

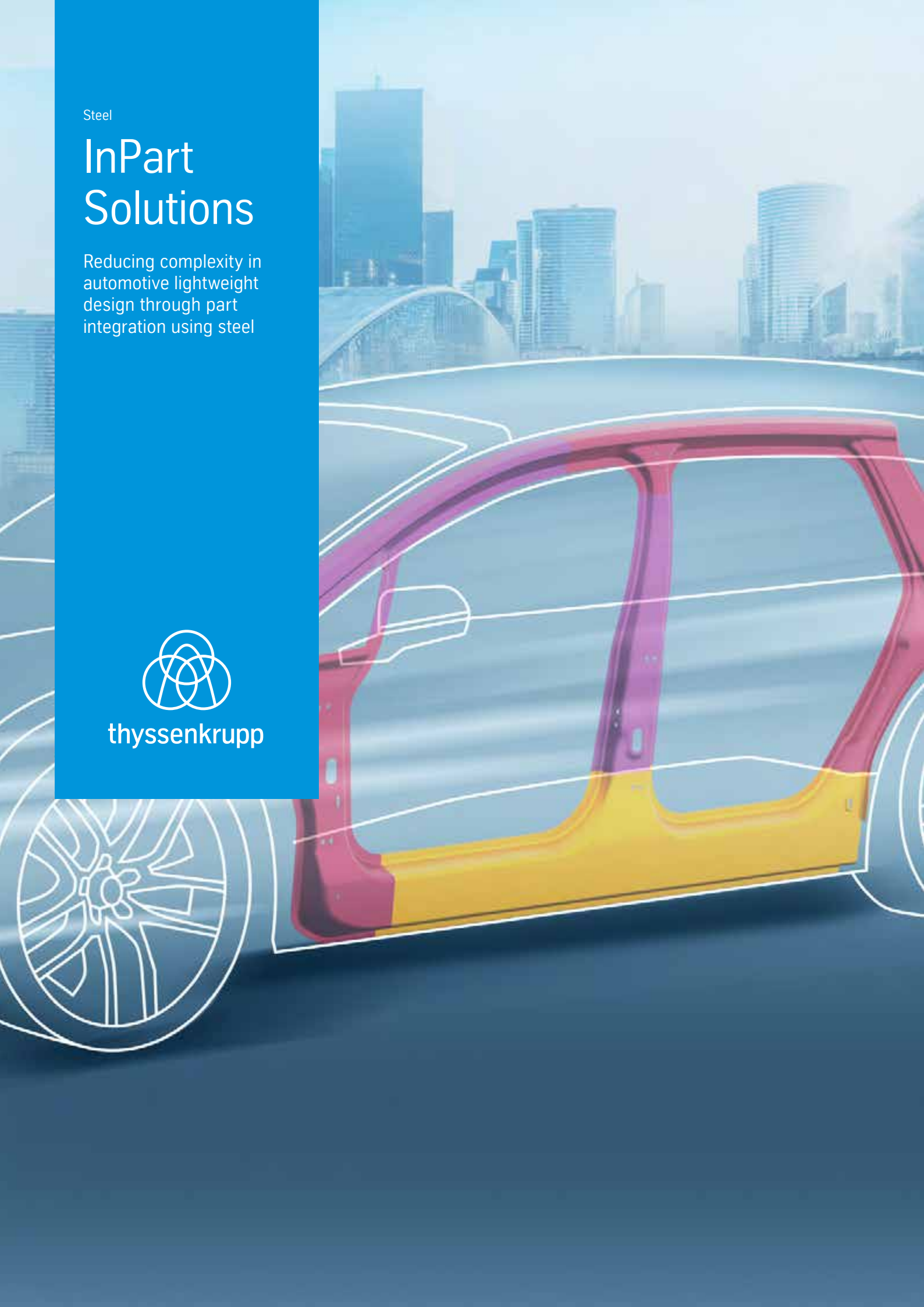
Steel

InPart Solutions

Reducing complexity in
automotive lightweight
design through part
integration using steel



thyssenkrupp





InPart – Intelligent Part Integration: for less complexity in vehicle manufacturing and more sustainable mobility

InPart Solutions focus on reducing complexity in the vehicle manufacturing by reducing the number of parts and thus improving material and process efficiency. This is associated with cost, weight, and/or performance optimizations, for example through reduced cycle times.

