

Steel

patinax®

Product information for weathering steel
(hot-rolled strip, cut-to-length plate and quarto plate)



thyssenkrupp

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Areas of application

patinax® weathering steel from thyssenkrupp gets its weather-resistant properties from the alloying elements copper, chromium, nickel and phosphorus. Due to its chemical composition, weathering steel displays greater resistance to atmospheric corrosion than conventional structural steel because an oxide protective layer forms on its surface under changing weather influences which is virtually impermeable to oxygen. This protective layer is what gives patinax® its optimized weathering properties. Particularly in outdoor use, these properties ensure patinax® provides advantages that conventional structural steel cannot offer. The cost of additional coatings can therefore be saved, especially in outdoor applications. patinax® is mainly used unprotected, i.e. without additional paint or metallic coatings.

Due to its natural rust color, weathering steel blends in beautifully with the surroundings, which is why it is typically used for bridges, landscape structures, electricity pylons, facades and steel sculptures. Thanks to its high corrosion resistance, patinax® is also used for containers, mine cars and tanks.

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Available steel grades

patinax® is available as uncoated wide hot strip and quarto plate in the sizes listed in the section "Available dimensions". Cut-to-length plates on request.

Steel grade	Reference grade DIN EN 10025-5	Material No.
● patinax® 355	S355J2W	1.8965
● patinax® 355P	S355J2WP	1.8946

- Hot-rolled strip, cut-to-length plate, quarto plate

patinax® 355P has a higher phosphorus content than patinax® 355, giving it even better corrosion resistance.

Comments

The admissible tolerances are based on DIN EN 10029 for quarto plates and on DIN EN 10051 for wide hot strip and cut-to-length plates.

Plates are supplied with a maximum flatness tolerance in accordance with DIN EN 10029, table 4. Smaller flatness tolerances in accordance with DIN EN 10029, table 5 can be agreed separately when ordering.

For surface quality requirements of quarto plates, wide hot strip and cut-to-length plates DIN EN 10163 is applicable. By special arrangement, quarto and cut-to-length plates can be supplied in blasted and primed condition.

Unless otherwise agreed upon in the order, the delivery will be governed by the conditions outlined in DIN EN 10021.

The steel grade patinax® 355 can be supplied as quarto plate on request with multiple certifications (e.g. according to ASTM, JIS G 3114 and DIN EN 10025-5).

Technical characteristics

State of delivery: +AR or +N.

Chemical composition									
Mass fractions in ladle analysis	C [%] max.	Si [%]	Mn [%]	P [%]	S [%] max.	Cr [%]	Cu [%]	V [%]	Ni [%] max.
Steel grade									
● patinax® 355	0.16	0.30–0.50	0.80–1.25	≤0.030	0.030	0.40–0.65	0.25–0.40	0.02–0.10	0.40
● patinax® 355P	0.12	0.25–0.75	0.20–0.50	0.07–0.15	0.030	0.50–1.25	0.25–0.55	–	0.65

● Hot-rolled strip, cut-to-length plate, quarto plate

In order to obtain fine grain structure a sufficient amount of nitrogen absorbing elements is added, e.g. ≥ 0,02% Al.

Mechanical properties – test direction transverse to rolling direction at room temperature										
	Yield strength		Tensile strength		Minimum elongation			Notch impact energy		
	R_{eH} [MPa]		R_m [MPa]		A [%] $L_0 = 80$ mm		$L_0 = 5.65 \sqrt{S_0}$	KV [J] at a test temperature of –20 °C		
	Thickness ≤ 16.0 mm	> 16.0 mm	Thickness < 3.0 mm	≥ 3.0 mm	Thickness > 1.5 ≤ 2.0 mm	> 2.0 ≤ 2.5 mm	> 2.5 < 3.0 mm	≥ 3.0 mm		
Steel grade										
● patinax® 355	≥ 355	≥ 345	510–680	470–630	14	15	16	20	≥ 27	
● patinax® 355P	≥ 355		510–680	470–630	14	15	16	20	≥ 27	

● Hot-rolled strip, cut-to-length plate, quarto plate

Number of tests

Hot-rolled strip

Unless otherwise agreed upon in the order, when ordering a test report 2.2 or an inspection certificate 3.1 to DIN EN 10204 the scope of testing will be applied according to DIN EN 10025-5.

