FLEXX ECO BOGIE – ECOACTIVE TECHNOLOGIES

M - SIZE BOGIES

The BOMBARDIER® FLEXX® Eco bogie is optimised to reduce track damage, minimize weight (30% reduction in total bogie mass) and reduce maintenance costs. In addition, the FLEXX Eco design enables significant reductions in energy consumption and noise.

The FLEXX Eco bogie has been developed to satisfy market requirements, driven by life cycle cost and environmental considerations. The success of the design depended on a fundamental rethink of the conventional bogie layout, whilst still retaining and improving on the overall safety and performance that is expected from a modern bogie design.

The overall design simplicity combined with the inboard bearing wheelset concept is fundamental to the success of the bogie. This has resulted in a compact, lightweight and robust bogie design.

The FLEXX Eco bogie is already successfully operating in the UK under the Voyager, Meridian & Turbostar trains, and in Norway for Norwegian Railways (NSB). Currently being manufactured for new Bombardier trains: AVENTRA trains for Crossrail, MOVIA C30 metros for Stockholm (Sweden) and INNOVIA metros for Riyadh (Kingdom of Saudi Arabia). A higher speed higher axle load variant is also in production for ICE4** trains in Germany.

With almost 1,000 units in operation worldwide, the reliability and operational benefits of the FLEXX Eco have been proven. The excellent stability properties allow its use not only for commuter and regional applications but also for high speed.

**MITRAC DR 1320 for INNOVIA 300 Metro**
- Open self-ventilated for high performance in hot climate
- Sand protected motor and gearbox sealing concept to prevent ingress of abrasive sand
- Easy to maintain and efficient sand filter concept to allow high cooling air flow with minimum particle content.
- Efficient and robust 1-stage gearbox

**MITRAC DR 1520 W for AVENTRA**
- Highly compact and performance dense drive due to forced ventilation cooling
- Low noise emission and fully TSI compliant
- Extremely robust with few components and die-cast rotor instead of conventional fabricated rotor
- Low overall maintenance cost with long over haul intervals
- Use of advanced bearing, insulation and grounding concept to prevent premature failure generated by stray currents
- Efficient and robust 1-stage gearbox

**MITRAC DR 1820 W for MOVIA C30 Stockholm**
- Closed self-ventilated for low noise emission and ability to operate in very dirty and dusty environments
- Very compact design
- Noise optimised
- Optimised life cycle costs with focus on low energy consumption and low overall maintenance cost with longer overhaul intervals
- Use of advanced bearing, insulation and grounding concept to prevent pre-mature failure generated by stray currents
- Efficient and robust 1-stage gearbox

**Technical data:**
- **Traction motor:** MITRAC TM 1300
  - Rated power: 145 kW
  - Rated voltage: 750-1000 V
  - Rated torque: 578 Nm
  - Maximum motor speed: 5000 rpm
  - Open self-ventilated
  - Motor weight: 486 kg
  - Insulation class: C/200
- **Traction gear unit:**
  - Gear unit reductions: 1-stage
  - Gear ratio: 5.57, 6.105 & 7.235

**Technical data:**
- **Traction motor:** MITRAC TM 1520AF
  - Rated power: 265 kW
  - Rated voltage: 900 V (DC Link)
  - Rated torque: 1004 Nm
  - Maximum motor speed: 5393 rpm
  - Ventilation type: Open forced-ventilated
  - Motor weight: 605 kg
  - Insulation class: C/200
- **Traction gear unit:** MITRAC GB 1520PS
  - Gear unit reductions: 1-stage
  - Gear ratio: 4.783 & 5.29

**Technical data:**
- **Traction motor:** MITRAC TM 1820AS
  - Rated power: 170 kW
  - Rated voltage: 465 V
  - Rated torque: 650 Nm
  - Maximum motor speed: 4590 rpm
  - Ventilation type: Closed self-ventilated
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**BOGIES AND PROPULSION**

**AVENTRA for Crossrail (UK), equipped with FLEXX Eco bogie**

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Major benefits of the FLEXX Eco bogie

- **Train weight reduction**
  - 30% reduction in bogie mass compared with conventional bogie
  - 25% reduction in unsprung mass

- **Track friendliness**
  - Reduced track damage due to reduced unsprung wheelset mass
  - Reduced rail wear due to better curving performance
  - Reduced risk of rail RCF damage

- **Optimised total cost of ownership**
  - Reduced track access charge
  - Reduced energy consumption
  - Reduced bogie maintenance
  - Reduced aerodynamic drag

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**FLEXX Eco bogie vs conventional bogie**

<table>
<thead>
<tr>
<th>Category</th>
<th>Technical background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>The integrated design of FLEXX Eco bogie with inboard bearing and short wheelbase results in:</td>
</tr>
<tr>
<td></td>
<td>- Low weight frame (reduced transom length)</td>
</tr>
<tr>
<td></td>
<td>- Low weight wheelset (reduced stress level on axle, hollow shaft axle, small wheel diameter)</td>
</tr>
<tr>
<td>Unsprung mass</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>6,8t 70%</td>
</tr>
<tr>
<td></td>
<td>4,6t 60%</td>
</tr>
<tr>
<td>Space required</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>3,8t 25%</td>
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<tr>
<td></td>
<td>2,7t 25%</td>
</tr>
<tr>
<td>Life cycle costs</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>6,8t 70%</td>
</tr>
<tr>
<td></td>
<td>4,6t 70%</td>
</tr>
<tr>
<td>Track access charges</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>6,8t 83%</td>
</tr>
<tr>
<td></td>
<td>4,6t 83%</td>
</tr>
</tbody>
</table>

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**ECO4** – Energy, Efficiency, Economy, Ecology: The FLEXX Eco bogie forms part of Bombardier’s ECO4* environmentally friendly technologies. Addressing the growing challenges among operators to reduce energy consumption, improve efficiency, protect the Ecology while making sense economically, ECO4 is the concrete validation of Bombardier’s declaration – *The Climate is Right for Trains*. The MITRAC drives portfolio embraces three-phase asynchronous motors with aluminum or copper rotor and synchronous motors with permanent magnet rotor as well as different cooling types. All drives are available for single axle or group converter topologies. Furthermore, single or multi-stage gearboxes for fully, partly, nose or wagon-wheel suspended drives can be applied.

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**MOVIA C30 for Stockholm (SE), equipped with FLEXX and MITRAC technology**

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**Wagon-wheel suspended drives**
The wagon-wheel suspended drive family features a highly compact and modular drive design, which is tailored for integration into the FLEXX Eco bogie or narrow gauge applications in the medium power propulsion range.

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**Fully suspended drives**
This sophisticated concept features the lowest unsprung mass and facilitates high speed and performance combined with low track wear.

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**Partly suspended drives**
This design has a low unsprung mass, which enables high speed with low track wear. The single reduction gear unit requires a lower upfront investment than any other system.

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**Nose-suspended drives**
This robust, basic design is geared to meet demanding service and maintenance needs, it generates hightractive output at low speed and is ideal for heavy-haul service.