

G r e a t D e s i g n s i n

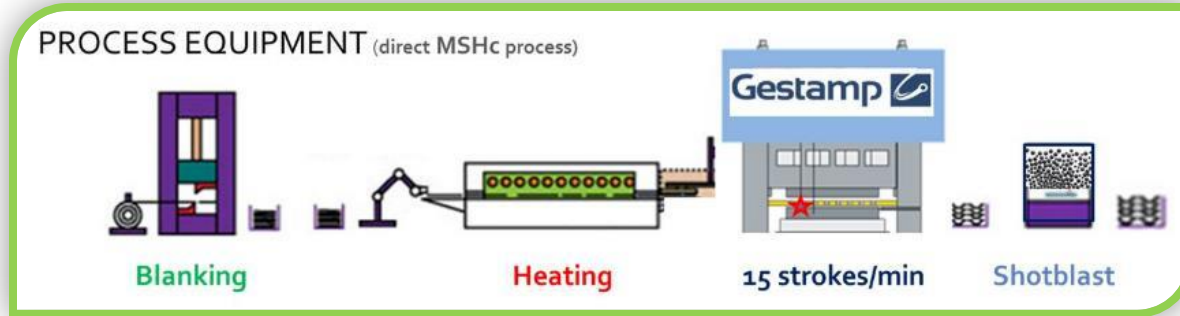
STEEL

New Zn Multistep Hot Stamping Innovation

Paul Belanger

Gestamp

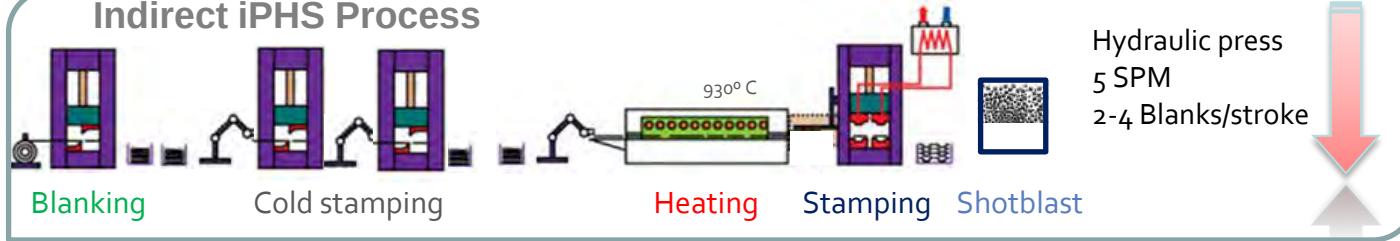
Multistep Hot Forming Transfer - Process



- Transfer press cycle times = cost reduction
- Laser cutting process eliminated = cost reduction
- Formability increased = more complex geometrical possibilities (Negative angles possible)
- Zn-coated material = Cathodic corrosion protection
- Tailored Properties as Soft-Zones, -Flanges, -Spots
- Similar mechanical properties to conventional 22MnB5
- No Microcracks > 10 μm
- Prototypes available
- Serial production line ready by the beginning of 2018

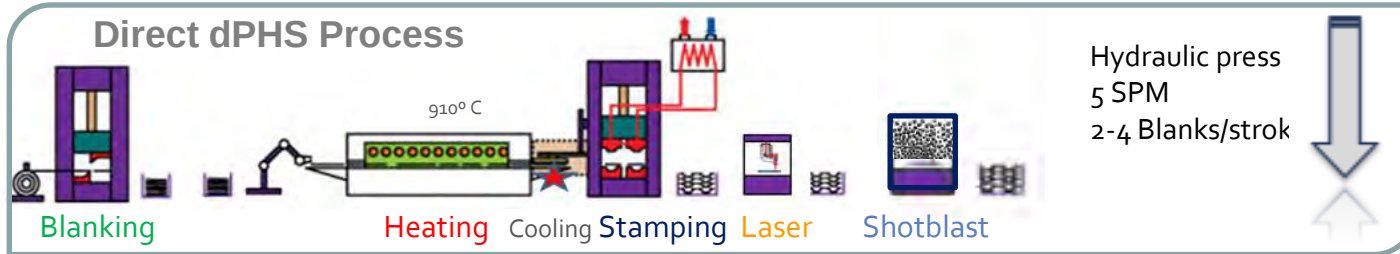
Zn Hot Stamping Market Overview

Indirect iPHS Process



Special-Process
22MnB5 + Zn

Direct dPHS Process



Standard-Process
AlSi & (Zn)
22MnB5

Direct MSHc Process



High-Speed
Transfer-Process
22MnBx + Zn

Multistep Hot Forming Transfer - Tryout line

ZN PHS material Process and product development

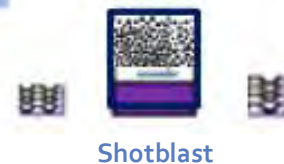
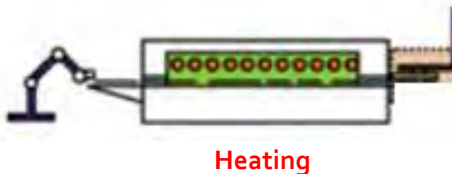
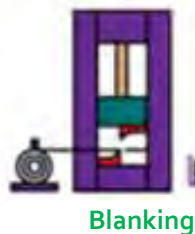
Offering to support today's vehicle requirements, the most advanced and complete PHS solution.

