

Automotive & Transportation

# Ultimate lightweight solutions

Outokumpu Forta H-Series



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### B-Pillar inner shell

Lightweight potential  
compared to 22MnB5: -35 %

Otokumpu has been developing a new generation of Ni-free austenitic manganese-chromium materials for structural vehicle components since 2012. One particular focus is on crash-relevant and thus safety critical parts.

A yield strength of  $R_{p0.2} \geq 1000$  MPa in combination with high elongations at fracture is opening up new opportunities in lightweight engineering and design with steel. The material also has very high energy absorption in the event of an impact. The new Forta H-Series is available as Forta H500, Forta H800 and Forta H1000, where the designations refer to yield strength. Discover a new austenitic material that meets high demands for lightweight solutions, occupant safety, CO<sub>2</sub> reduction, lower material costs, 100 % recyclability and worldwide availability.

Our specialists provide you with expert support throughout the entire product development process, backed by more than 100 years of experience in austenitic materials and more than 20 years of experience in the automotive sector.

Discover new possibilities in automotive design with the Forta H-Series!

# About Outokumpu

Outokumpu is the global market and technology leader with excellent technical expertise in advanced materials based on steel alloys.

## Outokumpu – global technology leader

Our history dates back to our sites in Germany and the UK, where our first groundbreaking advanced material, stainless steel, was invented in the early 1900s, and in Sweden, where Duplex was invented in 1930.

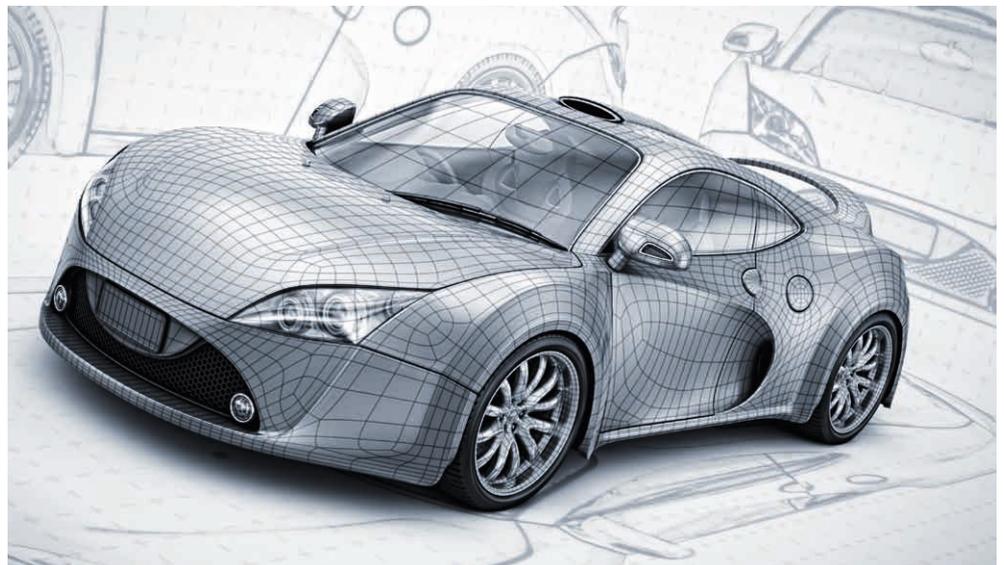


Outokumpu is the strategic choice and a strong partner for all OEMs around the world. We began producing enduring materials for exhaust systems in the early 1970s.

Today, we are the largest supplier of exhaust materials to the automotive industry. Outokumpu has been delivering specialist austenitic steels to the automotive industry for structural applications since 2001.

Outokumpu's new Forta H-Series is ideal for automotive lightweight constructions.

The advanced manganese-chromium alloy forms a new material group for sustainable design and optimized crash performance within the automotive technology.



## Customer focus – worldwide 24/7



Customer satisfaction is our top priority.

We are pushing forward product development in state-of-the-art research and development centers in Germany, Finland and Sweden. Product development works hand-in-hand with our extensive network of sales and service centers (in more than 30 countries).

Around the world, more than 12 000 employees work for Outokumpu with a passion for fulfilling customer needs.

