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Metro – Oslo MX, Norway

115 Three-Car Units

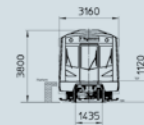
Siemens was awarded the contract to supply 33 new three-car trains for the Norwegian capital Oslo in September 2003. The first option for additional 30 trains was ordered in September 2005, a second option for 20 trains was ordered in September 2008. The third and last option for 32 trains followed in December 2010. Production of the trains is taking place in Siemens' Vienna plant, with testing and commissioning being performed in Rail Tec Arsenal's climatic chamber in Vienna, Siemens' own test center in Wildenrath and on-site in Oslo. Delivery of the trains was started by the end of 2005 with a pre-series of two trains. The last train was delivered to the customer in February 2014.

Train configuration

The complete train design was developed and coordinated by Porsche Design Studio. The trains are capable of carrying a total of 678 passengers each, with seating for 124 (additional 14 flap seats) and standing room for 554. The train is designed for metro operation and based on the Siemens modular concept which enables trains to be optimally adjusted to specific customer requirements.

Technical Data

Train configuration	Mc1+M+Mc2
Wheel arrangement	Bo'Bo'+Bo'Bo'+Bo'Bo'
Carbody material	Aluminum
Track gauge	1,435 mm
Length over couplers	54,340 mm
Width of car	3,160 mm
Floor height above top of rail	1,120 mm
Wheel diameter new / worn	850 / 770 mm
Tare weight / total weight	94 / 141.5 t
Max. axle load	12.5 t
Number of seats / flap seats	124 / 14
Train capacity 6 pers./m ²	678
Passenger doors per car	6
Min. curve radius service line / depot	100 / 50 m
Max. gradient	6.2 %
Max. speed	80 km/h
Max. starting acceleration	1.27 m/s ²
Mean deceleration service brake	1.35 m/s ²
Power supply	750 V DC / Third rail



Interior



Climate test

The smallest operable unit of an Oslo MX train is called a "module" and consists of three cars. The designations for the three cars are as follows: two motor cars with cab (Mc1 and Mc2) and one intermediate motor car (M). For normal passenger operation a train consists of 1 or 2 modules (3 or 6 cars) and for towing operation, up to 4 modules can be coupled.

Both the Mc1 and the Mc2 cars are equipped with a driver's cab to provide bidirectional use. The three cars of a module are mechanically connected by means of semipermanent couplers.

Between the cars of a module there are wide, open gangways, which ensure unrestricted passage through all three cars during revenue service.

Both end cars of a module are equipped with automatic couplers.

The basic structure of the Mc1 car and the Mc2 car is largely identical. The main differences between Mc1 car and Mc2 car are: The air compressor is only on the Mc1 car. Only the Mc2 is equipped with the ATP control unit.

Each car is carried by two bogies. The wheelsets of the bogies are each driven by a traction unit (traction motor with gearbox), thus there are two traction units per bogie and four traction units per car. The four traction motors per car are fed by one traction inverter.

Material Composition

The metro train is designed as a lightweight construction. All materials have been chosen with regard to minimizing environmental impact and to enhancing recycling ability.

The three-car train has a tare weight of 94 tons. The carbody is designed as a lightweight aluminum-profile construction consisting of a welded assembly of large- and medium-sized aluminum extrusions with integrated C-rails. The bogies mainly consist of high-alloy steel. The interior components mostly consist of FRP, glass, stainless steel, aluminum, plastic and electronic parts.

Recycling Behavior

An Environmental Product Declaration according to ISO 14021 has been drawn up showing a total recycling rate of 94.7 % for the metro train resulting from an 84.7 % material recycling rate and 10 % thermal recycling rate. The dismantling procedures for the train components are described in the maintenance and repair manual.



Noise and Vibration

The external noise level created by a passing train is 76 dB(A) at a distance of 10 m from the track center line and the internal noise level in the passenger compartment is 64 dB(A), both measured at 80 km/h. The measuring method is according to ISO 3095 (external noise) and ISO 3381 (internal noise).

Carbody Structure

The crashworthy design ensures that the complete energy released at a collision speed of up to 15 km/h will be absorbed by the couplers without any damage to the carbody. The exterior carbody surface is painted.

Doors

All cars are equipped with three electrically powered passenger doors on each side. The passenger doors are of double leaf sliding plug type. The closed door leaves are flush with the outside of the carbody. The opening width of the doors is 1,300 mm. All passenger doors are equipped with sensitive edges for detection of small objects which are jammed between the door leaves. The driver can enter a Mc car normally by one of the two cab side doors. The cab partition wall contains a connecting door for cab and passenger area. The front mask of the driver's cab is made of FRP. In the middle of the mask an emergency door is located. This emergency door provides the possibility of a train-to-train or train-to-track evacuation.

Passenger Information and Communication System

The Passenger Information Display & Announcement System provides both visual and audio information inside and outside the cars. It consists of several internal and external loudspeakers, internal and external displays, the control system and the interfaces to other train systems. The vehicles of option 3 were additionally equipped with an automatic passenger counting system with WLAN data transfer.

Driver's Cab

The driver's cab is equipped with a pivoting driver seat and a foldable instructor seat. The driver seat is flexibly adjustable. It is placed in the middle of the cab behind the emergency door during normal operation, but can be moved aside in case of emergency. The arm rests of the driver seat are equipped with master controller and control buttons.

The driver's desk is divided into two parts, a Human Machine Interface (HMI) device is installed on the right side. The HMI touchscreen displays operating and fault information to the driver. It also serves as input from the driver for various operational commands.

The HMI device is connected to the Multi-functional Vehicle Bus (MVB) System and can transmit diagnostic data via WLAN to a stationary service PC. It also serves as communication interface to the Passenger Information System and to the ATP (Automatic Train Protection) system.



Driver's desk



Driver's cab



Holmenkollen Line



Bogie

Traction Equipment

Proven, forced air-cooled Sibac® traction containers power traction motors which are installed in the motor bogies. Each motor car is controlled independently by one IGBT VVVF (Variable Voltage Variable Frequency) inverter. High efficiency wheel slip-slide protection is provided on a per bogie basis.

The new Sitrac™ control allows electro-dynamic braking until standstill. This feature provides the advantage of a non-wearing service brake under normal conditions and particularly increases the stopping precision.

For depot shunting and in case of a loss of traction power supply, the vehicle is able to drive with a reduced speed of 2 km/h powered by its own battery.

Bogies

The SF 1000 bogie was developed for operating speeds up to 80 km/h and a maximum axle load of 13 tons in accordance with the requirements for modern light metro cars.

This type of bogies is equipped with one brake disk and one brake actuator per axle and partially with spring brake actuators for the parking brake. Magnetic track brakes are installed on the bogies in the intermediate cars to support the brake in case of unfavourable weather conditions and challenging topography. High driving comfort can be ensured by air springs as secondary suspension and steel coil springs with rubber guidance as primary suspension. One current collector is mounted on each side of the bogies of the end cars. The traction motors are transversally integrated into the bogies.

Highlights

- 100 % traction
- No motor speed sensors
- Driving on battery in depot
- Dynamic braking to standstill
- Magnetic track brakes
- Passenger doors with sensitive door edges
- Forced air-cooled compact traction inverter
- WLAN for data communication
- Environmental Product Declaration according to ISO 14021

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The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.

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