MATERIAL & PERFORMANCE FACTS

HOT-ROLLED STEEL STRIP FOR THE AUTOMOTIVE INDUSTRY

The hot-rolled drive product family was specially developed by voestalpine for lightweight automotive design. It can be used to achieve complex component geometries with demanding deformations and economical cold-forming processes.

The high-strength hot-rolled strip steels achieve properties pursuant to VDA 239-100 and are characterized by above-average processing properties.

Convincing advantages

- Achievement of demanding component geometries through excellent bending and deep-drawing properties
- Best cutting and punching properties
- Excellent formability of punched edges, high resistance to edge cracking
- Excellent welding suitability in essential processes (MAG, laser welding) due to the low C equivalent

greentec steel

Premiumqualität
mit reduziertem CO_2-Fußabdruck

hot-rolled drive
greentec steel

voestalpine Steel Division
www.voestalpine.com/ultralights/en

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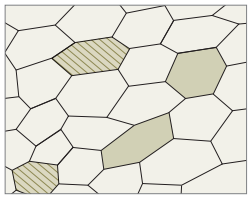
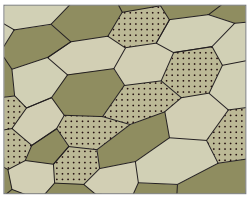
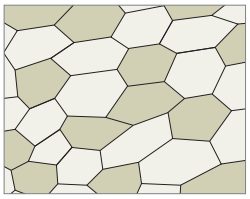
OVERVIEW OF STEEL GRADES

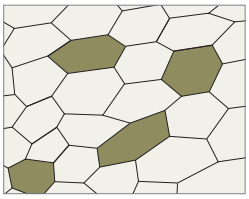
Different microstructures, different properties

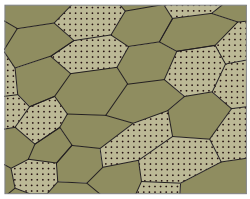
Due to the broad range of hot-rolled drive steels various specific component characteristics and requirements can be met. hot-rolled drive offers the right steel for every strength class with a microstructure and formability that is tailored to the component.


Microalloyed steels


Complex-phase steels


Ferritic-bainitic steels

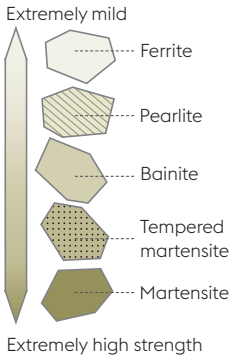

Dual-phase steels


Martensitic steels

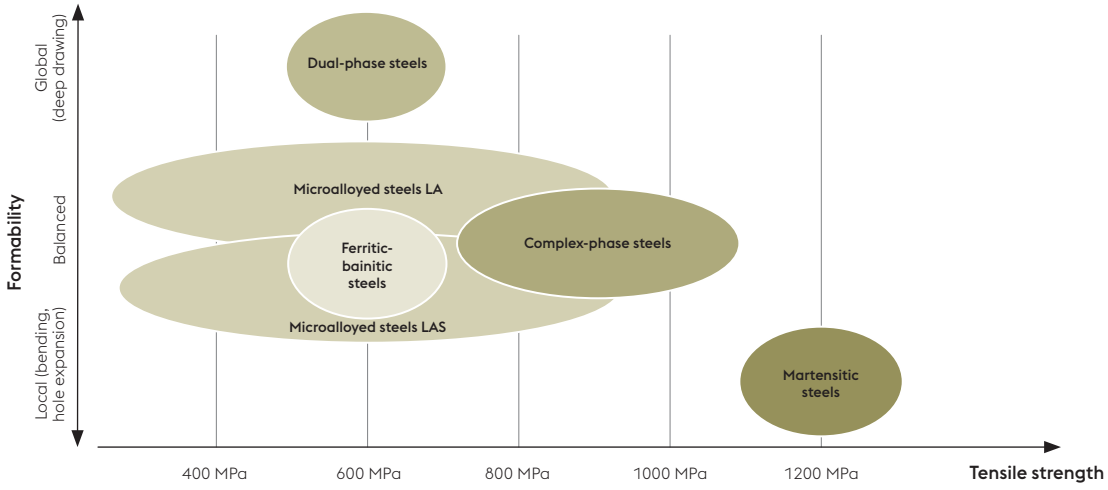
Microalloyed steels exhibit a very fine-grained, largely single-phase microstructure. The steels of the LAS series are especially suitable for the most demanding forming of punched edges.

Complex-phase steels, ferritic-bainitic steels and **dual-phase steels** feature a more pronounced transformation-hardened microstructure with a higher proportion of secondary phases. Each steel grade provides a customized balance between global and local ductility in order to achieve challenging forming operations.

