Advanced Magnetic Materials and their Applications 2007

Permanent magnet motors in elevator applications
### KONE Key Figures 2006

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>EUR 3,601 million</td>
</tr>
<tr>
<td>Operating income</td>
<td>EUR 360 million</td>
</tr>
<tr>
<td>Order intake</td>
<td>EUR 3,116 million</td>
</tr>
<tr>
<td>Personnel</td>
<td>29,000</td>
</tr>
<tr>
<td>Market capitalization</td>
<td>EUR 5,382 million</td>
</tr>
<tr>
<td>Share holder base</td>
<td>approx. 14,000</td>
</tr>
</tbody>
</table>

- KONE delivers 40,000 new elevators and escalators per year
- Approx. 600,000 elevators and escalators under maintenance contract
Market Shares 2003

Based on publicly disclosed sales figures and analysts’ estimates
Elevator technology evolution
OTIS Sky Linear
KONE MonoSpace™
Linear Induction Motor

Normal rotor

Linear motor

Curl Linear motor

OTIS LIM

Uncurl rotor

KONE Ecodisc
Kone Technology

Selected technology (reasoning)

• Permanent magnets (space requirement, efficiency)
• Sintered NdFeB magnets (feasible cost, temperature & energy product)
• Magnet shape optimized for (good ride quality, small torque ripple & noise)
• Axial flux synchronous motors (space & manufacturing easiness& no existing manufacturing for radial flux machines)

Technology co-operation
• HUT, LUT, VTT, TUT, Magnet Technology Center
KONE EcoDisc® – the money-saver

The revolutionary EcoDisc® weighs less than half of a conventional geared traction machine, has only one moving part, and is roughly twice as efficient.

EcoDisc® efficiency is three times that of a hydraulic power unit and it uses 60% less energy – a saving which can represent half or more of the annual cost of elevator maintenance.

Comparing the EcoDisc® with typical conventional hydraulic and 2-speed traction elevators confirms clear technological advantages:

<table>
<thead>
<tr>
<th>Item</th>
<th>Hydraulic</th>
<th>Traction</th>
<th>EcoDisc®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (m/s)</td>
<td>0.63</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Load (kg)</td>
<td>630</td>
<td>630</td>
<td>630</td>
</tr>
<tr>
<td>Motor size (kW)</td>
<td>11</td>
<td>5.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Main fuse size (A)</td>
<td>50</td>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>Energy consumption (kWh/y)</td>
<td>7200</td>
<td>5000</td>
<td>3000</td>
</tr>
<tr>
<td>Thermal losses (kW) *)</td>
<td>3.8</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Oil requirements (l)</td>
<td>200</td>
<td>3.5</td>
<td>0</td>
</tr>
<tr>
<td>Weight (kg) **)</td>
<td>650</td>
<td>430</td>
<td>230</td>
</tr>
<tr>
<td>Typical noise level (dbA) ***</td>
<td>65-70</td>
<td>65-75</td>
<td>50-55</td>
</tr>
<tr>
<td>Typical machine-room (m³)</td>
<td>5</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>
Single EcoDisc™ Construction

• “Rotational Linear Motor” combined with synchronous axial motor technology.

• NeFeB permanent magnets.

• Machine sizes MX05, MX06, MX10, MX20 for MonoSpace™
Elevator technology evolution

- **In big motors, increasing the diameter of the stator results in uneconomical construction.**

- **It is better to use two motors on both sides of the traction sheave.**

- **Machine sizes MX32, MX40, MX100 for high rise buildings.**
KONE MonoSpace® The most celebrated elevator innovation of modern times

1996  Announced to world press
1996  Wins Grand Prix at Building Fair, Prague
1997  Wins the Grand Prix ‘97 at CONECO Fair, Bratislava, Slovakia
1997  Wins Top Prize for Innovation at SAIE ´97 Fair, Bologna
1997  Wins Grand Prize for Innovation at Batimat Fair, Paris
1998  Wins Electrical Industry’s (SET) Annual Award, Finland
1999  Chosen for “Eyecatcher”, a Swissbau showcase green building, Switzerland
KONE MonoSpace® The most celebrated elevator innovation of modern times

- 1999 Wins NOVA Award for Construction Innovation, Detroit, USA
- 1999 Wins the Construmat 1999 Prize for Innovative Technology, Barcelona, Spain
- 1999 Wins Top Prize for Innovation, Baucon Fair, Singapore
- 2000 Wins Nikkei Outstanding Quality Products and Services Award, Japan (Nihon Keizai Shimbun group of economic newspapers)
- 2000 Chosen for Thermo-Staete, Netherland´s most energy-efficient office building
- 2000 Recommended Product for Engineering Construction, China Engineering Construction Association, China
- 2002 Chosen for ‘Product of the Year’, British Lift Industry Awards, UK
- 2003 Wins ‘Best Innovation’ Award at Building Specialist Contractor Awards by Building Magazine, UK
- 2003 Awarded the ‘Premio Quatrum for Innovative Solutions’ by Via Inmobiliaria, Spain
KONE INNOTrack™

- Surface mounted, no pit required
- Architectural freedom
- Easier installation
- A flat and light construction
- Green drive technology
- Decorative pallets
- Flexibility of use
- Reusability
- Solves difficult transportation problems

