

# **ATM Milan Trolleybuses**

## **Main Features and Experiences**

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## **Urban Lines of Trolleybuses**

### **The Fleet**

### **State of the Art Features of Trolleybuses**

### **Trolleybuses Vs. Buses: Strong Points**

### **Trolleybuses Vs. Buses: Weaknesses**

# Urban Lines of Trolleybuses

➔ **Lines 90 – 91**  
21,115 km  
(69 % independent way)

➔ **Line 92**  
10,800 km  
(33 % independent way)

➔ **Line 93**  
8,800 km  
(7 % independent way)



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# The Fleet - SOCIMI 8820 - 12 m

Units: 35

Years of construction 1983 - 1985



➔ Seats	20	➔ Tare weight [kg]	11.450	➔ ANSALDO rheostatic traction system with static control logic
➔ Standing room	80	➔ Full-load weight [kg]	18.250	➔ Engine hourly power: 120 kW
➔ Total places	100	➔ Payload [kg]	6.800	➔ Stand-alone driving by means of batteries

# The Fleet - SOCIMI 8843 – 18 m

Units: 32

Years of construction 1992 - 1995



➔ Seats	30	➔ Tare weight	[kg]	17.950	➔ AEG full chopper traction system with GTO
➔ Standing room	126	➔ Full-load weight	[kg]	28.537	➔ Engine hourly power: 194 kW
➔ Total places	156	➔ Payload	[kg]	10.587	➔ Stand-alone driving by means of batteries
					➔ TELMA electric braking system



# The Fleet - BREDABUS F04 – 18 m

Units: 30

Years of construction 1992 - 1994



➔ Seats	30	➔ Tare weight	[kg]	18.968	➔ ABB full chopper traction system with GTO
➔ Standing room	122	➔ Full-load weight	[kg]	29.306	➔ Engine hourly power: 186 kW
➔ Total places	152	➔ Payload	[kg]	10.338	➔ Stand-alone driving by means of batteries
					➔ TELMA electric braking system

# The Fleet - CAM Busotto MAN NGT 204F - 18 m

Units: 8

Years of construction 1999 - 2001



➔ Seats	31	➔ Tare weight	[kg]	19.240	➔ KIEPE inverter traction system with IGBT
➔ Standing room	102	➔ Full-load weight	[kg]	29.070	➔ Engine hourly power: 260 kW
➔ Wheelchair place	1	➔ Payload	[kg]	9.830	➔ Stand-alone driving by means of a 60 kW motor generator
➔ Total places	134				➔ Rheostatic braking system
					➔ Air-conditioning of both passenger compartment and driving seat
					➔ Electric wheelchair ramp



# The Fleet - IRISBUS CRISTALIS – 18m

Units: 10

Years of construction 2005 - 2006



➔ Seats	30	➔ Tare weight	[kg]	20.400	➔ ALSTOM traction system with 4 ONIX 350 inverters
➔ Standing room	101	➔ Full-load weight	[kg]	29.376	➔ 4 driving wheels, each one with a 60 kW hourly power engine
➔ Wheelchair place	1	➔ Payload	[kg]	8.976	➔ Stand-alone driving by means of a 65 kW diesel auxiliary generator
➔ Total places	132				➔ Rheostatic braking system
					➔ Air-conditioning of both passenger compartment and driving seat
					➔ Electric wheelchair ramp