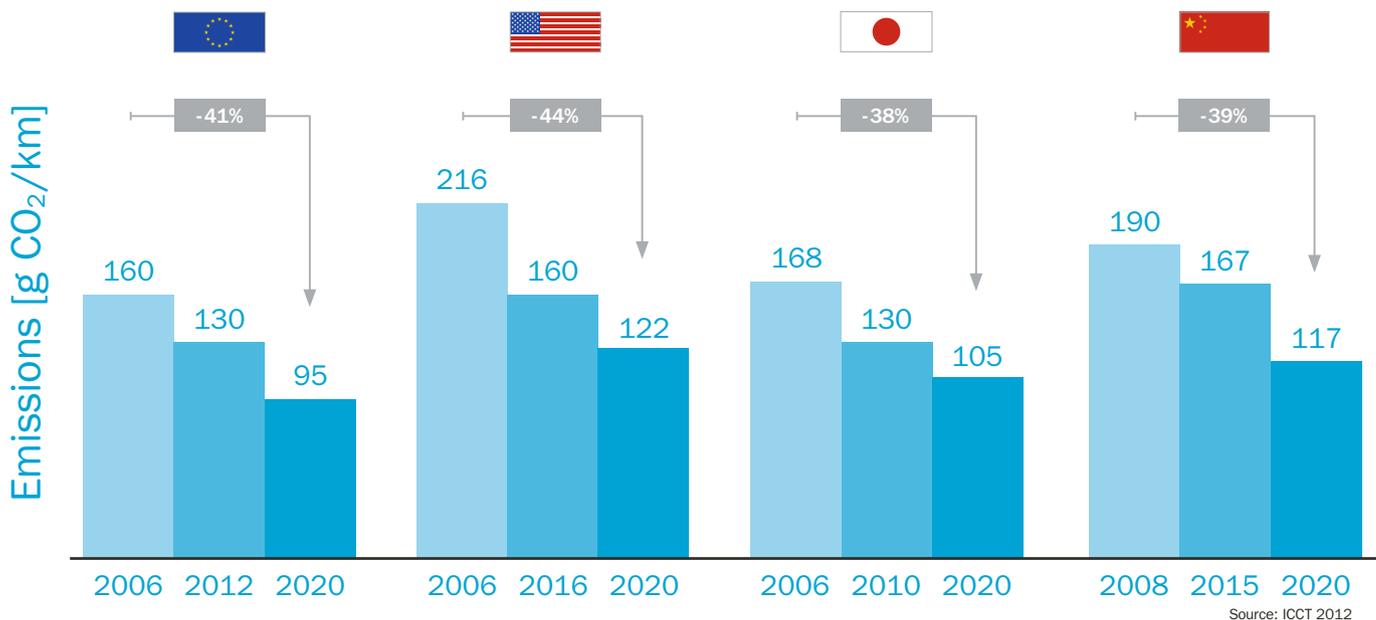
- Integrated melt shop, hot and cold rolling
- Other mills
- Mine
- Service center
- Network of sales offices
- R&D centers in Krefeld (GER), Tornio (FI) and Avesta (SWE)

# CO<sub>2</sub> reduction

New materials are an essential factor in achieving the challenging emission targets set for sustainability and environmental protection. Outokumpu's new Forta H-Series exceeds the performance characteristics of competing materials.

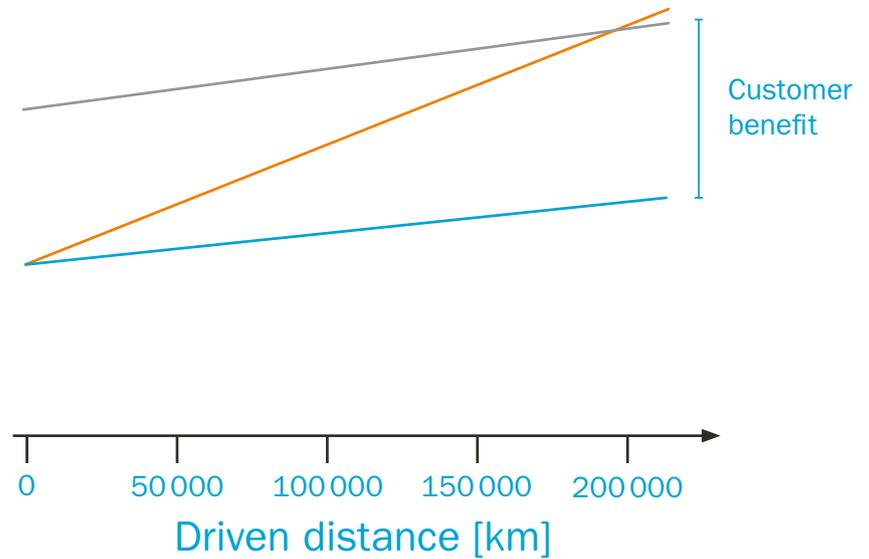
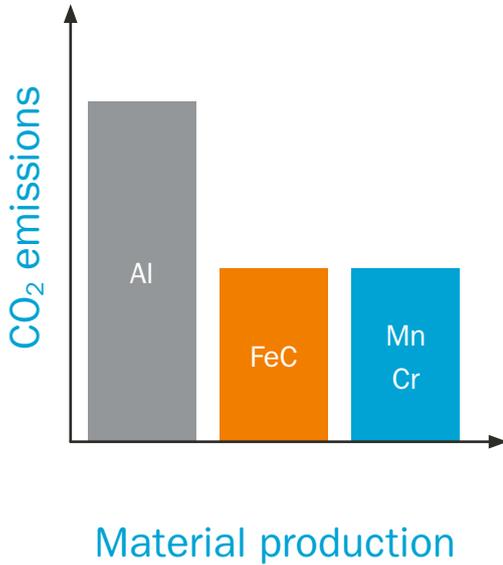
## CO<sub>2</sub> emission regulations

Forta H-Series is the perfect solution for many demanding applications in the automotive industry. Manganese-chromium materials are extremely durable and 100 % recyclable. Looking ahead to the year 2050, we want to contribute to a reduction in the greenhouse effect. To limit global warming to 2° C, it will be necessary to reduce CO<sub>2</sub> emissions by more than 85 % relative to 1990 levels.