With their hardened microstructure, **martensitic steels** achieve the highest strengths and are very well suited for bending forming processes.



Tensile strength and formability



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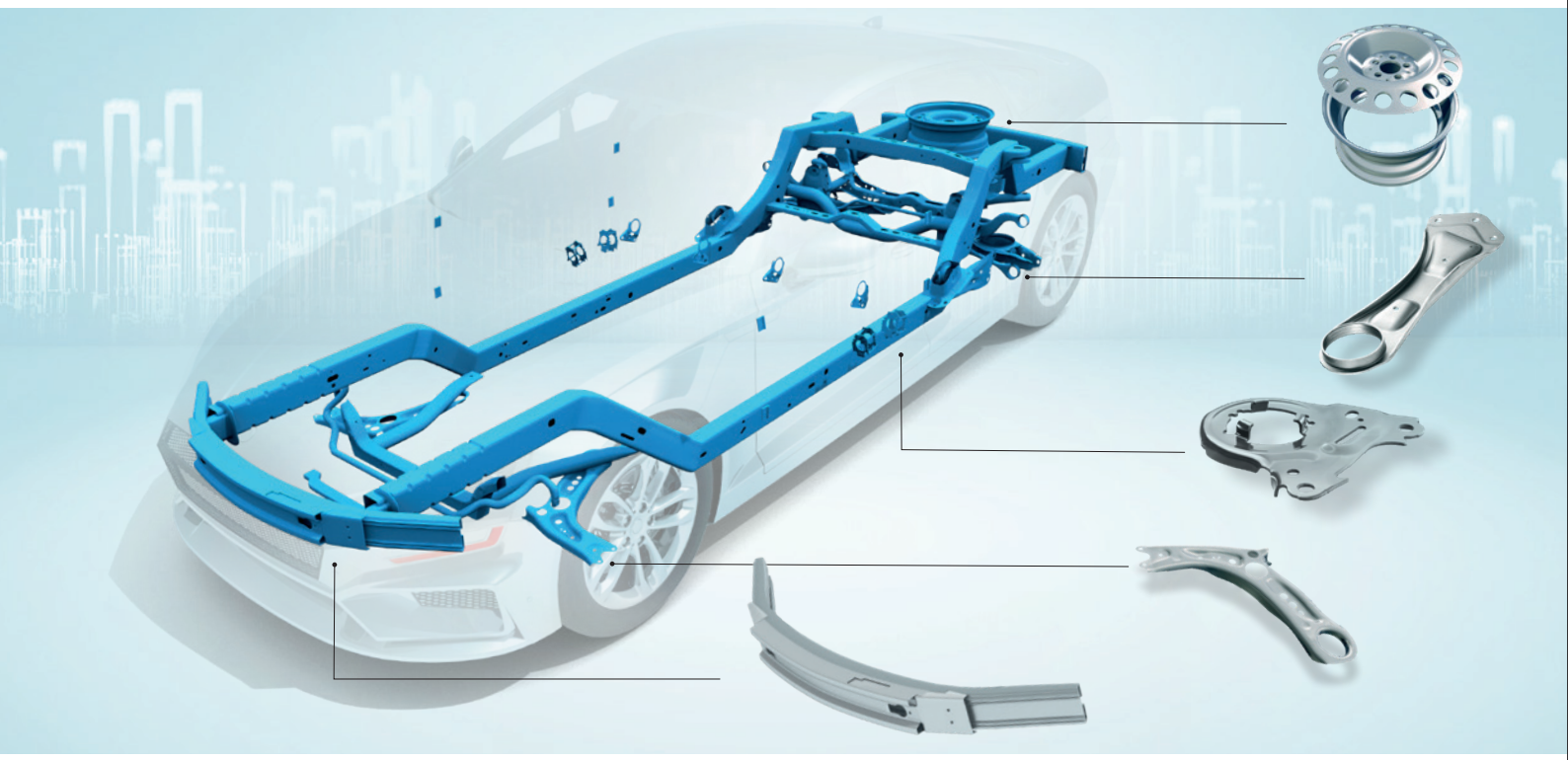
EXAMPLES OF APPLICATIONS

Broad steel spectrum, tailor-made solutions

hot-rolled drive provides the optimum steel for a wide range of applications with a specific strength class and forming requirements.



