

## W 1.2311

## W 1.2311: A prehardened mold steel (300 HB/32 HRC)

**Material properties**

Standard prehardened steel designed for plastic mold industry.

**For which tools**

Plastic injection mould cores and cavities, extension dies for thermoplastics.

**For which plastics**

Thermoplastics (PE, PP, PS), thermosetting plastics, transparent melts.

## PROPERTIES

**STANDARD**

> EN	40 CrMnMo7
> WERKSTOFF Number	1.2311
> AISI	≈ P20

**CHEMICAL ANALYSIS**

Typical values (weight%)

C	S max	P max	Si	Mn	Cr	Mo
.4	.005	.012	.3	1.5	1.9	.2

**MECHANICAL PROPERTIES**

1.2311 is delivered **quenched and tempered to 280 - 325 HB (29 - 33 HRC)**.

Hardness	Rp 0.2 Yield Strength		Rm Tensile strength		Elongation	Reduction of area	K <sub>C</sub> V 20°C	Elastic modulus	
	MPa	ksi	MPa	ksi				GPa	ksi
300	854	124	1014	147	11	50	25	205	29733

**PHYSICAL PROPERTIES**

Thermal conductivity W.m <sup>-1</sup> .K <sup>-1</sup>		Thermal expansion Coefficient (10 <sup>-6</sup> .K <sup>-1</sup> )				
20°C		20-100°C	20-200°C	20-300°C	20-400°C	Specific heat J/kg.°C
34		11.5	11.6	12.5	12.8	470

Typical value

## PROPERTIES

### METALLURGICAL PROPERTIES

#### Internal soundness

All plates are ultrasonically tested. The acceptance standards of ASTM A578.96.S9 is guaranteed.

#### Grain size

Uniform 7/8 grain according to ASTM E112.

#### Cleanliness

W1.2311 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 etching ability. Non metallic inclusions content is assessed in accordance with ASTM E45 Method A ("worst field").

#### Homogeneity

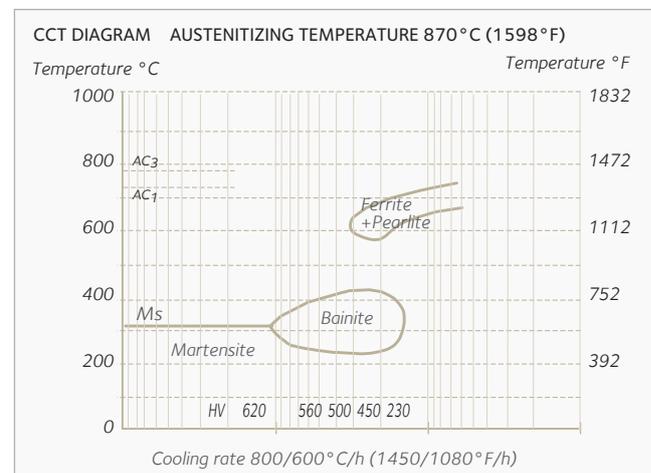
W1.2311 has an excellent hardenability resulting in good uniformity of hardness and microstructure.

#### Metallurgical transformation points

AC <sub>1</sub>	AC <sub>3</sub>	M <sub>s</sub>	V <sub>1</sub>	V <sub>2</sub>
733 °C 1351 °F	780 °C 1436 °F	320 °C 608 °F	1000 °C/h 1830 °F/h	300 °C/h 540 °F/h

Heating conditions:

150 °C/h up to 875 °C, holding time 10 minutes,  
270 °F/h up to 1607 °F, holding time 10 minutes.



## DELIVERY CONDITIONS

### DIMENSIONAL PROGRAM

Thickness	Width
7 - 150 mm (.27" - 5.9")	1000 - 2500 mm (39 - 98.4")
150 - 610 mm (5.9" - 24")	1000 - 2000 mm (39" - 78.7")

Length: up to 6000 mm (20 ft). For specific dimensions, please contact our sales department.

## HEAT TREATMENT

For specific applications where mechanical properties higher than 300HB are required, hardening can be performed in the following way:

- > heating about 850°C - (1560°F) with a sufficient holding time 1 hour/25 mm (1 hour/inch)
- > water, oil or air quenching depending on thickness (see C.C.T diagram)

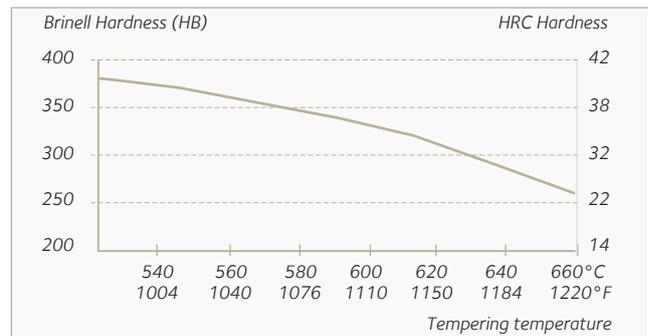
The tempering temperature controls the mechanical characteristics. Generally, instructions given here after must be followed to obtain an efficient tempering:

- Uniform heating at the selected tempering temperature (see tempering curve),
- Holding time of one hour per inch of total thickness,
- Double tempering with complete cooling to room temperature for each treatment.

## Tempering curve

Test conditions:

- > austenitization 870°C (1600°F)
- > tempering/holding time 1h
- > air cooling



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 on the surface roughness and polishing quality. 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

W1.2311 grade performs very well in drilling and in milling using high speed steel or carbide tools. Cutting conditions (cutting speed, feed rate, etc...) depend on the tool, but W1.2311 is a well known grade for which any tool maker can provide cutting conditions adapted to its tools.

## ELECTRICAL DISCHARGE MACHINING (EDM)

This method of machining can be used on W1.2311 grade. Precaution should be taken to avoid the presence, after machining, of a rehardened surface layer ("white layer"). This layer should be completely removed by grinding and polishing.

## POLISHING

W1.2311 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:

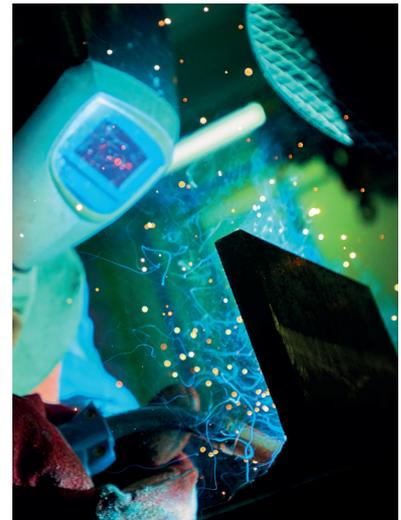
Grinding	->	<b>Emery polishing paper or stones</b> FEPA120 -> 240 -> 320 -> 600 -> 1000 GRIT 120 -> 220 -> 280 -> 360 -> 500	->	<b>Diamond paste</b> 10µm -> 6µm
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## TEXTURING

W1.2311 is particularly adapted for texturing. Industeel steelmaking process leads to uniform structure and homogeneous hardness which ensure accurate and consistent pattern reproduction.

## WELDING

GTAW is 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... Pre and postheating treatment must be achieved to ensure crack free welds. Industeel has developed a specific procedure to limit the risks of cracking and improve the response of the welded area to polishing and etching. For more information about it, please contact us.



## YOUR CONTACTS

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*Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.*