

Case Study with Alstom



Use under the harshest conditions

Sensors from ASC ensure both safety and comfort in rail transport

Alstom is one of the world's leading manufacturers of rail vehicles. Among other things, the company test the running dynamics and bogie strength of new trains at their Salzgitter, Germany site. Capacitive acceleration sensors from ASC GmbH – a globally leading manufacturer – provide crucial measurement data during testing.

At their German works, Alstom produce regional trains, trams, rapid-transit and underground trains and locomotives. Before they can be approved for personnel transport by the German Federal Railway Authority (EBA), however, the trains must pass a host of tests under realistic conditions. "We carry out running tests and other dynamic tests, among other things. This enables us to verify that a train is technically incapable of derailing," reported Tim Michatz, deputy director of the test laboratory for Alstom Germany. "Technically" means that the train cannot come off the track or tip over without an outside influence. In addition to train safety, riding comfort is also a priority.

ASC sensors impressed with their precision and high working stability

The test engineers in Salzgitter test rail vehicles in accordance with the EN14363 (running dynamics) and EN13749 (bogie strength) standards. When doing so, they are reliant on the data recorded by high-precision sensors during testing. Capacitive acceleration sensors from ASC GmbH have been used for test runs since 2013. Until then, the company were using sensors from a competitor which became defective after five years in the field. The decision for ASC as the new supplier was taken not only thanks to the high precision of the sensors, but also due to their high working stability and impact resistance – very important criteria indeed. "During tests on the wheel pairs and the bogie, impacts with a force of up to 400 g occur," said engineer Tim Michatz of the conditions experienced. Loads like this are harmless to ASC sensors, which are actually capable of withstanding impacts up to 6,000 g.

DAkkS calibration an important advantage

To Alstom, there was another aspect which played a large role as well – ASC calibrate the sensors for their customers and have been accredited by the German Accreditation Authority (DAkkS) for this purpose. "This was a good fit, as we are also accredited by the DAkkS (as per DIN EN ISO/IEC 17025) as the Alstom test laboratory, meaning that the sensors we use also have to fulfil these conditions," said Michatz.

It wasn't easy at all to find a manufacturer whose products meet these specifications, though. "Many of them spare the effort and don't have their sensors calibrated with accreditation. Sometimes, they don't even calibrate the sensors at all. In this case, the customer has to do it themselves – a very laborious task."

Trains are tested on sections of open rail

Alstom thus received fully calibrated sensors of type ASC 4421¹ (uniaxial) and ASC 5521¹ (triaxial) made with special plug connectors and were able to use them for measurements straight away. Contrary to what you might think, they're only used to a small degree in Salzgitter itself. The reason for this is the applicable standards, which specify that the tests must be carried out on the public rail network. For these test runs, the company use certain sections of rail with very specific properties. "For the running dynamics tests, we traverse the section from Nuremberg to Augsburg and a section near Trier, as the arc radius of the tracks are narrow there, enabling us to easily test how the trains will behave on curves," explained Michatz. These sections are blocked for the duration of the test, as the trains travel 10 % faster than normal during the test runs, creating a risk of collision.



Among other things, Alstom is testing the running dynamics of the trains with ASC's capacitive accelerometers



Photo Alstom

High measurement sensitivity and broad frequency range

General-series capacitive acceleration sensors from ASC are highly suitable for test set-ups like Alstom's thanks to their high measurement sensitivity and stability. They enable precise measurement, even of slight linear acceleration and low-frequency dynamic acceleration. ASC have since included the successor line, the MF series, in their product range. These medium-frequency acceleration sensors are also equipped with a large frequency range from 0 to 7 kHz (± 3 dB), which opens up wide-ranging applications, including in the car and wind energy fields. The MF acceleration sensors also feature a differential output, measure reliably in higher operating temperature ranges and are able to work with very low voltages.

The sensors are impervious to environmental influences

At least as important as the high measurement sensitivity of the sensors is their extreme ruggedness, as they are exposed to rain, snow and mist during the test runs and must function flawlessly within a broad temperature range between -20 and $+100$ °C. Other than their own housing, the electronics do not feature further protection, as they are only screwed to magnetic blocks and then mounted in the position to be measured by the Alstom engineers. This makes the rugged construction of the sensors a big advantage. The sensor specialists at ASC have designed their sensors in such a way that they work reliably and precisely even under these demanding conditions. Not only are they rated protection class IP67, but they are also designed for a very broad temperature range from -40 to $+125$ °C.

¹ The imaged sensors ASC 4421MF and ASC 5521MF are the follow-up products of the ASC 4421 and ASC 5521.