Structural components

- Crash elements (CP)
- Frame structures (LA/LAS)
- Crossmember/Bumper (MS)

Chassis components

- Longitudinal and trailing arms (CP, FB)
- Control arms (CP, FB)

Reinforcing components, hinges, rims

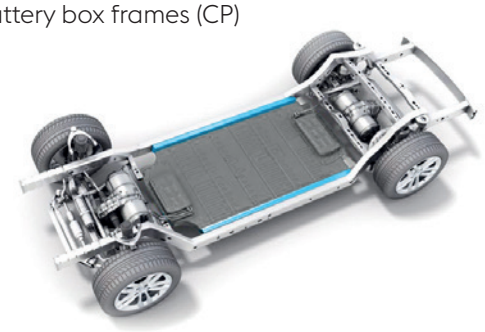
- Rim nave (DP)
- Wheel rim (LA/LAS, FB)

Seat structures

- Adapter plates (LA/LAS, FB)
- Seat belt tightener housing (LA/LAS)

Electromobility

- Battery box frames (CP)



(LA/LAS)	Microalloyed steels
(CP)	Complex-phase steels
(FB)	Ferritic-bainitic steels
(DP)	Dual-phase steels
(MS)	Martensitic steels

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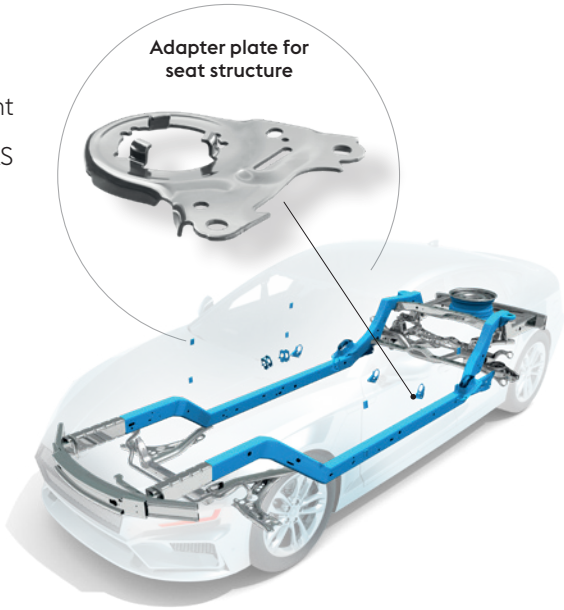
HOT-ROLLED MICRO-ALLOYED STEELS

Wide range of strength classes with best cold formability

Hot-rolled, microalloyed steels are supplied by voestalpine pursuant to VDA239-100 as HR300LA to HR700LA and HR300LAS to HR700LAS in pickled and hot-dip galvanized condition.



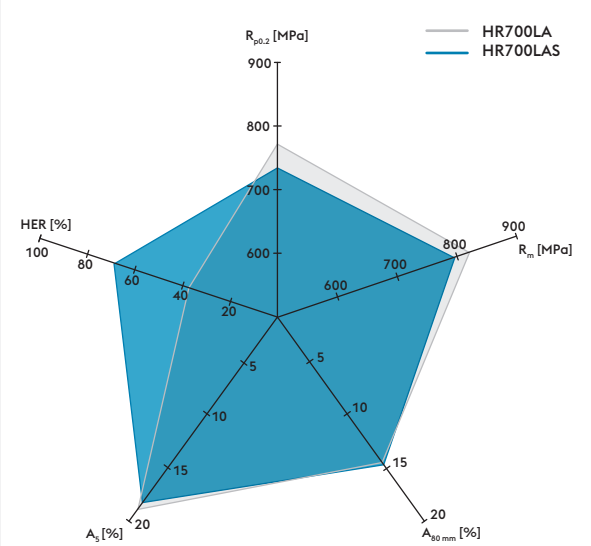
Typical applications

- Seat components
- Hinges
- Belt tightener housings
- Frame structures

Highlight: formability of punched edges

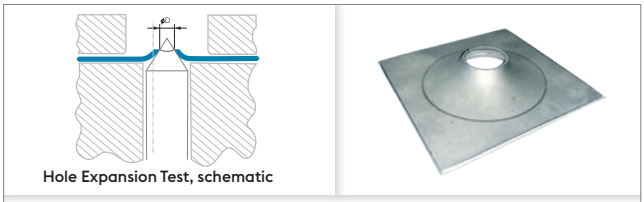
The LAS steel series exhibits especially clear advantages over conventional microalloyed steels when forming punched edges. Challenging forming operations involving hole expansion, collar forming, edge stretching and narrowest bending radii at the edge are possible as demonstrated by the hole expansion ratio that is improved across all minimum yield limits. The exceptional properties are achieved by demanding steelmaking processes at voestalpine and by optimized hot-rolling conditions.

