Tailor made alloys for crash and structural applications

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Aleris International Inc.

Aleris is a global leader in the production and sale of aluminum rolled and extruded products, recycled aluminum, and specifications alloy manufacturing

Global Headquarters in Beachwood, OH, a suburb of Cleveland (USA)

Approximately 42 production facilities in North America, Europe, South America and Asia

Approximately 7,000 employees

Aleris Europe Business overview

Rolled Products

- 2 Western Europe Plants
- Capacity: 430´000 tons
- 2´600 Employees ca.
- 1.1 Billion EUR Sales

Key Applications

- Aerospace
- HT/ NHT Plate
- Automotive
- Transportation
- Heat Exchangers
- Standard Sheet & Coil

Extruded Products

- 4 Western Europe Plants
  1 China Plant
- Capacity: 130´000 tons
- 1´300 Employees ca.
- 0.3 Billion EUR Sales
- 11 Presses: 16 to 90 MN

Key Applications

- Aerospace
- Automotive
- Rail
- Engineering
- Building & Construction
- Distribution

Recycling

- 6 Western Europe Plants
- Capacity: 550´000 tons
- 600 Employees ca.
- 0.5 Billion EUR Sales

Key Applications

- Wrought alloys
- Foundry alloys
- Magnesium

Aleris Aluminum Extrusions

Global Extrusions Division

Plant **Vogt:**
- 2 Presses (28MN, 45 MN)
- Sawing, BUG system, Automotive, Building & Construction, Engineering

Plant **Bitterfeld:**
- 2 Presses (20MN, 42 MN)
- Engineering, Automotive, Building & Construction

Plant **Bonn:**
- 2 Presses (43MN, 90MN)
- Welding, CNC, Casthouse
- Railway (Highspeed-trains, Trams, Metros) & Ship, Long Profiles, Automotive

Plant **Duffel:**
- 2 Presses (16 MN, 50MN)
- Casthouse, drawing, US inspection
- Aircraft, defense &Automotive in hard & machining alloy

Plant **Tianjin:**
- 1 Press (55MN)
- 28MN Q2 2012
- Railway/Metro and Transport, Automotive

1. Cast house: External billet sales, possibilities

- Two (2) furnaces and casting units @ total capacity of 24.000 to/a
- Five (5) homogenising units and a cooling station
- Different turning lathes
- Ultrasonic testing on billets possible
- Special liquid metal treatment

- **Over 150 alloys**
- **High quality cast products**
- **Diameter 178mm to 750mm**

Cast house - product example

Billets for the Aircraft Industry

Green Area

Billet: Ø590 x 1.450 mm
(Ø23.2” x 4.8 ft)
Alloy: 2219 - 100% US

Red Area

Billet: Ø590 x 1.450 mm
(Ø23.2” x 4.8 ft)
Alloy: 6061 - 100% US

2. Extrusion Automotive

Products

- All type of alloys, all tempers
- Profiles (bridge die) to customer design
  - Thickness range 1-200 mm
  - Circumscribed circle up to 330mm
  - Profile weight from 0.2 kg/m to 350 kg/m
- Drawing capacity from 9mm to 120mm
- Further fabrication if desired (internally/externally)
  - Cut to length, bending, machining
  - Anodizing, washing

Applications

- Structural parts
  - Crush cans, side impact beams
  - Bumpers
  - Chassis profiles and stiffeners
- Suspension parts (forging)
- Brake systems
  - ABS housings, actuators
- Automatic gearbox actuators
- Airbag ignitions

Adjusting extrusion Process steps

Aleris' long term experience and strength

casting &homogenizing

Billets Preheating

Extruding

Cooling

Stretching

Die & tooling know-how

Cutting

By adjusting each process step to that of customer's process best results are achieved

