TG Steels

2316
PRIME

Stainless mold steel hardened at 300 HB, for excellent corrosion resistance and good mechanical properties

2316 PRIME is stainless steel, which can be used for making small and medium-sized plastic injection molds where an excellent corrosion resistance is required. It is delivered in hardened condition, ready to be used without any additional heat treatment, at a hardness of 300 HB.

Applications

2316 PRIME has an excellent corrosion resistance *(suitable for PVC injection molds),* excellent polishability *(suitable for transparent parts)* as well as correct machinability.

2316 PRIME needs to be used when the corrosion resistance of the CROMIS PRIME *(1.2083)* is not enough for he application.

If higher polishability is required *(e.g. for miror polish)* we recommend to use the 2316 ESR *(remelted steel with the highest cleanliness)*.

2316 PRIME can be used for injection molds for corrosive plastic *(PVC, recycled plastics...)*, extrusion screws and barrels for extruders, molds for food, medical equipment.

2316 PRIME is delivered in the annealed condition and in use it should be treated to a hardness of 52 HRC.

Main properties

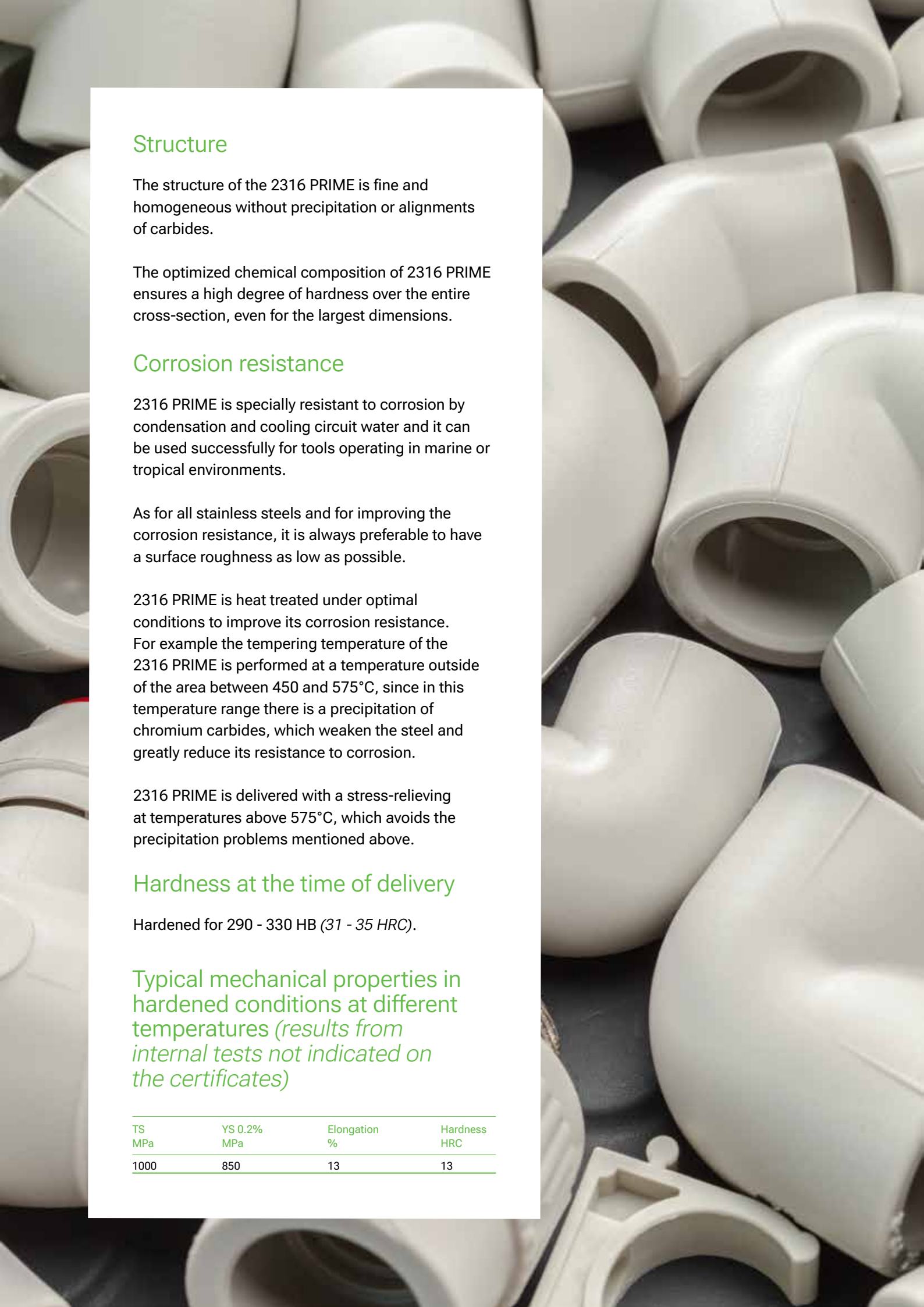
- Excellent corrosion resistance
- Very Good polishability
- Delivered in hardened condition at 300 HB.
- High hardenabilty

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo
0.40	0.90	< 0.35	< 0.015	<0.005	16.00	0.90

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
1.2316	X38CrMo16	-	SUS420J2	-	422	-	Z38C16	-



Structure

The structure of the 2316 PRIME is fine and homogeneous without precipitation or alignments of carbides.

