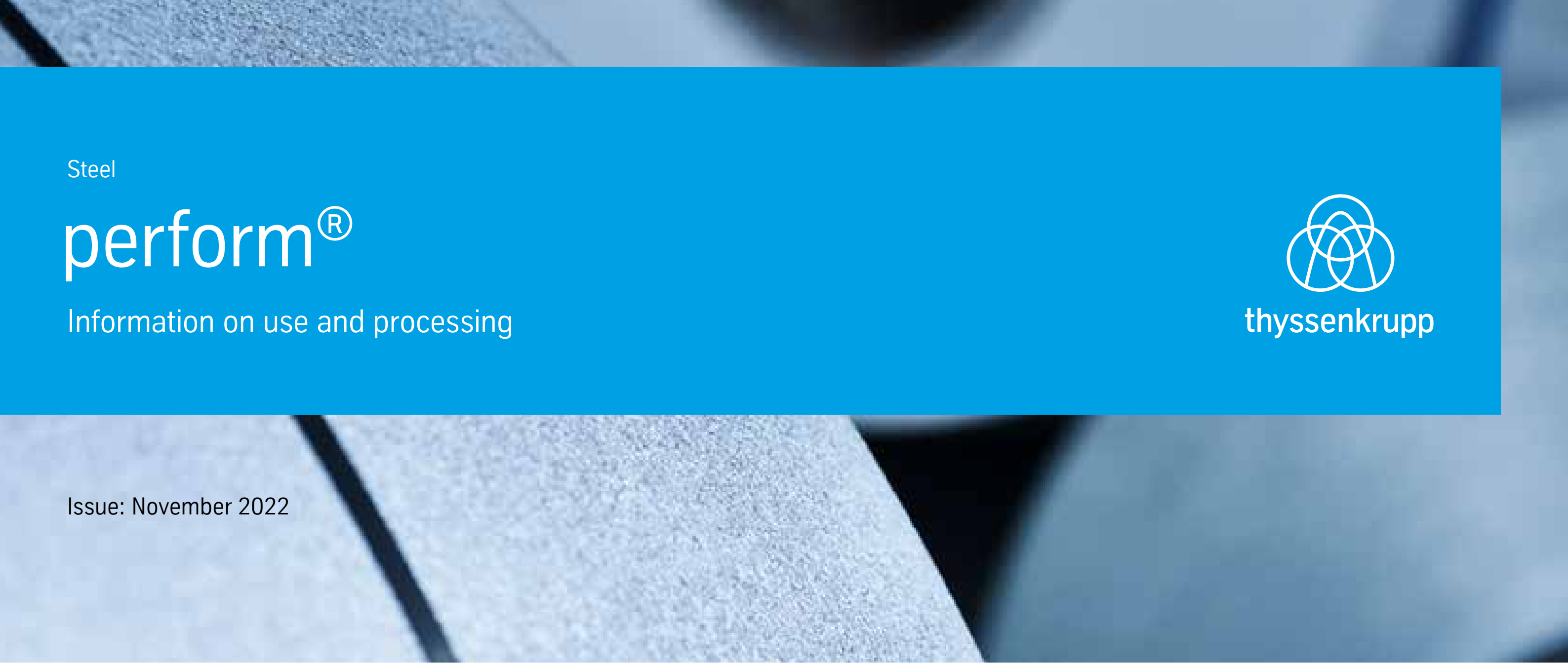

Steel

perform®

Information on use and processing

thyssenkrupp

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Content

Brief profile

perform® from thyssenkrupp is a microalloyed thermomechanically rolled steel for cold forming. perform® steels are characterized by a very low levels of sulfur and a low carbon content, microalloying with niobium, vanadium, titanium as well as their combination.

The combination of microalloying and the special thermomechanical rolling process gives perform® steels outstanding cold formability and weldability. The extremely fine-grain microstructure additionally results in very good toughness levels with a low risk of cold cracking. thyssenkrupp supplies perform® steels in various yield strengths from 300 to 700 MPa.

Instructions on processing

Forming

Microalloyed steels are particularly suitable for structural and crash-relevant parts, e.g. longitudinal members, frame constructions and profiles. The choice of grade for a particular strength level should take into account the anticipated forming loads so that individual advantages can be optimally exploited and the steels can also be used for difficult forming operations.

The typical r- and n-values for microalloyed steels do not make them suitable for a particular kind of forming operation. They are equally suitable for stretch-forming and deep-drawing.

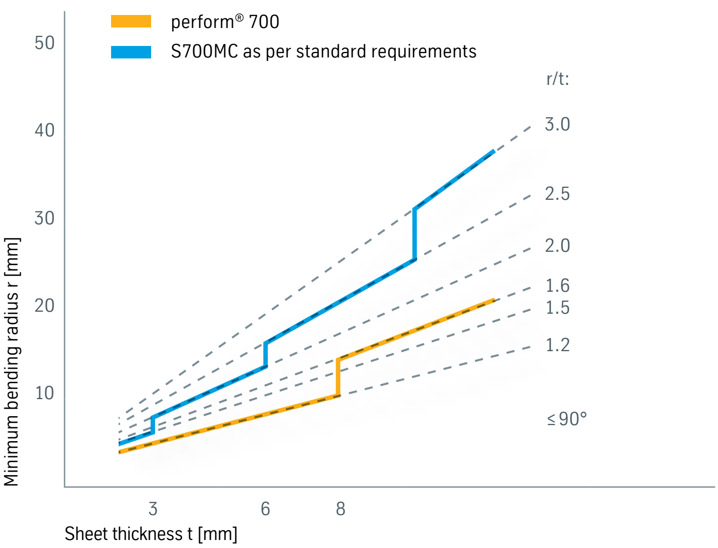
Bending and press braking

With their particularly fine-grain microstructure and high cleanness levels, perform® steels offer optimum forming behavior. They are also suitable for multi-stage forming processes. The drawing limit ratios differ very little from those of mild steels.

