

PRESS



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Optimized and systematized vehicle measurement for quality improvement in rail vehicle construction

Innovations in the rail industry have to impress rail passengers – which hopefully includes you, the reader. Only then does innovation have a real purpose. The requirements are obvious: Better punctuality, less noise, greater availability, better capacity utilization, lower energy consumption.

Not to mention improved comfort, reliability, and of course maximum safety and value for money. It sounds simple, and it basically means a demand for improved quality of existing possibilities.



Photo 1: MULTIRAIL® BogieLoad: installed in 2012 at SIEMENS AG Austria, Rail Systems, Graz works

From the development process to production, maintenance and field-based monitoring, the measurement of geometry data and forces plays a crucial role. Vehicle manufacturers, infrastructure and rail operators and maintenance companies perform measurements every day, sometimes recording huge volumes of data.

While measuring geometry data is an everyday occurrence, measuring this data and changes in geometry under load is a much more challenging task. Yet it's only the combination of force and geometry information that can provide reliable data, for example relating to the anticipated comfort of travel or for estimating the degree of derailment protection. In the workshop, this is increasingly becoming standard practice. In the bogie pressure measuring stand or when measuring corner load or vertical wheel force, force and geometry are measured simultaneously, so the issue of deformation under load and therefore the effect on load distribution is taken into account.

On the track, force measurement still takes priority because the simultaneous measurement of geometries from outside – on the vehicle or indeed on the deformed track – is no trivial matter.

In each of the cases shown here the measurement is complex, with many aspects to be taken into consideration:

- » Which errors are caused by the measuring chain?
- » What effect do environmental influences have?
- » How many measurements are required?
- » What sampling rates are necessary?
- » How does calibration take place?
- » And last but not least: What is the human / operator influence?

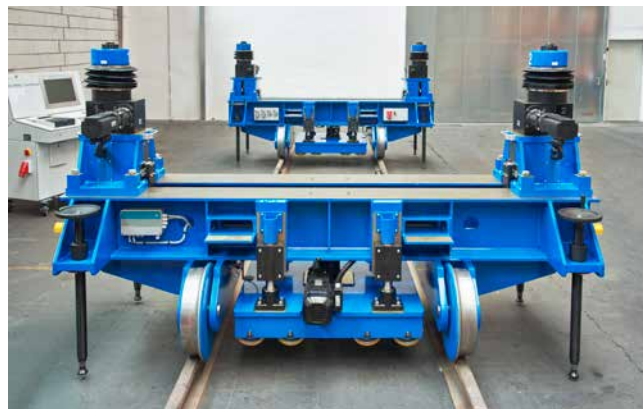


Photo 2: MULTIRAIL® CornerLoad

What are the important factors from a technical standpoint?

- » Optimally adjusted, comfortable and safe bogies compatible with bogie interchangeability.
- » Safe force flows in the vehicle combined with homogeneous force distribution and reproducible conformity with all geometric parameters.
- » Bogies and rail car bodies must be well coordinated to one another.
- » Documented production processes support optimization.

And finally, field-based systems allow vehicles to be monitored during operation. This means that unusual load distributions or unusual dynamic loads (e.g. of out-of-round wheels) can be detected promptly and in good time. Condition-based maintenance becomes a reality. For the most part, vehicle manufacturers, infrastructure and rail operators and maintenance companies work independently of one another. Each party has its own aims, measuring methods, databases and evaluation procedures. Some of these methods and data are completely different, which includes the measurement errors, verification methods and calibration procedures.

What would happen if more exchange of data and knowledge took place in the rail industry?

Here is an example of a vehicle manufacturer which systematically optimized its measurement technology by using field- and track-based data. When recording vertical wheel forces, it's essential to calculate the (overall) measurement uncertainties.

With the previous, conventional approach, the status of the process measurement uncertainty was unknown. The vehicle was weighed statically, one axle at a time, on a singular wheel force measurement device, then weighed dynamically in the second step and the wheel forces were



Photo 3: Measuring track curve at Siemens AG, test center PCW Wildenrath

calculated. Only the level of the measurement track and the measurement uncertainty of the force measuring device were verified by means of a reference load cell. This was done without consideration of the vehicle influence, i.e. the interplay between the measuring system and the vehicle system. Other influences caused by the operator, weather, temperature, track configuration and so on were also not taken into account. The variations within several series of measurements (reproducibility measurements) were correspondingly high, not explainable, and unsatisfactory.

By examining the operating data of network and vehicle operators, the vehicle manufacturer was able to very quickly develop a completely new measurement concept. Instead of singular measurements, the individual wheels are now recorded several times during the slow transit (a process referred to as 'quasi-static' measurement). The measurement points are distributed over a defined area of track. This allows a wide range of conditions relating to the interaction of vehicle, track and measuring equipment to be recorded, fully corresponding to later operational use. The vehicle passes over the measuring system in both orientations and both directions of travel. For each wheel, this means an averaging of 4 (journeys) × 8 (measurement points) = 32 measurements.

