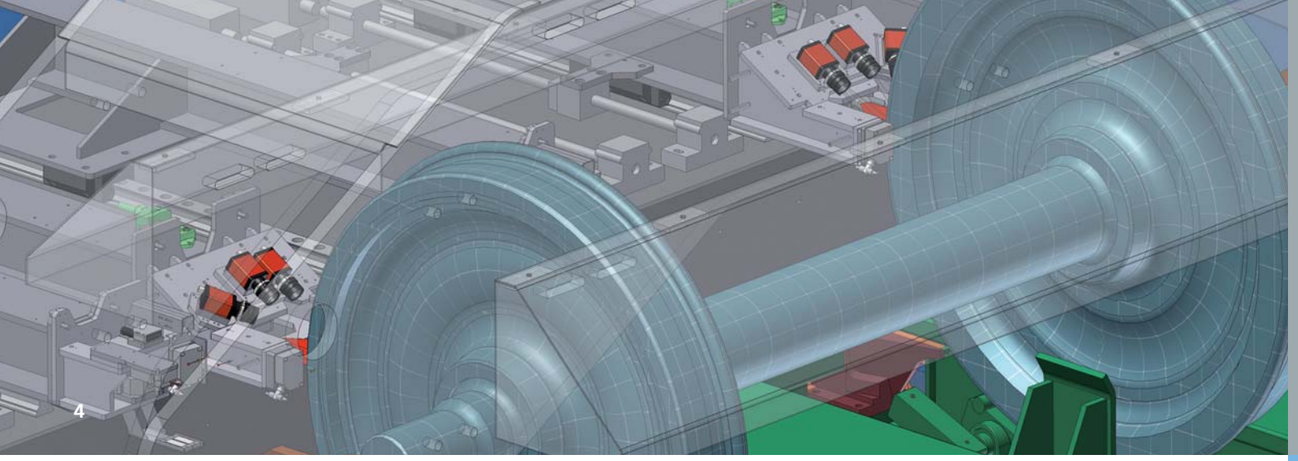

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AUTOMATED WHEELSET GEOMETRY SCANNING

Technical Specification

1. Main dimensions
Width:5,600 mm
Height[1]: 2,660 mm
Depth: 3,100 mm

2. Total weight
Approx. 17 t

3. Connection data
Power supply: 400V, 50Hz
Installed load: approx. 24 kVA

4. Permissible ambient temperature
+10° C to +35° C

5. Permissible wheelsets
Gauge width[2]: 1435 mm
Measuring circle diameter[2]: 630 – 1005 mm
Max. wheelset weight[2]: 2 t
Axle length[2]: 2000 – 2300 mm

6. Typical cycle time
Approx. 5.0 min
Handling: approx. 2.5 min
Scanning time: approx. 2.5 min

[1] Additionally requires a machinery pit for the lift frame
[2] Modifiable at customer request

OPTO INSPECT 3D Measuring Device

Title *Wheelset scanning*
1 *Wheelset measuring stand*
2 *Wheelset in the measuring stand*
3 *Optical wheel profile sensor*
4 *CAD model measuring stand*
Photos: Fraunhofer IFF

