



phs-scalefree®

The first hot forming steel up to 2000 MPa with a thin zinc coating

The high-quality grade phs-scalefree 2000 is an outstanding development in the field of lightweight automotive design and opens up new perspectives for the economical production of ultra-high-strength components.

The single-phase zinc ferrite coating ensures unique scale protection with excellent hot forming properties and provides corrosion protection. All phs scalefree® grades can be processed in both direct and indirect hot forming processes.

Manganese-boron steels with thin zinc layers enable complex component geometries and are recommended for large components. For example, they are ideal for B pillars or internal structural components.

Available steel grades: phs-scalefree 2000, phs-scalefree 1500, phs-scalefree 490

Convincing advantages

- » Excellent workability up to 2000 MPa with a thin zinc coating
- » Increased tool life and longer cleaning intervals based on clean processes
- » No hydrogen uptake in the press hardening process
- » Complex component geometries
- » Large components
- » Very good welding and adhesive bonding properties
- » Both direct and indirect hot forming processes possible



Premium quality
with reduced carbon footprint

phs-scalefree®
greentec steel

In the direct process, the blanks are heated to roughly 900 °C. They are then formed to their final geometry and hardened prior to final cutting.

In the indirect process, the blanks are first formed to their final geometry by shape cutting and conventional cold forming processes. The material is subsequently form-hardened in hot condition. This adjusts the mechanical properties and finalizes the component geometries.

The entire process chain can be simulated down to the detailed component properties.

Depending on customer requirements, surface conditioning and/or transport corrosion protection is applied by the component manufacturer.

Chemical composition in mass %

Steel grade ¹⁾	C	Si max.	Mn	P max.	S max.	Al	Cr max.	Ti + Nb max.	B	Cu max.	N max.	Ni max.
phs-scalefree 490	≤ 0.13	0.5	≤ 1.5	0.03	0.025	≥ 0.015	-	0.15	-	0.2	-	-
phs-scalefree 1500	0.20 – 0.25	0.5	1.1 – 1.5	0.02	0.005	0.02 – 0.08	0.35	*)	0.002 – 0.005	0.2	0.01	0.1
phs-scalefree 2000 ²⁾	0.30 – 0.38	0.5	≤ 2.0	0.02	0.005	0.02 – 0.08	0.5	0.20	0.002 – 0.005	0.2	0.01	0.5

*) Ti 0.02 – 0.05 / Nb -

Mechanical properties in as-delivered condition: Tensile test

Testing transverse to rolling direction

Steel grade ¹⁾	0.2 % yield strength R _{p0.2} [MPa]	Tensile strength R _m [MPa]	Fracture elongation A ₈₀ [%] min.
phs-scalefree 490	280 – 500	380 – 540	21
phs-scalefree 1500	350 – 480	470 – 700	18
phs-scalefree 2000 ²⁾	400 – 650	550 – 800	15

Typical mechanical properties after hot forming and hardening

Testing transverse to rolling direction

Steel grade	Typ. 0.2 % yield strength ³⁾ R _{p0.2} [MPa]	Typ. tensile strength ³⁾ R _m [MPa]	Typ. fracture elongation ³⁾ A ₅₀ [%]	Typ. bending angle ^{3) 4)} α _{1 mm} [°]
phs-scalefree 490	400	490	16	130
phs-scalefree 1500	1050	1500	6	70
phs-scalefree 2000 ²⁾	1200	1900	5	45

Typical mechanical properties after hot forming, hardening and cathodic dip coating

Testing transverse to rolling direction

Steel grade	Typ. 0.2 % yield strength ³⁾ R _{p0.2} [MPa]	Typ. tensile strength ³⁾ R _m [MPa]	Typ. fracture elongation ³⁾ A ₅₀ [%]	Typ. bending angle ^{3) 4)} α _{1 mm} [°]
phs-scalefree 490	400	490	16	130
phs-scalefree 1500	1150	1500	6	70
phs-scalefree 2000 ²⁾	1400	1850	5	50

¹⁾ The voestalpine steel grades meet the specifications of VDA 239-500.

²⁾ Indication of preliminary values

³⁾ Mechanical parameters in hardened condition are standard values achieved in professional processing of flat sheets.

The indicated values are not guaranteed by voestalpine Stahl GmbH.

» Austenitization conditions: Furnace chamber temperature of 910 °C, 45 s annealing time after achieving a blank temperature of 870 °C

» Transfer time approx. 8 – 14 seconds (transfer time = time between furnace opening and complete pressure buildup in the press)

» Cooling conditions: Cooling rate > 40 K/s during cooling between water-cooled plates

» Temperature at which blanks are removed < 200 °C

» Conditions of heat treatment during bake-hardening simulation: 170 °C/20 min, oil

⁴⁾ Instrument measurement of bending angle during bending test according to VDA 238-100, α_{1 mm} = α x thickness ^{0.35}

Coating in as-delivered condition

Coating class ¹⁾ pursuant to VDA 239-100 / EN 10346	Layer thickness [µm] max.	Fe content in coating [mass %] max.	Al content in coating [mass %] max.
GI35/35 - Z80	7.5	≤ 1	1.0
GA35/35 - ZF80		8 - 15	

¹⁾ Other layer thicknesses upon request

Typical values after hot forming

Coating class pursuant to VDA 239-100 / EN 10346	Layer thickness [µm]	Fe content in coating [mass %]
GI35/35 - Z80	10	> 65
GA35/35 - ZF80		

Available dimensions

Maximum width [mm] per thickness, minimum width of 900 mm for wide strip

Steel grade	Thickness [mm]				
	0.5	0.7	1.0	1.4	2.0
phs-scalefree 490	1490	1690	1740	1740	1740
phs-scalefree 1500	-	1350	1510	1510	1510
phs-scalefree 2000 ²⁾	-	-	1300	1400	1400

²⁾ Indication of provisional values

Standard end trimming reduces the maximum width by 20 mm.
Additional dimensions upon request.



Premium quality with reduced carbon footprint

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greentec steel

Hot-dip galvanized steel strip – greentec steel Edition

Max. carbon footprint 2.30 kg CO₂e per kg of steel ¹⁾

¹⁾ per EN 15804+A2 (EPD methodology) cradle to gate

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

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