CASE STUDY

Austria

Automotive, Transportation

PULSE, Transducers, Customised software

ÖBB – Österreichische Bundesbahn Railway Locomotive Chassis Testing

Since its first steam locomotives were built and commissioned some 170 years ago, state-owned Austrian Railways (ÖBB) has always invested in the latest state-of-the-art technology.

In 1997, ÖBB placed an order with Siemens Austria AG ordered for 400 high-performance 'Taurus' class locomotives. ÖBB needed a test-cell solution that could automatically perform many different tests, and which could efficiently store test data. After a thorough investigation into the possible options, a Brüel & Kjær solution based the PULSE™ data acquisition system was chosen.

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ÖBB – Österreichische Bundesbahn

For more than 170 years, ever since its first steam locomotives were deigned and built, state-owned Austrian Railway – Österreichische Bundesbahn (ÖBB) – has always invested in the most modern advanced technology. For example, work to electrify the Austrian railway network was started as early as 1912.

Today, more than 5000 locomotive drivers, working round the clock, keep ÖBB's passenger and freight trains on the move. And over 2000 employees in the technical rolling stock service and shed services ensure that ÖBB's locomotives, coaches and wagons are in top-class condition. Some 600 employees are responsible for the related administrative work, planning and controlling the necessary procedures.

Further information on ÔBB can be found at www.oebb.at

The 'Taurus' Locomotive

Fig. 1
ÖBB placed an order with Siemens Austria AG for 75 high-performance 'Taurus' class locomotives – they began entering service in January 2000

In 1997, ÖBB placed an order with Siemens Austria AG for 400 high-performance 'Taurus' class locomotives. These began entering service in January 2000. With a power output of 7000 kW (almost 10 000 hp), a 'Taurus' locomotive can accelerate passenger trains up to a speed of 230 km/h or haul freight trains of 1600 tons. Final assembly of the locomotives is carried out in ÖBB's workshop at Linz.

R&D

Fig. 2
Manfred Eder is responsible for the technical management of the project

Mr. Manfred Eder is responsible for the technical aspect of the project. Mr. Eder says, "Back in 2000, during the development phase of 'Taurus', we searched for a test-cell solution that could automatically perform many different tests, and which could efficiently store test data for future comparison and evaluation".

He continues, "We had a number of meetings with Brüel & Kjær's sales engineers and measurements were made to ensure that the solution we finally selected would provide the results and benefits we wanted."

ÖBB selected a Brüel & Kjær solution based on a 24-channel PULSE data acquisition system, a customised user-defined software interface, eight laser triangulation displacement sensors, accelerometers and a Microsoft® Access-based database.

Mr. Eder adds, "These components, when integrated together, provided us with a highly efficient total test system".

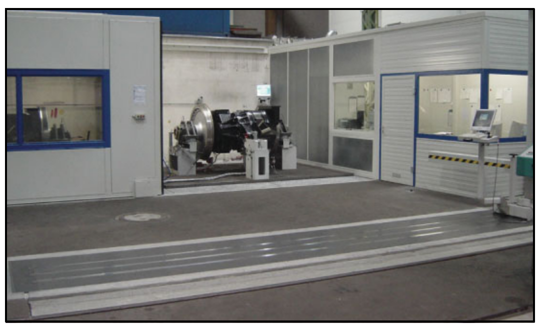
Mr. Gerhard Frattner managed the complete project. He explains, "Our new locomotive chassis test facility is the first of its type to be commissioned in Europe. We are proud of making this first big step, and very pleased with the results".

Fig. 3
Gerhard Frattner is the project manager and responsible for the complete test facility

The Brüel & Kjær solution for vibration measurement was a part of the total project in which the system integrator and the company responsible for the test cell housing played a major part. Therefore, the coordination of all the different aspects of the total project was a critical success factor.

Test Facilities

Fig. 4
There are two similar test cells in the testing area. When in use, each test cell is closed by automatic doors



The locomotive chassis testing area comprises two similar test cells. These are closed by automatic doors while the test cycles are performed.

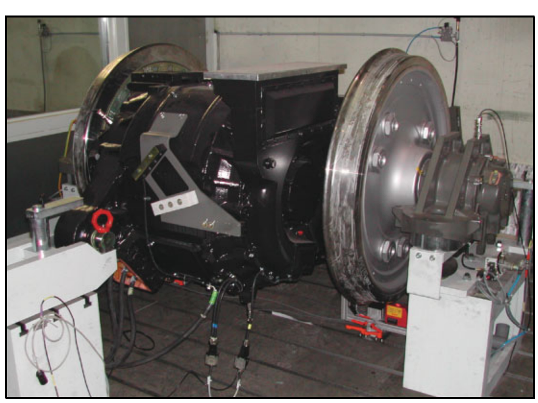
"Mr. Eder says, "For a complete test cycle, six accelerometers are mounted on selected points to measure vibration, four lasers are positioned, and an electric motor is connected to power the chassis"

"The test chassis comprises three axles, a gearbox, several bearings and the wheels. Four of these chassis are installed on each locomotive."

A master PC, installed by the system integrator, automatically controls the full test process.

