

Weathering fine grain structural steel	Steel grade		Material No.	Material Specification
	TKSE-Short name	EN-Short name		
Heavy plates	PATINAX 355	S355J2W+N	1.8965	532 July 2014

Scope

This Material Specification applies to plates up to 50 mm in thickness made from PATINAX 355. For thicknesses > 50 mm special agreements at the time of ordering are necessary. The values given in the following table for the mechanical properties are pertinent to the state of delivery condition.

Definition

In this case weathering means that due to its chemical composition the PATINAX 355 steel, when utilised unprotected, exhibits increased resistance to atmospheric corrosion compared to unalloyed steels. This is because it forms a protective layer on its surface under the influence of the weather.

The corrosion retarding effect of the protective layer is produced by the nature of its structure components and the particular distribution and concentration of alloying elements in it. The layer protecting the surface develops and regenerates continuously when subjected to the influence of the weather.

Formation, duration of development and protective effect of the covering layer on weathering steels depend largely upon the corrosive character of the atmosphere. Its influence varies and depends mainly upon the general weather conditions (e.g. continental) macroclimate (e.g. industrial, urban, maritime or country-side climate) and the orientation of the structure components (e.g. exposed to or shaded from the weather, vertical or horizontal position). The amount of aggressive agents in the air has to be taken into account. In general the covering layer offers protection against atmospheric corrosion in industrial, urban and country-side climate.

When utilising this steel in unprotected condition it is up to the designer to take into account the expected loss of thickness due to corrosion and as far as necessary, compensate for it by increasing the thickness of the material.

In cases of particular air pollution by aggressive agents conventional surface protection is recommended. Coating is absolutely necessary in cases of contact with water for long periods, when permanently exposed to moisture, or if it is to be used in the vicinity of the sea. The susceptibility of paint coats to undercreepage by rust is less in the case of weathering steel than in the case of comparable non-weathering steel.

Application

The steel is used for various types of welded, bolted and riveted constructions e.g. steel frame structures, bridges, tanks and containers, exhaust systems, vehicles and equipment constructions.

Basic guidelines for the use of this steel in the unprotected condition are described in EN 10025-5 and DAST rule 007.

The entire application technology is of fundamental importance for the performance of the products made from this steel. It must be taken into account that not only general climatic conditions but also specific unfavourable local climate conditions in the broadest sense as well as details of a construction may affect the corrosion behaviour of unprotected weathering steel. The dependency on these facts makes it understandable that no warranty can be given. It is recommended to control the corrosion progress of unprotected parts out of weathering steel exposed to the influence of the weather in reasonable time intervals. A minimum thickness of 5 mm is recommended when exposed to the weather in the unprotected condition.

To use the benefits of the higher atmospheric corrosion resistance of PATINAX 355 in comparison to unalloyed steel it is necessary that design and execution of structures as well as the performance of maintenance works allow an unimpeded formation and regeneration of the protective rust layer. The methods must meet the latest requirements of the technical progress and must be suited for the proposed application. Due consideration must be given to relevant construction specifications.

The selection of the material is up to purchaser.

Apart from PATINAX 355 the weathering steel PATINAX 355P is also available (see Material Specification 531).

Chemical composition (heat analysis, %)

C	Si	Mn	P	S	Cr	Cu	V	Ni
≤ 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

In order to obtain fine grain structure a sufficient amount of nitrogen absorbing elements is added (e. g. ≥ 0.02 % Al).

State of delivery: N according to EN 10025-5.

Mechanical properties in the state of delivery condition at room temperature (transverse test specimens according to ISO 6892-1, method B).

Material thickness mm	Minimum yield point R_{eH} MPa ^{*)}	Tensile strength R_m MPa	Minimum elongation A ($L_0 = 5.65 \sqrt{S_0}$) %
≤ 16	355	470 - 630	20
> 16 ≤ 50	345		

^{*)} 1 MPa = 1 N/mm²

The notched-bar impact energy is determined on ISO-V longitudinal test specimens at a test temperature of - 20 °C as an average of three tests. For product thicknesses ≥ 10 mm the average value is at least 27 J. For thicknesses between 10 and 6 mm, the minimum impact value is reduced proportionally to the specimen width (product thickness).

No impact test is performed on products below 6 mm in thickness.

Number of tests

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

1 tensile test	1 test specimen per 40 t from each heat ^{*)}
1 notched bar impact test (3 specimens)	1 set of specimens per 40 t from each heat ^{*)} (at a test temperature of - 20 °C)

^{*)} as referenced in EN 10025-5.

General processing information

The information given below can only deal with some important points.

Forming

The conditions for hot forming are in accordance with those stated in EN 10025-5. For cold forming the statements according to table 6 of EN 10025-5 are valid. If the mechanical properties have undergone changes due to cold forming, the properties indicated in the table can be substantially restored by stress relieving - at least 30 minutes at 530 to 580 °C - see STAHL-EISEN-Werkstoffblatt 088 (Weldable fine grained structural steels, processing directives, especially for welding). For higher degrees of cold forming subsequent normalizing is recommended.

Machining

The methods, tools, and working processes to be applied comply with the conditions for unalloyed structural steel according to EN 10025-2.

Flame cutting

PATINAX 355 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 edged are to undergo cold forming, the hardening effect should be prevented by preheating - as in the case of S355J2 or the hardened zones must be worked off e.g. by appropriate grinding.

Welding

PATINAX 355 can be welded both manually and mechanically, provided the general rules of welding practices are observed. A prerequisite for obtaining identical mechanical properties in the weld and in the base material is the application of suitable welding consumables and the choice of appropriate welding conditions. To consider are EN 10025-5 - Technical delivery conditions for structural steels with improved atmospheric corrosion resistance - and STAHL-EISEN-Werkstoffblatt 088 - Weldable fine grained structural steels, processing directives, especially for welding.

Recommendations for welding are also given in EN 1011 part 1 and part 2 - Welding, Recommendation for welding of metallic materials -.

Lime basic electrodes, inert-gas welding wire, and wire/power combinations equivalent to the tensile strength of S 355 are used as welding consumables.

For unprotected use care must be taken that the welded joint is also weather resistant. This is possible by using welding consumables matching the base material.

If due to design or building specification stress relieving is required, it should be performed in the range of temperature from about 530 to 580 °C (see STAHL-EISEN-Werkstoffblatt 088).

Bolting and riveting

Joining elements such as bolts, rivets, and their accessories (nuts and washers) must be so selected that the formation of local electro-chemical cells are avoided. The joining elements should preferably consist of weathering steel.

At these joints capillary action can lead to permanent moisture resulting in increased corrosion. Critical zones should therefore be protected by painting, sealing or other protective means.

In the case of high-strength connections (HV) the conditions for non-weathering structural steels as given in DIN 18800 Part 1 apply.

General information

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

The admissible tolerances are based on EN 10051 and EN 10029 unless other terms have been agreed upon.

The plates will be supplied with a maximum flatness tolerance according to EN 10029, table 4L. Smaller flatness tolerances can be agreed upon at the time of ordering.

For surface quality requirements EN 10163 is applicable.

At the time of ordering it is possible to make further agreements with regard to the testing conditions.

Publisher`s addresses

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