LEADING THE CRITICAL MATERIALS REVOLUTION
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Overview

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

AMG Engineering
- Tantalum & Niobium
- Antimony
- Graphite
- Silicon
- Engineering
- Heat Treatment Services

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.

- **Port Huron, USA** (Sales office)
- **Wixom (MI), USA** (Production facility)
- **East Windsor (CT), USA** (Headquarters)
- **Grenoble, France** (Heat Treatment Services facility)
- **Hanau (Headquarters), Germany**
- **Limbach, Germany**
- **Krakow, Poland**
- **Bangkok, Thailand**
- **Moscow, Russia**
- **Suzhou, China**
- **India**
- **Japan**
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(^1)</th>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automotive</strong></td>
<td></td>
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<tr>
<td></td>
<td>Vacuum heat treatment furnace systems</td>
<td></td>
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<tr>
<td></td>
<td>Vacuum case hardening heat treatment services</td>
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<tr>
<td><strong>Aerospace</strong></td>
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<tr>
<td></td>
<td>Turbine blade coating furnace systems</td>
<td></td>
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<tr>
<td></td>
<td>Vacuum precision casting furnace systems</td>
<td></td>
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<tr>
<td></td>
<td>Vacuum re-melting furnace systems</td>
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<tr>
<td><strong>Energy</strong></td>
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<tr>
<td></td>
<td>Solar silicon melting and crystallization furnace systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vacuum sintering and annealing furnace systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vacuum powder metallurgy furnace systems</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Specialty Metals &amp; Chemicals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vacuum re-melting furnace systems</td>
<td></td>
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<tr>
<td></td>
<td>Vacuum melting furnace systems</td>
<td></td>
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<tr>
<td></td>
<td>Vacuum powder metallurgy furnace systems</td>
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<tr>
<td><strong>Infrastructure</strong></td>
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<td></td>
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<tr>
<td></td>
<td>Vacuum re-melting furnace systems</td>
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</tr>
<tr>
<td></td>
<td>Vacuum powder metallurgy furnace systems</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

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
- Vacuum Induction Melting
  - >460 systems delivered
- Silicon Melting and Crystallisation (Solar)
  - >440 systems delivered
- Precision Casting and Sintering
  - >160 systems delivered

Core technology in melting or treating materials in a vacuum
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
2. Scrap

**Primary Melting**
2. Purify
   - Chemical control

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

**Final Processing**
4. Extrude Forge Roll
   - Cast Products
   - Wrought Products
      - Bar sheet
      - Extrude forge roll to shape

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
Technology and Products – Metallurgy

**Technology**

- **Investment Casting**
  - VIM-IC / Leicomelt

- **Coating**
  - EB-PVD, Smart Coater

- **Powder**
  - VIGA, EIGA

**Products**

- **Turbine blades**
- **TiAl Valves**
- **Turbocharger**
- **Golf clubs**
- **Engine for Aviation Industry**
- **Turbine blade coated with TBC**
- **Spherical powder**
- **Plasma spray and applications for MIM parts**
- **3D printing application**
Technology and Products – Metallurgy

**Technology**

- SCU 650 – Gen6
- SMC1000 – 4x Gen5

**Products**

- Si-Bricks
- Si-Ingots
- PV-Panel

**Solar**

- Vacuum Creep Forming of Glass
- Glass Annealing

**Glass Forming & Treatment**

- Hot Isothermal Forging for Near Net Shape Technologies

- Turbine blades, turbine disks, for jet-engines and energy supply turbines, etc. using advanced materials such as Titanium and Nickel-based alloys
# 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**

- **One-Piece-Flow LPC system**
- **Sintering**

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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