

HERZLICH WILLKOMMEN BEI  
BHARAT FORGE  
ALUMINIUMTECHNIK

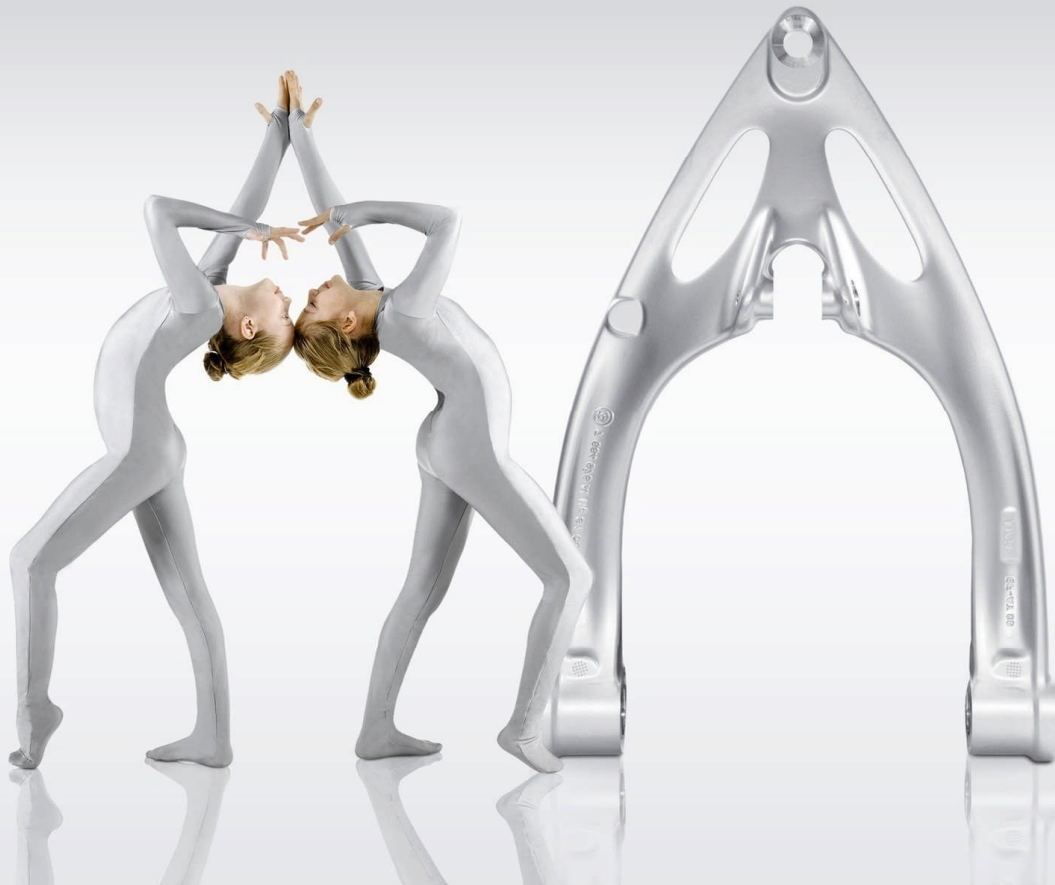


**Innovative aluminium  
forging chassis parts -  
light and more resilient**

1. FACTS AND FIGURES
2. DEVELOPMENT AND PRODUCTION PROCESS
3. FORGING PRE-MATERIAL
4. CHARACTERISTICS OF FORGING PARTS
5. OUTLOOK

## FACTS AND FIGURES

- Founded:  
1996
- Location:  
Brand-Erbisdorf  
(40 km to Dresden)
- Turnover p.a.:  
30 - 45 Mio. EUR
- Material consumption p.a.:  
5.000 - 9.000t (Aluminium)
- Part weight:  
1 - 7 kg
- 100% automotive supplier



### Kalyani Group

Headquarters: Pune (India)

Group turnover 2011:  
approx. 2,5 Mrd. USD

Employees worldwide:  
ca. 10.000

### Business areas

Automobile components & -  
systems

(steel forging parts)

