MÜLLER-BBM

mbbmRM1200
Measuring device for acoustic roughness of running surfaces of the rail

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Instrument on rail, right outrigger extended (1), clamping lever activated (2), handles folded out (3)

Roughness of the running surfaces is the predominant source of noise of tracked transport systems in the speed range of 60 km/h to 250 km/h. Therefore, for reliable sound measurements on rail vehicles, dependable roughness measurements of the running surfaces of the rail are required. European standards EN ISO 3095 and 3381 for internal and external track noise demand that the roughness level of the test track be determined and compared with the limiting curves. The new European technical specifications (TSI-HS and TSI-CR) are defining limiting noise values for the trans-European rail network. Measurements, carried out as specified in the standards, are to be used to verify the noise limits specified in the TSIs.

A first device to measure the roughness of the running surfaces of rails in the magnitude and wave length range necessary for acoustical investigations, the RM1200E, was developed by Müller-BBM and Deutsche Bundesbahn in the late 1980ies. Based on the experience of more than 15 years of measurements with the RM1200E and the increasing demand for more measurements, a successor to the RM1200E has been developed. Well proven features were maintained, others were improved or added and the handling was significantly simplified.

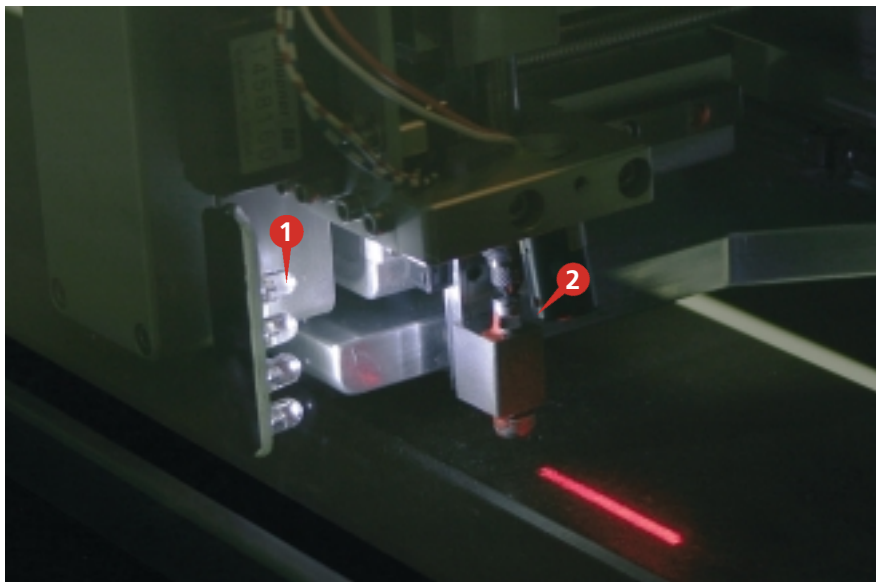
The measurement principle is based on the sliding contact between a carbide swivel and the running surface of the rail. Due to practical size and weight limitations, the measurement length was kept at 1200 mm. Like the old instrument, the mbbmRM1200 rests on two points on the rail to be measured and is stabilised via an outrigger on the second rail of the track. The device is clamped to the rail at both ends, aligned to the outer side of the rail. The device is protected by two mechanical dampers to avoid shocks while placing it on the rail.

In order to simplify the lateral adjustment of the measurement track, a line laser has been added. For measurements in the darkness, the transducer tip can be illuminated by a white LED array. Two additional line lasers place markers on either side of the foot of the rail and help to position the device accurately on the track section to be measured. The device can be shifted along the rail from one cross section position to the next by means of a fold-out tail wheel and two moveable, ergonomic handles.

For the longitudinal concatenation of traces for the evaluation of longer wave lengths, an inclinometer value is registered with every data set.

The instrument can measure automatically a set of up to 20 traces equidistantly spaced across the rail head in lateral direction in a range of 60 mm in one clamping position. The time needed for the measurement of 3 traces is approximately 70 s. Number and distance of the traces are checked for plausibility upon entry, in dependence of the type of rail selected (vignole rail, UIC 60).