The reproducibility variations between the specific vertical wheel forces of a wheel is now the measure for the measurement uncertainty of the overall process. In the new measurement process, in addition to level under load and the static measurement uncertainty of the force measuring device calculated with the reference load cell, the quasi-static measurement uncertainty in interaction with the vehicle is therefore also verified in relation to the vertical wheel force through the 'vehicle rotation test' (changing the vehicle's direction of orientation). The measured value is returned through the (statically measured) total of the vertical wheel forces of the tested vehicle (corresponding to

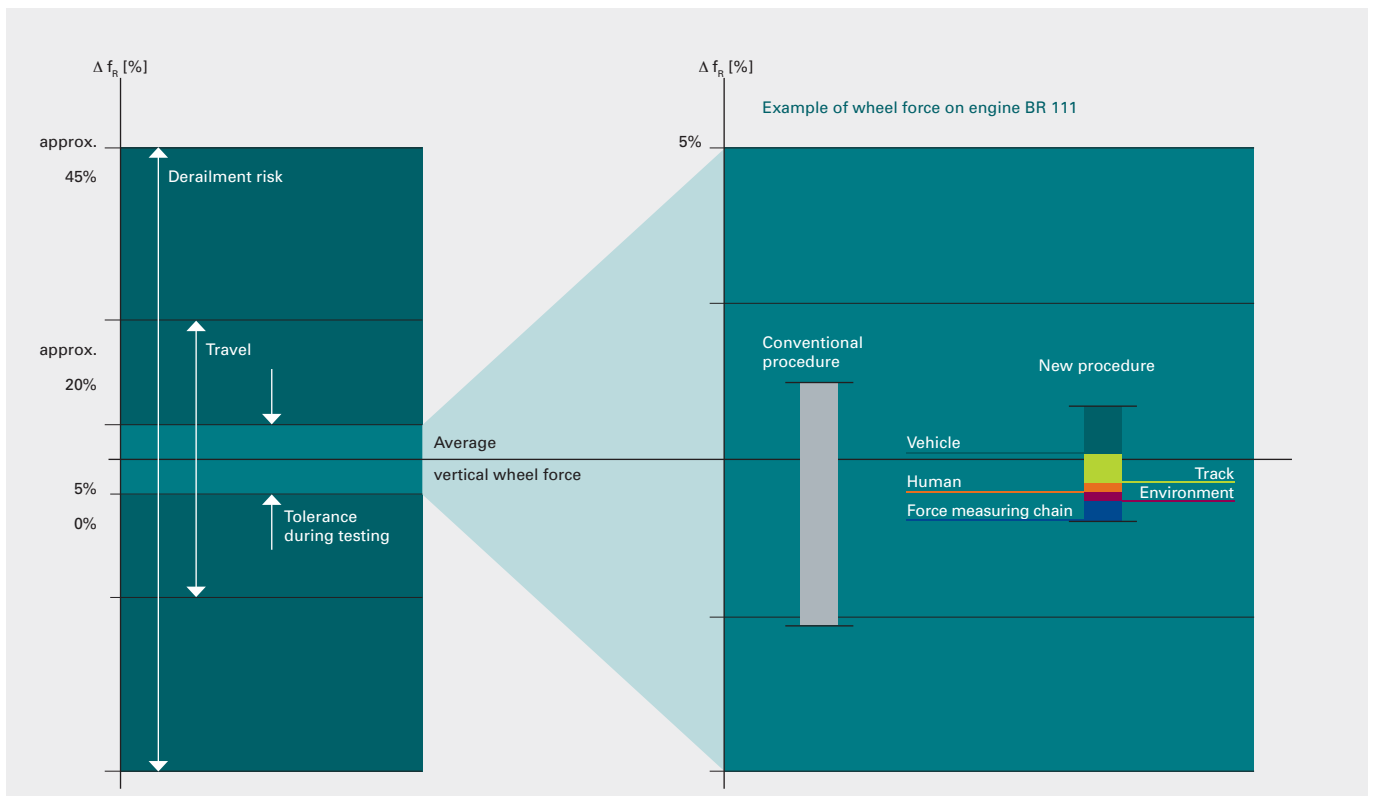


Photo 4: Measurement uncertainty of vertical wheel forces

the vehicle mass). This remains constant (within the specified tolerances) despite the changing vertical wheel forces / vertical wheel force distribution.

The example described above illustrates how essential its success is to the vehicle manufacturer, but there are also fundamental benefits when consistent measurement data is used across the board, up to and including the adaptation of a complete test process.

When all individual systems reflect the state of the art and are considered as part of an integral whole, all stakeholders stand to reap significant benefits:

A) ...THE VEHICLE MANUFACTURER

- » develops and delivers the highest possible quality
- » creates a basis for ongoing product improvement
- » can make recommendations for preventive or predictive maintenance

B) ... THE TRAIN OPERATOR

- » improves safety
- » increases punctuality and reliability
- » has satisfied passengers
- » achieves higher service performance
- » benefits from better ROI

C) ... THE RAIL NETWORK OPERATOR

- » protects infrastructure through reduced wear
- » achieves reduced noise emissions on the track
- » can calculate on a use basis

D) ...THE MAINTENANCE COMPANY

- » can optimize capacity planning
- » reduces costs
- » optimizes maintenance times

When approval authorities, vehicle developers, vehicle manufacturers, train operators and workshops work closely together, share data and to some extent analyze and interpret data together, then improved quality in rail vehicle construction becomes a competitive advantage for all stakeholders, but above all, rail travel becomes more attractive to all of us.



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