Factors:

- Size of part
- Wet area vs not
- Customer Pref
- Joining tech



PROCESS EQUIPMENT (direct MSHc process)

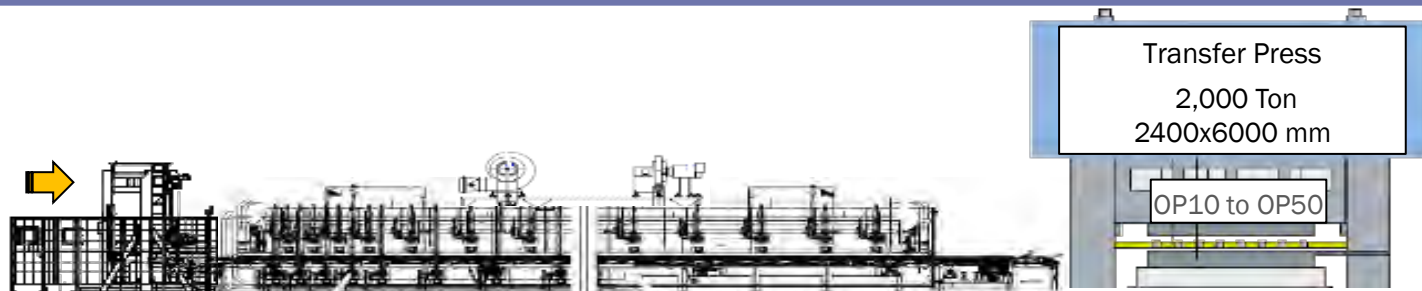


- Thermo-stabilized tool technology

Gestamp Patent pending



Multistep Hot Forming Transfer – Serial line

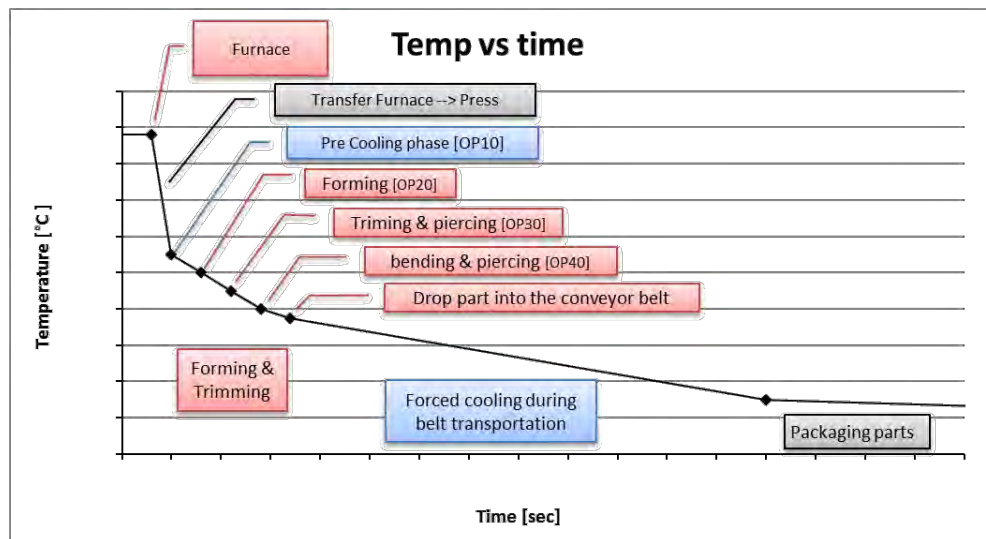
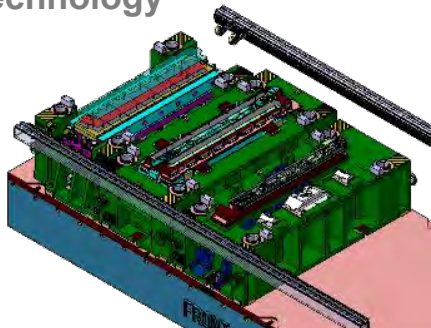


Gestamp

- Servo Mech Press
- Transfer system
- Cycle time = 15+ SPM
- 3,000k Stokes/yr
- Thermo-stabilized tools

Tooling & material technology

Thermo-stabilized tooling technology



Multistep Hot Forming Project – Base Steel

Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation

Multistep material

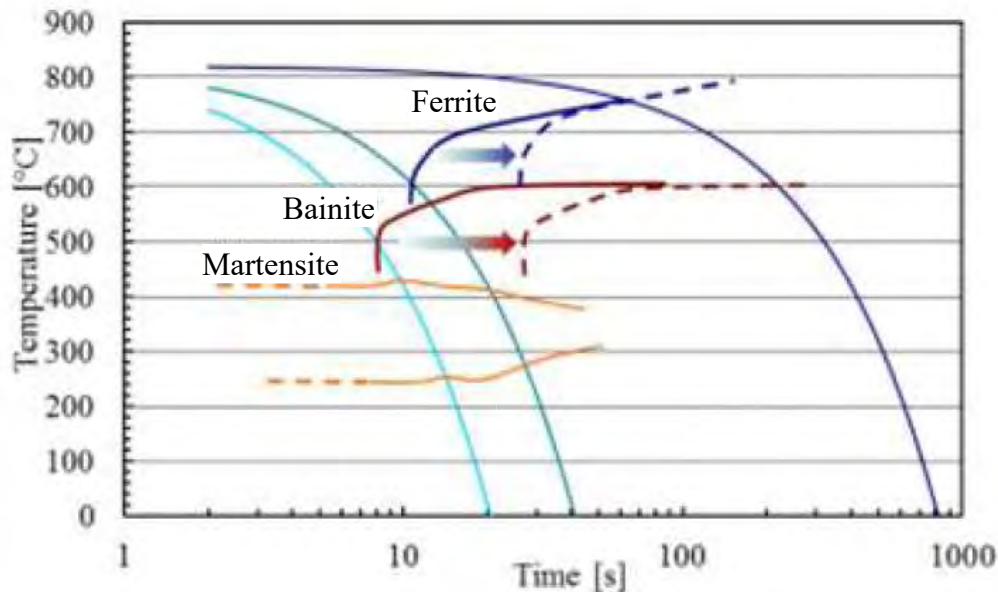
Base material (~**22MnB5**) zinc coated (GA)
with chemical modifications:

Si (anti self tempering)

Mn (hardenability)