The measurement sequence and all functions of the device are controlled and monitored by an integrated microcontroller. A tablet PC with a display suitable for daylight use is utilised as control panel, to which the measurement data is transferred wirelessly during the measurement via WLAN. The data is displayed as



Lighting for sensor (1), sensor with measuring stylus (2)

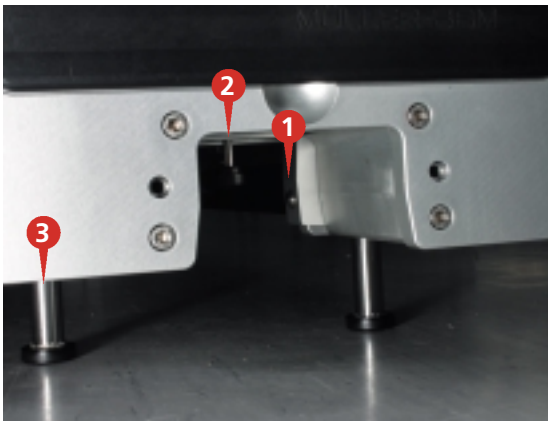
Battery compartment side: Clamping lever (1), tail wheel lifted (2)

roughness graph in real time and saved on hard disk. Once all tracks are measured, the data can be represented graphically as 1/3 octave spectra.

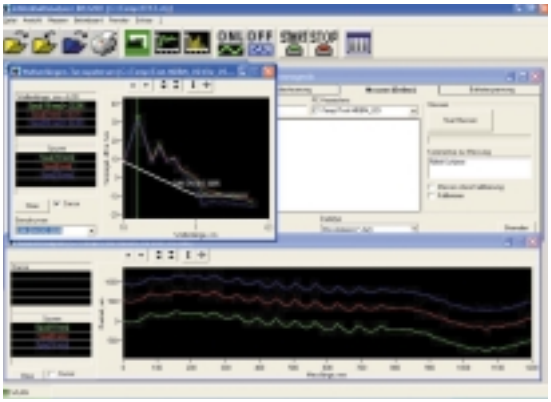
The Windows XP operated tablet PC runs a special "RailAnalyzer" software for control of the mbbm-RM1200 device and data storage. In the offline mode, measurement data can be retrieved and displayed in the displacement or spectral domain. For data evaluation, a special offline software "RoughnessAnalyzer" is available. With this software, data processing tasks such as pits and spikes removal, concatenation of traces in longitudinal direction for the evaluation of longer wavelengths and averaging of the spectra of one measuring cross section according to EN ISO 3095, can be performed. Standardised plots can be exported as WMF-file, ready to be included in a report.

For measurements on grooved rails, the device can be equipped with extenders which lift the device by approx. 50 mm. For calibration, the device is set on a calibration stone with certified planarity.

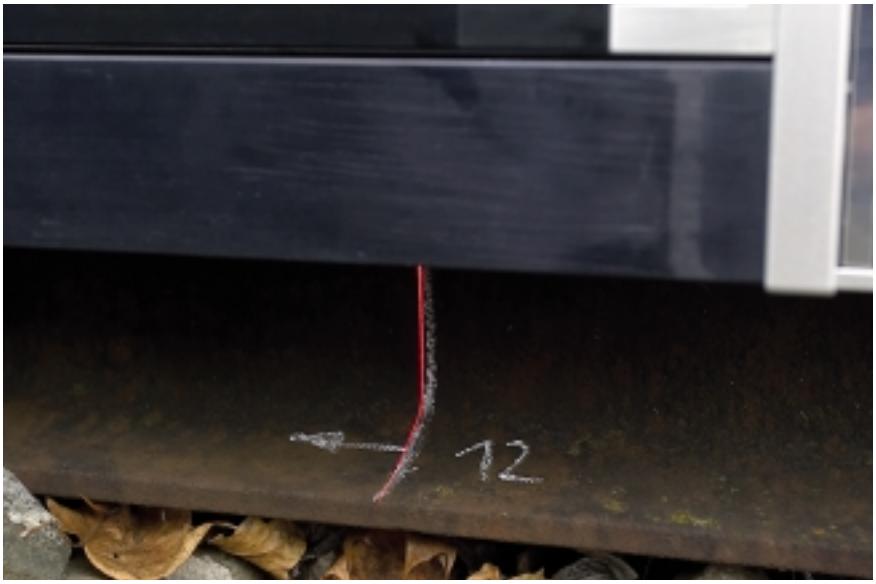
The mbbm1200 device and the tablet PC have a built-in battery power supply and can be operated independently from the mains.



