Innovating since 1942
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Maintenance equipments

Talgo Worldwide

Maintenance services
Created in 1942, Patentes Talgo (Talgo) develops three business lines: design and manufacture of high speed and very high speed trains, long distance, regional and locomotives; manufacture of maintenance equipments; and the provision of maintenance services for railway operators around the world.

Its own technology and innovative nature allow it to achieve the highest levels of quality, availability, reliability, safety and respect for the environment in its products, keeping itself at all times at the forefront of railway technology.

In Spain, Talgo has its headquarters, two factories and five maintenance workshops. The two factories build trains, locomotives and coaches, as well as bogies and wheel sets. Talgo also makes its own maintenance equipments such as underfloor wheel lathes, measuring equipment for wheel parameters, callipers and shunting cars. Besides, the maintenance of these equipments it is also carried out by Talgo. In the five maintenance workshops, integral maintenance is undertaken for all Talgo trains, day, night, intercity and high speed, that are in commercial service.

Talgo also develops its activity in several countries in which it has its own offices and maintenance centres, such as Germany, United States, Bosnia and Herzegovina, Kazakhstan and Uzbekistan.
Mission

To be the leading company in the Spanish railway sector, with international industrial presence, renowned worldwide for its capacity in innovation, technology, quality, reliability and the added value of its products and services.

Vision

To be a company that supplies products and services capable of implementing integral and innovative solutions in new segments and markets.

Values

- Technological innovation
- Customer service
- Identification and commitment
- Professional development
- Integrity
- Health and safety of our employees

Prizes and Awards

- Prize for Exporting 1998 - Year 2000
- Príncipe Felipe Prize for Business Excellence - Year 2000
- Prize for "Company with Greatest Exporting Vocation" - Year 2002
- National Design Prize - Year 2004
- Extraordinary Prize in the category of Innovation and Technology, Sustainability and Enterprises - Year 2006
- Economic Current Events Prize - Year 2008
- "Agustín Planas" Prize for Metallurgical Research TALGO - Year 2008
- Prize for Exporting and Internationalisation - Year 2009
- Bonaplate Prize 2009 in its category of Special Heritage Prize (collaboration) granted by the Association of the Science and Technical Museum of Catalaonia - Year 2009
- Academiae Dilecta Prize of RAI - Year 2010
- Prize for Innovative Lifetime Achievement - Year 2010
- European Citizen Prize in its category of European Trayectory - Year 2011
- Diamond award for purchasing in the Strategy category awarded by AERCE - Year 2012
- Spaino award in the Best Company category - Year 2012
- Leaders Group Excellence Prize in the Internacionalization category - Year 2012
- FUNDACION ONCE Discapnet Award- The train in your mobile - Year 2013
- European Inventor Award by popular vote from the European Patent Office (EPO) - Year 2013
Characteristics and advantages

**Characteristics**

- Lightweight construction
- Articulated union between cars
- Guided axles
- Independent wheels
- Natural tilting
- Accessibility
Advantages

- Accessibility
- Low energy consumption
- Eco-friendly
- High standards of safety and comfort for passengers
- Greater speed on curves
- Minimum noise emission

- High adaptability to any kind of track
- Less wear on the infrastructure
- Great flexibility and modularity to being adapted for different customers needs
- Very long experience in maintenance services
- Lower maintenance costs
Talgo 350 Very High Speed
Number one High Speed AVE Train in Spain

Technical specifications

- Maximum commercial speed: 330 km/h
- Maximum lateral acceleration in curve: 1.2 m/s²
- Track gauge: 1435 mm
- Traction: Electric
- Traction units: 2
- Maximum passenger cars: 12
- Tractive axles: 8
- Maximum number of axles per train: 21
- Maximum axle weight: 17 tons
- Maximum train length: 200 m (656.2 feet)
- Sense of travel: Bidirectional ("push - pull")
- Type of operation: Single trainset or multiple mode
- Power supply: 25 kV, 50 Hz
- Power equipments: Two identical and independent
- Front design: Aerodynamic. Optimized for pressure waves and lateral winds
- Pneumatic brake equipment: Three disc brakes per axle (two of them on the wheels)
- Electric brake equipment: Regenerative (4200 kW) and rheostatic (3200 kW)
- Maximum width: 2.96 m (9.7 feet)

