

Manual Corrugation Measurement: **bi-CAT**

bi-CAT

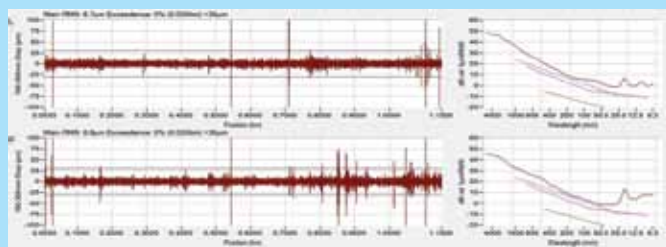


RailMeasurement's bi-CAT is suitable for embedded and flat-bottomed rails.

The **bi-CAT** is ideal for undertaking a manual survey of corrugation: typically about 3km/h of track is measured consistently (12km in a typical 4 hour night shift). Files can be added together (concatenated) to give a continuous record for a line from files that have been recorded on separate shifts, and even in different directions.

The bi-CAT is based on the same technology as the CAT. The technical performance (repeatability, accuracy etc) of the two sets of equipment is essentially identical. The equipment offers the accuracy required to measure corrugation and acoustic roughness on both rails at walking speed.

A single measurement is made along each rail at a prescribed position from the gauge face. The lateral position can easily be adjusted e.g. to run along a running band that is consistently to one side of the rail.

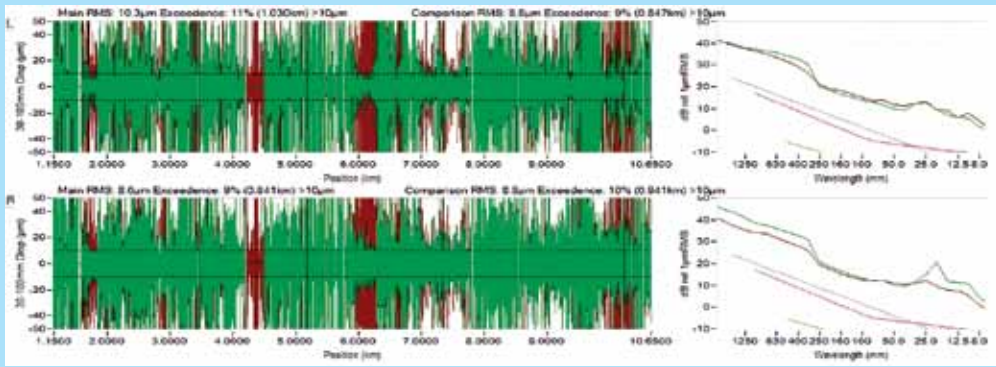


A measurement of 1.15km of a metro line made a few days after grinding. The grinding site has been reprofiled well within the requirements of EN13231-3:2012 not only in the 100-300mm wavelength range shown (0% exceedance on both rails) but in other wavelength ranges. The one-third octave spectra, to the right of the main graphs, show that irregularities exceed the limit for EN ISO3095:2013. There is a peak in the spectra at a wavelength of about 20mm, which is typical of the so-called "grinding signature". This gives a "whistling" that is characteristic of trains running over freshly ground track.

The measurement was made by one person in 20 minutes: an average speed of over 3.3km/h.



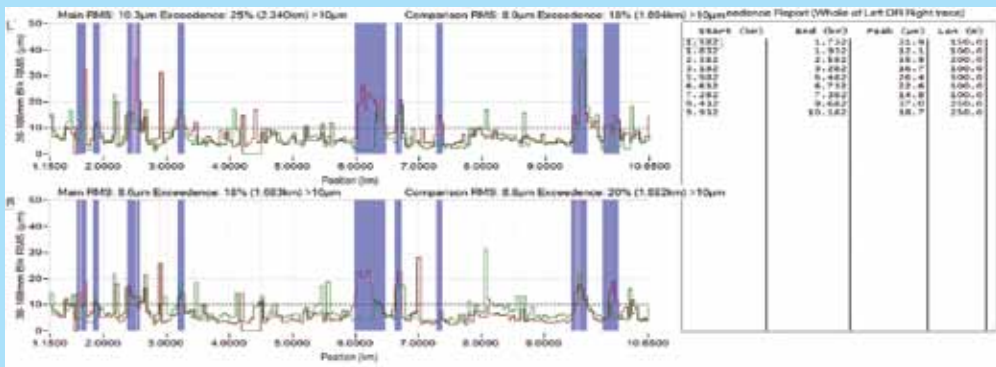
As with its parent, the CAT, the bi-CAT is extremely compact and portable: the photo above shows the equipment packed into the wheeled instrument case. The bi-CAT is powered by a USB lead to a laptop computer, so only the laptop needs to be charged to run the equipment. The frame collapses into the equivalent of a ski-pole bag, which is easily slung over a shoulder. Usually the frame is made to suit a single gauge, but can be supplied to suit two or more gauges that are not dissimilar e.g. equipment was recently supplied for 1435mm and 1495mm gauge track. The equipment in total weighs about 29kg. It can be transported to site and used by a single person.



bi-CAT measurements are shown here in two sets of graphs from 9.5km of a light rail line, with measurements from **2017** and **2018**.

The graphs above show “filtered displacements” in the 30-100mm wavelength range, which are used for quality assurance of reprofiling. There is clearly a large variation in amplitude of irregularities along the line. Spectra are shown to the right. The overall level of irregularities is high, which is typical of light rail systems.

The graphs below use the same measurements but have been analysed to find where reprofiling should be prioritised for corrugation removal in **2018**. These areas are highlighted in **purple**. Although some of the track was ground following the **2017** measurements, there is remarkable consistency in where corrugation occurs and recurs. About 18% of this line requires reprofiling in 2018, according to objective criteria developed by RailMeasurement and used on this system since 2011. After an initially high requirement for reprofiling in 2011, reprofiling requirements for the system have remained consistent (at about half the initial level) from one year to the next.



Bi-CATs can be purchased or hired from RailMeasurement Ltd. The equipment is supplied with a full suite of review software that can be applied to many uses including quality assurance of rail grinding, acoustics work and prioritisation of reprofiling. We also provide a service to undertake corrugation surveys and measurements to EN15610:2009 / EN ISO3095:2013. Please contact us to discuss your requirements.

Technical Data: bi-CAT			
interval at which data are saved	2mm or 1mm	Output compatible with requirements of	<ul style="list-style-type: none"> EN 13231-3:2006 and 2012 EN ISO 3095:2013 EN 15610:2009
Measuring speed (within +/-25%)	<ul style="list-style-type: none"> 1m/s or 0.5m/s 	Output	<ul style="list-style-type: none"> raw and filtered displacements moving average amplitudes (RMS and peak-to-peak) vs. distance percentage exceedances ASCII data graphs to cut-and-paste directly in reports tabulation of areas in which irregularities exceed prescribed limits (useful for showing reprofiling requirements)
Precision of measurements (displacement)	0.01µm		
Data storage requirements	< 4MB per kilometre of track		
Accuracy (measurement of 2.5m calibration beam)	Better than <ul style="list-style-type: none"> 0.2µm RMS 10-30mm 0.5µm RMS 30-100mm 2.0µm RMS 100-300mm 	Filters, built-in	<ul style="list-style-type: none"> 10-30mm, 30-100mm, 100-300mm, 300-1000mm, 1000-3000mm
Options	<ul style="list-style-type: none"> configuration to suit track of different gauges training course 	Weight	<ul style="list-style-type: none"> 23kg in carrying case additional 6kg for poles