Sounds interesting? Our experts in economical lightweight design will assist you with all material-specific questions.



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Reducing complexity in automotive lightweight design through part integration with steel

InPart Solutions by thyssenkrupp Steel comprise innovative concepts for part integration with steel to reduce complexity in body and chassis design. Ultra-high-strength materials and leading steel technologies such as Tailored Blanks form the basis for reducing the number of parts in vehicles and achieving high material and process efficiency with appropriate part design.

- ➞ Reducing complexity by minimizing the number of parts in body and chassis
- ➞ Solutions for cold and hot-formed parts in electric and conventionally powered vehicles
- ➞ Efficiency advantages in terms of material and process possible through the use of optimized manufacturing technologies
- ➞ Advantages in repair concepts compared to large-format cast parts
- ➞ All InPart Solutions available with CO₂-reduced bluemint® Steels for even more climate-friendly mobility





Fewer parts –
less complexity

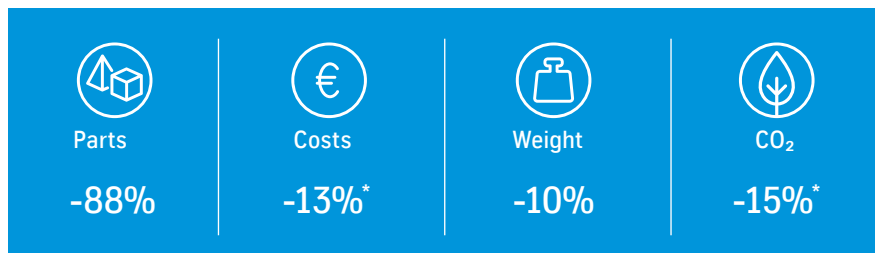
- ➔ Cost advantages
- ➔ Weight reduction
- ➔ Performance gains

Application example hot forming

Door Ring

A collaboration between Baosteel Tailored Blanks and thyssenkrupp Steel Europe

- ➞ Reduced complexity in the body shop process by use of Tailored Blanks for hot forming
- ➞ Laser beam welding without decoating of the shaped blank using the GONA^{tech}® process from Baosteel Tailored Blanks
- ➞ MBW® manganese-boron steels with strengths of up to 1,900 MPa ensure high material efficiency
- ➞ High flexibility in the selection of grades, surfaces, and material thicknesses in the Tailored Blank
- ➞ Use of the innovative hot-dip aluminized material AS Pro from thyssenkrupp Steel possible



Reference: conventional sidewall reinforcement in framing construction made from up to 8 individual parts (cold and hot forming)

* According to an analysis by



● MBW® 1200

● MBW® 1500

● MBW® 1900

A collaborative project by:



Application example cold forming

Longitudinal member commercial vehicle

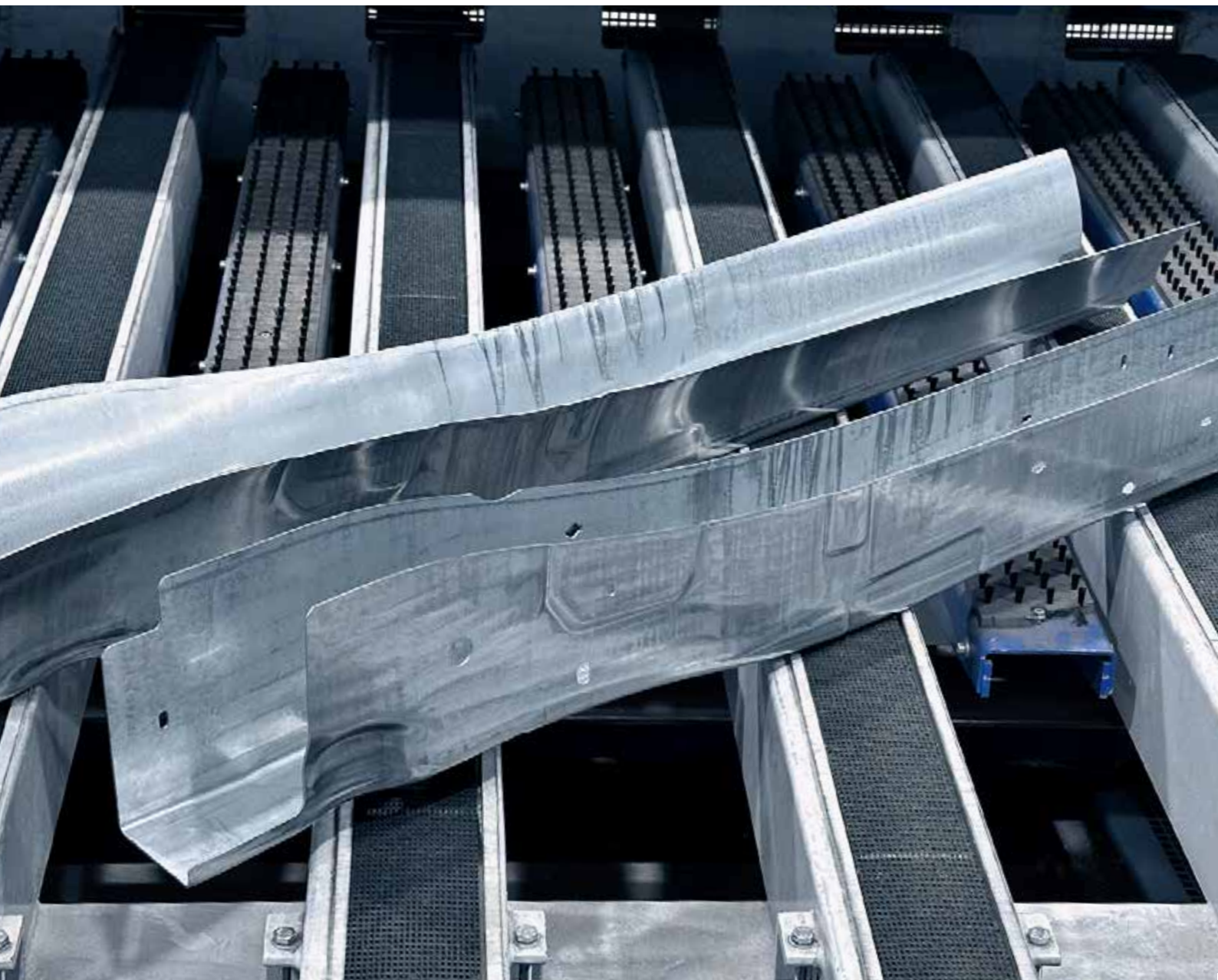
Fewer parts with smartform®:
forming with compressive stress superposition

- ⇒ Process optimally applicable for part integration
- ⇒ High material efficiency by the use of minimal blank shapes (blanks with final part contour)
- ⇒ Approx. 14% less material usage significantly improves the CO₂ footprint of the part; part weight is reduced by approx. 6%
- ⇒ High dimensional accuracy by compressive stress superposition in the springback-intensive part areas
- ⇒ Elimination of costly post-forming operations increases process efficiency



Reference: conventional 2-part solution (0° opening angle)

* Cradle-to-gate LCA according to a certified model; battery-electric drive, 200,000 km, EU electricity mix



smartform®: preform (top) and near-net-shape part (bottom) after calibration step