- Mechanical properties similar to standard PHS

→ Delayed Bainite & Ferrite transformations



Multistep Hot Forming Project – Microcracks

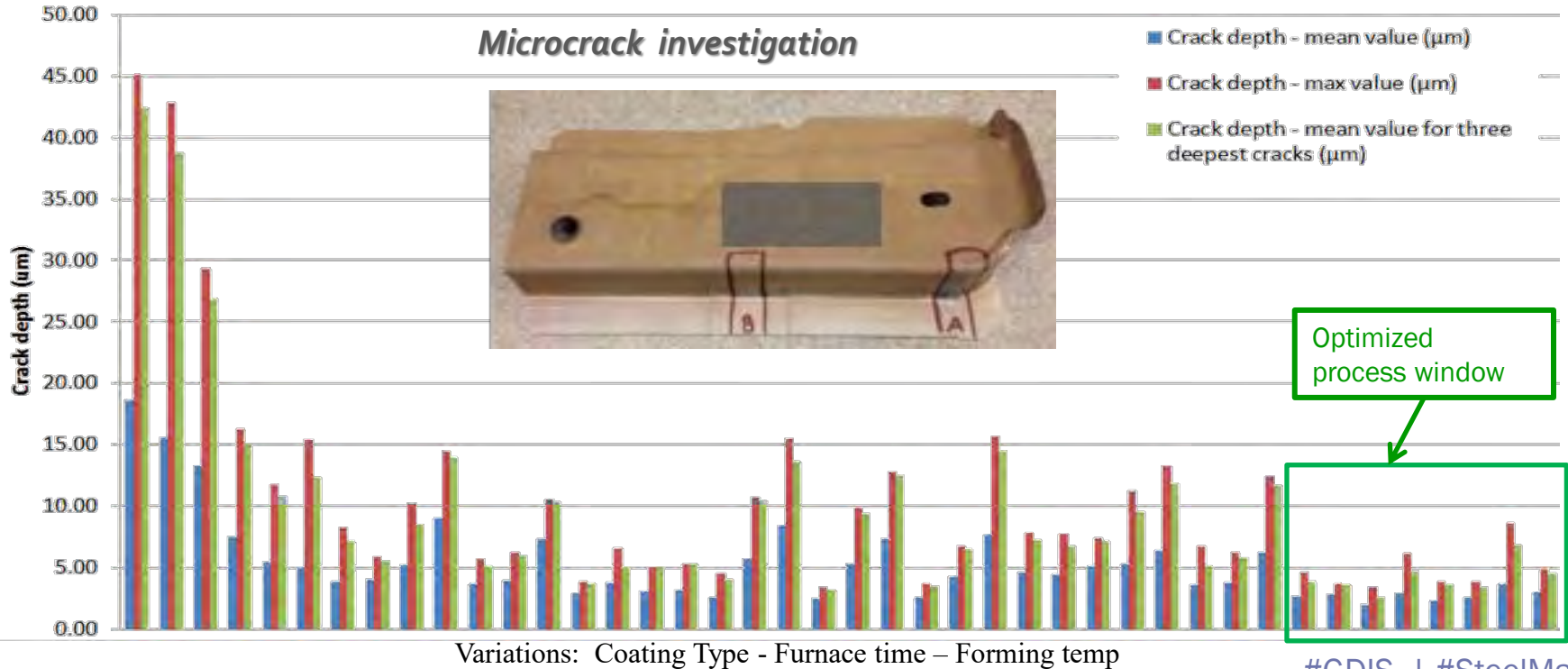
Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation



Multistep project status overview – GDOES

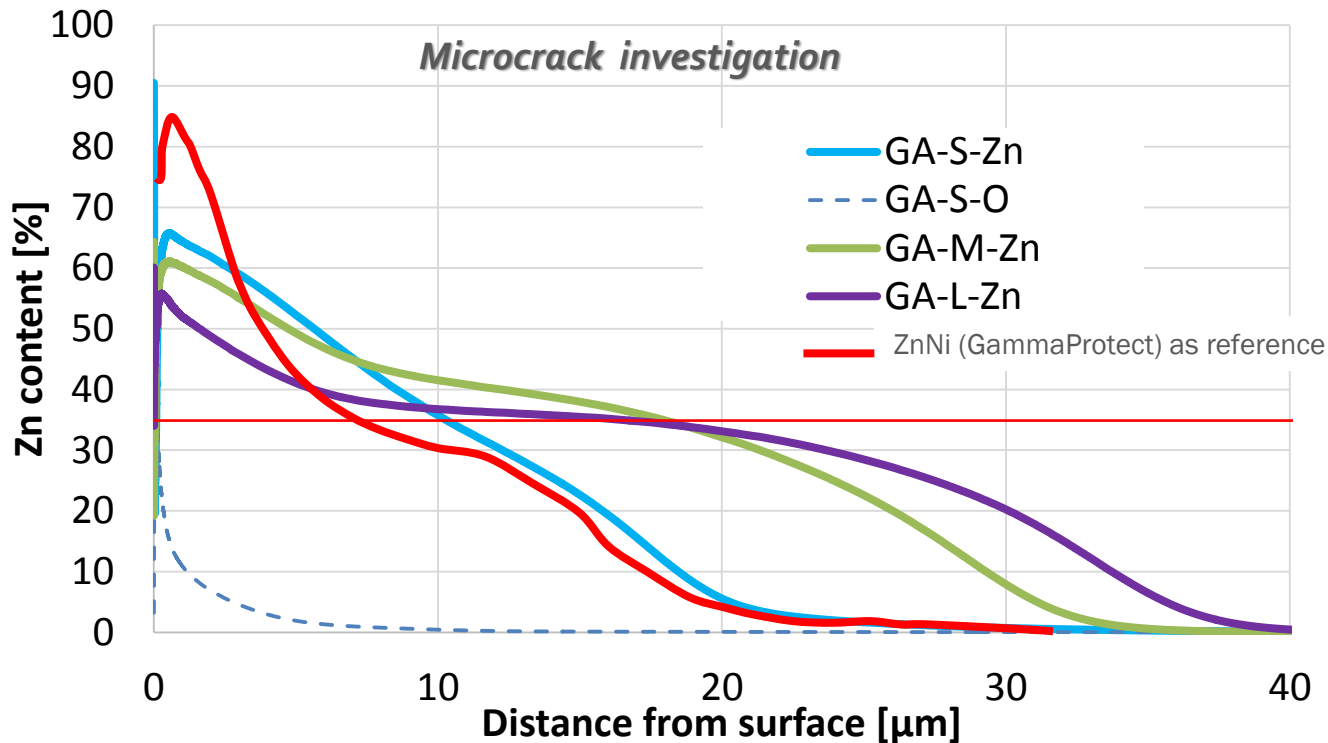
Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation



GDOES measurement of Zinc (Zn) and Oxygen (O) heat treated with Short (S), medium (M), and long (L) furnace dwell times.