Clamping of device on rail (1), (2) shock damper, (3) support foot for parking

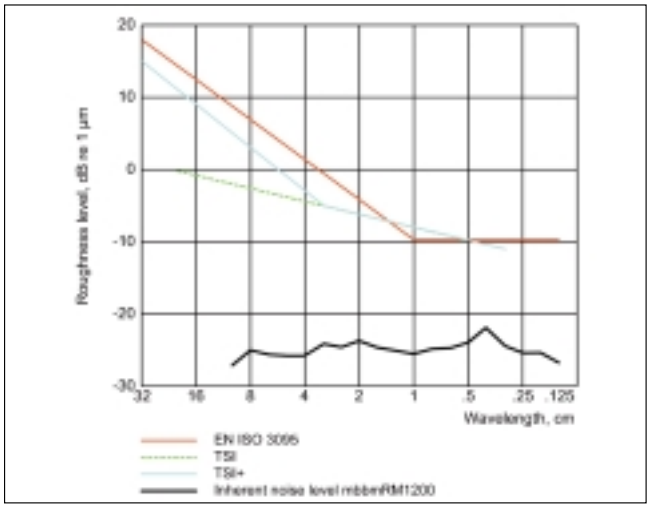


Screen display of three measurement traces and corresponding 1/3 octave spectra after completion of a measurement

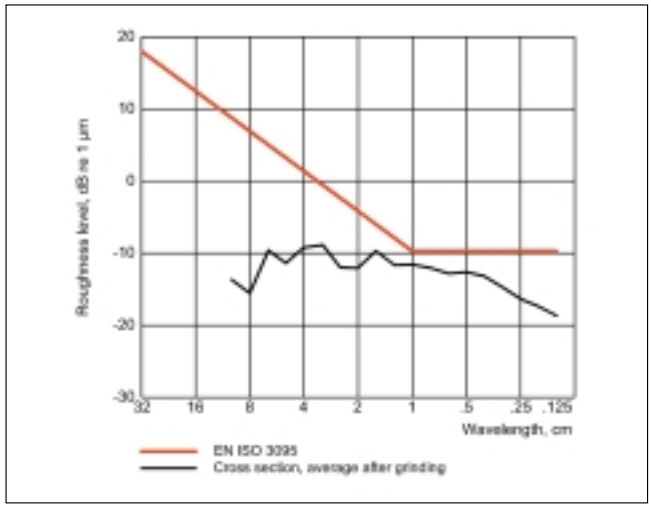


Laser marker at a measuring cross section

Instrument in transportation case



Limits according to ISO standard and TSI compared to the inherent background noise of the mbbm1200 device



Example data of a standard evaluation

Technical data

Instrument

Size, outrigger in rest position	H x W x L 35 cm x 29 cm x 160 cm
Mass of instrument	54 kg
Measurement length, longitudinal	1200 mm
Measurement during forward and backward motion of the sensor	
Longitudinal discretisation	0.5 mm
Number of measurement points	2401
Transverse positioning range	60 mm
Number of measurement traces	1 – 20
Measurement duration	70 s for 3 measurements
Measurement range of transducer	12 mm
Resolution of transducer	0.5 µm
Stylus tip: carbide swivel	R = 7 mm
Longitudinal speed during measurement	100 mm/s
Resolution of inclinometer	< 0.01°
Operating temperature range	0° C bis 40° C

Case

Size	H x W x L 57 cm x 40 cm x 189 cm
width at axle	55 cm
Mass	37 kg

Power supply

Rechargeable NiMH battery: 21.6 V, 15 Ah, sufficient for more than 250 traces or 6 h continuous operation

Controller

Tablet PC	1.2 GHz
Operating system	Windows XP Professional Tablet Edition
Hard disk capacity	40 GByte
Data transfer and control	WLAN

Müller-BBM is one of the leading German societies of consulting engineers offering expertise with regard to buildings, environment and technology.
Based on our experience of more than 40 years in the entire scope of acoustics, we offer interdisciplinary engineering services for planners, manufacturers, operators and public authorities.
We plan, test and consult in Germany and abroad. Our reports and expert opinions are objective, neutral and independent.

Quality Management

Müller-BBM has a quality management system which includes all our business areas at all our offices.
The system is based on the international standard ISO 9001 and was certified by the Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen, DQS GmbH. The certificate registration number is 5398.
Müller BBM is approved as subcontractor of the notified body interoperability EBC including tests according to the directive 2001/16/EG and its technical specifications for interoperability (TSI). Additionally, Müller-BBM is approved by the German Eisenbahn-Bundesamt (EBA) as a testing laboratory for railway engineering tests on rail vehicles. This approval (identification number EBA 12/03/05) includes the measurement of interior and exterior noise and the test of the electromagnetic environmental compatibility (EMC) of rail vehicles.

Accredited Test Laboratories

For more than 40 years, Müller-BBM has also been active in the field of test measurements.
Our test laboratories are accredited according to the international standard DIN EN ISO/IEC 17025 and conduct noise and vibration measurements as well as air pollution control and electromagnetic environmental compatibility measurements.
Accredited by Deutsche Kalibrierdienst (DKD) as a calibration laboratory for sound and vibration measurement devices.

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