



Velaro Novo Rolling Stock and Maintenance Information

GEMINI TRAINS AND CHANNEL TUNNEL OPERATIONS BETWEEN THE UK AND MAINLAND EUROPE

SIEMENS

Executive summary

Siemens has vast experience in train and high-speed train delivery. Our expertise is in the delivering of complex train systems in challenging environments. The Velaro Novo is Siemens 5th generation state of the art high speed train, with a pedigree across the globe. It has routes in ground breaking rolling stock, reliability and performance. Railigent X is Siemens AI supported platform for digital and condition based maintenance. Joining state of the art trains with AI supported condition monitoring gives you a highly optimised, highly reliable, truly ground breaking train and passenger experience.

About Siemens

Siemens Mobility specialises in delivering intelligent, sustainable transport solutions globally. With expertise spanning rolling stock, signaling, electrification, automation, and digital mobility services, Siemens Mobility is committed to making mobility efficient, safe, and environmentally friendly through innovation and digitalisation.

Siemens has been a leader in high-speed rail since the 1980s, beginning with the ICE1 in Germany. The Velaro platform, introduced in 2001, is now in its 5th generation, with over 1,000 trainsets in operation worldwide, covering more than 3 billion kilometers. High-speed key deployments globally include in Turkey, Egypt and the USA as well as major projects across Europe:

- ICE4 (Germany and Switzerland)
- Velaro MS (Germany, Belgium and Holland)
- Velaro D (Germany and France)
- Velaro e320 (HS1/Channel Tunnel, France, Belgium, Holland)
- Velaro E (Spain)

Siemens has extensive experience delivering high-speed trains across complex cross border operations within Europe and across the globe, ensuring compliance to regulatory, technical and safety requirements to deliver trains ready for operation. Furthermore, with Siemens presence in Temple Mills Depot, Siemens is uniquely placed to support Gemini to deliver trains and maintenance capable of meeting Gemini's Operational strategy.

Velaro Novo Capability

The Velaro Novo is Siemens' latest high-speed EMU, designed for up to 360 km/h operation. The Velaro product is a proven global train, 5th generation state-of-the-art high-speed train with proven performance.

The 5th generation product benefits operators and passengers with innovations such as:

- Up to 30% energy savings via, among other measures, aerodynamic roof and bogie housing.
- 10% weight reduction in car body shell.
- 14–17% increased passenger capacity due to innovative system packaging and longer vehicles.
- Optimised maintenance reducing cost and increasing availability.

Velaro Novo In figures

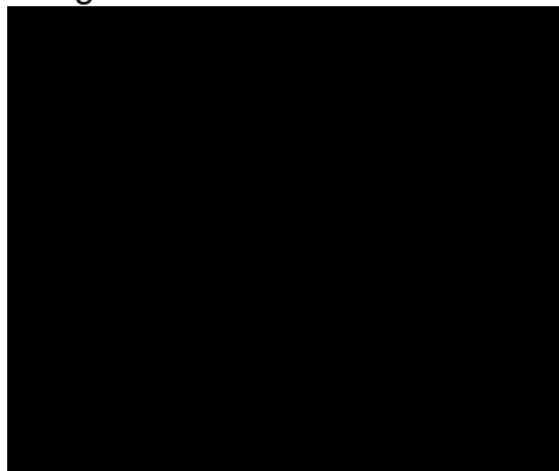


Figure 1: Velaro Novo for Gemini Trains and Channel Tunnel operation

Velaro Novo is engineered for predictive maintenance and high availability:

- Extended inspection intervals from previous generations maximising availability and reducing depot capacity requirements
- Ethernet-based SIBAS PN system for real-time diagnostics.
- Train-to-ground connectivity via Railigent X (AI-supported) platform.

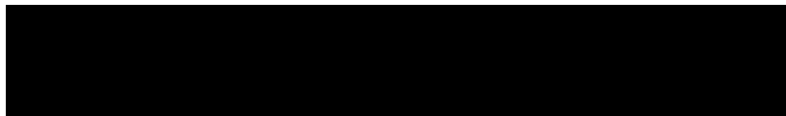
Compatibility with the Channel Tunnel

Velaro Novo will be certified to TSI 2023 (or higher), with homologation planned for the United Kingdom, Channel Tunnel, France, Belgium and Germany. Siemens has extensive experience with cross-border certification, including the Velaro e320, which operates through the Channel Tunnel and across four national networks. This experience and knowledge of the requirements, technical capability, complexity and timescales required to deliver cross border services through the Channel Tunnel gives Siemens and Gemini excellent footing to develop well planned and robust timeline for contracting and delivering trains into services across the complex border and national network arrangement.