Traction unit

- Power installed: 4000 kW
- Bogies: Bo - Bo
- Wheelbase: 2.65 m (8.7 feet)
- Length: 20 m (65.6 feet)
- Height: 4 m (13.1 feet)

Number of seats: 370

(-- Versus --)
### Technical specifications

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### Traction unit

- **Power installed**: 4000 kW
- **Bogies**: Bo - Bo
- **Wheelbase**: 2.65 m (8.7 feet)
- **Length**: 20 m (66.6 feet)
- **Height**: 4 m (13.1 feet)
Talgo 250 Dual
The comfort of travelling with electric and diesel traction

S730 Dual Train
(Talgo 250 Dual)

It has a Technical End Coach equipped with a powerful generator unit, able to run on to different gauges, (European and Iberian) as well as on electrified (electric traction of 25 kV ac, and 3kV dc) and non electrified lines (diesel).

The energy needed for travelling on non-electrified lines comes from two diesel generator units fitted in the end cars.

The changing of systems from electrical to diesel and vice versa is done without stopping the train.

It can travel at top speeds of 250 km/h (UIC gauge) and 220 km/h (Iberian gauge).

It offers the possibility of accessing the High Speed network without incurring on any costly investments in infrastructure.

### TRAIN SET CONFIGURATION

<table>
<thead>
<tr>
<th>Type of car</th>
<th>Units/train</th>
<th>Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor unit</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tech. End car</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Tourist</td>
<td>6</td>
<td>216 - 240</td>
</tr>
<tr>
<td>Bistro</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>PRM 1st class</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td>2nd class</td>
<td>1</td>
<td>26</td>
</tr>
</tbody>
</table>

**Total spaces**: 265 - 289

### DATA ON THE DIESEL MOTOR

<table>
<thead>
<tr>
<th>Model</th>
<th>12v4000-431</th>
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</thead>
<tbody>
<tr>
<td>Power</td>
<td>1800 kw (2448 cv) at 1800 rpm</td>
</tr>
<tr>
<td>Compliance with emission standards</td>
<td>EU 26/2004 STAGE IIIa</td>
</tr>
<tr>
<td>Consumption</td>
<td>190 g/kWh</td>
</tr>
<tr>
<td>Unit cylinder capacity</td>
<td>4.77 litres</td>
</tr>
<tr>
<td>Total cylinder capacity</td>
<td>57.23 litres</td>
</tr>
<tr>
<td>Weight</td>
<td>6600 kg</td>
</tr>
</tbody>
</table>
Talgo XXI
Intercity, Regional Diesel
First high speed train with variable gauge system

Technical specifications

Max. speed (straight track) 220 km/h (140 mph)
Max. lateral acceleration (curved track) 1.5 m/s² (5° cant deficiency)
Fixed track gauges 1,668 / 1,520 / 1,435 mm
Variable track gauges 1,668 <-> 1,435 / 1,520 <-> 1,435 mm
Minimum curve radius 100 m. (17.4°)

Traction unit

Length 15 m. (43.2')
Height 3,600 mm. (11.8')
Tractive truck wheel-base 2,800 mm. (9.2')
Bogies configuration Bo'T(*)
(*) Back bogie shared with the adjacent pendular car.

