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Tram System – Combino Plus MST, Metro Sul do Tejo, Almada, Portugal

24 Four-Section 100% Low-Floor Trams

Siemens is a leading tram provider, supplying world-class trams to world-class cities all around the globe.

The Concessionaire MTS – Metro Transportes do Sul S.A. ordered 24 100% low-floor trams from Siemens for a new light rail transit (LRT) system to link the cities of Almada and Seixal, south of Lisbon, Portugal. The first vehicle was delivered in May 2005.

This new LRT system offers a number of connections to the main railway line and ferries serving Lisbon. The first phase of the project includes the construction of an approximately 13 km long LRT system of three routes, as well as a LRV maintenance and repair facility.

The customer, the newly established company Metro Transportes do Sul (MTS) of which Siemens is a stakeholder, has received the concession from the Portuguese Government to build and operate the light rail system for a period of 27 years.

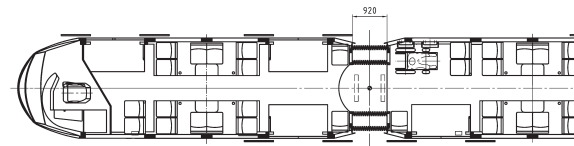
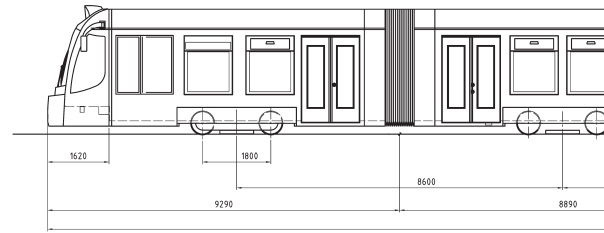
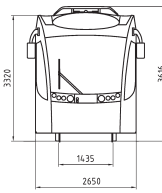
A 20 km extension is being planned in order to tie even more cities into the system.

Technical Data

Type of vehicle	Four-section, 100% low-floor articulated, power car for bi-directional operation
Traction adhesion	75%
Wheel arrangement	Bo'Bo'2'Bo
Track gauge	1,435 mm
Vehicle length	36,360 mm
Vehicle width	2,650 mm
Vehicle height	3,616 mm over top of rail (pantograph lowered)
Max. axle load	< 10 t
Vehicle capacity 4 pers./m ²	232, including 74 seats / 4 folding seats
Maximum speed (design speed)	70 km/h
Max. speed (operational)	60 km/h
Max. starting acceleration	1.3 m/s ²
Mean service deceleration	1.1 m/s ²
Number of doors	5 double doors per side
Line voltage	(750 V DC) +20% / -30% via overhead contact wire
Traction motors (nominal operating point)	6 x 100 kW
Wheel diameter new / worn	600 mm / 520 mm
Low-floor percentage	100%
Floor height	350 mm
Entrance height	320 mm



MST Network map



Project	
Customer	Concessionaire MTS – Metro Transportes do Sul S.A.
Line	Line 1 (Cacilhas – Corroios), Line 2 (Corroios – Pragal), Line 3 (Cacilhas – Universidade)
Delivery period	March 2005 – November 2005
Number of units	24 four-section 100% low-floor trams
Scope of supply	Rolling stock, complete signaling and operations control equipment, communications system, traction power supply, overhead contact lines, LRV maintenance equipment and repair facility and building technologies
Test	Type and routine tests were performed on the first three vehicles in the Vienna factory and at the Wildenrath Test Center. Testing was conducted on all vehicles in Lisbon.

General Arrangement

This modern and attractive tram design is based on the standard Combino elements as the platform and approved technical features as the traction technology. Each end of the car is equipped with driver's cabs to enable bi-directional operation.

Each vehicle comprises four sections (or modules) of the same length and features four bogies, three of which are powered. The bogies are arranged in the centre of each module. These modules are linked by articulation joints and intercar gangways to create a completely open and bright interior.

The tram is equipped with a passive hydraulic ride stabilization systems, each linking two modules. This system

improves the ride quality of the vehicle and ensures an optimum envelope under all operating conditions. The Combino Plus® Lisbon is capable of carrying a total of 338 passengers, with seating for 74 and standing room for 158. Additionally the trams are equipped with four folding seats and two large areas for mobility impaired people or passengers with prams.

To ensure quick and convenient passenger flows, the door concept envisions five double-leaf doors on each side with a clear width of 1.3 metres and a convenient allocation over the whole length of the tram. Seating and handrail arrangements are optimally matched to the specific customer requirements.

