AGV
FULL SPEED AHEAD INTO THE 21ST CENTURY
The AGV in final assembly in our La Rochelle facility: placing the lead car on bogies

In the 21st century, very high speed rail is emerging as a leading mode of travel for distances of up to 1000 km.

INTERNATIONAL OPPORTUNITY KNOCKS

Clean-running very high speed rail offers clear economic and environmental advantages over fossil-fuel powered transportation. It also guarantees much greater safety and security along with high operational flexibility: a high speed fleet can be easily configured and reconfigured in its operator’s service image, whether it is being acquired to create a new rail service or to complement or compete with rail and airline operations.

Major technological advances in rail are helping to open these new business prospects. As new national and international opportunities arise, such advances will enable you to define the best direction for your company in this next generation of higher speeds, higher expectations and higher potential rewards.

AGV, INNOVATION WITH A CLEAR PURPOSE

The AGV is designed for the world’s expanding market in very high speed rail. It allows you to carry out daily operations at 360 km/h in total safety, while providing passengers with a broad new range of onboard amenities.

The single-deck AGV, along with the double-deck TGV Duplex, bring operators flexibility and capacity on their national or international itineraries. Solidly dependable, the AGV delivers life-long superior performance (15% lower energy consumption over competition) while assuring lower train ownership costs from initial investment through operating and maintenance.

The AGV combines the well-established design philosophy of the TGV and 30 years of technological expertise in very high speed rail with ground-breaking innovation. Over 560 Alstom Very High Speed Trains (VHSTs) currently operate at speeds above 300 km/h - that’s over 60% of all VHSTs worldwide. Together they have transported over 1.7 billion passengers.

With responsible energy consumption a key consideration in transportation, very high speed rail is emerging as a serious contender for market-leading positions in the competition between rail, road and air over distances ranging from 100 to 1000 km.

ALSTOM’S 21ST CENTURY RESPONSE
your operational needs, your high speed choice

Safe, economical and versatile, our very high speed range is at once environmentally-friendly and built for comfort. Operators can order either the single-deck AGV or the TGV Duplex to build the interoperable VHST fleets that best serve their needs.

The double-deck train is for dense traffic. It offers the highest train capacity on this market as well as a very high level of comfort. It will also comply with the latest TSI* requirements and be fitted with best-in-class comfort features including a passenger information system.

Complementing our high density carrier, the AGV offers flexible composition in single-deck architecture. Developed for seamless international operations at 360 km/h, AGV has been designed from the start for full compliance with TSI. It can be used for service with multiple stops, bifurcations and international routes.

AGV, PROVEN INNOVATION FOR A NEW RAIL ERA

The AGV is the very first VHST to be designed from the outset as an internationally interoperable train that meets the needs of all involved: operators, passengers (including those with reduced mobility), train drivers, train fleet maintainers and railway infrastructure managers.

* Europe’s Technical Standards for Interoperability

New world speed record in rail

On April 3, 2007, the Alstom V150 train tested in partnership with SNCF and RFF reached a speed of 574.8 km/h on the new East European high speed line in France. The V150 trainset consisted of 2 TGV power cars, 3 TGV Duplex coaches and 2 AGV motorized bogies and traction units. The new AGV bogie design demonstrated excellent stability in extreme performance conditions. The AGV Permanent Magnet Motors (PMMs), pantographs, traction units and transformer were fully validated. The world record was the culmination of thousands of hours of testing involving over 300 engineers and technicians.

The AGV weighs 70 tons less than competitor models. This results in savings of 650,000 kWh for a train travelling 500,000 km a year.
ARTICULATED TRAINSET ARCHITECTURE

The AGV is not just equipped for safety. Safety is integral to its basic design. Take the proven articulated trainset architecture: each car shares a bogie with the adjacent car, creating a semi-rigid link between cars. In addition to providing superior dynamic comfort, this full-train architecture minimises the risk that the trainset will break up and cars will pile up, in the event of a derailment. This, in turn, limits the risk of a derailment becoming a very serious accident.