The optimized chemical composition of 2316 PRIME ensures a high degree of hardness over the entire cross-section, even for the largest dimensions.

Corrosion resistance

2316 PRIME is specially resistant to corrosion by condensation and cooling circuit water and it can be used successfully for tools operating in marine or tropical environments.

As for all stainless steels and for improving the corrosion resistance, it is always preferable to have a surface roughness as low as possible.

2316 PRIME is heat treated under optimal conditions to improve its corrosion resistance. For example the tempering temperature of the 2316 PRIME is performed at a temperature outside of the area between 450 and 575°C, since in this temperature range there is a precipitation of chromium carbides, which weaken the steel and greatly reduce its resistance to corrosion.

2316 PRIME is delivered with a stress-relieving at temperatures above 575°C, which avoids the precipitation problems mentioned above.

Hardness at the time of delivery

Hardened for 290 - 330 HB *(31 - 35 HRC)*.

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

TS MPa	YS 0.2% MPa	Elongation %	Hardness HRC
1000	850	13	13

Physical properties

Temperature	20°C	100°C	200°C	300°C
Volumic mass kg/m³	7720	7700	7660	7650
Young Modulus N/mm²	205000	202000	197000	192000
Thermal conductivity W/m.K	23	23.5	24	24.1
Coefficient of linear expansion 10^{-6}/K		11	11.2	11.7

Heat treatment

2316 PRIME is delivered heat treated for a hardness of 290 to 330 HB *(31- 35 HRC)*. There is no need for extra heat treatment.

In the case of the necessity for the heat treatment of 2316 PRIME *(e.g.: need for higher hardness, material damaged by thermal processing...)* the data below could be used:

SOFT ANNEALING

Temperature: 810 - 820°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 a temperature over 580°C and at 30°C *(minimum)* 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 2 steps.

- 1st preheating step: temperature: 600°C time: 30 s/mm of thickness
- 2nd preheating step: 800°C time: 30 s/mm of thickness

Recommended austenitizing temperature: 990 - 1020°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 room for 30 minutes at the austenitizing temperature, as soon as the core of the room has reached the austenitizing temperature.

QUENCHING MEDIUM

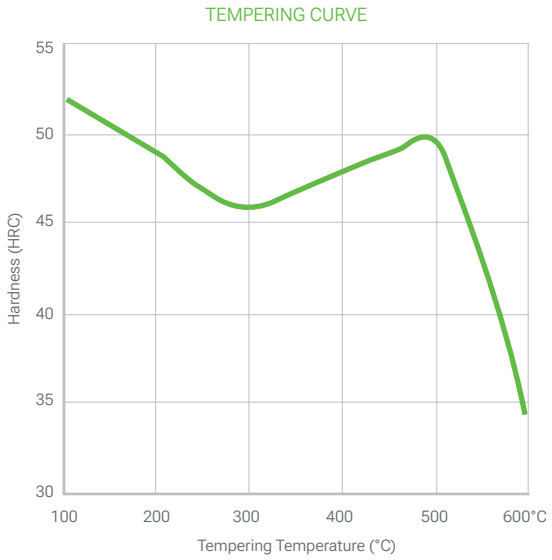
Oil at 80°C, vacuum *(pressure> 6 bars)*, salt bath 500 - 550°C. To ensure good toughness, treatment with oil or salt bath is preferable.

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)*.

Tempering temperature and corrosion resistance:

In order to avoid a better corrosion resistance it is highly recommended to avoid tempering temperatures in the range 450 to 575°C since at these temperatures there is a precipitation of chromium carbides at the grain boundaries leading to an increase of the local corrosion at these locations.



Surface treatment

NITRIDING

2316 PRIME is a stainless steel and CANNOT BE nitrided.

The stainless steels are not suitable for nitriding since during the nitriding process some inclusions of chromium nitrides will precipitate in the matrix *(due to the reaction between nitrogen and chromium)*. Such nitrides will lead to the diminution of chromium content near the precipitates and as a consequence a sharp decrease of the corrosion resistance near the precipitates and finally some pitting on the entire surface of the part in use.

