PAS steels for cold forming.
When strength and formability are needed.

ThyssenKrupp high form **PAS**

ThyssenKrupp high form **PAS-LC**

ab/from 01.10.09

ThyssenKrupp Steel Europe

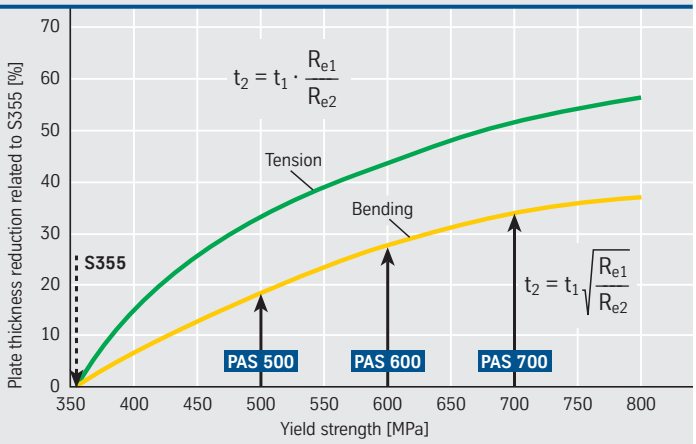
ThyssenKrupp Steel

PAS – high strength, outstanding cold formability.

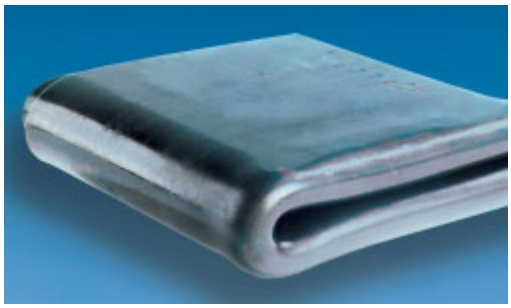
Truck manufacture requires high-strength steels capable of reducing gross vehicle weight to allow greater payloads. At the same time, these steels have to be easy to weld and cold-form, for example for the production of truck substructures or the booms of truck mounted cranes.

Developed more than 30 years ago by ThyssenKrupp Steel, PAS steels (low-pearlite special structural steels) meet these requirements in full. PAS steels contain low amounts of carbon and microalloying elements, resulting in outstanding weldability. They also offer very high cleanness, achieved by means of ladle metallurgy in the steel melting shop, and an extremely fine-grained microstructure, developed by thermo-mechanical rolling. From these factors result the excellent ductility and cold formability of PAS steels.

Plate thickness reduction related to S355 due to use of high-strength special structural steels for cold forming



PAS – a wide spectrum of grades for different applications



PAS steels are usually produced via the hot strip mill route as cut-to-length plates with minimum yield strength levels from 315 to 700 MPa. Their chemical composition is characterized by a low carbon content (max. 0.12 %), microalloying with niobium, vanadium and/or titanium, and particularly low levels of phosphorus and sulfur.

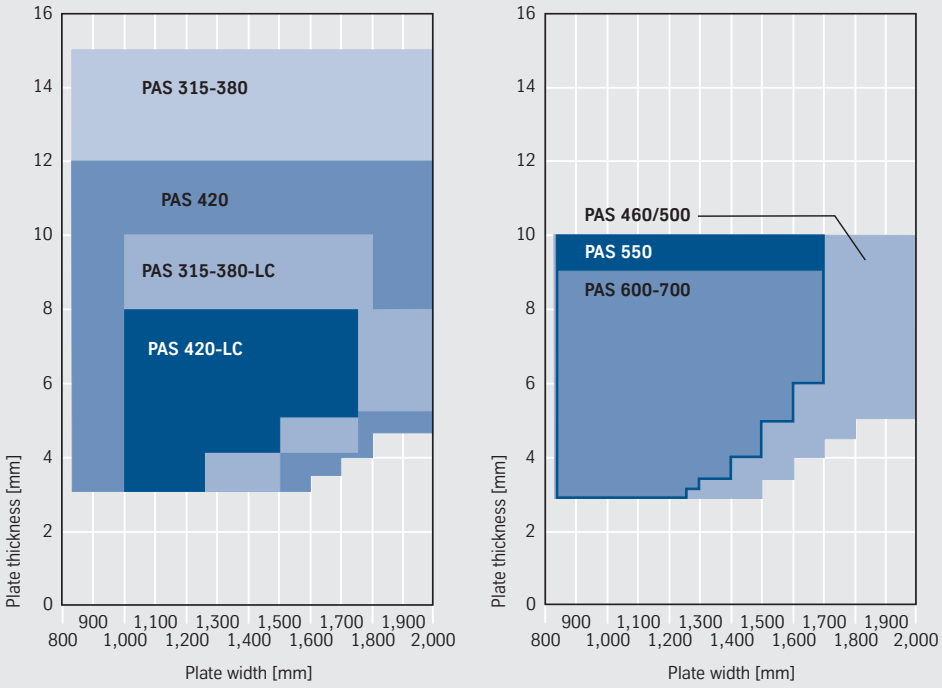
Chemical composition (ladle analysis, %) and mechanical properties (longitudinal specimens)

