



phs-directform®

Galvanized hot forming steels for the production of press-hardened components using the direct process

phs-directform®, the innovation developed by voestalpine, is directly hot-formed, hot-dip galvanized steel strip to be used in corrosion-resistant light-weight components for the Automotive industry. phs-directform® is a conversion-delayed boron steel with a galvanized coating. Hot forming can be performed in existing hot-forming lines with a minimum of adaptation.

phs-directform® is the simple and economical solution for press-hardened components that are subject to heavy corrosion. With its excellent properties in joining, paintability and crash performance, phs-directform is recommended for many applications.

Typical applications

- » Roof frames
- » Bumpers
- » A and B pillars
- » Hinge reinforcements
- » Rocker panels
- » Cross members
- » Side members

Convincing advantages

- » Economical manufacturing, even when processing small lots
- » Excellent processability
- » Exceptional cathodic corrosion protection
- » Brilliant paintability
- » Component production in a direct phs processing system (with pre-cooling) possible



Premium quality
with reduced carbon footprint

phs-directform®
greentec steel

The blanks are heated to roughly 900 °C. The subsequent pre-cooling prevents microcracking during the following forming process. The blanks are then formed into their final geometry and hardened prior to final cutting.

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 min.	Cr max.	Ti + Nb max.	B	Cu max.	N max.	Ni max.
phs-directform 490 ²⁾	≤ 0.13	0.5	≤ 1.50	0.03	0.025	0.015	-	0.15	-	0.2	-	-
phs-directform 1500	0.17 – 0.23	0.5	1.7 – 2.5	0.02	0.005	0.02 – 0.3	0.05	*)	0.002 – 0.005	0.2	0.01	0.1

*) Ti 0.02 – 0.05 / Nb -

Mechanical properties in as-delivered condition

Testing transverse to rolling direction

Steel grade ¹⁾	0.2 % yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Total elongation A_{80} [%] min.
phs-directform 490 ²⁾	280 – 500	380 – 540	17
phs-directform 1500	350 – 600	600 – 850	12

Mechanical properties after hot forming and hardening (Typical values)

Testing transverse to rolling direction

Steel grade	0.2 % yield strength ³⁾ $R_{p0.2}$ [MPa]	Tensile strength ³⁾ R_m [MPa]	Total elongation ³⁾ A_{50} [%]	Bending angle ^{3) 4)} α_{1mm} [°]
phs-directform 490 ²⁾	380	490	18	130
phs-directform 1500	1050	1500	6	70

Mechanical properties after hot forming, hardening and cathodic dip coating (Typical values)

Testing transverse to rolling direction

Steel grade	0.2 % yield strength ³⁾ $R_{p0.2}$ [MPa]	Tensile strength ³⁾ R_m [MPa]	Total elongation ³⁾ A_{50} [%]	Bending angle ^{3) 4)} α_{1mm} [°]
phs-directform 490 ²⁾	380	490	18	130
phs-directform 1500	1150	1500	6	70

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

²⁾ Indication of provisional values

³⁾ Mechanical parameters in hardened condition are standard values achieved in the 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. 10 seconds (transfer time = time between furnace opening and complete pressure buildup in the press)

» Pre-cooling rate of > 20 K/s to roughly 500 °C

» Cooling conditions: Cooling rate > 40 K/s up to roughly 200 °C, 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 pursuant to VDA 238-100, $\alpha_{1mm} = \alpha \times \text{thickness}^{0.35}$

Coating in as-delivered condition

Coating class ¹⁾ pursuant to VDA 239-500	Layer thickness per side [g/m ²]	Indication of coating thickness [µm]	Fe content in coating [mass %]	Al content in coating [mass %] max.
GA80/80	80 – 120	11 – 17	8 – 14	0.8

¹⁾ Other layer thicknesses upon request

Coating after hot forming (Typical values)

Coating class	Layer thickness [µm]	Fe content in coating [Mass %]
GA80/80	20	65

Available dimensions

Steel grade	Thickness range [mm]	Width range [mm]
phs-directform 490 ¹⁾	0.5 – 2.3	900 – 1630
phs-directform 1500	1.0 – 2.0	900 – 1490

¹⁾ Indication of preliminary values

The available combinations of widths and thicknesses vary depending on the steel grade.
Additional dimensions upon request.



Premium quality with reduced carbon footprint

phs-directform®
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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