PVD, CVD

2365 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

2316 PRIME is suitable for polishing in the heat treated condition and it can be used for applications requiring a high polished level *(Rt ≤ 30 µm, CNOMO level 2, Rugotest N7 - N8)* as used for transparent parts. 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

2316 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	160 - 200	210 - 250	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

	Carbide tool	
	Rough machining	Finishing
Cutting speed m/min	160 - 200	250 - 280
Feed mm/r	0.2 - 0.4	0.1 - 0.2
Depth of cut mm	2 - 4	0.5 - 2

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/r	0.02 - 0.2	0.07 – 0.2	0.01 - 0.3
Depth of cut mm	NA	P20 – P30	NA

DRILLING: HSS TWIST DRILL

Drill diameter mm	Cutting speed m/min	Feed mm/t
< 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 carbide	Carbide tip
Cutting speed m/min	210 - 230	80 - 100	70 - 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 2316 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.

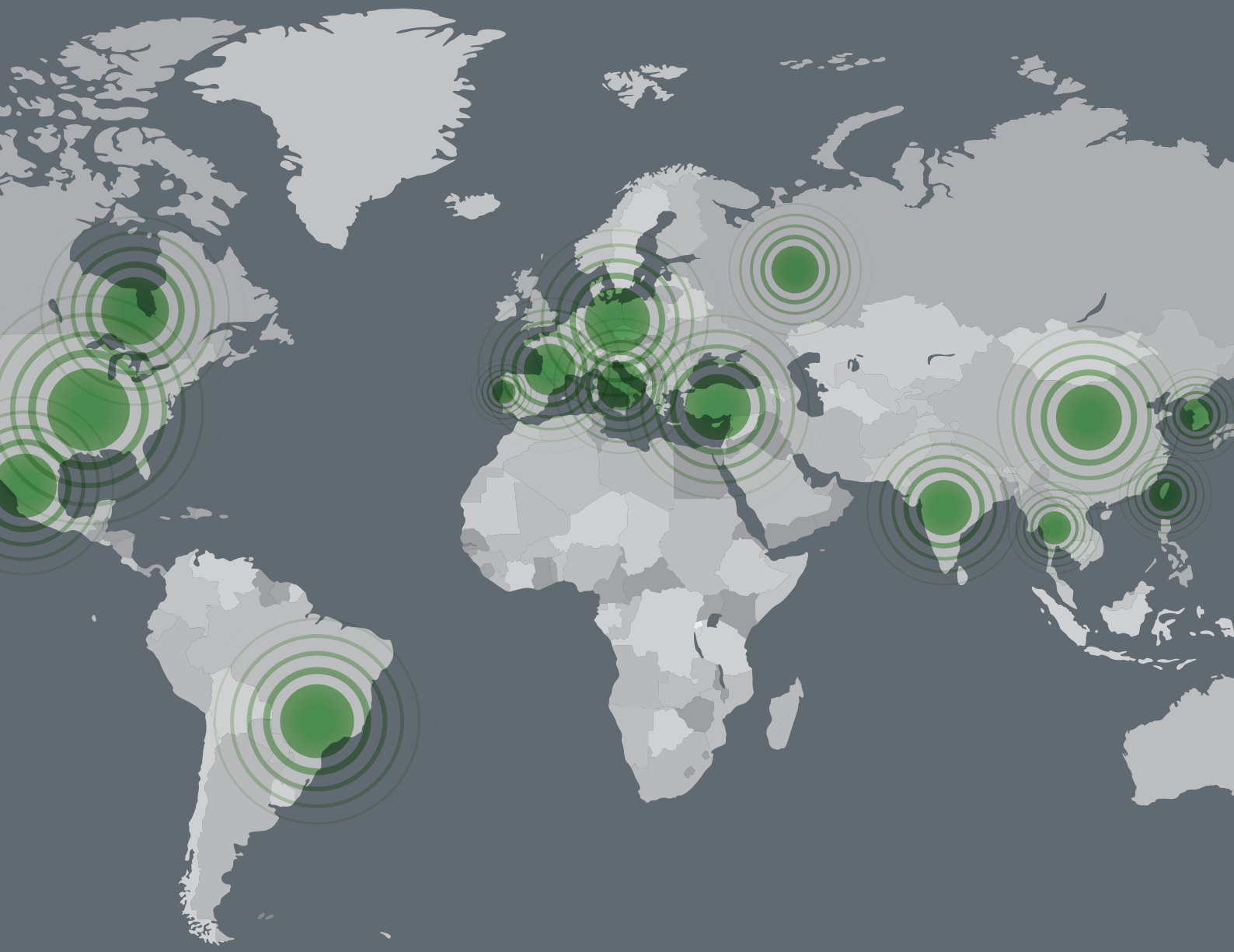
ELECTRO-DISCHARGE MACHINING

2316 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 and always over 575°C 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

2316 PRIME is not recommended to be welded. In case of need consult us.



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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