BOMBARDIER BN

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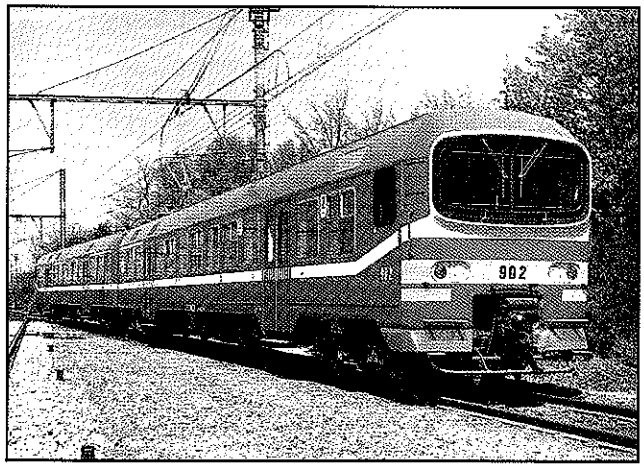

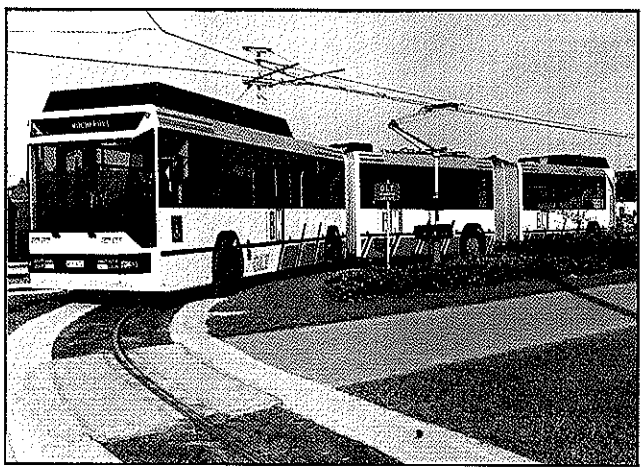

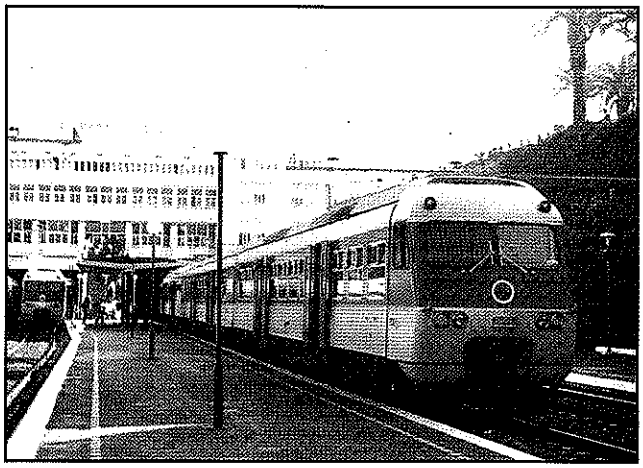

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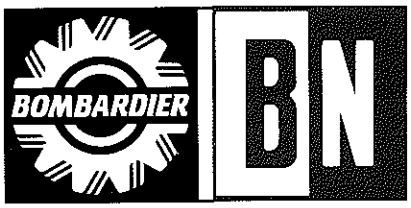
1 – Electrical locomotive type 12 with double-deck coaches M 5 (S.N.C.B.)
2 – Two-car EMU type AM 86 for the Belgian National Railways (S.N.C.B.)
3 – 8-axle Light Rail Vehicle in Amsterdam (The Netherlands)
4 – 6-axle Light Rail Vehicle in Portland (U.S.A.)
5 – The GLT – Guided Light Transit
6 – Three-car electrical multiple unit – Moroccan National Railways (O.N.C.F.)



WHO...

BN, a Belgian privately owned company, is a recognised international leader in the rail transportation technology and in the mechanical engineering fields thanks to :

- Experienced Engineers, Research and Development Teams
- Highly skilled Technicians and Craftsmen
- Dynamic and competent Export Team...

WHAT...

BN designs and constructs products and systems used in the rail, urban transportation and mechanical industries :

- Urban and suburban transportation : Light Rail Vehicles, Mass Rapid Transit and Commuter Trains.
  New products : GLT – Guided Light Transit
  SUBURBAN – Vehicles of Modular concept
- Railway transportation :
  – electric locomotives and EMU's
  – diesel-electric locomotives
  – single and double-deck coaches
  – freight wagons
  – bogies
- Industrial products such as maritime containers, aluminium truck bodies, lifting and civil engineering equipment, general and precision mechanical engineering...

WHERE...

Daily, throughout the world, passengers and merchandise are carried on BN-built vehicles. In places as diverse and distant as : Philippines, Brazil, The Netherlands, USA, France, Belgium, Morocco, India, Korea, Thailand, Zaïre, Luxembourg, Germany...

HOW...

- As main contractor for rolling stock
- In association with electrical partners
- As member of international consortia for turnkey projects
- In cooperation with local industry

Our objectives : **Quality, Flexibility, Service...**

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LIGHT RAIL TRANSIT SYSTEM — LRV (LIGHT RAIL VEHICLES)

In response to the major economic problems of energy use and the population explosion and city migration experienced by many countries, BN's Research Department is engaged in an audacious R & D programme. The results so far can be seen in the form of highly advanced equipment.

A major attraction of the light rail transit system is its greater flexibility and versatility, making it adaptable to any infrastructure and to the geographical and architectural features of any city.

It can be placed in high-speed subways, on elevated structures, in the streets, on private right-of-ways with or without level crossings, on abandoned railroads, etc. Often a mixed solution of these possibilities is adapted.

The light rail transit system can be gradually extended to a developing transport demand and, when necessary, the infrastructure can also be adapted.
With a staged construction of the system, investment, too, can be gradual.

The system is characterized by various types of cars with a wide range of transport capacities.
The light rail vehicles designed by BN are high-capacity, articulated 6 or 8 axle units which can also operate in trains of 2, 3 and 4 units.

Articulation of BN vehicles is highly reliable and allows curves down to 25 m radius. The inner lining has been carefully chosen to obtain maximum sound and thermal insulation.

In 1980/81, Charleroi and the Belgian coast saw this system put into operation. Furthermore, the cities of The Hague, Rio de Janeiro and Manila have opted for the "BN Articulated Light Vehicle". With a view to promoting even further BN exports to South America, BN has signed a collaboration agreement with the Brazilian compagny COBRASMA.

A similar agreement was signed with BOMBARDIER of Canada in 1979. This had the aim of promoting and marketing passenger transport equipment in the USA and Canada. In 1982 BN/Bombardier obtained a contract for 26 LRVs for the city of Portland, Oregon, USA, which were supplied, in 1984-85.

The years 1988-90 were equally important for several reasons:
1988 saw the orders for 45 Stadstrams for Amsterdam (delivery 1990-91) and for 13 Sneltrams (delivery 1990). 1989 represented a break-through into the UK market with the order for 44 automated LRV for the Docklands Light Rail system. In 1990 the city of The Hague ordered another batch of 34 bi-articulated 8-axle LRV's which will be built as from 1992. Meanwhile the LRV 2000 with full length low floor design on basis of the bogie BAS 2000 is being developed and built for extensive testing as from 1990.

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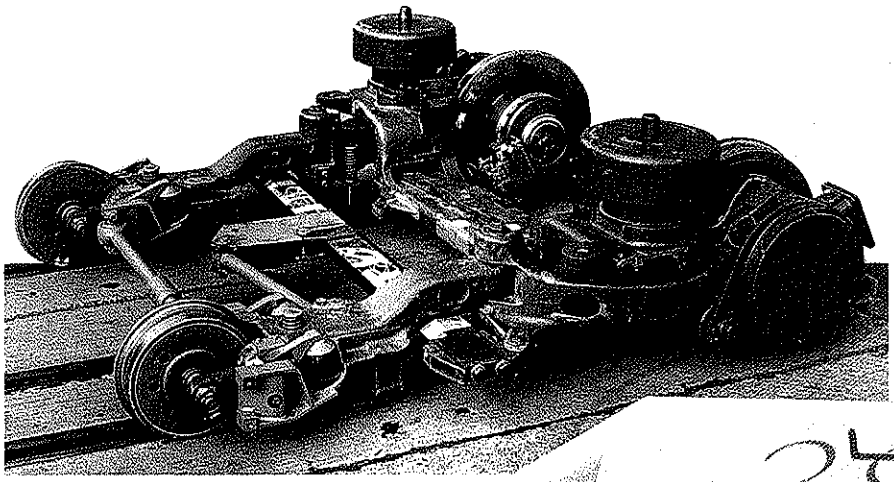
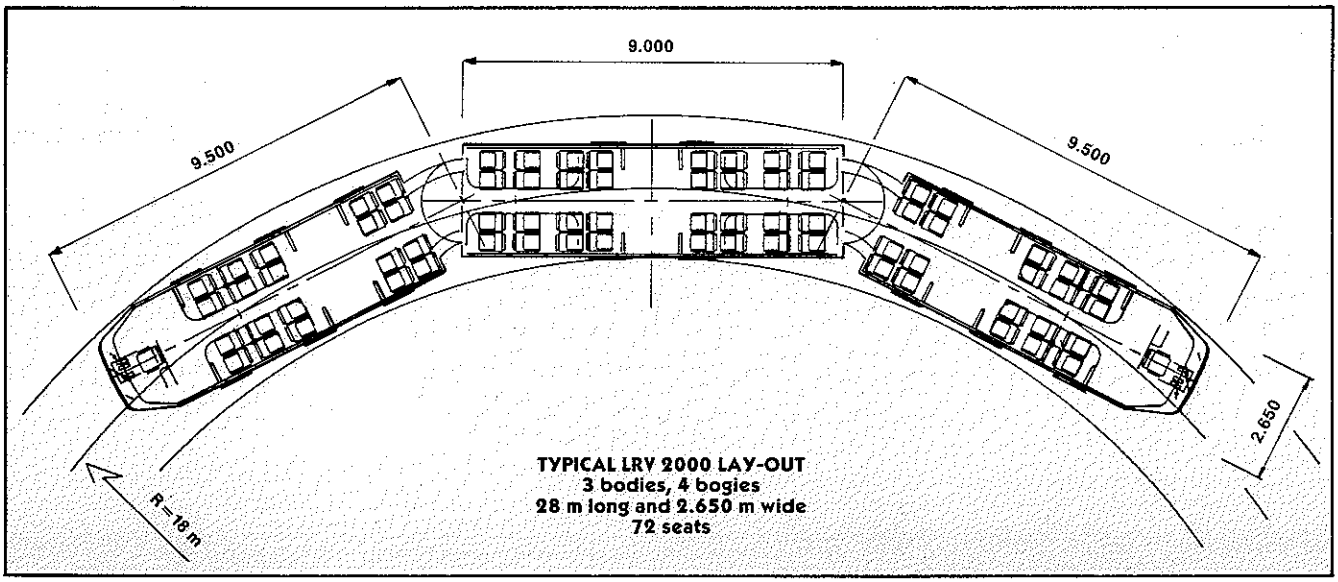
LRV 2000

BN's 100% Low-Floor Tram.





TYPICAL LRV 2000 LAY-OUT
3 bodies, 4 bogies
28 m long and 2.650 m wide
72 seats

General data

Track gauge	1 to 1.435 m
Length	18 m (2 bodies) to 42 m (4 bodies)
Width	2.2 m to 2.7 m
Height	3.300 m
Floor height	350 mm (constant)
Wheel diameter	640/400 mm
Axle load (max.)	10.5 t.

