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Automotive

Lightweight Chassis Cradles

Dr. Lothar Hein & Ken Weise
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Why Benteler Light Weight Steels?

- Benteler light weight steels can provide significant mass reductions, approaching that of aluminum, at significantly lower cost.
- Benteler's steel making expertise allows for formulations tailored to the needs of the automotive industry.
- Benteler uses different types of materials and processes depending upon the vehicle and component needs.
- Heat treatment during the component manufacturing process allows the engineer to optimize yield, tensile and elongation, thus saving weight.

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Benefits of BTR165 and BAS100

BTR 165 (for hot forming)

- ⇨ Ultra high strength with good ductility
- ⇨ High crash resistance and fatigue strength
- ⇨ Good weldability with conventional techniques
- ⇨ Exact part shape; no springback-effect
- ⇨ Forming of complex parts possible

High Potential combinations of material and process

BAS 100 (for post forming heat treatment)

- ⇨ Ultra high strength with excellent ductility
- ⇨ High crash resistance and fatigue strength
- ⇨ Good weldability (high strength over weldseam)
- ⇨ Different material conditions adjustable
- ⇨ High tempering resistance up to 600°C
- ⇨ Batch galvanizing without loosing strength

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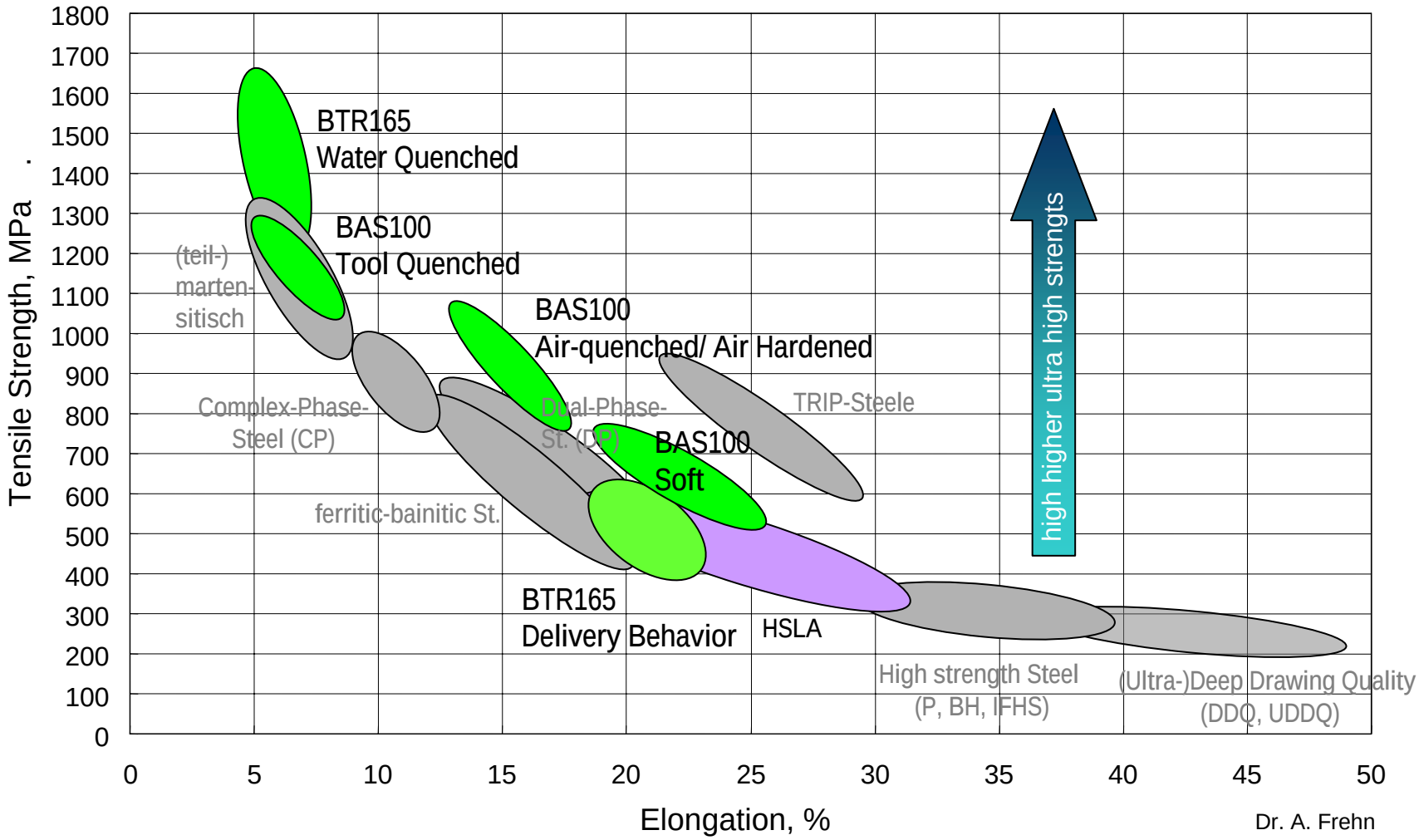
Chassis Materials



