Trends in Die Casting and Extrusion Call for Premium Tool Steel Solutions
1. A short introduction to Kind & Co.

2. Kind & Co. – a relevant specialist in the niche

3. Automotive trends and challenges/opportunities for tool steel

4. Innovative tool steel solutions for demanding applications

5. Concluding theses
Kind & Co.: A privately owned hot work tool steel specialist

KIND & CO., EDELSTAHLWERK, GmbH & Co. KG

» Founded 1888 – 130 years of experience!
» Located close to Cologne, Germany
» Privately owned

Tool steel revenues 2015

- Extrusion: 22%
- Die casting: 30%
- Drop forging: 8%
- Distribution partners: 23%
- Others: 16%
Kind & Co.: Excellent quality and service, deep value creation, global network

Excellence across the entire value chain

» Steel melting and remelting

» Forging

» Heat treatment

» Vacuum hardening

» Milling/machining

» 3D processing/near net shape

» Stocks

» Mill in Bielstein, Germany

» Own entities (processing, stocks) in Italy, US, China

» Long-time distribution partners in all relevant markets
<table>
<thead>
<tr>
<th>OEMs</th>
<th>Tier 1</th>
<th>Mould makers</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHRYSLER</td>
<td>Meridiar</td>
<td>ZANUSSI</td>
</tr>
<tr>
<td>FERRARI</td>
<td>UniWheels</td>
<td>aurrenax</td>
</tr>
<tr>
<td>BMW</td>
<td>Visteon</td>
<td>aK</td>
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<tr>
<td>Mercedes-Benz</td>
<td>nemak</td>
<td>costamp</td>
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<tr>
<td>RENAULT</td>
<td>KSPG Automotive</td>
<td>Exco</td>
</tr>
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<td>MASERATI</td>
<td>Brabant Alucast</td>
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<tr>
<td>PEUGEOT</td>
<td>AMTEK</td>
<td>vetimec</td>
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<td>volkswagen</td>
<td>BOSCH</td>
<td>BORBBET Leichtmetallader</td>
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<tr>
<td>FORD</td>
<td>MONTUPET</td>
<td>BoCar Group</td>
</tr>
<tr>
<td>GM</td>
<td>DICASTAL</td>
<td>HECK+BECKER Der Formenbauer</td>
</tr>
</tbody>
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Hot work tool steel: Kind & Co. a relevant player in the niche within the niche!

Tool steel by category, in kt

- Plastic mould
- Cold work
- Hot work
- HSS

- Approx 60kt 1.2714/L6 included in the 530 kt hot work tool steel
- Thus approx. 470kt „real“ hot work tool steel
- Approx 4% global market share for Kind & Co.

Source: SMR, Kind & Co.
Hot work tool steel: A view on end use and application and the role of Kind & Co.

By end use, in kt
- Transport: 250 kt
- Industry: 200 kt
- ABC: 50 kt
- Other: 30 kt

By application (wild guess!)
- Die casting
- Forging
- Extrusion
- Mandrel bars
- Special (LQ) plastic mould
- Press Hardening

» Kind & Co. market share estimates
» Die casting: approx. 10-15%
» Forging (excl. 1.2714) approx. 5-10%
» Extrusion: approx. 10-15%
» ... and a significant share of the growing press hardening market!

Source: SMR, Kind & Co.
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Trends with potential for disruptive change exist in the Automotive value chain

Potentially disruptive trends in Automotive:

» Electrification of the power train

» Carsharing/ diverse mobility

» Autonomous driving

» Connectivity

» Peak production for conventional (internal combustion engine (ICE), including hybrid (HEV)) cars already reached in 2030?

» Progress in electrification seems more likely today than 2-3 years ago (VW „Dieselgate“, emission „tricks“ of other OEMs, increasing level of subsidies for e-cars, …)

Source: „Automotive revolution – perspective towards 2030“ (01/2016, McKinsey); Bloomberg (03/2016); Kind & Co.
Scenario for the drop forging market: double or triple whammy?

Electrification: Potential impact on drop forging industry

» Vehicle numbers for ICE cars will drop (in approx. 10 years)
» Currently, approx. 270 kg of parts from drop forging in power train and engine of a reference car (full weight 1740 kg)
» Vehicle downsizing and emission regulation will lead to further weight savings especially in the power train
» Sooner or later: no growth, rather gradually shrinking
» Further pressure by additive manufacturing?

Potential impact on tool steel producers

» Drop forging continues to be a sizable market for a while, but no long term growth perspective
» „Cutthroat competition“ among customers will further increase price pressure
» Trend to form large forging groups (M&A) likely to be continued and intensified – negotiation power in fewer hands
» Is there still room for technical solutions or will it be a purely price-driven market?

