

**TG** Steels

**2312**  
**PRIME**

# Prehardened mold steel with excellent machinability suitable for general applications

## 2312 PRIME;

- is produced by a process that ensures a good level of cleanliness and homogeneity.
- has a good polishability and for better polishability and texturing we recommend to use 2311 PRIME.
- exhibits an excellent machinability.
- is delivered at a hardness of 300 HB and can be machined without further heat treatment.
- has a very good suitability for surface treatments such as gas, ionic or salt bath nitriding, as well as PVD or CVD coatings.

## Applications

2312 PRIME can be used for small sizes to very large injection molds requiring an excellent machinability.

2312 PRIME can be used for the compression or injection molds used for thermoplastics.

2312 PRIME can be used for all the secondary parts in molding applications and also frames for plastic moulds where an important machining is required.

## Main properties

- Prehardened steel at 300 HB ready to be machined without any further heat treatment
- Excellent machinability
- Suitable for surface treatments

## Chemical composition (*typical*)

C	Mn	Si	P	S	Cr	Mo
0.40	1.50	0.35	< 0.035	0.060	1.90	0.20

## Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
1.2312	40CrMnMo7+S	3Cr2Mo	-	-	≈ P20+S	40KHGM	40CMD8+S	-



## Structure

The structure of the 2312 PRIME is fine and homogeneous without precipitation or alignments of carbides. The heat treatment (*quench and tempering*) is optimized for high homogeneity of hardness from surface to core even for thicker blocks.

## Hardness at the time of delivery

Heat treated for 280 - 340 HB.

Typical mechanical properties in hardened conditions (*results from internal tests not indicated on the certificates*)

TS MPa	YS 0.2% MPa	Elongation %	KU J à 20°C
960	850	10	≈10

## Physical properties

Temperature	20°C	100°C	200°C	300°C
Volumic mass kg/m <sup>3</sup>	7825	7810	7780	7760
Young Modulus N/mm <sup>2</sup>	205000	202000	195000	190000
Thermal conductivity W/m.K	34	33	31	30
Coefficient of linear expansion 10 <sup>-6</sup> /K	11.5	11.6	12.5	12.8

## Heat treatment

The 2312 PRIME is delivered heat treated at 280 - 340 HB and there is no need for further heat treatment.

In case of need (e.g. if other mechanical properties are required) the following parameters can be used.

### SOFT ANNEALING

Temperature: 710 - 730°C, duration 1h + 1h for 25mm thickness. slow cooling in the furnace (10 to 20°C/h). The atmosphere in the furnace must be reducing to avoid decarburization of the steel.

### STRESS RELIEVING

After machining, it is recommended to perform stress relieving at 550°C maximum for a minimum of 2 hours, followed by slow cooling in the furnace to 450°C.

### AUSTENITIZATION

In order to avoid any risk of cracking it is recommended to preheat in 2 steps.

- 1st preheating step: temperature: 450°C time: 30 s/mm of thickness
- 2nd preheating step: temperature: 650°C time: 30 s/mm of thickness

Recommended austenitizing temperature: 850 - 870°C. The holding time should not be too long to avoid a risk of grain coarsening and a loss of toughness. It is recommended to keep the part at the austenitizing temperature 30 minutes per inch of thickness as soon as the temperature of the surface reach the austenitization temperature.

### QUENCHING MEDIUM

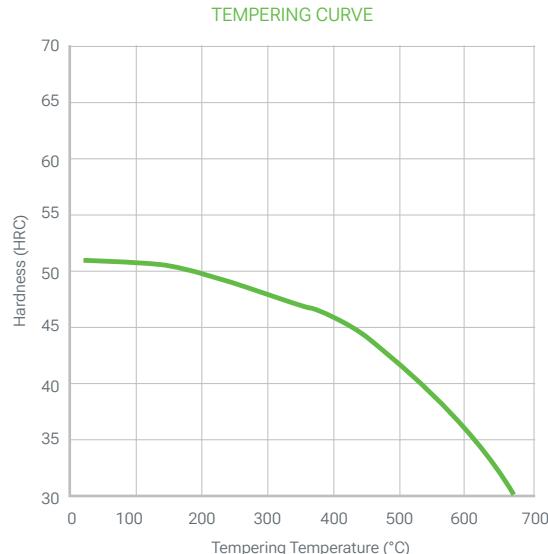
Oil at 80°C, vacuum (pressure >6 bars), salt bath 500 - 550°C.