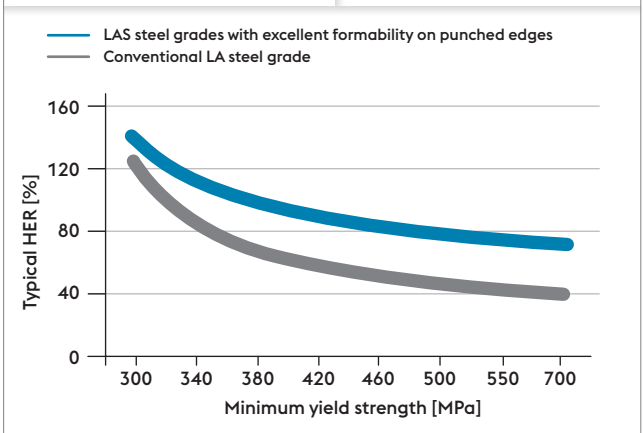
Comparison of LA and LAS steels



Thickness range between 2 and 4 mm
Yield strength $R_{p0.2}$ (MPa), tensile strength R_m (MPa), elongation at break $A_{80\,mm}$ (%), elongation at break A_5 (%), hole expansion ratio HER (%)

Formability of punched edges





Thickness range between 2 and 4 mm

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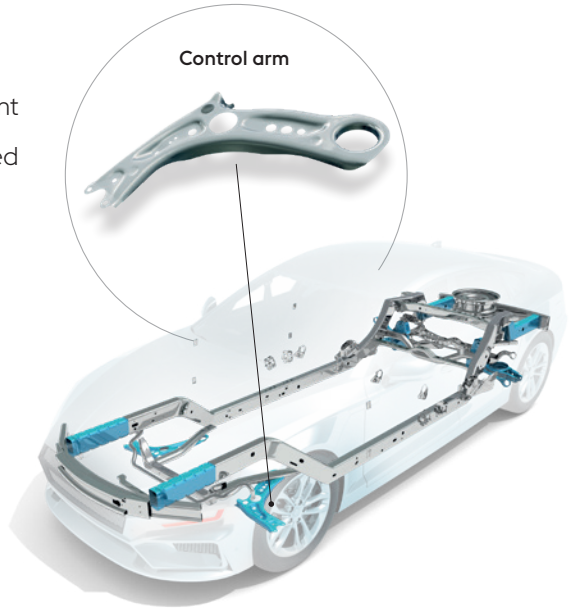
HOT-ROLLED COMPLEX-PHASE STEELS

High strength with good global and local formability

Hot-rolled complex-phase steels are supplied by voestalpine pursuant to VDA239-100, for example as steel grade HR660Y760T-CP in pickled and hot-dip galvanized condition.



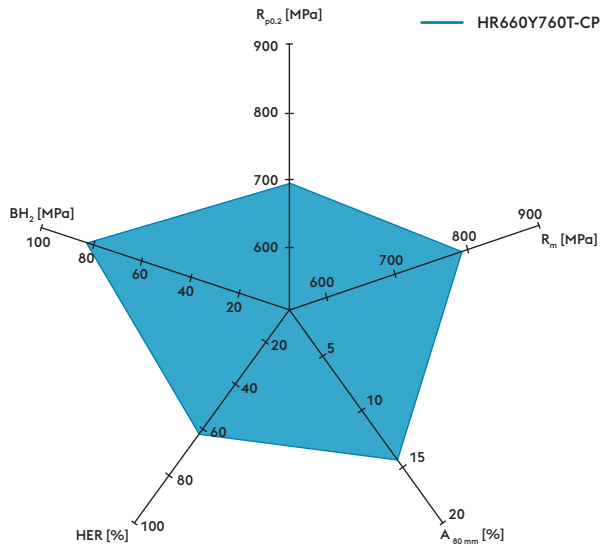
Typical applications

- Chassis components, control arms and trailing arms
- Crash-related structural components

Highlight: outstanding balanced properties

The property profile (HR660Y760T-CP as an example) shows the typical yield strength ratio for complex-phase steels and the good balance of global forming parameters such as elongation at break and local forming properties such as hole expansion. This results in excellent suitability for components with complex geometries (control arms) and for use in crash-relevant structural components. This is confirmed by the high force absorption in the axial crash test and crack-free buckling.