A real low floor (350 mm high) over the full vehicle length

- Constant 350 mm floor height even at the bogie location
- No internal steps
- No internal ramps
- Seats directly on the floor without platform

Low operating costs

- Low weight, reduced energy consumption
- Corrosion-free materials
- Fully sealed traction motor
- Easily repairable body
- Reduced rail and wheel wear

A modular design accorded to the customer's requirement

- Length, width, clearance easily adaptable to each network
- Lay-out and seat arrangements compliant with each specific operating requirements
- Flexible bodyshell structure achieved by bolted aluminium structure and bonded lining.

Performances

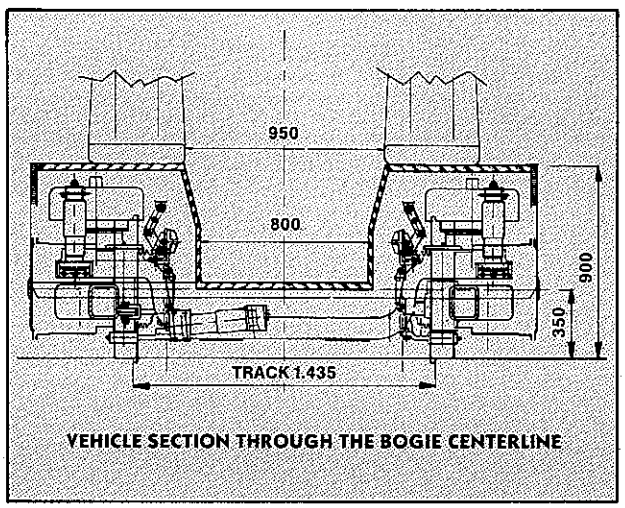
Max. speed	70 km/h
Acceleration	1.25 m/s^2
Service brake	1.25 m/s^2
Emergency brake	3 m/s^2
Minimum track radius	12 m

A.C. drive

- GTO controlled AC drive
- Watercooled wheel motor
- Fully regenerative or rheostatic electrical service brake

Articulated bogie

- Articulated frame allowing each wheel to be tangent to the rail
- Low noise-emission level
- Excellent dynamic stability
- Independent wheels driven by AC motor placed inside the wheel
- High comfort level provided by rubber primary and air spring secondary suspension



VEHICLE SECTION THROUGH THE BOGIE CENTERLINE

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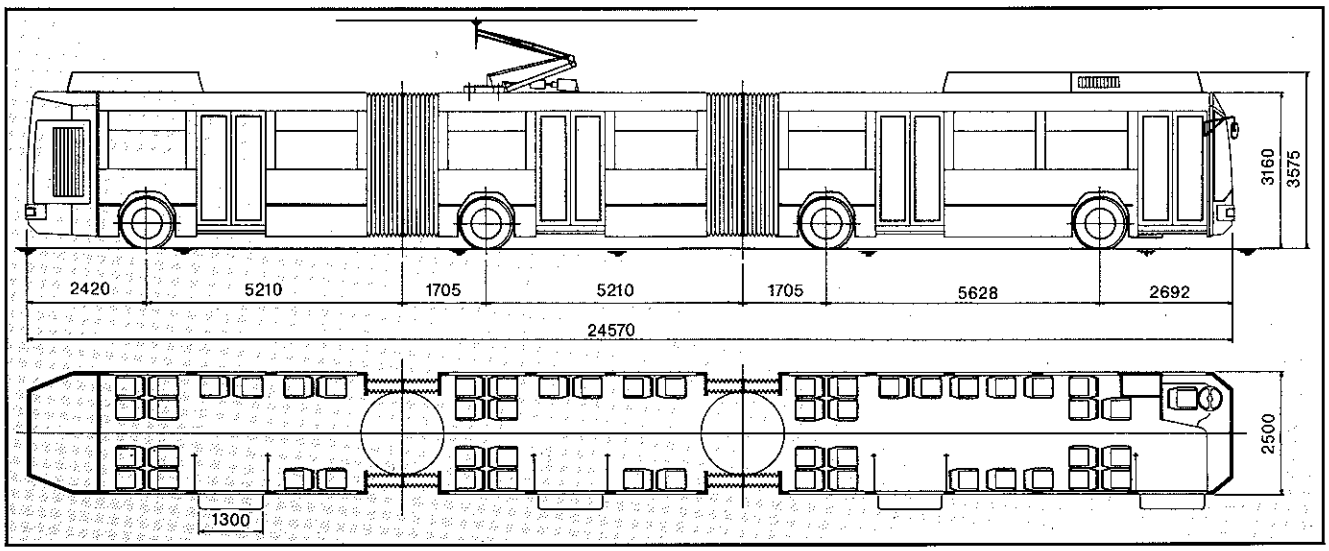
BOMBARDIER BN

FORMERLY **LA BRUGEOISE ET NIVELLES-BELGIUM**

GLT

Guided Light Transit



The GLT (Guided Light Transit) is a new system for urban transport which has been developed and tested during many years in the context of a special R & D programme.

Its main characteristics are:

- Low cost mass transit system, reliable and safe, transporting passengers from suburban areas to the city centre without transfer.
- Bi-mode: it can be operated in guided, as well as in unguided mode, with electric power supplied by catenary, or alternatively by a built-in diesel generator.
- The vehicles are guided by a central rail, imbedded at surface level, each axle being steered within narrow tolerances by a patented guiding system.
- Low-noise vehicles, causing little pollution due to the use of pneumatic tires and electric power.
- The system can be operational from the very start, thus generating revenue for the operators, even prior to any investment in civil works.
- The vehicles are specially designed for any kind of urban and suburban traffic, e.g. on viaduct, in tunnel, on segregated or mixed right of way.
- Infrastructure facilities can be limited to locations of high density traffic.

TECHNICAL CHARACTERISTICS

Undercarriage in corten steel; aluminium car body	
Weight	
empty	26,000 kg
total	40,000 kg
Passenger capacity	198
seats	51
standees (6 pers/m²)	147
Traction	
2 electrical motors	360 kW
Power supply	
either by catenary	600 V d.c.
or by diesel-electric generator	260 kW
Performances	
Max. service speed	70 km/h
Max. acceleration	1.2 m/s²
Max. deceleration	5.5 m/s²
Gradeability	15 %
Minimum curve radius on rail and on road	12 m
Steering axles	4
Reversibility	
Automatic coupling	

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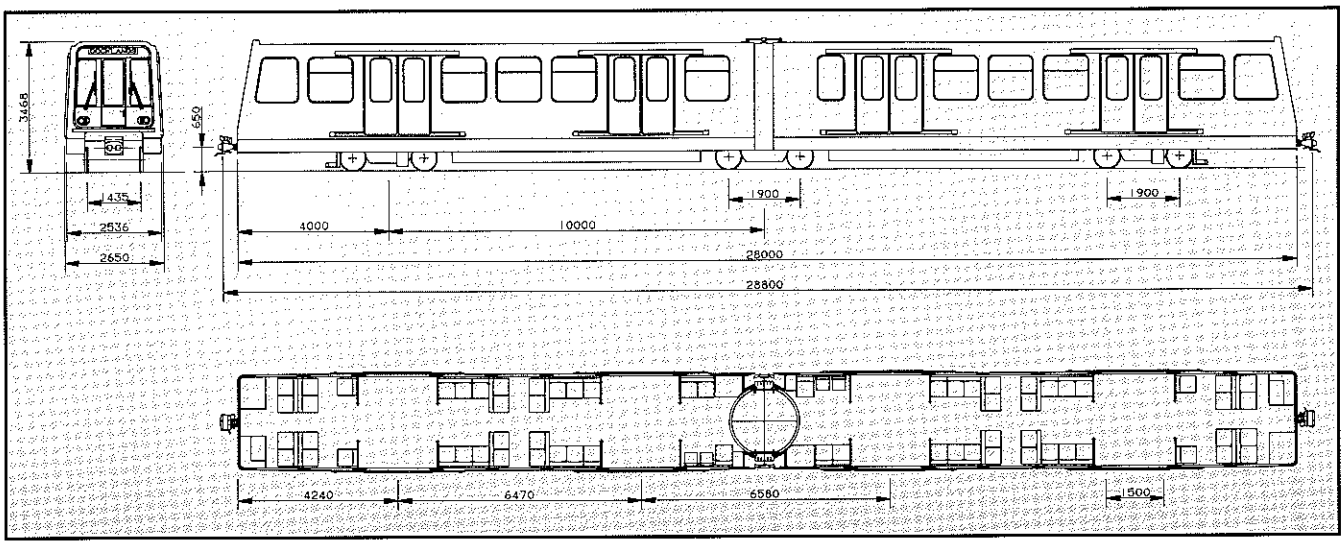
FORMERLY LA BRUGEOISE ET NIVELLES – BELGIUM

Light Rail Vehicle

Docklands Light Railway Ltd

London



Main features

Track gauge	1.435 m
Length	28.000 m
Length over coupler	28.800 m
Width over doors	2.650 m
Floor height	1.025 m
Overall height	3.468 m
Wheel diameter, new/worn	740/660 mm
Doors : number per side	4 double
type	outside sliding
free opening	1.500 m
Weight empty	36 t
Number of seats (not including 4 tip-up seats)	66
Standees (6 p/m^2)	218
Total capacity	284

Performance

Maximum service speed	80 km/h (50 mph)
Acceleration rate	1.1 m/sec^2 average
Service deceleration rate	1.3 m/sec^2
Minimum curve radius	38 m

Carbody

The body is steel-welded. The steel has anti-corrosion properties. A door is provided at the front and end. The two cars are connected by a BN patented wide passage articulation with full passenger protection and anti-vandalism design. The vehicle design complies with the fire protection regulations applying for tunnel operations.

Bogies

2 BN monomotor bogies.
1 BN trailer bogie under articulation.
Rubber primary and air spring secondary suspension.
Disc brake.
Axle bearing inside wheels.

Traction

Supplied by BEM (Brush Electrical Machines Ltd)
Power supply : 750 V d.c. third rail.
Motor power (continous rating) : 2 x 140 kW.
2 DC chopper control units.
Electrodynamic brakes with resistor or regenerative.

Mechanical brakes

Disc brakes; air applied for service brake, spring applied air released for parking brake.

ATO/ATP

ATO supplied by WBS (Westinghouse Brake and Signal Ltd) and ATP supplied by GEC for the 23 first vehicles, ATO/ ATP equipment supplied by Alcatel (Canada) for the remaining 47.
The ATO equipment operates the vehicle automatically by means of an on-board computer without any human intervention.
The ATP equipment and the signalling system ensure the safety operations.

Auxiliary equipment

750 V d.c. / 28 V d.c. static convertor.
Heating system : supplied by WBS
Doors and door mechanisms : supplied by WBS

The 70 Light Rail Vehicles ordered by DLR are manufactured by BN Belgium in collaboration with HSRP (U.K.).
The cars are operated and monitored fully automatically without driver by an on-board computer and a sophisticated track signalling system.
These cars will cover the growing demand in the field of transport in the Docklands due to the development of the Dockland area and to the opening of the Bank and the Beckton extension.

