TG Steels

TGE 25

BRILL ESR

High toughness electroslag remelted *(ESR)* cold and hot work tool steel with a very high isotropy

TGE 25;

- is an Electroslag Remelted steel that ensures a very high level of cleanliness and homogeneity. Moreover the TGE 25 is forged by a 3 dimensional forging process leading to a very high homogeneity; of the properties in all the directions.
- is a medium alloyed steel with a high toughness associated with a high wear resistance.
- has a good dimensional stability during heat treatment.
- exhibits a good hardenability and good resistance to softening during tempering.
- can be used either for cold work or hot work applications.
- exhibits a high temperature strength and very good resistance to thermal fatigue.

Applications

TGE 25 can be used for cold or hot working blanking dies, punches, and all kinds of tools requiring a high level of toughness.

TGE 25 can be used for long-life injection or compression molds, especially for reinforced plastics.

Main properties

- Very good toughness
- Very high isotropy
- Very high polishability
- Very good shock resistance
- Good chipping resisitance
- Good wear resistance

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo	V
0.49	0.50	0.30	≤ 0.03	≤ 0.005	5.15	2.35	0.55

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
-	X50CrMoV5 2	-	-	-	-	-	-	-

Structure

Because of the forging process and the medium chromium content the structure of the TGE 25 is isotropic, fine and homogeneous without precipitation or alignments of carbides.

Hardness at the time of delivery

Annealed for 220 HB max.

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

TS MPa	YS 0.2% MPa	Hardness HRC
2050	1700	54
2150	1750	56
2250	1800	58

Physical properties

Temperature	20°C	250°C	400°C
Volumic mass kg/m^3	7800	7740	7700
Young Modulus N/mm^2	210000	190000	180000
Thermal conductivity W/m.K	23	25	28
Coefficient of linear expansion 10^{-6}/K	10.5	11.8	12.4

Heat treatment

SOFT ANNEALING

Temperature: 820 - 850°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 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 3 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)*:
  930°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 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.

QUENCHING MEDIUM

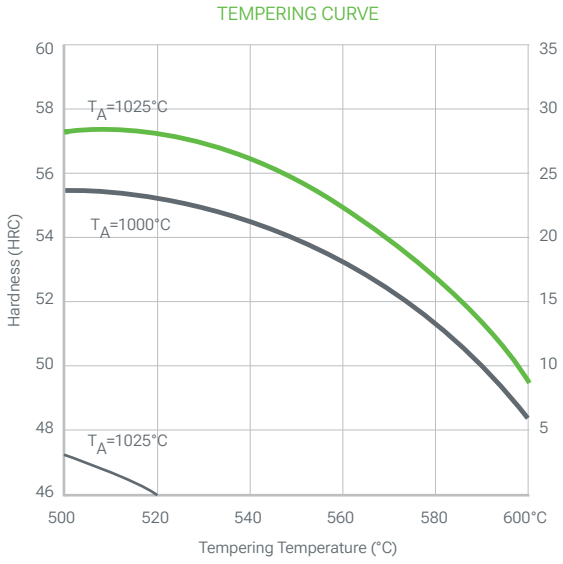
Oil at 80°C, vacuum *(pressure > 6 bars)*, salt bath 500 - 550°C.
To ensure good toughness, treatment with oil or salt bath is preferable.
The hardness after quenching is 61 to 63 HRC.

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)*.

The recommended tempering temperatures are over 525°C.



Surface treatment

NITRIDING

TGE 25 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

TGE 25 is suitable for all kind of PVD and CVD treatment as soon as the treatment temperature is 30°C lower than the last tempering temperature.

Polishing

TGE 25 is a remelted grade and perfectly suitable for polishing it can be used for applications requiring a mirror polished level *(Rt ≤ 0.25 µm, 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.

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.

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 - 180	190 - 220	17 - 22
Feed mm/r	0.15 - 0.3	0.1 - 0.15	0.1 - 0.3
Depth of cut mm	2 - 3	0.5 - 1.5	0.5 - 2

MILLING: SURFACING

	Milling with carbide tools		Solid tool
	Rough machining	½ Finishing	Finishing
Cutting speed m/min	140 - 160	180 - 200	110 - 130
Feed mm/r	0.30	0.1 - 0.2	0.15 - 0.05
Depth of cut mm	2 - 3	1 - 1.5	

DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/t
< 5	14 - 17	0.05 - 0.15
5 - 10	14 - 17	0.15 - 0.20
10 - 15	14 - 17	0.20 - 0.30
15 - 20	14 - 17	0.30 - 0.40

DRILLING: CARBIDE DRILL

	Carbide type		
	Indexable insert	Solid carbid	Carbide tip
Cutting speed m/min	160 - 180	100 - 130	55 - 80
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 TGE 25 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

TGE 25 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.