Diesel-Hydraulic version

Installed traction power per locomotive 1,500 kW / 1,800 rpm
Maximum weight per axle 18 t
Braking systems Hydrodynamic and Pneumatic on discs
Travca Locomotive
First locomotive on the world with variable gauge system and dual voltage

Technical specifications

Axle arrangement: Bo' Bo'
Variable gauge: 1 668 / 1 435 mm
Dual voltage: 3 kV DC / 25 kV 50 Hz
Top speed: 260 km/h
Continual power at wheel rim: 3 200 kW
Max. power (1 hour) at wheel rim: 3 600 kW
Total weight: 72 tn
Length between buffers: 19 400 mm
Length between bogies: 11 000 mm
Wheelbase: 2 800 mm
Wheel diameter: 1 010 mm
Traction effort: up 160 kN
Main Equipments

- Automatic variable gauge system.
- Automatic variable voltage system.
- Safety and excellent drivers cab comfort.
- A redundant computer system and an ergonomic central driving desk.
- Electric (rheostatic and recovery) and pneumatic on discs braking.
- One piece welded steel frame. Aluminium roof.
- Double pressurised and hermetic driving cabin.
- Latest high voltage and water-cooled IGBT traction power converter technology.
- One asynchronous engine per axle.
- Independent inverter and traction motors guarantee ¾ power at the first failure.
- Two groups of 2 pantographs. 100% redundant.
- Signalling: LZB and ASFA.
- Preconfigured for ETCS/ERTMS Level I and II with STM LZB and EBICAB.
- Communication systems: RENFE train-ground and GSM-R.
- Crash-optimized design, with energy absorption buffers.
New Night Train with advanced features. Super-reclining seats, grand class cabins and access for people with reduced mobility.

ASPR Seating Car
A total of 6 ASPR seating cars for each composition. Space for passengers, designed down to the smallest detail for giving a greater sensation of comfort. Thought out for providing the best features, it will succeed in letting the passenger enjoy the comfort of travelling by train to the full.

• Mobile environment.
• Sensation of comfort.
• Fitted with super-reclining seats.
• Suitable for resting.

BISTRO Coach
• Wide obstacle-free space for preventing overcrowding.
• Social zone of the train.
• Light-filled area.
RESTAURANT Car

One car per composition, makes of it a space defined by simple and elegant forms, that give a sensation of amplitude in an intimate setting. Partitions made of toughened glass are introduced as separation between seats, producing a state of privacy. It is also easily accessible on account of the folding seats it consists of.

- Warm and elegant space.
- Intimate night-time ambience, ideal for dining.
- Place set aside for bar - breakfast in the morning.
- Folding seats to facilitate access to diners.
- Separators between seats for preserving the intimacy.

GRAND CLASS Coach

Set of 6 coaches per composition, is the reason for being of the Night train. A tidy, warm and welcoming space. Elegant in its forms and designs. Very complete and thought-out, designed with attention to detail, as reflected in the quality of its finishings.

It fully meets the needs of passengers given the varied quantity of accessories and features, as well as the extras for the coach.

Ideal for traveling during the day and resting during the night.

- Place for rest for the passenger.
- Comfortable and intimate travel compartment.
- Fitted with all manner of accessories.
- Includes a range of leisure possibilities.

GRAND CLASS PRM

There exist two types of PRM with the necessary equipping and characteristics for facilitating the accessibility and functionality for people with reduced mobility (PRM):

- Grand Class PRM: Cabin with beds and their own accessible WC.
- Accessible super-reclining seats, located in the passenger lounge, with specific WC for PRM.

The Night Train also has an accessible Bistro and Restaurant.

The transit between the PRM coaches, the WC areas, the Bistro and Restaurant are adapted for persons with reduced mobility.

20 cars with PRM: 138 seats + 91 beds + 1 PRM bed + 2 PRM seats
Technical Characteristics