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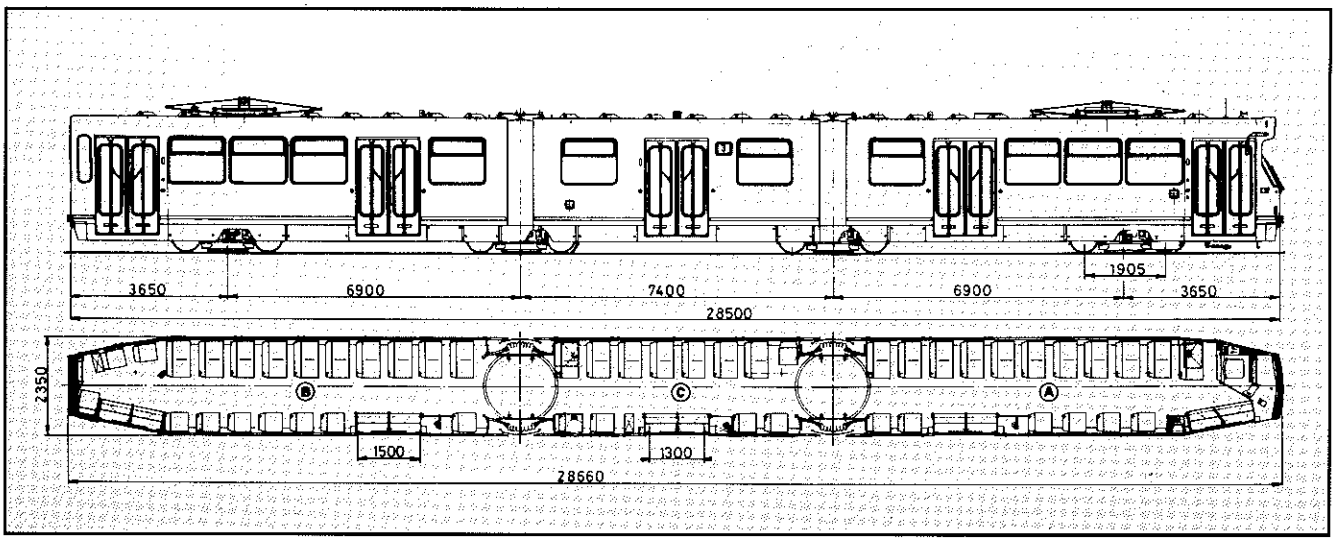
BN

FORMERLY LA BRUGEOISE ET NIVELLES-BELGIUM

Light Rail Vehicle

The Hague (Netherlands)



8-axle double articulated light rail vehicle for the city of The Hague, Netherlands.

General characteristics

Track gauge	1.435 m
Body length	28.500 m
Body width	2.350 m
Floor height	0.860 m
Height rail to roof	3.185 m
Wheel diameter, new	0.655 m
Doors : number	5 double
type	bifolding
free opening	1.300 m
Weight empty	37.7 t
Number of seats	77
Standing passengers (4.5 pass / m^2)	108
Total operational capacity	185

Performance characteristics

Max. service speed	70 km/h
Acceleration rate	1.2 m / sec^2
Average service deceleration	1.3 m / sec^2
Emergency deceleration rate (depending on pass. load)	3 to 4 m / sec^2
Minimum track radius	16 m

Articulation

Two BN patented wide passage articulations, full, passenger protection and anti-vandalism design.

Bogies

Four BN bi-motor trucks providing 100 % adhesion.
Elastomeric primary and secondary suspension.
Resilient wheels.

Propulsion system and electrical auxiliaries

(designed and realised by HOLEC, Netherlands)
Power supply : 600 V d.c. overhead wire.
Motor power (ACEC) : 8 x 37 kW. (cont. rating)
DC chopper control with electrodynamic and regenerative brake system. Two separate traction groups.
Auxiliaries 24 V d.c.

Brake equipement

Service brake : electrodynamic and regenerative.
Substitution and stopping brake : friction brake system with 8 drums : hydraulically operated.
Emergency : supplemented with 8 electro-magnetic track brakes.

One hundred of this type of cars have been delivered to the HTM. (Urban transportation company of The Hague) since 1981 and are operated in extensive service.

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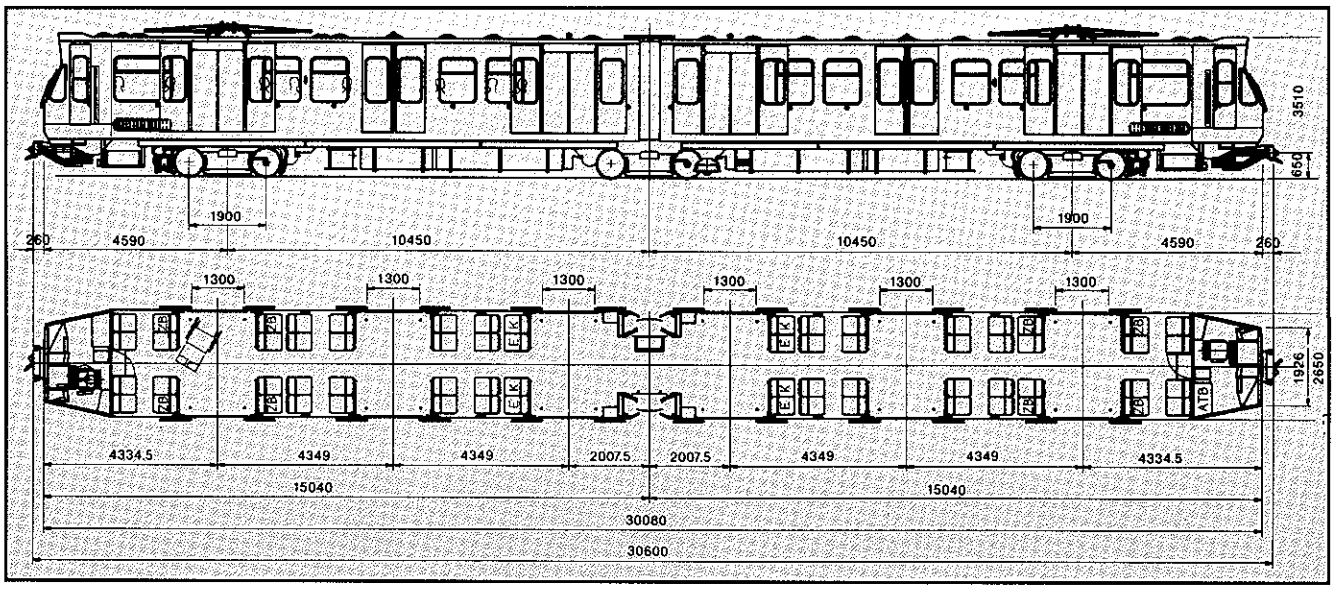
Light Rail Vehicle "Sneltram"

Amsterdam (Netherlands)



6-axle articulated light rail vehicle for the city of Amsterdam, Netherlands.

General characteristics

Track gauge	1.435 m
Body length	30.080 m
Body width	2.650 m
Floor height	1.100 m
Height rail to roof	3.424 m
Wheel diameter, new	0.690 m
Doors : number	12 double
type	sliding-plug
free opening	1.300 m
Weight empty	46.3 t
Number of seats	64
Standing passengers (4.0 pass / m^2)	169
Total operational capacity	233

Performance characteristics

Max. service speed	70 km/h
Acceleration rate	1.3 m / sec^2
Average service deceleration	1.5 m / sec^2
Emergency deceleration rate (depending on pass. load)	3 to 4 m / sec^2
Minimum track radius	40 m

Articulation

One BN patented wide passage articulation, full passenger protection and anti-vandalism design.

Bogies

Three BN bi-motor trucks providing 100 % adhesion.
Resilient wheels.

Propulsion system and electrical auxiliaries

(designed and realized by Holec, Netherlands)
Power supply : 600 V d.c. overhead wire / 750 V d.c. 3-rail.
Motor power : 6 x 74 kW (cont. rating).
DC / AC invertor control with electrodynamic and regenerative brake system. Two separate traction groups.
Auxiliaries 24 and 110 V d.c. & 220/380 V a.c.

Brake equipment

Service brake : electrodynamic and regenerative.
Substitution and stopping brake : friction brake system with discs : hydraulically operated.
Emergency : supplemented with 6 electro-magnetic track brakes.

Thirteen of this type of vehicle are delivered to the GVBA (Urban transportation company of Amsterdam) in 1990 for the rapid rail link Amsterdam-Amstelveen.

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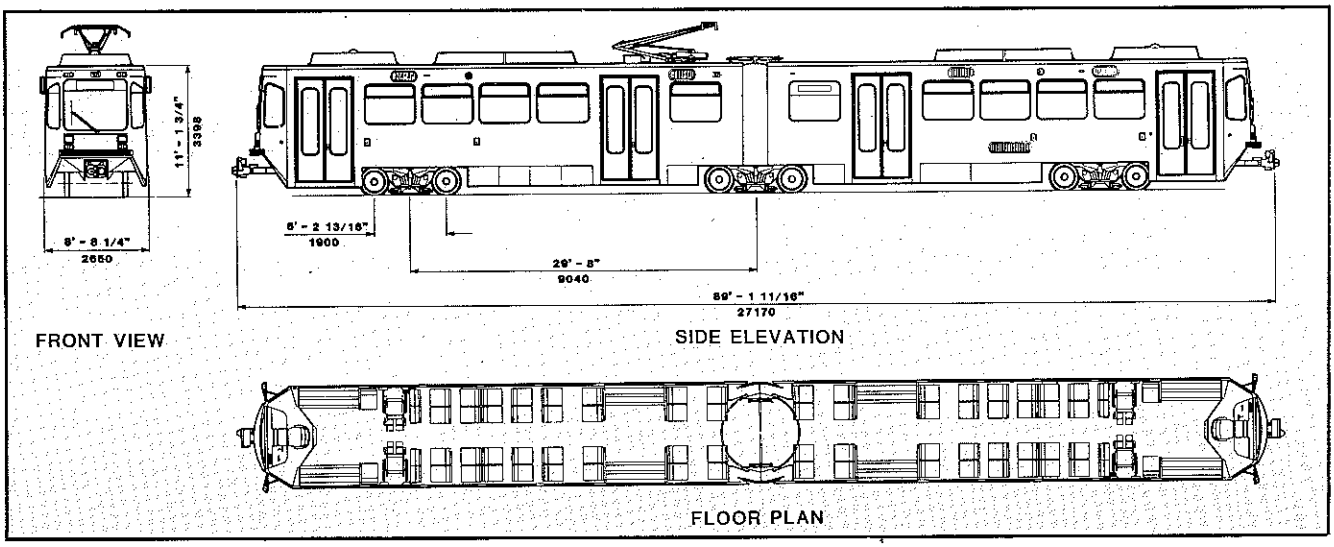
Articulated Light Rail Vehicle

Operated by the Tri-County Metropolitan Transportation District of Oregon (Tri-Met, Portland, Oregon)



General characteristics

Track gauge	1.435 m
Body length	26.510 m
Body length over coupler	27.170 m
Body width	2.650 m
Floor height	0.984 m
Height rail to roof	3.398 m
Wheel diameter, new/worn	711/660 mm
Doors : number per side	4 double
type	swing-plug
free opening	1.320 m
Weight empty	41.8 t
Number of seats	76
Standing passengers (6 pass / m^2)	135
Total capacity	211

Performance characteristics

Max. service speed	88,5 km/h (55 mph)
Acceleration rate	1.34 m / sec^2
Service deceleration rate	1.34 m / sec^2
Emergency deceleration rate	2.1 m / sec^2
Minimum horizontal radius	25 m

Articulation

BN patented wide passage articulation, with full passenger protection and anti-vandalism design.

Bogies

2 BN monomotor bogies.
1 BN trailer bogie under the articulation.
Elastomeric primary and secondary suspension.

Propulsion system and electrical auxiliaries

Power supply : 750 VDC overhead wire.
Motor power, continuous rating : 2 x 195 kW.
DC cam-controlled propulsion system.
Solid state low voltage converter.

Brake equipment

Discs, spring applied hydraulic released.
6 electromagnetic track brakes.

The 26 Light Rail Vehicles ordered by Tri-Met are manufactured by Bombardier under license to BN of Brussels, Belgium. The cars are of Corten steel and are equipped with the efficient BN-articulation. Inboard bearing trucks, two powered and one unpowered, are also of BN design, based on millions of miles of operating experience. The cars operate from the Central Business District of Portland to the suburban area of Gresham, a distance of approximately 15 miles.

