Manufacturing Technology and Actual Exports of Main Forging Product for Wind Turbine
## 1. Company Profile

<table>
<thead>
<tr>
<th>Section</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CEO</strong></td>
<td>Yong Do Huh</td>
</tr>
<tr>
<td><strong>Foundation</strong></td>
<td>16 May, 1981</td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td>Open-die Forging</td>
</tr>
<tr>
<td><strong>Capital</strong></td>
<td>KRW 8.3 billion</td>
</tr>
<tr>
<td><strong>Sales</strong></td>
<td>KRW 347 billion (2010)</td>
</tr>
<tr>
<td><strong>Employee</strong></td>
<td>320</td>
</tr>
<tr>
<td><strong>Head Office</strong></td>
<td>Songjeong-dong, Gangseo-gu, Busan, Korea</td>
</tr>
</tbody>
</table>

- **1981.05** | Establishment of Taewoong Forging Co.
- **1985.03** | Register approval by Shipping Classes (KR,LR,DNV,GL,NK,BV,ABS,RINA etc.)
- **1987.06** | Changed name to Taewoong Forging Industrial Co., Ltd.
- **1989.08** | Changed name to Taewoong Co., Ltd.
- **1991.07** | Moved to the new factory (Dadae Factory) / Installed Ø3000 Ring Rolling Mill
- **1996.06** | Won ISO 9002:1994 certificate
- **1998.11** | Awarded Stone Tower Order of Industrial Service Merit
- **1999.06** | Developed forging technology of high strength Aluminum Alloy Ring
- **2001.08** | Completion of Noksan Manufacturing Facilities / Installed 5000ton Forging Press
- **2001.11** | Listed Stocks on KOSDAQ
- **2004.11** | Installed Ø9000 Ring Rolling Mill
- **2005.06** | Installed 8000ton Forging Press
- **2005.11** | Awarded Gold Tower Order of Industrial Service Merit
- **2006.06** | Certified as a world-class product maker of Korea (Main Shaft for Wind Power)
- **2007.11** | Certified as a world-class product maker of Korea (Main Shaft for Wind Power)
- **2008.06** | Won the KOSDAQ Best Company Award / Installed 15,000ton Forging Press
- **2008.11** | Awarded US$ 200 million Export Tower
- **2009.11** | Awarded US $300 million Export Tower
- **2010.03** | Won ASME MO certificate
- **2011.03** | Won China Pressure Vessel Certificate
2. Policy of TAEWOONG

Customer Satisfaction

- Employees Satisfaction
- High Quality
- On Time Delivery
- Competitive Cost

Culture

- Continuous Efficiency Improvement
- Accumulated Manufacturing Technology
- Self-Improvement of Employees, Performance-Oriented Culture
3. Quality Assurance

- 1985 Approval by Shipping Classes (KR/LR/DNV/GL/NK/BV/ABS/RINA, etc.)
- 1993 Approval by KHK for the supply of forged items
- 1996 Won ISO 9002:1994 certificate
- 1999 Developed forging technology of high strength aluminum ring
  Approval by Hitachi Zosen Nuclear Power Plant Division
  for the supply of forged items
- 2000 Approval by GE Energy
  Approval as the supplier for nuclear power plants by KEPIC
- 2002 Approval by EIL, India
- 2004 Won ISO 9001:2000 certificate
- 2005 Developed manufacturing technology for large size ring
  Of titanium-alloyed structure
- 2006 Certificated as a world-class product maker by Korean Government
- 2008 Won ISO 14001 certificate
  Won OHSMS 18001 certificate
- 2010 Won ASME MO certificate
- 2011 Won China Pressure Vessel Certificate
4. Production Equipments

The Best Open Die Forging Company In The World
- Manufacture Capacity : 300,000 Tons (Forging) -

Ø 9500 Ring Rolling Mill
8000 Ton Forging Press
5000Ton Press & 125MT Manipulator

Ø 3000 Ring Rolling Mill
2000 Ton Forging Press
1500Ton Press & 40MT Manipulator

15000 Ton Press & 400MT Manipulator
4. Production Equipments

Shop
Inside View
5. Main Products

- Aerospace
  - Aluminium Alloy Ring
  - Titanium Alloy Ring
  - Crane Wheel
  - Main Cylinder for Hydro Press & Ram
- Shipbuilding & Marine Engine
  - Tower Flange
  - Intermediate Shaft
  - Propeller Shaft
  - Tower Flange
  - Pintle
  - Cross Head Pin
  - Piston Crown
  - Piston Rod
  - Connecting Rod
- Petrochemical Plant
  - Forged Shell
  - Forged Neck
  - Tube Sheet
  - Channel Flange & Cover
- Industrial Machinery & Plant
  - Forged Shell
  - Forged Neck
  - Channel Flange & Cover
- Electric Power Generation
  - Diaphragm Half Ring
  - Trunnion
  - Drum Tube Sheet
  - Forged Shell
- Wind Power Energy
5. Main Products for Wind Power