Further application examples

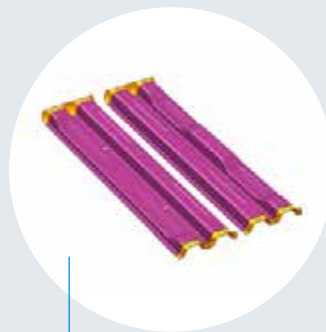
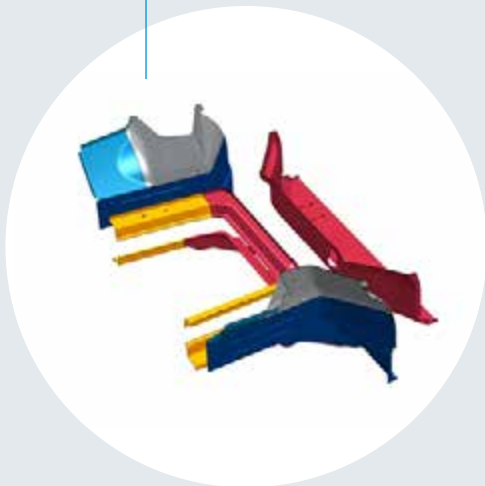
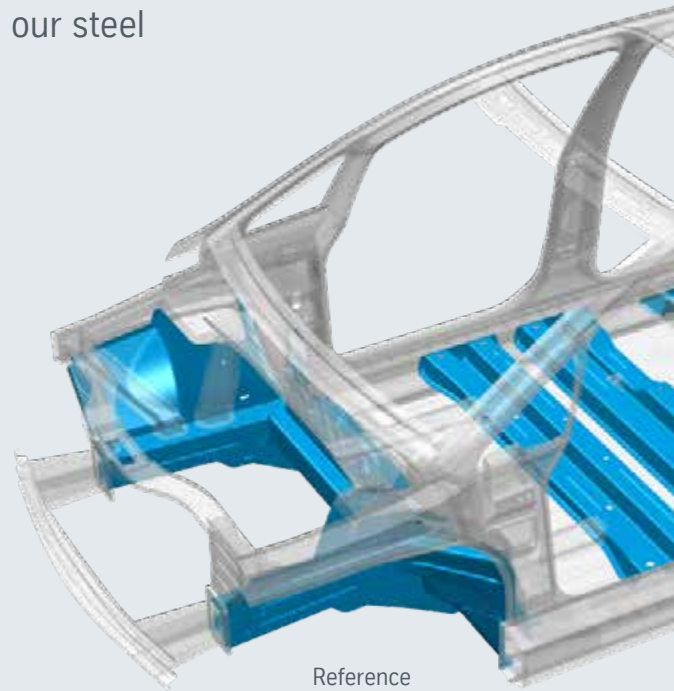
Potential of part integration

InPart Solutions are as individual as your requirements. We are pleased to advise you on all topics related to our steel products, their applications and processing.

Front end

			
-71%	-0.5%	+2.9%	+1.0%*

Reference: conventionally manufactured front end; primarily cold-formed with separate longitudinal and cross members. Complexity reduction of the InPart solution by use of Tailored Blanks; high proportion of hot forming.