Multistep Hot Forming Transfer – Corrosion

Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation

Corrosion Delamination Results (VDA 233-102)

Indirect process

22MnB5

Z100

22MnB5+AS150



Multistep GA
(not hardened)

Multistep GA
(short dwell time)

Multistep GA
(mid dwell time)

Multistep GA
(long dwell time)

Multistep Hot Forming Transfer – Corrosion

Basic Research

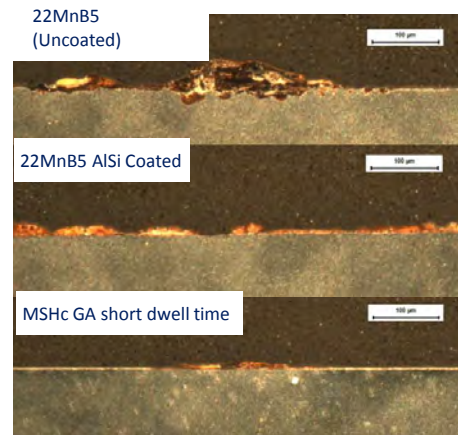
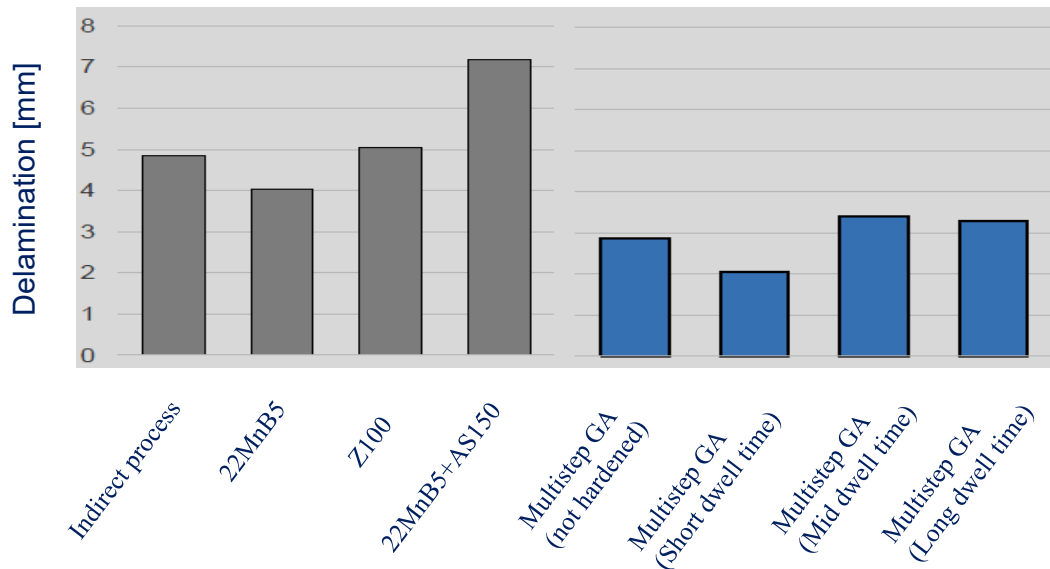
Functional Validation

Industrial Validation

Industrialization

Global Implementation

*Corrosion Delamination Results
(VDA 233-102)*



Cross section of the corrosion attack

Multistep Hot Forming Transfer – Project status

Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation

Material Properties

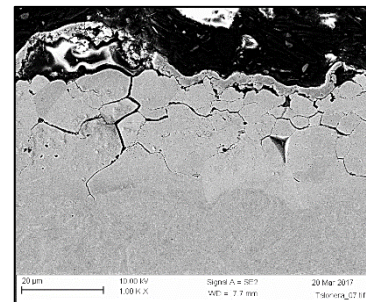
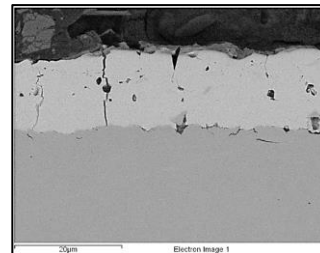
Coating thickness (μm)

Galvanneal 22MnBX – raw condition

Typ. 15

Galvanneal 22MnBX – hardened condition

Typ. 25



Mechanical properties

Condition	0.2% Yield Strength Rp0.2 (MPa)	Tensile strength Rm (MPa)	Elongation in %		Hardness HV10
			A80	A50	
Raw	Typ. 700	Typ. 800	Typ. 5	Min 7	-
Hardened	Typ. 1000	Typ. 1400	-	Typ. 7	Typ. 460