HR660Y760T-CP property profile



Thickness range between 2 and 4 mm
Yield strength $R_{p0.2}$ (MPa), tensile strength R_m (MPa), elongation at break $A_{80\,mm}$ (%), Hole expansion ratio HER (%), yield limit increase BH_2 (MPa)

Crack-free buckling during axial crash (welded hollow profile, thickness of 2 mm)

	Relative mean force in axial crash with same profile geometry [%]
HR340LA	100%
HR440Y580T-FB	122%
HR660Y760T-CP	158%

Axial crash: high force absorption in HR660Y760T-CP

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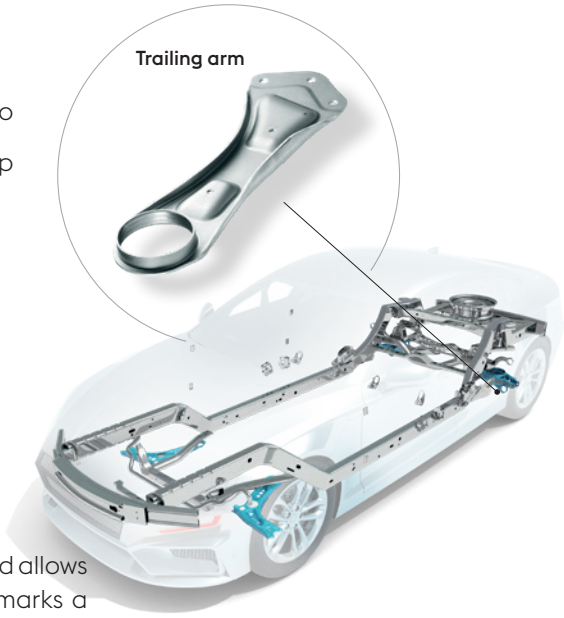
HOT-ROLLED FERRITIC-BAINITIC STEELS

Best damage tolerance in complex forming operations

Hot-rolled ferritic-bainitic steel is supplied by voestalpine pursuant to VDA239-100 as steel grade HR440Y580T-FB in pickled and hot-dip galvanized condition.



Typical applications

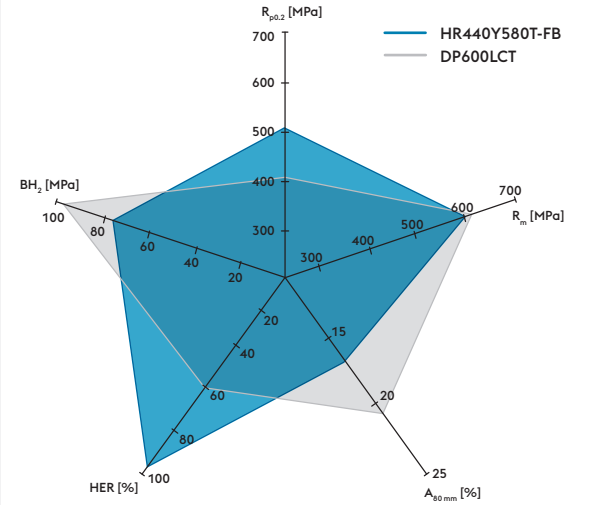
- Chassis components, control arms and trailing arms
- Structural components

Highlight: the advantage for hole expansion on punched edges

The ferritic-bainitic microstructure leads to high damage tolerance and allows hole expansion and collar forming, even on punched edges. This marks a stark contrast, particularly with dual-phase steels, which exhibit reduced local formability (with greater global ductility).

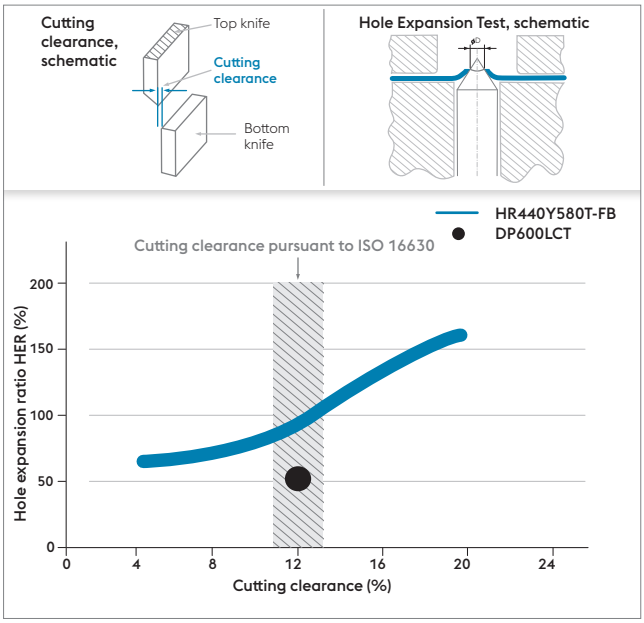
Correlation between cutting clearance and hole expansion: The choice of the cutting clearance when cutting or punching has a significant effect on the behavior of materials during subsequent forming. Optimal forming results are achieved using tailored cutting clearances depending on the material, as shown in the example of HR440Y580T-FB. Understanding this behavior ensures optimum matching of tool geometry and steel grade. The technical advice provided by voestalpine on forming processes will ensure the best results.