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BN

FORMERLY LA BRUGEOISE ET NIVELLES-BELGIUM

Light Rail Vehicle

Charleroi and the Belgian Coast

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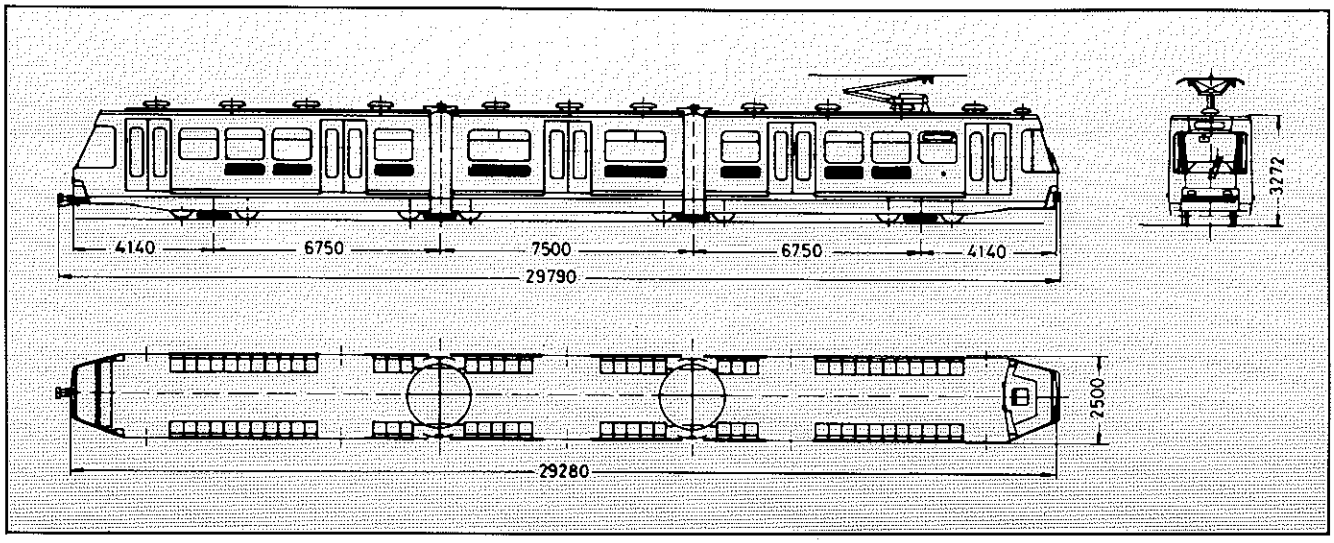
Light Rail Vehicle Manila



8-axle articulated light rail vehicles operating in Manila in trains of 2 units

General characteristics

Track gauge	:	1.435 m
Body length	:	29.280 m
Total width	:	2.500 m
Floor height	:	0.900 m
Height, rail to roof	:	3.272 m
Wheel diameter raw	:	0.660 m
Doors : number	:	5 double (on both sides)
type	:	«BN» swing outboards plug
opening	:	1.300 m
Empty weight	:	41 t
Number of seats	:	81
Standing passengers	:	293 (7 pass/m²)
Total passengers	:	374

Performance characteristics

Max. service speed	:	60 km/h
Acceleration (7 pass/m²)	:	1 m/s²
Average service deceleration (7 pass/m²)	:	1.3 m/s²
Average emergency deceleration (7 pass /m²)	:	2.08 m/s²
Minimum horizontal radius	:	25 m

Articulation

2 BN patented articulations with access passage of 1.66 m, full passenger protection, and anti-vandalism design.

Bogies

2 BN monomotor bogies at car ends
2 BN trailer bogies under the articulations

Electrical system

Nominal line voltage : 750 V
Motor power : 2 x 217.7 kW
Traction equipment with chopper control for regeneration of energy (ACEC Belgium)

Brake equipment

Electro-dynamic (rheostatic) brakes acting as service brake.
2 disc brakes per motor bogies acting as emergency and substitution brake
2 disc brakes per trailer bogie acting as service brake
2 electromagnetic track brakes per bogie for use in case of emergency.

BN Light Rail vehicles help the Manila Authorities to solve their city congestion problems. The vehicles operate in trains of 2 units (748 passengers) providing the line with a transport capacity of 20,000 passengers per hour in each direction. Later, by introducing trains of 3 vehicles (1,122 passengers) the capacity could be increased to 30,000 passengers per hour in each direction.

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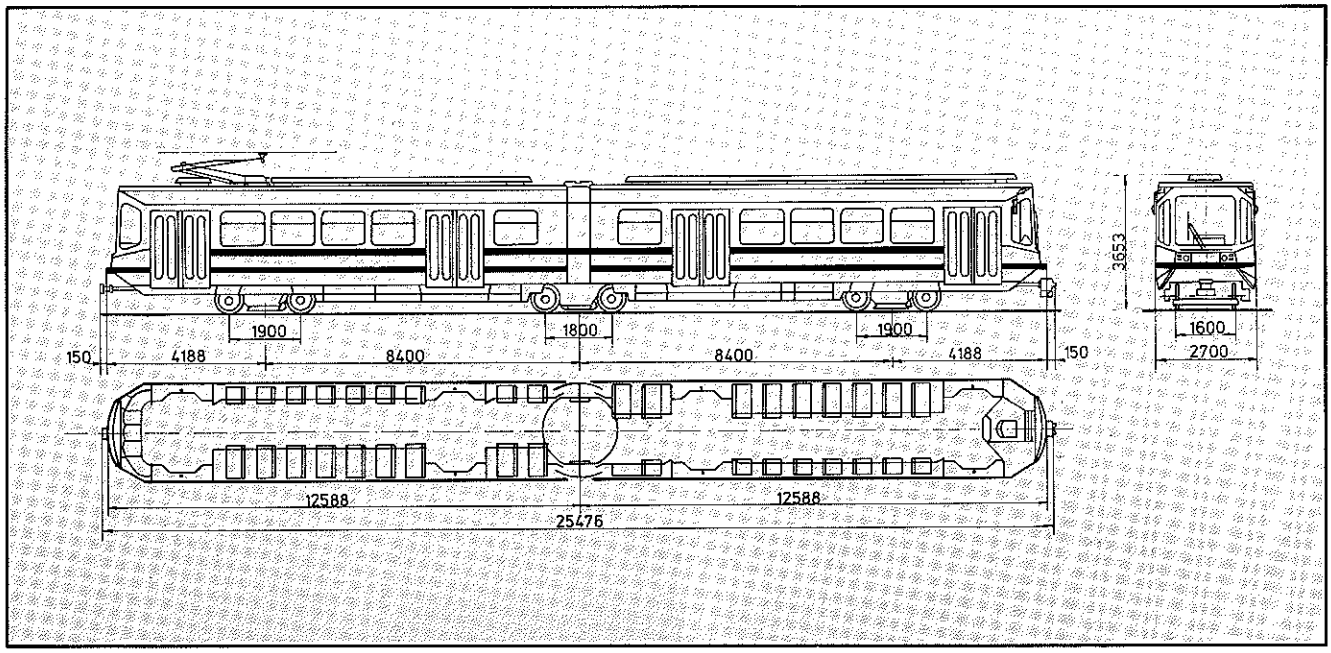
Light Rail Vehicle

Rio de Janeiro



6-axle articulated light rail vehicles for the city of Rio de Janeiro, designed to run in 4-unit trains.

General characteristics

Track gauge	: 1.600 m
Body length	: 25.476 m
Total width	: 2.700 m
Floor height	: 0.950 m
Height, rail to roof	: 3.400 m
Wheel diameter, new	: 0.680 m
Doors - number	: 4 double
- type	: bifolding
- width, open	: 1.350 m
Weight, empty	: 38.360 T
Number of seats	: 58
Standing passengers (6 pass./m²)	: 193
Total passengers	: 251

Performance characteristics

Max. service speed	: 80 k.p.h.
Acceleration	: 1 m/s²
Average service deceleration	: 1.2 m/s²
Average emergency deceleration	: 1.5 m/s²
Minimum horizontal radius	: 25 m

Articulation

1 BN patented articulation with access passage of 1.74 m, full passenger protection and anti-vandalism design.

Bogies

2 single-motor bogies (MTE type)
1 trailer bogie (MTE type) under the articulation.

Electrical system

Nominal line voltage : 750 V
Motor power : 2 x 200 kW
Traction equipment "Siemens/BBC" with resistors switched by electro-magnetic contactors.
Current collector: pantograph and 3rd rail
Automatic coupler BSI.

Brake equipment (Knorr)

2 disc brakes per single-motor bogie
2 disc brakes per trailer bogie (service brake)
6 independent suspended track brakes

68 light rail vehicles have been ordered by Companhia do Metropolitano do Rio de Janeiro for the Rio network.
8 vehicles have been built in the BN workshops and 60 vehicles manufactured by Cobrasma Sumaré S.A., under licence from BN, are now being delivered.

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THE MODULAR SUBURBAN CAR

This car is designed for use in large urban areas with high travel demand. It meets the general requirements of modern, comfortable, and economical urban and suburban transport.

Many different combinations based on the concept of standardisation and modularity ensure an appropriate solution for any specific demand.

HEAVY RAIL VEHICLES

From 1976 to 1982, BN delivered 80 double-unit metrocars to the Brussels Mass Transit Authorities (STIB).

The Brussels metrocar has an aluminium body-shell with unpainted brushed side walls. The body assembly concept is characterized by the use of profiles and rivets, plus overall modularity, which enables rapid and efficient assembly.

The rivetting technique is based on technology from the aircraft industry, while the driving cab arrangement and the passenger-seat design result from ergonomic studies.

As from 1991, BN will convert 32 double units into triple ones by adding a motorized mid-section.

TRAMWAYS

Tram travel is popular in Belgium where the earliest tramcars were built in our workshops in 1885. Among the numerous tramways exported by the company, the first went to Athens in 1907, and in 1922 double-deck trams were ordered by the city of Valparaiso, Chile.

Over the years, tramway systems have continued to be developed. Thus, for example, the first trams mounted on bogies began to operate in 1922. In 1947, BN bought the american P.C.C. (President Committee Car) licence for construction of an all-electric tramway. Without wasting time, a prototype was built the same year. Since then, four generations of vehicles have been developed.

Type 7900 double-articulated vehicles were delivered to the STIB in 1977 for use on the Brussels pre-metro system. This project is a link between the old TRAMWAYS and the LIGHT RAIL TRANSIT concept.