The predominant forming technique for cold forming steels is press brake bending. In most cases, bending with a defined inside radius in a die is limited by the rigid design of the die. The higher the strength of the steel, the greater the minimum press brake bending radius.

Graphic 1 shows the press brake bending radii for perform® 700 compared with grade S700MC as per standard requirements independent of direction.

Graphic 1: Press brake bending radii perform® 700 versus S700MC



perform® 700 is significantly better for press brake bending compared to the comparative grade according to DIN EN 10149-2.

Minimum bending radii during cold forming

	Recommended smallest bend radius for nominal thicknesses t in [mm] [1)]				
	t ≤ 3	3 < t ≤ 6	6 < t < 8	8 ≤ t ≤ 10	t > 10
Thermo-mechanically rolled steel for cold forming					
Steel grade					
perform® 700	1.2 t	1.2 t	1.2 t	1.6 t	1.6 t
Reference grade DIN EN 10149-2					
S700MC	1.5 t	2.0 t	2.5 t	2.5 t	3.0 t

1) Values for bending angles ≤ 90°.

Shearing, blanking, machining

perform® steels can be sheared and blanked. In general the quality of the cut edges and consequently the cutting process are of great importance. Defect-free cut edges are essential to achieve the stated inside bending radii.

To achieve smooth material flow, grinding the cut edges in the bending zone and measures such as lubrication have proven effective.

The behavior of perform® steels during drilling, turning and milling is similar to that of conventional cold forming steels. Normal tools can be used for high-strength grades provided the cutting parameters are adapted accordingly.

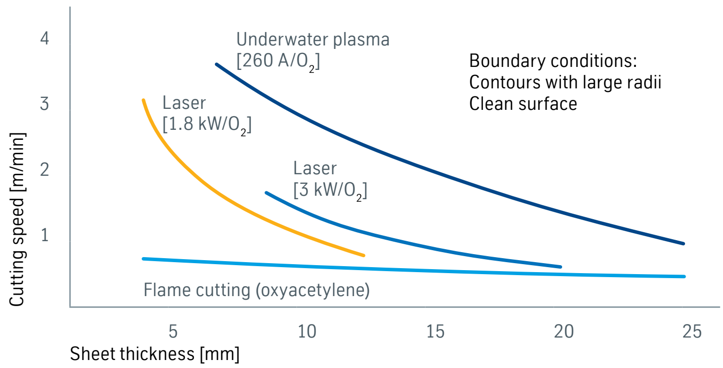
Thermal cutting

The following thermal cutting processes can be used with perform® steels:
- Plasma cutting
- Laser beam cutting
- Flame cutting

The plasma and laser beam techniques offer major advantages in terms of cost-efficiency and workpiece distortion. Plasma cutting permits the highest cutting speeds, as shown in graphic 2, albeit with certain limitations with regard to cut edge quality.

Depending on sheet thickness and laser power, laser beam cutting offers significantly higher cutting speeds than flame cutting. Other advantages include a very narrow heat-affected zone, low distortion and high dimensional accuracy. Graphic 2 shows thermal cutting speeds for ferritic steels.

Graphic 2: Cutting speed



Joining

Microalloyed steels display good weldability for both similar and dissimilar joints with other common steel grades on condition that the welding parameters are matched to the material.

Welding

For welding follow DIN EN 10149-2 chapter 7.5 “Technological Properties” and STAHL-EISEN-Werkstoffblatt 088.

Recommendations for welding are also given in DIN EN 1011 part 1 and part 2. For those, who process this steel for the first time it is recommended to consult the steel supplier to take advantage of the experiences gathered so far.

Resistance spot welding

Resistance spot welding is widely used in automotive body making. Sheets in thicknesses of less than 3 mm in particular can be joined cost-efficiently and reliably by this method in mass production, although in general this calls for adjustments to welding current, welding time and electrode force. Particularly important is the influence of electrode force and welding time on the welding range. With increasing sheet thickness and strength, higher electrode forces and longer current flow times are generally required to achieve an adequate welding range. Alternatively the use of multiple-pulse welding based on SEP12202 can have a favorable effect on the welding range.

The welding range depends not only on the grade, surface and thickness of the sheet; process parameters such as current type (AC 50 Hz / DC 1,000 Hz) and electrode geometry are also important. The welding ranges of conventional high-strength steels largely overlap. In addition to the good weldability of the individual steel grades, by setting similar parameters it is thus also possible to achieve good weldability for combinations of a broad range of materials available from the steel industry.

MIG arc brazing

The data sheet DVS 09382 “Arc brazing” describes the brazing of steels with tensile strengths up to approx. 500 MPa. As the material described has a higher tensile strength, it is advisable to check the suitability of parts for brazing.

Fatigue strength and crash behavior

Microalloyed steels guarantee higher minimum yield and tensile strengths than deep-drawing steels. These parameters allow reliable and practical evaluation of fatigue strength. Microalloyed steels are available in various strengths. The higher the yield strength and tensile strength, the higher the fatigue strength. Formability tends to decrease with increasing strength, so designers and production planners need to find the optimum solution. Microalloyed steels are traditionally used for stamped and welded parts and structural components. Thanks to their high residual elongation they demonstrate very robust crash behavior. However, compared with dual-phase and retained-austenite grades they display lower work hardening and possibly lower yield strength, which reduces their energy absorption capacity.

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