Steel grade	C max.	Si max.	Mn max.	Nb max.	V max.	Ti max.	Mo max.	B max.	R_e [MPa]	R_m [MPa]	A [%]	KV, –20 °C [J]
PAS 315	0.10	0.15	1.30	0.05	0.08	–	–	–	315	390 – 510	24	40
PAS 355			1.50	0.06					355	430 – 550	23	
PAS 380*									380	450 – 590	23	
PAS 420			1.60	0.07	0.10				420	480 – 620	19	
PAS 460				0.08					460	520 – 670	17	
PAS 500			1.70		0.12				500	550 – 700	14	
PAS 550		0.50	1.80		0.14				550	600 – 760	14	
PAS 600			1.90		–	0.14	0.50	0.005	600	650 – 820	13	
PAS 650		0.60	2.00						650	700 – 880	12	
PAS 700	0.12		2.10						700	750 – 950	12	

Notch impact energy can also be demonstrated at a test temperature of –40 °C. The minimum notch impact energy is then 27 J.
*) Steel grade QStE 380 TM has not been integrated into EN 10149 but is available furthermore as PAS 380.

Available sizes for PAS and PAS-LaserCut (LC), cut-to-length and four-high mill plates.

1. Cut-to-length plates



2. Four-high mill plates
PAS 315/355/380/420

Thickness: 12 – 20 mm
Width: 1,500 – 3,000 mm
Length: 4,000 – 15,000 mm

3. Four-high mill plates LaserCut
PAS 315/355/380/420-LC

Thickness: 12 – 14.9 mm
Width: max. 2,500 mm

Thickness: 15 – 20 mm
Width: max. 3,000

Length: 4,000 – 12,000 mm

Depending on grade, PAS cut-to-length plates can be produced in widths up to 2,000 mm. The grades PAS 315 to PAS 420 can also be produced on a modern four-high reversing mill in thicknesses from 12 to 20 mm and widths up to 3,000 mm.

Due to their outstanding range of properties and high surface quality, cut-to-length plates of PAS cold forming steel are ideal for continuous parts manufacture from laser-cut blanks. The close thickness and width tolerances not only benefit press brake forming (more uniform forming properties, reduced springback), but also contribute to a reduction in gross vehicle weight. They therefore permit increases in productivity in vehicle manufacture. PAS steels have been used successfully for a long time in a variety of applications, including the production of

- vehicle frame structures
- vehicle side and cross members
- booms of truck mounted cranes and concrete pump trucks
- agricultural machinery
- profile structures and containers.

PAS-LaserCut (LC) for modern laser cutting shops.

Laser cutting machines are increasingly becoming the standard in modern fabricating shops, with parts frequently being produced on automatic laser cutting centers. For applications like these, ThyssenKrupp Steel offers LC (LaserCut) plates in grades PAS 315 to PAS 420. These plates are ideal for laser cutting.

As LC cut-to-length plates are produced in a smaller size range compared with normal production, they offer particularly favorable residual stress levels. Laser cutting properties are also enhanced by the high surface quality (firmly adherent rolling skin) and low silicon content (< 0.03%) of the plates. Plates in the 3 to 6 mm thickness range can also be supplied pickled/oiled (width: max. 1,600 mm). Thicker plates can be supplied shot blasted and primered.