## The material solution from Outokumpu

Compared with aluminum and carbon steel, the new Forta H-Series contributes to a reduction in CO<sub>2</sub> emissions over its total lifecycle. Less material thickness leads to 30-40 % less energy consumption in production. Low weight results in lower fuel consumption and in a decrease in CO<sub>2</sub> emissions per kilometer.



## Reverse the weight spiral

A lightweight vehicle body brings indirect benefits for the whole vehicle.



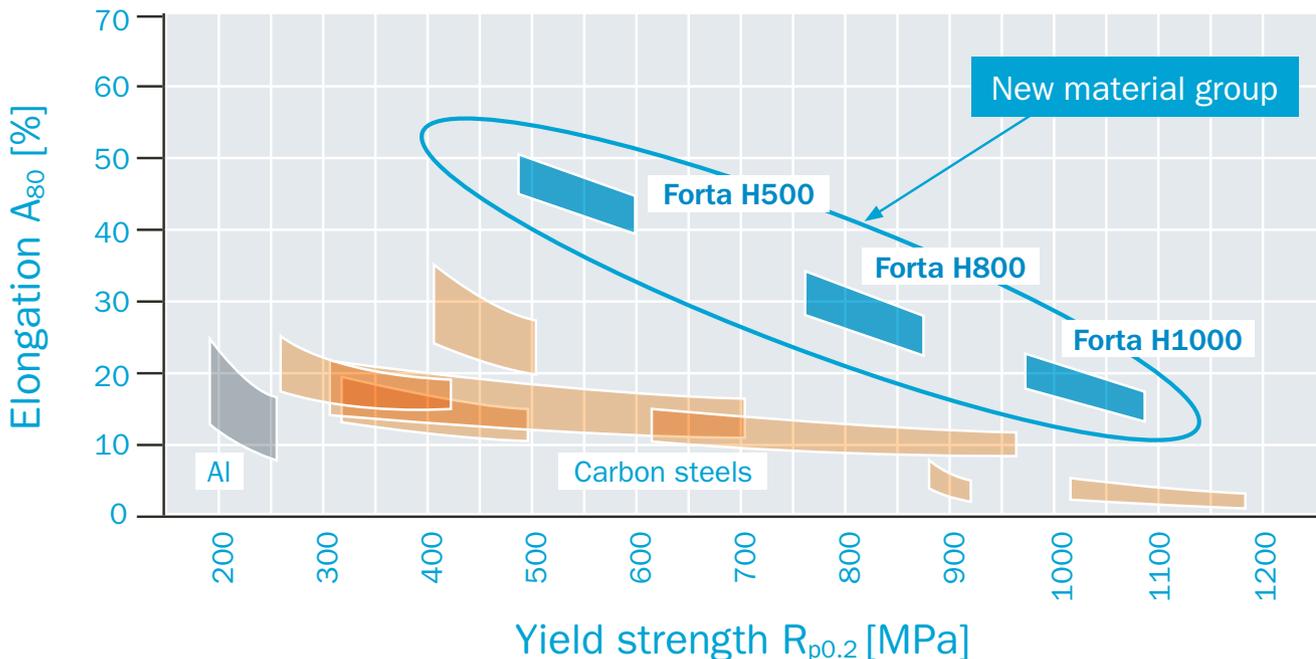
# New material group

Outokumpu has developed a new high-strength material group with a fully austenitic microstructure. Due to the natural  $\text{Cr}_x\text{O}_y$  passivation layer, Forta H-Series can be used without a zinc coating. Our extensive expertise in alloyed steels is based on decades of research in the field of high-strength materials.

## Forta H-Series – Outokumpu’s new lightweight material

Material	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation after fracture $A_{80}$ [%]
Typical values			
Forta H500	530	900	51
Forta H800	800	1000	31
Forta H1000	1000	1200	13

## Yield strength vs. elongation curves

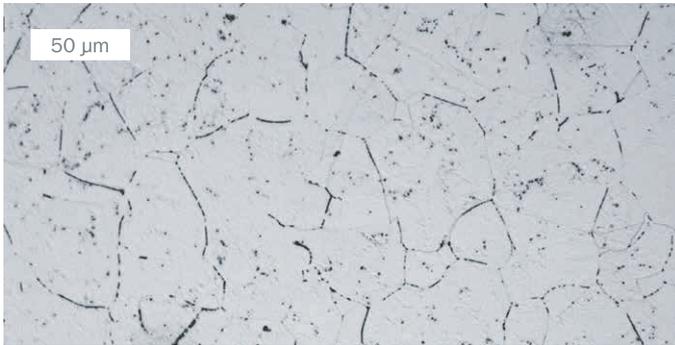


# Material properties

- Brand name: Forta H500 / Forta H800 / Forta H1000
- Material number<sup>1</sup>: 1.4678
- Microstructure: full austenitic
- Surface: uncoated
- Alloying system: Fe-Mn-Cr

## Hardening effect

Due to the well-balanced alloy composition Forta H-Series obtains the fully austenitic structure. The result is a non-magnetic microstructure which forms no martensite and is not prone to delayed fracture. The austenitic structure is characterized by the TWIP (Twinning Induced Plasticity) strengthening mechanism: when formed or crashed the material structure transforms creating deformation twins and therefore hardens continuously.