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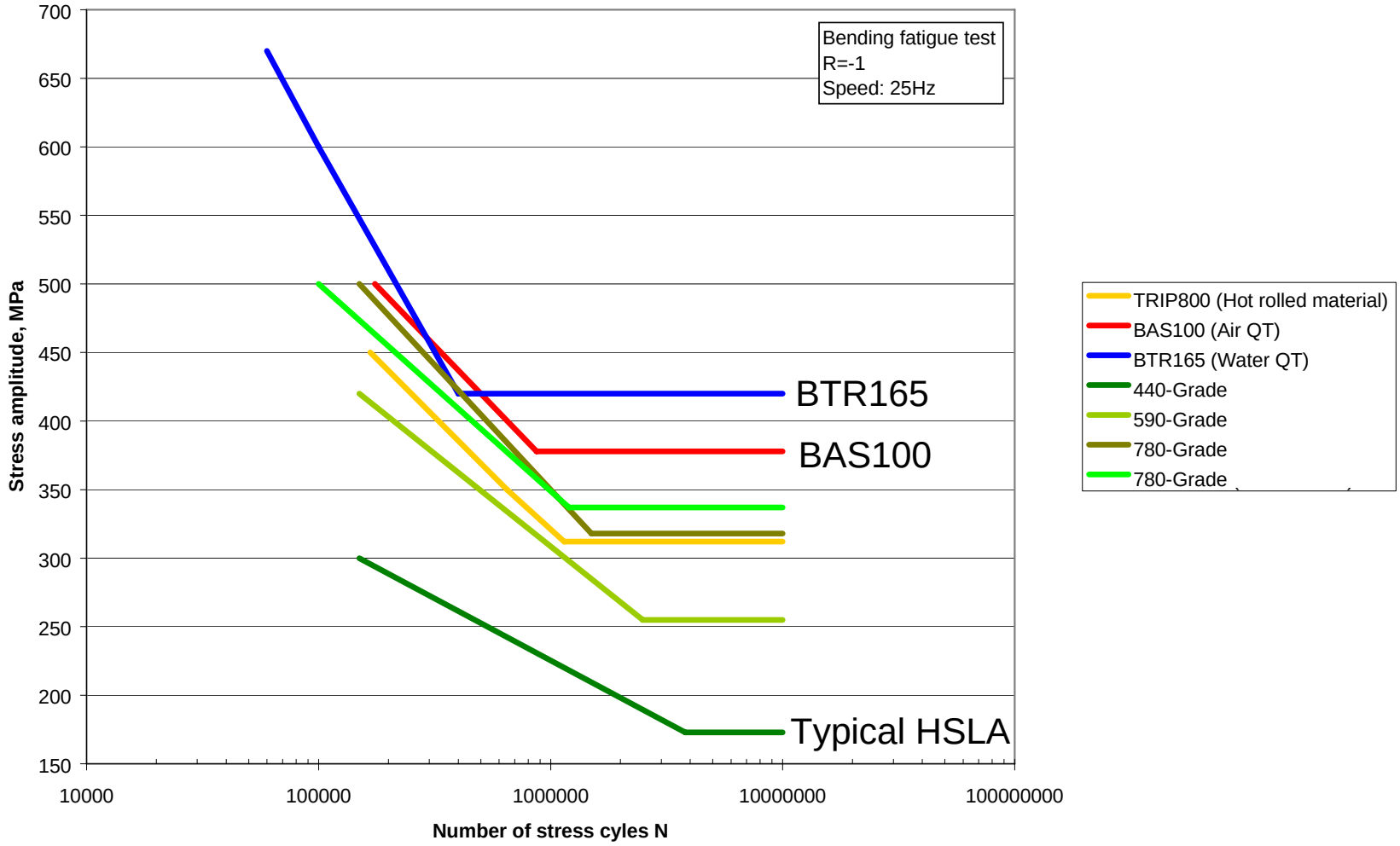
Bending Fatigue Properties



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General Information - BTR 165

BTR 165:

- A steel grade developed by Benteler
- successfully used for structural and chassis components
- Manganese-Boron-alloyed QT-steel
- Optimised for the hot forming process
- Good formability in the soft annealed condition and ultra high strength in hot formed components
- A steel with good weldability (with conventional welding techniques)
- Free of spring back effects in hot formed components
- Has sufficient ductility for chassis components
- Available as cold and hot rolled strip, ERW- and seamless tubes
- Available worldwide including also Asia-Pacific

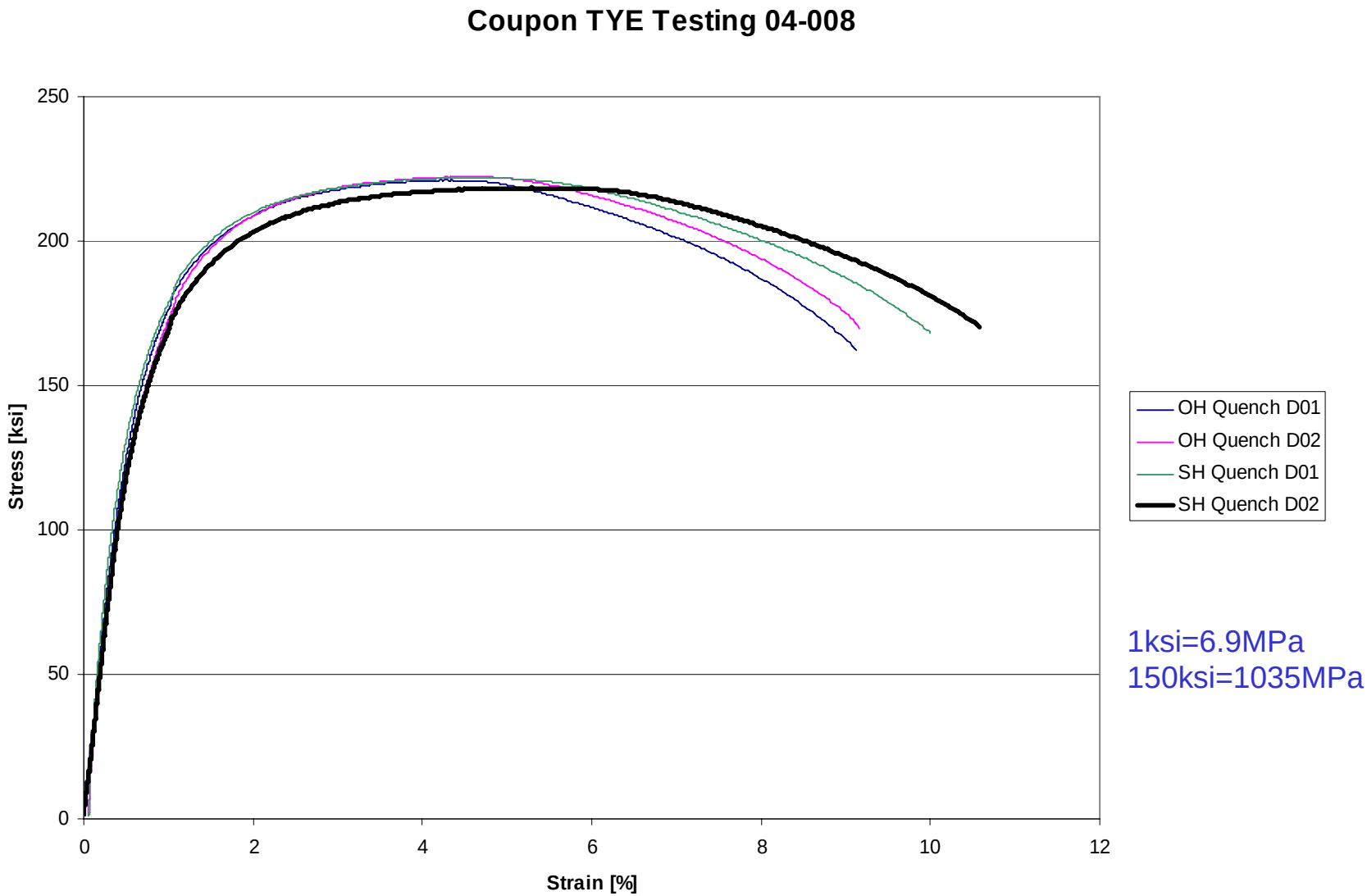
Typical microstructure after hot forming: 100% martensite