Shipment

Final check & release

Heat Treatment

Quality Control during process

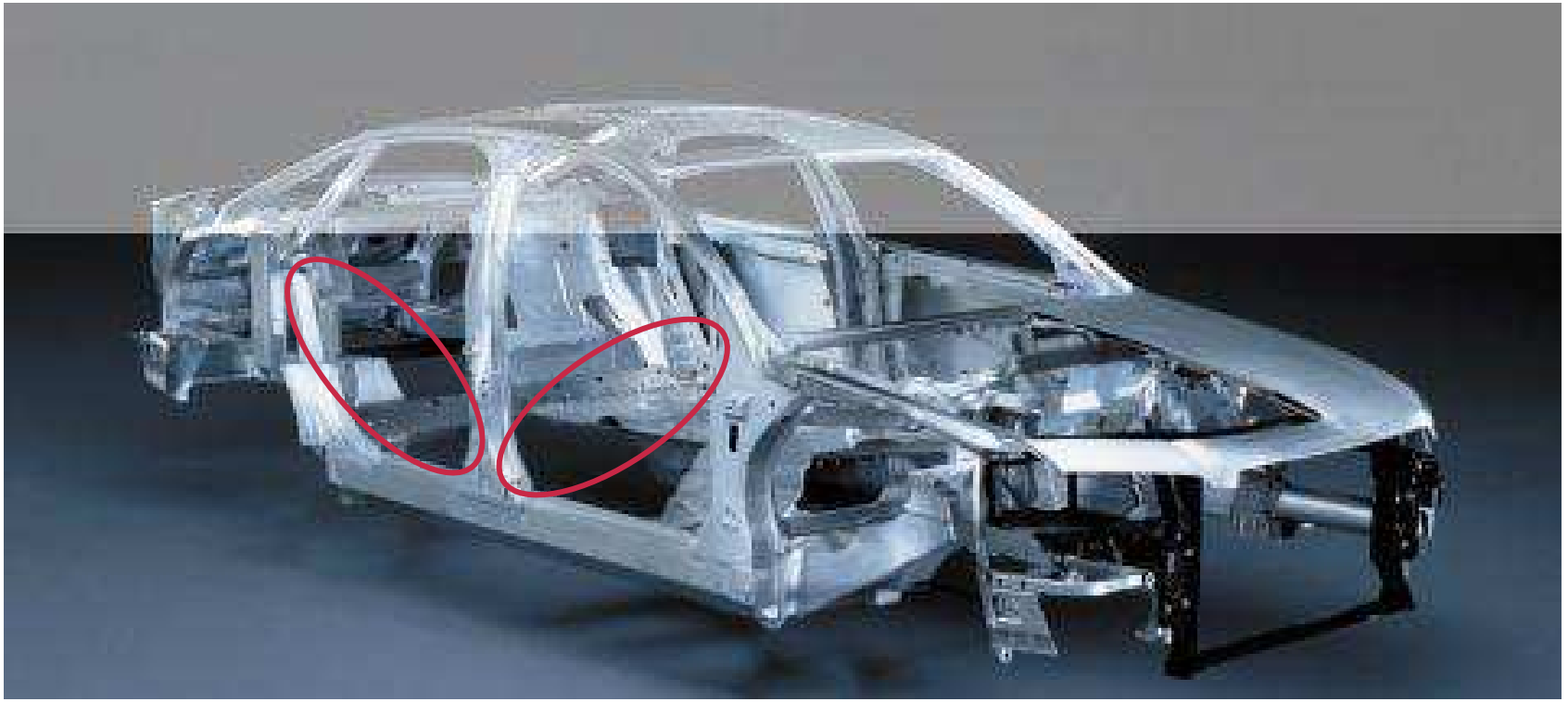
Adjusting extrusion Process steps

Aleris' long term experience and strength

- Early stage contact between Aleris' engineers and customer
  - Better understanding of product needs and processes
- Adjusting:
  - Alloy compositions
  - Thermal heat treatments
  - Process parameters
  - Profile design
- Test order processing and adjustments accordingly
- Validation of entire process