Steel production

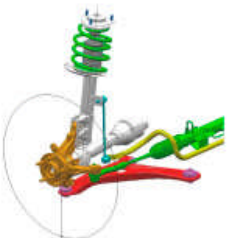

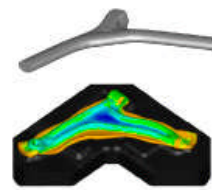

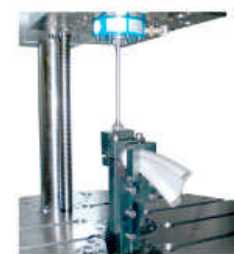

Special chemistry

Renewable energies and  
infrastructure



„... hot forming of aluminium and his alloys is not widely used because of numerous risiks by microstructure changes and with it losses of hardness and surface changes.“

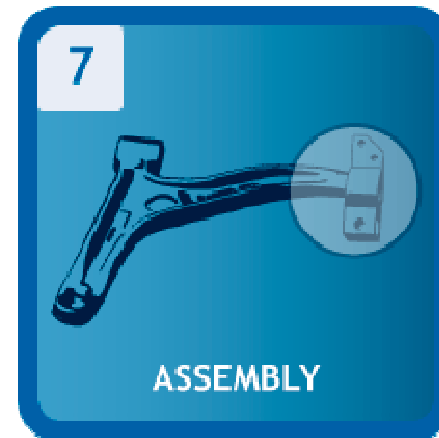
source: page12 Cochius Normen Richtlinien Hinweise; Max Cochius GmbH,  
publisher: Thyssenkrupp Materials International GmbH, Technischer Verkauf, Essen

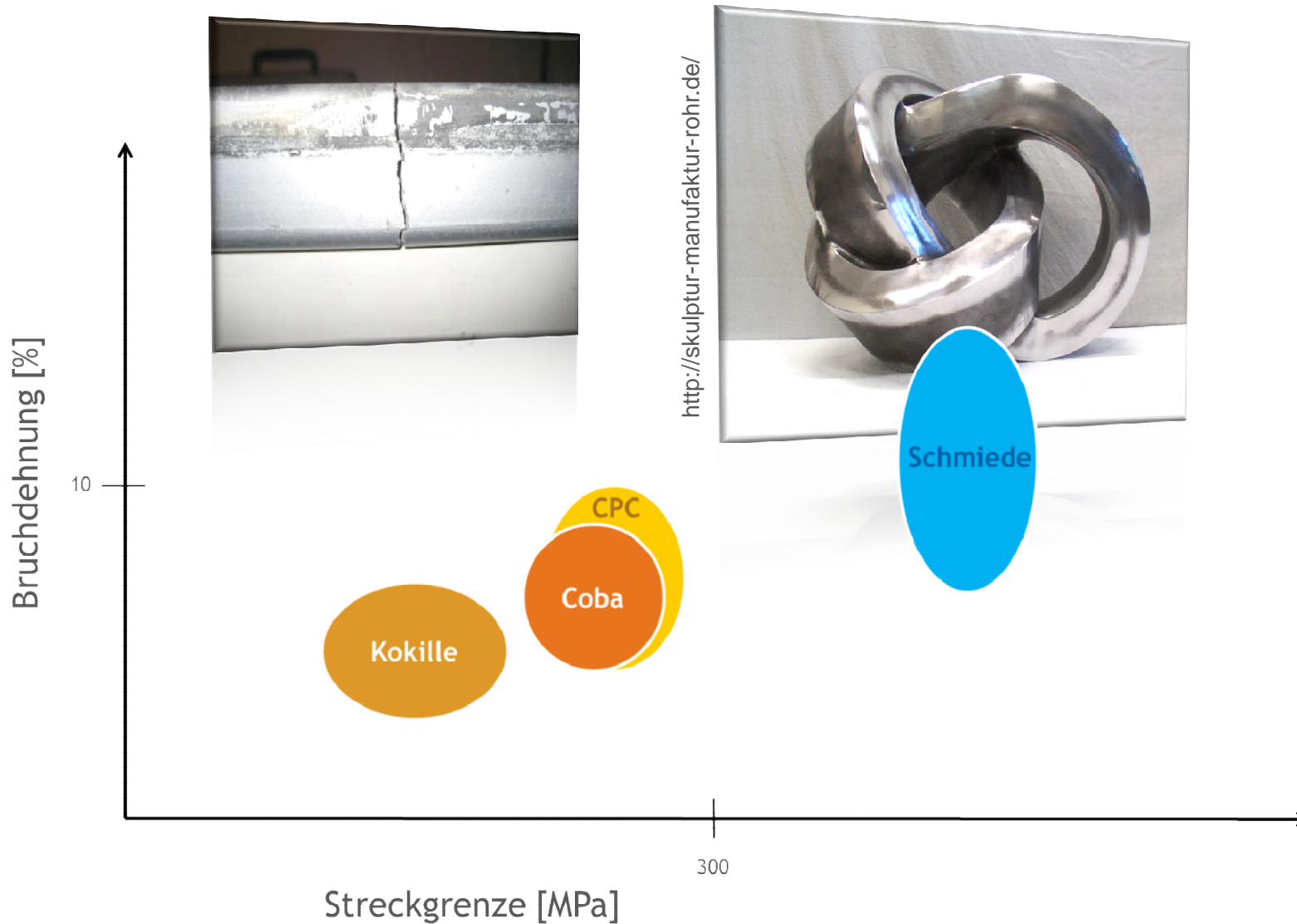
Customer specifications	Part development	Process development	Prototypes	Process approval	Series production
					