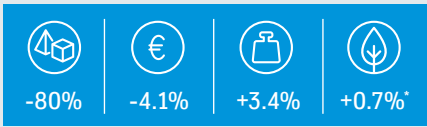
Seat cross member

			
-67%	-15.7%	+22.8%	-29.2%*

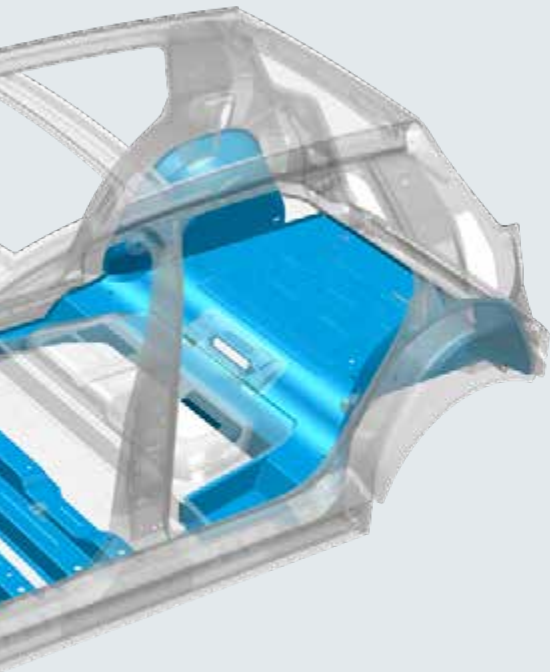
Reference: high-strength cold-rolled martensitic steel, roll-formed with brackets made of microalloyed grades. Use of a hot-formed Tailored Blank made of high-strength MBW® 1900 with MBW® 1200 as joining partner in the InPart Solution reduces complexity, costs, and the carbon footprint.

* Cradle-to-gate LCA according to a certified model; battery-electric drive, 200,000 km, EU electricity mix

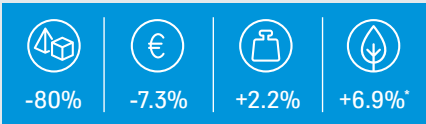
Floor panel rear



Reference: multi-part strike plate made of three different grades in three thicknesses. Reducing the number of grades and material thicknesses reduces complexity and costs of the InPart Solution.

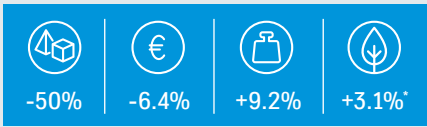


Cross member floor



Reference: five-part cross member made of high-strength steels. Part integration of the Inpart Solution by use of a Tailored Blank made of dual-phase steels in strength classes 800 and 1,200 MPa for complexity and cost optimization.

Wheelhouse



Reference: two-piece component made of IF steel with damper connection made of high-strength dual-phase steel. Reduction the number of grades by use of a Patchwork Blank in the InPart Solution enables cost savings in tooling and body-in-white construction.

- HX 260
 - DP-K® 290Y490T/330Y590T
 - jetQ® 700Y980T
 - jetQ® 850Y1180T
- MBW® 600
 - MBW® 1200
 - MBW® 1500
 - MBW® 1900



Key factors for InPart Solutions

Successful teamwork: materials and technologies

InPart Solutions focus on reducing complexity in the vehicle manufacturing industry through targeted part integration. The goal: to reduce the number of parts. Fewer parts in the body and chassis reduce development expenses and the number of joining operations, enable faster cycle times, and thus also allow more vehicles to be produced per unit of time. Key factors here are, on the one hand, technologies such as Tailored Blanks or advanced forming processes with compressive stress superposition and, on the other hand, high-performance steels for cold and hot forming.

Together, they not only reduce the complexity of the body-in-white, but also improve material and process efficiency. Cost, weight, and performance optimizations can thus be tailored to individual requirements.

Tailored Blanks

Tailored Blanks and Hotform Blanks – a variant of Tailored Blanks for hot forming – are customized, semi-finished steel sheets made of different steel grades and thicknesses. They enable parts with locally tailored properties to be formed in a single step. This reduces the number of joining processes in the body-in-white and the use of reinforcements. Using less material also reduces the weight and climate-damaging emissions of the parts.

Tailored Blanks were originally developed by thyssenkrupp Steel and are now offered in many designs by various companies. thyssenkrupp Steel specializes in supplying these companies with the appropriate steel products and is continuing to drive forward the development and application of this technology with selected partners. You can find an example of this on page 6: “Door ring”.