- Yaw Bearing
- Rotor Brake
- Heat exchanger
- Generator
- Gear box
- Yaw drive
- Nacelle
- Main shaft
- Hub
- Nose cone
- Blade
- Pitch drive
- Nacelle
- Yaw drive
- Gear box
- Heat exchanger
- Ventilation
- Generator
- Tower Flange
- Yaw Bearing
- Pitch Bearing
- Gear Rim
6. Long-Term Contract of Major Wind Turbine Maker in the World

Step of Cooperation (Long-term contract)
- Share of Business Plan
- Share of Cost Reduction
- Technology exchange (Materials → Design)

Step of Mass Production
- Step of mass production
- Guaranteed stability of Delivery and quality

Pilot Product
- Evaluated stability of delivery and quality management

Manufacturing of Prototype
- Evaluation of QA/QC System
- Evaluation of facilities capacity and calibration management
- Evaluation of manufacture and quality management
- Evaluation of quality for prototype
7. Long term Suppliers

- **Main Shaft**
  - GE
  - Siemens

- **Tower Flange**
  - Vestas
  - Siemens

- **Yaw/Pitch Ring**
  - NIEBUHR Gears
  - Kaydon
8. Competitive Power

- Modernized Facilities
- Batch manufacturing
  (Small forging, Ring Rolling, large forging)
  (Forging to Painting & Coating)
- Lean manufacturing
- Planned Mass Production
- Specialized Production
- Accumulated Know-how
- High Productivity
- Qualified Vendor
- Well Organized QA/QC System

High Quality

Short Delivery

Competitive Cost

Strong Competitive Power
9. Manufacturing Process

1) Quality requirements

**Main Shaft**
- a) High Tensile & Fatigue strength
- b) Good impact absorb energy
- c) Good internal soundness
- d) Good surface roughness & soundness
- e) Fine micro structure
- f) Homogeneity

**Tower Flange**
- a) Good weld ability
- b) Good strength (yield strength)
- c) Good impact absorb energy at lower temperature
- d) Cleanliness
- e) Internal soundness
9. Manufacturing Process

2) Steel & Ingot Making

a) Blast furnace process

- Iron Ore
- Limestone
- Bituminous Coal

Iron Ore → Sinter Plant → Blast Furnace → Torpedo Car → Converter → Continuous Casting

b) Electric Arc furnace process

- Raw material (steel scrap)
- MELTING EAF
- LADLE REFINING LF
- Vacuum degassing
- Vacuum cast ingot (Top pouring)
- Air cast ingot
- Ingot marking
- Heating
- Rolling
- Rolled forging (billet)
- Rolled Slab
- Slab
- Bloom
- Ingot
# 9. Manufacturing Process

- **Main shaft**

**Raw material** → **1st Heating** → **1st forging** → **Discarding**

- **Heat treatment** → **After finish forging** → **Finish forging**
  - **Machining** → **Coating** → **Packing**
9. Manufacturing Process

Tower Flange & Yaw Ring

- Raw material
- Heating
- Blanking
- Ring Mill

- Tower flange
- Heat treatment
- Machining

- Yaw Ring
- Gear machining
- Induction hardening heat treatment
## 10. Export & Production Plan

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Actual Exports</th>
<th>Production Plan (2011)</th>
<th>Customer</th>
</tr>
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<tbody>
<tr>
<td>Main Shaft</td>
<td>34CrNiMo6</td>
<td>24,500pcs (2004~2010)</td>
<td>2,500pcs</td>
<td>GE, VESTAS, SIEMENS, KENERSYS, DOGFANG TURBINE, NINGXIA YINXING, ACCIONA, WIKOV etc</td>
</tr>
<tr>
<td></td>
<td>42CrMo4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>US$ 1,342,600,000</td>
<td>US$ 137,000,000</td>
<td></td>
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<tr>
<td>Yaw/Pitch Ring</td>
<td>42CrMo4</td>
<td>4,800pcs</td>
<td>3,000pcs</td>
<td>SIEMENS, GE, 신라정밀, NIEBUHR, KAYDON 外</td>
</tr>
<tr>
<td></td>
<td>SCM440</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>US$ 15,528,000</td>
<td>US$ 9,705,000</td>
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<tr>
<td>Gear</td>
<td>42CrMo4</td>
<td>500pcs</td>
<td>1,000pcs</td>
<td>SIEMENS, NIEBUHR, KAYDON 外</td>
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<tr>
<td></td>
<td>SCM440</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>US$ 1,325,000</td>
<td>US$ 2,650,000</td>
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11. Quality Evaluation of Supplier

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Avg. score &gt; 95%</th>
<th>Supplier</th>
<th>Avg. score &gt; 90%</th>
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<tbody>
<tr>
<td>Vestas</td>
<td>ScoreCard for TAEWOONG</td>
<td>GE</td>
<td>Supplier Qualification Form</td>
</tr>
<tr>
<td>Siemens</td>
<td>Supplier Evaluation Award 2010</td>
<td>Certificat</td>
<td>Certificate of Green Technology</td>
</tr>
<tr>
<td></td>
<td>세계일류상품인증</td>
<td>ion</td>
<td>녹색기술인증</td>
</tr>
</tbody>
</table>
Thank You!