



Our innovative Syntegra® concept fundamentally revolutionizes the characteristics of today's powered bogies and represents a new and highly integrative approach in bogie design. Syntegra combines the traction, bogie and braking technology to form a unified mechatronic system. This approach and, above all, the change of technology generate a large number of synergetic benefits. This new generation of powered bogies unites high efficiency and low weight with reduced lifecycle costs (LCC) and offers considerably better performance than conventional bogie solutions.

Syntegra integrates the following technologies:

- gearless single-axle direct drive based on completely encapsulated permanent magnet synchronous machines
- a new type of flexible and compact bogies for high payloads with inside bearings and a lightweight design
- electric safety brake

Major advantages of the system

Reduced weight at a higher payload

Elimination of the gear unit

Elimination of the full mechanical brake

Lower LCC

- improved efficiency of the power train
- longer operating life due to less wear
- greater availability due to high drive redundancy
- lower maintenance costs for bogie and tracks due to oil-free direct drive concept
- free selection of wheel diameter per axle during reprofiling of wheel tires
- lower number of bearings

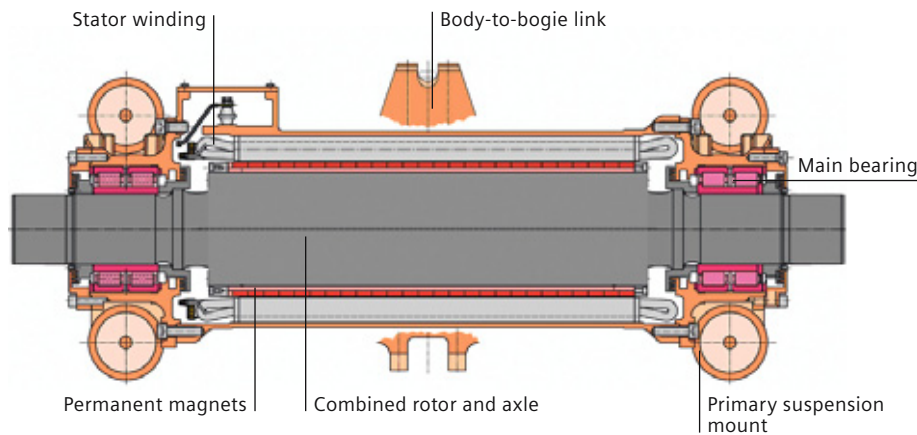
Low overall height and less installation space

Greater safety and better running characteristics due to flexible bogie frame

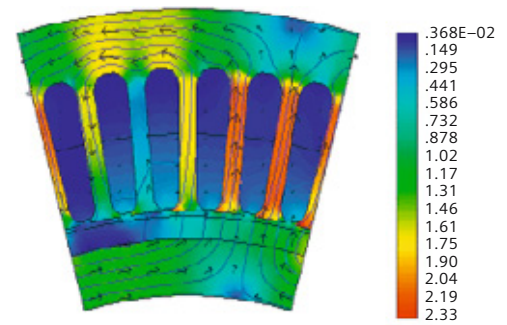
Lower noise emission of the drive system

Syntegra

The complete integration of
traction, bogie and braking technology



Cross section of the direct drive



FEM calculation of the direct drive

Direct drive

The structurally very simple gearless three-phase drive is based on permanent magnet synchronous machine and replaces the mechanically complex conventional traction drive. The underlying concept of this direct drive has already been tested in the form of a drive for standard-gauge railways.

The completely encapsulated traction motor effectively protects the winding against dirt and water. This ensures maintenance-free operation and a long durability. The basis of the design for sudden load is analogous to that of today's unsprung components. The combined rotor and axle carries the laminated rotor core and also the permanent magnets, which are made of neodymium iron boron (NdFeB). It has no wearing parts of any kind.

The direct drive is cooled via the completely enclosed cast casing. The heat losses occurring in the rotor lamination and in the magnets are dissipated via the axle to the wheel disks by means of a patented method.