Material Properties – BTR165

BTR165	Condition of delivery	R_e, MPa	R_m, MPa	A_5, %
	Water quenched, annealed at ~ 250°C	min. 1100	1400-1850	min. 8
	Water quenched, annealed at ~ 630°C	min. 900	1000-1300	min. 10
	Normalised	min. 320	520-640	min. 20
	Soft annealed	min. 250	min. 400	min. 20
	BKS	min. 500	min. 650	min. 15

Bending Performance of BTR165

BTR165 TYE Properties



1ksi=6.9MPa
150ksi=1035MPa

General information - BAS100

BAS100:

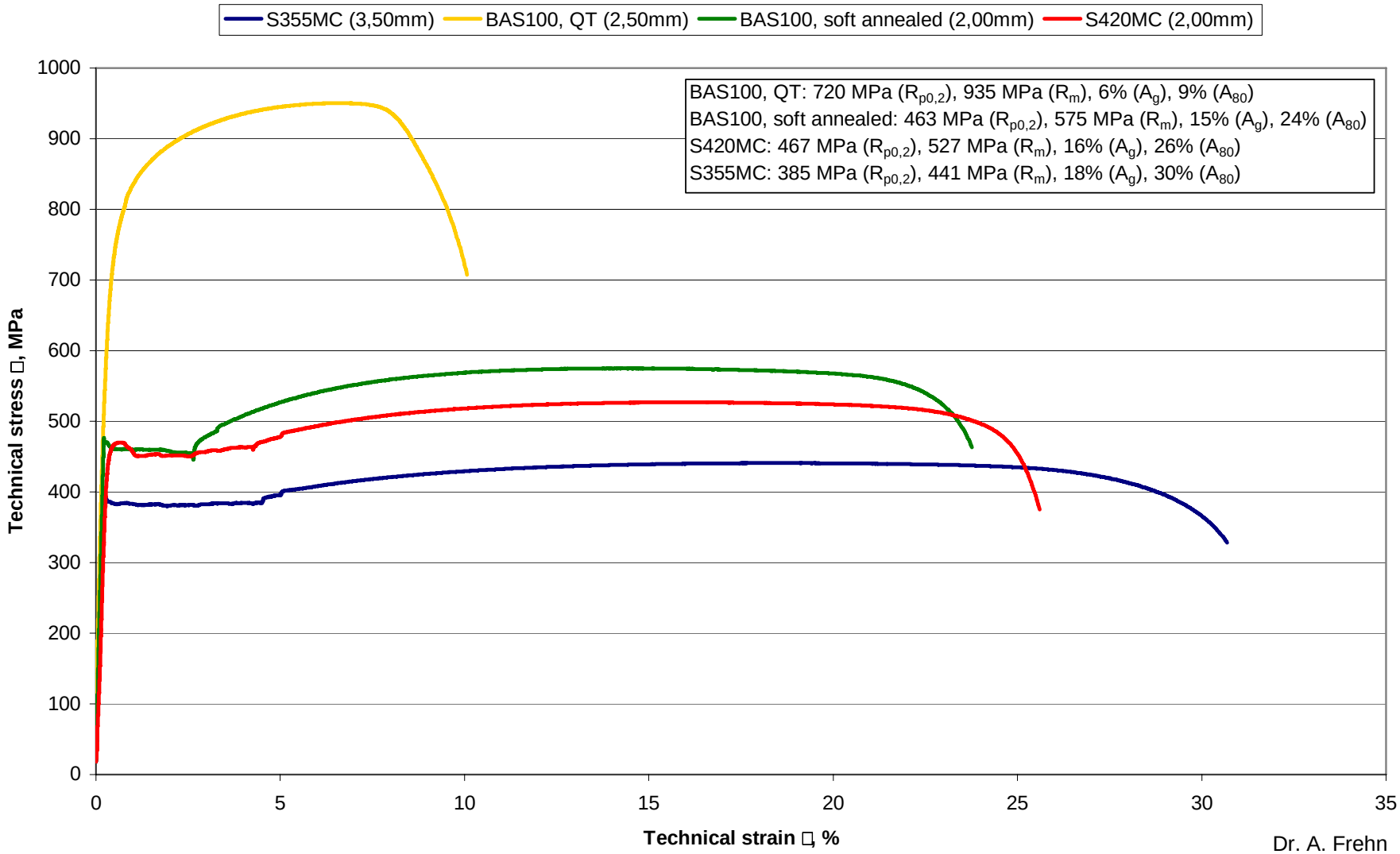
- A steel grade developed by Benteler
- An air-hardening steel mainly alloyed with Mn-Cr-Mo-V
- Combines good formability in the soft annealed condition and high strength in the post forming heat treatment condition
- A steel with excellent weldability due to the low Carbon content
- Showing no hardness decrease over weldseams due to self-QT-effects
- Has good ductility and crash resistance for chassis components
- Stable regarding heat treatments up to 600°C (e.g.: tempering, batch galvanising, etc.)
- Available as cold and hot rolled strip, ERW- and seamless tubes
- Currently used for the front subframe of the Mercedes C-class

Typical microstructure after air-QT: Ferrite, Bainite, precipitations

Material Properties – BAS100

BAS100	Condition of delivery	R_e, MPa	R_m, MPa	A_5, %
	Air quenched	min. 700	950-1100	min. 14
	Air quenched, annealed at ~ 600°C	min. 700	850-1000	min. 15
	Soft annealed	max. 650	max. 750	min. 18