➤ **Similar mechanical properties to 22MnB5:**

Multistep Hot Forming Transfer – Project status

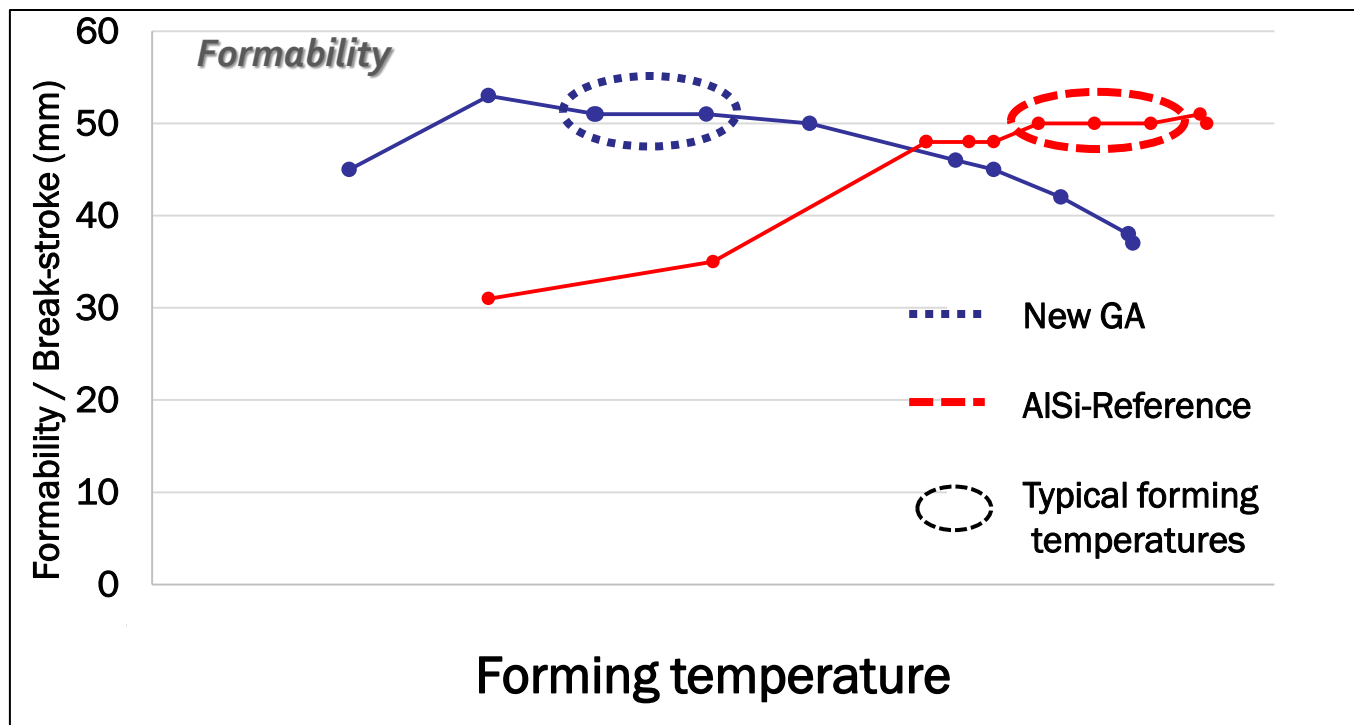
Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation



Multistep Hot Forming Transfer – Project status

Basic Research

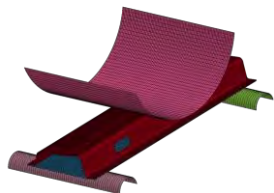
Functional Validation

Industrial Validation

Industrialization

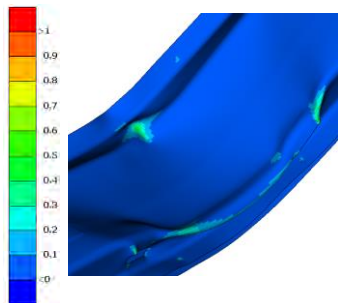
Global Implementation

Component Crash Correlation

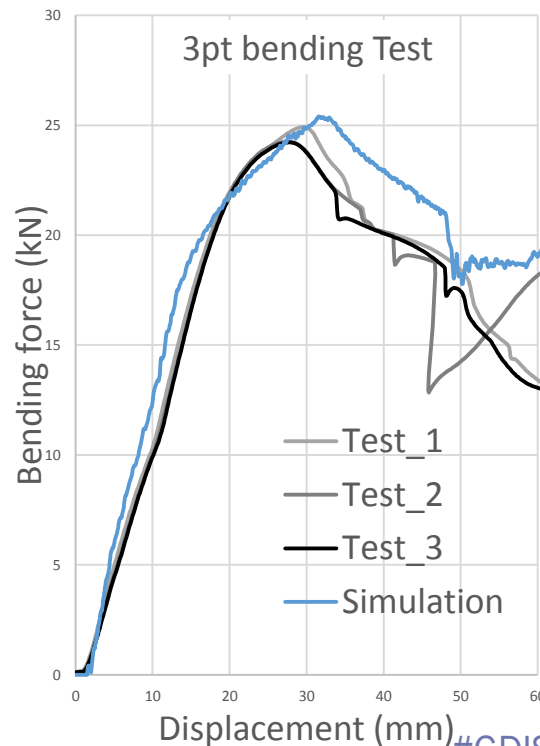


Simulation

- 2mm elements
- Quasi-static test
- No failure modeling



Test



Maximal force level OK

Multistep Hot Forming Transfer – Project status

Basic Research

Functional Validation

Industrial Validation

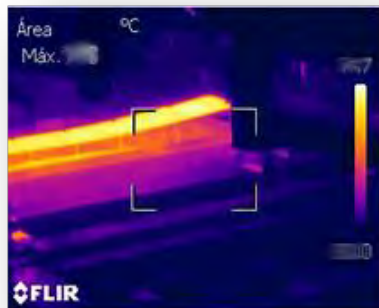
Industrialization

Global Implementation

OP10

LOADING

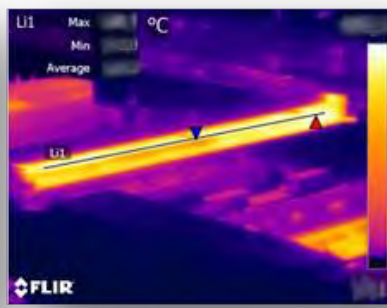
UNLOADING



OP20

LOADING

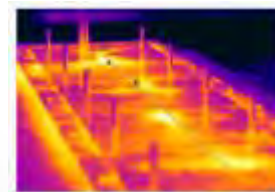
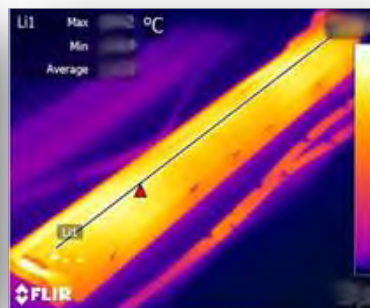
UNLOADING