Examples of Automotive process adaptations

Structural profiles



Automotive Components - EN AW-6082

Example of a Door Beam

Alloy EN AW-6082

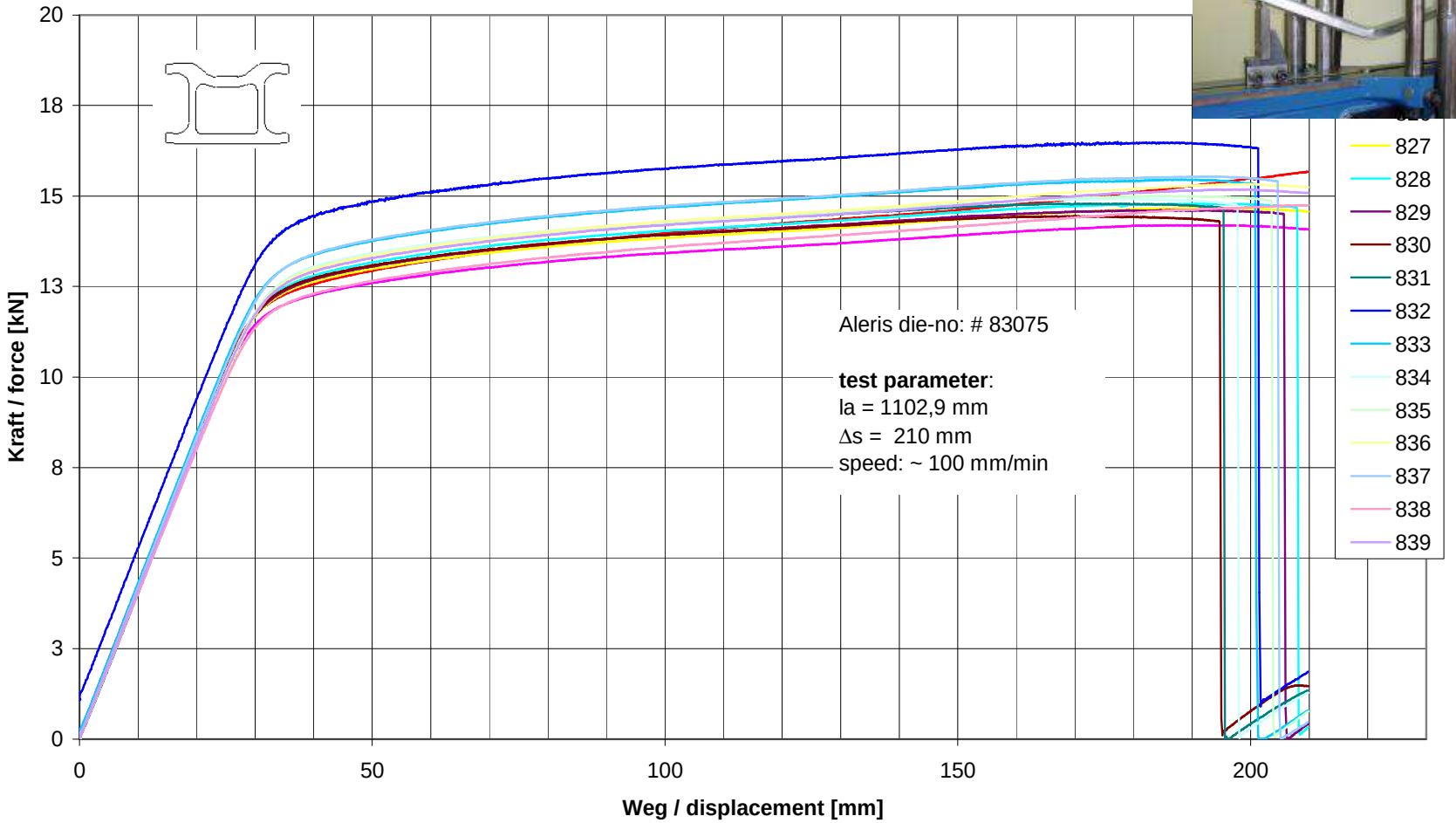
- Technical specification before Paint Bake:
  - YS: 295 ± 15 MPa
  - UTS : ≥ 325 MPa
  - A_{50} > 13%

- Technical specification after Paint Bake:
  - YS: 295 ± 15 MPa
  - UTS : ≥ 335 MPa
  - A_{50} > 12%

- Technical data (Energy Absorption) before and after Paint Bake:
  - EA at 165 mm: ≥ 1910 J
  - EA at 210 mm: ≥ 2650 J

