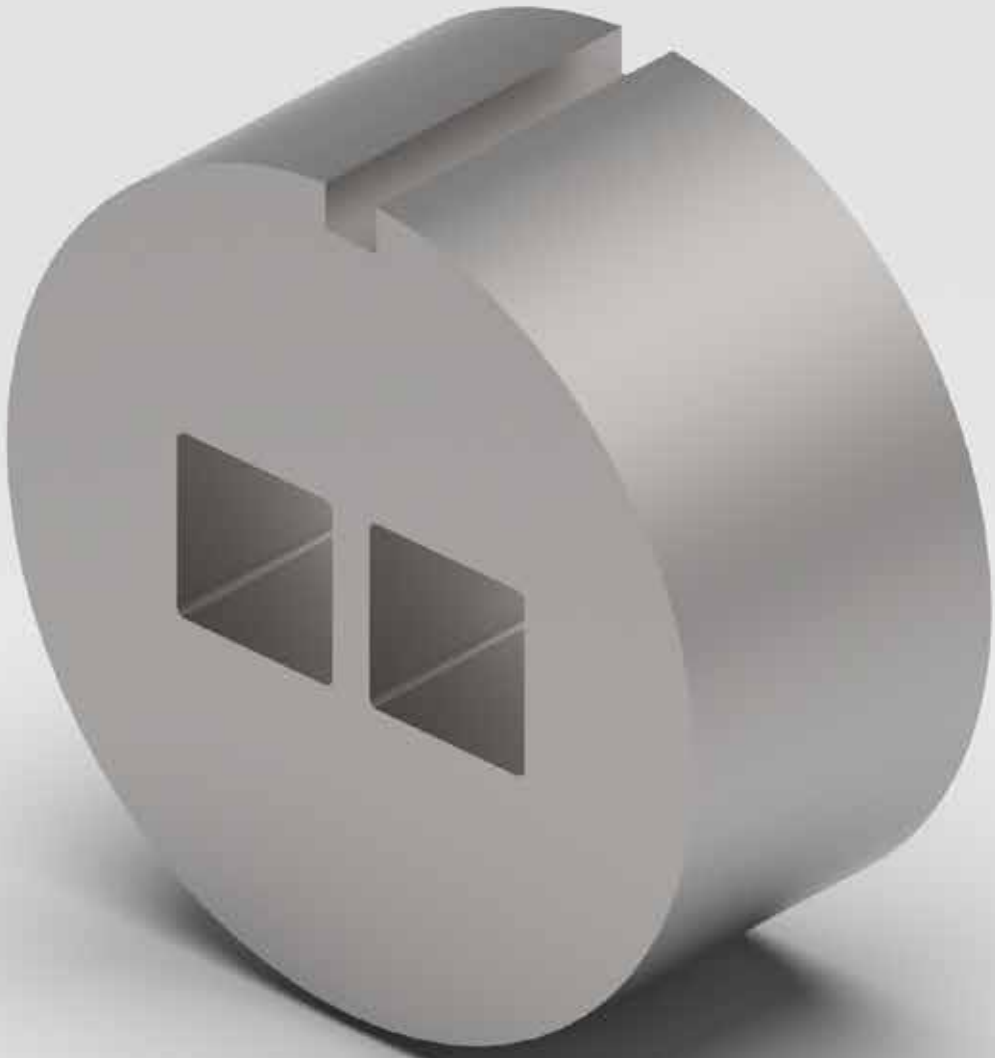
TG Steels



2329

PRIME

Hot work tool steel with good hot properties and an excellent thermal conductivity for hot work applications with intensive cooling

2329 PRIME;

- Is a 2% chromium hot-work tool steel produced by a process that ensures a good level of cleanliness
- Has a good hot strength and tempering back resistance.
- Has an excellent thermal conductivity and is suitable for hot work tools cooled by water.
- Can also be welded and exhibits a good machinability
- Has a very good suitability for surface treatments such as gas, ionic or salt bath nitriding, as well as PVD or CVD coatings.

Applications

2329 PRIME is suitable for the manufacture of die inserts and forging machine tools, die-casting moulds of light and heavy alloys, as well as spindles, mandrels and spinning punches.

2329 PRIME is suitable for containers for die casting presses, extrusion press blocks and sleeves for extrusion presses.

Compared to CUDA PRIME steel *(1.2343)*, 2329 PRIME has a better thermal conductivity and is suitable for hot work tools intensively cooled *(by water for example).*

Main properties

- Good thermal conductivity
- Good toughness in hot conditions
- Suitable for hot work tools cooled by water
- Good hot strength and tempering back resistance
- Suitable for surface treatments

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo	V
0.45	0.80	0,70	≤0.025	≤0.025	1.80	0.30	0.20

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
1.2329	46CrSiMoV7	-	-	-	-	-	-	-

Structure

The structure of the 2329 PRIME is fine and homogeneous without precipitation or alignments of carbides.