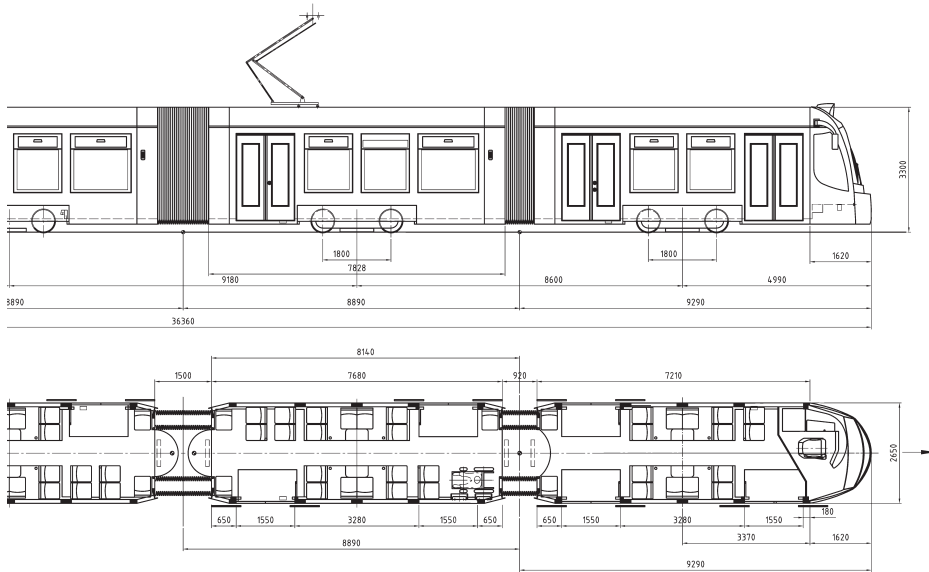
Hinged windows and ventilation system, with separate air conditioning units for the driver's cab and the passenger area, provide for a superior distribution and circulation of air. Safety features include passenger compartments equipped with six emergency intercommunication terminals, which allow the passengers to talk with the driver.

Car Body

The car body is a welded stainless-steel construction with a special corrosion-resistant steel for the middle section of the underframe.

Traction Equipment

The electrical equipment is concentrated in containers which are integrated into the roof structure of the car body.



Interior

Three modern Integrated Gate Bipolar Transistor (IGBT) pulse-width-modulated inverters, low-wear three-phase asynchronous motors and a 32-bit traction control unit (Sibas® 32) are used as traction equipment. The traction system also allows power recovery. The vehicle's control equipment is based on a vehicle data bus system backed up by wired control lines for essential train control functions.

For the auxiliary and secondary equipment, low-wear and low-maintenance components are used throughout the vehicle.

Brake System

The Combino Plus Lisbon features four separate and independent brake systems:

- electrodynamic brake on powered running gear
- hydraulically passive spring-loaded brake on powered running gear
- hydraulically active disk brake on non-powered running gear
- electromagnetic track brake on all running gears

Design and brake performance conforms to the German standard BOSTrab.

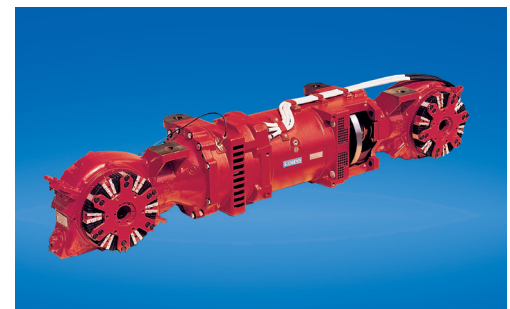
Bogies

The powered bogies with their two longitudinally arranged drives are characterized by their low center of gravity, minimised unsprung masses, and running characteristics which, due to mechanical coupling of the wheels in the longitudinal direction, have been improved over those of conven-

tional 100 % low-floor running gear. Moreover, mechanical decoupling of the opposing wheel pairs rules out the inherent, additional longitudinal slip that causes wear when the vehicle travels through curves.

Technical Features / Highlights

- spacious and light-colored interior design
- safety during vehicle movement: sufficient arrangement of horizontal and vertical hand rails in brushed stainless steel
- easy to clean due to smooth surfaces inside and outside
- easy to enter: the door height is 2.1 metres and width 1.3 metres
- slide plug doors: five double-leaf doors per side
- two large spaces reserved for buggies or wheelchairs for disabled passengers
- unobstructed view: the absence of electronics cabinets affords an un-obstructed view through the entire tram
- heating and ventilation system: separate air-conditioning units for the driver's cab and the passenger area
- impact buffers with energy absorption device
- large, easy-to-read destination and station displays
- four electrically adjustable exterior mirrors



Traction unit



Driver's cab



Motorized bogie

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required features should therefore
be specified in each individual case
at the time of closing the contract.