- **Speed:** 250 Km/h
- **Boxes:** In aluminium, short length. Light, sealed and resistant to changes in pressure in tunnels and crossings. Very low weight per seat.
- **Union between coaches:** Articulated with anti-topple and anti-overriding systems.
- **Centre of Gravity:** At low height, improving the running stability.
- **Running gear:** Located between the cars on a single axle, with independent wheels and primary suspension (T350) or gauge change system (T250) and conventional.
- **Running axles:** Permanently guided on the track, keeping the wheels parallel to the line both on the straight and on bends.
- **Natural tilting system:** Pneumatic suspension, with natural inclination of the boxes towards the inside of the bends.
- **Braking:** Pneumatic on 4 discs per axle (T350) or 2 discs per axle (T250), with ABS system.
- **Air conditioning:** Equipment fitted beneath frame. In Club class, one variable flow diffuser for each seat.
- **Safety and control:**
  - Anti-topple and anti-overriding systems
  - Intelligent computerised system for continuous monitoring of the safety controls and of the different equipment
- **Accessibility:**
  - Floor level close to the platform level: easy access to the train without steps.
  - Passageway between coaches of width 815 mm.
  - Interior and exterior doors with automatic actuation.
  - Cars with special installations for PRM.
  - Aid devices for persons with visual or auditory disabilities.
- **Seats:** Very comfortable, anatomical, folding and rotating so that they can be orientated in the direction of travel, and with foot-rests. Wide space between rows in all classes.
- **Services for the passengers:**
  - Large luggage areas
  - WC in each car with ecological toilets and evacuation of waste by means of the vacuum method.
  - Cafeteria coaches with optimum equipping and distribution
• **Passenger attention:**
  - Ambient screens for video and individual audio equipment with channel selector (4 for music and 2 for video) and volume control for sound.
  - Electronic information screens in cars and vestibules.
  - GPS for continual information on the location of the train.
  - Automatic activation of warnings by audio and video.

• **Privacy:** Individual reading light, small table and electrical connection for computer or mobile phone, in each seat.

• **Types of coaches:**
  - **Tourist:** 36 - 44 plazas.
  - **1st Class:** 26 - 29 plazas.
  - **1st Class for PRM:** 22 + 1 plazas.
  - **End cars:** 14 plazas.

• **Possibility of customizing the cars**

## Advantages

• Different types of coaches and configurations
• Low energy consumption
• Maximum safety
• High degree of comfort
• Solutions thought out for the needs of the passengers
• More space: large luggage areas, wide corridor, greater space between chairs, zones for wheelchairs, etc.
• Entertainment offer: possibility of listening to music, watching videos and connecting laptops
• Areas for leisure and business: complete and spacious bistro coaches
• Optimum accessibility specially designed for persons with reduced mobility (access to the train without any steps or need for devices)
• Greater flow and safety for passengers in stations, guaranteed by the accessibility of the cars
• Coaches without any architectural barriers inside and with automatically operating doors, guaranteeing a smooth and easy mobility via the interior of the train
• Solutions for persons with auditory disabilities (electronic panels with written information) and persons with visual disabilities (use of pictograms in Braille)
• High quality on-board services
• Innovative interior and exterior design
• Multiple configurations
AVRIL
the future of high speed

Exterior:
- Designed by Pininfarina
- Optimum aerodynamics
- Exclusivity

Competitiveness:
- Maximum capacity on a single deck configuration
- Configuration of seat for every use
- Minimum electricity consumption and high capacity
- The best accessibility available in the market
- Minimum weight
- Optimum aerodynamic performance
- The most eco-friendly train
A unique solution:

- 3,200 mm wide car:
  Greater interior space and comfort
- 3+2 configuration (tourist class):
  Greater flexibility in operation

- Low floor coaches
- Interoperable standard platform of 760 mm
- Maximum respect for people with reduced mobility
- Minimum passenger transfer time at station

Individual passengers
Couples
Groups of three
Families or groups of four
Families or groups of six
Middle seat only if the occupational factor is over the 80%
Talgo portfolio latest product and our first solution designed for suburban and medium-distance rail service. Provided with a completely customizable platform, it offers two key competitive advantages: excellent accessibility and high energy efficiency.

Characteristics

- **Excellent accessibility**
  The only train on the market with maximum passenger capacity, low floor along the whole train length and a 550 mm height above the rail head surface.

- **Lower energy consumption**
  Talgo running gear design considerably reduces time during which the flange remains in contact with the inner side of the rail. Less wheel wear, more efficient energy use, optimum power-to-weight ratio.

- **Better performance**
  Faster acceleration and deceleration, important reduction in passengers boarding and deboarding times. Higher operational availability and better performance on saturated lines.