Base material



13.6 % strain-hardening



24.3 % strain-hardening



56.8 % strain-hardening

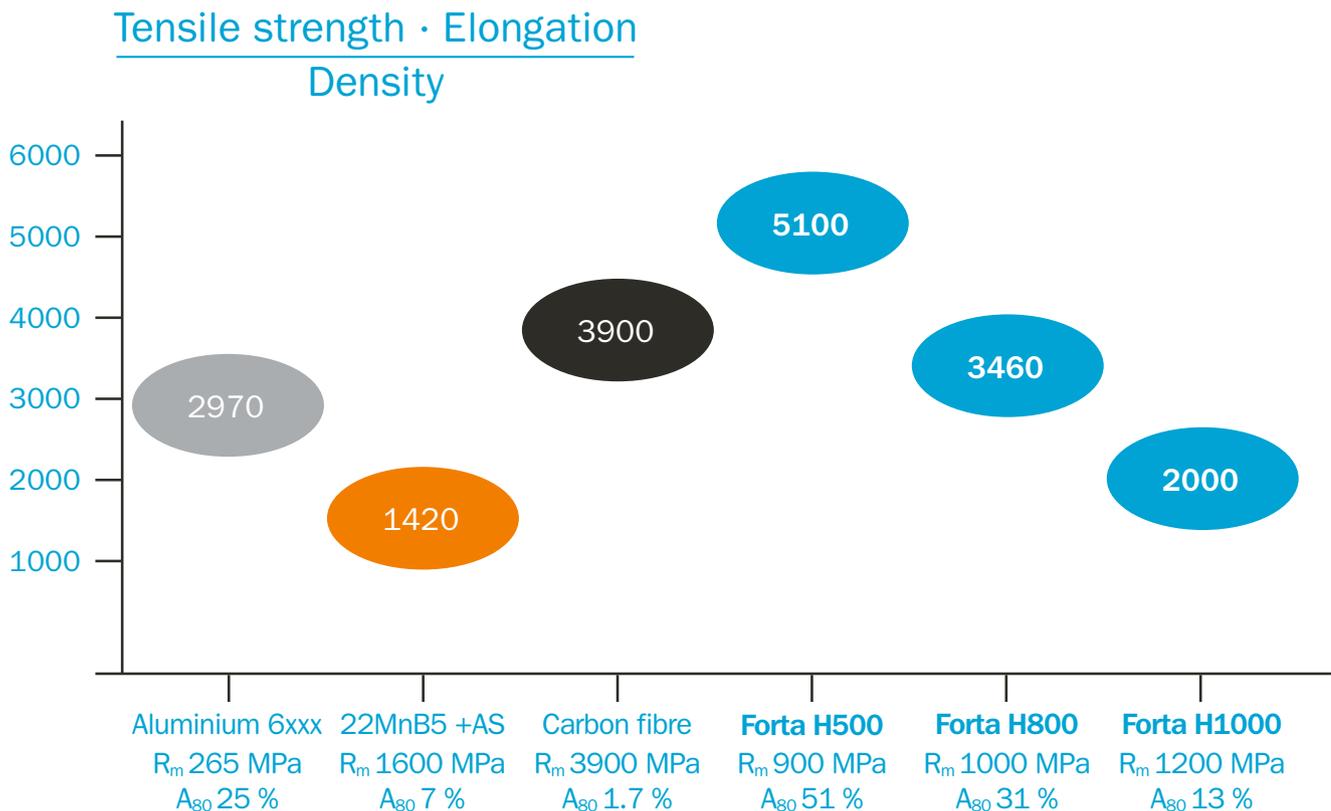
1. According to Register of European Steels