TYE Properties of BAS100



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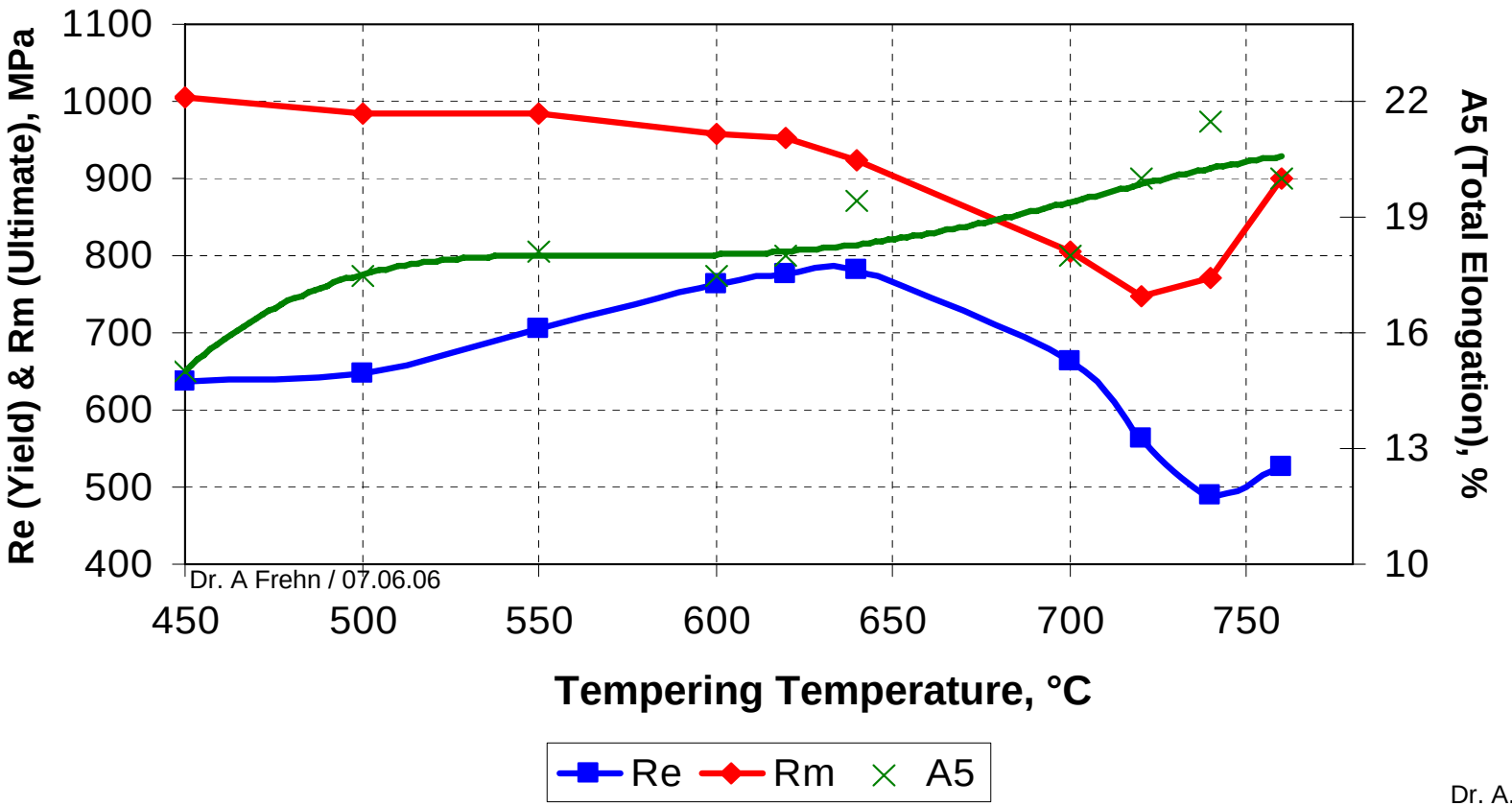
Temperature Effects on BAS100



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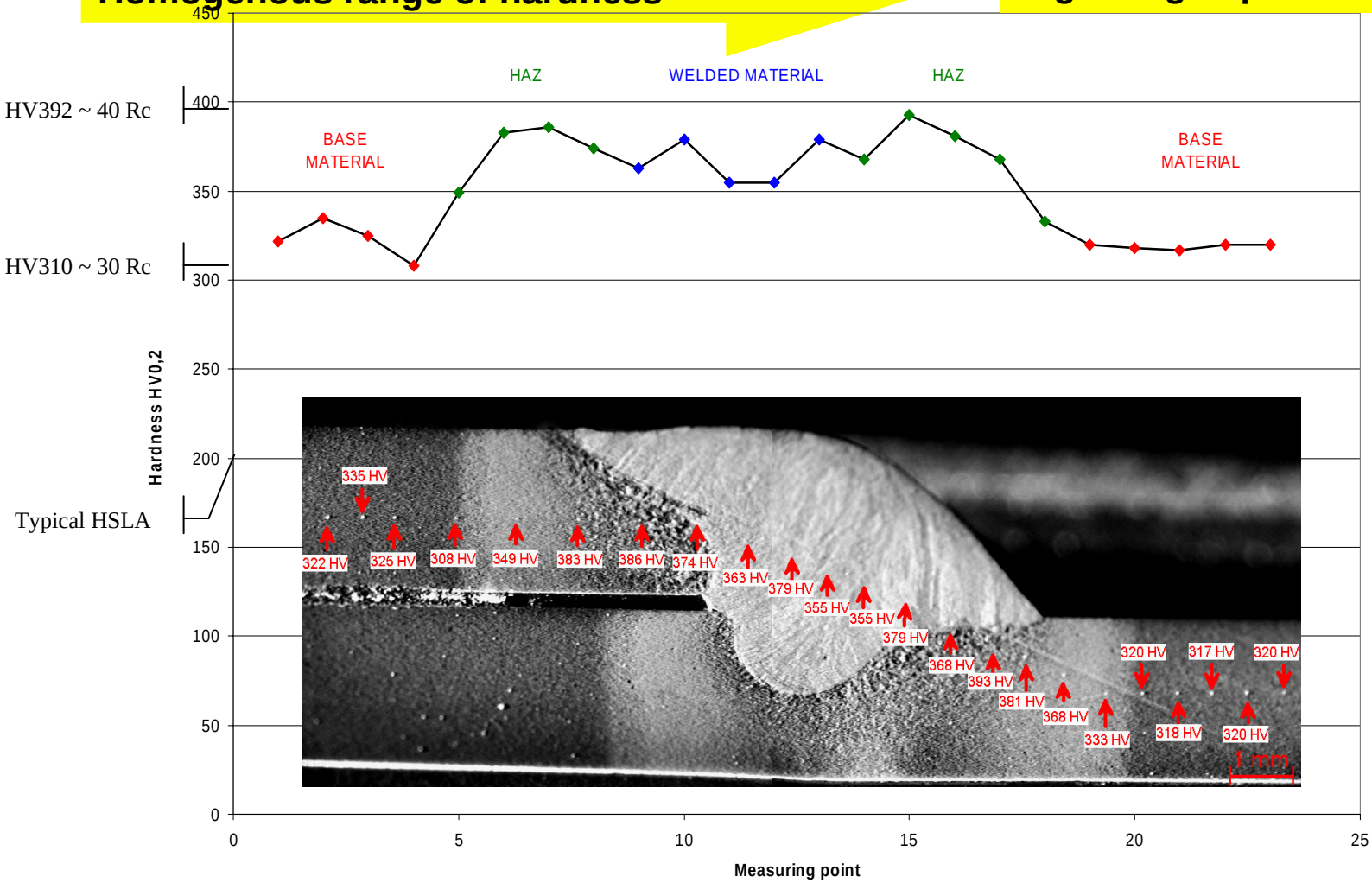
Heat Affected Zones – BAS100