LC four-high mill plates are generally supplied shot blasted and primered.

For primered plates, a silicate primer with low zinc content is generally used. The good laser cutting properties of plates with a thin primer coating of approximately 15 µm have been proven in various tests.

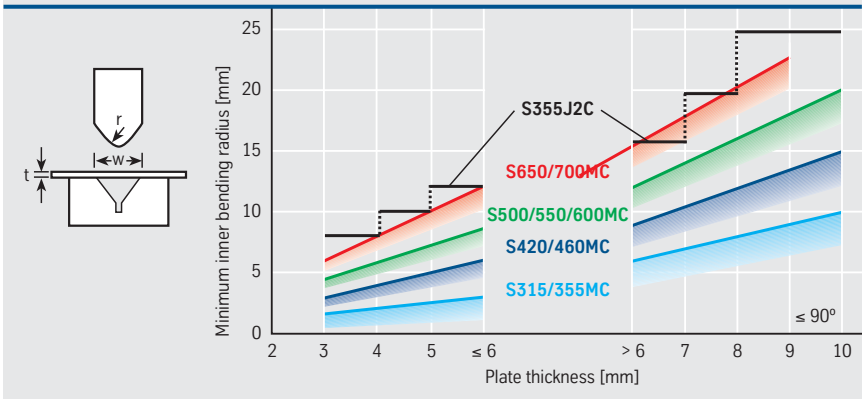
PAS – for problem-free plate fabrication

Thanks to their outstanding ductility and cold formability, PAS steel plates can be press-brake formed and bent with tight radii despite their high strength. Compared with the cold forming variant S355J2C, much smaller bending radii are recommended for press brake forming.

In many cases, practical experience shows that PAS plates can be bent and press-brake formed without problems using even tighter radii than specified in the standard, provided tooling and machine are in very good condition.

Due to the low carbon and microalloying element contents of PAS steels, carbon equivalent values are significantly lower than the corresponding values of S355J2. This results in low hardening and reduced susceptibility to cold cracking during welding. PAS steels require practically no preheating for welding.

Recommended minimum inner bending radii based on EN 10149-2 compared with S355J2C



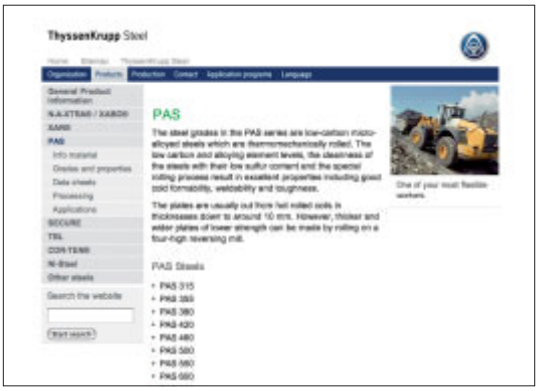
The ThyssenKrupp Steel "world of special structural steels" on CD

Optimized processing and application of PAS steels requires close contact between supplier and customer. A comprehensive technical customer service has therefore been established to provide support in all material processing and design questions. A multilingual compact disc

containing information about our special structural steels, including data sheets, processing recommendations and ProWeld, a computer software developed by ThyssenKrupp Steel for calculating welding parameters, is available free of charge from ThyssenKrupp Steel. All the information is naturally also available in printed brochures. Customers can see the very latest developments on the internet homepage – only a click away from ThyssenKrupp Steel.

ThyssenKrupp Steel – more than just a material supplier

ThyssenKrupp Steel is more than a reliable material supplier. The expansion of our worldwide distribution network is aimed not just at guaranteeing the availability and just-in-time delivery of PAS steels to consumers. The close cooperation with first-class steel service



centers also makes it possible to offer components which are prefabricated by means of cutting, cold forming or welding. In this way ThyssenKrupp Steel meets the steadily growing demands of its customers for quality, service and delivery performance.

General note

All statements as to the properties or utilization of the materials and products mentioned in this brochure are for the purpose of description only. Guarantees in respect of the existence of certain properties or utilization of the material mentioned are only valid if agreed upon in writing.

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