# Lightweight design

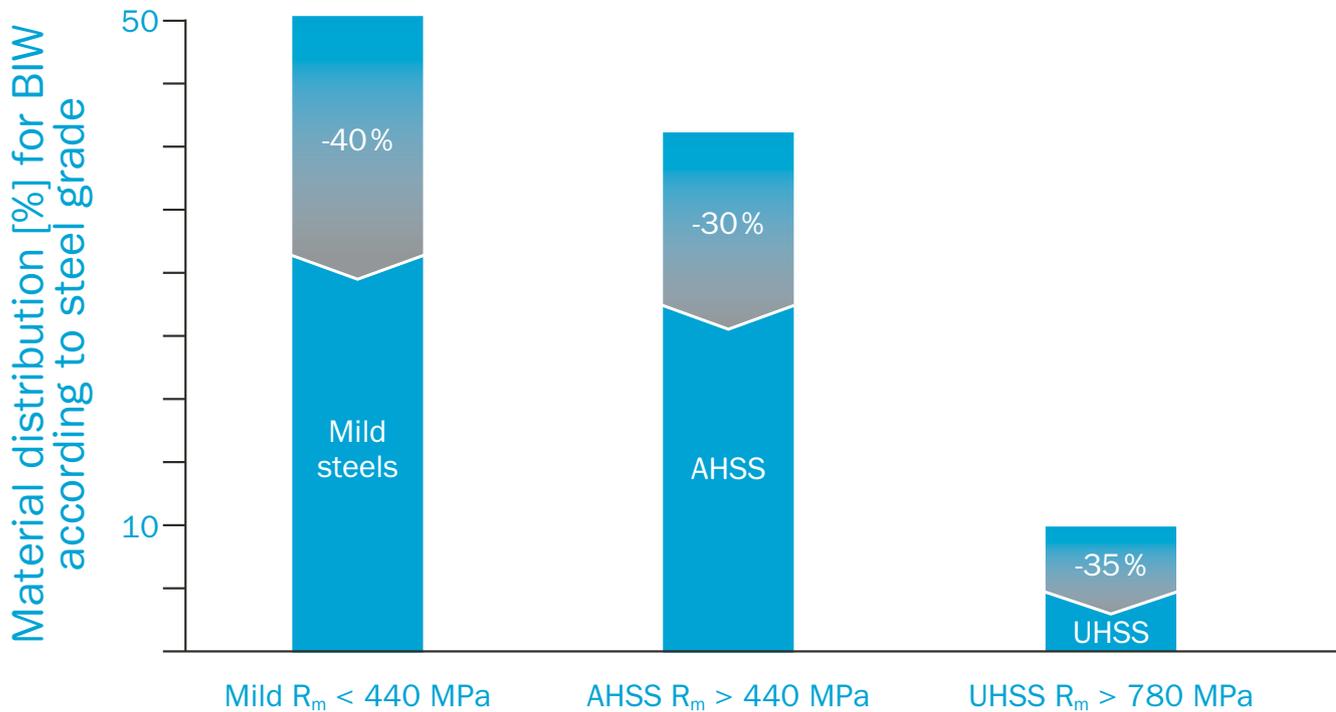
The trend in automotive design is clearly evident – the demand is for lighter vehicles with lower CO<sub>2</sub> emissions paired with the very highest occupant safety. Innovative materials help achieve the weight reduction necessary to meet increasingly stringent CO<sub>2</sub> limits.

## Lightweight materials for crash parts

The special combination of the alloy system, microstructure and hardening characteristics gives the Forta H-Series excellent potential for lightweight engineering. It presents a wide array of solutions for direct and indirect lightweight design. Benefits can be derived from geometric or integrative effects. Special manufacturing processes like hydroforming or roll-forming enable new designs for lightweight parts.



## Lightweight potential of MnCr material in BIW



### Benefits

- Where mild steels are still used, weight savings of as much as 40 % are possible
- Due to excellent ductility of these materials, complex geometries can be produced
- Functional integration helps reduce part count
- Outstanding production processing in, e.g. forming, joining and painting

# Crash performance

Outokumpu's global R&D network is continuously developing new material concepts to meet the high demands of crash performance and lightweight engineering going forward.

## Axial crash test

Alongside ongoing developments in the field of lightweight engineering, Outokumpu's number one priority is safety. The new Forta H-Series has enormous potential for reducing material thickness while raising crash performance. The test results represent a crash at a speed of around 30 km/h. The hot-formed steel profile does not withstand the impact and suffers a brittle failure. The work-hardening austenitic Forta H1000 absorbs the impact energy without failing and can absorb even greater energy. In addition, the ductile welded areas allow the transmission of crash energy to the surrounding parts.



High ductility of  
MnCr materials in welded areas



22MnB5 (left) and Forta H1000 (right)