Velaro Novo is designed for seamless operation across European networks and through the Channel Tunnel with the following systems as standard:

- Four-voltage capability (15kV/25kV AC and 1.5kV/3kV DC)
- ETCS compliance + national signaling systems
- Pressure sealed cabins
- UIC loading gauge compliance

Velaro Novo is inherently suited for UK/ HS1 and Channel Tunnel operations but will require limited adaptations for successful operation:



These adaptations ensure full compliance with Channel Tunnel Intergovernmental Commission (IGC) requirements – all other requirements for operation through the Channel Tunnel, and onward to Paris, Brussels and Cologne are considered a standard part of the Velaro Novo platform.

Velaro Novo Maintenance

The Maintenance of our Velaro platform high-speed trains focus on ensuring safety, reliability and efficiency. This is achieved through a combination of scheduled servicing, predictive monitoring, and digital diagnostics.

The Velaro Novo is Siemens next generation of our high-speed Velaro platform, and as such is equipped with advanced condition-based monitoring systems that continuously track the performance of critical components such as brakes, bogies, traction systems, and on-board electronics. This allows the maintainer to identify wear or faults before they cause service effecting failures thus ensuring the operator can be confident in their trains reliability and safety at all times.

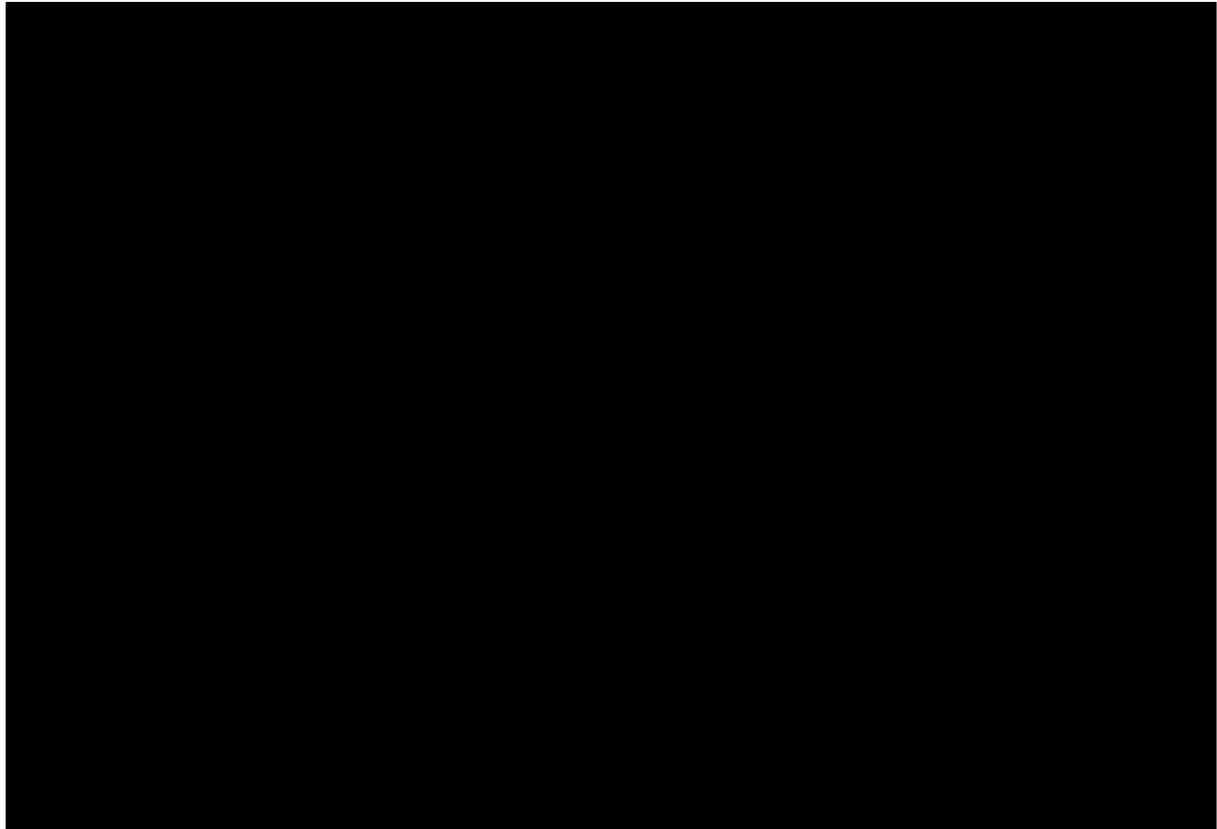


Figure 2: Structure Maintenance Schedule

Velaro Novo Overhaul and Routine Maintenance (I1,I2, M1-M4, R1-R4)