A NOSE FOR SAFETY

Thanks to its uniquely designed nose, the AGV meets TSI crashworthiness requirements in full, as defined in terms of a set of specific crash scenarios. The kinetic energy absorption unit installed in the AGV nose provides the highest levels of protection to both driver and passengers in the first coach in the event of a collision. It consists of a 3-stage crumple device that absorbs 4.6 MJ (equivalent to the impact of a heavy truck at 110km/h).

THE AGV DRIVER, SAFE AND SECURE

Beyond ergonomics and comfort, the driver’s cab has been the subject of studies to assure a maximum level of driver safety. The cab area’s structure has been specially studied to remain integral in case of collision. The driver’s desk and surrounding areas have been designed with rounded forms to avoid injury in case of impact; simulations have been carried out with crash test dummies to verify that the environment is truly non-aggressive. To heighten security, the driver has a dedicated entry door and all cabinets containing critical equipment are located in the secure driver zone, completely inaccessible to unauthorized parties.

TUBE DESIGN LEAVES OPTIONS OPEN

The AGV is designed basically as a hollow tube that operators can fit out as they see best fitting their business model. With such flexibility, operators can choose to install different areas for leisure, work, meetings, reading and rest. In each of these areas, lighting can be customized to enhance the ambiance desired. Textures, paint colours and new lightweight textiles co-developed by Alstom and our partners are also part of the palette available to operators to lend character to different travel areas. Thanks to the AGV’s “tube” design, operators can easily re-configure interiors and seat pitches during the train’s lifetime.

THE IMPORTANCE OF BEING FLEXIBLE

The AGV is offered in trainset configurations of 7, 8, 10, 11 and 14 cars. Up to three 7-car AGV trains may be operated in multiple units (within the standard TSI length limit of 400 m) on an initial itinerary and then separated for different final destinations. This flexibility brings operators significant benefits in terms of yield management. The AGV’s flexibility-by-design also allows each operator to guide the configuration of train interiors according to their own marketing strategy and their ideal balance between high comfort and high capacity.

THE FLEXIBILITY TO MEET YOUR SERVICE NEEDS

The AGV is designed to give operators the flexibility they want in terms of train composition and interiors.

DESIGNED FOR SAFETY & SECURITY

Safety & security are essential attributes of the AGV’s pedigree and have been perfected by Alstom over 30 years of accumulated VHST know-how.
DESIGNED FOR SAFETY & SECURITY

ENERGY ABSORPTION DEVICE

Initial state

Step 01 / Automatic occupier absorption

Step 02 / Upper absorber compression

Step 03 / Main absorber compression

DRIVER AND PASSENGERS SAFE & SECURE

FOR THE DRIVER

FOR PASSENGERS

Distance between first row of passengers' seats and AGV nose

Approx. 4 meters

Distance between driver's seat and AGV nose

Approx. 4.5 meters

Secure door with suction control
Improving on board comfort

Putting passengers first

Attractive and comfortable trains are critical to the success of your transport business. To provide optimum comfort, AGV cars are wider than any other very high speed car on the market (in the UIC loading gauge). This will give you the possibility to propose wider seats or wider corridors. The AGV has the largest windows on the VHS market, ensuring luminosity from natural light along with scenic views to enhance the passenger’s feeling of spaciousness.

The AGV is designed to offer all travellers new levels of comfort: spacious interior compartments and wide gangways, large window surfaces, a smooth ride, lower levels of interior noise and multimedia amenities.

The driver’s desk

The AGV driver position and controls are located centrally. The cab has a generously dimensioned conical front bay, affording the driver an excellent view and natural light. The desk can be manned by a single driver and a seat is provided for a co-driver. An ergonomic study was done using digital modelling to minimise driver fatigue and to make user-friendly screens for the modern TCMS (Train Control and Monitoring System).

Quality time to spend as you choose aboard the AGV

The driver’s desk has been designed ergonomically for comfort, optimum performance and safety.

e-capabilities:
Infotainment and security

The AGV is equipped with a standard Ethernet backbone dimensioned to deliver the multimedia and connectivity services your passengers expect in the 21st century. A wide range of optional equipment for passenger information and entertainment services is offered including WiFi and onboard Internet. Designed for modularity, our IT technology can be tailored to meet your specific needs, either as an integrated system or as separate modules. Our IP-based system solutions allow us to easily integrate equipment of any make. All meet new European and US standards for visual and audio communications for passengers with disabilities.