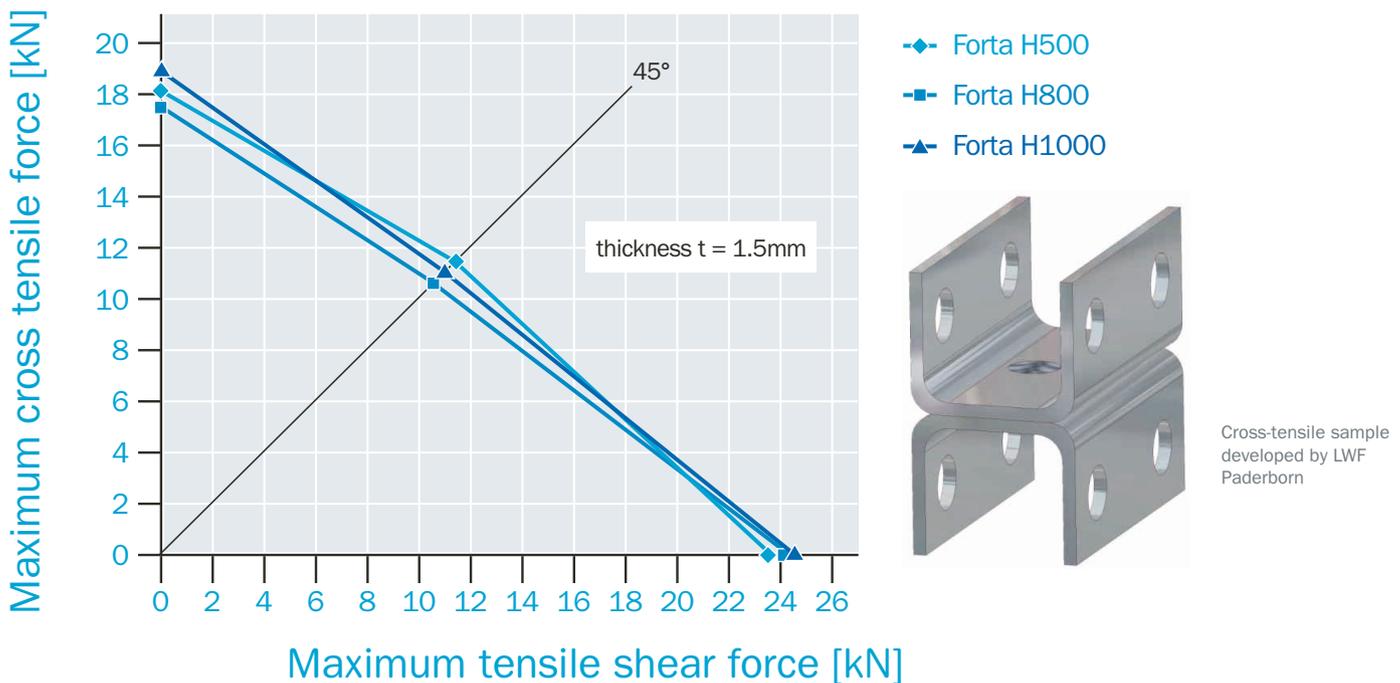
## Benefits

- Outokumpu's Forta H-Series has outstanding energy absorption characteristics
- In contrast to press-hardened materials, the Forta H-Series plays an active role in energy absorption
- High force transmission even in welded areas
- Excellent crash characteristics deliver significant lightweight engineering benefits, while raising occupant safety
- High ductility enables complex part design, despite ultra-high strength
- Lower processing costs

## Force transmission in joined condition

Outokumpu's new Forta H-Series displays its benefits over the complete life cycle. Cost-efficient industrial processes are critical to component manufacturing, with high processability an essential factor. Outokumpu's Forta H-Series is notable for its excellent processing characteristics and reproducibility, enabling it to fulfill the very highest quality standards.

## Force transmission of similar resistance spot welded joints



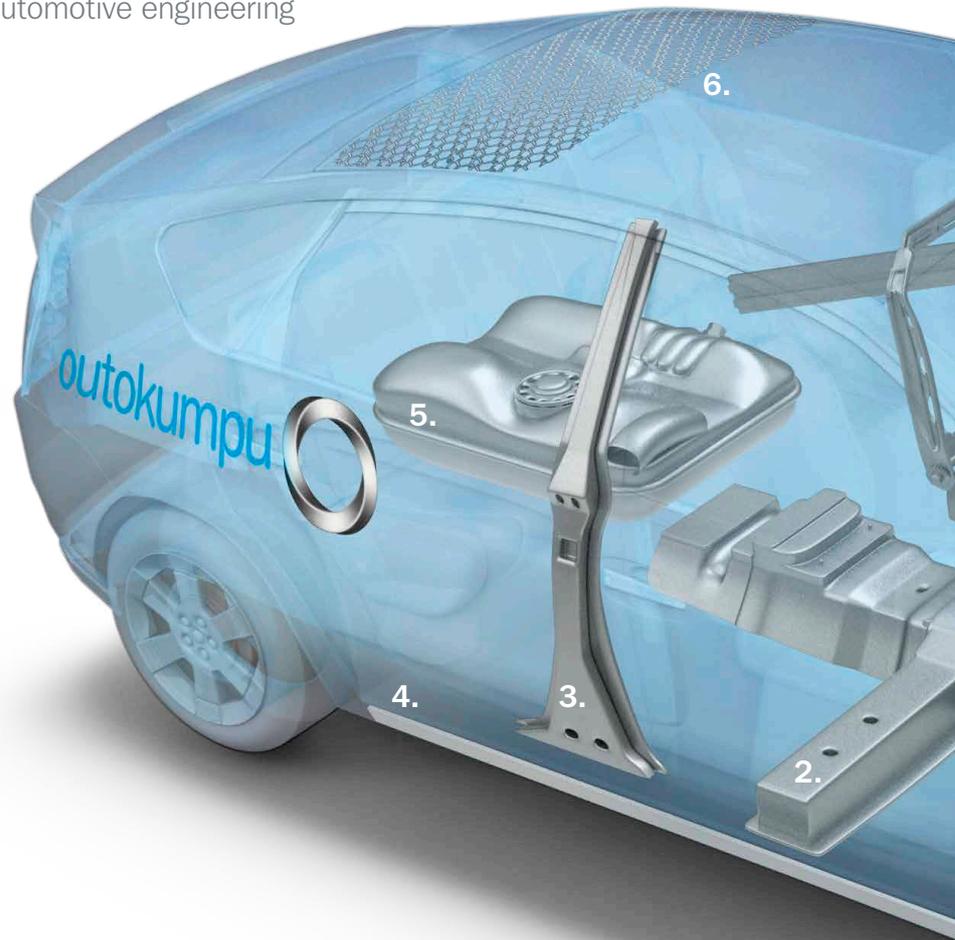
## Benefits

- Welded joints between similar or dissimilar materials enable transmission of high forces, paired with ductile plug fracture characteristics. Suitable for all regular and automotive joining processes, such as laser beam, resistance or arc welding processes, but cold joining technologies such as adhesive bonding and mechanical joining.
- The entire material group can also be processed with other materials as tailored product.
- Forming is where the Forta H-Series displays one of its greatest benefits. It presents opportunities for new design choices and component integration, as there is no risk of delayed fracture and it enables highly complex formed parts.
- In combination with electrophoretic coating, manganese-chromium material offers high resistance to lattice cut, stone chipping and disbonding.