Homogenous range of hardness

High fatigue performance



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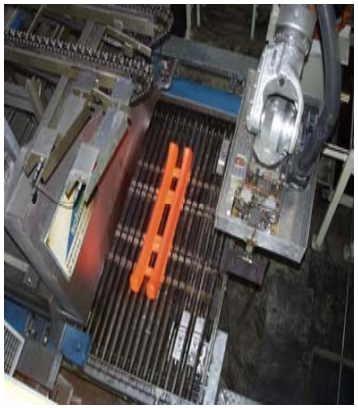
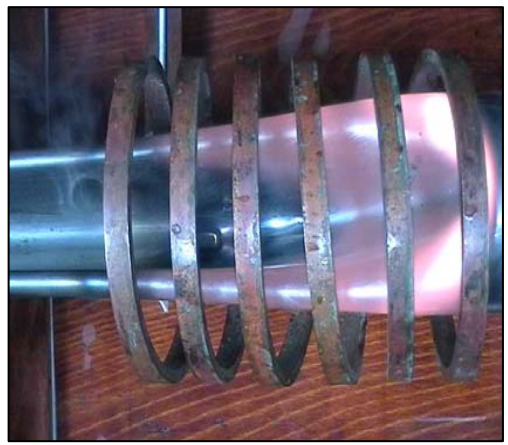
Heating Options



Possibilities of heating

- **Inductive Heating**
- **Gas Oven**
- **Electric Resistance Heating**
- **Salt Bath Heating**
- **Radiating Heating**
- **Contact Heating**



Inductive Heating

- What is it?
  - A process where specialized Benteler steels are inductively heated and water quenched to locally increase the yield strength of the steel.
- What materials are used?
  - Post form heat treatment is accomplished with one of two specialized Benteler steels; BTR165 and BAS100.
  - Both can obtain high yield strengths while maintaining good elongation.
  - Both have excellent welding capability.
  - BAS100 is air quenched, minimizing heat affected zones in welding areas.
- Useful for any area needing light weight and high strength.

Oven Heating

Gas fired furnace heats the part to working temperature.

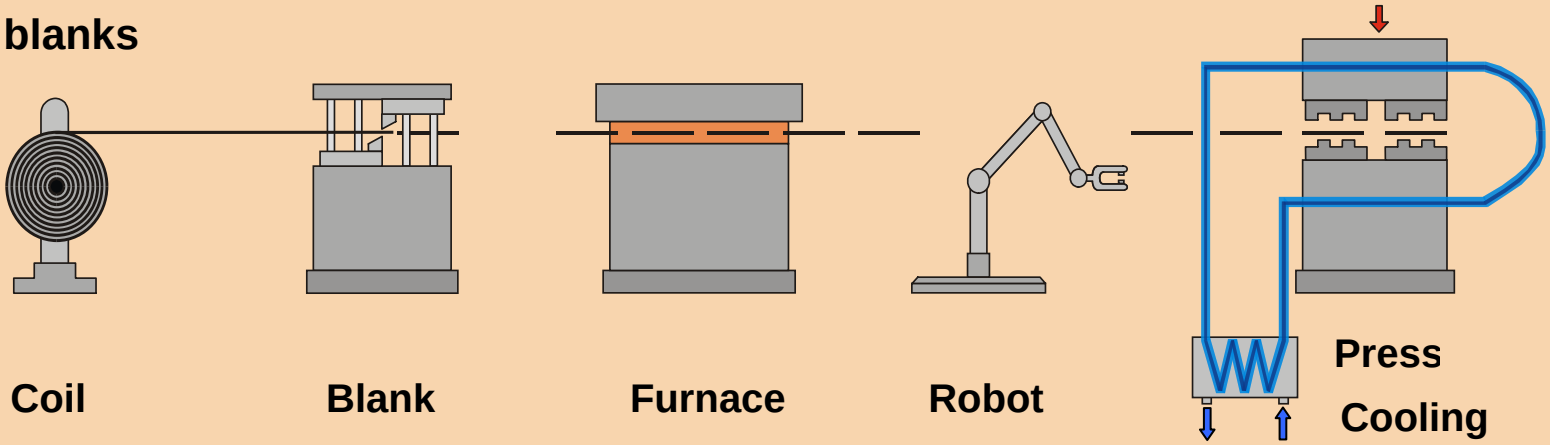
- Suitable for single components or fully welded assemblies.
- Can be configured for heating, tempering, annealing, or any combination thereof.

Full Assembly Heating and Tempering Oven

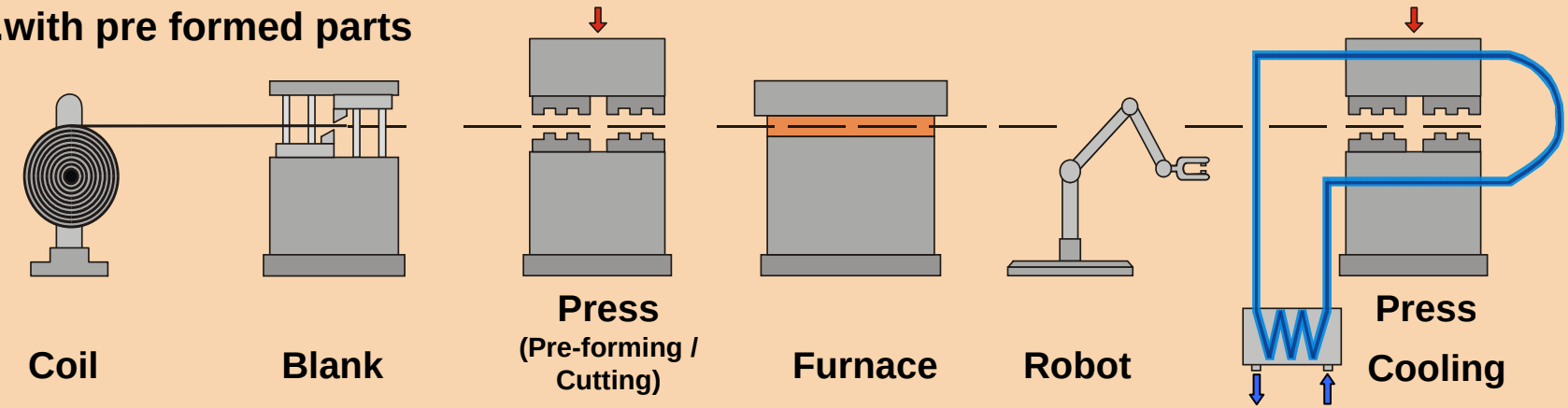
Component Oven

Hot Stamping

... of blanks



...with pre formed parts



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Benteler Hot Stamping Locations