Driver considerations

The AGV is designed to offer all travellers new levels of comfort: spacious interior compartments and wide gangways, large window surfaces, a smooth ride, lower levels of interior noise and multimedia amenities.

The AGV’s floor height allows passengers to enter trains from the platform by two 200mm steps, which is fully compliant with TSI for people with reduced mobility. Special care was taken to keep noise low. Passengers can expect a more comfortable ride with less vibration and less noise, thanks to the trainset’s articulated architecture. The heating, ventilation and air-conditioning (HVAC) system is designed to offer the best climatic comfort to passengers, whatever the countries the AGV operates in.
WIDE GANGWAYS: 1,000 m
SPACIOUS INTERIOR: 2,750 m
LARGE WINDOWS: +15% OF SURFACE

OPTIONS IN THE VESTIBULE AREA

CATERING AREA CONFIGURATION: 3 OPTIONS
- Automatic vending machine
- Coffee machine
- Service at place including hot meals

TRAIN MASTER OFFICE

BAGGAGE STORAGE

CONFIGURATION WITH PROVISION FOR PASSENGERS IN WHEELCHAIRS
DESIGNED FOR ENVIRONMENTAL AND ECONOMIC EFFICIENCY

CO2 EMISSIONS PER PASSENGER-KM

The AGV is designed to meet the environmental and economic challenges of today and tomorrow.

IMPROVED LIFECYCLE COSTS

The AGV delivers superior lifecycle cost performance. Operators can count on:

- Energy consumption savings of 15%: thanks to the train’s articulated architecture (less bogies, reduced aerodynamic drag), the permanent magnet motors’ improved efficiency and body shape optimized for aerodynamics, and thanks to the train’s total weight, at 410 tonnes (for a 200 m long AGV), 70 tonnes lighter than competitors.
- Further energy savings: come from the AGV’s maximized use of regenerative electrodynamic braking, in which energy is returned in priority to the power supply network during braking phases.
- Maintenance savings of 15%: thanks in particular to less bogies and to the closed, self-ventilated permanent magnet motors.

ENVIRONMENTAL RESPECT

Trains are a naturally environmentally-friendly mode of transport. The AGV goes even further: The AGV’s 15% lower energy consumption results in savings of 650,000 kWh for a train travelling 500,000 km a year. Although the AGV generates no CO2 itself, the type of power station that produces the electricity will be a source of CO2 within a full “well-to-wheel” CO2 calculation. Today operators can choose to purchase “carbon-free” electricity and thus eliminate any contribution to their “carbon Footprint” from the energy used by their electric trains.

The AGV is designed for end-of-life recyclability with a target to use over 90% of recyclable materials. Finally, the AGV makes less external noise as it runs, lessening its environmental impact, thanks to its aerodynamic design and reduced number of bogies.

DESIGNED FOR EASY MAINTENANCE

A further technological advance is our TCMS (Train Control Monitoring System), which conforms to European standards. A highly modular combination of hardware and software, this system acts as the AGV’s brain and nervous system. It is organized into three independent subdivisions that can be modified, tested or homologated separately.

The AGV offers low energy consumption, and so lower CO2, reduced maintenance expense, reduced generation of external noise and end-of-life recyclability.
INTEROPERABILITY FROM THE OUTSET

The AGV is the first very high-speed train to be designed from the outset for international interoperability, fully compliant with the EU’s Interoperability Technical Standards:

• The signaling cabinet can house interoperable ETCS (European Train Control System) and national train speed control signaling equipment for operations on any international high-speed corridor in Europe.
• The AGV can operate with any of its four distinct power supply voltages (25kV - 15kV - 1,5kV - 3kV) or a combination of those.
• The driver’s desk layout and equipment are compliant with international standards for interoperability and designed in keeping with EU-D (European driver) recommendations.

ERTMS, UNITING EUROPEAN RAIL

The EU’s new common European Railway Traffic Management System (ERTMS) will allow all rail traffic to flow throughout Europe, freed of yesterday’s different signaling technologies. Rail traffic will be faster, safer and more cost-effective.

