



SIEMENS

Ingenuity for life

Eurostar e320

high-speed trains
for Eurostar International Limited

In December 2010, Eurostar International Ltd. awarded Siemens a contract for ten interoperable 16-car high-speed trains. These trains are based on Velaro®, the world's most highly diversified high-speed platform. In 2015, they were added to the existing Eurostar fleet operating on the Channel Tunnel line between Great Britain and the European continent. In early 2015, Eurostar exercised an existing option and ordered seven more units.

Rated at 16,000 kW, the Eurostar e320 (Class 374) reaches a top speed of 320 km/h. The flexibility of its interior furnishings and its high seating capacity allow alternate configurations that can provide maximum riding comfort

for more than 894 passengers. The new multiple units are also equipped with innovative communications and entertainment systems.

At 400 m, the longest train in the Velaro family is the latest installment in an extraordinary success story: In addition to Spain, China, Russia, Germany and Turkey, Eurostar International Ltd. will now rely on proven Siemens technology to run services to a range of destinations.

Distributed traction

Like all its successful predecessors, the fourth-generation Velaro is purely a multiple-unit trainset in which the entire propulsion system and all technical modules are distributed under-floor throughout the train, thus making the full length of the train available for passengers. Compared to conventional trains with locomotives, vehicles on the Velaro platform offer 20% more usable length in the passenger area, and thus a much higher seating capacity.

Technical Data

Maximum operating speed	320 km/h
Train length	400 m
Voltage system	25 kV AC and 1.5 / 3 kV DC
Traction power	16,000 kW
Brake systems	Regenerative, rheostatic, pneumatic
Track gauge	1,435 mm
Number of axles	64 (32 driven)
Wheel arrangement	2xBo'Bo'+2'2'+Bo'Bo'+2'2'+2'2'+ Bo'Bo'+2'2'+Bo'Bo'
Number of bogies	32
Max. axle load	17 t
Number of cars per train	16
Number of seats	894
Operating temperature range	-25° C to +40° C
Signaling systems	ETCS, KVB, TVM, TBL, MEMOR, ATB

The multiple-unit concept has achieved international success and enjoys a high level of acceptance among customers. Since the first generation, the Velaro has been continuously refined and further optimized in terms of reliability and performance characteristics.

The Velaro offers the following operational advantages:

- High utilization of the adhesion coefficient during acceleration, because 50% of the axles are driven.
- Ability to run on steep line sections with gradients of up to 40 ‰.
- Thanks to the uniform distribution of weight over the entire length of the multiple unit, the individual wheelsets bear less weight. This reduces track wear and bogie maintenance while ensuring excellent running characteristics.
- Because there are eight identical, independent traction converter units, the failure of one converter does not affect the remaining units.

Maximum flexibility

The Eurostar e320 has eight pantographs on its roof for dealing with the different power systems and contact line types in Europe. The corresponding national automatic train control systems and ETCS are also installed. As a multisystem trainset, it is capable of navigating the High Speed One (HS1) line in Great Britain, the Channel Tunnel, and lines in Belgium, France, and the Netherlands. For operation in the 50 kilometer-long Channel Tunnel, the Velaro Eurostar also complies with the strict guidelines laid down in the Eurotunnel Network Statement as well as the special structural requirements for operation in the tunnel. Modifications to the train control system TVM were also made.

In the case of fire, for example, the train must remain operable for 30 minutes in the event of a fire so that it can exit the tunnel under its own power. For this purpose, it is equipped with special fire extinguishing equipment and fireproof doors. In the event of an evacuation, the Eurostar e320 ensures that all passengers will be able to reach an emergency exit as quickly and safely as possible and enter the rescue tunnel.

Moreover, a humidity level of 70–85% and a year-round temperature of 25° C inside the Eurotunnel require that measures be taken to reliably protect all components from condensation water that is present.