# The Fleet - VAN HOOL AG300T – 18m

Units: 30

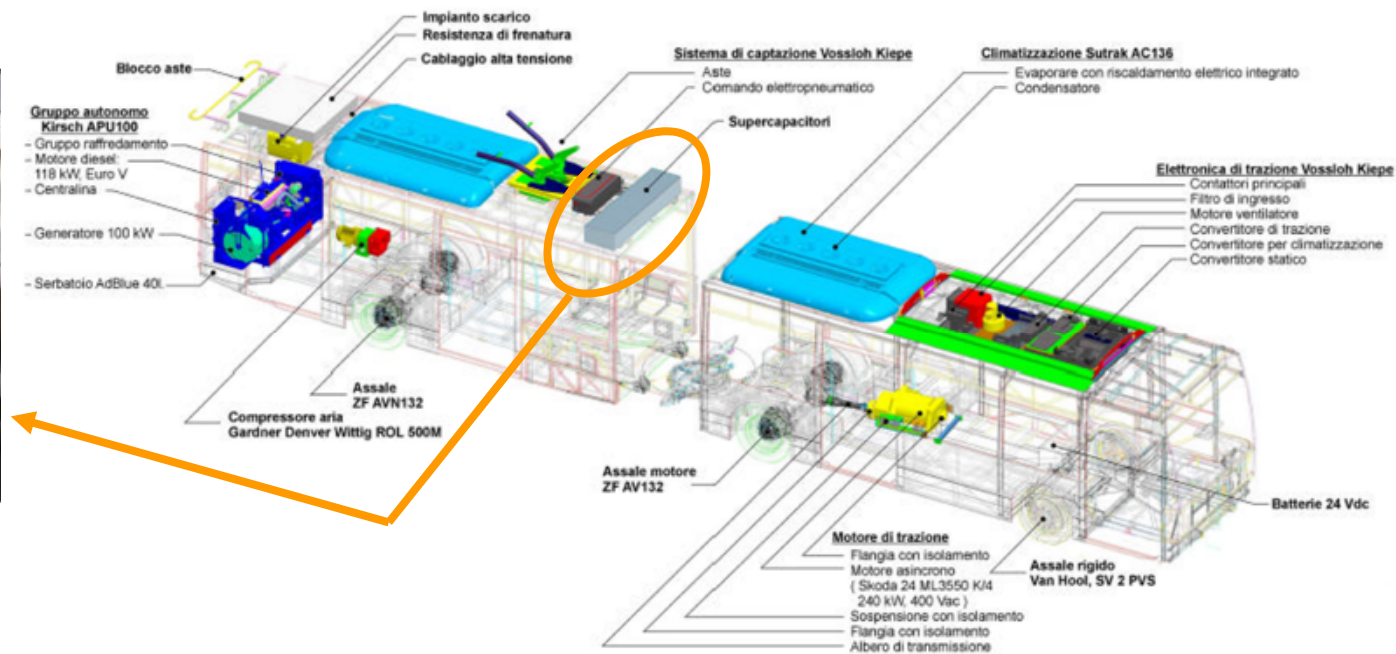
Year of construction 2009



➔ Seats	31	➔ Tare weight	[kg]	19.700	➔ VOSSLOH KIEPE inverter traction system with IGBT
➔ Standing room	120	➔ Full-load weight	[kg]	29.975	➔ Engine hourly power: 240 kW
➔ Wheelchair place	1	➔ Payload	[kg]	10.275	➔ Stand-alone driving by means of a 100 kW diesel auxiliary generator
➔ Total places	152				➔ Regenerative braking system
					➔ Supercapacitors for braking energy recuperation
					➔ Air-conditioning of both passenger compartment and driving seat
					➔ Manual wheelchair ramp

# The Fleet - VAN HOOL AG300T – 18m

- ➔ 2 modules, each one with 76 high capacity, double layer capacitors (total weight ~ 300 kg)
- ➔ the capacitors are linked in order to supply a variable tension / capacity (series / parallel sequences)



# The Fleet – Energy Consumption Comparison

<b>VEHICLES</b>	<b>TOTAL PLACES</b>	<b>LENGTH [m]</b>	<b>TARE WEIGHT [kg]</b>	<b>TARE ENERGY CONSUMPTION [kWh/km]</b>	<b>FULL - LOAD ENERGY CONSUMPTION [kWh/km]</b>
<b>SOCIMI 8820 (901-970)</b>	<b>100</b>	<b>12</b>	<b>11.450</b>	<b>1,27</b>	<b>2,03</b>
<b>SOCIMI 8843 (100-132)</b>	<b>156</b>	<b>18</b>	<b>17.950</b>	<b>3,17</b>	<b>5,04</b>
<b>BREDABUS F04 (200-232)</b>	<b>152</b>	<b>18</b>	<b>18.968</b>	<b>3,19</b>	<b>4,93</b>
<b>CAM Busotto (300-308)</b>	<b>134</b>	<b>18</b>	<b>19.240</b>	<b>3,12</b>	<b>4,81</b>
<b>Irisbus Cristalis (400-409)</b>	<b>132</b>	<b>18</b>	<b>20.400</b>	<b>3,98</b>	<b>5,73</b>
<b>Van Hool AG300T (with Supercapacitors)</b>	<b>152</b>	<b>18</b>	<b>19.700</b>	<b>2,64</b>	<b>4,02</b>

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# State of the Art Features of Trolleybuses

- ➔ Low floor passenger car
- ➔ Inverter traction system with IGBT
- ➔ Supercapacitors
  - braking energy recuperation
  - continuous equipment supplying (i.e. air conditioning on a switch)
- ➔ Stand-alone driving by means of a diesel motor generator
- ➔ Air-conditioning of passenger compartment and of driving seat
- ➔ Wheelchair ramp with kneeling
- ➔ Predictive integrated diagnostic system
- ➔ Video surveillance system

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# Trolleybuses Vs. Buses: Strong Points

- ➔ Ecological impact toward the city due to absence of polluting emissions
- ➔ Lower noise and vibrations
- ➔ Possibility of braking energy recuperation (about 25 % of energy saving)
- ➔ Longer technical life (about 20 years)

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# Trolleybuses Vs. Buses: Weaknesses

- ➔ Lower lines flexibility
- ➔ Higher life cycle cost
  - purchasing cost (up to 2 times with respect to a bus)
  - vehicle and infrastructure maintenance
  - electric energy (with respect to diesel oil, per km)
- ➔ Higher vehicle failures incidence  
(more failure occurrences, each one with a higher cost)
- ➔ Negative visual effect of aerial electric line