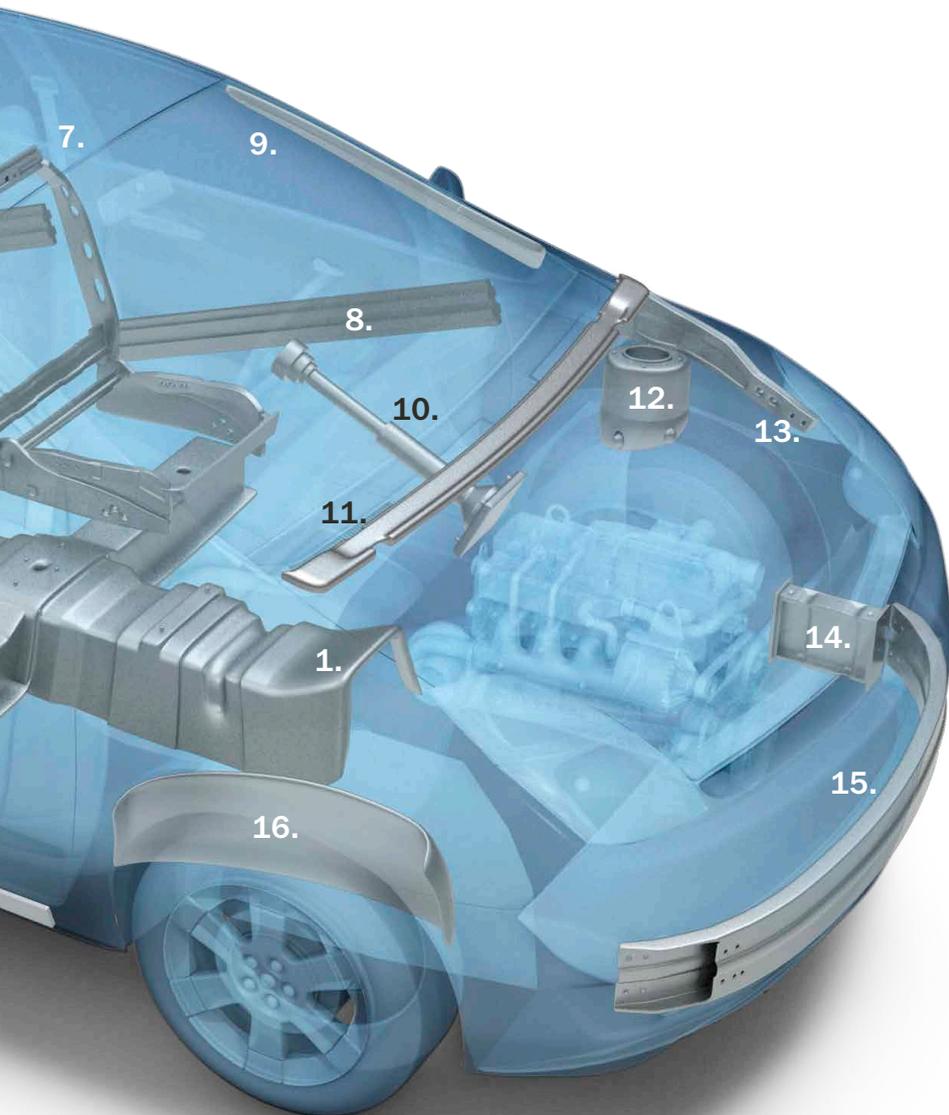
# Automotive engineering

Outokumpu is a technology leader in advanced material solutions for many vehicle engineering applications. The new high-performance Forta H-Series offers extensive opportunities for use in automotive engineering thanks to its fully developed combination of mechanical properties and individual forming characteristics.

- 1. CHANNEL**  
High formability.  
Complex geometries.  
High stiffness.
- 2. SEAT CROSS MEMBER**  
High stiffness. Impact resistance.  
Relatively complex forming.
- 3. B-PILLAR**  
Lightweight. Impact resistance.  
High ductility areas.  
Energy absorption during crash.
- 4. ROCKER RAIL**  
High stiffness. Energy absorption.
- 5. HYBRID TANK**  
Very complex forming.  
High resistance against inner pressure.  
Lightweight.
- 6. STAINLESS STEEL FABRIC**  
Excellent strength and stiffness.  
Lightweight.
- 7. SEAT STRUCTURES**  
High stiffness. Impact resistance.  
Complex forming.



MnCr austenites in  
automotive engineering solutions



8. **DOOR SHOCK ABSORBER**

High impact resistance.  
Complex geometry.

9. **A-PILLAR**

Lightweight. Impact resistance.  
High ductility areas.  
Energy absorption during crash.

10. **STEERING COLUMN**

Good fatigue resistance.

11. **DASHBOARD COWL**

High strength. High stiffness.  
High crash energy absorption.

12. **STRUT DOME**

Good fatigue behavior.

13. **LONGITUDINAL BEAM**

High stiffness.  
High impact resistance.  
Energy absorption.

14. **CRASHBOX**

High ductility.  
Crash energy absorption.