As manufacturer and systems integrator, Alstom has been a major contributor to ERTMS development from its inception. Today, our trainborne and track-side ERTMS solutions are at work in several European countries, making seamless, cross-border rail operations possible at speeds of 300 km/h and above in total safety. Alstom is the leader in ERTMS operational deployment, with over 1,200 trains equipped and close to 20 million kilometers covered in commercial service.

INTEROPERABLE REFERENCES IN VERY HIGH SPEED

Alstom has played a pioneering role in the development of very high-speed rail for international routes, supplying many of Europe’s interoperable fleets. We have the skills and knowledge of national network requirements to assure satisfaction.

EUROSTAR

Eurostar, the very high-speed rail service linking London, Paris and Brussels, celebrated its 10 millionth passenger at Christmas 2008. An Alstom-led consortium had designed the Eurostar train back in 1989, meeting safety and comfort requirements despite wide disparities in gauge, electrical supply, signaling system and platform heights. Alstom supplied 38 trains, each offering a capacity of nearly 800 passengers. We also provided a centralized traffic control system for shuttles and international train operations in the Channel Tunnel, allowing automatic route control for timetabled traffic.

THALYS

French, Belgian, Dutch and German national railways created Thalys International, a high-speed passenger rail service operating on their respective networks in the 1990s. Alstom, renowned in high speed rail and interoperability, was chosen to supply the fleets for this multiple-border, multi-system route. Each of the 17 trains in the Thalys PBKA fleet (Paris – Brussels – Cologne – Amsterdam), based on our classic single-deck tGV, is equipped for four national signaling systems and associated line voltages. Alstom also supplied 10 additional Thalys PBA trains equipped to run between the three capitals. Both fleets, remarkable for their passenger and driver comfort, operate at up to 300 km/h on high-speed lines and 220 km/h on standard track.

TGv EAST

For this new very high-speed line linking France and Germany, Alstom is supplying some 38 power cars. The first of these were put into service in 2007. The aerodynamic design of the East European TGV power cars is derived from our Thalys and TGV Duplex trains. The new link will ultimately connect Paris to Strasbourg, at speeds up to 320 km/h (300 km/h in Germany). The power car is not only faster but also 7% more powerful than the previous TGV Duplex generation thanks to a new IGBT traction system and asynchronous motors.

THE PANTOGRAPH

Pantographs can have bows of various widths (1,450, 1,600 or 1,950 mm) and of different materials (pure carbon or a combination of carbon and copper) adapted to the AGV’s different routes. The AGV pantograph is equipped with a real-time electronic control system, ensuring the bows’ constant pressure on the catenary. This was used in the recent world speed record at 574.8 km/h.

INTEROPERABILITY FROM THE OUTSET

The AGV pantograph is equipped with a real-time electronic control system to ensure constant pressure on the catenary.

SETTING HIGHER SIGNALING

Standard AGV signaling equipment includes ETCS level 2 with GSM-R radio communication. National signaling equipment is chosen by the operator.
permanent magnet motors…

PMM technology uses magnets in the rotor of a synchronous motor combining the benefits of both synchronous and asynchronous motor technologies. AGV PMMs are sealed and self-ventilated, reducing noise emissions, isolating interior parts from sand or dust, eliminating the need for external cooling fans, and as a consequence, reducing maintenance. PMMs are permanently fluxed, allowing a full availability of electro-dynamic braking for safety.

The AGV’s new bogie design was based on service-proven TGV bogie technology. The difference lies in the PMMs, mounted directly in the AGV bogie, which allow a simplified drive transmission to the wheels compared to the TGV. With the number of drive bogies reduced and optimized, significant gains were achieved in reliability and train weight. The AGV motor bogie has proved its intrinsic stability and safety at high speed, covering over 700 km in test runs at more than 500km/h during the world high speed record.

