TG Steels

TGX 12

DIODON ESR

Electroslag Remelted cold work tool steel with excellent chipping and cracking resistance associated with a very good wear resistance

TGX 12;

- is an Electroslag Remelted steel that ensures a very high level of cleanliness and homogeneity.
- shows an excellent resistance to chipping and cracking.
- hardness reaches more than 60 HRC after high-temperature tempering ensuring a very good wear resistance.
- shows a very good dimensional stability during heat treatment.
- has a good grinding and wire-cutting performance.
- has a very good suitability for surface treatments such as gas, ionic or salt bath nitriding, as well as PVD or CVD coatings.

Applications

TGX 12 is highly suitable for cold working dies under harsh operating conditions, such as punching and forming dies for ultra-high strength steel plates.

TGX 12 can be used in all applications where high compressive strength associated with good toughness is required.

TGX 12 can be used for industrial knives for cutting plastics and also for cold forming rollers.

Main properties

- Excellent chipping, cracking and wear resistance
- High hardness
- High compressive strength
- Simple heat treatment with a very slight change in size
- High hardenability

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo	V
0.70	0.45	0.30	≤ 0.030	≤ 0.005	5.15	2.50	0.65

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
-	X70CrMoV5-2	7Cr5Mo2V	-	-	-	-	-	-

Structure

The structure of the TGX 12 is fine and homogeneous without precipitation or alignments of big carbides.

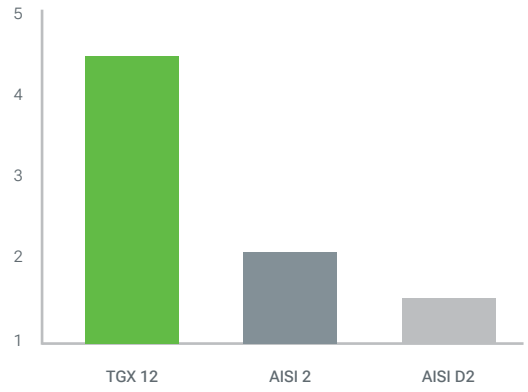
Hardness at the time of delivery

Annealed for 230 HB max.

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

Hardness	Compressive yield strength MPa
58	2230
60	2350
61	2430

Relative chipping resistance



Physical properties

Temperature	20°C	200°C	400°C
Volumic mass kg/m³	7800	7770	-
Young Modulus N/mm²	213000	192000	180000
Thermal conductivity W/m.K	22	23.9	27.5
Coefficient of linear expansion 10^{-6}/K	10.8	11.6	12.3

Heat treatment

SOFT ANNEALING

Temperature: 820°C, duration 1h + 1h for 25 mm thickness. slow cooling in the oven *(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 600 - 650°C for a minimum of 2 hours, followed by slow cooling in the oven to 450°C.

AUSTENITIZATION

In order to avoid any risk of cracking it is recommended to preheat in 2 steps and eventually 3 steps for bigger parts:

- 1st preheating step: temperature: 600°C time: 30 s/mm of thickness
- 2nd preheating step: temperature: 900°C time: 30 s/mm of thickness
- 3nd preheating step *(for bigger parts only)*: 900°C time: 30 s/mm of thickness

Recommended austenitizing temperature: 1000 - 1025°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.

SUB ZERO TREATMENT

For parts 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 25 mm 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 better stability associated with improved hardness and 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 ultrafine carbides improving a lot the wear resistance without modification of the toughness.

This treatment is optional for common applications.

