

IWT4 goes into operation

WHEELSETS Interfleet Technology's new generation of instrumented wheelset has recently been accredited by German railway authority EBA

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formal accreditation it is now being marketed worldwide. Building on almost 50 years of experience with instrumented wheelsets, IWT4 takes a radically different approach to earlier designs, using advanced mathematical processing and cutting edge radio telemetry and signal conditioning to measure accurately the dynamic forces between rail and wheel.

Digital signals

As Mikael Wrang explained in RG 9.06 p611, IWT4 uses wireless transmission to replace the physical links previously required to connect the wheel-mounted strain-gauges and the on-train processing system. Although this sounds simple, in practice it is not. Conventional wheelsets use the physical geometry of the wheel to separate wheel-rail forces into their vertical and lateral components, with the gauges being applied in different positions on the wheel where they are relatively insensitive to either vertical or lateral forces so as to detect the other.

IWT4 uses a 'post-assembly' identification process, which at its most basic level involves applying known loads at known positions. The characteristics of the wheel are then 'learned' by advanced algorithms developed by Interfleet. This approach means that IWT4 does not require any special wheel geometry, so the



Above: Sensors on the wheels are connected to a digital signal processor and telemetry unit mounted on the axle.

Below: The first vehicle type to be measured using IWT4 was this close-coupled car carrier tested by Brunel RailMotive in Austria and Switzerland.

instrumentation can be fitted to any vehicle's standard wheelsets. Furthermore, the strain gauges can be bonded to either the inside or outside of the wheel disc in the most convenient locations.

The signals are digitised on the wheel using a specially-developed analogue-to-digital converter. This minimises the length of cable carrying analogue signals, reducing the risk of electromagnetic interference degrading the signal quality. A digital signal processor mounted on the wheelset provides anti-aliasing filtering, re-sampling and data reduction, after which the digital signals are transmitted from each wheel disc using radio telemetry. This in turn removes the need to use slip rings or other rotating devices, and has the advantage that no holes need to be drilled in the axle or the wheel disc.

An on-board radio unit on the train receives the signals, which are then processed in real time using force-resolving software. This produces analogue signals which readily interface with commercial data acquisition systems.

In the most basic form, IWT4 records the vertical and lateral wheel-rail forces. However using most wheelsets it is also possible to measure

The approval last year of a four-axle, close-coupled car transporter wagon design by the Brunel RailMotive test centre in Germany marked a significant step in the development of vehicle acceptance testing, as it was the first commercial application of IWT4, the latest generation of instrumented wheelsets.

IWT4 has been under development by Interfleet Technology's Swedish team for about 10 years, and following





longitudinal wheel-rail forces, the lateral position of the wheel-rail contact point and the rotational speed of the wheel. In the future we hope that even more forces can be measured, such as the spin moment at the wheel-rail contact point.

Development and approval

As part of the development process, IWT4 was tested on passenger and freight vehicles, using both conventional and stub axles, on powered and unpowered wheelsets, and at speeds above 250 km/h. The system also underwent tests for EMC emissions and immunity, climate chamber temperature tests, and shock and vibration

Above: Two different sizes of instrument wheel were needed for the car-carrier tests; the blue cylinder is not part of the wheelset testing equipment.

Below: Interfleet Technology provided two specialists to assist with mounting the calibrated wheelsets on the test vehicle and setting up interfaces with the data recorders.



testing against tough military standards. This programme confirmed that the technology met the requirements of the relevant European directives.

With central Europe being seen as one of the most important markets for instrumented wheelset technology, Interfleet considered that accreditation by Germany's Federal Railway Office (EBA) was essential. Work on achieving this began in 2006. EBA appointed an independent advisor which specialised in vehicle running dynamics to delve deep into the IWT4 algorithms to obtain a full understanding of the operating principles.

This was supplemented by evidence of the wheelsets' performance during roller rig and on-track testing, and a quality review of Interfleet production processes. Throughout the process, EBA used its own vehicle dynamics expert for peer review, resulting in the granting of full accreditation for the IWT4 technology in April 2008.

Commercial applications

Working under a preliminary EBA approval, Brunel RailMotive began using IWT4 in commercial applications last year. The first vehicle to be tested was a four-axle, close-coupled car transporter wagon, which was more complicated because the inner and outer wheelsets were of different diameters – 730 and 840 mm respectively. One wheelset of each size was sent to Stockholm for instrumentation by Interfleet. They were instrumented,

calibrated and returned to RailMotive in a fraction of the time normally required for conventional IW techniques.

Two Interfleet measurement specialists supervised the fitting of the IWT4 wheelsets, plus the installation of the transmission and processing equipment, which had to be interfaced with RailMotive's data acquisition system. After one day of initial trials in Austria, the test programme moved to Switzerland, where the vehicle was tested against the European running dynamics standard EN14363. Testing was concluded within a month, and the vehicle was successfully approved for commercial operation.

According to Rail Motive's Head of testing Dr Klaus Hempelmann 'IWT4 was very attractive for us, as we had to test a vehicle requiring instrumented wheelsets of quite unique dimensions, and with an extreme curvature of the wheel web. The alternative of sourcing wheelsets with a special geometry would have caused us significant delay and introduced another project risk.'

Following accreditation, IWT4 is now being marketed to other test centres, operators, infrastructure owners and manufacturers. Whilst Interfleet envisages that the majority of applications will be for vehicle acceptance testing, IWT4 will also be usable for the validation of simulations, research, troubleshooting, and system optimisation. It may also have a role in the monitoring and studying of track quality. ❏