TG Steels

3247

PRIME

Remelted High Speed Steel with high wear resistance associated with high hot hardness

3247 PRIME;

- is an electroslag remelted *(ESR)* high-speed steel that allows it to obtain a very high cleanliness and a very fine structure, which improves its toughness.
- has a high cobalt content and it gives it a high hot hardness as well as a very high resistance to embrittlement on tempering.
- has a very high wear resistance associated with a high hardness and a good toughness.
- shows a good suitability for surface treatments such as gas, ionic or salt bath nitriding, as well as PVD or CVD coatings.

Applications

3247 PRIME can be used for fine cutting tools *(punches and dies)*, cold or semi-hot forming tools *(punches and dies)*.

3247 PRIME can also be used for manufacturing milling cutters, reproduction bars, forming tools without shaving, cold spinning punches.

3247 PRIME can be used for other cutting tools as drills, taps, dies, spindles, reamers, thread rolling combs, segments for circular saws, etc and also, shear blades, cold working cylinders.

3247 PRIME can be used for cavities and injection sills of plastic molds and in some cases for hot work tools due to its high hot hardness.

Main properties

- Excellent wear resistance
- High resistance to tempering embrittlement
- High hot hardness
- High compressive strength
- High hardenability

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo	V	W	Co
1.10	0.20	0.45	≤ 0.030	≤ 0.030	3.90	9.40	1.10	1.35	7.95

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
1.3247	HS 2-9-1-8 / X110MoCoCrWV 10 8 4 2 1	W2Mo9Cr4VCo8	SKH59	BM42	M42	-	-	-

Comparison HSS grades

GRADE	EXECUTION	HOT HARDNESS	WEAR RESISTANCE	TOUGHNESS	MACHINABILITY (ANNEALED)	GRINDABILITY
3343	Conventional	●●●●●	●●●●●	●●●●●●	●●●●●●●●●●	●●●●●●●
3243	Conventional	●●●●	●●●●●	●●●●	●●●●●●●●●	●●●●●●
3247	Conventional	●●●●●●●	●●●●●●	●●●	●●●●●●●●	●●●●●●●
TPM M4	PM steel	●●●●●●●●	●●●●●●	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●
TPM M42	PM steel	●●●●●●●●●	●●●●●●●●	●●●●●●	●●●●●●●●●	●●●●●●●●●
TPM23	PM steel	●●●●●●	●●●●●●	●●●●●●●●●●	●●●●●●●●●	●●●●●●●●
TPM30	PM steel	●●●●●●●●●	●●●●●●●●	●●●●●●	●●●●●●●	●●●●●●●●●
TPM60	PM steel	●●●●●●●●●●	●●●●●●●●●●	●●●●●●	●●●	●●●●●●

Structure

The structure of the 3247 PRIME is fine and homogeneous without precipitation or alignments of big carbides. The carbide distribution and the micro cleanliness are controlled and in conformity with the Stahl-Eisen Werkstoff Blatt 1570 / 61 standard.

The austenite grain size is determined on the surface of the specimen according to Snyder-Graff method. The minimum permissible values *(average of 10 measurements)* before tempering are given below.

Section (mm)	Austenitic grain size
0 - 25	12
25 - 50	11
50 - 125	10
> 125	9

Hardness at the time of delivery

Annealed for 300 HB max.

Physical properties

Temperature	20°C	350°C	700°C
Volumic mass kg/m³	8120	7930	7725
Young Modulus N/mm²	220 000	200 000	178 000-
Thermal conductivity W/m.K	20	18.7	18.0
Coefficient of linear expansion 10^{-6}/K	11	12	12.6

Heat treatment

SOFT ANNEALING

Temperature: 820 - 860°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

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 furnace to 450°C.

AUSTENITIZATION

In order to avoid any risk of cracking it is recommended to preheat in 3 steps.