Total: 30 Lines in production
1 Lines under construction
2 Lines planned
(w/production orders)

First hot stamp line launched in 1991

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Goshen	6 Hot stamp lines
Puebla	2 Hot stamp lines
Campinas	1 Hot stamp lines 1 Hot stamp line planning

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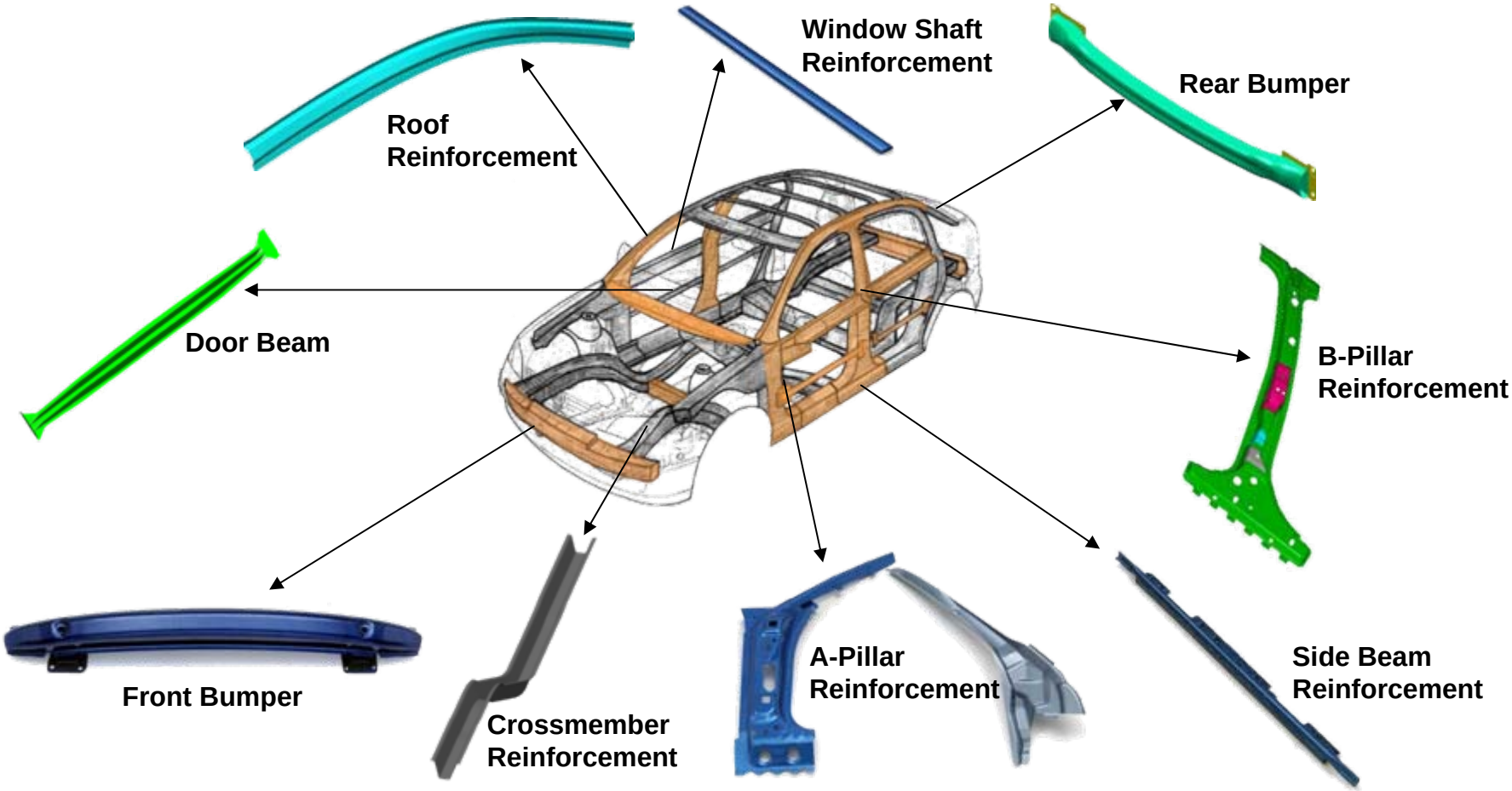
Paderborn	10 Hot stamp lines 1 under construction 1 prototype line
Migennes	3 Hot stamp lines
Burgos	2 Hot stamp lines
Vigo	1 Hot stamp line
Chrastava	3 Hot stamp lines
Rumburk	1 Hot stamp line
Changchun	1 Hot stamp line
Shanghai	1 Hot stamp line planning

Aisin Takaoka

Japan	3 Hot stamp lines

Current Hot Forming Applications



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Hot Stamping Portfolio

45,000,000 Hot Formed Parts in 2006

Case Study – Aluminum Replacement

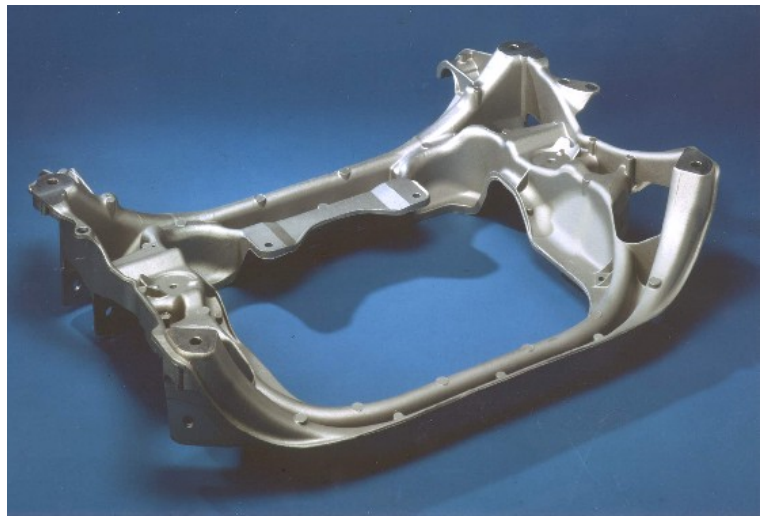
Mercedes W204 (C-Class) Engine Cradle

Prior (W203) Design:

- Die cast aluminum cradle.
- Added parts to manage crash.