**Targets Developers OEM**  
 Short delivery times for prototypes  
 Prototype costs  
 Maximum weight saving  
 Secure series solution  
 Secure technologies  
 Minor series costs



**Targets Developers Tier x**  
 Involvement as early as possible  
 Minor material usage  
 Adequate pricing  
 Efficiency of equipment  
 Secure long-term business



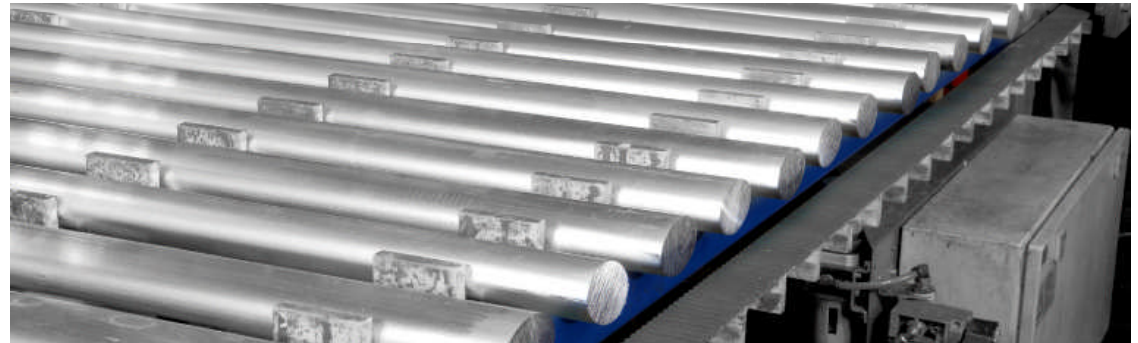


Stability and ductility values on considerably higher level

Safety reserves  
Lower sections required  
Weight savings



Ally elements [%]	EN AW-6082 [AlSi1MgMn]
Si	0.7 - 1.3
Fe	max. 0.5
Cu	max. 0.1
Mn	0.4 - 1.0
Mg	0.6 - 1.2
Cr	max. 0.25
Zn	max. 0.20
Zr	-
Ti	max. 0.1
Pb	-
Others	max. 0.05
Others (total)	max. 0.15



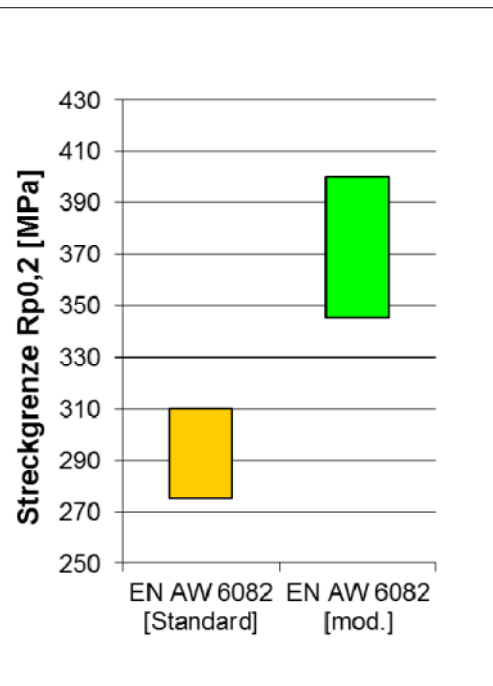
- Superior stability potential
- High corrosion resistance
- Uniformity of crystalline structure with no pores, bubbles etc.
- Weldability
- High Pre-forming