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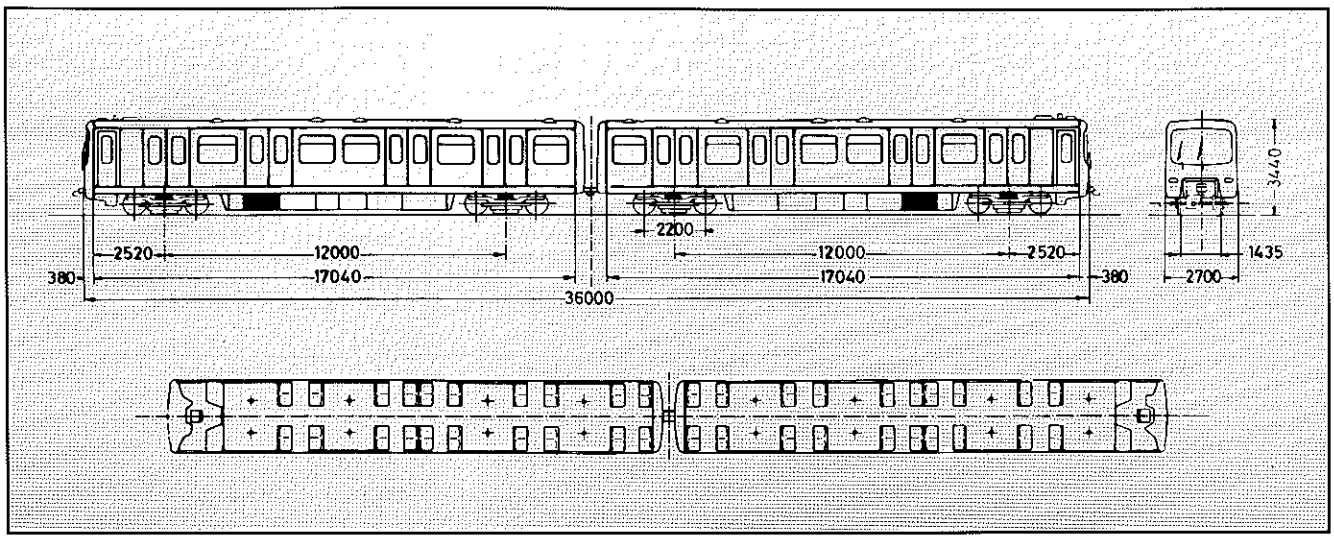
BOMBARDIER BN

FORMERLY LA BRUGEOISE ET NIVELLES-BELGIUM

The Brussels Subway Cars



TECHNICAL CHARACTERISTICS OF THE TRACTION UNIT (2 CARS)

General characteristics

Track gauge	: 1.435 m
Length	: 36.000 m
Total width	: 2.700 m
Height, rail to roof	: 3.440 m
Doors:	
number	: 8 double
type	: sliding plug
opening	: 1.300 m
Empty weight	: 62 T
Number of seats	: 80
Standing passengers	: 340
Total passengers	: 420

Performance characteristics

Max. service speed	: 72 km/h
Acceleration	: 1.16 m/s^2
Service deceleration	: 1.10 m/s^2
Emergency deceleration	: 1.70 m/s^2

Bogies

4 monomotor bogies
Self-ventilated, fully suspended motors
Motorpower: 4 x 266.2 kW
Primary suspension by rubber elements
Secondary pneumatic suspension, with levelling valve.

Electrical system

Nominal line voltage: 750 V
Traction equipment with chopper control for regeneration of energy (ACEC, Belgium)
Current collector: third rail

Brake equipment

Electro-dynamic (rheostatic) brakes acting as service brake.
2 disc brakes per bogie acting as emergency, substitution, parking and immobilizing brake.
2 electromagnetic track brakes per bogie for use in case of emergency.

The traction unit consists of two cars permanently coupled. BN has delivered 80 double-unit metrocars to the Brussels Mass Transit Authorities (STIB, Société des Transports Intercommunaux de Bruxelles).
The Brussel's metrocar has an aluminium body-shell with brushed and unpainted sidewalls.
The body assembly concept is characterized by the use of profiles and rivets for the joining techniques and its modularity for the manufacturing aspect.
The rivetting technique is based on the technology used and experienced in the aircraft industry.
The driver's cab arrangement and the passengers seat design result from ergonomic studies.
As from 1991 BN starts supplying 32 motorized intermediate cars, enabling STIB to operate 32 metrocar sets as triple units.

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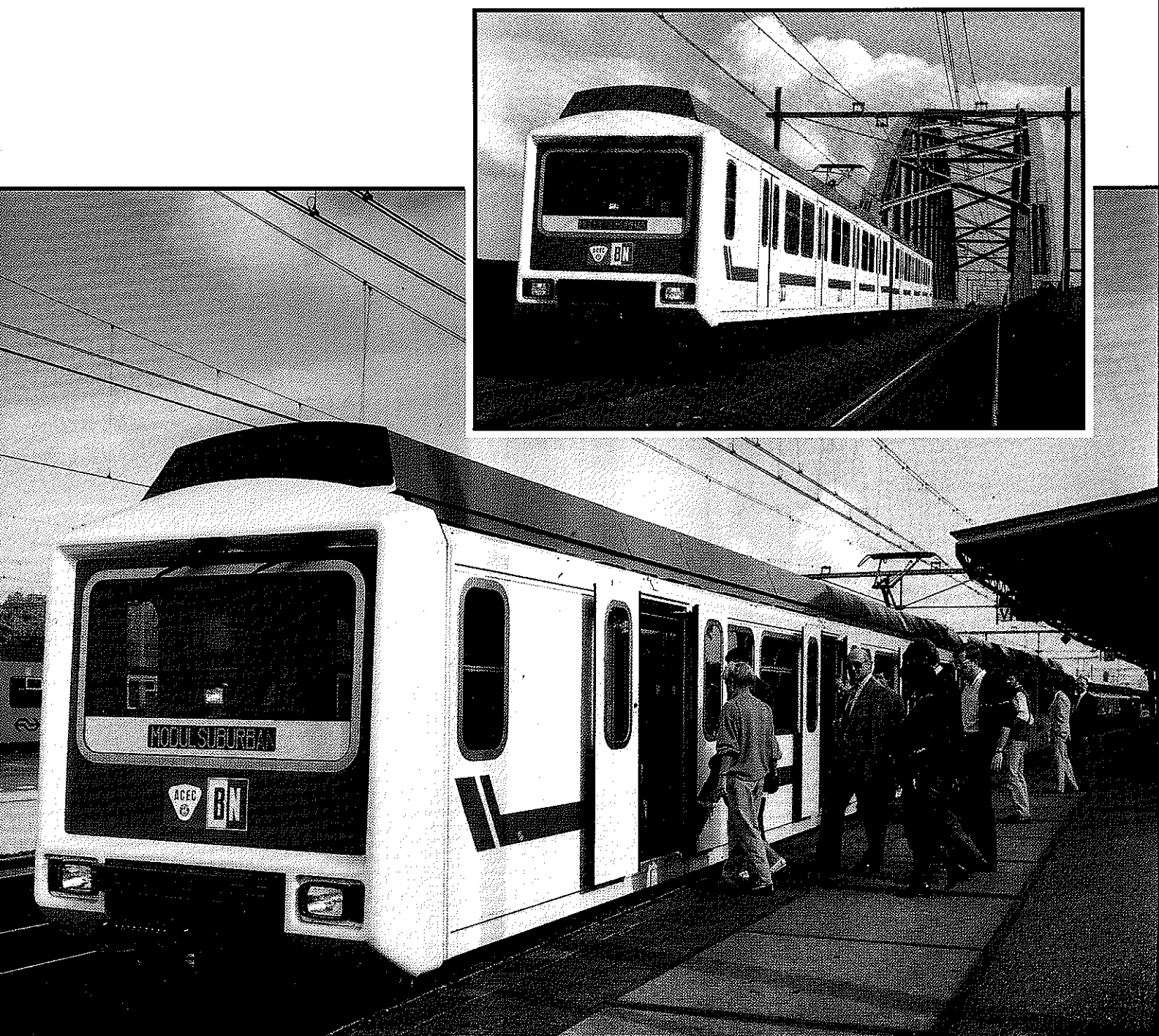
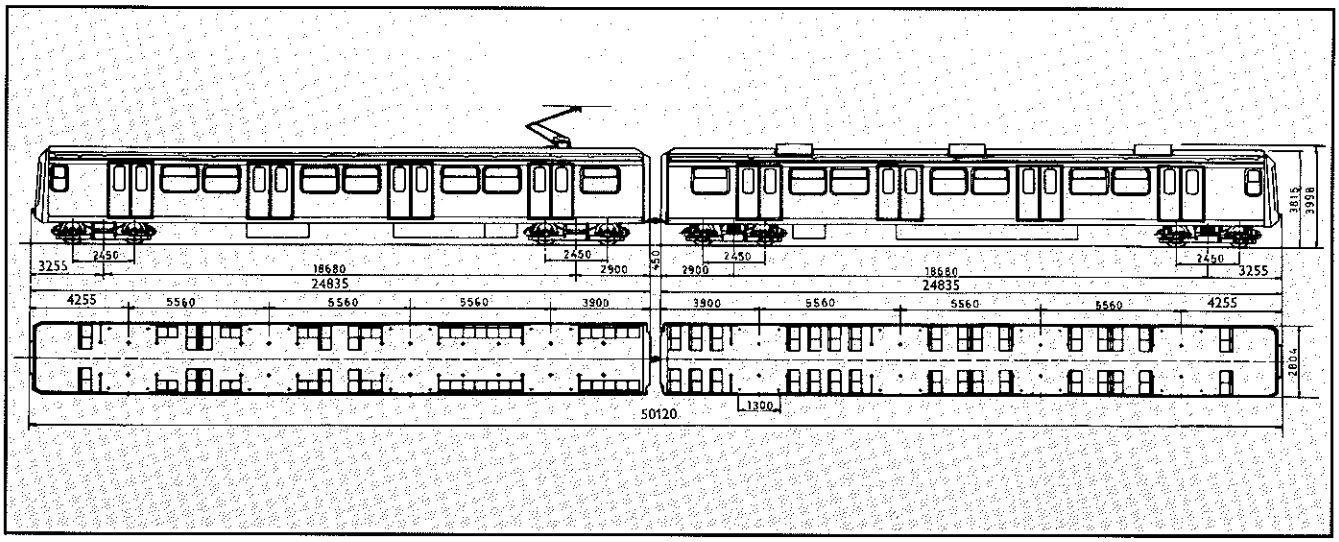
FORMERLY **LA BRUGEOISE ET NIVELLES-BELGIUM**

BN-Modular Suburban Electrical Motor Unit





Main characteristics

	Long type	Short type	Medium type
Body length	24.835 m	19.275 m	21.855 m
Body width	2.800 to 3.200 m		
Floor height	1.150 m		
Height rail to top of roof	3.580 m		
Tare weight motor coach approx.	49.0 ton	45.5 ton	46.8 ton
Tare weight trailer coach approx.	40.0 ton	36.7 ton	38.1 ton
Passenger capacity per car with width of 3000 mm (depending on seating arrangement)			
– seats	64 - 72	44 - 56	54 - 64
– standees 4 P/m²	147 - 179	110 - 136	130 - 157
– total	211 - 245	158 - 188	184 - 221
Doors:			
– number of double door per side	4	3 or 4	4
– free opening	1.300 m		

Performances

Depending on the motor unit formation and gear ratio:

maximum service speed:	80 km/h	alt. 100 km/h
acceleration rate:	0.75 m/sec²	to 1.2 m/sec²
service deceleration:	1.15 m/sec²	to 1.25 m/sec²

Propulsion system

Power supply: 1,500 V d.c.
DC chopper control with regenerative braking. Static converter for AC and DC low voltage auxiliaries.

Brake equipment

Service brake is electrodynamic and regenerative, supplemented by the friction brake. Friction brake with discs and (or) thread brake. Possibility of providing electromagnetic track brakes.

BN-Bogies

Flat frame for easy construction, assembly and disassembly.
Bolsterless bogie.

Secondary suspension: air suspension or helicoil.
Bi-motor service proven nose-suspended motor-box assembly.
Maximum standardisation between motor and trailer truck.

The BN suburban car is designed for use in large urban areas with high travel demand. It responds to the general requirements of modern, comfortable and economical urban and suburban mass transportation.
The car concept is based on standardisation, modularity and flexibility. Consequently, many different combinations based on the same standards and modules can be proposed, thus obtaining a suitable solution for every specific demand. Furthermore the aim of the car concept is to meet all requirements for an easy and profitable transfer of technology.

