

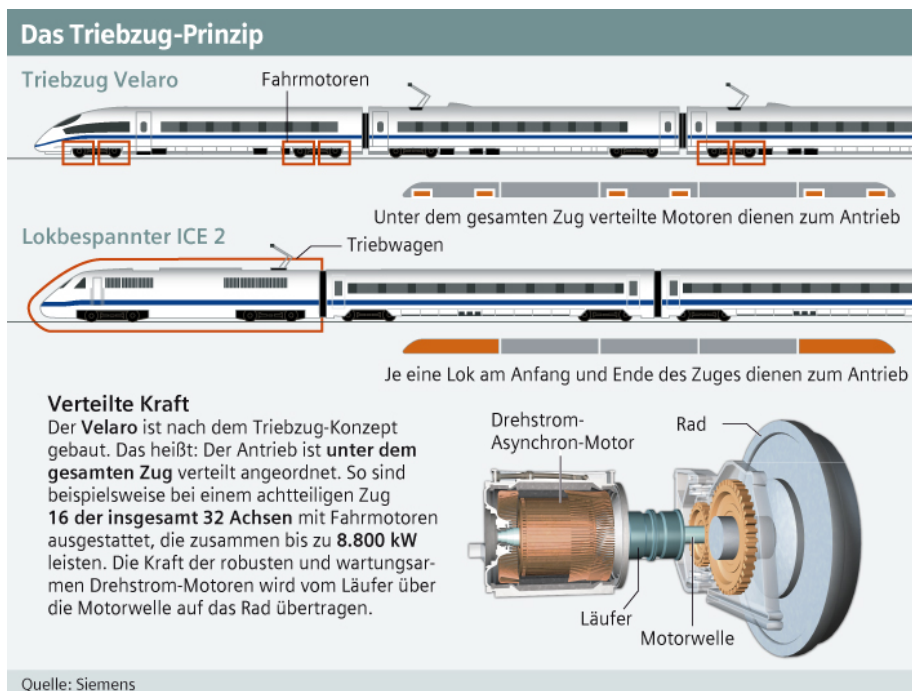
## The Siemens Velaro in worldwide service

As a driving force in technology, Siemens has always provided a crucial impetus for the development of high-speed rail transportation. Now the Velaro – developed entirely by Siemens itself – is one of the fastest multiple unit train series in the world with a top speed of up to 350 kilometers per hour. Thanks to its standardized platform concept, it can be adapted to suit the needs of different rail networks and customers. Rolling stock from the Velaro series is in service all over the world: for the Spanish national railways (Renfe) since 2007, for the Chinese Ministry of Railways since 2008 and for Russian Railways (RZD) since 2009. The German national rail company Deutsche Bahn started operating high-speed trains of this type in 2013, while the Turkish state railways (TCCD) launched passenger services with Velaro units in May 2015. And in December 2015, Eurostar International Limited introduced the Velaro for Eurotunnel service between Great Britain and continental Europe. The total number of vehicles using Velaro technology from Siemens sold worldwide has now reached 823. Of these, 143 are complete Velaro trains and the remaining 680 are trainsets equipped with Velaro components.

### **Velaro – multiple-unit technology**

Today, the Velaro already leads the field in terms of proven technological experience. The revolutionary leap forward was made in the late 1990s, when Siemens switched from concentrated traction with power cars to distributed traction. There are two principal ways of moving a passenger train: either the "push-pull" technique using a locomotive, or the multiple-unit system. The first European high-speed train with distributed traction entered service for the Expo 2000 in the form of the ICE 3 (Intercity Express). From a technological viewpoint, the Siemens Velaro platform is based on consequent further developments of the successful ICE 3 multiple-unit concept as used by Deutsche Bahn.

In the case of the Velaro – as with the successful ICE 3 multiple-unit design – the drive components and technology modules (e.g. traction motors, brakes and transformers) are distributed underneath the entire train and not – as is the case with conventional trains – concentrated in locomotives at the front or rear of the train. This allows up to 20 percent more room to be used for passengers within a train of the same length. Since 50 percent of the axles in the Velaro are driven, these units can accelerate faster and climb steeper grades due to the better distribution of traction. Furthermore, the even weight distribution reduces the load on each individual wheelset, resulting in less wear and conserving both the rails and the wheels of the train.



### Velaro T for Turkey

In May 2013, Turkish State Railways (TCDD) placed an order with Siemens for a first Velaro D-based train. A further order for six additional 8-car high-speed trains followed. The contracts also cover a maintenance agreement for up to seven years, including spare parts, and the delivery of a driving simulator. To complete the first order, a Velaro was taken from the ongoing Velaro D production, converted for operation in Turkey and delivered within 180 days. The train initiated passenger

service between Ankara and Konya on May 24, 2015. Delivery of the six other trains has begun and is scheduled for completion in 2017.