QUENCHING MEDIUM

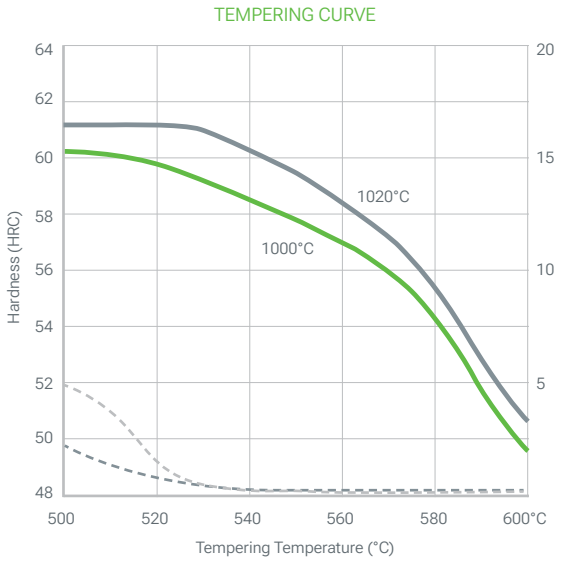
Oil at 80°C, vacuum *(pressure > 6 bars)*, salt bath 500 - 550°C.
To ensure good toughness, treatment with oil or salt bath is preferable.
The hardness after quenching is 60 to 62 HRC.

TEMPERONG

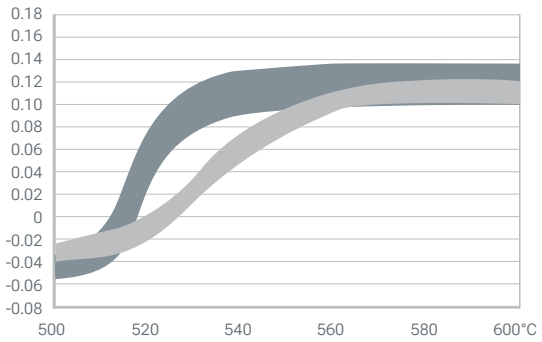
To ensure a minimum residual austenite rate as well as greater tool stability, it is essential to perform a double (triple is better) tempering. Each tempering is followed by a cooling under 100°C.

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

For highest dimensional stability with a good toughness and cracking resistance it is recommended to temper at temperatures over than 540°C. If higher hardness and compression resistance are required it is recommended to increase the austenitizing temperature without exceeding 1050°C.



Dimensional changes



Surface treatment

NITRIDING

TGX 12 can be nitrided at temperatures less than or equal to 20°C below the tempering temperature without risk of deterioration of the mechanical characteristics. After nitriding the surface hardness of the layer is around 1000 - 1200 HV 0.1 and the thickness depends on the nitriding method and parameters *(time, temperature)*.

PVD, CVD

TGX 12 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

TGX 12 is a remelted grade and perfectly suitable for polishing it can be used for applications requiring a mirror polished level *(Rt ≤ 0.25µm, CNOMO level 1, Rugotest N1)* as used for parts requiring a mirror polishing level as optical components, medical devices.

Optimal polishing is achieved by performing consecutive steps of fairly close roughness and stopping each step as soon as the last scratch of the previous step disappears.

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	150 - 170	180 - 220	12 - 17
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	120 - 140	160 - 180	100 - 120
Feed mm/r	0.2 - 0.4	0.1 - 0.2	0.02 - 0.2
Depth of cut mm	2 - 4	0.5 - 2	

DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/t
< 5	15 - 18	0.05 - 0.10
5 - 10	15 - 18	0.10 - 0.20
10 - 15	15 - 18	0.20 - 0.25
15 - 20	15 - 18	0.25 - 0.30

DRILLING: CARBIDE DRILL

	Carbide type		
	Indexable insert	Solid carbid	Carbide tip
Cutting speed m/min	150 - 190	100 - 1400	55 - 75
Feed mm/t	0.05 - 0.10	0.10 - 0.20	0.15 - 0.25

FINE GRINDING

General indications for grinding wheels to be used on TGX 12 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

TGX12 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 age hardening temperature 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.

There is no increase of hardness after EDM machining.

