

# Manual Corrugation Measurement: CAT

# CAT

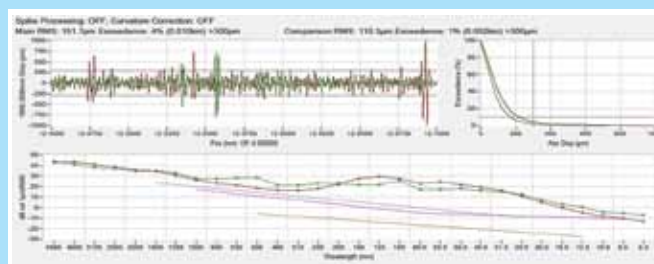
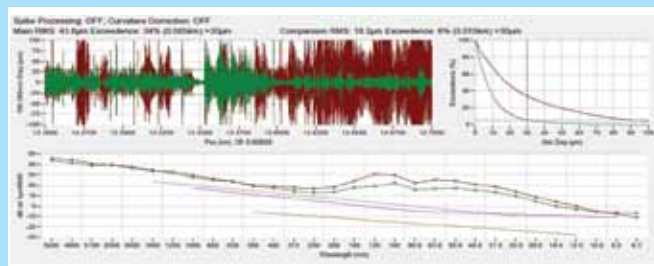


CAT in use. The equipment is suitable for both embedded and conventional flat-bottomed rails.

RailMeasurement's **CAT** (Corrugation Analysis Trolley) is used worldwide for making accurate and reliable measurements of rail corrugation, irregularities and acoustic roughness. The CAT is used by the full range of those working on railways: track workers, reprofiling contractors, equipment suppliers, universities, research workers and acousticians. Remarkably the same equipment satisfies all requirements: it is sufficiently accurate for research work yet sufficiently robust and reliable to be used routinely on a reprofiling train.

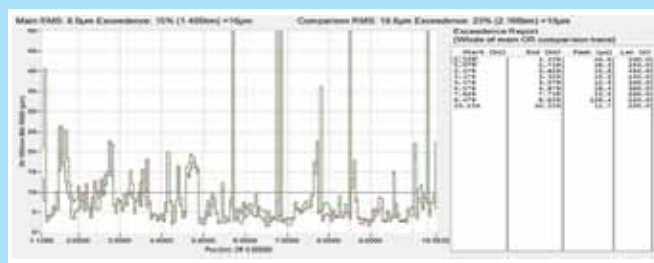
The equipment was originally developed to help with quality assurance of reprofiling work, at a time when no equipment of satisfactory accuracy was available to demonstrate routinely that rail had been reprofiled to the extremely demanding requirements of railway administrations. Quality assurance of reprofiling work remains one of the most common uses of the equipment.

The CAT and the laptop used for logging data are packed in a convenient wheeled instrument case. The equipment can be transported by a single person in the metro or as checked baggage on a plane to the other side of the world, then assembled quickly and used for measurements.

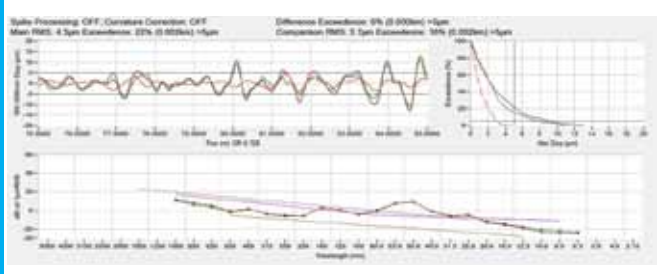
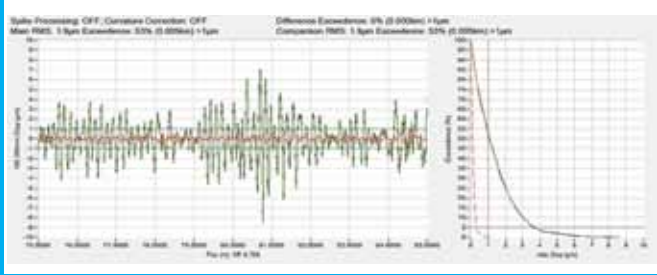


CAT measurements made on the left (above) and right (below) rails over a section of a metro system **before** and **after** grinding of a curve towards the right. The curve itself has been well ground, with very low residual irregularities in the 100-300mm range. Grinding has relatively little effect at longer wavelengths: 1000-3000mm irregularities are shown below, and spectra are calculated to 5m wavelengths.

Measurements are typically made at a comfortable walking speed of 1m/s (3.6km/h). The CAT is powered by a USB lead to a laptop computer, so only the laptop needs to be charged to run the equipment. When the equipment is used for surveying a small railway system, an average of about 3km/h of rail (1.5km of track) can be measured by a single person and concise data presented to a client regarding areas in which reprofiling is required according to prescribed criteria.