For the measurements, the ASC sensors are mounted on the wheelsets of the trains
Photo: Alstom

Six to eight weeks of continuous use

Although the running dynamics of Alstom trains are tested on only a few sections of track, the vehicles cover distances of around 2,000 km for bogie strength testing. “To do this, we cover a loop from the Ruhr region through Cologne to Frankfurt, stopping at every station,” said Michatz. “During the tests, we simulate normal train operation in every conceivable operating situation.” Though every test run is concerned with operating safety first and foremost, riding comfort is also “put on the test bench.” This has been expressed in numerical values which are specified in EU standard EN12299 and apply across Europe. The ASC 4421 is predestined for the measurement of the smooth running of trains, as it can also precisely measure slight linear acceleration.

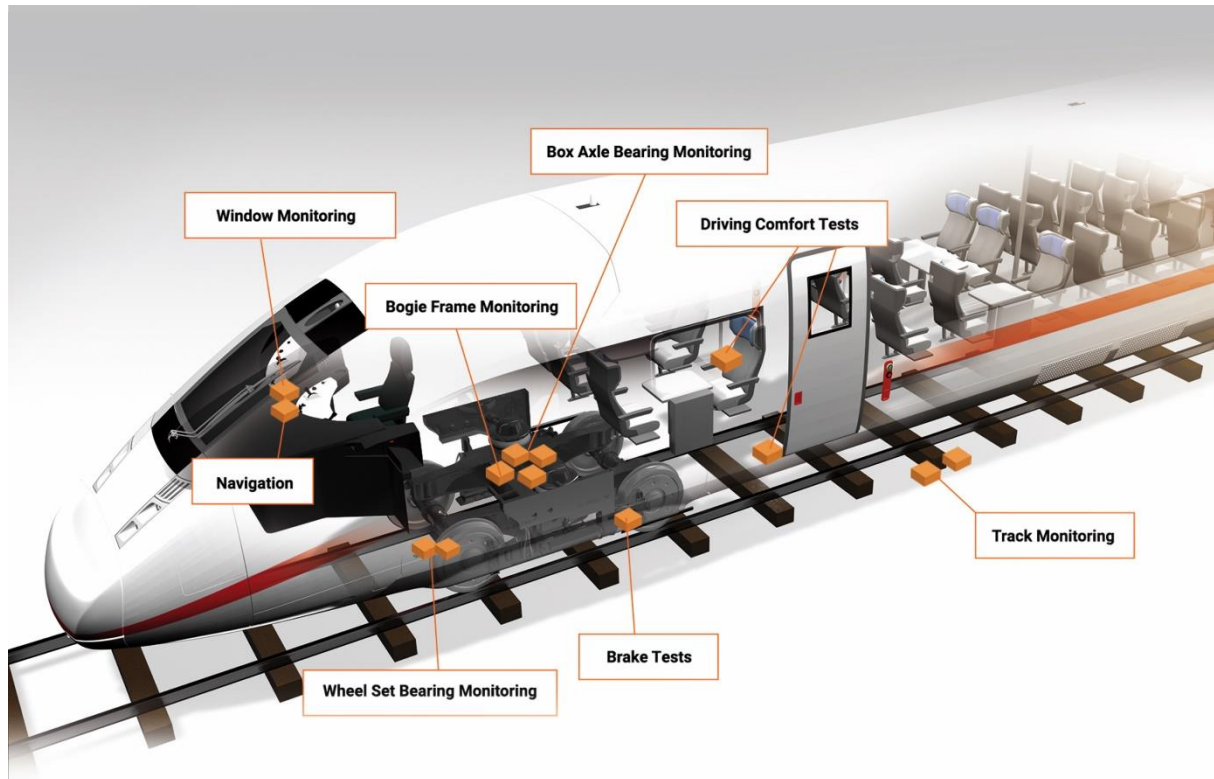
Every train is subjected to tests, but only one train per series needs to undergo full running dynamics and bogie strength testing. The trains are equipped with the sensors two weeks before testing and then run with them for six to eight weeks. “During this time, we measure eight to 10 hours per day at low frequencies under 15 Hz,” said Michatz. The sensors are scanned at 500 Hz, and their signals are recorded by measurement amplifiers.

Rotation rate sensors from ASC to reduce costs

In order for the test runs to be carried out at all, Alstom require the line routing data on the test sections. These are precise specifications on the course and location of the tracks. Previously, the company had to purchase these data externally every six months, as they changed slightly on a continual basis due to external influences. To save money, Alstom would like to collect the data themselves in future. In addition to the 70 acceleration sensors already in use, an additional rotation rate sensor which will soon be on board during test runs was ordered from ASC. The results will then be analysed at the Salzgitter test site.

Still extremely stable after five years

Usable data are only generated during testing if sensors are always in proper working order, however. This is why ASC offer their customers calibration as a service – including for sensors from other manufacturers. Alstom’s sensors are recalibrated every two years, and the values are recorded in an “ageing log.” Even after five years, the sensors are still extremely stable.



ASC's sensors measure a wide variety of parameters in rail vehicles, helping to improve safety and ride comfort

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