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LIGHT RAIL VEHICLES (LRV)

TECHNICAL DATA

CITY / COUNTRY		RIO DE JANEIRO BRAZIL	THE HAGUE NETHERLANDS	CHARLEROI BELGIUM	BELGIAN COAST BELGIUM	MANILA PHILIPPINES	PORTLAND U.S.A.	AMSTERDAM STADSTRAM NETHERLANDS	AMSTERDAM SNELTRAM NETHERLANDS	LONDON DOCKLANDS UNITED KINGDOM
YEAR FIRST BUILDING		1979	1981	1981	1982	1983	1984	1989	1990	1990
NUMBER		68	100	54	49	64	26	45 (20 x 11G) (25 x 12G)	13	44
TRACK GAUGE	m	1.600	1.435	1.000	1.000	1.435	1.435	1.435	1.435	1.435
TARE WEIGHT	t	38.40	37.75	35.00	34.25	39.20	42.50	37.0	48.0	39.3
BODY LENGTH	m	25.476	28.5	21.78	21.78	29.79	26.51	25.63	30.08	28.80
BODY WIDTH	m	2.70	2.35	2.50	2.50	2.50	2.65	2.35	2.65	2.65
FLOOR HEIGHT	m	0.950	0.860	0.860	0.860	0.900	0.984	midsection 280 mm	1.100	1.025
ARTICULATIONS		1	2	1	1	2	1	2	1	1
BOGIES		3 (2 powered)	4	3 (2 powered)	3 (2 powered)	4 (2 powered)	3 (2 powered)	4	3	3 (2 powered)
MOTOR POWER (1 h)		2 x	8 x	2 x	2 x	2 x	2 x	8 x	6 x	2 x
		230 kW DC	42.5 kW DC	228 kW DC	228 kW DC	230 kW DC	210 kW DC	38.5 kW AC	77 kW AC	140 kW DC
MAXIMUM SPEED	km/h	80	70	65	75	60	88.5	70	70	80
AVERAGE SERVICE ACCELERATION	m/sec^2	1.00	1.20	1.10	1.00	1.1	1.34	1.25	1.30	1.1
AVERAGE SERVICE DECELERATION	m/sec^2	1.20	1.30	1.35	1.35	1.35	1.34	1.35	1.50	1.3
LINE VOLTAGE		750 V. DC	600 V. DC	600 V. DC	600 V. DC	750 V. DC	750 V. DC	600 V. DC	600 V. (catenary) 750 V (3rd rail)	750 V. DC
ACCOMODATION : SEATS		58	77	44	59	81	76	52 (11G) 63 (12G)	64	70
STANDEES ($4/m^2$)		128	96	98	88	168	90	87 (11G) 91 (12G)	169	145
STANDEES ($6/m^2$)		192	144	148	132	252	135	130 (11G) 136 (12G)	253	218
MINIMUM CURVE (RADIUS)	m	25	16	18	18	25	25	16.5	40	38
BRAKING SYSTEM		ELECTRO-PNEUMATIC	ELECTRO-HYDRAULIC	ELECTRO-PNEUMATIC	ELECTRO-PNEUMATIC	ELECTRO-PNEUMATIC	ELECTRO-HYDRAULIC	ELECTRO-HYDRAULIC	ELECTRO-HYDRAULIC	ELECTRO-PNEUMATIC
OPERATION		Unidirectional	Unidirectional	Bidirectional	Unidirectional	Unidirectional	Bidirectional	11G = bidirectional 12G = unidirectional	Bidirectional	Automated Bidirectional

LOCOMOTIVES

The first steam locomotive left our workshops in 1849 and, by 1910, we were able to exhibit our 1,000th model at the Brussels Universal Exhibition.

Our first electric rail locomotive made its appearance in 1927.

Since 1950, our Nivelles plant has been engaged in the construction of diesel-hydraulic and diesel-electric locomotives, many of which are exported to Bolivia, Zaïre, Angola, India, and Argentina. Turkey, Korea and Vietman have also been importing our locomotives over the past decade.

But our principal customer is Belgian National Railways (SNCB) which operates a large number of electric and diesel-electric locomotives built in our workshops.

ELECTRIC MULTIPLE UNITS (EMUs)

During the Second World War, the Nivelles plant produced the first prototype of a double electric unit. Since then several generations of EMUs have been manufactured. In 1976, an important series of quadruple electric units was built.

Among the most recent products, BN has delivered to SNCB 140 two-car units of a new EMU generation, known as type AM80, and to

Moroccan National Railways (ONCF) 8 three-car units derived from the AM80 type and operating as six-car sets at 160 km/h. Another of 6 units will be delivered in 1992.

The newest derivation, named type AM 86, is in production as from 1987 for SNCB.

Indonesian Railways ordered 7 four-car EMUs for delivery starting in 1992.

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FORMERLY LA BRUGEOISE ET NIVELLES-BELGIUM

Main Line Electric Locomotive Type 11

Dual-voltage locomotive for both freight and passenger rapid transit

BOMBARDIER BN

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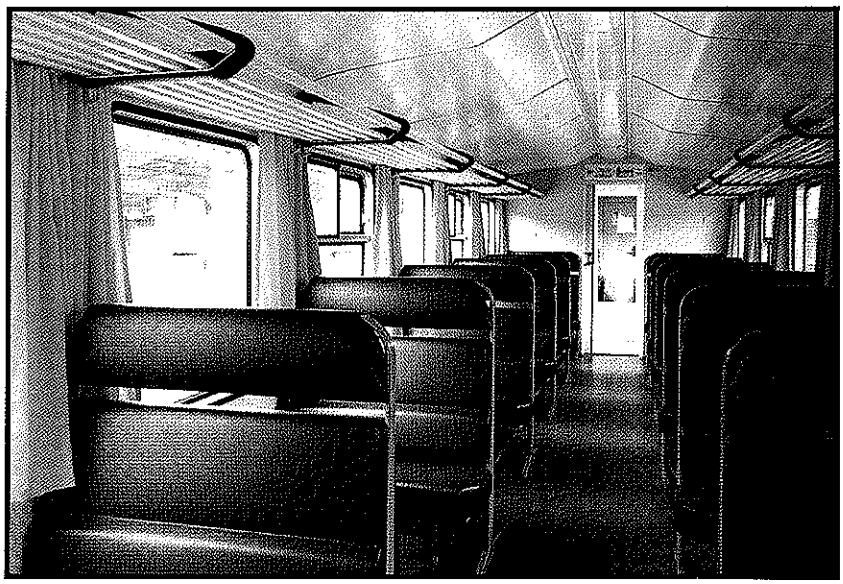
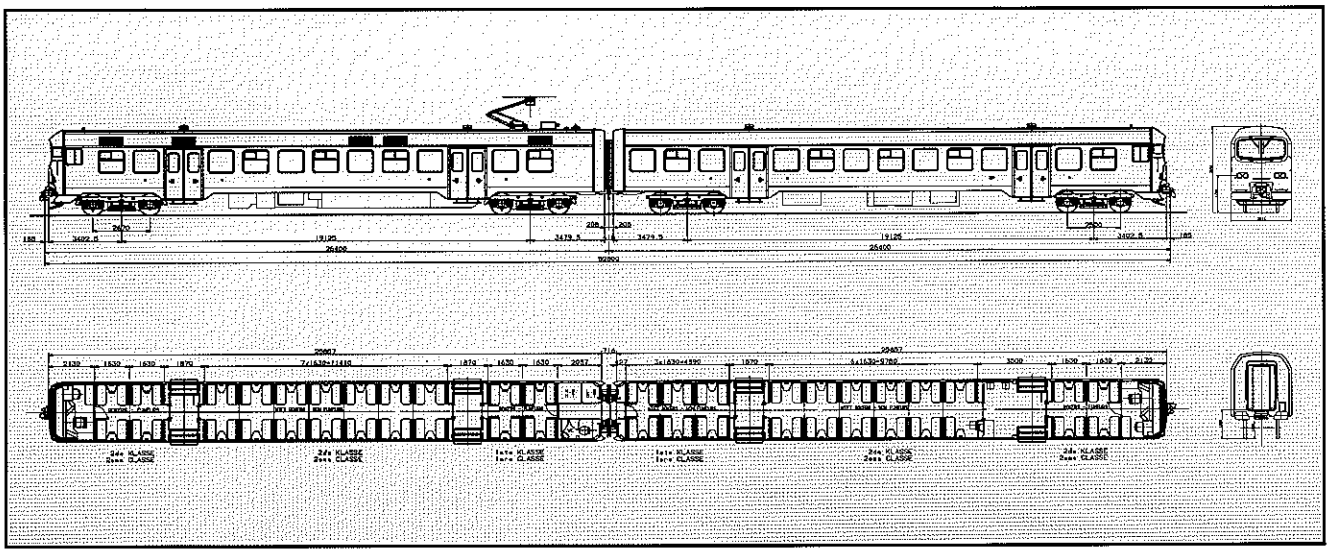
3kV D.C. electric multiple units type AM86

for the Belgian National Railways





TECHNICAL CHARACTERISTICS

TYPE		MOTOR COACH AB	TRAILER ABD
Dimensions			
Overall length	m	26.400	26.400
Overall width	m	2.800	2.800
Height	m	3.960	3.960
Centre distance of trucks	m	19.125	19.125
Height of floor above rail	m	1.265	1.265
Doors : sliding plug door clear width	m	1.300	1.300
Number of seats : 1st Class		16	24
2nd Class		72	63
Total of passengers including standees at 5 pers/m²		118	137
Tare weight	kg	59 000	47400

Coupling : automatic front coupler : GF
between coaches : UIC Standard

Heating and ventilation system :
power 39.6 kW
heating/ventilation 30 renewals/h

Performances :
maximum speed 120 km/h
acceleration at normal load 0.55 m/sec²
deceleration 0.75 m/sec²
motor power (continuous rating) 690 kW

Bogies :
type : motor coach and trailer SCHLIEREN
secundary suspension coil spring
track gauge 1,435 mm
2 motor bogies and 2 trailer bogies
truck wheel base :
motor coach 2,670 mm trailer 2,500 mm
wheel diameter :
motor coach 1,010 mm trailer 1,010 mm

Brake system :
Type : Oerlikon ESt3
Electro-pneumatic friction brake system with 2 disk-brakes per axle.
Disk braking only
disk diameter : motor coach Ø 820 mm
trailer Ø 700 mm
Electronic anti-skid system according to latest UIC specifications.
Air-operated emergency brake.
Parking brake : on one truck per coach.

Electrical motor unit meeting UIC recommendations.
A "one-man car" service is possible (pneumatically operated rear view mirrors installed on both sides of the driver's cab).
Built up from standard modules (passenger or technical compartments).
Accomodation for wheelchairs on one platform.
Application of GRP for outside lining, reducing maintenance and risk of corrosion.
Production of initial order of 35 sets started in 1987, with first delivery in May 1988.
In 1990 production started for another order for 17 sets, to be delivered in 1991-1992 and code-named AM89.