Ferritic-bainitic steel vs. dual-phase steel



Thickness range between 2 and 4 mm (HR440Y580T-FB), thickness range between 3 and 4 mm (DP600 LCT); yield strength $R_{p0.2}$ (MPa), tensile strength R_m (MPa), elongation at break $A_{80\,mm}$ (%), hole expansion ratio HER (%), yield strength increase BH_2 (MPa)

Higher hole expansion when cutting clearance is correctly selected



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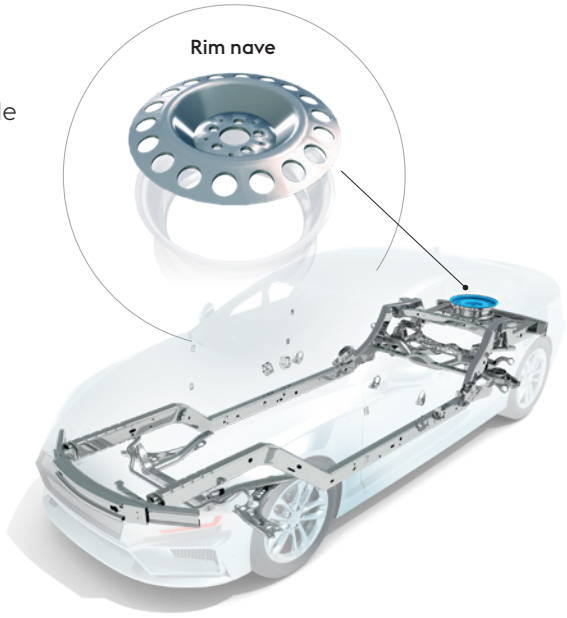
HOT-ROLLED DUAL-PHASE STEELS

The steel for global forming operations

Hot-rolled dual-phase steel is supplied by voestalpine with steel grade DP600LCT in pickled condition based on VDA239-100.

Typical applications

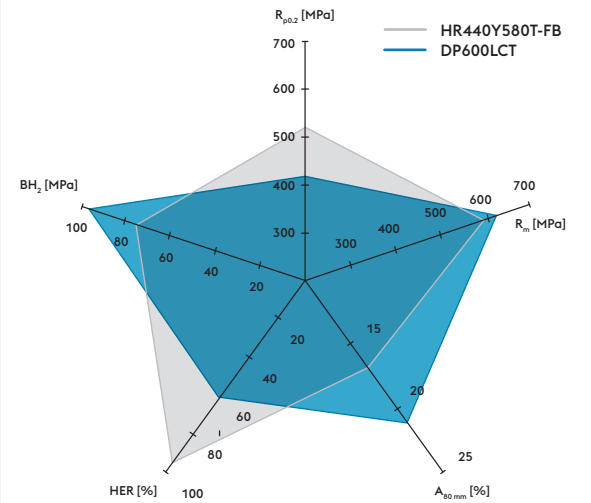
» Rim nave
» Structural components



Highlight: the benchmark for deep drawing

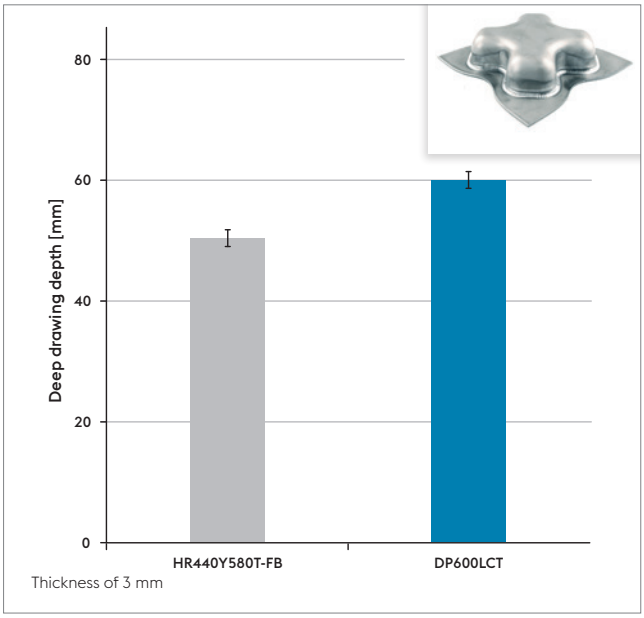
The ferritic-martensitic microstructure of steel grade DP600LCT enables very good global formability. In this respect, DP steels exceed the comparably strong ferritic-bainitic steels, which are characterized by their local ductility characteristics. Pronounced work hardening and a high elongation at break determine excellent suitability for deep-drawing forming operations as shown by the comparison with achievable drawing depths.