W204 Design Objectives:

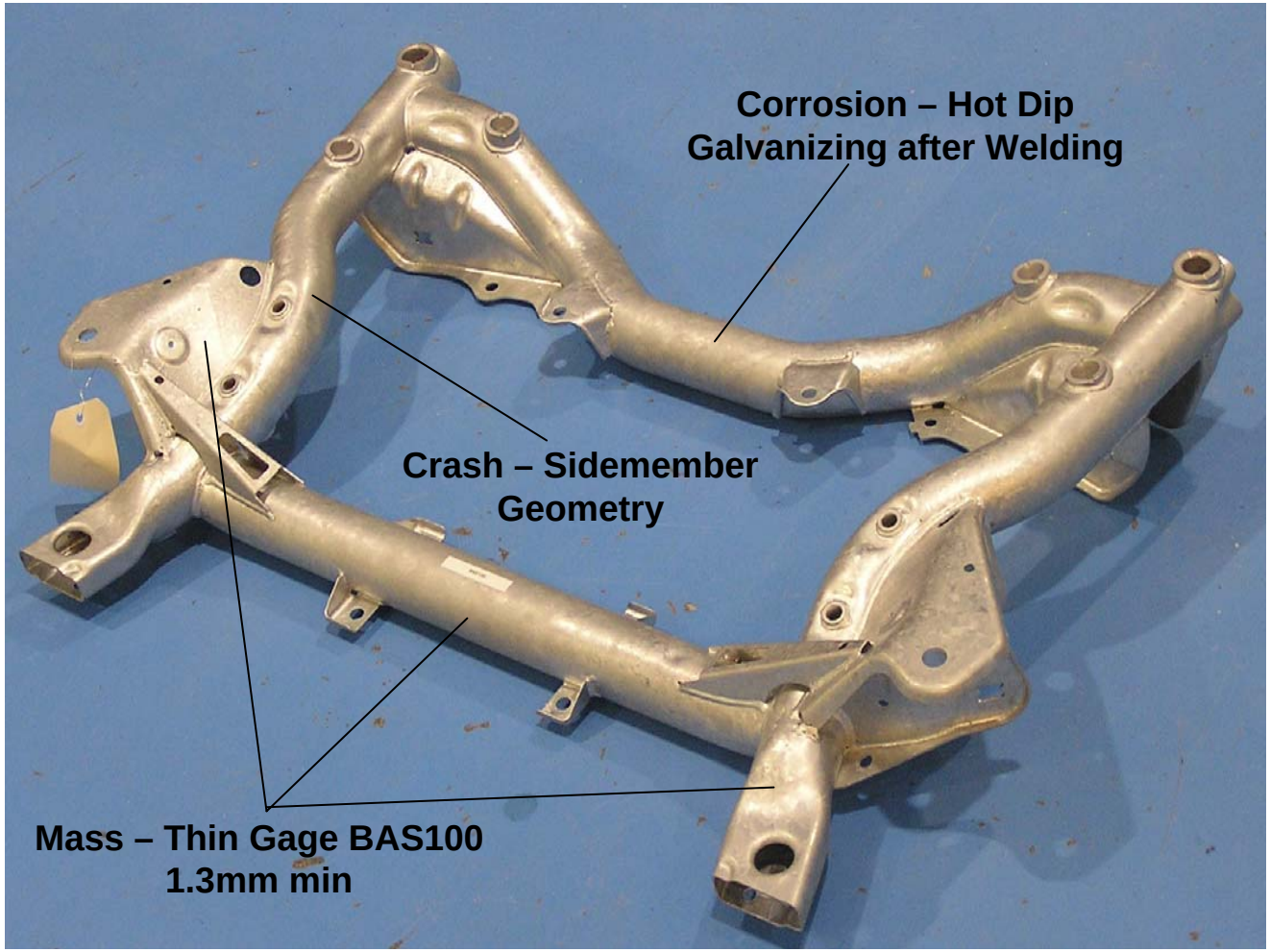
- Crash Energy Absorption
- Reduced Mass
- Reduced Cost