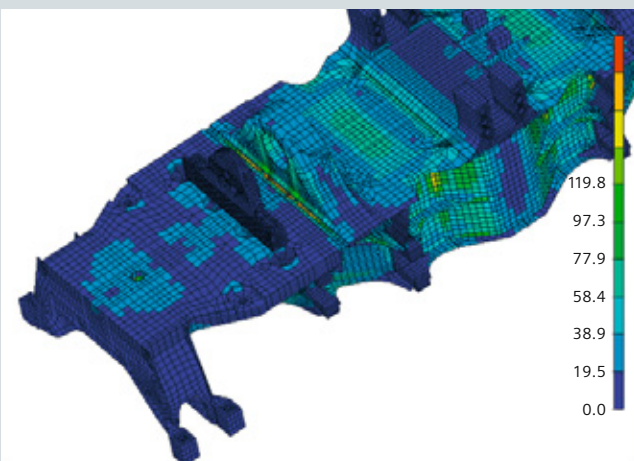
Bogie

The Syntegra bogie frame consists of a cross beam with two flexibly connected longitudinal beams. All the horizontal guidance forces as well as the forces exerted by dampers and stabilizers are taken by the cross beam to which they are attached. Only the mass of the vehicle is distributed (without torsion) to the primary springs via the two longitudinal beams in a manner similar to beam scales. As a result, the rigidity of the primary springs has almost no influence on derailment protection. Vehicles with this technology can be configured for very large payload without there being any reaction on the overall construction.

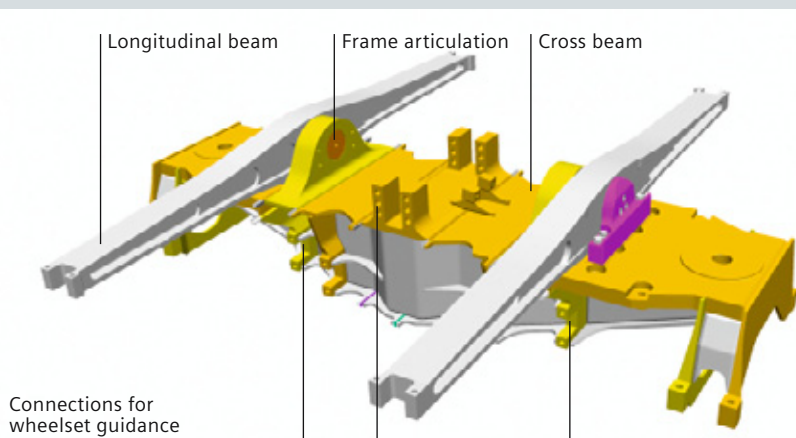
The direct drive is an integral component of the bogie. The bogie is directly linked to the car body via the traction motor housing. The bogie frame is therefore not subjected to any traction forces. The resulting symmetrical load on the traction motors enables optimum utilization of the installed traction power. Moreover, axle load shift at the wheelsets is only very low.

Syntegra direct drive





FEM calculation of the bogie frame



CAD design of the frame

Electric safety brake

Accompanied by a suitable external snubber circuit, permanent magnet synchronous machines generate inherent braking torque. This physical characteristic enables fail-safe electric braking and, because a full mechanical brake is no longer needed, fundamentally changes existing brake concepts. The inherent electrodynamic brake (IED) as a second independent brake circuit in addition to the electrodynamic (ED) brake consists of an additional power contactor and an additional brake resistor. As a result of the basic principle, the IED brake system also features wheel slide protection.

Advantages of the system (examples)

Compared to conventional metro type bogie with the same traction power and payload the prototype is more than 15 % lighter. In conjunction with the further weight-reduction measures envisaged for series manufacture, i.e. a lightweight construction, this weight advantage will

increase to almost 30 %. The energy costs for the operator are lowered by as much as 20 % due to weight reduction, reduction of the rotating masses and a higher degree of efficiency of the drive. Considerable advantages in respect of the maintenance costs can be expected, especially as a result of the lower degree of wear.

Outlook

Syntegra is scalable. All the usual axle loads, drive ratings and vehicle speeds are possible. The use of Syntegra technology in series-produced vehicles will take place once testing in a pilot application has been completed. The next stages of development are primarily aimed at making the solution ready for series production and consistently improving aspects of the lightweight construction.

One main bearing

Syntegra favours wheelsets with inside bearings, thus significantly reducing the load on the axle. The wheelset and traction motor bearings are combined to form one common main bearing. The rolling-contact bearings of this combined traction motor / axle bearing are a further development of conventional axle bearings taking into account the special operating conditions.

Sensorless control

Syntegra uses a sensorless drive control method which works by means of rotor-position identification. Only measurement signals of the motor phase currents and of the DC link voltage are evaluated. The control system is supported by test pulses during the vehicle starting phase, but, at higher speeds, it works solely with a voltage model of the machine.

Syntegra bogie frame



Siemens AG
Industry Sector
Mobility Division
P.O. Box 3240
91050 Erlangen
Germany

www.siemens.com/syntegra