Cut-to-length and quarto plates

Unless otherwise agreed upon in the order, the tests listed below will be performed during inspection:

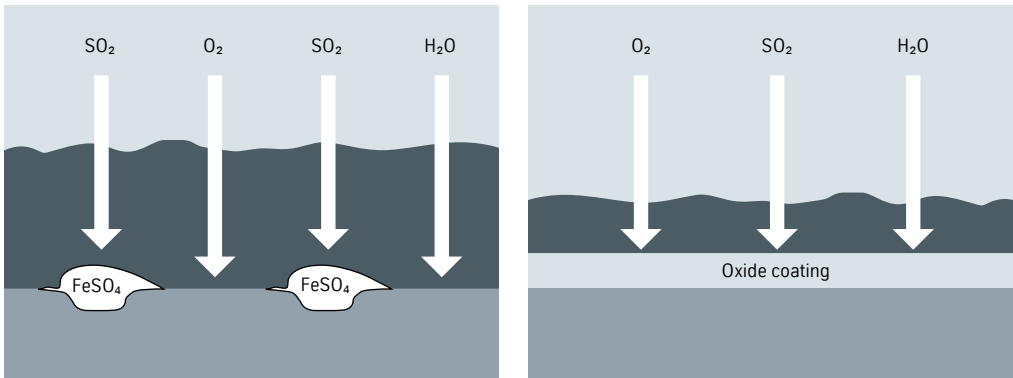
Test	Scope of testing
1 tensile test	1 specimen per 40 t from each heat
1 notched bar impact test ¹⁾	1 set (3 specimens) per 40 t from each heat

¹⁾ The notched bar impact tests are carried out in accordance to EN ISO 148 by using longitudinal specimens. The values for the impact energy are minimum values obtained as the average of three specimens, no single value being less than 70% of the value stated in the table. For thicknesses below 10 mm the required minimum impact value is reduced proportionally to the specimen width (product thickness). No impact test is performed on products below 6 mm in thickness.

The addition of copper, chromium, nickel and – depending on grade – phosphorus gives the steel weather-resistant properties. During the oxidation process over a period of one to two years a tightly adherent coating of low-solubility sul-

fates or phosphates develops between the base metal and any existing corrosion, provided the surface is exposed to cyclic weathering (wet/dry periods). This oxide coating significantly slows further rusting of the base metal.

Corrosion losses of carbon structural steel and weathering steel



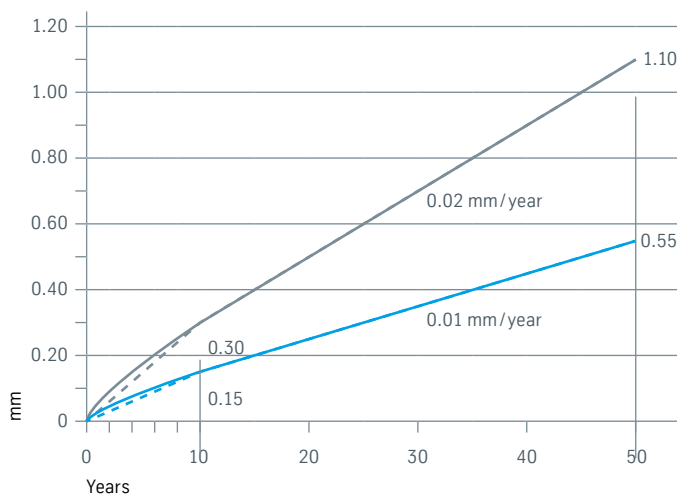
Carbon structural steel.

Weathering steel.

Source: German Steel Federation, Documentation 585

At the end of the roughly three-year process, weathering steel displays a dark reddish-brown color, but with clear differences in coloring and surface characteristics depending on the environment (urban, rural, marine).