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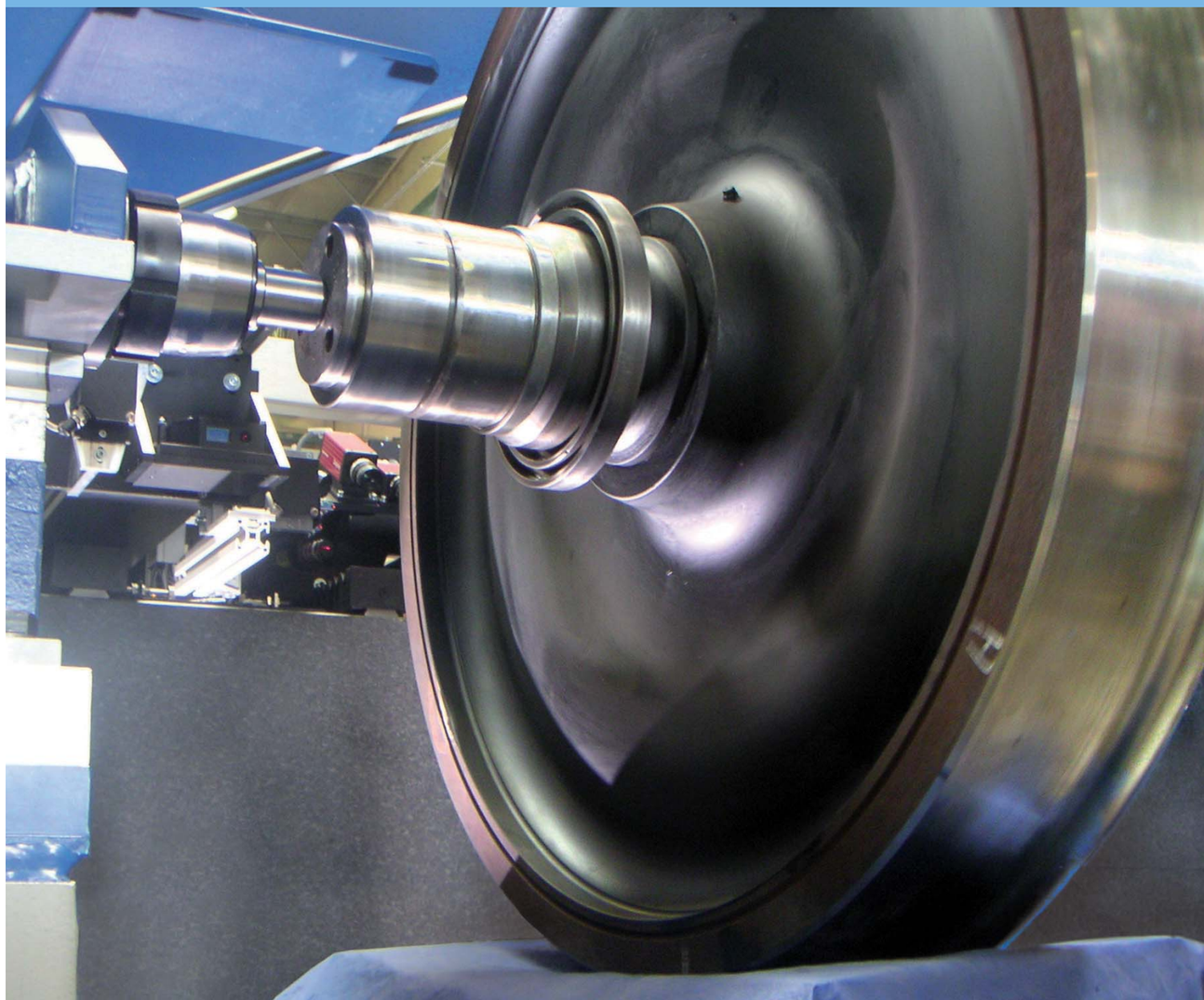