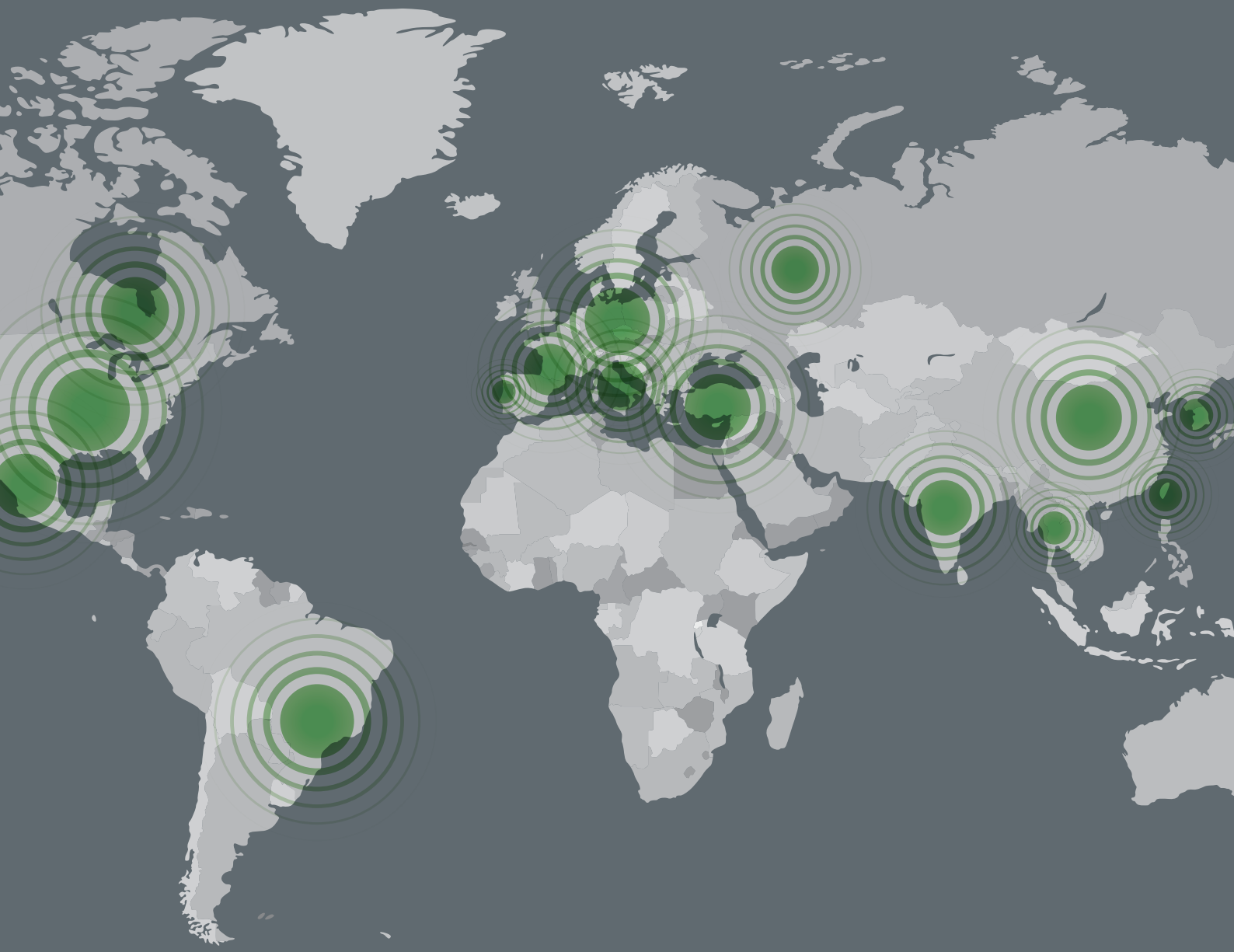
Welding

The TGX 12 could be welded in the heat treated or annealed conditions.

- Method: TIG
- Feeder wire: ask us
- Preheating: 250°C.

Hold at 200°C during the welding operation with a maximum interpass temperature at 350°C. Slow cooling *(max 20°C/h)* after welding.

- Post treatment:
  - » On hardened conditions: Temper at 510 - 520°C, duration 1h + 1h for 25 mm of thickness. Slow cooling in the oven *(10 to 20°C/h)*.
  - » On annealed conditions: perform a soft annealing as described in the chapter "soft annealing".



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