Automotive Components - EN AW-6082

Aleris Aluminium Profiltechnik Bonn GmbH
Alloy EN AW- 6082

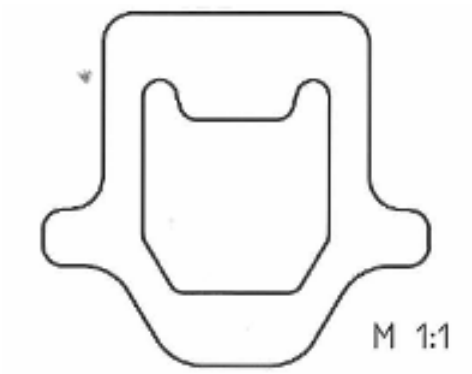


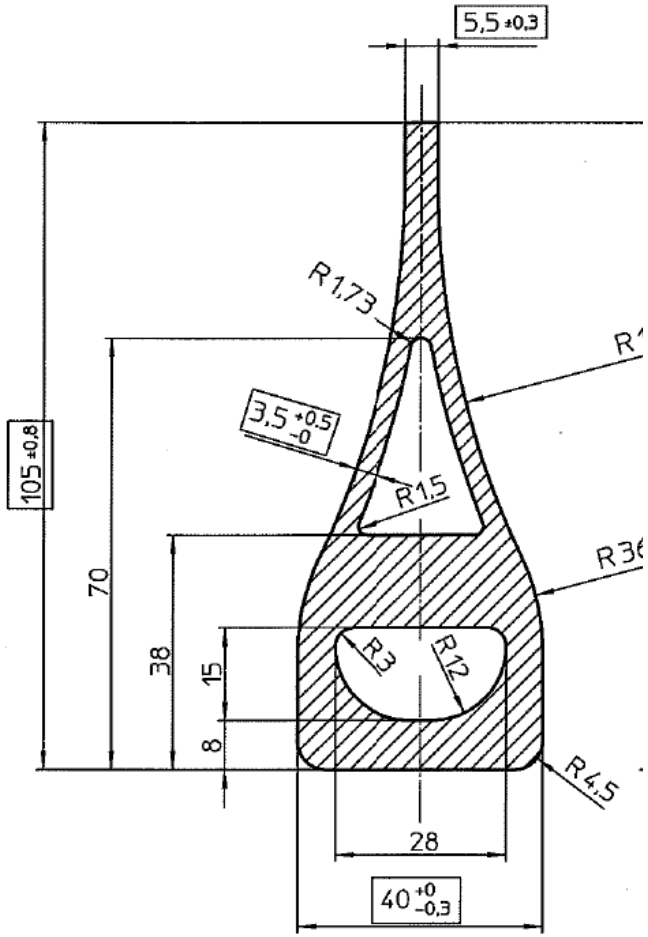
Typical 7xxx alloy, press quenched

- **Some examples typical shapes in serial production on direct presses**
  - High strength alloy, more difficult to extrude and worse corrosion performance
  - Typical wall thickness from 3 >15mm
  - Radius of 3mm to avoid hot tearing

- **Typical mechanical properties:**
  - medium: Rm:375 MPa, Rp 0.2: 325 MPa
  - high : Rm:387 MPa, Rp 0.2: 345 MPa

- **Improvement process on the alloy:**
  - trial results: Rm:440 MPa, Rp 0.2: 420 MPa





Examples of Automotive process adaptations

Structural profiles

Automotive Crash Elements