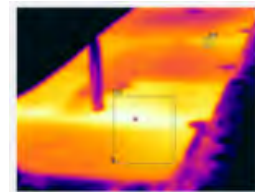
OP30

LOADING

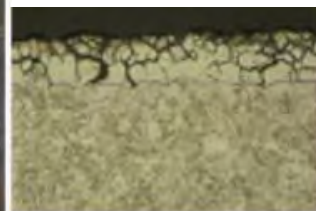
UNLOADING



Low forming temperature



Without microcracks



Process window and Industrial Validation

- ✓ Best forming temperature
- ✓ Microcrack containment
- ✓ Trimming/Piercing temperatures
- ✓ Mechanical properties

Multistep Hot Forming Transfer – Project status

Basic Research

Functional Validation

Industrial Validation

Industrialization

Global Implementation



Multistep Hot Forming Transfer – Project status

Basic Research

Functional Validation

Industrial Validation

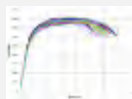
Industrialization

Global Implementation

2014/2015

1. Material characterization analysis

- Mechanical properties
- Coating behavior and Corrosion
- Formability
- Bending tests
- Tribology

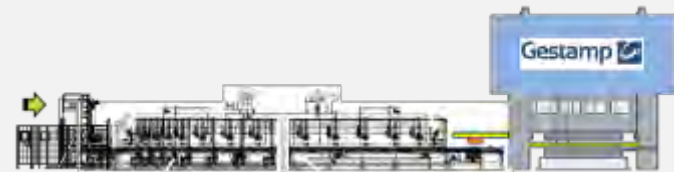


2. Process definition

- Heating possibilities
- Shot blasting
- Joining technologies (RSW/TWB)
- Tailored properties (Flex laser / TPP)