Corrosion losses of carbon structural steel and weathering steel



— Carbon structural steel
— Weathering steel

According to EN ISO 9224 with cyclic wet/dry exposure and long wet periods.
Source: German Steel Federation, Documentation 585

Possible color and texture of patinax®



Weathering steel in use – Façades panels made of patinax®.
Source: AMS GmbH, www.ams-mbt.de

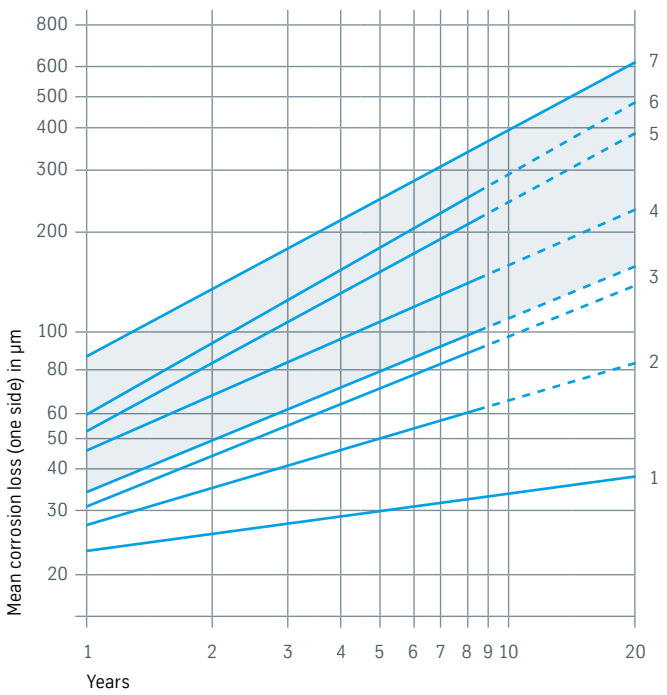
The orientation of patinax® weathering steel (facing towards or away from the weather, vertical or horizontal) also has a significant impact on the development, time of formation and protective effect of the oxide coating. patinax® is less prone to under-paint corrosion creep than non-weathering steel.

In particularly contaminated atmospheres additional surface protection is recommended. Such protection becomes indispensable when the steel is exposed to long-term wetting/

permanent moisture or installed in a marine environment. It is important to note that general and local climate conditions as well as particular design details can have effects on corrosion behavior. In the light of these factors no guarantee can be given.

It is therefore advisable to check the corrosion behavior of weathered patinax® surfaces at appropriate intervals. In addition, the planning of the structure must allow the protective oxide coating to develop and regenerate.

Corrosion behavior of weathering steels¹⁾



- Direct exposure in industrial areas with heavy emissions
- Measured
- - - Extrapolated

¹⁾ Long-term testing on natural rusting stands
 Source: DAST guideline 007

- 1 South Bend (USA), rural atmosphere, south facing, 30° inclination
- 2 Olpe, rural atmosphere, south facing, 45° inclination
- 3 Cuxhaven, urban/rural atmosphere, south facing, 45° inclination
- 4 Mülheim a. d. Ruhr, industrial atmosphere, south facing, 45° inclination
- 5+6 Oberhausen, industrial atmosphere, north facing, vertical
- 7 Envelope derived from test results

Notes on application and processing

Forming

The conditions for hot forming comply with the requirements of EN 10025-5. For cold forming operations the information in Table 6 of EN 10025-5 applies. If mechanical properties are altered by cold forming, the strength properties specified in the table can be largely restored by stress relieving – for at least 30 minutes at 530 to 580 °C. Subsequent normalizing is recommended for higher degrees of forming. Cold formability may be reduced by phosphorus.

Machining

With regard to the processes, tooling and practices to be used the same conditions apply as for comparable carbon structural steel in accordance with EN 10025-2.

Flame cutting

patinax® is suitable for flame cutting, provided proper operating methods are used. At temperatures below 5 °C a sufficiently wide zone on either side of the intended cut should be preheated. If flame cut edges are to undergo cold forming, the hardening effect should be prevented by preheating or the hardened zones must be removed, e.g. by grinding.

Welding

patinax® is suitable for both manual and mechanized welding applying recognized standards of good practice (DIN EN 10025-5 and STAHL-EISEN-Werkstoffblatt 088). Recommendations for welding are also given in DIN EN 1011 part 1 and part 2. Special precautions should be taken when welding the high-phosphorus grade patinax® 355P. Suitable filler metals and appropriate welding conditions are essential to obtain the same mechanical properties in the weld as in the base material. Basic electrodes, gas-shielded welding wire and wire-powder combinations of strength class S355 are used as fillers. In unprotected use it must be ensured that the weld deposit is also weather-resistant. This can be achieved by using a weather-resistant filler metal matched in its alloying constituents to the base metal. If stress relieving is necessary for design reasons or due to building regulations, it should be carried out in the temperature range from roughly 530 to 580 °C.

