LEADING THE CRITICAL MATERIALS REVOLUTION
**TABLE OF CONTENTS**

- Overview 4
- Strategy 7
- Market 9
- Value Chain 12
- Technology and Products 13
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Overview

AMG Critical Materials
- Vanadium
- Superalloys
- Titanium Alloys & Coatings
- Aluminum Alloys

AMG Engineering
- Tantalum & Niobium
- Antimony
- Graphite
- Silicon

AMG Engineering Key Facts
- Over 100 years of experience in vacuum metallurgy and heat treatment
- Engineering facilities in Germany, France, USA, India and China; three heat treatment service centers in Germany, the U.S., and Mexico
- Owns 85 patent families
- Approximately 850 employees
Overview

AMG Engineering’s Business Profile

- Asset light
- High-tech engineering with outsourced manufacturing
- People are the main business asset

Note: Figures based on 2015 revenue split
Overview – Locations

Highlighted countries represent AMG Engineering’s physical presence.
Strategy

- AMG Engineering provides vacuum process technology and services for high-purity metals and critical materials products to the global market
  - Deliver customer-specific solutions across all market segments
  - Leading market presence in core technologies
  - New technology and products provide upside potential
  - Well represented in key economic regions serving blue chip clients

- AMG Engineering’s vision is to defend its position as:
  - No. 1 innovator in vacuum metallurgy and vacuum heat treatment
  - Global market leader in vacuum furnaces, processes and services
  - Cost leader in its fields of competence
Strategy – Value Drivers in Engineering

- Diversification and stability – broad product portfolio, global customer base and industry sectors
- Reduce Market Volatility – generate services revenue
- Technology Innovations
- Minimize Working Capital – order intake with high portion of down payment
- Avoid cost overruns – precision in product quality and cost calculation
- Global Sourcing – collaborate with experienced/qualified suppliers
- Develop human capital – people are the main asset
## Market – Products, End Markets, and Applications

<table>
<thead>
<tr>
<th>% of revenues&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automotive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46%</td>
<td>▪ Vacuum heat treatment furnace systems</td>
<td><img src="image1" alt="Car" /></td>
</tr>
<tr>
<td>22%</td>
<td>▪ Vacuum case hardening heat treatment services</td>
<td><img src="image2" alt="Car Part" /></td>
</tr>
<tr>
<td>24%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aerospace</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21%</td>
<td>▪ Turbine blade coating furnace systems</td>
<td><img src="image3" alt="Airplane" /></td>
</tr>
<tr>
<td>12%</td>
<td>▪ Vacuum precision casting furnace systems</td>
<td><img src="image4" alt="Engine Part" /></td>
</tr>
<tr>
<td>2%</td>
<td>▪ Vacuum re-melting furnace systems</td>
<td><img src="image5" alt="Forged Part" /></td>
</tr>
<tr>
<td>18%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>▪ Solar silicon melting and crystallization furnace systems</td>
<td><img src="image6" alt="Solar Panel" /></td>
</tr>
<tr>
<td>2%</td>
<td>▪ Vacuum sintering and annealing furnace systems</td>
<td><img src="image7" alt="Vacuum Furnace" /></td>
</tr>
<tr>
<td>12%</td>
<td>▪ Vacuum powder metallurgy furnace systems</td>
<td><img src="image8" alt="Powder Metallurgy" /></td>
</tr>
<tr>
<td><strong>Specialty Metals &amp; Chemicals</strong></td>
<td>▪ Vacuum re-melting furnace systems</td>
<td><img src="image9" alt="Furnace" /></td>
</tr>
<tr>
<td>17%</td>
<td>▪ Vacuum melting furnace systems</td>
<td><img src="image10" alt="Furnace" /></td>
</tr>
<tr>
<td>1%</td>
<td>▪ Vacuum powder metallurgy furnace systems</td>
<td><img src="image11" alt="Furnace" /></td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>▪ Vacuum re-melting furnace systems</td>
<td><img src="image12" alt="Infrastructure" /></td>
</tr>
<tr>
<td>3%</td>
<td>▪ Vacuum melting furnace systems</td>
<td><img src="image13" alt="Furnace" /></td>
</tr>
<tr>
<td>1%</td>
<td>▪ Vacuum powder metallurgy furnace systems</td>
<td><img src="image14" alt="Furnace" /></td>
</tr>
<tr>
<td>1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) 1% of revenues is allocated to other end markets based on 2015

- % of revenues from engineering
- % of revenues from services

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Market – Leading Market Position

Core technology in melting or treating materials in a vacuum

Heat Treatment
• >280 systems delivered

Heat Treatment Services
• >100m parts treated
• World’s Largest LPC Heat Treatment Service Centers

