

8 December 2008

The AGV, Alstom's latest very high speed train, starts test runs at 360 km/h

After four months of adjustments made on the speed ring at the Velim rail testing centre in the Czech Republic, the AGV¹ has begun its first dynamic tests at 360 km/h, the commercial speed for which it has been designed. The test runs are to be performed on a 170-kilometre section of the Eastern high-speed line, between the Champagne-Ardenne and Lorraine stations, the same line on which the world speed record of 574.8 km/h was set in April 2007 by Alstom, SNCF and RFF. The runs will allow for validation of Alstom's new very-high speed platform at the limits of its commercial speed with a view to its future approval. In total over the 12 nights of testing, close to 60 engineers from the various industrial sites of Alstom Transport and Eurailtest² will be involved, and over 7,500 kilometres covered on board the AGV. The measurements and data compiled thanks to the 4,000 sensors with which the trainset is equipped will be transmitted and analyzed by the Alstom engineering departments of Alstom, who will suggest the adjustments and modifications necessary for the train to be validated.

The tests are being conducted on the AGV prototype built by Alstom to enable it to check, in real conditions, the computer simulations and models produced by the engineers and design offices. A veritable laboratory for the requirements of the Velim dynamic testing campaign, and now the tests on the Eastern high-speed line, the prototype is composed of seven cars. Only two of these are fitted with seats, while the five other cars have been fully equipped for test purposes. The first two and the fifth cars serve as workstations for the engineers, the third houses the two generators supplying electricity to the measurement instruments, and the fourth serves as a spare parts store for the train.

The AGV continuing its programme of validation at very high speed

The Eastern high-speed line was used for the world rail speed record of 574.8 km/h set by the V150 trainset, and is one of the few tracks in the world on which it is possible to operate trains at a speed of 360 km/h. The AGV will be following an intense programme of tests to a plan almost identical to that used in Velim, but over a much shorter time period - four weekends between 21 November and 14 December. In the initial tests, speeds will be limited, then gradually increased.

¹ "Automotrice à Grande Vitesse". AGV is a registered trademark of Alstom.

² Set up in 1999 by French railways SNCF and the Paris mass transit authority RATP, EurailTest markets a fully qualified comprehensive technical testing service for rolling stock, infrastructures and the environment.

The tests in Velim were conducted at speeds ranging between 60 km/h and 200 km/h, the maximum speed authorized on the site, but on the Eastern high-speed line, the AGV will be running at over 200 km/h and up to 360 km/h. The task now is to check the train's dynamics and that of its components in real-life conditions, that is to say at very high speed on an open track in commercial operation. Certain physical phenomena, in particular those linked to aerodynamics and aero-acoustics, such as the effect of the train's slipstream on structures adjacent to the track, are extremely difficult to assess without conducting such tests.

The measurements taken by the engineers will therefore include all the train's critical elements, as well as the fundamentals of very-high speed rail travel.

The first challenge is to check the **wheel-rail** dynamics, i.e. the quality of contact between these two elements. Extremely difficult to model using computers, the tests involve measuring the transversal and vertical forces that are exerted between the wheels and the track and checking the level of vibration perceived by passengers by placing sensors and accelerometers on the bogies and inside the trainset. In the case of the AGV, the first very-high speed train to be composed entirely of articulated cars, it will also be necessary to check the dynamics of the trainset.

Alstom's engineers will also be examining the **pantograph-catenary pairing**. Roof-mounted cameras and sensors will enable the effect of the pantograph on the catenary to be observed at various speeds, as well as the quality of the current collection. In particular, the number and duration of electric arcs will provide engineers with information on the adjustments to be made. Measurement of the catenary rising as the train passes will also provide valuable information.

Unique in the world of rail, the synchronous permanent magnetic motors on the AGV are equipped with the latest developments in terms of power electronics, enabling them to operate under all four types of voltage found in Europe: 1,500, 3,000, 15,000 and 25,000 volts. Their operation at these voltages, as well as that of the **traction drive**, was the subject of highly precise adjustment at Velim. On the Eastern high-speed line, the voltage for which is 25,000 volts, their operation will be monitored with a view to controlling the phenomena of wheelspin during the start-up phases and locking of the wheels during the braking phases.

Following the same plan used for the static tests conducted at La Rochelle and Velim, all **functional elements** of the train are to be revalidated. In particular, over 100 functions controlled from the driving cab are to be tested in normal operating mode and in restricted mode: control of the pantographs, the choice of voltage, the train's interior and exterior lighting, the air conditioning and the closing of the circuit breakers. The tests will allow for checks to be performed to ensure that information is correctly fed back to the driver in the event of a piece of equipment on the train malfunctioning.

The dimensioning of the AGV's **braking system** is a key area when it comes to safety and one that is very strictly regulated. The system must be tested in the most extreme conditions, in emergency situations, in normal and restricted modes and in conditions of normal and reduced adhesion. One of the tests involves activating the train's braking system on a portion of track made slippery with soapy water, simulating, for example, the presence of leaves on the line. The stopping distances of the train will indicate the adjustments to be applied.

Measurements will be made of the **electromagnetic compatibility** (CEM) of the trainset. During operation, the train must not disturb the environment through which it is travelling (e.g. interference with the reception of radios or televisions), and, conversely, it must not be sensitive to external electromagnetic disturbances and still be able to emit and receive data by radio frequency. Embarked aerials will make it possible, for example, to measure the magnetic field of the train.

The AGV is a means of transport that fulfils the imperatives of sustainable development, with very low greenhouse gas emissions. It emits no more than 2.2g/km/passenger, 13 times less than a bus (30g), 50 times less than a car (115g) and 70 times less than an airplane (153g)³. While **rolling resistance**, one of the major elements causing the train to consume energy, can be simulated quite precisely in a wind tunnel, it is nevertheless advisable to verify the train's performance under real-life conditions. Alstom's engineers will be checking the aerodynamic coefficient (Cx) of the AGV.

The reduction of noise pollution is another environmental aspect in which Alstom's engineers took particular interest when designing the AGV, with the aim of maintaining acoustic comfort at 360 km/h at the same level as that of its competitors at 300 or 320 km/h. The **acoustic tests** here will consist of placing aerials along the track to measure the noise emitted when the train passes and identify what the sources are. Synonymous with passenger and driver comfort, a reduction in aerodynamic and rolling noise is being meticulously studied. Microphones installed at various heights in the cab framework, in the carriages and in the gangways will make it possible to simulate passenger perceptions in seated and standing positions.

Following the four weekends of testing on the Eastern high-speed line, the AGV will return to the test centre at Velim, where it will complete its validation programme. It will also be run during 2009 on the Italian railway network, with a view to gaining approval for delivery of the trainsets ordered by NTV⁴. The Italian transport company has placed a firm order for 25 trainsets (with an option for a further 10), with an associated maintenance contract for a period of 30 years. The first production trains will be delivered from 2010.

About Alstom Transport

With sustainable transport in mind, Alstom Transport develops and offers the most complete range of systems, equipment and services on the rail market. Alstom Transport can manage an entire transport system, from rolling stock to signalling and infrastructure, as well as offering turnkey solutions. In 2007-2008, Alstom Transport's orders increased by 39% over the previous financial year and its turnover rose by 4%.

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³ Source ADEME, reference CO2 rate/Kw.h on the production of electricity in France

⁴ Nuovo Trasporto Viaggiatori

Website: www.transport.alstom.com

All documents concerning the tests on the AGV at 360 km/h (videos and photos) can be downloaded from the site www.capaentreprises.com > login: *alstompresse* > password: *alstpr6543*. Use of these documents is reserved exclusively for the press.