15. **BUMPER**

Lightweight. Impact resistance.  
High ductility areas.  
Energy absorption during crash.

16. **WHEEL HOUSE**

Lightweight. High formability.  
Complex geometries.

# Commercial vehicles

The ultra high-strength Forta H-Series increases crash performance and contributes to the achievement of ambitious safety requirements while simultaneously providing an excellent basis for lightweight design and thickness reduction. The Forta H-Series is thus a truly specialist choice for extreme applications.

## Benefits



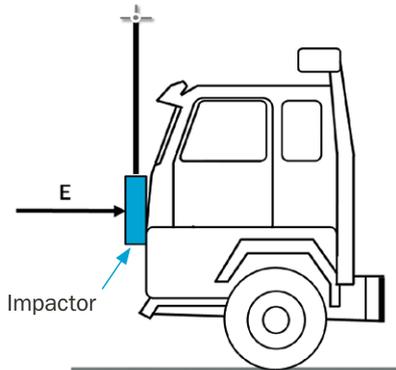
## Protection plate

When used for a 3.0 mm protection plate, the Forta H-Series combines the protective function with an elegant, shimmering design.

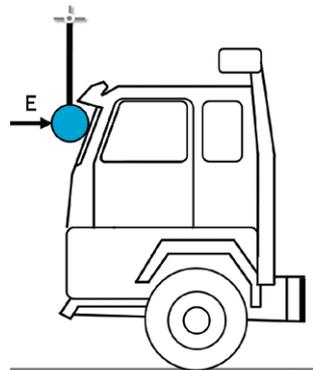


## Forta H-Series for improved safety

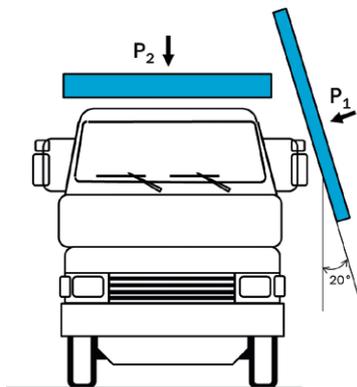
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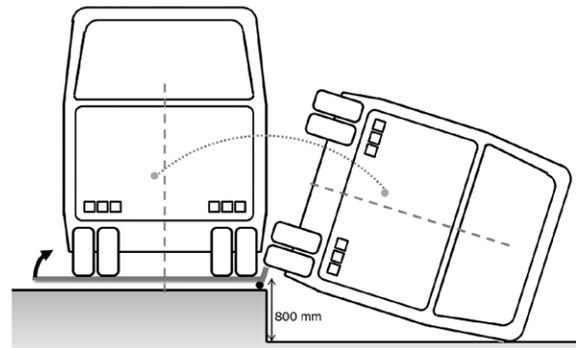
A: Front impact<sup>1</sup>



B: Front pillar impact<sup>1</sup>



C: Roof strength<sup>1</sup>



D: Rollover test<sup>2</sup>

New, more stringent safety regulations take effect from year 2017 as laid out in:

1. UN standard ECE R29-03 "Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants of the cab of a commercial vehicle"
2. UN standard ECE R66-02 "Uniform provisions concerning the approval of large passenger vehicles with regard to the strength of their superstructure"

# Automotive parts

## Cross member

High lightweight potential  
Excellent corrosion resistance  
Outstanding crash absorption  
Good formability for limited space



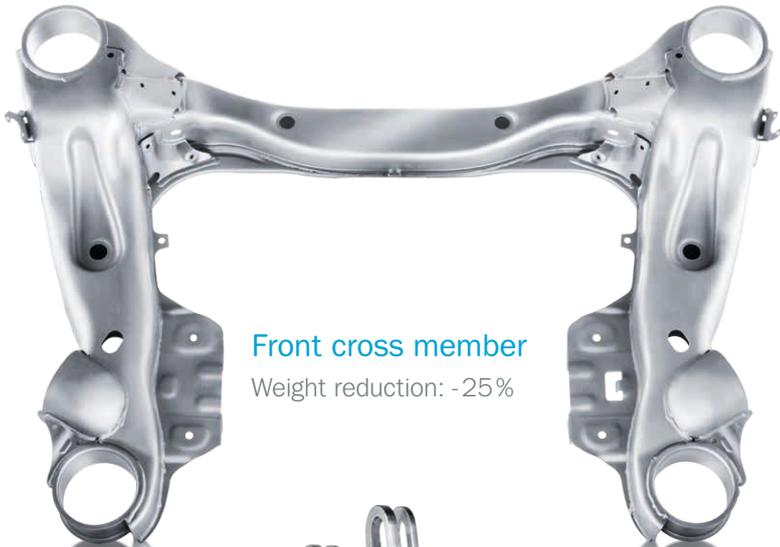
## Seat cross member

System integration: 3 in 1



## Dashboard cowl

Hydroformed/complex  
Outstanding crash absorption



**Front cross member**

Weight reduction: -25%



**Strut tower**

Ultra-high strength  
Excellent formability



**Control arm**

Weight reduction: -20%

**Shock absorber**

High corrosion  
resistance  
Lightweight potential



# Working towards forever.

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water and efficient infrastructure. Because we believe in a world that lasts forever.

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