STEAM TURBINE BLADES, VANES AND COMPONENTS

FROM REVERSE ENGINEERING TO FUNCTIONAL PARTS
CONTENTS

• OEM Experience & Knowledge
• Supply Chain
• Reference Cases
• Reverse Engineering
• Global Influences
• Additional Benefits
OEM Experience & Knowledge

• Years of experience with OEM’s and their products.
• Continuous tracking of design evolution and history.
• Extensive knowledge base, over 20,000 OEM drawings.
• We’ve supplied aftermarket parts to both end users and OEM’s, and are experienced in the designs and materials of OEM’s such as:

  • Siemens
  • General Electric
  • ABB / Alstom
  • Westinghouse
  • Woodgroup / Ruston
  • Mitsubishi
  • Parsons
  • Franco Tosi
  • Rolls Royce
  • Toshiba
  • MAN
  • Hitachi
  • Dresser-Rand
  • Allen
  • And more
Supply Chain

- Our production facilities are assets in any supply chain.
- Capable of quickly producing Turbo Machinery Parts.
- Adaptive and quick to respond Engineering Team.
- Certified approach to Quality.
- Determination to supply as quickly as possible to prevent downtime.
- Multiple production facilities set up to continually manufacture components.
- On site 3D Scanning and data gathering possibilities.
Reference Cases

- The next slides will highlight some relevant projects we’ve executed in the past, in particular large Rotor Blades which pose the most challenges when it comes to manufacturing:

- ABB / Alstom LP-0 Rotor Blades
- General Electric LP Rotor Blades
- Siemens LP Rotor Blades
- Skoda LP Rotor Blades
ABB / Alstom LP-0 Rotor Blades

<table>
<thead>
<tr>
<th>OEM:</th>
<th>Alstom (License)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Type:</td>
<td>Steam Turbine</td>
</tr>
<tr>
<td>Project Type:</td>
<td>Complete Manufacturing from precision forging including Stellite brazing.</td>
</tr>
<tr>
<td>Product:</td>
<td>Rotor Blade LP-0 (L=900mm)</td>
</tr>
<tr>
<td>Lead Time:</td>
<td>10 Weeks</td>
</tr>
<tr>
<td>Material:</td>
<td>Z12CnDV12-02</td>
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## General Electric LP Rotor Blades

<table>
<thead>
<tr>
<th>OEM:</th>
<th>General Electric</th>
</tr>
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<tbody>
<tr>
<td>Machine Type:</td>
<td>Steam Turbine</td>
</tr>
<tr>
<td>Project Type:</td>
<td>Manufacturing of finger root, airfoil including midspan.</td>
</tr>
<tr>
<td>Product:</td>
<td>LP Rotor Blade RH L=1025mm</td>
</tr>
<tr>
<td>Lead Time:</td>
<td>4 Weeks</td>
</tr>
<tr>
<td>Material:</td>
<td>Jethete M152 (Envelope Forgings)</td>
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</table>
### Siemens LP Rotor Blades

<table>
<thead>
<tr>
<th><strong>OEM:</strong></th>
<th>Siemens</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machine Type:</strong></td>
<td>Steam Turbine</td>
</tr>
<tr>
<td><strong>Project Type:</strong></td>
<td>Reverse Engineering &amp; Manufacturing of LP-0 rotor blades from forging.</td>
</tr>
<tr>
<td><strong>Product:</strong></td>
<td>LP Rotor Blades Last Stage GE+TE, including shot peening and laser hardening of airfoil inlet side. Blade Length = 900mm</td>
</tr>
<tr>
<td><strong>Lead Time:</strong></td>
<td>12 Months</td>
</tr>
<tr>
<td><strong>Material:</strong></td>
<td>X20Cr13 (W-no. 1.4021)</td>
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</table>
Skoda LP Rotor Blades

<table>
<thead>
<tr>
<th>OEM:</th>
<th>Skoda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Type:</td>
<td>Steam Turbine</td>
</tr>
<tr>
<td>Project Type:</td>
<td>Reverse Engineering &amp; Manufacturing of multiple stages LP Blades</td>
</tr>
<tr>
<td>Product:</td>
<td>LP Rotor Blades Stage 8, 9, 10</td>
</tr>
<tr>
<td>Lead Time:</td>
<td>6 Weeks</td>
</tr>
<tr>
<td>Material:</td>
<td>Jethete M152 / H46</td>
</tr>
</tbody>
</table>
Reverse Engineering

• Based on samples Stork can quickly acquire data and generate CAD/CAM models.
• Stork has invested in Sophisticated hard- and software to achieve its goals in realizing high-tech production facilities.
• These processes are in place to ensure the customer gets their desired Turbo Machinery Products with minimal lead times.
• The next slides will highlight our Reverse Engineering Process.
Reverse Engineering

• Single or Multiple samples used for Reverse Engineering.
• Data comes together to reproduce nominal model in digital CAD environment.
• New Model is designed based on available technical information.
• Production method is designed around the model and started as soon as possible.
ATOS III optical measuring device used for digitizing samples to 3D pointcloud and meshed model.
Reverse Engineering

- Data Analysis.
- Sample Models.
- Comparison.
- Tolerances.
- Production method analysis.
- Redesign.
Reverse Engineering

• Transitional fillets and blends.
• Root and Airfoil Design verification.
• Assembly simulation, FEM Strength Analysis, CFD Flow Dynamics, Frequency and Damping, Moment Weight sequencing, and more.
Reverse Engineering - Special Studies
Stork Turbo Blading is the preferred global supplier of many companies in the Turbo Machinery Business.

We have relations and conducted business with companies in all parts of the world, including Europe, Asia, Middle East, USA, Africa, Australia and much more.
Additional Benefits

- Longer warranty period than OEM manufacturers.
- Technical Assistance and Knowledge when fitting blades, assembling rotor components, or anything related to Turbo Machinery.
- Extensive database of OEM drawings and knowledge.
- Impressive portfolio related to Turbo Machinery.
- Provision of fit-for-purpose products.
- Short lead time, quick supply.
THANK YOU
STORK TURBO BLADING