PULSE

Fig. 5
Each chassis comprises three axles, a gearbox, several bearings and the wheels. Four chassis are installed on each locomotive



The PULSE Type 3560 D data acquisition system makes measurements in both test cells. Therefore, as measurements are being made in one test cell, another chassis is prepared in the second test cell.

Mr. Frattner says, "Being able to mount or dismount a chassis in the second test cell while measurements are being made in the first saves us a considerable amount of expensive measurement time".

Up to 12 channels of PULSE data per test cell can be viewed in real-time while a test is performed. PULSE uses a variety of analysis methods such as FFT, envelope analysis and three different order analyses. The PULSE software runs in the background.

User Interface

The test engineer controls the test system and views the results via a customised user-interface. This indicates, on every measurement point and in each test cycle, if the test parameters are within the prescribed limits with a PASS/FAIL indication. The various test parameters are defined in the customised software, for example, for the gearbox, bearings, displacement and balancing. If the user interface indicates a failure, the relevant component details are displayed together with the parameter that is outside the prescribed limits.

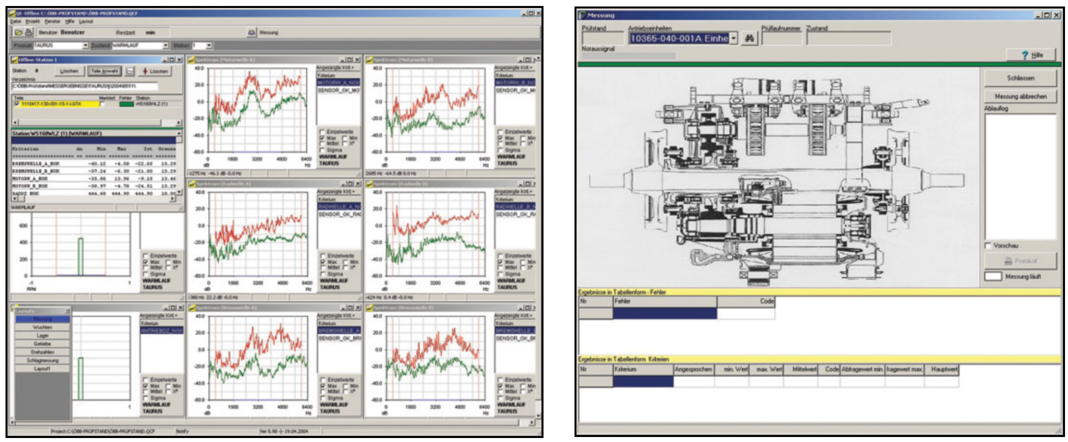


Fig. 6
Left: The multi-layered user interface provides simple Pass/Fail indications for each test parameter. The red curve is the reference while the green line is the actual result. There is automatic extraction of specified cursor values
Right: A schematic of the test object is provided together with a log of all measurements and a print out. Test results are displayed in tabular form and any fail criteria are indicted

Laser Sensors

Fig. 7
Each test cell uses four laser triangulation sensors to check the ovality of the wheels, forwards and backwards, both radially and axially

A total of eight displacement sensors (four per test cell) check the ovality of the wheels in both rotation directions, also radially and axially. The result is the displacement averaged over a number of revolutions related to 360 degrees. In this measurement cycle, because the tolerance on the ovality of the wheels is in the micrometer region, the positioning of the laser triangulation sensor is a critical factor, especially if the chassis being tested has run on the rail network for 500 000 km.

Balancing

Another test checks the balance of the axle with the wheels. This requires the calculation of both the compensation mass and the phase. Therefore, three measurements have to be made. The first verifies the original condition while the second and third runs are made with a known trial mass in both planes. The calculations are made from these six values.

Data Handling and Reporting

The test cells run under Windows® 2000. All test data are stored in an Access database. Via the network, data can be accessed, analysed and compared by different departments.

After the full test cycle is completed, a report is easily produced which shows all essential test parameters.

Mr. Fratttner concludes by saying, “We are able to make many different tests in a very short time and, due to the database, we are building up a history of every locomotive we test. From time to time, each locomotive comes back to us for testing and it’s easy to compare the new test results with the data stored in the database. The Brüel & Kjær solution is highly efficient, we have confidence in the accuracy of the data, and it does just what we need. The service and support from Brüel & Kjær’s local office in Vienna has been excellent”.

Key Facts

- For more than 170 years ÖBB has invested in the most modern advanced technology
- ÖBB placed an for 400 high-performance ‘Taurus’ class locomotives
- ÖBB searched for a test-cell solution that could automatically perform many different tests, and which could efficiently store test data for future comparison and evaluation
- ÖBB selected a Brüel & Kjær solution based on a PULSE data acquisition system
- “Our new locomotive chassis test facility is the first o to be commissioned in Europe”
- “Being able to mount or dismount a chassis in the second test cell while measurements are being made in the first saves us a considerable amount of expensive measurement time”
- Up to 12 channels of PULSE data per test cell can be viewed in real-time while a test is performed. PULSE uses a variety of analysis methods such as FFT, envelope analysis and three different order analyses
- The various test parameters are defined in the customised software – if the user interface indicates a failure, the relevant component details are displayed together with the parameter that is outside the prescribed limits
- “We are able to make many different tests in a very short time and, due to the database, we are building up a history of every locomotive we test and it’s easy to compare the new test results with the data stored in the database
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