To ensure good toughness, treatment with oil or salt bath is preferable.

### TEMPERING

To ensure a minimum residual austenite rate as well as greater tool stability, it is essential to perform a double tempering. Each tempering is followed by a cooling under 100°C.

Each tempering time must be at least equal to 1h + 1h for 25 mm of thickness of the treated part (equivalent thermal thickness).



## Surface treatment

### NITRIDING

2312 PRIME can be nitrided at temperatures less than or equal to 20°C below tempering temperatures without risk of deterioration of the mechanical characteristics. With gas nitriding at 520°C (25 h) the surface hardness is 750 HV1 with a diffusion layer of 0.2 mm.

### PVD, CVD

2312 PRIME is suitable for all kinds of PVD and CVD treatment as soon as the treatment temperature is 30°C lower than the last tempering temperature.

### Polishing

2312 PRIME is perfectly suitable for polishing in the treated state and can be used for applications requiring a sufficient level of polish for parts with a good surface aspect ( $Rt \leq 50 \mu\text{m}$ , CNOMO level 3, Rugotest N9).

Optimal polishing is achieved by performing consecutive steps with similar roughness and stopping each step as soon as the last scratch from the previous step disappears.

### Texturing

2312 PRIME is not suitable for chemical or laser texturing. This is due by the high sulfur content of the 2312 PRIME.

# Machining

Compared to the 2311 PRIME, at a constant cutting speed, by using the 2312 PRIME the service life of cutting tools is increased by 500%, the drilling speed by 300% with high-speed steel tools, and the milling speed by 30% with tools with carbide inserts.

The machining parameters below are given for information only and must be adapted according to the equipment and usual machining conditions.

## TURNING

	Carbide tool	
	Rough machining	Finishing
Cutting speed m/min	150 - 180	180 - 250
Feed mm/r	0.15 - 0.35	0.05 - 0.2
Depth of cut mm	2 - 4	0.6 - 2

## MILLING: SURFACING

	Milling with carbide tools		Solid tool
	Rough machining	½ Finishing	Finishing
Cutting speed m/min	80 - 150	150 - 180	50 - 90
Feed mm/r	0.15 - 0.35	0.1 - 0.2	0.005 - 0.15
Depth of cut mm	2 - 5	2	

## DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/t
< 5	14 - 16	0.05 - 0.15
5 - 10	14 - 16	0.15 - 0.25
10 - 15	14 - 16	0.25 - 0.35
15 - 20	14 - 16	0.35 - 0.42

## DRILLING: CARBIDE DRILL

	Carbide type		
	Indexable insert	Solid carbide	Carbide tip
Cutting speed m/min	170 - 190	150 - 170	70 - 90
Feed mm/t	0.05 - 0.10	0.10 - 0.25	0.15 - 0.25

## FINE GRINDING

General indications for grinding wheels to be used on 2312 PRIME in the heat treated condition.

Usually, rather soft vitrified aluminum oxide grinding wheels (*grades G* for *plane grinding* to *K* for *cylindrical grinding*) are used.

Particular attention will be paid to effective cooling of the surface during grinding to prevent degradation of the material surface.