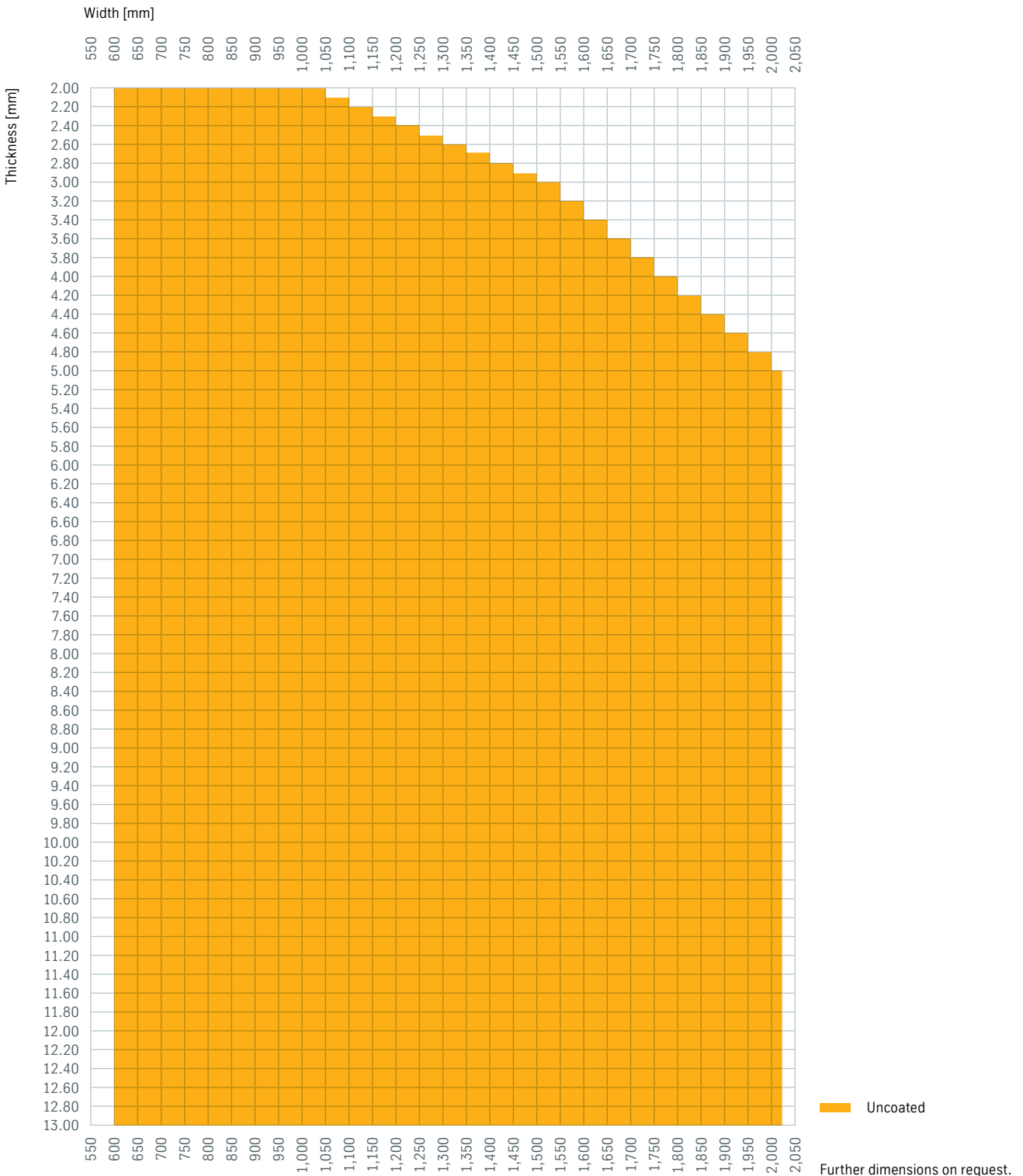
Bolting and riveting

Fasteners such as bolts, rivets and accessories (nuts and washers) must be selected so as to avoid the formation of local electrochemical cells. Fasteners should preferably be made of weathering steel, but experience shows that the use of stainless steel has no adverse effect. In these joints, capillary action can lead to permanent moisture resulting in increased corrosion. Critical zones should therefore be protected by painting, sealing or other means.