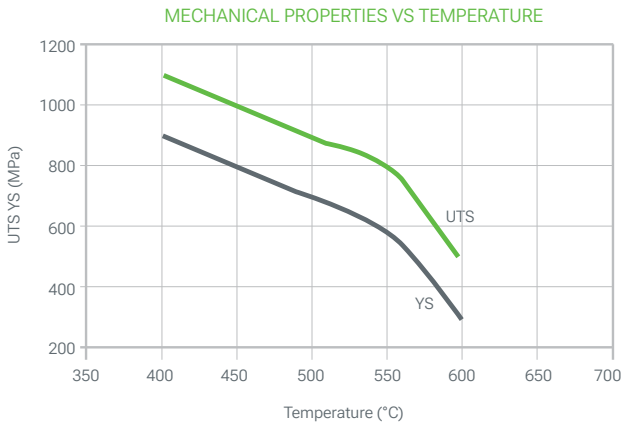
Hardness at the time of delivery

Annealed for 230 HB max.

Physical properties

Temperature	20°C	200°C	400°C	600°C
Volumic mass kg/m³	7800	7770	7700	7540
Young Modulus N/mm²	210 000	198 000	185 000	175 000
Thermal conductivity W/m.K	27	28	29.1	32.5
Coefficient of linear expansion 10^{-6}/K	12	12.5	13.1	14.5

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



Heat treatment

SOFT ANNEALING

Temperature: 750°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 50°C under the last tempering temperature 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 1 step.

- 1st preheating step: Temperature: 550°C time: 30s / mm of thickness

Recommended austenitizing temperature: 870 - 900°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.

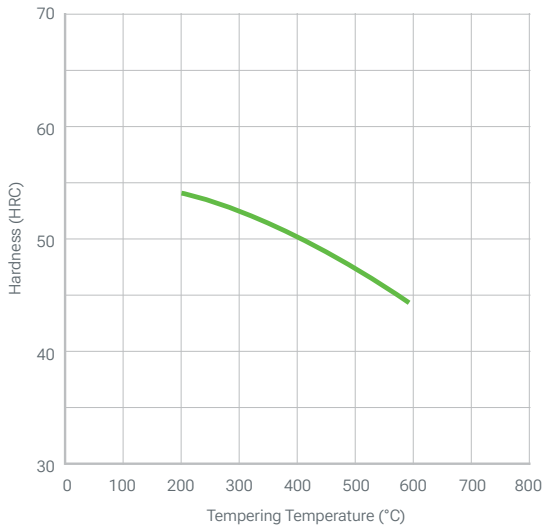
SUB ZERO TREATMENT

For parts used in cold work applications that need to have high dimensional stability and to increase wear resistance without reducing toughness, it is recommended to perform a subzero treatment at a temperature between -70°C and -190°C for 1 hour for 25mm of thickness of the part. The temperature range from -70°C up to -120°C *(named cold treatment of steel)* leads to the complete transformation of austenite into martensite and as a consequence to a better stability associated with an improved hardness and a better wear resistance and the temperature range from -135°C down to -190°C *(named cryotreatment of steel)* leads also to the complete transformation of austenite and also the precipitation of ultra fine carbides improving a lot the wear resistance without modification of the toughness. This treatment is optional for common applications

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 25mm of thickness of the treated part *(equivalent thermal thickness).*

TEMPERING CURVE



Surface treatment

NITRIDING

2329 PRIME can be nitrided at temperatures less than or equal to 20 ° C below tempering temperatures without risk of deterioration of the mechanical characteristics.

PVD, CVD

2329 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

2329 PRIME is perfectly suitable for polishing in the treated state and can be used for applications requiring a sufficient level of polish for translucent - transparent parts (Rt ≤ 20µm, CNOMO level 2, Rugotest N7).

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

2329 PRIME is suitable for chemical or laser texturing.

Machining

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

TURNING

	Carbide tool		HSS tool
	Rough machining	Finishing	Finishing
Cutting speed m/ min	140 - 180	180 - 230	17 - 22
Feed mm/r	0.2 – 0.4	0.1 – 0.2	0.1 – 0.3
Depth of cut mm	2 - 4	0.5 – 2	0.5 - 2

MILLING: SURFACING

	Milling with carbide tools		Solid tool
	Rough machining	½ finishing	Finishing
Cutting speed m/ min	160 - 180	180 - 200	210 - 280
Feed mm/r	0.45	0.4 - 0.25	0.15 - 0.05
Depth of cut mm	1. - 3	1. - 2	1 - 0.5

END MILLING

	Milling with carbide tools		HSS milling tool
	Solid carbide	Carbide indexable insert	
Cutting speed m/ min	120 - 150	160 - 210	25 - 29
Feed mm/teeth	0.02 – 0.2	0.07 – 0.2	0.01 – 0.3
Carbide designation ISO	NA	P20 – P30	NA

DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/tr
< 5	14 - 16	0.05 – 0.15
5 - 10	14 – 16	0.15 – 0.20
10 - 15	14 – 16	0.20 – 0.25
15 - 20	14 - 16	0.25 – 0.30