## ELECTRO-DISCHARGE MACHINING

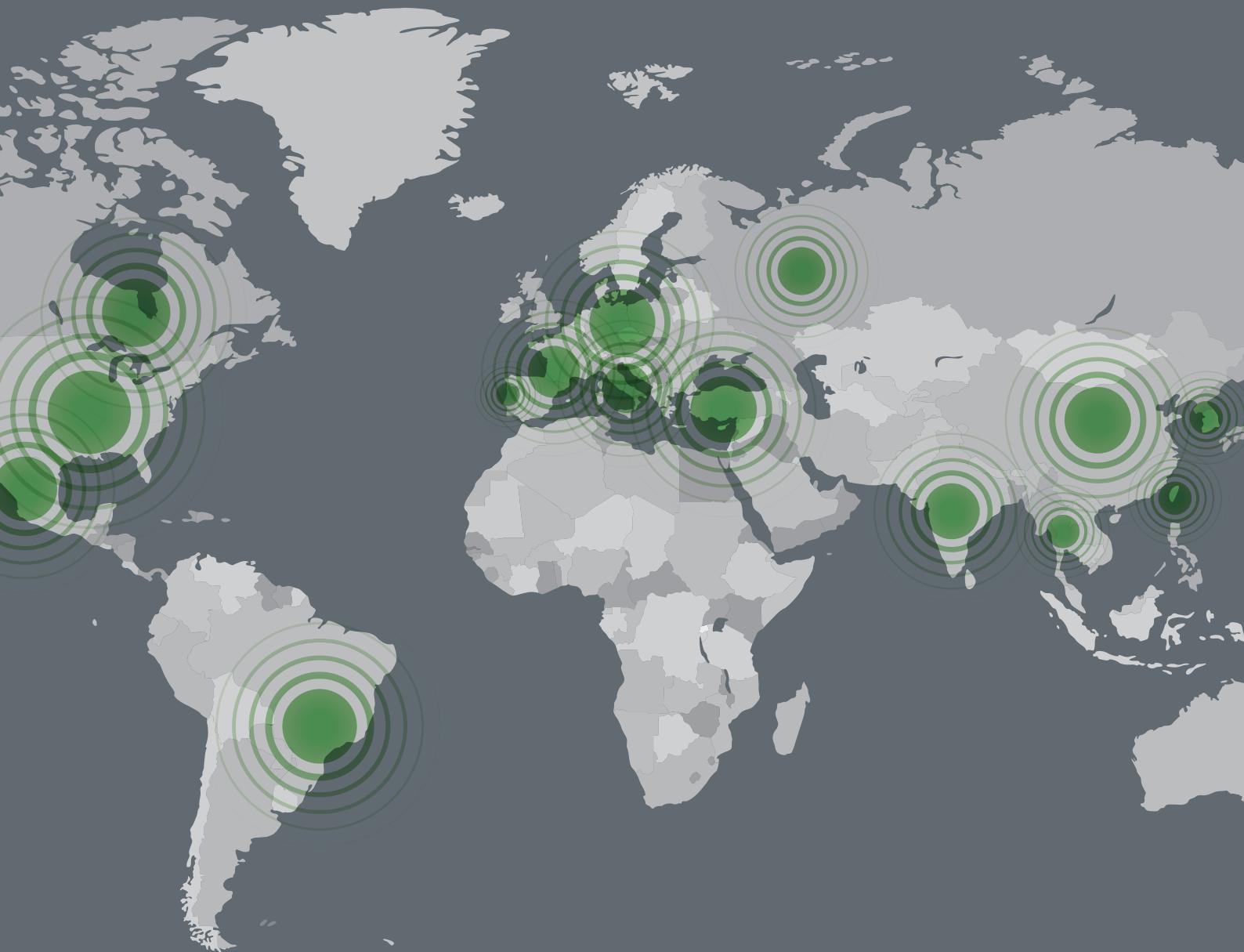
2312 PRIME is also suitable for EDM machining (*wire or electrode*). Preferably, the machining will be carried out with a low current density and a high frequency in order to limit the thickness of the white layer as much as possible.

Then it is necessary to carry out a stress relieving at 25°C below the last tempering in order to reduce the level of residual stresses (*which could lead to a risk of cracking*) and to carry out a polishing to completely remove the white layer formed during the discharge machining process.

## Welding

It is not recommended to weld the 2312 PRIME because of its high sulfur content leading to an important risk of cracks.

In case of need this is mandatory to preheat the part at a minimum temperature of 350°C. Please consult us for more details on welding parameters.



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