### **Velaro Eurostar for the Eurotunnel**

In December 2010, Eurostar International Limited ordered ten Velaro Eurostar high-speed trains from Siemens. An order for seven additional trains followed in January 2015. These 16-car trains, each 400 meters long, have seating for up to 950 passengers and, with a power output of 16,000 kilowatts, can reach a maximum speed of 320 kilometers per hour. These trains have been supplementing the existing Eurostar fleet on the Paris – London line since December 2015, and service on the Amsterdam – Brussels – London route will follow. New communication and entertainment systems offer passengers Internet access and films on these journeys. Besides the order for delivery of the trains, Siemens has also been contracted to convert the Eurostar Temple Mills Depot near London and provide maintenance support for a ten-year period. Delivery of the second lot of trains will begin in the summer of 2016 – just 16 months after the order from Eurostar International Ltd. was received. Production of the second lot, like the first order, is currently underway at Siemens' factory in Krefeld, Germany.

### **Velaro D for Germany**

In December 2008, Deutsche Bahn AG (DB) placed an order with Siemens for 15 Velaro D high-speed trains with a value of around 500 million euros, and two additional trains were later added to the order. The trains, which can run on any of the four electrification systems in Europe, are being operated by DB as a new Series 407 version of the ICE 3. The Velaro D is the first member of the fourth Velaro generation. These 8-car trains are being deployed on cross-border routes between Germany and France, and are equipped with all relevant European train control systems. The trains will also serve Belgium in the future. They can travel at up to 320 kilometers per hour and have a power output of 8,000 kilowatts, or roughly 11,000 horsepower. Each train is 200 meters long and offers 460 seats in two different classes, as well as a restaurant car. In addition, there are easily accessible spaces for wheelchair users.

### **Velaro RUS for Russia**

In 2006, Russian Railways (RZD) ordered eight Velaro RUS high-speed trains that are operated by RZD under the name of "Sapsan" (Russian for "Peregrine Falcon").

Five years later, in December 2011, RZD ordered eight more Velaro RUS trains and expanded the Russian Velaro fleet to a total of 16 vehicles. The first Velaro trains began service in December 2009 and today are operating extremely reliably, with a punctuality rating of about 99 percent on the route between Moscow, Saint Petersburg and Nizhny Novgorod. With a maximum operating speed of 250 km/h, which can be upgraded to 300 km/h, the travel time for the Moscow to Saint Petersburg section has been reduced by 45 minutes. The Velaro RUS can accommodate more than 600 passengers in its ten cars. All elements of the train, such as technology, insulation and lubricants, have been adapted for the extreme climatic conditions in Russia. This means that the Sapsan can operate at temperatures as low as -40°C. To protect the traction components against ice and snowdrifts in winter, and at the same time cool them sufficiently, the cooling air is fed through special air channels from the roof to the floor pans, which are practically air-tight. The material for the bogie was also developed further and its strength was tested at extremely low temperatures. With its widened bogies, the Velaro RUS is designed for the Russian broad-gauge system (1520 mm) and is about 33 centimeters wider than the ICE 3. In contrast to the other Velaro trains, the Russian version has ten cars, making it 50 meters longer than the Velaro E operated by Spanish National Railways, for example. A part of the Velaro RUS fleet can be used on both DC and AC electrified routes. Siemens is manufacturing the second order of Velaro trains for Russia, like the first, at its factory in Krefeld, and will service and maintain all trains for a period of 30 years. The total value of the orders for 16 trains and their maintenance comes to about 1.2 billion euros.

### **Velaro CN for China**

In November 2005, the Chinese Ministry of Railways (MoR) ordered 60 Velaro CN high-speed trains, also known as the CRH3, which can travel at speeds of up to 300 kilometers per hour. The first five trains entered service on time for the Olympic Games in Beijing in August 2008. Since then they have connected Beijing to Tianjin with a journey time of just 30 minutes, running at 10 minute intervals. The bodyshell of the Velaro CN is 3265 mm wide instead of 2950 mm, as is usual for the European version. The total train length of 200 meters offers seating for more than 600 passengers. Siemens built the trains in collaboration with its Chinese partner company Tangshan Locomotive & Rolling Stock Works. The Siemens share of this order was worth about 670 million euros. Together with Chinese partners, Siemens has supplied Velaro components for another 680 trains.

**Velaro E for Spain**

Siemens received its first order for the Velaro in 2001 from Spain: Spanish National Railways (Renfe) ordered 16 high-speed trains of the Velaro E type with an order volume of around 700 million euros which includes maintenance of the trains for a period of 14 years. In March 2004, Renfe ordered ten more trainsets. The Velaro E, known in Spain as the "AVE S 103", operates at speeds of up to 350 kilometers per hour. On a test run without any technical modifications in September 2006, the Velaro E even achieved the world record speed at that time of 404 kilometers per hour for series trains. The eight-car train is 200 meters long and has seating for 404 passengers in three classes: Club, Preferente and Turista. Since February 2008, the Velaro E has been operating on the 625 kilometer long route between Madrid and Barcelona with a journey time of 2 hours and 38 minutes. Today, the Velaro E has an excellent reliability factor of around 99 percent: the mean interval between two technical problems that cause more than ten minutes delay is about 1.4 million kilometers – the equivalent of almost four years of service. Since the Velaro E train entered service, rail has increased its market share on this route by about 11 percent to approximately 50 percent, while airline services have recorded a corresponding decline.

**Contact for journalists:**

Ellen Schramke, tel.: +49 (0)30 386 22370

E-mail: [ellen.schramke@siemens.com](mailto:ellen.schramke@siemens.com)

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