Requirements for crash elements:

- **Mechanical characteristics**
  - ✓ YS and UTS within a well defined field of tolerance
  - ✓ Good elongation values (repeatable energy absorption)
- **Formability**
  - ✓ Excellent, repeatable formability
  - ✓ Realisation of high deformation
  - ✓ Crack formation may not negatively influence the function of the part
- **Thermal stability**
  - ✓ Short term thermal stability: 1h – 205℃
  - ✓ Long term thermal stability: 1000h – 150℃

Automotive Crash Components - EN AW-6060

Example of a Beam System : Low Strength Application Crashbox

Crashbox; Alloy EN AW-6060

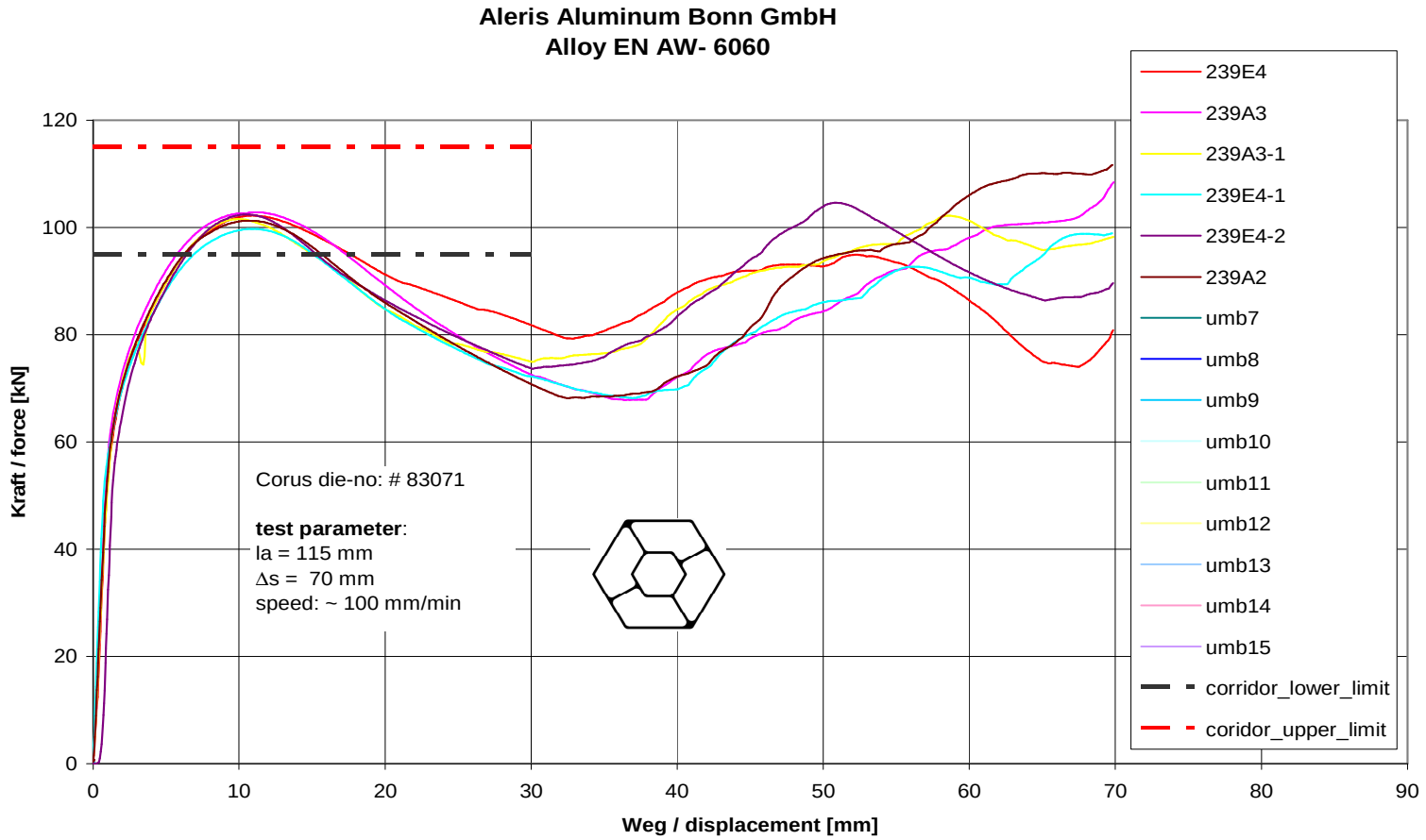
- Technical data:
  - YS: 70 ± 10 MPa
  - UTS : 145 ± 15 MPa
  - A_{50} > 18%

