Industeel

Superplast®2311.i

ArcelorMittal

SP 2311.i: is a prehardened 300 HB steel grade

Material properties

SP 2311.i is specially designed for plastic mold industry. Chromium, molybdenum, manganese, nickel and boron additions are optimized to have a fully martensite-bainite microstructure after quenching. The steel is melted in an electric furnace and refined with VOD or DH device. The cleanliness of the steel is guaranteed as well as the soundness. This makes the steel particularly well adapted for mold steel even when polishing or chemical etching are required for surface finish quality.

Comparing to a regular 2311, our **SP 2311.i** is offering a maximum drop of Hardness at mid thickness not greater than 20HB (A regular 2311 could reach 70-80 Hb drop in 600 mm thick block and 40 HB for a 1.2738) along with an improved machinability and polishability.

For which applications

Plastic injection molds for thermoplastics, extrusion dies for thermoplastics, compression molds.

Properties

According to standard

> WERKSTOFF 1.2311 ~1.2738 E

> AISI ≈ P20 Mod

Chemical Analysis (*% Weight*).

	C	Mo	Ni	Si	Mn	Cr	S	P	B
Min	0.35	0.15	0.30	0.20	1.30	1.60	-	-	-
Typical	0.36	0.20	0.50	0.25	1.40	1.90	<0.005	<0.012	+
Max	0.45	0.25	0.60	0.40	1.60	2.10	-	-	-

Physical Properties (*Reference values*).

Hardness range	Thermal conductivity $W.m^{-1}.K^{-1}$	Thermal expansion Coefficient ($10^{-6}.K^{-1}$)		
280 - 320 HB	20°C	20/100°C	20/200°C	20/300°C
Min 270	36	11.5	11.57	12.47

Metallurgical properties

Internal soundness: all plates are ultrasonically tested. The acceptance standards of ASTM A578 table S9 are guaranteed.
Grain size: uniform 7/8 grain according to ASTM E112.
Cleanliness: **SP 2311.i** is melted in an electric arc furnace and refined through a VOD or DH process-consequently, the content of non metallic inclusions is reduced to an extremely low level. This ensures a good polishability and chemical texturing ability and laser engraving.
Non metallic inclusions content is assessed in accordance with ASTM E45 Method A ("worst field").
SP 2311.i has a very good hardenability resulting in good uniformity of hardness and microstructure.

Plate processing

Homogeneity

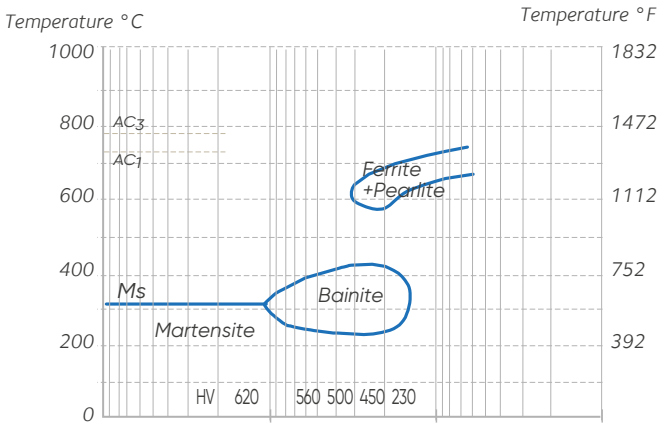
SP 2311.i has an excellent hardenability resulting in very good uniformity of hardness and microstructure. A maximum spread of 20 Brinell is obtained from surface to the center in any position of the block which guarantees a uniform hardness and structure in all directions. (A regular 2311 could be 60/70 for a 600 mm thick block)

SP 2311.i has a very good hardenability resulting in good uniformity of hardness and microstructure.