Available dimensions

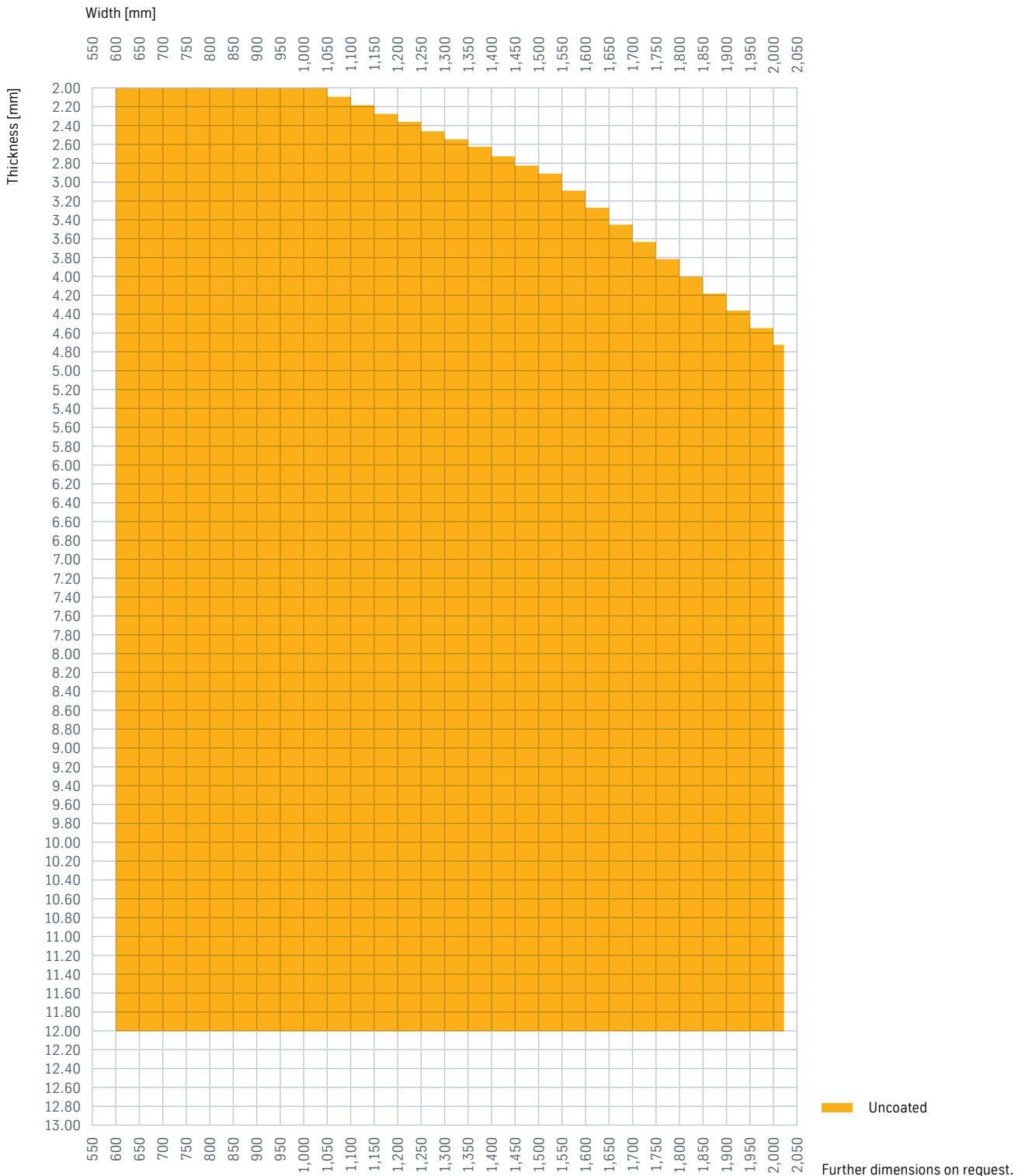
Hot-rolled coil

patinax® 355

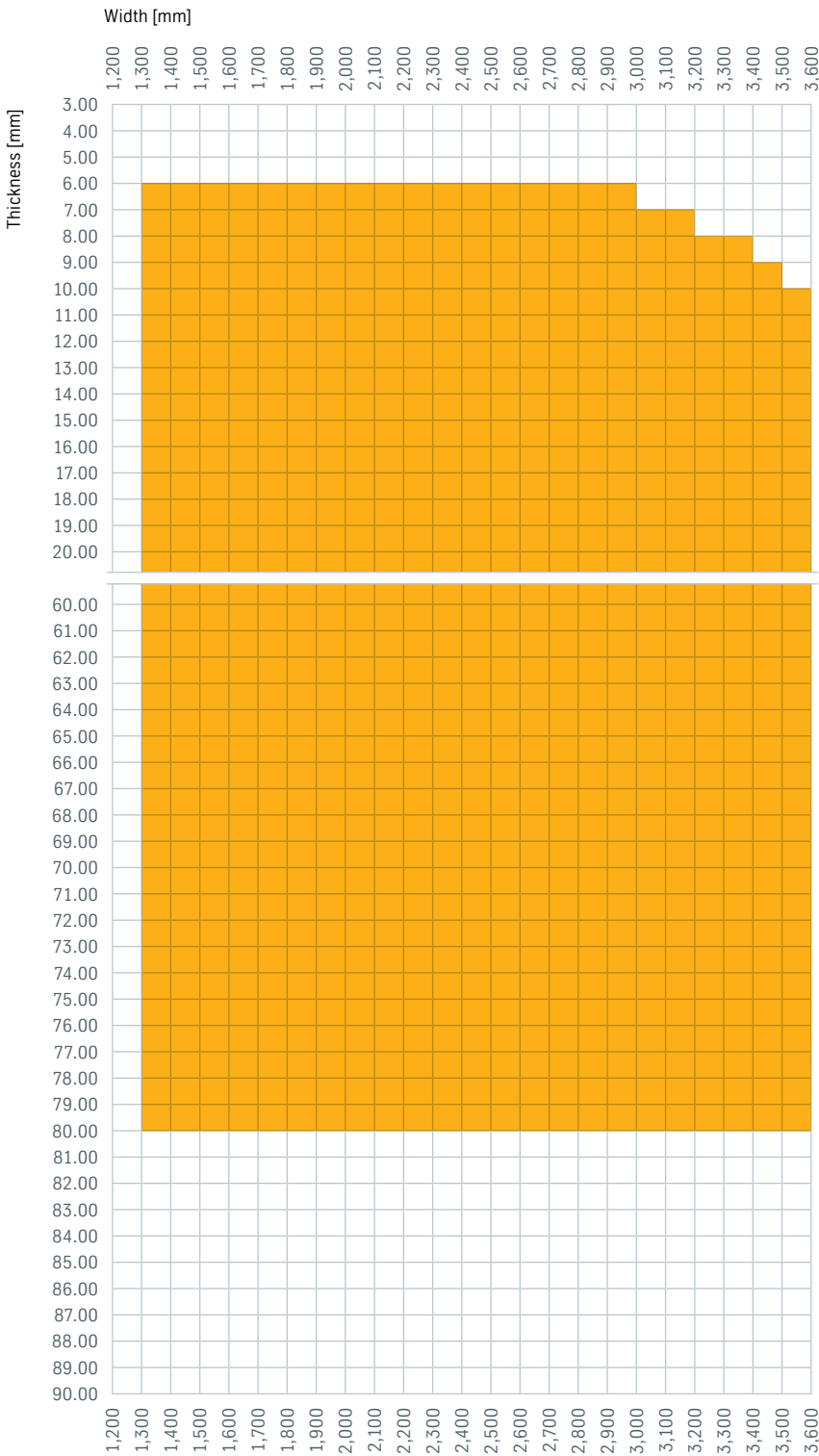


Hot-rolled coil

patinax® 355P



Quarto plate patinax® 355

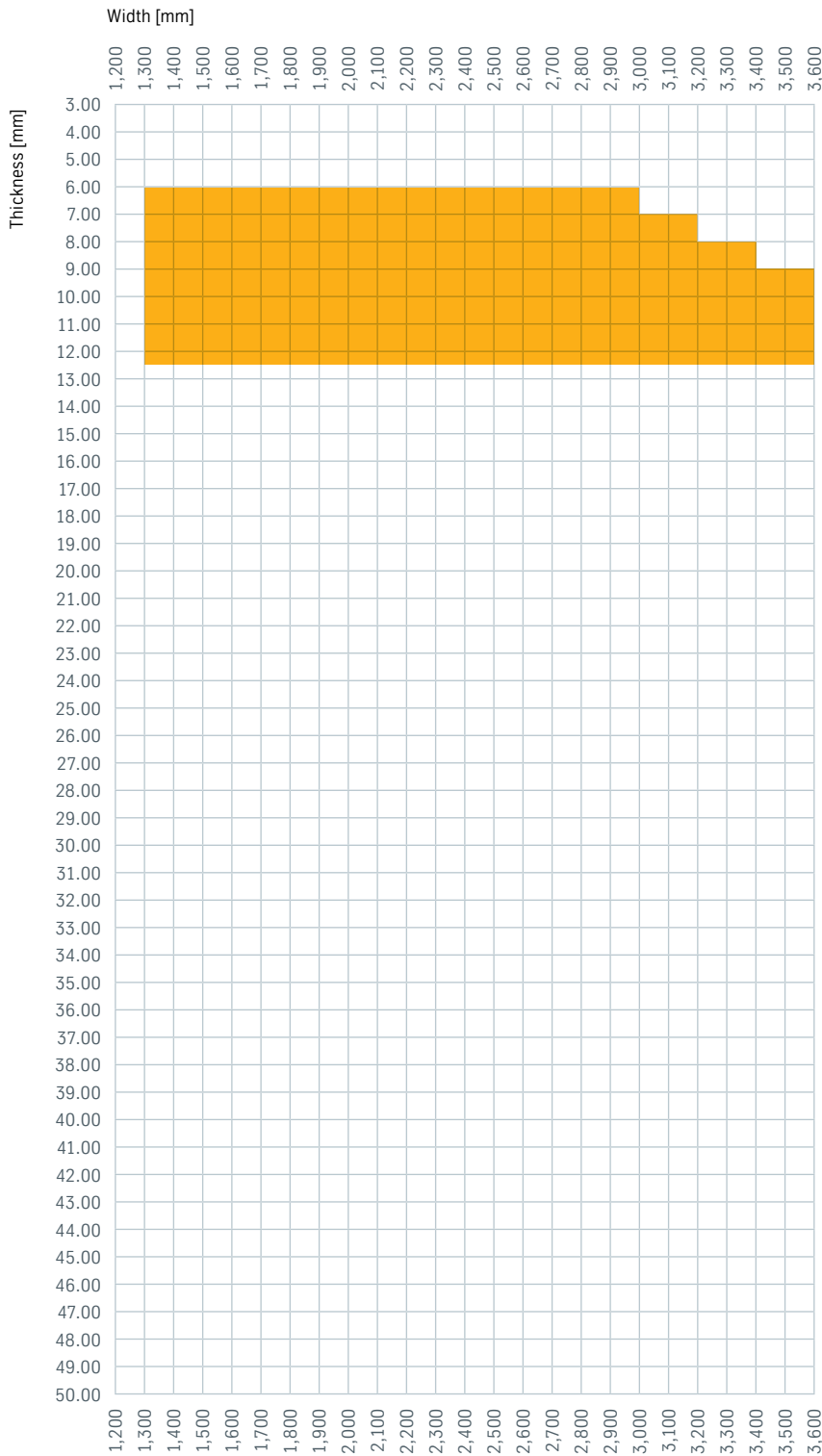


Uncoated

The maximum individual plate length is 19.5 m depending on the width/thickness combination.

Further dimensions on request.

Quarto plate patinax® 355P



Uncoated

The maximum individual plate length is 19.5 m depending on the width/thickness combination.

Further dimensions on request.

Sample applications



Experience Elevator Castle Altena – steel façades made of patinax®.
Source: AMS GmbH, www.ams-mbt.de



Raw materials trading Georg Lech in Schweinfurt – steel façades made of patinax®.



Art & Design Hotel Miura in Čeladná – materials such as concrete, wood and glass in combination with patinax® characterize the architecture.



Sculpture Park, Museum Liaunig – sculpture made of patinax®.
Source: Museum Liaunig, www.museumliaunig.at

Special mill grades are supplied subject to the special conditions of thyssenkrupp. Other delivery conditions not specified here will be based on the applicable specifications. The specifications used will be those valid on the date of issue of this product information brochure.

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