Tested Sample: uniform folding, no crack presence

Automotive Crash Components - EN AW-6060

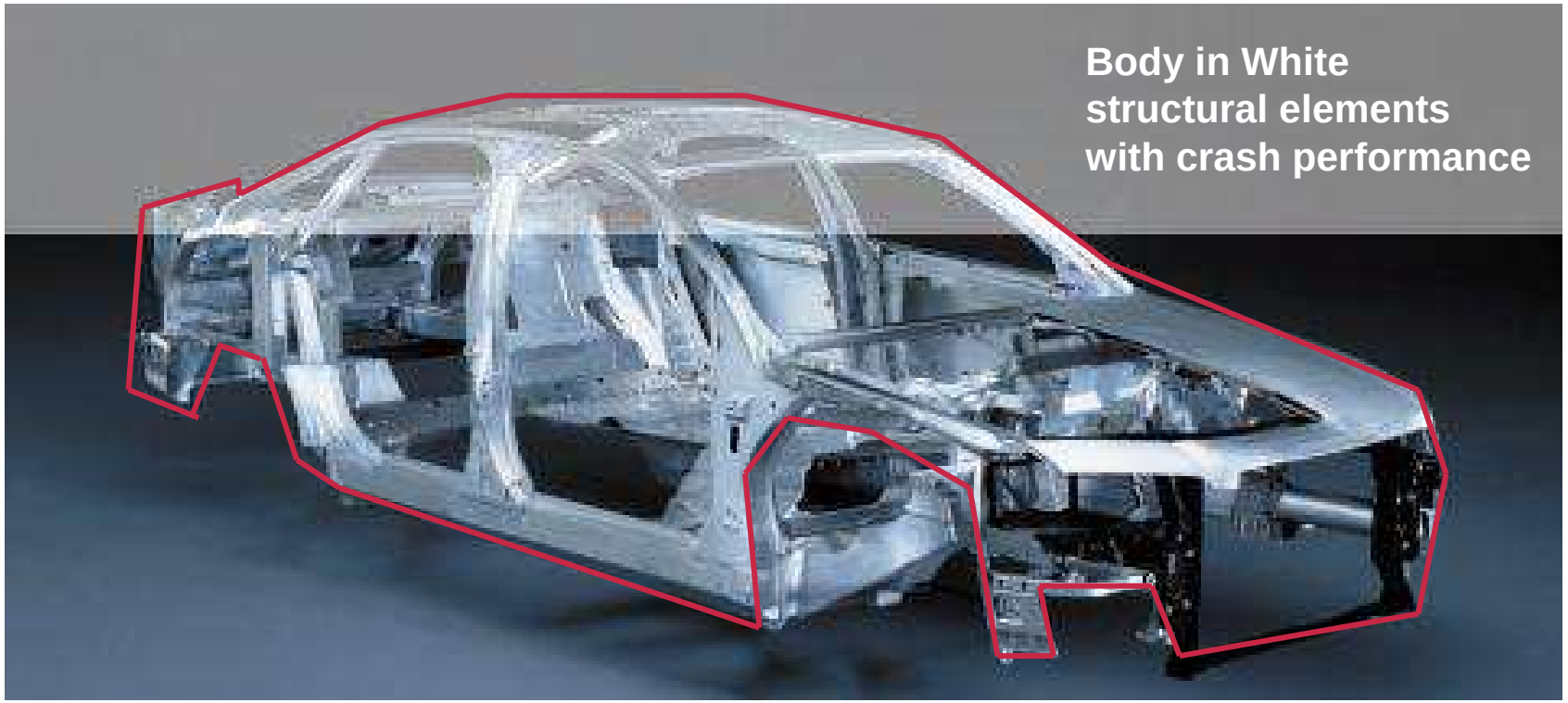
Energy Absorption

- min. Absorption Peak: 4600 J
- Energy Peak: 95 -120 KN



Examples of Automotive process adaptations

Structural profiles



Automotive Crash Components - EN AW-6008

Example of a structural part

Alloy: EN AW 6008 (8 chambers)

- Requirements:
  - YS > 240 MPa
  - UTS > 260 MPa
  - A_5 > 11%
  - uniform folding
  - no crack formation
  - repeatability of the energy absorption

- Thermal Stability
  - after 1h at 205°C: YS > 240 MPa
  - 1000h at 150°C: YS > 230 MPa

Automotive Crash Components: C 28

Example of a high strength crash alloy:

- Technical Data:
  - YS > 280 MPa
  - UTS > 305 MPa
  - A_5 > 10 %
- Thermal Stability
  - after 1h at 205℃: same as above
  - 1000h at 150℃: YS > 265 MPa

- uniform folding
- no crack formation
- repeatable energy absorption

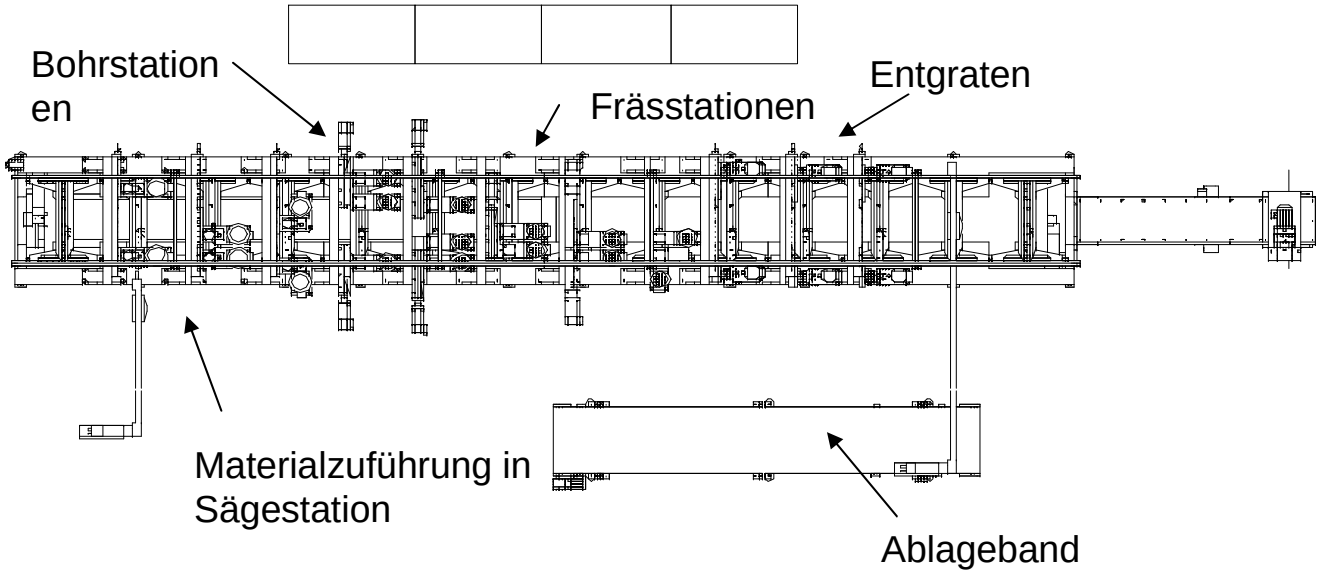
You need technical support ?

We have solutions for all kind of structural applications

- Whole alloy range from 6060 , 6082 , 6008 towards 7xxx
- depending on requirements about strength, corrosion, energy absorption…
- If desired complete finishing lines can be build