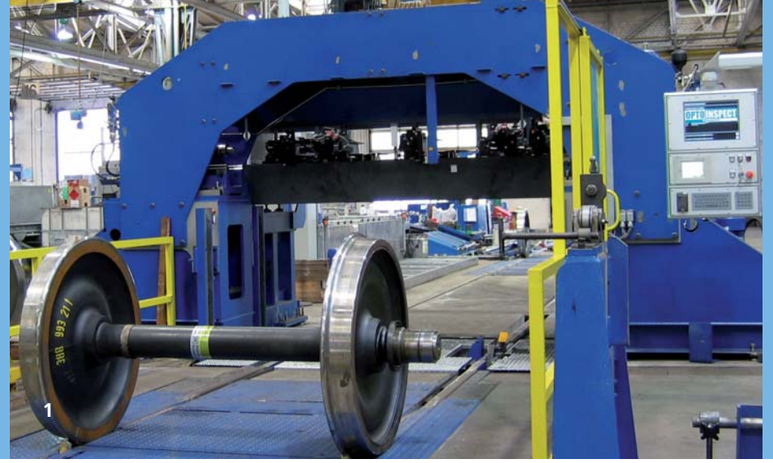
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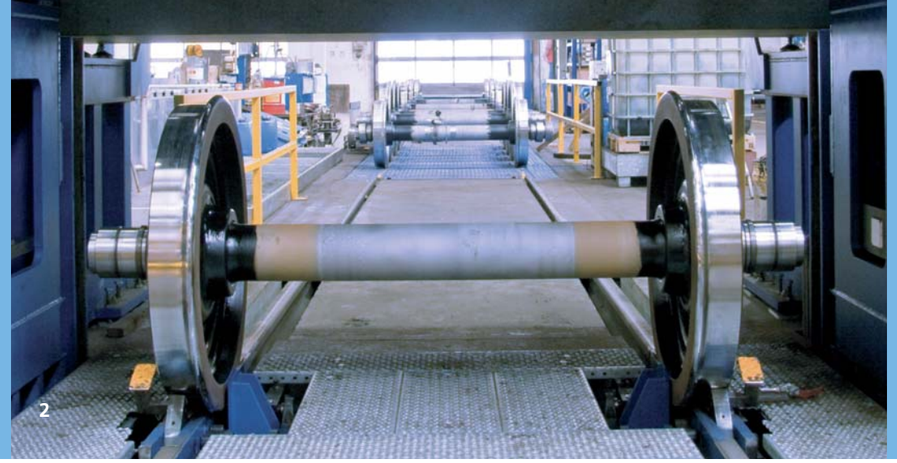
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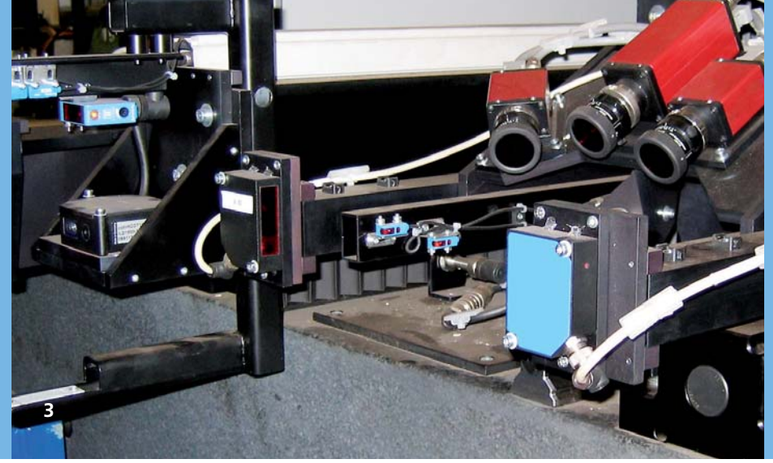
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Initial Situation: Increased Requirements for Train Wheelsets

The interaction between wheel and rail stresses the wheels of rail vehicles tremendously. The wheel profile geometry, the radial and axial runout tolerances and the wheel disks' position on the shaft are critical quality parameters for a rail vehicle's safe operation and high ride comfort. These quality parameters must be assured by objective measurements, especially as vehicle speeds continue increasing.

Parameters are measured both when wheelsets are manufactured and when they are serviced.

Train wheelset maintenance in a wheelset shop requires inspection of their geometry before and after machining. Preliminary measurement determines condition (wear condition) before maintenance begins. This serves as the basis to establish specifications for machining at the wheelset lathe. Statistical data on the performance of different wheelset designs can be acquired.

Once maintenance has concluded or when wheelsets are refinished, every relevant geometric parameter must be inspected and compliance with the specifications assured. Thus, potential quality problems can be detected early on in the manufacturing process.