- Thermo-stabilized tool technology
- Advanced process equipment



2016/2018

3. Product definition

- Crash material data card
- Forming material data card
- Design Guidelines



4. Prototyping



Today

→ 5. Industrial validation

6. Full scale line installation in Gestamp

Multistep Hot Forming Transfer – Project status

Basic Research

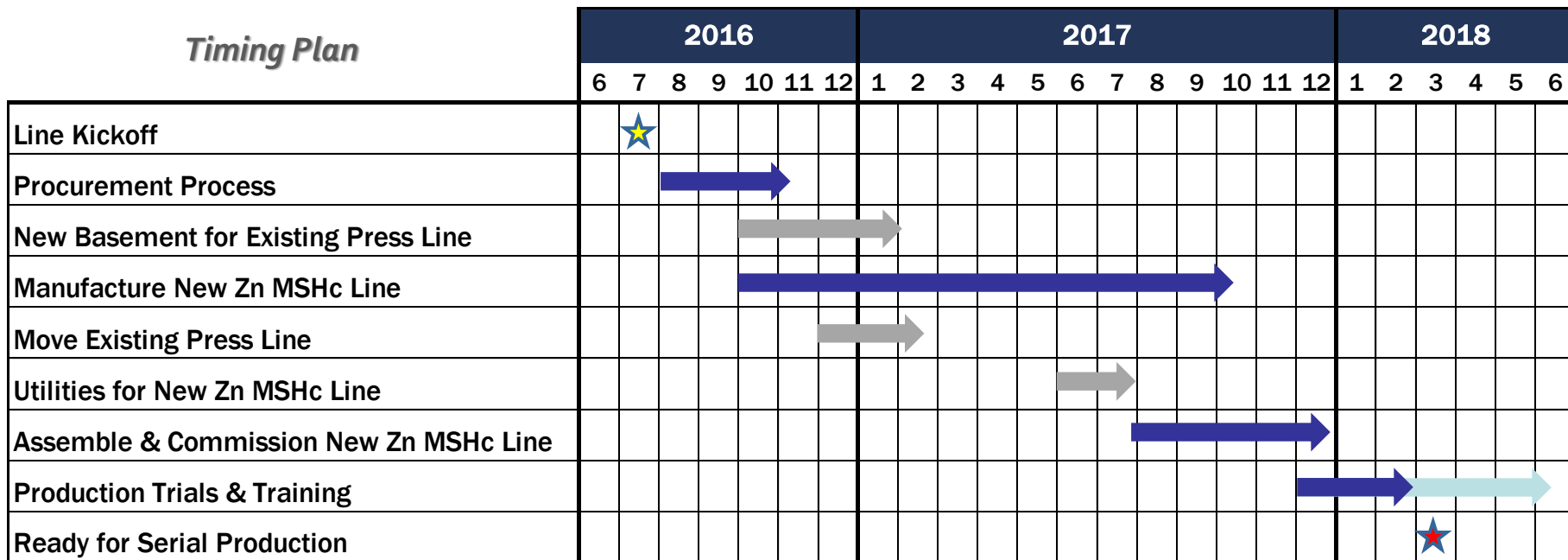
Functional Validation

Industrial Validation

Industrialization

Global Implementation

Timing Plan



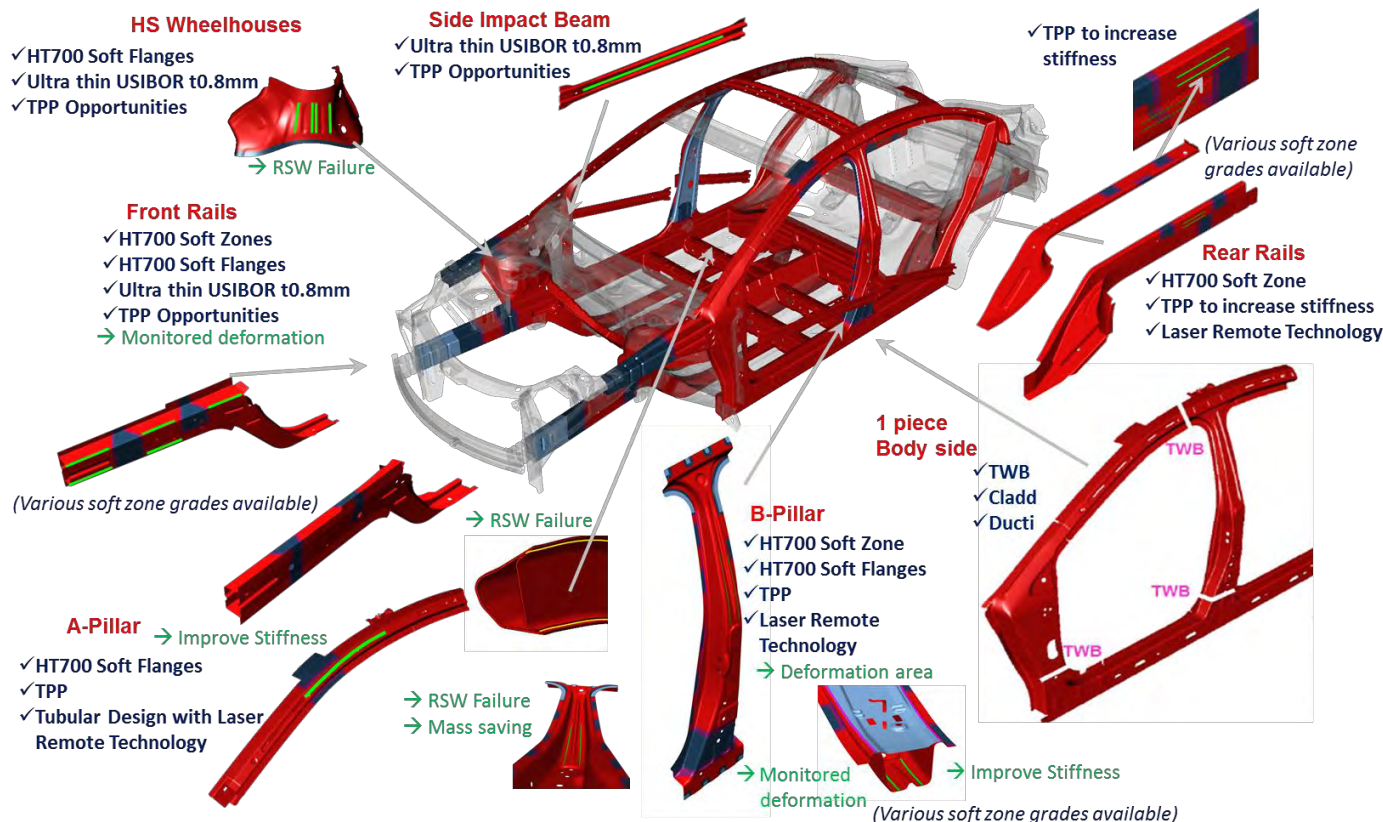
Multistep Hot Forming – Serial Production Line



PHS Technologies and Products –at a Glance

Applications

- Solution in PH for cost efficient body structures
- All NEW technologies can be mixed together
- All NEW applications can run in AlSi and Zn

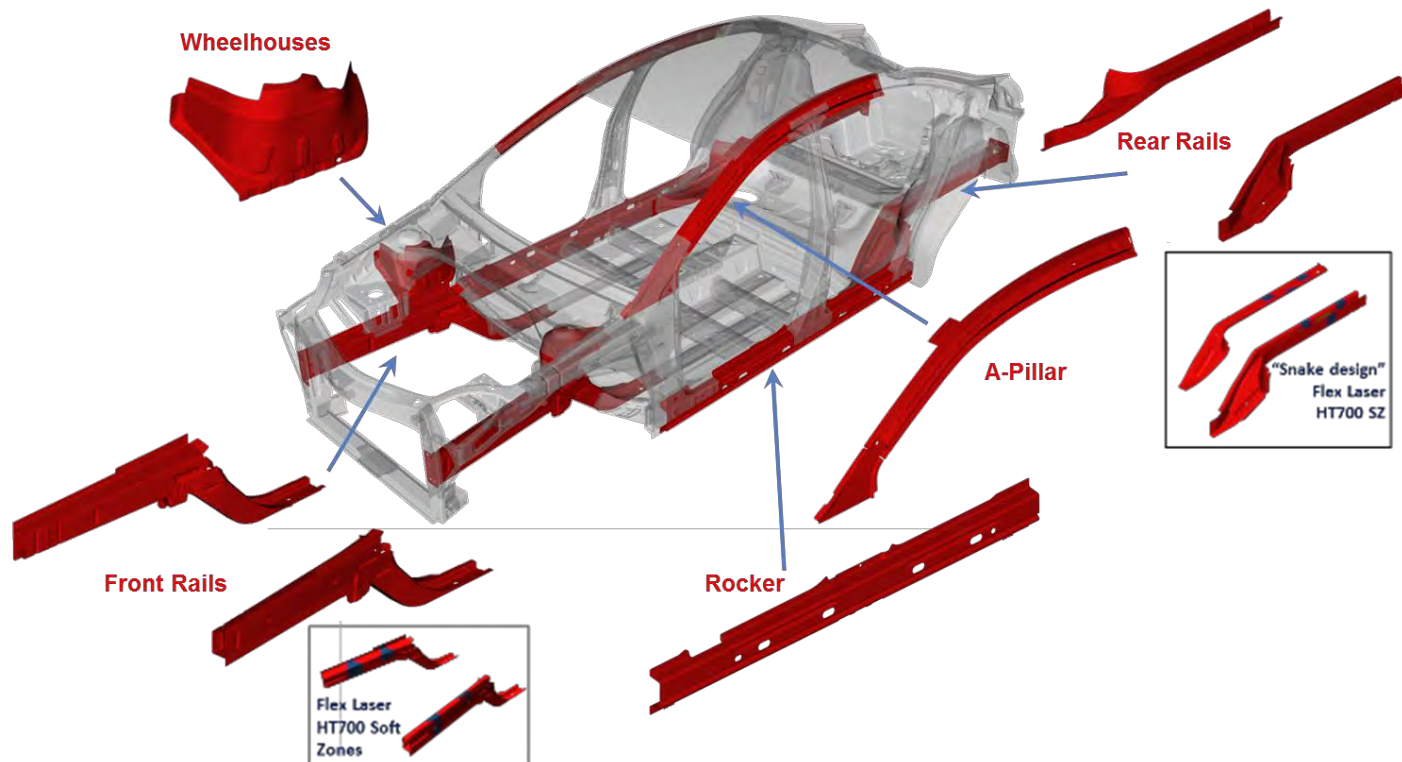


Zn Multistep Hot Stamping –At a glance

~10% of press hardened products moving to the multistep technology

Cost-Saving

- Zn can run in all parts but Multistep technology shows highest saving potential in key parts
- Here we show the part where the biggest cost savings can be achieved