Dual-phase steel vs. ferritic-bainitic steel



Thickness range between 3 and 4 mm (DP600 LCT), thickness range between 2 and 4 mm (HR440Y580T-FB)
Yield strength $R_{p0.2}$ (MPa), tensile strength R_m (MPa), elongation at break $A_{80\,mm}$ (%), hole expansion ratio HER (%), increase in yield strength BH_2 (MPa)

Higher total deep drawing depth in dual-phase steel



Thickness of 3 mm

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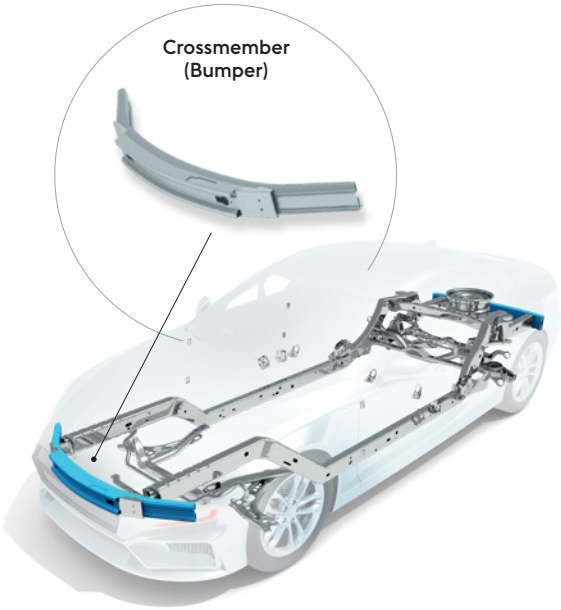
HOT-ROLLED MARTENSITIC STEELS

Convincing combination of highest strength and bendability

Hot-rolled martensitic steel is supplied by voestalpine pursuant to VDA239-100 as steel grade HR900Y1180T-MS in pickled condition.



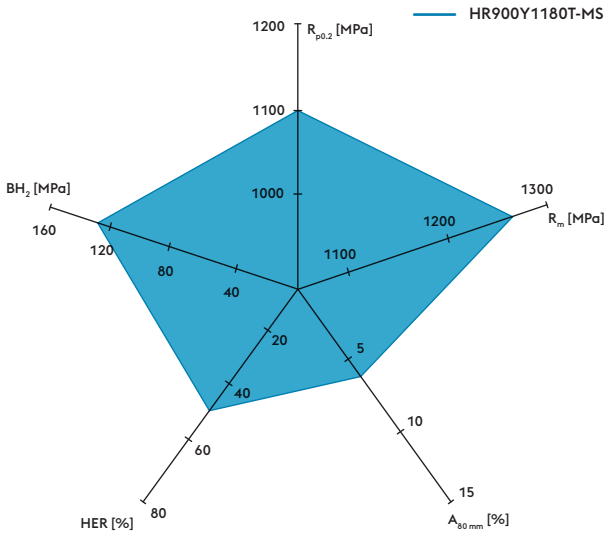
Typical applications

- Crossmember (Bumper)
- Underrun guards

Highlight: minimal bending radii, excellent profiling

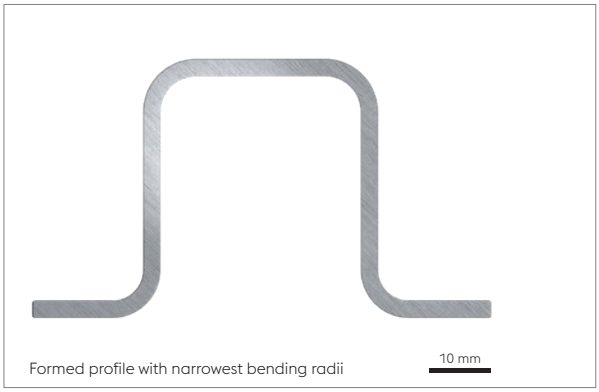
The single-phase martensitic microstructure of martensitic steels offers a convincing combination of highest strength and good suitability for bending and forming processes, such as further processing by roll-profiling. Despite their high strength, these steels provide excellent hole expansion capability.

HR900Y1180T-MS property profile



Thickness range between 3 and 4 mm
Yield strength $R_{p0.2}$ (MPa), tensile strength R_m (MPa), elongation at break $A_{80\,mm}$ (%), hole expansion ratio HER (%), increase in yield strength BH_2 (MPa)

HR900Y1180T-MS achieves the narrowest bending radii (roughly four times the thickness of the sheet) in the three-point bending test with orientation of the bend line in the direction of rolling. Experience has shown that even lower bending radii can be achieved during roll-profiling. The sequence of the forming steps, residual stresses and the associated springback must be observed during the forming process.