**EN AW-6082 (AlMgSi1) T6**

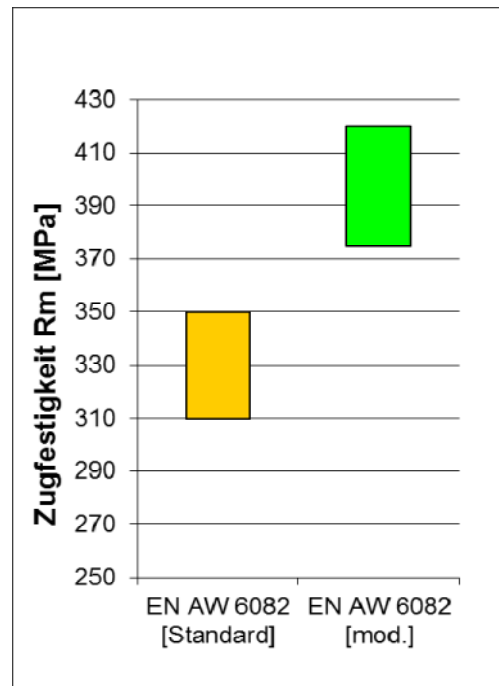
Tensile strength Rm > 310 N/mm<sup>2</sup>  
 Elastic limit Rp0,2 > 275 N/mm<sup>2</sup>  
 Extension at break A5 > 8 %  
 Brinell hardness HB > 100 HB

## HIGHER STABILITY POTENTIAL BY ALLOY VARIATION

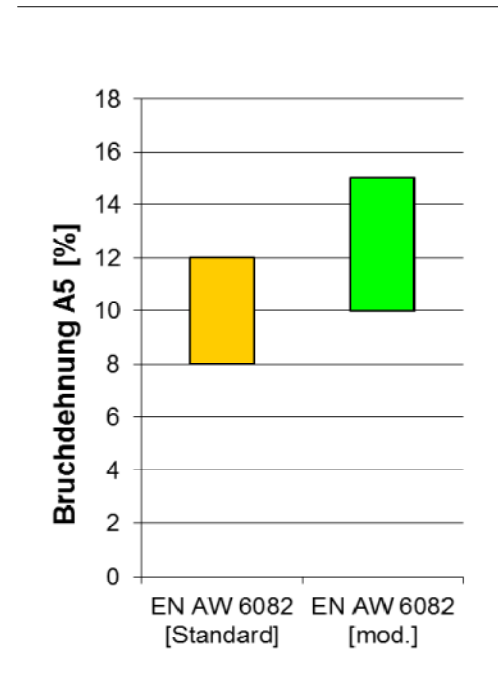
Elastic limit -Rp0,2-



Tensile strength -Rm-



Extension at break -A5-



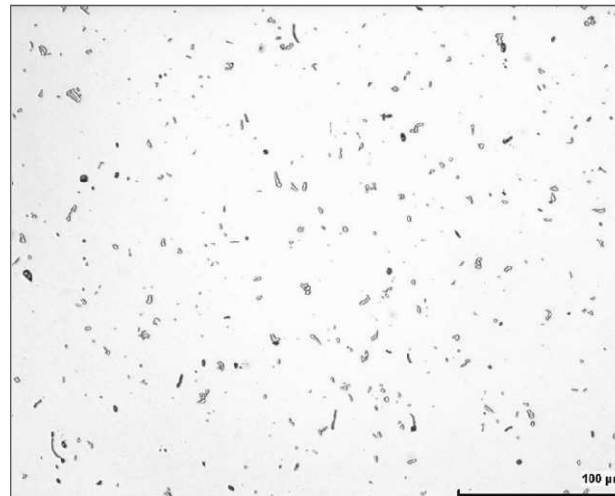
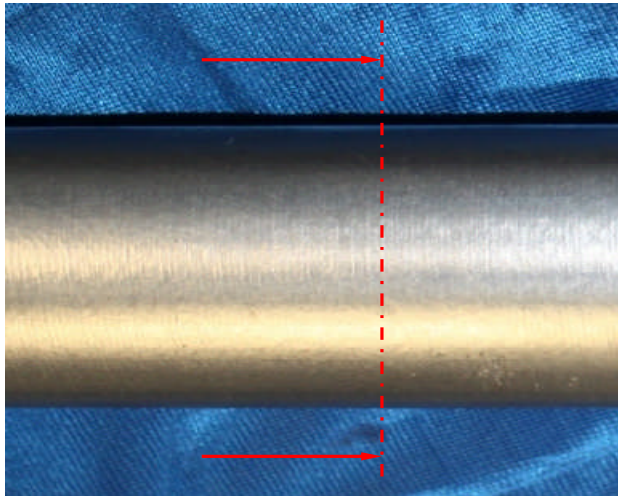
◆ EN AW-6082 [Standard alloy]