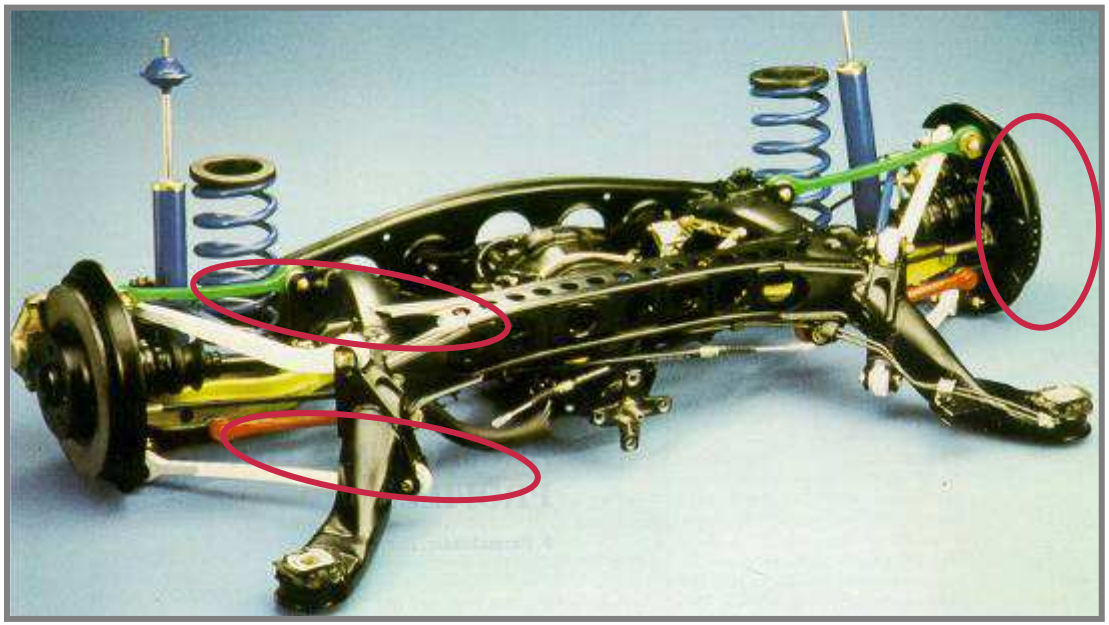
Aleris special equipment lines in the Vogt plant

Dedicated machining line for stiffeners



Examples of Automotive process adaptations

Forging material



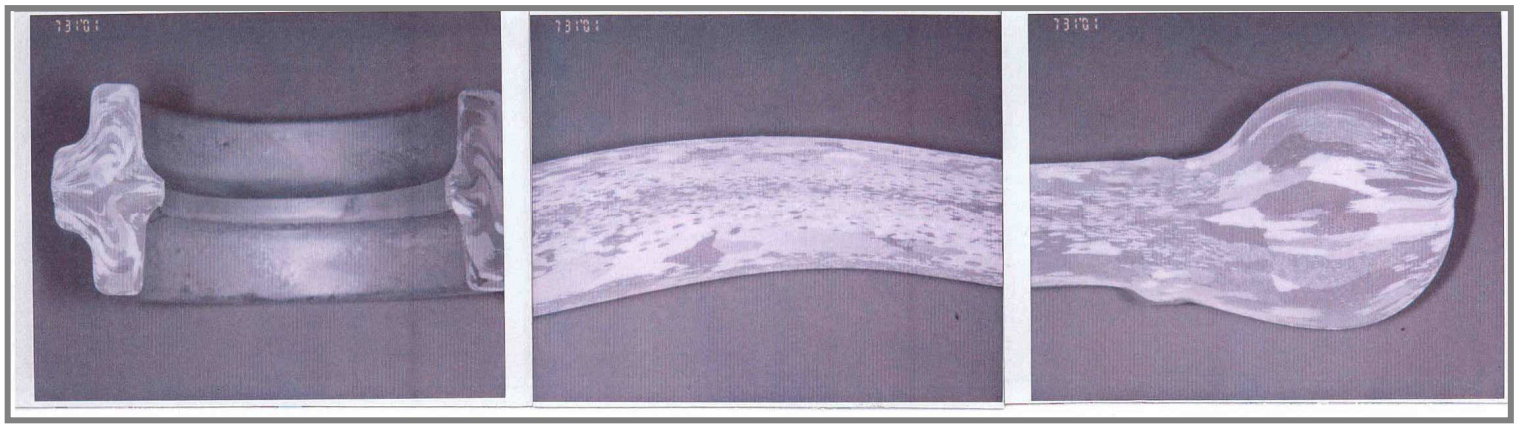
- Several high strength 6xxx forging alloys within the EN AW 6082 range are developed
- Patented EN AW 6182 with improved recrystallization behavior
- High strength/high temperature EN AW 2618A

- Important to choose this alloy that guarantees final mechanical properties with biggest operating process window