Exemplary energy efficiency

Knowledge about aerodynamics was systematically collected and evaluated from Velaro generations already in service. New aerodynamic design features were tested in the wind tunnel and on the Velaro in China at speeds of 350 km/h. This led to a continuous refinement of the Velaro platform and to the 4th generation that can be seen on the Eurostar e320. A high roof that starts in the middle of the end car reduces the sonic boom during movement through tunnels, improves running resistance, and reduces



exterior noise. Roof-mounted equipment such as pantographs and air-conditioning units is integrated, thereby decreasing the energy demand.

Spoiler, nose, and front section have been aerodynamically optimized. The brake system of the Velaro is also energy-efficient. Since the first generation, the Velaro's electric brake has been feeding surplus braking energy back into the power grid. The result is 10% energy savings and a reduction in mechanical wear.

Maximum riding comfort

The bright and modern design of the Eurostar e320's interior creates a pleasant environment for passengers, the crew, and particularly individuals with limited mobility. Extra-wide entrances allow passengers to comfortably enter and exit, and an elevator assists in the loading of strollers and wheelchairs.

A powerful and reliable air-conditioning system guarantees a comfortable indoor climate, and the air suspension car bodies ensure superior riding comfort at all speeds.

The Eurostar e320 high-quality, attractive furnishings that can be quickly and flexibly exchanged. Integration of additional luggage racks or the addition of face-to-face arrangements with tables can be quickly implemented, allowing different operating requirements to be accommodated.

A sophisticated on-board power supply system

Maximum passenger comfort requires an especially efficient electrical system. Bus-bars installed throughout the train ensure a reliable supply of power to consumers:

- Air-conditioning, ventilation, and heating
- Fans and pumps
- Restaurant operation
- Lighting

Perfect control

The proven Sibas 32 train control system guarantees a safe and smooth transfer of data via the Train Communication Network (TCN), which consists of the train bus (WTB) and vehicle bus (MVB).

The fully redundant design of the TCN system provides additional advantages:

- Significantly increased availability of the data communication paths.
- Savings with respect to hardware, installation dimensions, weight, and lifecycle costs.
- Increased data transparency and reduced data propagation delays thanks to a reduced number of interfaces and subsystems





Consistent, end-to-end information

The passenger information systems take advantage of the latest technologies. Flat screens in all the cars and entrance areas display information on the journey and the route. Seat reservation displays using OLED technology remain highly legible under all lighting conditions, allowing passengers to find their seats as quickly as possible. An innovative, train-wide communications network allows data to be exchanged quickly and securely for supplying passenger information and entertainment programs.

Best connections

An uninterrupted connection to communications networks and the Internet throughout the journey is ensured by a train-wide WLAN (Wireless Local Area Network) and repeaters for the 4G (UMTS) and 3G networks. A satellite link for transmitting data to and from the ground is also used to ensure powerful, uninterrupted communication.

Fine entertainment

All cars offer a comprehensive entertainment and information program on large video displays that are clearly visible from all seats. The innovative communication and entertainment systems additionally facilitate Internet on Board and Video on Demand over WLAN, which passengers can use from their own mobile devices. This system provides them with top-quality music, video and travel information as well as ebooks, games and the latest feature films.

Proven safety

Having undergone continuous further development since the first generation, the Eurostar e320's bogies provide perfect guidance and thus outstanding riding comfort. Even more important than rapid acceleration is rapid deceleration. The Velaro's electric brake automatically distributes braking energy between the pneumatic and regenerative braking systems. The optimized body-shell and train concept complies with the EN 15227:2008 standard for collision safety. A crash energy absorption system and crash elements protect passengers and crew in the unlikely event of an accident.

Summary

The Eurostar e320 is the 16-car representative of the Velaro family. It combines the knowledge gained from fleets already in service and takes it one step further by integrating the current requirements and preferences of our customers. With its improved capacity, the constant evolution of its systems in terms of reliability and lifecycle costs, and the experience of the people who build it, it represents the current benchmark for high-speed trains with distributed traction.

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