Mercedes W203 Front Cradle
Aluminum Die Casting – 14kg

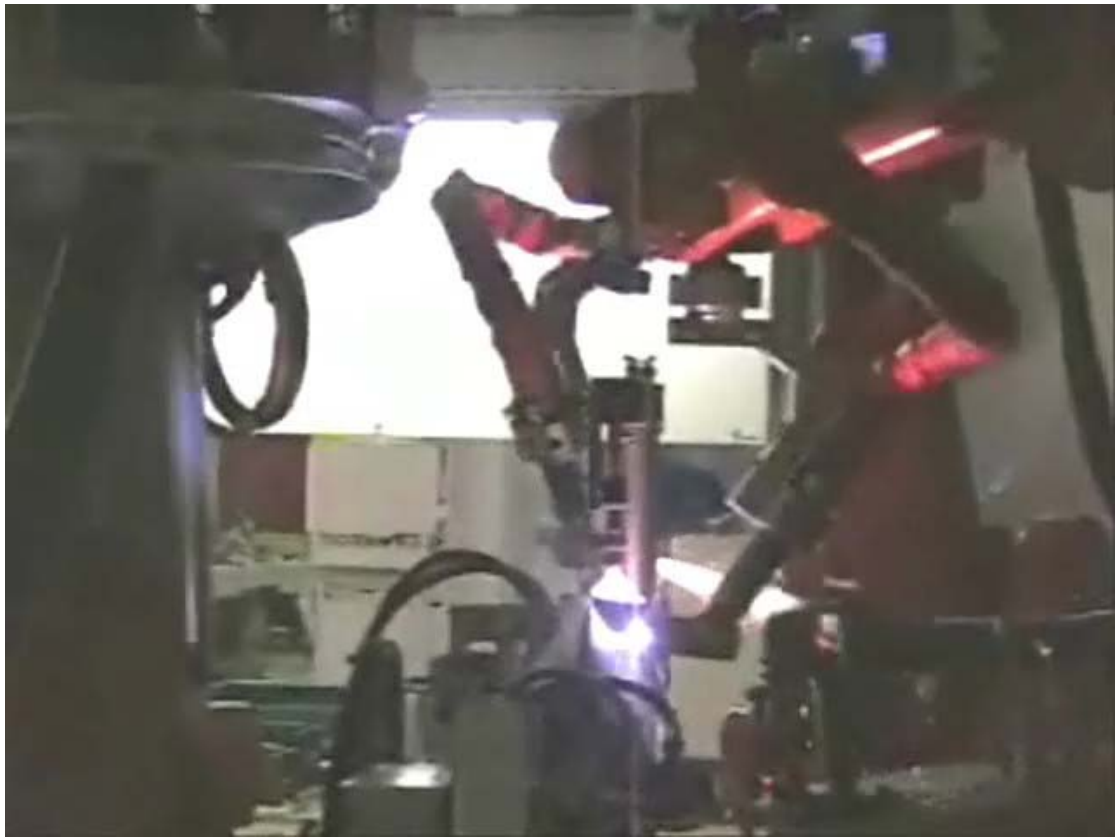
Case Study – Aluminum Replacement

Design Constraints



Case Study – Aluminum Replacement

Manufacturing Constraints and Solutions



To ensure proper fit between the thin walled tubes and mating components, trim edges are plasma cut under a water fog.

Case Study – Aluminum Replacement

Manufacturing Constraints and Solutions

Fully welded frames are hardened and tempered in a gas fired oven. Only materials compatible with this process are included in the design.

Case Study – Aluminum Replacement

Manufacturing Constraints and Solutions

Dimensional integrity is maintained by post heat treatment machining and punching.

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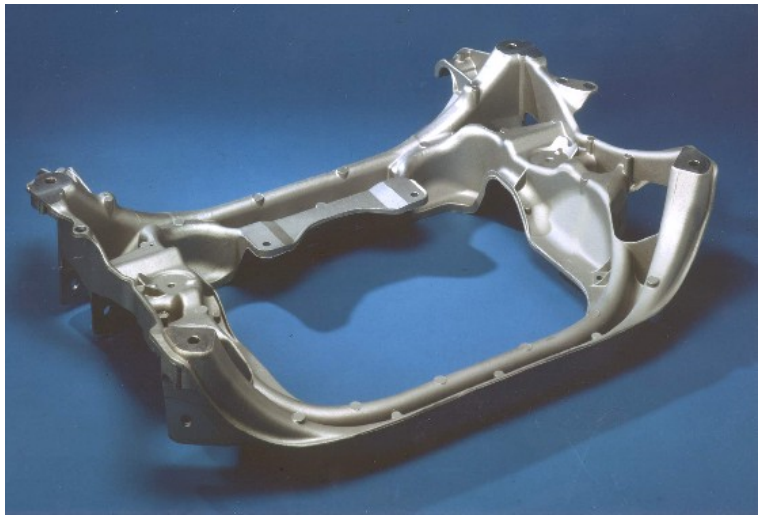
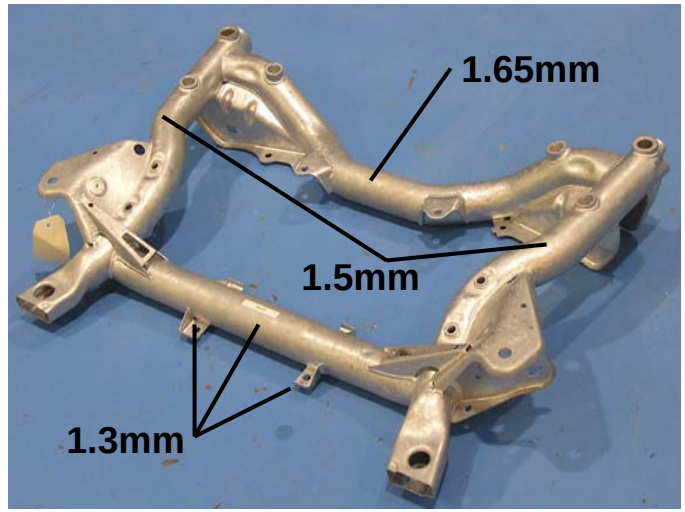
Case Study – Aluminum Replacement

Results



Mercedes W203 Front Cradle
Aluminum Die Casting – 14kg

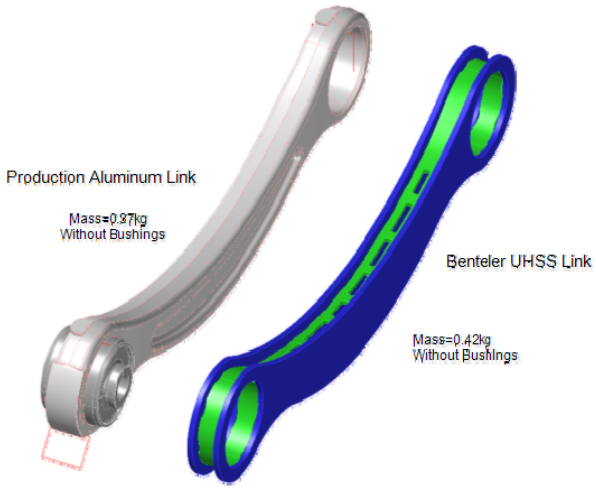


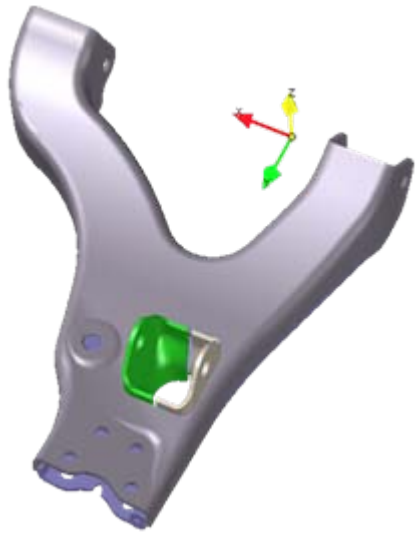
Mercedes W204 Front Cradle
Benteler BAS100 – 12kg

- Weight Reduced 14% (2kg)
- Cost Reduced 45%
- Crash Energy Managed

Conclusion

Benteler materials and processes make it possible to reduce weight without the high cost of aluminum.





Questions?

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Contacts

Dr. Lothar Hein
Technical Product Group Leader
Chassis Systems
lothar.hein@benteler.com
(248) 364-7282

Ken Weise
Technical Director
Chassis Systems
ken.weise@benteler.com
(248) 364-7231

Dr. Andreas Frehn
Materials Specialist
Chassis systems
Andreas.Frehn@benteler.de
011-49-5254-81-5015

Additional company information available at:
http://www.benteler.com