TGP80

ESR

Electroslag Remelted (ESR) prehardened mold steel with good machinability suitable for large scale applications with excellent polishability and wear resistance

TGP80 ESR;

- Is an Electroslag Remelted steel that ensures a very high level of cleanliness and homogeneity
- Has an excellent polishability, and can be used for molds for optical instrument components, optical discs, medical devices, etc., and for all kinds of molds where the surface quality after electrical discharge machining is a priority.
- Has an excellent wear resistance.
- Is good for texturing.
- Can also be welded and exhibits a very good machinability (20% higher than 2738 PRIME).
- Is delivered at a hardness of 400HB for 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

TGP80 ESR can be used for small sizes to very large injection molds requiring excellent polishability and good texturing level.

TGP80 ESR can also be used for molds for abrasive polymers and reinforced plastics with or without appropriate surface treatment.

TGP80 ESR can be used for all the secondary parts in molding applications and also frames for plastic molds.

TGP80 ESR can also be used for mechanical applications requiring a hardness around 400 HB.

Main Properties

- Prehardened steel at 400 HB ready to be machined without any further heat treatment
- Excellent polishability and good texturing
- Very good wear resisitance
- Very good machinability
- Suitable for surface treatments

Chemical composition (typical)

C	Mn	Si	P	S	Cu	Ni	Mo	Al
0.15	1.55	< 0.45	< 0.025	< 0.015	1.00	3.10	0.35	0.95

Designation

Werkstoü Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
-	15NiMnCuAlMo 12 6-	10Ni3MnCuAl	-	-	çP21	-	-	-

Structure

The structure of the TGP80 ESR is óne and homogeneous without precipitation or alignments of carbides. The heat treatment is optimized for high homogeneity of hardness from surface to core even for thicker blocks.

Hardness at the time of delivery

350 - 390 HB (38 - 42 HRC).

Note on hardness and wear during surface contact

The TGP80 ESR is delivered at a working hardness of ~ 40 HRC. Because the TGP80 is a precipitation hardening steel, the surface of the steel is in compression and as a consequence it warrants very good wear properties.

In case of sliding contact between 2 parts in TGP80 ESR a potential excess wear , leading to jamming could occur. In such conóguration we recommend to use a counterpart with a hardness about 10 HRC less than the TGP80 ESR (typically 30 HRC).

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

TS MPa	YS 0.2% MPa	KV J 20°C
1250	1000	20

Physical properties

Temperature	20°C	100°C	200°C	300°C
Volumic mass kg/m³	7725	7715	7680	7665
Young Modulus N/mm²	206000	203000	201000	186000
Thermal conductivity W/m.K	29	31.0	32.5	32.7
Coeώcient of linear expansion 10^{-6}/K	11.1	11.5	12.5	13.4

Heat treatment

The TGP80 ESR is delivered heat treated at 350 - 390 HB (38 - 42 HRC) 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: 640 - 660°C, duration 1h + 1h for 25 mm 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

There is no need to perform stress relieving on the TGP80 ESR.

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: 800 - 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.

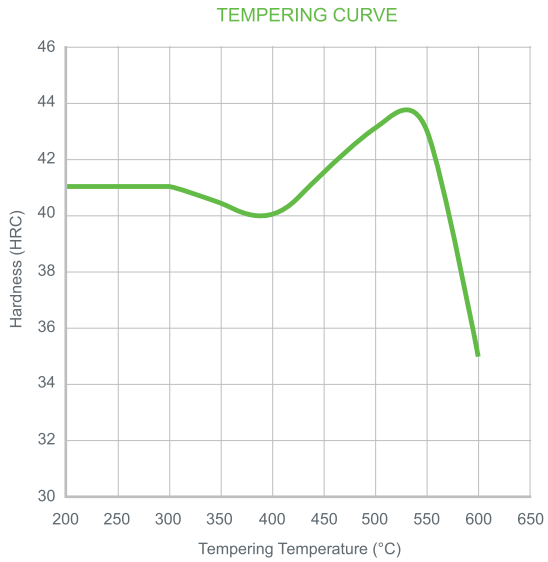
QUENCHING MEDIUM

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.

AGE HARDENING

The TGP80 ESR is a precipitation hardening steel and so the heat treatment is slightly diüerent than the treatment of other tool steels.

For the “nominal” hardness of 40 - 42 HRC, heat up to 550°C with heating speed 60°C/h, then hold 5 hours at temperature as soon as the surface of the part reach the hardening temperature. Then cool slowly in air out of the furnace.



Surface treatment

NITRIDING

TGP80 ESR can be nitrided at temperatures less than or equal to 20°C below the age hardening temperatures without risk of deterioration of the mechanical characteristics.

Because of its high Al content, Aluminum nitrides can be built in the surface during the nitriding process and as a consequence surface hardness up to 60 HRC can be reach after nitriding.

PVD, CVD

TGP80 ESR is suitable for all kinds of PVD and CVD treatment as soon as the treatment temperature is 30°C lower than the age hardening temperature.

Polishing

TGP80 ESR is a remelted grade and perfectly suitable for polishing it can be used for applications requiring a mirror polished level (Rt χ 0.25 ìm, 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 with similar roughness and stopping each step as soon as the last scratch from the previous step disappears.

Texturing

TGP80 ESR 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	
	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	110 - 180	120 - 190	200 - 250
Feed mm/r	0.20 - 0.40	0.1 - 0.25	0.05 - 0.15
Depth of cut mm	2 - 4	0.5 - 1.0	0.05 - 0.5

DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/t
< 5	25	0.05 -0.10
5 - 10	25	0.10 - 0.15
10 - 15	25	0.18 - 0.25
15 - 20	25	0.22 - 0.29

DRILLING: CARBIDE DRILL

	Carbide type		
	Indexable insert	Solid carbid	Carbide tip
Cutting speed m/ min	150 - 170	90 - 120	
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 TGP80 ESR in the heat treated condition.

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

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

ELECTRO-DISCHARGE MACHINING

TGP80 ESR 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 TGP80 ESR could be welded in the heat treated condition.

- Method:
  TIG
- Filler wire:
  ask us
- Preheating:
  325°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:
  - At 450 to 500°C, duration h + 1h for 25 mm of thickness. Slow cooling in the furnace (10 to 20°C/h).
  - Hardness of the welded area:
    ç380 HBT

There is no increase (nor decrease) of hardness in the welded area as soon as the recommendations here over are used.

OUR PRESENCE

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