Source: Initiative Massiver Leichtbau (03/2014); Bloomberg (3/2016); Kind & Co.
Scenario for the die casting market: economics likely continue to work!

Electrification: Potential impact on die casting industry

» Weight saving still on the agenda, trend for structural parts still alive*

» Potential for new massive volume parts (housings for e-motor, batteries) that might be „normed“ across OEM brands

Potential impact on tool steel producers

» New massive volume parts may come in reach (e.g., 2-3 standard e-motors and batteries for the entire fleet of middle class cars)

» Economic pressure to provide tool steel that allows for >200,000 shots. Growth needs to be balanced by increased tool life!**

» Possibility to differentiate technically and in service from competition, particularly in massive volume parts

* Maybe also some space for extruded Al profiles in high strength alloys to substitute steel profiles/sections?

** While number of Al die casting parts 2005-2016 grew 3x, tool life grew from 60,000 shots up to 250,000!

Source: Audi; Kind & Co.
Scenario for plastic mould: the jury is still out on additive manufacturing

Electrification: Potential impact on plastic mould industry
» Less differentiation of cars through power train, but …
» … more by design (e.g., interior) and software and connectivity

Potential impact on tool steel producers
» Design differentiation on, e.g., the interior may demand for more plastic moulds – but unfortunately with lower life time expectations
» Is there an opportunity to capture or will additive manufacturing make the point here (individual design)?

Source: BMW; Kind & Co.
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### Kind & Co. steel to solve tomorrow’s die casting and extrusion challenges

<table>
<thead>
<tr>
<th>Steel Designation</th>
<th>Alloy Content in mass.-%</th>
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<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Mat.-No. 1.2343 H 11 USN</td>
<td>0.38</td>
</tr>
<tr>
<td>1.2367 RPU</td>
<td>0.38</td>
</tr>
<tr>
<td>TQ 1</td>
<td>0.36</td>
</tr>
<tr>
<td>HP 1</td>
<td>0.35</td>
</tr>
<tr>
<td>CS 1</td>
<td>0.50</td>
</tr>
</tbody>
</table>

- **Here is our idea:**
  - In die casting, tool life will decide the economics against additive manufacturing.
  - In extrusion, there is potential for high strength extruded profiles – requiring better steel for containers and extrusion dies/heading.
  - **Kind & Co. has developed special grades, e.g., TQ 1, HP 1, and CS 1, which are characterised by highest cleanliness and lowest concentrations of detrimental traces elements.**
Lower stresses in dies enable higher hardness of tool steel

![Graph showing the relationship between tempering temperature and hardness, as well as impact energy for different tool steels.](image-url)

- **1.2343**
- **1.2367**
- **TQ 1**
- **HP 1**
- **CS 1**

**ISO-V-Samples, transverse, 45 HRC**

- Impact energy in J:
  - 1.2343: 20
  - 1.2367: 15
  - TQ 1: 25
  - HP 1: 30
  - CS 1: 20
CS1 will solve the problems of the next generation dies and tools

<table>
<thead>
<tr>
<th>Steel Brand</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>Cr</th>
<th>Mo</th>
<th>V</th>
<th>Nb</th>
<th>Rm in Mpa</th>
<th>Rp0,2 in Mpa</th>
<th>Z in %</th>
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</thead>
<tbody>
<tr>
<td>TQ 1</td>
<td>0,36</td>
<td>0,25</td>
<td>0,40</td>
<td>≤ 0,012</td>
<td>≤ 0,003</td>
<td>5,20</td>
<td>1,90</td>
<td>0,55</td>
<td>---</td>
<td>1480</td>
<td>1250</td>
<td>53</td>
</tr>
<tr>
<td>CS 1</td>
<td>0,50</td>
<td>0,30</td>
<td>0,40</td>
<td>≤ 0,012</td>
<td>≤ 0,003</td>
<td>5,00</td>
<td>1,90</td>
<td>0,50</td>
<td>+</td>
<td>2074</td>
<td>1480</td>
<td>42</td>
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</tbody>
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Executive Summary

» Kind & Co. is a small, but relevant player in the double niche of hot work tool steel. Our strategy is built around excellent quality and service, deep value creation, and a global network.

» We believe that the electrification of the automotive power train is more likely to gain speed than 2-3 years ago, with different impact on traditional tool steel applications:

  » Drop forging:

  » Die casting (and extrusion):

  » Plastic mould:

» Kind & Co. is well prepared to support the automotive value chain, e.g., by special steel grades increasing the tool life: TQ1, HP1, CS1
Thank you very much for your attention!

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