Technical Solution: Wheelset Measuring Stand for Automated Geometry Scanning

OptoInspect 3D technology served as the basis to develop a measurement system that automatically scans wheelset geometry and captures every relevant geometric quality parameter. Such a fully automatic measuring stand receives a wheelset and sets it rotating to scan all the geometric features.

Data is acquired by a sensor cluster utilizing optical sensors that measure lines and points and operate based on the principle of triangulation. Software modules modified for the specific task evaluate the data and visualize the results.

Wheelset Measuring Stand Design

The wheelset measuring stand consists of a wheelset handling and a wheelset measuring equipment module.

The wheelset handling module automatically inserts, removes, lifts and clamps wheelsets between two rotatable spindle sleeves, which turn the wheelset on its own shaft axis to scan the geometric feature along the entire circumference.

The sensors of the wheelset measuring equipment module are mounted on a granite slab, which guarantees the structure remains geometrically stable. On precision linear guides, the sensors can be adjusted radially to the wheelset and simultaneously capture all relevant measured data. Optical sensors take measurements fully without contact and thus without wear.

A PC system is responsible for controlling the motion systems, acquiring data by optical sensors and analyzing and logging data.

Wheelset Handling

The wheelset being measured is rolled along a rail into the measuring stand where a mechanical stop brings it to a halt. A lifting system elevates the wheelset vertically until the axis reaches a specified setpoint position. Then two spindle sleeves move in axially to the ends of the axle and clamp the wheelset using the centering bores on the end faces. A friction drive rotates the wheelset continually.

An incremental encoder at the spindle sleeves ensures that all measured data are recorded synchronously to the angle of rotation.

Once measured data acquisition has concluded, the wheelset is released and lowered to the level of the rail with the lift table. A programmable logic controller (PLC) controls the necessary sequences, monitors all safety functions and communicates with peripherals (e.g. the transport system).

Wheelset Measuring Equipment

The wheelset measuring equipment performs the following tasks:
- Determining the wheelset and wheel profile coordinate system
- Determining all of a wheelset's relevant geometric parameters

This is done by adjusting a sensor cluster of a total of five optical sensors radially to the wheelset's shaft axis. The individual sensors of the cluster operate in a shared coordinate system.

Sensors 1 and 5 capture the reference surfaces at the axle journals in order to establish the references for all further measurements.

Sensors 2 and 4 measure the journal profiles including the front faces of the wheels. The linear measurement of the entire contour taken with the aid of light-sectioning makes it possible to incorporate all technical requirements when calculating the quantities measured at the wheelset.

Sensor 3 measures the wheelset shaft's radial runout tolerance and diameter. Optionally, the sensor cluster can be augmented by additional sensors, which scan the geometric features of shaft and wheel brake disks.

The measured data is acquired in the wheelset's horizontal neutral plane. Allowing for any deformation of the clamped-in wheelset by its own weight, this minimizes interferences.

Results of Measurement

The following measurands are determined in accordance with the guidelines of the Deutsche Bahn AG and compared with their nominal specifications:
- Distance of the inner wheel flange faces
- Distance of the inner wheel flange face to the center of the wheelset shaft and to the bearing journals
- Measuring circle diameter
- Radial runout tolerance in the measuring circle planes
- Axial runout tolerance of the wheel disks
- Diameter and radial runout tolerance of the wheelset shaft
- Gauge size

In addition, the following profile dimensions are determined on both sides:
- Flange thickness
- Flange height
- Cross dimension on the flange flank
- Flange and rim width

All runout tolerances (radial and axial runout tolerances) are calculated from minimums and maximums from 1,800 individual measurements over the entire circumference. This ensures that even local tolerances are measured reliably. All other dimensions are calculated from 360 individual measurements over the entire circumference. Afterward, the means and the minimums and maximums are output. The number of measurements can be modified for customer requirements.

An accredited calibration lab has systematically surveyed and evaluated the measuring accuracy for all wheelset measuring stands implemented thus far. The outcome was the validation of the applicability of the inspection, measuring and test equipment as well as the performance of the inspection process.