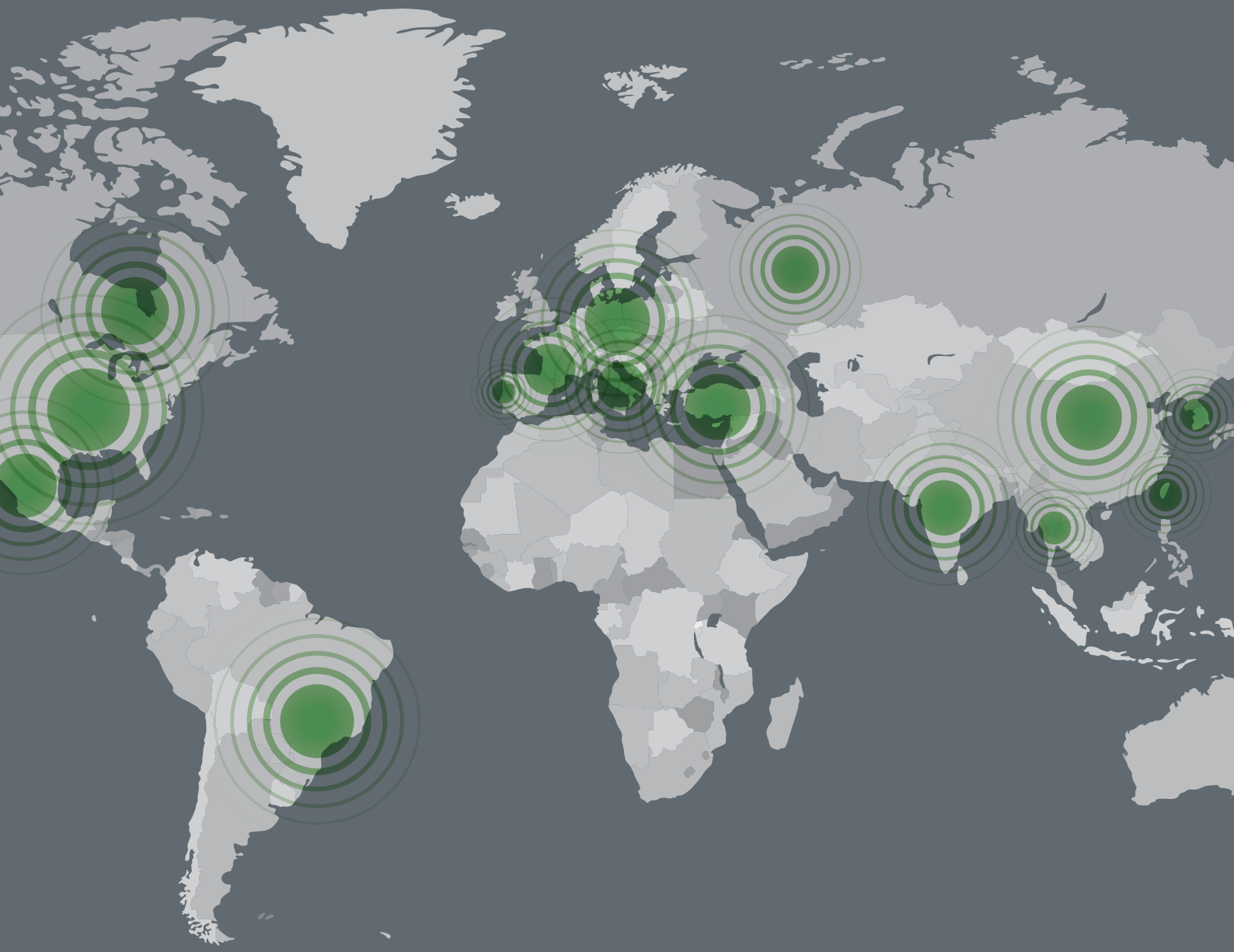
Welding

TGE 25 could be welded either in the annealed condition *(better)* or in the heat treated condition.

- Method: TIG *(pure Ar protection)*
- Feeder wire: UTP ADUR 600
- Preheating: 250°C.

Hold at 200°C during the welding operation with a maximum interpass temperature at 400°C. Slow cooling *(max 20°C/h)* after welding.

- Post treatment:
  - » In the treated state: tempering at 510°C with a tempering time at least equal to 1h + 1h for 25 mm of thickness of the treated part *(equivalent thermal thickness)*.
  - » In the annealed state: carry out a soft annealing under the usual conditions: temperature: 850°C, duration 1h + 1h for 25 mm of thickness. slow cooling in the oven *(10 to 20°C/h)*.



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