Formed profile with narrowest bending radii

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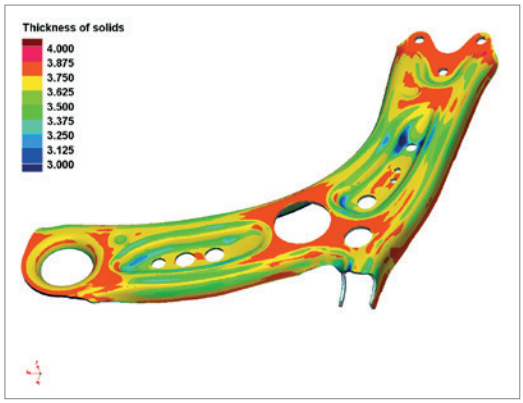
SUPPORT

More than optimum materials

Take advantage of our expertise and experience. We have extensive expertise, which we substantiate and make available with characteristic values, in processing, forming and welding technologies. Please contact our product management team.

Metal forming

We supply the following characteristic values for selected materials in order to clearly characterize hot-rolled drive steels for processing and later use:



Forming simulation of control arm; material: HR660Y760T-CP

Material characteristics

- Flow curves
- Forming limit diagrams
- Tests of material failure
- Formability of punched edges (application-oriented tests and evaluation of influence of cutting clearance)
- Bending tests
- Fatigue strength (stress and strain controlled fatigue curve)

Component tests

- Crash test
- Small-scale tests to prove formability

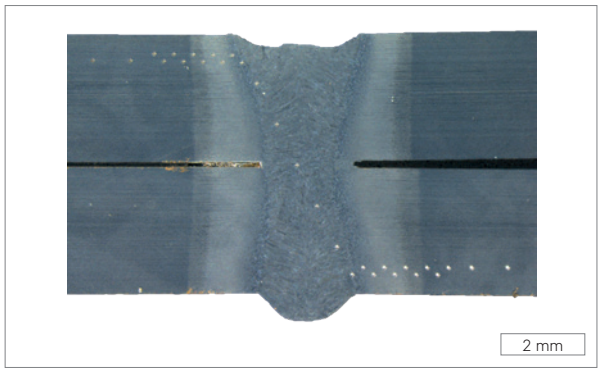
Data for FE-simulation

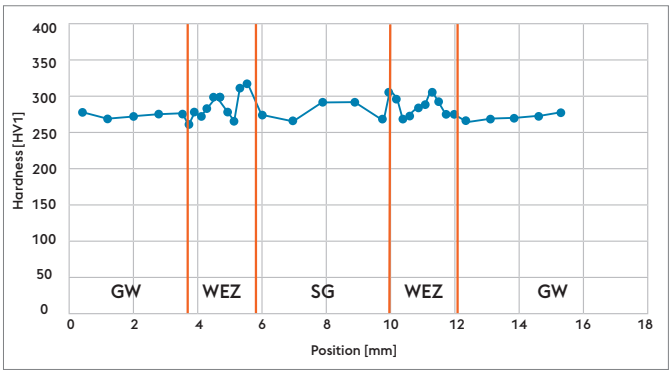
- Forming simulation
- Crash simulation

Welding technology

The low C equivalent of hot-rolled drive steels is the basis for their excellent welding suitability. We would be pleased to provide you with support based on in-depth investigations in areas such as the selection of filler materials or the behavior of materials during welding:

- Material behavior when using different welding techniques
- Physical simulation of the heat-affected zone





Hardness track on laser-welded seams; material: HR660Y760T-CP

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OUR PATH TO A GREENER FUTURE

Premium products in the greentec steel Edition

With greentec steel, voestalpine is pursuing an ambitious step-by-step plan in the long-term decarbonization of steel production. The declared objective is to achieve carbon-neutral production by 2050, and the initial steps have already been taken. Process-optimized production operations already prevent 10 % of the direct CO_2 emissions at the Linz site. The material and processing properties of the steel are not affected in any way in this production route. Each voestalpine steel strip product is available in premium quality in the greentec steel Edition with a reduced carbon footprint and unique benefits.

greentec steel

Premium quality with a reduced CO_2 footprint

hot-rolled drive

greentec steel

Hot-rolled steel strip, greentec steel Edition
Maximum carbon footprint 1.95 kg CO_2e/kg steel [1)]
Hot-dip galvanized steel strip, greentec steel Edition
Maximum carbon footprint 2.13 kg CO_2e/kg steel [1)]

[1)] Pursuant to EN 15804+A2 (EPD methodology), “cradle to gate”

All products, dimensions and steel grades listed in each voestalpine supply range are available in the greentec steel Edition.

Learn more by visiting us at
https://www.voestalpine.com/ultralights/en/Products/Cold-forming/hot-rolled-drive

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