DRILLING: CARBIDE DRILL

	Carbide type		
	Indexable insert	Solid carbid	Carbide tip
Cutting speed m/ min	160 - 180	100 - 130	55 - 80
Feed mm/tr	0.05 – 0.10	0.10 – 0.25	0.15 – 0.25

FINE GRINDING

General indications for grinding wheels to be used on 2329 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

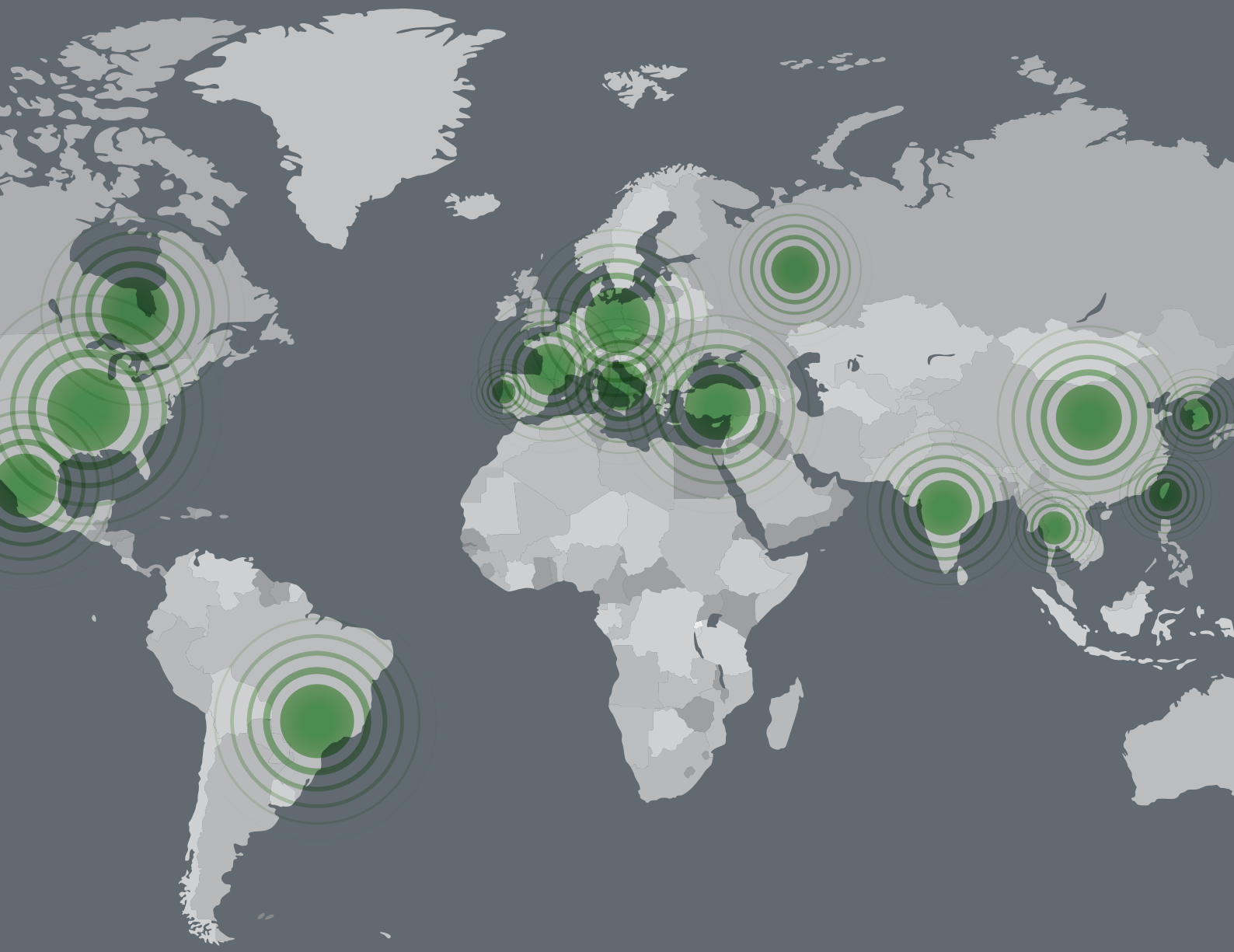
2329 PRIME is also suitable for EDM machining *(wire or electrode)*. Preferably, the machining will be carried out with a low current density and a high frequency in order to limit the thickness of the white layer as much as possible.

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 2329 PRIME but if this is mandatory it could be welded either in the annealed condition *(better)* or in the heat treated condition.

- Method: TIG *(pure Ar protection)*
- Feeder wire: AISI H10
- Preheating: 300°C.
- Hold at 200°C during the welding operation with a maximum interpass temperature at 450°C. Slow cooling *(max 20°C/h)* after welding.
- Post treatment:
  - In the treated state: tempering at 550°C or 50°C under the last tempering temperature with a tempering time at least equal to 1h + 1h for 25mm of thickness of the treated part *(equivalent thermal thickness)*.
  - In the annealed state: carry out a soft annealing under the usual conditions: temperature: 740°C, duration 1h + 1h for 25mm of thickness. slow cooling in the furnace *(10 to 20°C / h)*



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