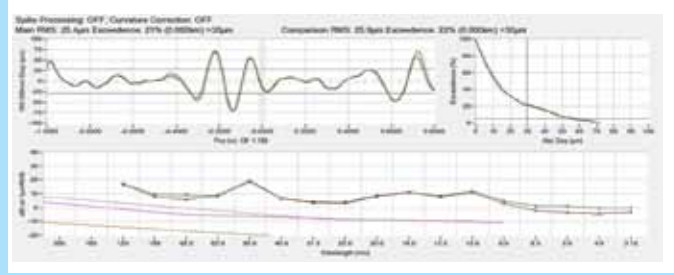
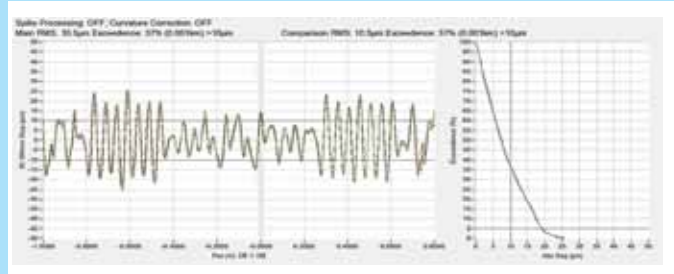
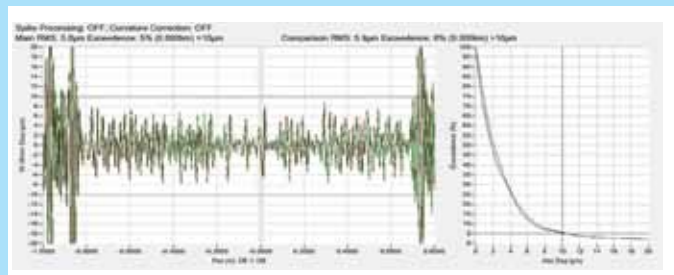


Measurements for about 9.4km of a tram line with a tabulation at right of areas that should be prioritised for reprofiling. These areas amount to a total of 1.7km of track (18%), in sections of 100-450m.



Measurements demonstrating the remarkable repeatability of this instrument. Lengths of 10m are extracted from two 100m runs over the same rail. In the 100-300mm range (top) the measurements differ by less than a micron. In the 300-1000mm range (below), the measurements differ by less than 5 microns. There is incipient corrugation of less than 20 microns depth in the 100-300mm range.

Measurements taken using this or any other equipment would be of little value if they were invalid. We have accumulated many measurements from users over the last 20 years. Much work, by ourselves and by those working independently, is published in the peer-reviewed scientific literature. No other instrument has similar independent validation, yet the same equipment that is used for this work is also used routinely on track.



Typical calibration curves: **CAT** and **CMM** measurements of a 1.8m section of a calibration beam.

CATs can be purchased or hired from RailMeasurement Ltd. 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: CAT			
interval at which data are saved	1mm or 2mm	Output compatible with requirements of	<ul style="list-style-type: none"> <li>EN 13231-3:2006 and 2012</li> <li>EN ISO 3095:2013</li> <li>EN 15610:2009</li> </ul>
Measuring speed (within +/-25%)	<ul style="list-style-type: none"> <li>0.5m/s (1mm interval)</li> <li>1m/s (2mm interval)</li> </ul>	Output	<ul style="list-style-type: none"> <li>raw and filtered displacements</li> <li>moving average amplitudes (RMS and peak-to-peak)</li> <li>percentage exceedences</li> <li>one-third octave spectra</li> <li>exceedence reports (to assist grinding)</li> <li>ASCII data</li> <li>graphs to cut-and-paste directly in reports</li> </ul>
Precision of measurements (displacement)	0.01µm		
Data storage requirements	< 2MB per kilometre of rail		
Accuracy (measurement of 2.5m calibration beam)	Better than <ul style="list-style-type: none"> <li>0.2µm RMS 10-30mm</li> <li>0.5µm RMS 30-100mm</li> <li>2.0µm RMS 100-300mm</li> </ul>	Filters, built-in	<ul style="list-style-type: none"> <li>10-30mm, 30-100mm, 100-300mm, 300-1000mm, 1000-3000mm</li> <li>30-300mm, 300-3000mm</li> <li>30-150mm, 150-1500mm</li> <li>150-1000mm, 1000-1500mm</li> </ul>
Options	<ul style="list-style-type: none"> <li>measurement of track with different gauge</li> <li>software to concatenate data files</li> <li>training course</li> </ul>	Filter, user-selectable	<ul style="list-style-type: none"> <li>band-pass, high-pass or low-pass</li> <li>zero phase delay</li> <li>wavelength of 5-5000mm</li> </ul>
		Weight	<ul style="list-style-type: none"> <li>18kg in carrying case</li> <li>8kg for instrument with laptop on rail</li> </ul>