- 1st preheating step:
  temperature: 500°C time: 30 s/mm of thickness
- 2nd preheating step:
  temperature: 850°C time: 30 s/mm of thickness
- 3rd preheating step:
  temperature: 1050°C time: 30 s/mm of thickness

Recommended austenitizing temperature: 1150 - 1180°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.
After quenching the hardness is 66 - 69 HRC.

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.

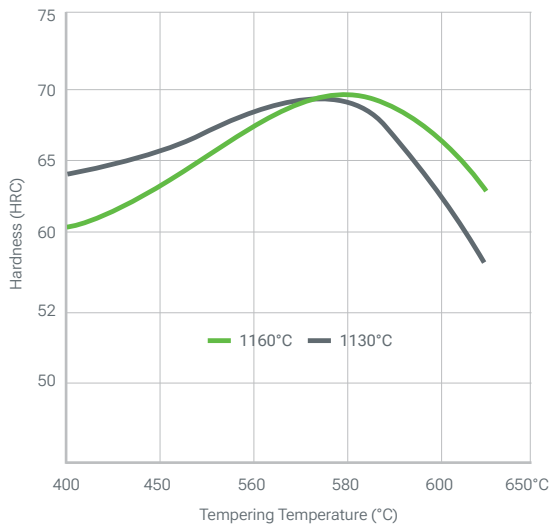
The temperature range from -70°C up to -120°C *(named cold treatment of steel)* leads to the complete transformation of austenite into martensite and as a consequence to a better stability associated with an improved hardness and a better wear resistance.

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.

TEMPERING

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

TEMPERING CURVE



Surface treatment

PVD, CVD

3247 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.

Machining

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

GRINDING IN ANNEALED CONDITIONS

	Carbide insert		Solid tool
	Rough machining	½ Finishing	Finishing
Cutting speed m/min	50 - 70	80 - 105	40 - 45
Feed mm/r	0.35	0.15	0.01 - 0.1
Depth of cut mm	2 - 3	1 - 1.5	0.01 - 0.1

TURNING IN ANNEALED CONDITIONS

	Carbide insert		HSS tool
	Rough turning	Finishing	Turning
Cutting speed m/min	90 - 110	115 - 130	15
Feed mm/r	0.35	0.15	0.1 - 0.2
Depth of cut mm	2 - 3	1 - 1.5	0.5 - 2.0

DRILLING IN ANNEALED CONDITIONS
CARBIDE DRILL

	Insert	Solid
Cutting speed m/min	120	60
Feed mm/r	0.10	0.20

HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/r
< 5	9	0.10
5 - 10		0.17
10 - 15		0.22
15 - 20		0.30

FINE GRINDING

General indications for grinding wheels to be used on 3247 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.