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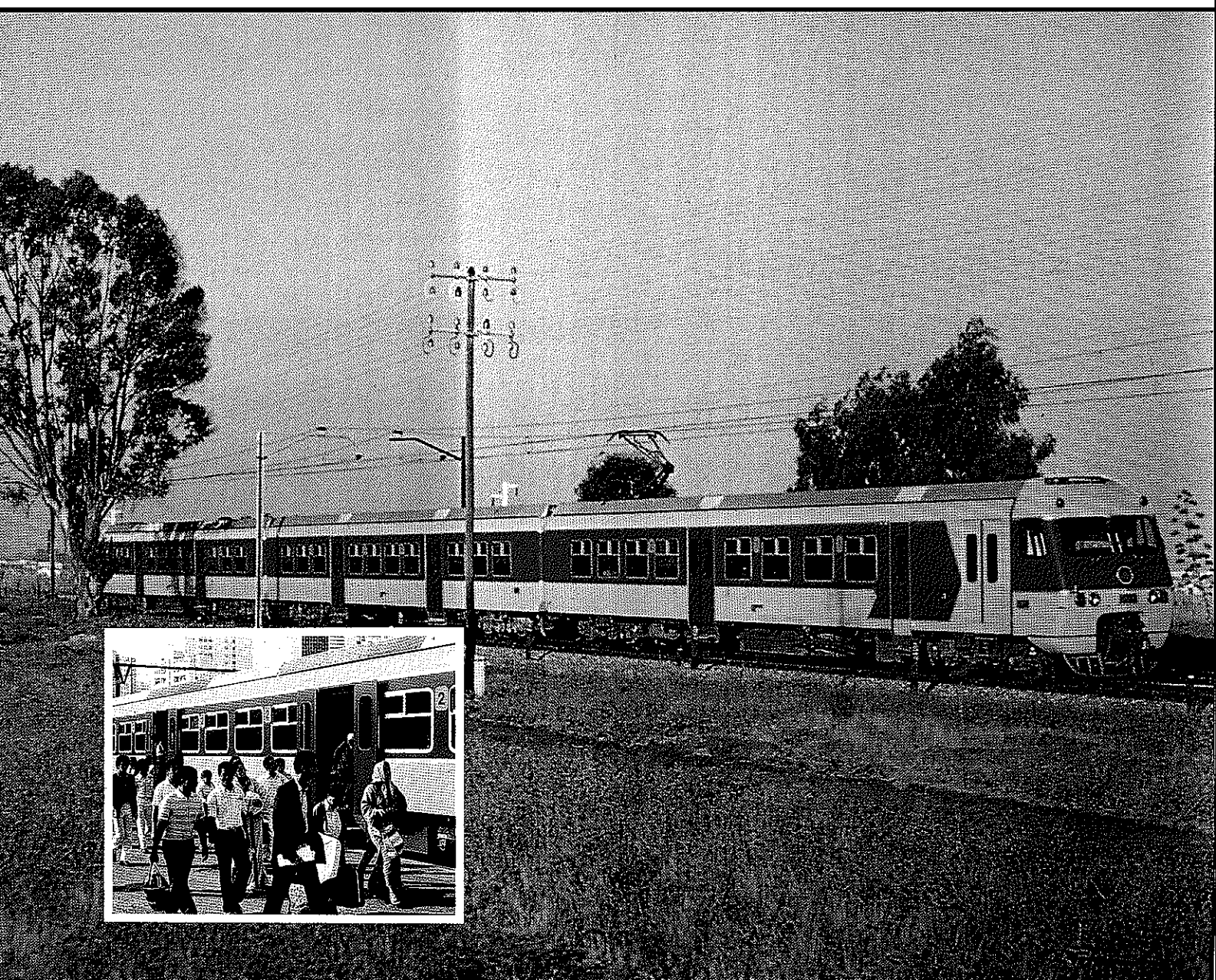
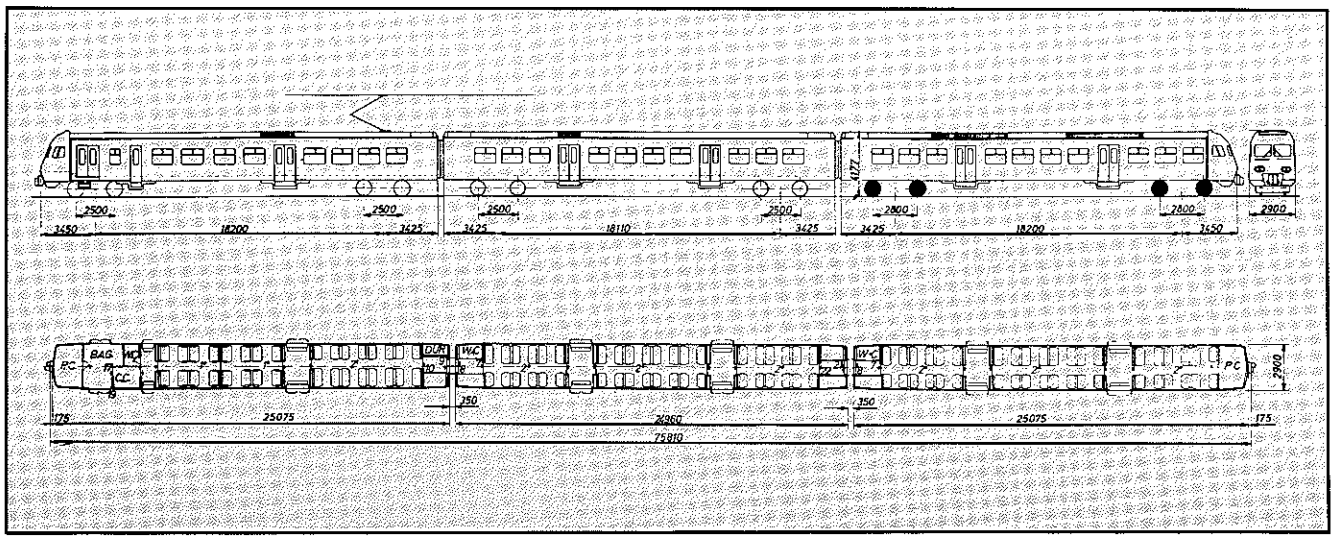
3 kV D.C. Electric Multiple Units with chopper control

for the Moroccan National Railways (ONCF)





Three-car traction unit designed for the ONCF

TECHNICAL CHARACTERISTICS OF THE TRACTION UNIT*

General characteristics

Track gauge	:	1.435 m
Weight, empty	:	145 T
Floor height	:	1.265 m
Length	:	75.810 m
Width	:	2.900 m
Number of seats		
1st class	:	32
2nd class	:	239
Standing passengers		
1st class	:	9
2nd class	:	75
Total passengers	:	355
Outward swinging plug doors		
Opening	:	1.260 m

Safety and comfort

Heating
20 airenewals/hour
Ventilation
40 airenewals/hour
Interphony system
Automatic Train Stop
Automatic coupler

Performance characteristics

Max. service speed	:	160 km/h
Acceleration	:	0.53 m/s²
Deceleration	:	0.75 m/s²
Power	:	1,416 kW

Bogies

WEGMANN WTR type
2 bimotor bogies
4 trailer bogies
Secondary pneumatic suspension

Motors

4 fully suspended motors
Chopper control equipment for regeneration of energy.

Brake equipment

Service braking: electropneumatic
2 disc brakes/axle
1 shoe brake/wheel
Emergency braking: pneumatic

* The traction unit consists of a motorized car with driving-cab, an intermediate trailer car and a trailer car with driving-cab.

Eight three-car units have been ordered by the Moroccan National Railways (ONCF).
These EMU's are operating in trains of 2 traction units (6 cars) on the new electrified line linking Rabat to Casablanca at the speed of 160 km/h.

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COACHES

The earliest rail coaches were built at Famillleureux in 1900 and at Brugge in 1905. They were of wooden construction.

Since then, coaches have witnessed continuous development, and production of the new M4 and RIC coaches is the result of continuous and intensive collaboration between BN and SNCB technical departments.

Similary, the succesful M5 Double-Deck coaches, in production since 1985, are the culmination of very close cooperation between BN and its customers.

WAGONS

The company manufactured its first wagons in 1875, at Manage.

After the Second World War, BN diversified production by constructing special wagons. In the 1950s, the firm introduced a major scheme of rationalization by adopting the continuous assembly-line system known in Brugge as the "Tunnelsyteem". By this method, a single wagon can be completed every 26 minutes!

The number of wagons constructed and exported to all parts of the world runs into tens of thousands, and innovations in this field are still being pursued by the creation of special-purpose wagons.

End 1989, BN - as member of the Euroshuttle Consortium - obtained the contract for the delivery as from 1992 of 126 special shuttle wagons of the single deck "Tourism" design, measuring 25 x 4.5 x 5.6 m. The body shells are made of stainless steel.

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BOMBARDIER BN

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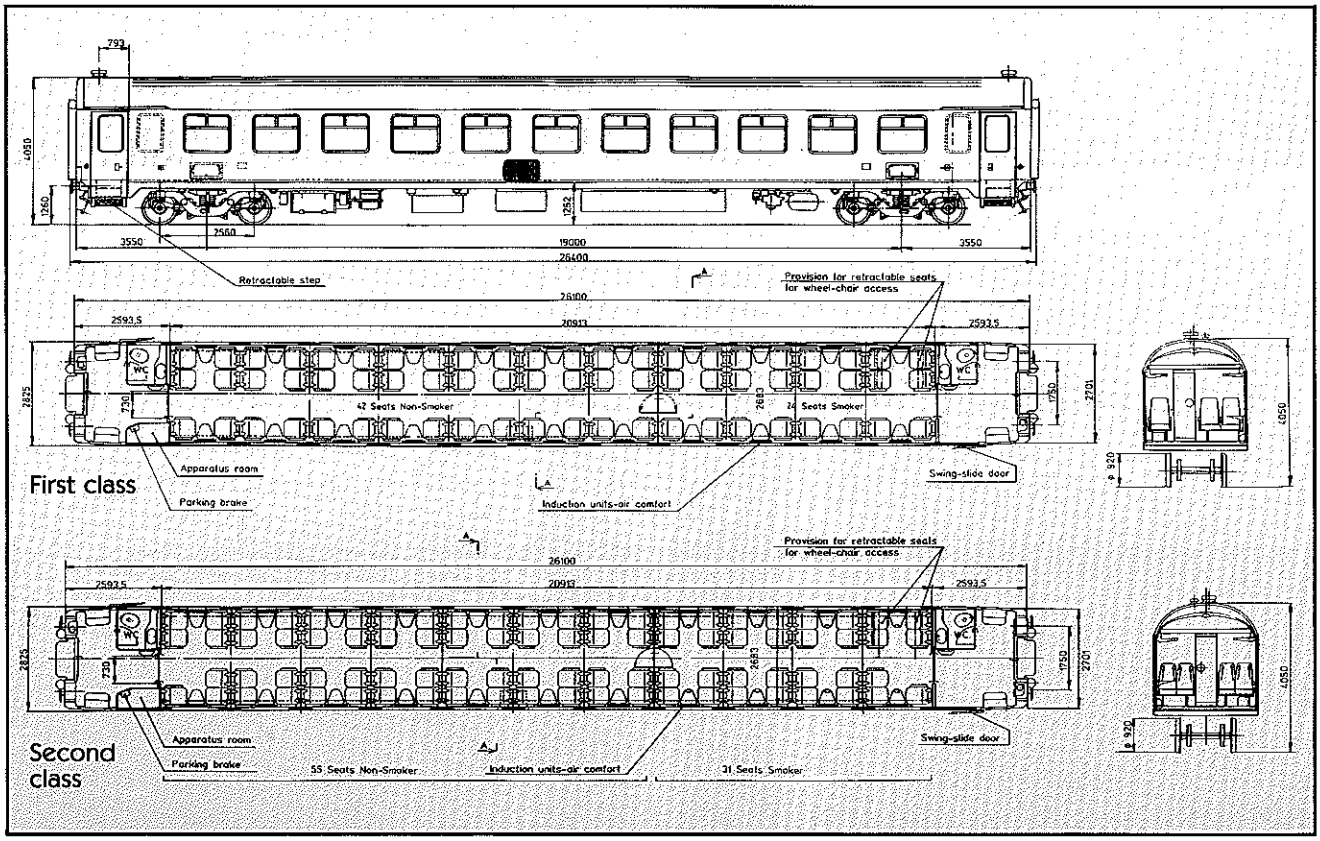
International Passenger Coaches type RIC



TYPE Kinematic gauge UIC 505		A 1st class	B 2nd class
Overall length	m	26.400	26.400
Overall width	m	2.825	2.825
Height	m	4.040	4.050
Bogie pivot pitch	m	19.000	19.000
Bogie wheel base	m	2.560	2.560
Height floor above rail	m	1.250	1.250
Swing slide doors: clear width	mm	800	800
Number of seats		66	86
Tare weight	t	41	41/42.6*
Power convertor	kW	11.4	11.4/35*
Power supply: as per RIC regulations			
Heating and ventilation system	kW	39.6	39.6
Airconditioning	kW		35*

* Coaches with airconditioning

Max. speed		160 km/h
Max. speed with adapted brake system		200 km/h
BOGIE		
– type		FIAT 0270
– secundary suspension		coil spring
– disc brake	mm	Ø 610
Wheel diameter new/worn	mm	920/870
Wheel type		monobloc
Track gauge	mm	1435
Brake		disc brake

BRAKE EQUIPMENT

- electro-pneumatic friction brake system with 2 disc-brakes per axle
- electronic anti-skid system according to latest UIC specifications
- air operated emergency brake
- parking brake on one truck per coach .
- brake system KE2d/SL/DE-EPZ6

- Saloon coach with bi-directional seating arrangement.
- Coaches in accordance with UIC and RIC prescriptions.
- All lining materials comply with SNCB, SNCF, UIC requirements concerning inflammability.
- Accomodation for wheelchairs in compartment.