◆ EN-AW 6082 [mod.]

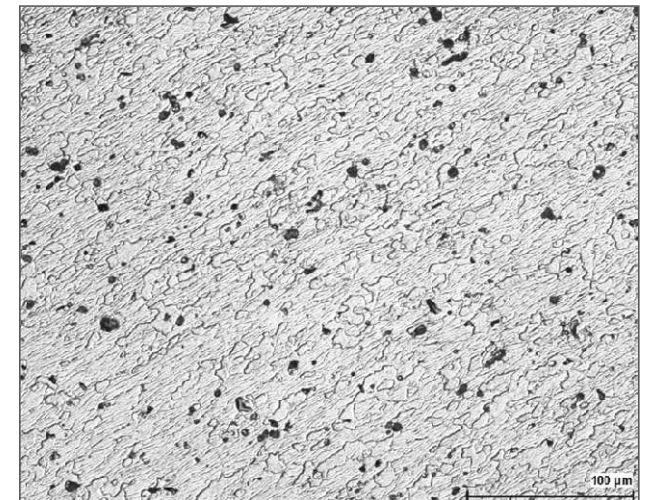
## EXTRUDED MATERIAL

### Structure characteristics - cross-section polish

- precipitation evenly spread
- No directionality



precipitation distribution  
polished

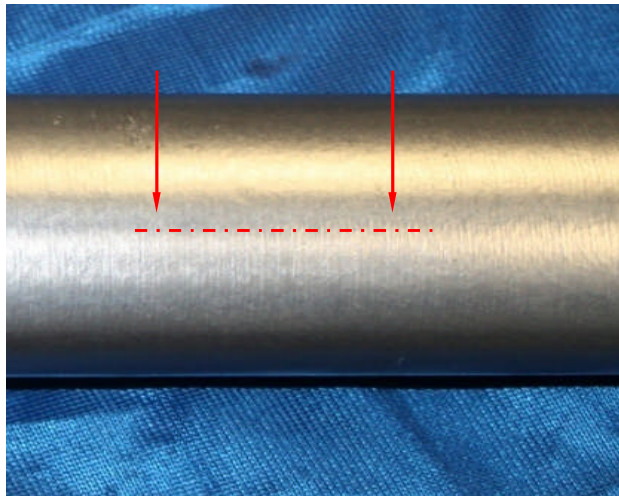


Crystalline structure  
etched

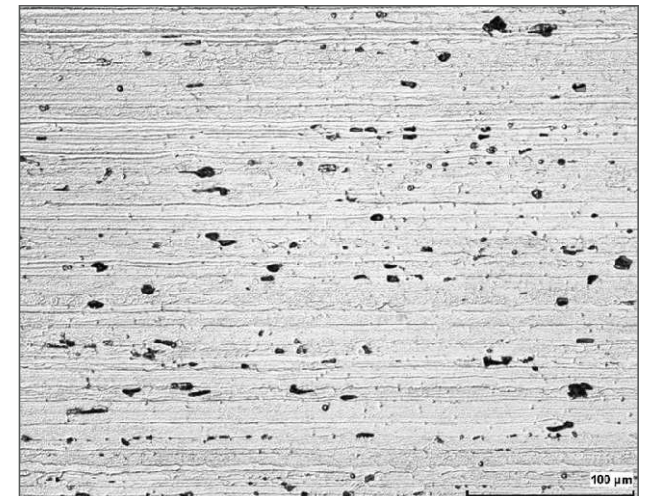
## EXTRUDED MATERIAL

### Structure characteristics - longitudinal-section polish

- precipitation evenly spread
- In direction of fibre partial higher stability

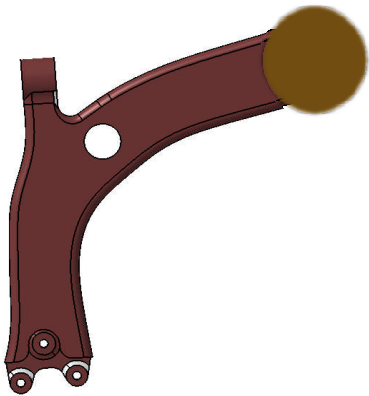


precipitation distribution  
polished

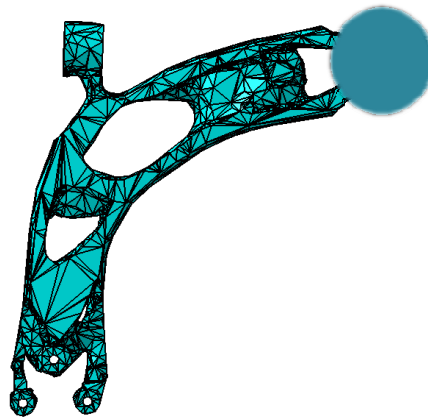


Crystalline structure  
etched

## IMPROVEMENT OF SHAPE AND TOPOLOGY



Take-off weight 2,1 kg



Weight reduction: 17%



Target weight 1,75 kg

### Funktional model

- Available space
- Connections
- Conditions

### Topological improvement

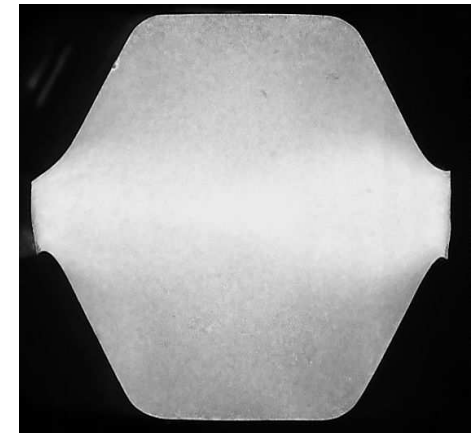
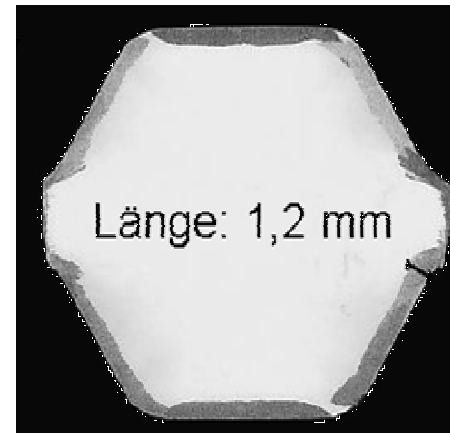
### Shape improvement linear elastic analysis of stress and deformation

### Forging part Consideration of forging process

## PROCESS IMPROVEMENT

### Additional measures within process

- Choose suitable forming strategies (e.g. method or number of forming levels, considering direction of fibre)
- Optimized heat treatment adapted for the parts requirements (e.g. T5 process)
- Insert internal stress using shot-blasting
- Additional improvement of resistance to corrosion by optimized shot-blasting material
- Use of pre-material free from tension



E.g. measures to avoid coarse grain

- Select pre-material free from tension
- Adjust forming levels
- Modify forging temperatures
- Adjust mould temperature control
- Modify temperature and time of solution heat treatment

## OUTLOOK MARKET DEVELOPMENT ALUMINIUM FORGING PARTS

Car applications	Quantity	↑	Potential on improvement of alloys	↑
	Quality	↑	Long-time experience in	
Demand for highest mech. performance		↑	large-volume production	↑
Plattform strategies			Innovative process improvements	↑
global production capacities		✓	Growth of capacity	✓
highest quality		✓	Global production structures	✍
best cost level		✓	Further cost improvements	✍
reliable supplier		✓	Partnership customer ↔ supplier	✓



**Thank you very much for your  
attention!**