Overhaul and Routine maintenance of the Velaro Novo involves a structured maintenance program shown in Figure 2. This maintenance schedule is specifically tailored for the Velaro high-speed platform and designed to ensure safety, reliability, and efficiency of operations. The Overhaul of the Velaro Novo is carried out on a component based programme to ensure maximum cost efficiency minimising downtime and impact on availability. Where applicable components are removed and a full disassembly, inspection and refurbishment is carried out by the Original Equipment Manufacturers or alternative authorised system expert.

The maintenance depot must provide accessibility to all areas of the unit including underside and roof via standard depot equipment such as pitted maintenance roads and gantries. The maintenance involves inspections and checks of safety and service critical components as well as ensuring full functionality of passenger effecting systems such as toilets, interior fittings and the Passenger Information Systems.

The Velaro Novo's advanced monitoring technology provides real-time data on critical components allowing predictive maintenance to minimise downtime. Furthermore, all routine maintenance is carried out on balanced exams enabling the maintainer and operator to fully understand the required 'downtime' of the unit and the resource requirements for an efficient return to service. This systematic approach ensures each routine maintenance exam duration is kept to a minimum so that the Velaro Novo delivers high-speed performance with maximum availability and minimal disruption.

Experience at TMI / Integration of Operations

Siemens has had a presence at Temple Mills depot since 2013 where we currently provide maintenance services for the Class 374 Velaro e320 with a TSSSA agreement for Eurostar. The team at Temple Mills have become an integral part of the depot workforce by demonstrating a proactive and collaborative working ethos. Siemens has developed an excellent relationship with the Eurostar staff and this harmonious relationship is and always has been one of our objectives ensuring a positive customer relationship and excellent service. The integration of additional maintenance services by Siemens would be seamless via Siemens existing knowledge of people, processes and the depot equipment and facilities.

The depot at Temple Mills is an eight road 400m maintenance pitted depot which is capable of providing the services needed to maintain the Velaro Novo. The depot capacity for supporting Gemini's fleet requirements of one 400m maintenance road and two stabling locations accommodating a total of 6 x200m sets on site is completely achievable without impacting the current maintenance or operational activities of the existing Eurostar fleet. Siemens have previously carried out our own depot capacity study of Temple Mills which also concurs with the independent IPEX report (Temple Mills Depot – Independent Capacity Assessment 2025) concluding that there is sufficient latent depot capacity to support the maintenance and stabling requirements of the proposed Gemini fleet of 10 Velaro Novo trains. Additionally, since the Velaro Novo is an evolution of the Velaro e320, the use of equipment such as the wheel lathe, wash-plant, CET facilities, will all be possible with little or no changes to the infrastructure, and the stores, office and welfare facilities can all be made to accommodate this additional fleet without detrimental effect of existing Eurostar activities.

Siemens has extensive experience maintaining several UK fleets under a TSA agreement where we are not the Depot Facility Owner (DFO) demonstrating that our approach to a collaborative relationship with stakeholders on site is something we are experts at.

Railigent X (AI Supported)

For high-speed Channel Tunnel operations, the Velaro Novo fleet will leverage Railigent X to deliver tangible benefits by enabling condition-based and predictive maintenance. Through real-time diagnostics and AI-powered fault analytics, maintainers can detect issues at the component level, such as traction systems, bogies, and brakes, before they escalate. This allows for extended inspection intervals and targeted interventions, reducing unplanned depot visits and improving first-fix efficiency. Further, Gemini will benefit from reduced lifecycle costs and enhanced fleet availability, with proven results from Velaro deployments in Turkey and Poland showing up to 100% system availability under full-service contracts. The AI models continuously analyse operational data to forecast wear, automate fault detection, and recommend optimal maintenance actions, delivering both short-term and long-term improvements backed by data and functional expertise. This makes Railigent X a strategic asset for cross border high-speed services like those through the Channel Tunnel, where reliability, safety, and operational agility are paramount.