Electrodynamic braking with energy recovery offers a host of new possibilities for reducing energy consumption and maintenance costs. The AGV produces its own electricity based on a braking system that features an energy-recovery and rheostatic brake. During braking stages, the electric power, which can reach up to 8 MW, is fed back into the grid. The AGV is designed to use this electrodynamic braking as much as possible in order to reduce friction-generated wear of mechanical parts. Moreover, the AGV’s mechanical and rheostatic brake system will ensure safe braking in all conditions, even in the event of a broken catenary, caused, for example, by an earthquake.
In November 2008, the AGV sped along at 360 km/h in a series of test runs on France’s TGV East high speed line, proving its ability to provide full comfort, safety and reliability at top speeds. These very high speed test runs were the culmination of a thorough campaign of dynamic tests at 200 km/h, held between April and September 2008 on test loop facilities in Velim (Czech Republic). The fundamentals of the AGV—its bogies, pantographs and complete traction chain, including the permanent magnet traction motors—had already been proven at low speed in our La Rochelle site between 2007 and 2008. The new AGV bogie design demonstrated excellent stability in extreme performance conditions.

**AGV DEVELOPMENTAL MILESTONES**

- **Since the 1970s**: More than 30-year experience in HST and Vhst
- **June 2004**: AGV prototype programme launched
- **Nov. 2005**: Scale model of design concept presented at EuralSpeed exhibition, Milan
- **Feb. 2007**: First AGV car built
- **April 3, 2007**: TGV Duplex with AGV components set new world speed record in rail at 574.8 km/h
- **Dec. 2007**: First 7-car AGV prototype rolled out for testing
- **Jan. 17, 2008**: Alstom and NTV announced first AGV contract
- **Feb. 5, 2008**: AGV officially unveiled to the press
- **April/Sept. 2008**: AGV tested at medium speed (160-200 km) in Velim, Czech Republic
- **End 2008**: AGV tested at very high speed (over 360 km/h) in France

**THE FIRST AGV FLEET, ITALY’S NUOVO TRASPORTO VIAGGIATORI (NTV)**

NTV, the first private operator on Italian high speed lines, chose the AGV for its new fleet of high speed passenger trains. Alstom is supplying NTV with 25 AGV trains, assembled at our La Rochelle (France) and Savigliano (Italy) facilities. We will also provide their full maintenance for a 30-year period. A new, state-of-the-art depot is being built in Italy for this purpose. There is also an option for an additional 10 trains.

The 11-car trains, which will run at 300 km/h, will give the operator high capacity and differentiated seating among the approximately 460 places. The AGV was designed in line with the latest European interoperability standards and complies with European and Italian environment and safety regulations. Commercial service will begin in 2011. NTV will run the new high speed fleet between the main cities in Italy, offering a total of 54 trips daily: Turin, Milan, Venice, Bologna, Florence, Rome, Barri and Reggio de Calabre.

The AGV clocked 360 km/h repeatedly during a series of runs on France’s new East HS line
AGV WITHIN THE FULL ALSTOM OFFER

Our train life services will make sure your AGV fleet reaches its full potential, in guaranteeing its reliability, availability and lifecycle costs. From parts supply to full maintenance and modernisation, our experts are there for you in specialised centres worldwide: 33 maintenance sites, 12 parts & logistics centres and 5 modernisation sites.

Alstom has been guaranteeing the maintenance of Spain’s Renfe fleet of 18 AVE high speed trains since 1992. It has a 100% rate of availability. After 15 years of successful service at 300 km/h, Alstom, the fleet’s manufacturer, also provided the full modernisation of the 18 AVE fleet for Renfe: train interiors, seats, passenger infotainment, and mobility impaired access as well as exterior painting.

Since 2004, Alstom has also assured the full maintenance of Virgin Trains’ fleet of 53 Alstom-built Pendolino trains as well as trains supplied by others. The Pendolino trains are equipped with our Traintracer system, allowing technical teams to anticipate repairs or parts wear and reduce train down time.

Full systems projects
You can also choose AGV trains within a full high speed systems project. We ensure complete system’s integration in such turnkey contracts, sharing the risk of your investment. Alstom Transport carried out a full turnkey project with technology transfer in South Korea with the very high speed train, KTX.

Through its know-how and the excellence of its products, Alstom is shaping the future of energy and transport infrastructure and contributing to improving the living and working conditions of people throughout the world. Today, more than 65,000 people in 70 countries are making an active contribution to the growth and sustainable development of its business.