Smart forming

Part integration or reduction can also be achieved by using suitable processing methods. With smartform®, thyssenkrupp Steel has developed an innovative forming process with compressive stress superposition that enables the production of dimensionally accurate structural parts from high-strength steel materials. This allows the design of parts that are usually made up of several parts, such as large commercial vehicle longitudinal members, from a single blank. The reduction in the number of parts and joining operations, as well as increased material efficiency by the use of so-called minimal-form blanks with reduced scrap, reduce costs and material consumption. You can find an application example on page 8. In collaboration with Renault, the longitudinal member of the “Master” light commercial vehicle was successfully integrated into a single-piece solution.

MBW® and AS Pro for hot forming

thyssenkrupp Steel is one of the leading suppliers of MBW® manganese-boron steels for hot forming. With a complete portfolio ranging from ductile materials for hot-formed blanks to ultra-high strength grades with a tensile strength of 1,900 MPa and above, there is a suitable steel grade for every requirement.

Hot-dip coated grades with aluminum-silicon coating are commonly used to protect against scaling in the furnace and for passive corrosion protection. However, these grades have a process-related tendency to hydrogen absorption, which can lead to embrittlement of the material and, in the worst case, part failure.

thyssenkrupp Steel has improved the conventional AS coating and, with AS Pro, offers an innovative coating system for greatly reduced hydrogen absorption and increased process reliability during hot forming. This eliminates the need for measures such as controlling the dew point of the furnace atmosphere or energy-intensive effusion annealing. AS Pro thus saves cost and energy in the long term.

Modern multiphase steels and 3rd generation AHSS

With a wide range of multiphase steels, InPart Solutions can also be implemented in cold forming applications. The key material here is dual-phase steel from thyssenkrupp Steel, which is available in all common strength classes up to 1,200 MPa and in three different versions: as a standard variant, with increased yield strength, or with improved ductility. Extreme requirements for the strength, formability, and ductility of steel materials can now also be met by the so-called 3rd generation of modern multiphase steels. jetQ® steels combine the advantages of hot and cold forming by combining high strength with high ductility, thus expanding the options, especially for crash-relevant structural parts with high strength requirements.

bluemint® Steel makes steel more climate-friendly

The most environmentally friendly material is the one that does not have to be produced at all! That is why material efficiency and lightweight design play an important role in the sustainability of mobility. Of course, material savings through weight reduction of parts are only possible to a certain extent. Under the name bluemint® Steel, thyssenkrupp Steel therefore offers CO₂-reduced steels that enable our customers to further reduce the CO₂ footprint of their parts and vehicles. All grades in our portfolio are already available for this purpose as the blast furnace product bluemint® recycled. Once the direct reduction plant is up and running, we also plan to produce direct-reduced bluemint® Steel to further reduce CO₂ emissions.



Portfolio

Overview of steel families

Steels for cold and hot forming from thyssenkrupp Steel

Mild steels		Conventional higher- and high-strength steels			
Deep-drawing steel		Micro-alloyed steel	High-strength IF steel	Bake hardening steel	Work hardening steel
Modern multiphase steels					
Dual-phase steel	Complex-phase steel	Ferritic-bainitic-phase steel	Chassis steel	Retained-austenite steel	jetQ®
Steels for hot forming		Surfaces			
Manganese-boron steel		• Uncoated • Electrolytically galvanized • Hot-dip galvanized • Galvannealed • ZM Ecoprotect® • Aluminum-silicon-coated • Aluminum-silicon-coated Pro			

You can find a detailed product overview on our website thyssenkrupp-steel.com



CO₂-optimized steels

All steel grades from thyssenkrupp Steel are already available with an optimized carbon footprint as bluemint® recycled or bluemint® recycled 25 from the blast furnace route and, following completion of our new direct reduction plant (DR plant), also as

directly reduced steels. The ramp-up time for bluemint® Steel from the DR plant may differ for individual products. If you have any questions about specific availability, please get in touch with your known contact person.

Disclaimer:

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Steel

thyssenkrupp Steel Europe AG
Kaiser-Wilhelm-Strasse 100
47166 Duisburg, Germany
P: +49 203 52 - 0
www.thyssenkrupp-steel.com

Sales
info.auto@thyssenkrupp-steel.com