Rail grinder or vehicle-mounted corrugation measurement: RCA

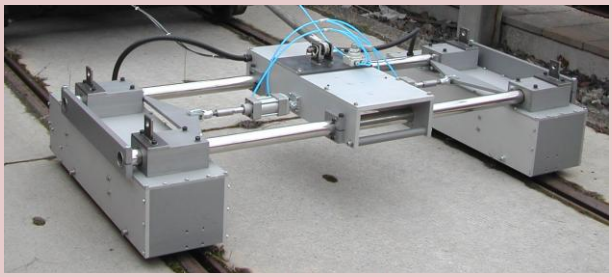
RCA on a metro grinding train, lowered onto rail. Usually the equipment is attached to the vehicle using simple hinged arms, as shown. Alternative arrangements are possible.

RailMeasurement's **RCA** (Rail Corrugation Analyser) was originally designed for routine use on a rail grinder or a reprofiling train more generally. A version of this instrument has also been produced as a self-contained measuring bogie that is attached to a vehicle to provide routine surveys of a metro and tram system. This unit can also be pushed by hand.

The RCA provides accurate measurements of the longitudinal rail profile (in particular corrugation and residual irregularities after grinding) and is typically used by the crew on a reprofiling train to decide if irregularities have been brought within acceptable limits e.g. those specified in European Standard EN 13231-3:2006 or an equivalent. Every RCA is validated by undertaking tests of repeatability and by demonstrating that effects of measuring speed, direction of measurement and grinding during measurement are minimal. A comparison is also made *in situ* with a CAT to assess accuracy.

RailMeasurement Ltd has been at the forefront not only of producing grinder-based equipment to measure irregularities of microns on a rail at speeds of several km/h but also of providing a "traceable" validation procedure for our equipment. There are few if any other instruments of similar accuracy that can be used routinely at typical measuring speeds of 3-10km/h. Measurement at higher speed e.g. for routine corrugation surveys, is possible with slightly reduced accuracy. Examples of this validation procedure and of pre- and post-grind corrugation measurements are given in ref [1].

Our RCA may also be unique in providing accurate measurements of corrugation over the full wavelength range of 10-1000mm that is commonly treated by reprofiling trains and of being able to do so during grinding and on freshly ground rail (see graphs over page). The inertial principle used in the RCA does not suffer from many of the intrinsic limitations of chord-based systems that are often used on reprofiling trains [2]. Although inertial-based equipment is not without problems, we appear to have found solutions to these.



RCA measuring bogie: this equipment is self-contained. It can be attached to a hi-rail or maintenance vehicle, or pushed by hand.

A reprofiling train represents an extremely severe operating environment. Our RCAs have not only been used on grinding trains worldwide, but several have also been used routinely for years with little maintenance. These continue to provide reliable measurements of irregularities to an accuracy of microns.

The standard RCA operates as a "stand-alone" instrument that is attached relatively easily to a vehicle. Different levels of integration with a reprofiling train are possible to reduce the need for operator intervention during multi-pass operation e.g. software that automatically associates changes in direction with a new reprofiling pass, and shows in a simple way both how large the residual irregularities are compared to specified limits and how these are being reduced by successive passes. Modifications such as these, which make the RCA easier to use, exemplify our commitment to combining state-of-the-art technical equipment with solutions to our customers' requirements.

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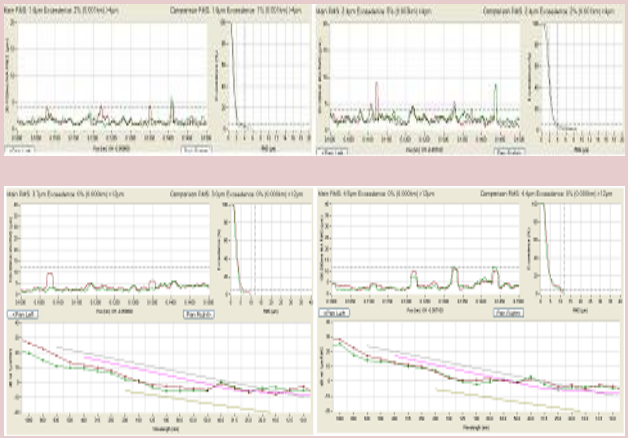
RCA measurements taken on the last grinding pass (green) and next to last grinding pass (red) of a 200m grinding site demonstrating that the final pass has reduced irregularities in 30-100mm and 100-300mm wavelength ranges from just outside the requirements of EN I3231-3:2006 to within those requirements. The main improvement has been at the ends of the site, probably by removing effects of "set down". Full scale on the y axes are 0.02mm and 0.06mm respectively.



comparison of RCA and CAT output over 50m of track
RMS moving averages and percentage exceedences,
30-100mm, 0.02mm full scale
100-300mm, 0.04mm full scale
one-third octave spectra

References

1. Grassie SL, "Rail corrugation: advances in measurement, understanding and treatment", *Wear,* 2005, 258/7-8, pp1224-1234
2. Grassie SL, "Measurement of railhead profiles: a comparison of different techniques", *Wear*, 1996, 191, pp245-251

Technical Data: RCA			
interval at which data are saved	2mm	Output compatible with requirements of	• EN 13231-3:2006 and equivalents
Measuring speed (typical)	3-10km/h	Output	• raw and filtered displacements • moving average amplitudes (RMS and peak-to-peak) vs. distance • percentage exceedences • tabular output of areas exceeding prescribed limits, for planning of grinding • ASCII data
Precision of measurements (displacement)	1µm		
Measurement of	• switch and crossing work • plain line		
Minimum curve radius	<200m (instrumented arms) <20m (measuring bogie)		
Repeatability (over site of >50m length within requirements of EN13231-3:2006)	Better than • 1µm RMS 10-30mm • 1µm RMS 30-100mm • 1µm RMS 100-300mm • 2µm RMS 300-1000mm	Reproducibility grinding and not grinding (over site of >50m length within requirements of EN13231-3:2006)	Better than • 1µm RMS 10-30mm • 1µm RMS 30-100mm • 2µm RMS 100-300mm • 5µm RMS 300-1000mm
Accuracy c.f. CAT (over site of >50m length within requirements of EN13231-3:2006)	Better than • 1µm RMS 10-30mm • 1µm RMS 30-100mm • 2µm RMS 100-300mm	Filters, built-in	• 10-30mm, 30-100mm, 100-300mm, 300-1000mm, 1000-3000mm • 30-300mm, 300-3000mm • 150-1500mm
Data storage requirements	< 2MB per kilometre of track	Options	• gauge-adjustable measuring system • training course

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