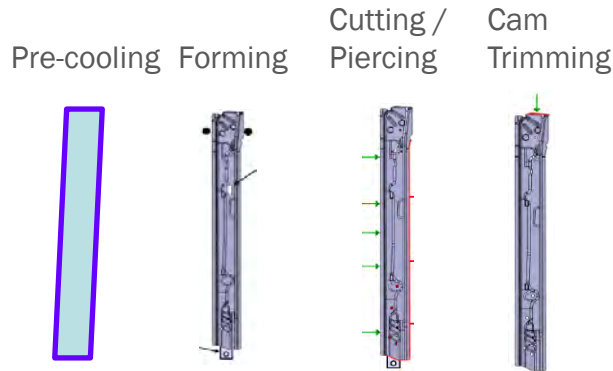


Zn Multistep Process Potential

German OEM development



Press Plan



Cost Potentials

		Material	Stamping	Shotblast	Laser
Conventional Hot Stamping	4/stroke @12 sec	Similar	Slower	Not required	Required
Multi Step Hot Stamping	2/stroke @6 sec		Faster	Required	Not required

-10%

Material cost similar

Process higher investment

No laser cutting needed

Limited to 2000 ton, Bolster: 2.5 m x 6 m

- ❖ Good for parts with significant laser content and up to 4 parts / stroke

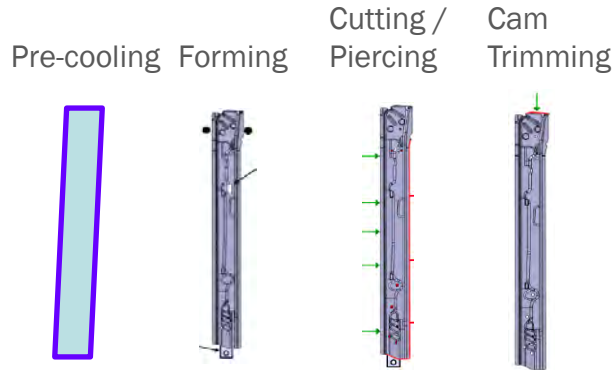
Saving potential as function of complexity and cutting requirements

Zn Multistep Process Potential

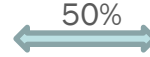
German OEM development



Press Plan



Cost Potentials



		Material	Stamping	Shotblast	Laser
Cold Stamping AHSS	2/stroke @4 sec	Higher	Fastest	No	Not required
Multi Step Hot Stamping	2/stroke @6 sec		Faster	Required	Not required

-10%

Material cost significantly different
Limited to 2000 ton, Bolster: 2.5 m x 6 m

- ❖ Good for parts with significant laser content and up to 4 parts / stroke

Saving potential as function of complexity and cutting requirements

Zn Multistep Product/Process Summary

❑ Base material

- Modified version of the well-known 22MnB5
- Similar mechanical properties to 22MnB5
- Better formability at lower temperatures than 22MnB5

❑ Zn-coating GA

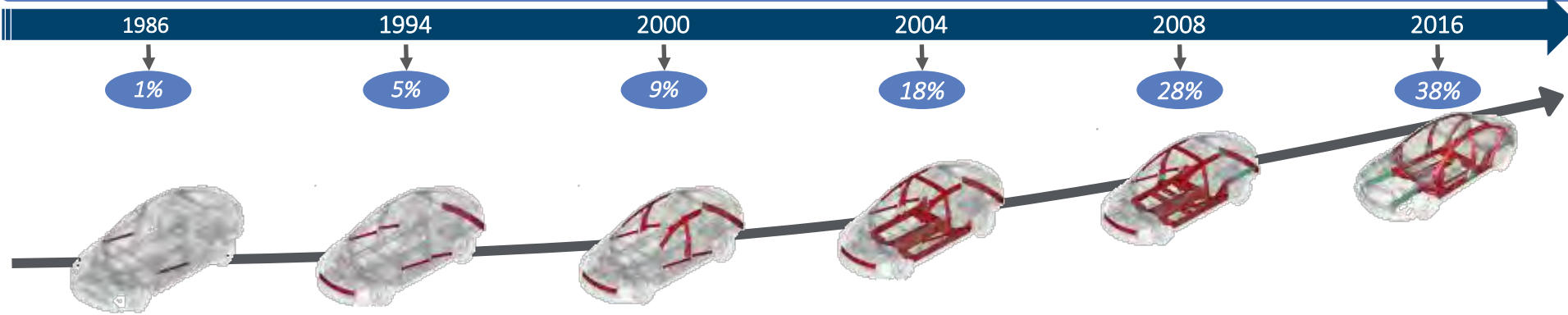
- Cathodic protection
- Lower friction compared to AlSi coated material → complex parts
- Suitable for direct hot stamping process
- Micro cracks under 10 µm

❑ Hot Stamping process

- High productivity due to short cycle time (aim 2-3 seconds)
- No protective atmosphere required into the furnace
- Multiple hits -Possibility to produce complex parts, negative angles
- No Laser cutting is needed

Summary

Evolution of Hot Stamping



Gestamp's historical performance

- 1) Gestamp Hardtech > 30 years experience
- 2) Quadrupled # Lines since 2007
- 3) Co-Development Partner BIW content 1% -38%
- 4) Driving the tailored material properties

Gestamp 'growing' forward

- 1) 1st to break 10 s cycle time
- 2) 1st to in-die soft zone
- 3) **1st to Multistep & eliminate laser**
- 4) **1st to Hot Stamping cost reduction**

Hot Stamping is Becoming the "Standard"

For More Information

Paul Belanger

Gestamp

pbelanger@us.gestamp.com