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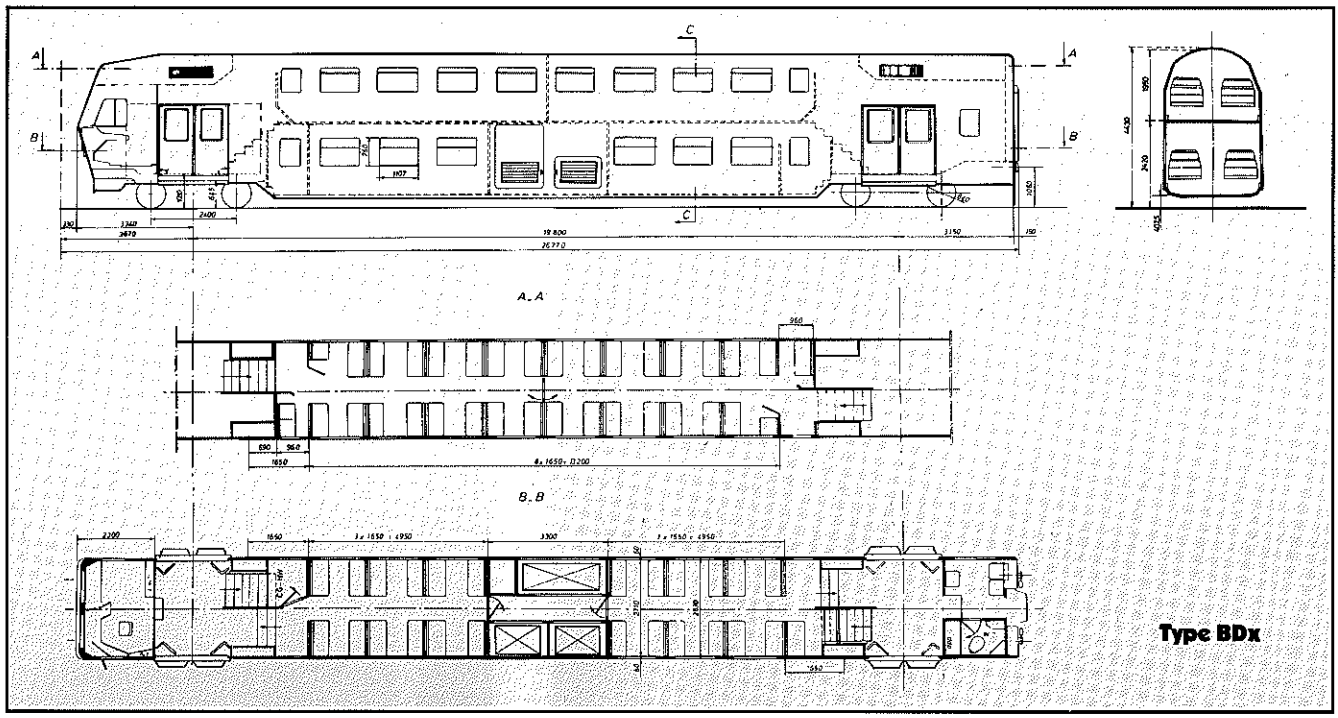
FORMERLY **LA BRUGEOISE ET NIVELLES-BELGIUM**

Double-Deck Passenger Coaches Type M 5



Type BDx

TYPE		BDx 2nd clas with driver's cab	B 2nd clas	A 1st class
Overall length	m	26.770	26.400	26.400
Overall width	m	2.830	2.830	2.830
Height	m	4.430	4.430	4.430
Centre distance of trucks	m	19.800	19.800	19.800
Truck wheel base	m	2.500	2.500	2.500
Wheel diameter	mm	840	840	840
Height of floor above rail				
– lower level	m	0.405	0.405	0.405
– upper level	m	2.423	2.423	2.423
– door treshold	m	1.050	1.050	1.050
Height under ceiling				
– lower compartment	m	1.953	1.953	1.953
– upper compartment	m	1.950	1.950	1.950
Swing plug doors : width	m	1.800	1.800	1.800
Number of seats		121	146	142
Number of seated passengers and standees (5 p/m²)		330	370	360
Tare weight	T	49	44	45

Max. speed	140 km/h
Track gauge	1,435 mm
Power converter ACEC	65 kVA
Line voltage (in-out)	3,000 V d.c./380 V a.c. 24 V d.c.
Brake system	Oerlikon ESt3f
Disc brakes	Ø 640 mm

TRUCKS

– type : Y 36 P
– secondary air suspension

Brake equipment

– electro-pneumatic friction brake system with 2 disc-brakes per axle
– variable load system controls brake cylinder pressure
– electronic anti-skid system according to latest UIC specs
– air operated emergency brake
– parking brake on one truck per coach

DESIGN-COMFORT-SAFETY

New generation of double-deck coaches for the Belgian Railways.
The lower compartment of the BDx coach includes two enclosed technical cabinets and a compartment for the guard. The ergonomically designed driver's cab at the end of he BDx coach is equipped with energy absorbers and a 3-layer laminated safety-windshield.
All internal materials comply with S.N.C.B., S.N.C.F.,- requirements concerning inflammability.
Technical cabinets are made of fire retardant materials.
Exterior doors are outside swinging plug doors with a width of 1.800 m.
Aircomfort system : – heating installation with 20 renewals per hour
(recirculation of air when heating up the car or by very cold weather)
– ventilation with 40 renewals per hour during summer.

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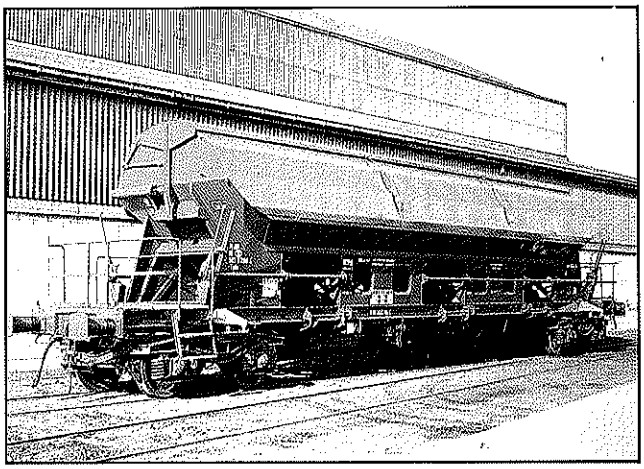
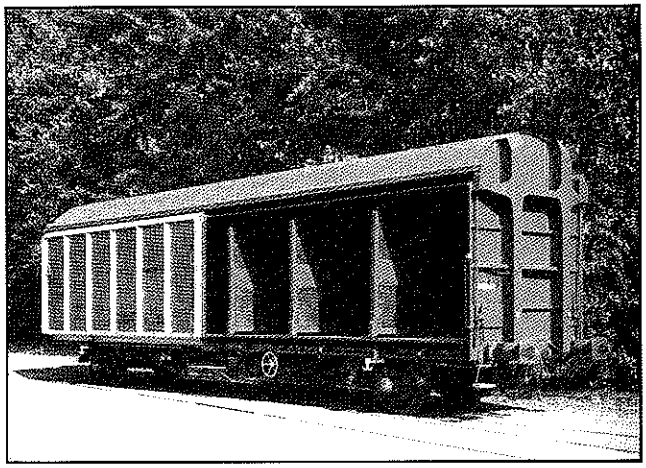
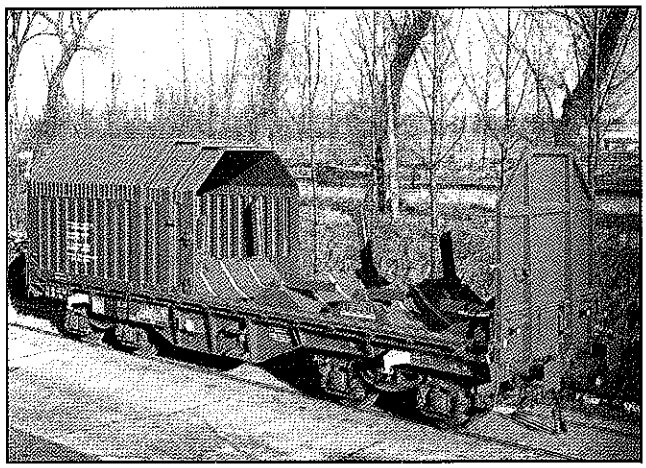
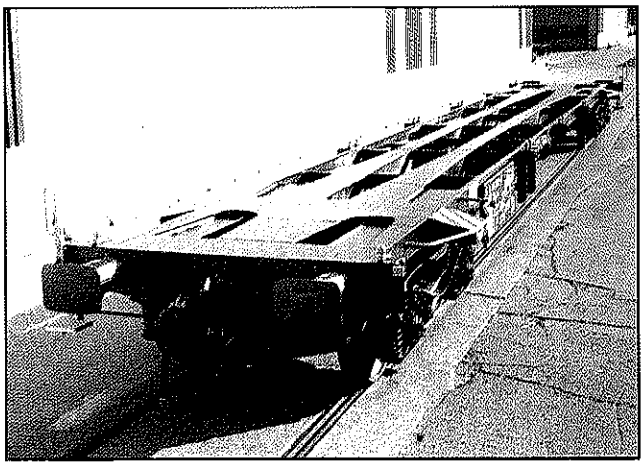
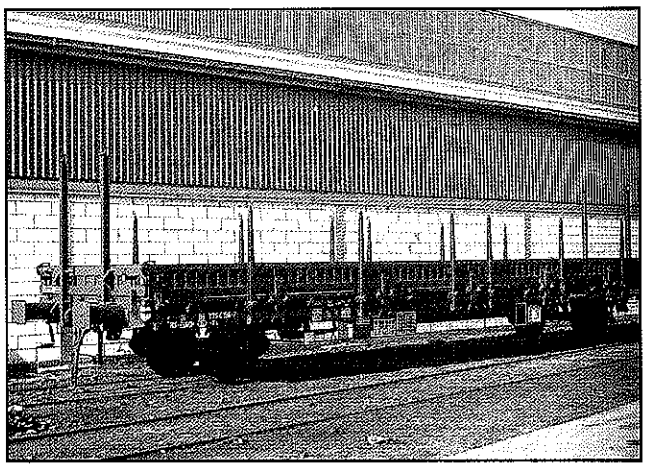
FORMERLY **LA BRUGEOISE ET NIVELLES**











1	2
3	4
5	6

1 – Self-discharging wagon with lateral sliding roof type Tadgs for Deutsche Reichsbahn - GDR
2 – Freight wagon with sliding sides type Hbikks for S.N.C.B. (Belgian Railways)
3 – Hopper wagon type Fals for C.F.L. (Luxemburger Railways)
4 – Coil wagon type Shimms for S.N.C.B. (Belgian Railways)
5 – Container wagon type Sgss for N.S. (Dutch Railways)
6 – Bogie drop sided flat wagon type Rmns for S.N.C.B. (Belgian Railways)

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