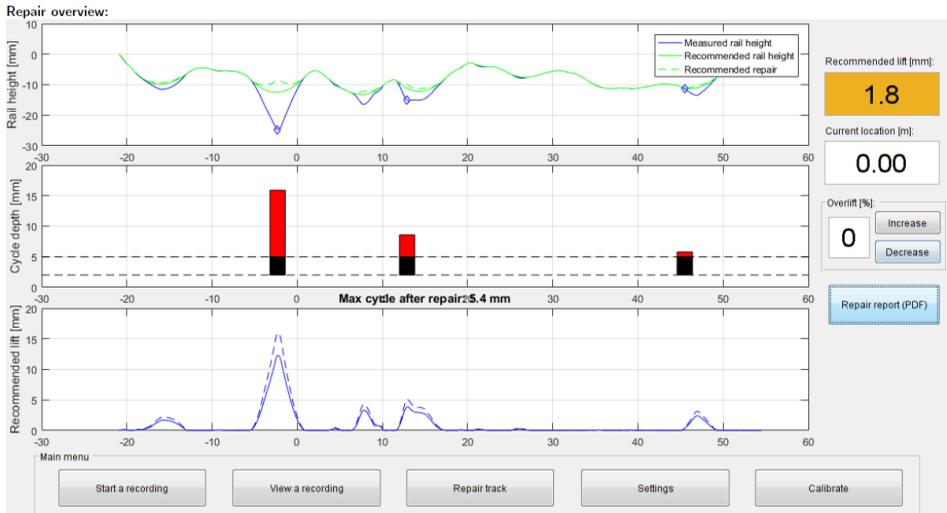
Click on 'Repair report (PDF)' to view a repair report.

### 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 zero position: 5234.8975N, 21.3621E  
 Length of measured track: 75.4 m  
 Rail: **A rail**  
 Tested wavelength: **18 m**  
 Max cycle depth before proposed repair: **15.9 mm**  
 Max cycle depth after proposed repair: **5.4 mm**  
 Max required lift (excluding overlift): **12.3 mm**  
 Max required lift (including overlift): **12.3 mm**  
 Overlift used to compensate track resettling: **0 %**

**Figure 34: Repair Report - Details**

The repair report shows the same details as the PDF 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 percentage of overlift that is required.



**Figure 35: Repair Report- Graphs**

The report contains the graphs showing actual and recommended rail height, cycle depth and recommended lift.

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	Dist [m]	Lift [mm]
-12	0	18	0	40	0
-11	0	19	0	41	0
-10	0	20	0	42	0
-9	0	21	0	43	0
-8	0	22	0	44	0
-7	0	23	0	45	0
-6	0	24	0	46	1
-5	1	25	0	47	2
-4	4	26	0	48	1
-3	9	27	0	49	0
-2	12	28	0	50	0
-1	6	29	0	51	0
0	2	30	0	52	0
1	0	31	0	53	0
2	0	32	0	54	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		

**Figure 36: Repair Report- Required lift at each metre**

Lastly the Repair Report PDF shows the required lift including overlift at each metre of the track, with meterage given from the zero position of the GPS coordinates.

## 13.0 Troubleshooting

<p><b>Cyclic Top Software not working</b> The software does not work as expected, for example graphs do not show or buttons in the user interface do not work.</p>	<p>Close the program, turn off the trolley, wait 3 seconds, turn on the trolley. Open the software and reconnect.</p>
<p><b>No Wi-Fi connection</b> The CTMD and Windows device are not connected.</p>	<p>Check in the Wi-Fi connection on the right side of the Windows taskbar that the device is connected to the CTMD Wi-Fi.</p>
<p><b>Negative distance</b> During a recording the current distance displayed is negative.</p>	<p>Negative distance is shown when the CTMD is pushed the wrong way round. The CTMD should be positioned with the fixed side on the left and the sprung side on the right, facing in the direction of travel of the measuring train.</p>
<p><b>Cannot get a GPS signal</b> The current GPS location will give a message saying 'No GPS signal'</p>	<p>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.</p>

## **14.0 Using the Geode GPS as a stand-alone product.**

It is not necessary to read this section.

### **14.1 When used as part of the CTMD**

The Geode GPS is automatically turned on when the CTMD is turned on. If the user presses the Geode power button, it will remain on.

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

### **14.2 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.

Use the Geode according to the Geode user manual.

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

## 15.0 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



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

**2014/30/EU** Conforms with the essential performance requirements of the Electromagnetic Compatibility Directive (EMC Directive) and its amending directives. Standard **EN50121-4**

**2014/53/EU** Conforms with the essential performance requirements of the Radio Equipment Directive (RED Directive) and its amending directives. Standard **EN300 328**

The CTMD also meets the following additional requirements:

**2013/35/EU** Conforms with the essential performance requirements of the Electromagnetic Fields Directive (EMF Directive) and its amending directives. Standard **EN62479**