More than 20 patents protect the innovations in KONE InnoTrack™.
KONE EcoDisc®

- The elevator invention of the 20th century
- Ensures a smooth ride, accurate stopping and reliable operation of the elevator
- Replaces several different solutions: featured in both machine-room-less applications and elevators with machine rooms.
- KONE is the only elevator company that can offer consistent technology to all types of buildings (low, mid and high)
Technology Impact

Consistent technology for all buildings

- A new industry standard replacing several different solutions

  Powered by KONE EcoDisc®

- KONE MonoSpace® for low rise
- KONE MiniSpace™ for mid range
- KONE Alta™ for high rise
- KONE TranSys™ for freight
**KONE MonoSpace®**

- The elevator invention of the 20th century
- Winner of many prestigious awards from around the world

**Add value for customers:**
- Easier building design and improved aesthetics
- Lower construction costs
- Space savings
- Lower energy and life-time costs
  - Greater building quality and
  - comfort
• KONE MiniSpace™ elevators feature the space-saving KONE EcoDisc® hoisting machine above the shaft
• Particularly suitable for medium to high-rise buildings
- KONE TransSys™ freight elevators use machine-room-less technology
- Especially suited for low-rise buildings
- Elevator stops accurately at landing, which facilitates the loading and unloading of heavy goods
MX 05 Hoisting Machinery

- Power 2.8 kW
- Nominal torq. 240 Nm
- Weight 180 Kg
- Width 730 mm
- Height 810 mm
- Axial length 230 mm
- Lift applications:
  - 2:1, 480 kg, 1 m/s
MX 06 Hoisting Machinery

- Power 3.6 kW
- Nominal torq. 370 Nm
- Weight 260 Kg
- Width 930 mm
- Height 890 mm
- Axial length 260 mm
- Lift applications:
  - 2:1, 630 kg 1 m/s 630 kg 1.75 m/s
MX 10 Hoisting Machinery

- Power 13.3 kW
- Nominal torq. 800 Nm
- Acc torq. 1400 Nm
- Weight 370 Kg
- Width 1070 mm
- Height 990 mm
- Axial length 280 mm
- Lift applications:
  - 2:1, 1000 kg 1.0 m/s
  - 1000 kg 1.6 m/s
  - 1150 kg 0.75 m/s
  - 1150 kg 2.0 m/s
  - 4:1, 2000 Kg 0.5 m/s
MX 18 Hoisting Machinery

- Power 36.0 kW
- Nominal torq. 1850 Nm
- Acc. torque 3800 Nm
- Weight 800 Kg
- Width 1060 mm
- Height 1170 mm
- Axial length 630 mm

Lift applications:
- 1:1, 1000 kg 3.5 m/s
- 2:1, 2050/1600 kg 3.5 / 4.0 m/s
- 4:1, 3700 kg 1.75 m/s

Shaft load 75kN
MX 20 Hoisting Machinery

- Power 34 kW
- Nominal torq. 1800 Nm
- Acc. torque 3800 Nm
- Weight 780 Kg
- Width 1350 mm
- Height 1290 mm
- Axial length 330 mm
- Lift applications:
  - 2:1/ED60  2050 kg  2.5 m/s
  - 1600 kg  3.0 m/s
  - 2:1/ED40  2500 kg  1.0 m/s
  - 2275 kg  1.75 m/s
  - 4:1/ED60  4000 kg  1.0 m/s
  - 3200 kg  1.6 m/s
  - 4:1/ED40  4500 kg  1.0 m/s
- Shaft Load  50 kN
MX 32 Hoisting Machinery

- Power 71.0 kW (S1 96 kW)
- Nominal torq. 3800 Nm
- Max. torque 9000 Nm
- Weight 1750 Kg
- Width 1280 mm
- Height 1360 mm
- Axial length 1130 mm
- Lift applications:
  - 1:1, 1600 kg 6.0 m/s
  - 2:1, 3200 kg 4.0 m/s
  - 4:1, 6400 kg 1.75 m/s
- Shaftload 148 kN
MX 40 Hoisting Machinery

- Power 90 kW (S1 121 kW)
- Nominal torq. 6200 Nm
- Max. torque 19000 Nm
- Eight 2700 Kg
- Width 1580 mm
- Height 1530 mm
- Axial length 1240 mm

Lift applications:

- 1:1, 2250/2050 kg 6.0 / 8.0 m/s
- 1:1, 4500/4000 kg 3.0 / 4.0 m/s
- 1:1, 9000/8000 kg 1.6 / 2.0 m/s

Shaft Load 220 kN
MX 100 Hoisting Machinery

- Power 250 kW (S1 330 kW)
- Nominal torq. 16000 Nm
- Max. torque 50000 Nm
- Weight 6150 Kg
- Width 1860 mm
- Height 2100 mm
- Axial length 1800 mm

Lift applications:
- 1:1, 4500 kg 10 m/s
- 2:1, 10000 kg 4.0 m/s
- 4:1, 18000 kg 1.75 m/s

Shaft Load 500kN
GMX1

- Power 6.5 kW
- Nominal torq. 81 Nm
- Weight 81 kg
- Width 564 mm
- Height 476 mm
- Axial length 186 mm
- Lift applications:
  - without counterweight
    - 10:1, 0.63 m/s 800 kg
    - 6:1, 1.0 m/s 480 kg
  - with counterweight
    - 4:1, 1.6 m/s 630 kg