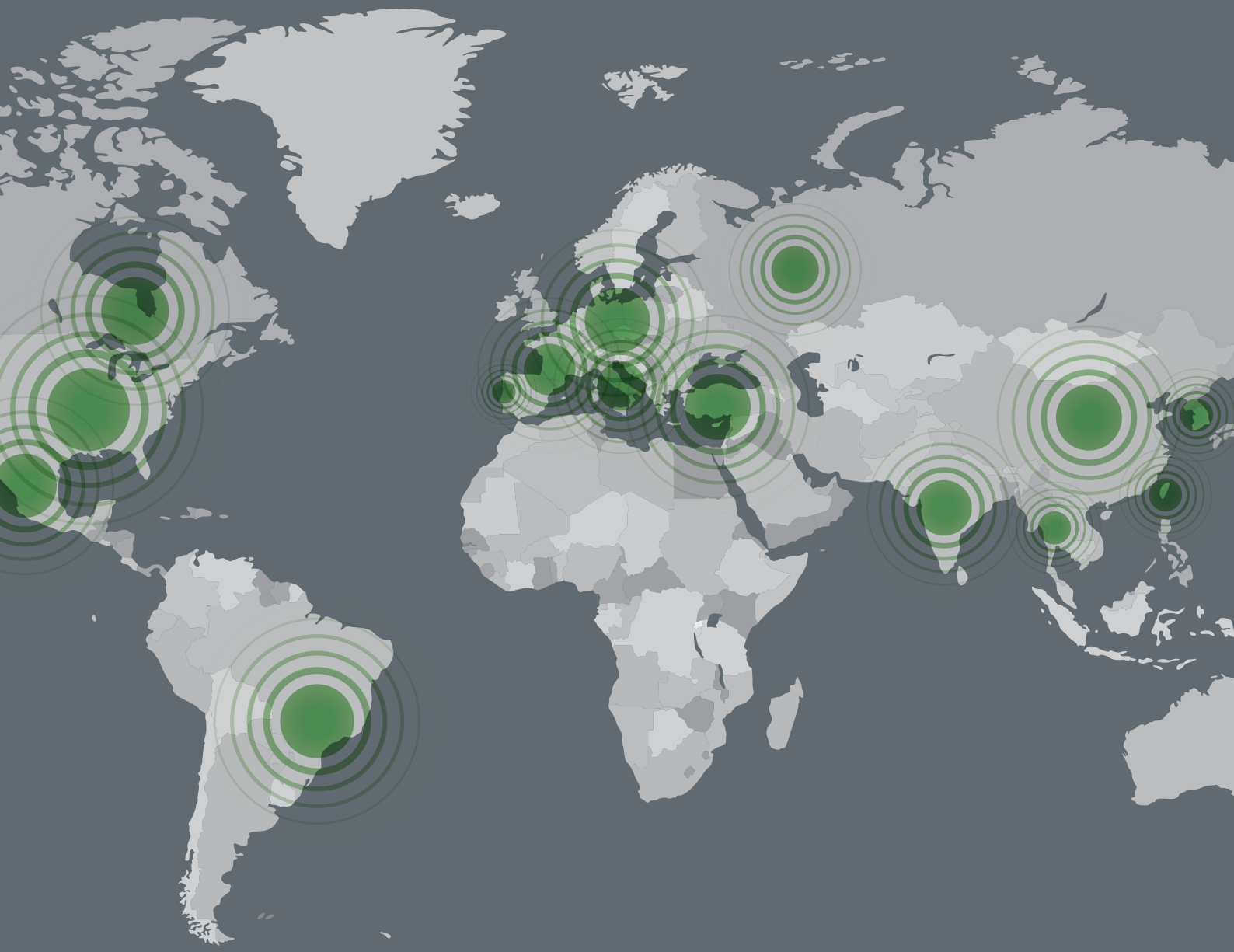
ELECTRO-DISCHARGE MACHINING

3247 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

3247 PRIME cannot be welded.



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E info@tgsteels.com **W** www.tgsteels.com

Atlas Special Steels, s.l.
Avinguda de Can Sucarrats, 88-92,
08191 Rubí, Barcelona, Spain
+34 938 233 590
info@atlassteels.eu

Atlas Special Steels Unipessoal, Lda
Rua do Antuã, nr. 64 pavilhão A e B
3720-558 Travanca – OAZ, Portugal
+351 256 245 497
info@atlassteels.eu

Five Star Special Steel Europe srl
Via Glenn Curtiss, 9, 25018
Montichiari BS, Italy
+39 030 524 3724
info@fssseurope.com

GNG Consultoria
Rua Ituporanga, 210 – Bom Retiro
Joinville – SC – 89222-430
+55 47 99669-5557
marcus@gngconsultoria.com.br

OSS Canada Special Steel Inc
2384 Speers Rd, Oakville,
ON, Canada L6L 5M2
905-827-5888
sales@oss-material.ca

OSS Special Steel Inc.
2015 Mitchell Blvd Suite C
Schaumburg, IL 60193
(618) 426 – 6158
sales@oss-material.com

TG Steels s.r.o.
Libušina 850, Dubí 272 03
Kladno, Czech Republic
info@tgsteels.com

TG Middle East
Kocaeli KOBİ OSB, Köseler Mh.,
3. Cd., No: 15 Dilovası, Kocaeli, Türkiye
+90 262 728 11 67 (pbx)
info@tgme.com.tr