Examples of Automotive process adaptations

Forging material

Standard 6082: completely recrystallised

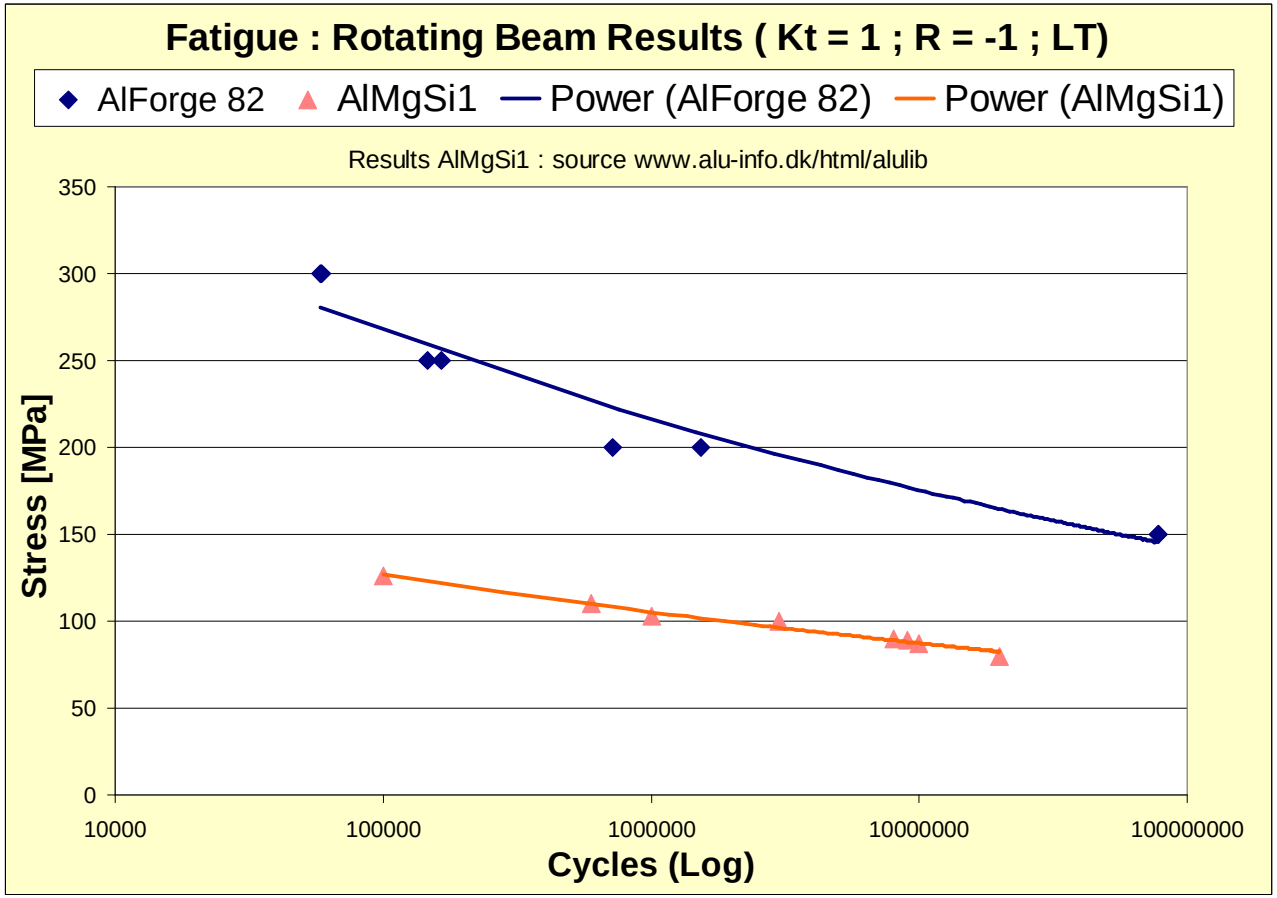


Aleris optimized 6182: not recrystallised

Examples of Automotive process adaptations

Forging material

Improved recrystallization behavior results in higher mechanical values and better fatigue performance



Examples of Automotive process adaptations

Forging material

- Several Aleris 6082 variants achieve high mechanical properties in T6 temper with proper heat treatment and have high resistance against recrystallization.
- Typical values:
  - Rm : 430-450 Mpa
  - Rp0.2: 390-420 Mpa
  - A5 : 11-12%
- Extruded rods show fibrous structure with elongated grains and possible pores are closed or squeezed by the extrusion process, attributing to improved fatigue properties and higher tensile strength in L-direction compared to cast products.
- This makes the Aleris forging rod ideal pre-material for your high strength applications

- Optimize together with Aleris the balance between:
  strength/ductility/quench sensitivity and corrosion resistance

Conclusion

- **Aleris‘ Portfolio of alloys covers a wide range of applications in the crash and structural sectors of the automotive market, with standard and customized alloys, both in the 6xxx and the 7xxx series.**

- **Aleris, with the in house knowledge of its own cast house and extrusion lines, always has the possibility of offering a customised solution to meet the different needs of the customers in the automotive market.**

Q & A ?

Thank you for your attention