GKN Additive
Leading the future with Additive Manufacturing

Binderjetting Technology Teaser 2018
GKN’s Vision – The Full Metal Solution Provider

Proven Heritage in Metal Processing:

- **GKN Hoeganaes**
  - Metal Powders
  - We are the world leader in the development and production of atomized metal powders.

- **GKN Sinter Metals**
  - Product Solutions
  - We are the world’s leading manufacturer of precision powder metal products and new advanced PM technologies.

- **GKN Additive**
  - Additive Solutions
  - We are making AM available for aerospace automotive and industrial applications.

Technology Portfolio:

Already Positioned to lead the AM Market:

1. **Knowledge of Advanced materials**
   - 40+ years experience of developing metal powders
   - Wide range of high purity, high productivity and high quality AM powders

2. **Best-in-class technology and engineering solutions**
   - Full range of design and engineering services
   - Instant quoting tool
   - Complete support throughout the design for AM process

3. **Widest range of AM process technologies**
   - At the forefront of AM technology
   - High performance Laser and high productivity Binder technology
   - Reduces mass and inertia
   - Improves wear resistance and thermal efficiency

4. **AM operational excellence**
   - Manufacturing expertise across multiple markets
   - Delivery of the highest quality AM components
   - Certified to the most rigorous industry and customer standards
### AM vs Other Small Series Production Technologies

<table>
<thead>
<tr>
<th>Tooling costs</th>
<th>Time</th>
<th>Series Close</th>
<th>3-D Design</th>
<th>Design Flexibility</th>
<th>Quantity of parts</th>
<th>Complex Geometries</th>
<th>Material variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACHINING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAND (IRON - AL) CASTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FINE BLANKING and FORMING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOST WAX-Casting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PUDDLE DEPOSITION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LASER POWDER BED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binder Jetting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Binder - emerging AM technology that plays to GKN strengths

- Print ‘green’ shape then post process
- Up to 50 times higher productivity
- Performance similar to PM or MIM
- Additive Design advantages
- Very good fit with PM’s existing value chain
- AM mass production

Print ➔ Debinding ➔ Sintering ➔ Finishing

A young technology with disruptive potential
Binder Jetting - Process chain

Controlling the whole process chain puts us on top of the market!
AM Powders

Spherical Powders
Inert Gas Atomized
AncorTi Titanium
Ti6A4V
CPTi
6Al2Sn4Zr2Mo
Beta21S
AncorAM Stainless
316L
17-4PH

High Productivity Powders
High Pressure Water Atomized
AncorAM Stainless
316L
17-4PH
AncorAM Steel
5120
8620
4605
Design for Binder Jetting

- Print design
- Automated handling
- Support structure
- Sinter design
- Nesting
- Volume utilization
- Existing knowledge
- Topology and fatigue optimized design

Design for Binder Jetting
ExOne Innovent R&D

- Screening different powders
- Optimizing print and curing parameters
- Printing first prototypes
- Simulating the whole process chain

- Build bed size 170 x 65 x 65 mm
- Minimum Powder quantity for build 6kg

HP early production system

- Optimizing software and hardware
- Developing ink
- Increasing productivity

- Build bed size 450 x 300 x 300 mm
- Build speed 1000 cm³/h (target 8000 cm³/h)*
- Minimum powder quantity for build 150kg

* theoretical max. build speed
Design and Process Guidelines

- Building Size max 200 x 360 x 80 mm
- Material: 316L (1.4404)
- Wall thickness 1.5 - 30 mm
- Surface: Rz 45 μm
- Support structure for sintering
- IT class 12-14
- Mechanical properties MPIF35
- Compact & complex design
ADDITIVE MANUFACTURING

Commercial:
Kevin Schmidt
Account Manager Additive, GKN Additive
Kevin.Schmidt@gkn.com

Technical:
Christian Josten
GPC Engineer, GKN Additive
christian.josten@gkn.com