- **100% customizable**
  Modular design and high adaptability of Talgo trains provide flexibility and allow us to strictly meet the requirements of our clients, even for small production volumes.
The following dates are calculated for 4-coaches trainset.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track Gauge</td>
<td>1,435 - 1,520 - 1,668 mm</td>
</tr>
<tr>
<td>Power Supply system</td>
<td>25 kV 50 Hz - 15 kV 16.7 Hz 1.5 kV DC - 3 kV DC Diesel Electric Power</td>
</tr>
<tr>
<td>Maximum Operational Speed</td>
<td>160 km/h</td>
</tr>
<tr>
<td>Starting acceleration</td>
<td>Up to 1.2 m/s²</td>
</tr>
<tr>
<td>Axle configuration</td>
<td>Bo’2’2’2’Bo’</td>
</tr>
<tr>
<td>Tare weight</td>
<td>131.5 tons</td>
</tr>
<tr>
<td>Floor height</td>
<td>550 mm, with all the access doors at the same height 100% of total length at low floor section.</td>
</tr>
<tr>
<td>Seating capacity</td>
<td>Regional configuration: 212 Urban configuration: 190</td>
</tr>
<tr>
<td>Standees capacity (4 pax/m²)</td>
<td>Regional configuration: 250 Urban capacity: 320</td>
</tr>
<tr>
<td>Nominal Output</td>
<td>2,000 kW</td>
</tr>
<tr>
<td>Maximum Tractive Effort</td>
<td>210 kN</td>
</tr>
<tr>
<td>Total Length</td>
<td>78,000 mm</td>
</tr>
</tbody>
</table>
In Talgo, the maintenance team is divided into 3 groups, encompassing the necessary areas for maintaining the rolling stocks in a perfect condition: underfloor wheel lathes, shunting cars and measuring equipments.

Corrective maintenance:

Underfloor wheel lathe

The TALGO Underfloor Wheel Lathes are the latest generation machine tools designed for turning (profiling) the railway wheels. Talgo has developed the following models which are perfectly adapted to the needs and demands of each of the customers:

- **MODEL 2112**: is specially designed for carrying out maintenance of trams, metros, suburban trains and sets of railway vehicles, whose maximum weight per axle does not exceed 18 tons.

- **MODEL 3112**: has been conceived for the maintenance of high speed trains, long distance trains, self-propelled suburban units, goods trains and sets of railway vehicles whose maximum weight per axle does not exceed 25 tons.

- **MODEL 4112**: has been developed for providing maintenance long distance trains, freight trains, locomotives and sets of railway vehicles, whose maximum weight per axle does not exceed 40 tons.

Maintenance equipments
Shunting Cars

The Talgo shunting cars are specially designed for moving vehicles simply, efficiently and without any need for shackles. The system consists of an electric vehicle, remotely operated, which is displaced along the lines and automatically takes the load of an axle of a vehicle, moving it at low speed. The installation can consist of one or two cars which are displaced autonomously along the track and are operated by a remote control.

Main characteristics:

- Saves time in the positioning of the vehicles
- Speed and precision in the positioning
- Increase in safety
- Does not occupy space on the track, therefore in no case does it interrupt the normal use of the tracks
- Possibility of interconnection with the Talgo underfloor wheel lathes and train air-cleaning and train wash tunnels.
- The speed of displacement of the shunting cars is variable

Preventive maintenance:

Measuring equipment

EVA

With this equipment, a measurement of the parameters of all the wheels is obtained with the train in movement, automatically detecting any wheel that is outside of tolerance. It’s functioning is based on the illumination of the wheel by means of lasers and the obtaining of images using special cameras.

Main characteristics:

- High speed of passage through the installation (EVA III up to 50 km/h; EVA II 15km/h)
- The measurements can be made at variable speeds (there is no need to maintain a constant speed)
- There is no physical contact with the wheel
**Maintenance equipments**

**DSR**

Thanks to its advanced system of detection by means of ultrasound patented by Talgo, the surface defects detection equipment for running gear (DSR) identifies and quantifies degradations of instantaneous origin that might have been caused to the tread of the wheel during the circulation of the train (cracks, fissures, flats, hollows, changes of material etc.).