CCT Diagram

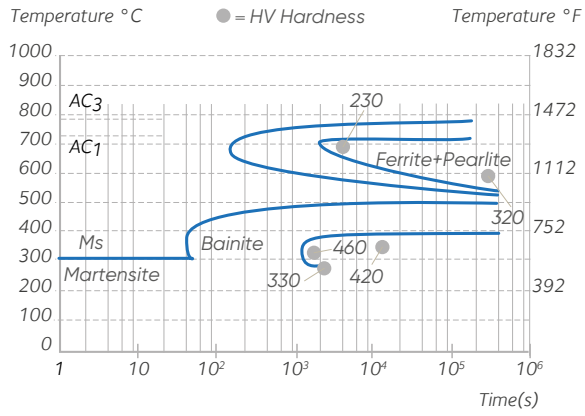
Autenitizing temperature : 1000°C

CCT DIAGRAM AUSTENITIZING TEMPERATURE 870°C (1598°F)



Cooling rate 800/600°C/h (1450/1080°F/h)

TTT DIAGRAM AUSTENITIZING TEMPERATURE 870°C (1598°F)



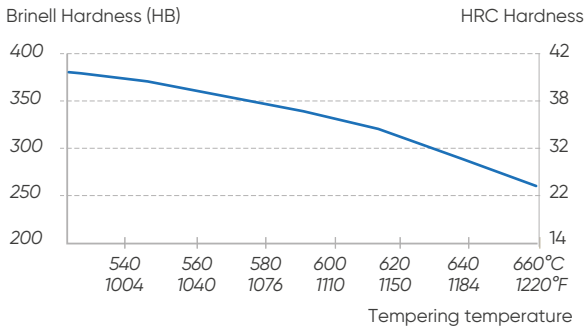
Heat treatment

For specific applications where mechanical properties are different than 270 - 320 HB, hardening can be performed in the following way:

- **Heating about 875°C with a sufficient holding time 1 hour/25mm of thickness**
- **water, oil or air quenching depending on thickness (see C.C.T diagram)**

Tempering

The tempering temperature controls the mechanical characteristics. Generally, instructions given here after must be followed to obtain an efficient tempering: - Uniform heating at the selected tempering temperature (see tempering curve), Double tempering with complete cooling to room temperature for each treatment



Note that complicated shapes require accurate control of steel temperature uniformity and sufficient holding times to limit stresses and prevent cracking.

Surface treatment

The quality of surface treatments depends widely on the surface roughness and characteristics after polishing. Homogeneity of hardness, microstructure and good cleanliness ensure a good behaviour for chromium plating, nickel plating or nitriding. Nevertheless, after hard-chromium plating, the steel should be tempered for about 4 hours at 180°C (356° F) to avoid any hydrogen embrittlement.

Machining

SP 2311.i grade performs very well in drilling and in milling using high speed steel or carbide tools. Cutting conditions (cutting speed, feet rate, etc..) can be taken from 1.2311 . Advice on machining conditions can be provided on demand.

SP 2311.i is suitable for EDM. Precaution should be taken to avoid the presence, after machining, of a rehardened surface layer ("white layer") on the steel. It is advisable to remove completely this layer by grinding and polishing.

Texturing

SP 2311.i is particularly suitable for texturing. Steel making process and heat treatment of plate leads to uniform structure and homogeneous hardness which ensure accurate and consistent pattern reproduction.

Polishing

SP 2311.i has a good polishability in quenched and tempered condition. After grinding, polishing shall be made with aluminium oxide or diamond paste.
A typical polishing sequence could be:

		Emery polishing paper or stones		Diamond paste
Grinding	→	FEPA 120 →240 →320 → 600 → 1000 GRIT 120 → 220 → 280→ 360 → 500	→	10µm →6µm →3µm →1µm

Welding

Carefully degrease, clean and dry the surface before welding; grind surface defects is necessary. A V - type bevel without sharp angle is recommended. Pre and postheating treatment must be achieved to ensure crack free welds. Laser welding or GTAW are the recommended process to ensure a clean weld without sulphides, porosities or oxides which affect properties of the weld such as chemical etching ability, polishability... Industeel has developed a specific procedure to limit the risks of cracking and improve the response of the welded area to polishing and etching.

Dimensions

Typical delivery sizes

Thickness	Width
150 mm up to 710 mm	2 000 mm

Your contact

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