Metallurgy
Remelting and Electron Beam Melting
• >200 systems delivered

Metallurgy
Vacuum Induction Melting
• >460 systems delivered

Metallurgy
Silicon Melting and Crystallisation (Solar)
• >440 systems delivered

Metallurgy
Precision Casting and Sintering
• >160 systems delivered
Market – Global Installed Base

Asia > ~ 660 systems installed
Europe > ~ 750 systems installed
North America > ~ 150 systems installed

Note: Shaded countries represent AMG Engineering’s countries of presence; Systems installed is based on the number of installed furnaces until March 2013
Value Chain for Metallurgy

Raw Materials
1.
- Virgin charge
- Scrap

Primary Melting
2.
- Purify
- Chemical control

Secondary Melting
3.
- Powder
- Investment Casting
- Vacuum Arc Remelting
- Electro Slag Remelting
- Electro Beam Remelting
- Plasma

Final Processing
4.
- Cast Products
- Wrought Products

Legend:
- External Process
- AMG’s operation
Technology and Products – Metallurgy

Technology

- VIM-VIDP

Products

- Rivets and Bolts
- Bearings
- Landing Flaps

Re-Melting

- ESR, VAR
- Cold Rolls
- Turbine and Crank Shaft
- Special steel ingot 165 t

Plasma Melting

- Electron Beam, Plasma Cold Hearth Melting
- Round Ingot and square slaps

Special steel ingot 165 t
## Technology and Products – Metallurgy

<table>
<thead>
<tr>
<th>Technology</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solar</strong></td>
<td></td>
</tr>
<tr>
<td>SCU 650 – Gen6</td>
<td>Si-Bricks</td>
</tr>
<tr>
<td>SMC1000 – 4x Gen5</td>
<td>Si-Ingot</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Glass Forming &amp; Treatment</strong></td>
<td></td>
</tr>
<tr>
<td>Vacuum Creep Forming of Glass</td>
<td>PV-Panel</td>
</tr>
<tr>
<td>Glass Annealing</td>
<td>Mobile Cover Sheet</td>
</tr>
<tr>
<td></td>
<td>Optical fiber</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hot Isothermal Forging</strong></td>
<td></td>
</tr>
<tr>
<td>Hot Isothermal Forging for Near Net Shape Technologies</td>
<td>Turbine blades, turbine disks, for jet- engines and energy supply turbines, etc. using advanced materials such as Titanium and Nickel-based alloys</td>
</tr>
</tbody>
</table>
## Technology and Products – Heat Treatment

<table>
<thead>
<tr>
<th>Technology</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>ModulTherm</td>
<td>Large size – multi layer loads</td>
</tr>
<tr>
<td>SyncroTherm</td>
<td>Small size - single layer loads</td>
</tr>
<tr>
<td>VKP Furnace</td>
<td>Cemented Carbides Tools</td>
</tr>
</tbody>
</table>

- **Modular, flexible LPC-system**: ModulTherm
- **One-Piece-Flow LPC system**: SyncroTherm
- **Sintering**: VKP Furnace

**Technology and Products**

**Technology**

- **ModulTherm**
  - Modular, flexible LPC-system

**Products**

- **Large size – multi layer loads**
- **Small size - single layer loads**
- **Cemented Carbides Tools**
Technology and Products – Heat Treatment Services

**Technology**
- ModulTherm

**Products**
- Large load size – high hardness and high distortion requirements
- Very large load size – moderate hardness and high distortion requirements

LPC/HPGQ based Services

Nitriding Services
Safety, Health, and Environmental

<table>
<thead>
<tr>
<th>Period Ending March</th>
<th>Lost Time Incidents in the Last 12 Months</th>
<th>12 Month Average Lost Time Incident Rate</th>
<th>Days Lost to Lost Time Incidents in Last 12 Months</th>
<th>12 Month Average Incident Severity Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>13</td>
<td>1.12</td>
<td>85</td>
<td>0.064</td>
</tr>
<tr>
<td>2016</td>
<td>10 ↓</td>
<td>0.62 ↓</td>
<td>25 ↓</td>
<td>0.018 ↓</td>
</tr>
</tbody>
</table>

**Leading Safety Indicators – Q1 2016 vs. Q1 2015**

- 5,664 hours of safety training to the 824 FTE, down 29%
- 137 near miss or unsafe conditions to 824 FTE, down 22%
- 263 internal safety audits or inspections, down 11%

**Incidents and Missed Days Q1 2016**

- 4 lost time incidents (LTI) in 2015 (25 missed work days)
- 6 serious (medical treatment required) incidents
- 47 first aid incidents