**Main characteristics:**

- Two ultrasonic feelers for picking up surface waves in each railway line, redundant system.
- High speed while passing through the installation (up to 10 km/h).
- The measuring can be taken at variable speed (it is not necessary to maintain a constant speed).

**EMO**

Talgo has developed the Wheel Ovalisation Measurement Equipment (EMO) in which artificial vision, sophisticated calculation and algorithms analysis are used for measuring the irregular wheel of the rim, in other words, its lack of roundness. The equipment monitors control the roundness defects along the course of the wheel which are presented on three rolling circles (selected by the customer) obtaining the ovalisation value of the wheel and the corresponding graph.

**Main characteristics:**

- High speed while passing through the installation (up to 10 km/h).
- The measuring can be taken at variable speed (it is not necessary to maintain a constant speed).
- There is no contact at all with the wheel.

**Manual gauges**

- Diameter Measurement Gauge
- Manual gauge to control wheel parameters
- Gauge for measuring distance between rims
COUNTRIES WITH TALGO PROJECTS
All business areas

OFFICES & MAINTENANCE WORKSHOPS

MANUFACTURING PLANTS

COMMERCIAL OFFICES

CHILE
Latam

RUSSIA
Moscow

TURKEY
Istanbul

INDIA
New Delhi

SAUDI ARABIA
Jeddah

SPAIN
(Alava) (Rivabellosa)
Madrid (Las Matas II)

KAZAKHSTAN
Astan

MAINTENANCE WORKSHOPS

SPAIN
Barcelona
San Andrés Condal
Canturís
Madrid
Malas I
Puencarral
Cerro Negro
Málaga

KAZAKHSTAN
Alma

UZBEKISTAN
Tashkent

GERMANY
Berlin

USA
Seattle

Total in September 2015:
Underfloor wheel sets: 143
Shunting cars: 139
EVA: 38  DSR: 19  EMO: 3
Maintenance services

Maintenance Development

- To repair when failure happens
- Scheduled inspections based on components wear and life expectation.
- Weak point based on the average time between fails.

CORRECTIVE

CORRECTIVE

PREVENTIVE

PREVENTIVE

PREDICTIVE

RCM

- Anticipate the mistakes by evaluating the state of the machine.
- Preventive diagnostics by Thermography, Ultrasonecs, oil analysis etc.
- Reliability centered Maintenance.
- Maintenance costs optimization.
- Recurrent process.

Modern Techniques in Maintenance Engineering

RCM PROCESS

Analysis system process

Functional description

Functional tree

FMECA

Critical components selection

Effects analysis

Selection of the maintenance procedures

Availability analysis

Results evaluation process
Talgo is the first designer and manufacturer of trains to offer an integral maintenance service for railway operators throughout the world. Since the 1950s it has been covering the cycle:

- Maintenance engineering
- Maintenance management system
- Cleaning service
- Maintenance of the installations
- After-sale service
- Remodellings

What we offer:

Level 1

Maintenance works in the actual stations. Interior and exterior cleaning, Corrective maintenance: All those repairs which do not require passing through the workshop: At least one complete development of it. The equipment is automatically controlled by the central computer. Predictive maintenance: Detecting and correcting minor anomalies before they become major breakdowns. High level of reliability.

Level 2

Diagnosis, review, repair and change of all kinds of elements with operations involving different intervention times. It includes actions of a predictive, preventive and corrective kind. The Talgo installations are always available and ready.

Level 3

Repairs of a major scope. These works guarantee the minimum cost since they are carried out by the manufacturer itself and complete availability of all the elements needed for a successful repair.

Level 4

All the modifications, transformations and repairs that are a consequence of accidents. Modifications and modernisations required by any of its vehicles, on which work is continually carried out for new improvements. Any remodelling or transformation which the customer requests, whether they be modifications for bringing a vehicle into line with new service features. Actions on the material ensuring that it meets new regulations. Operations on integral remodelling renovating the interior decoration with up to date solutions and materials.