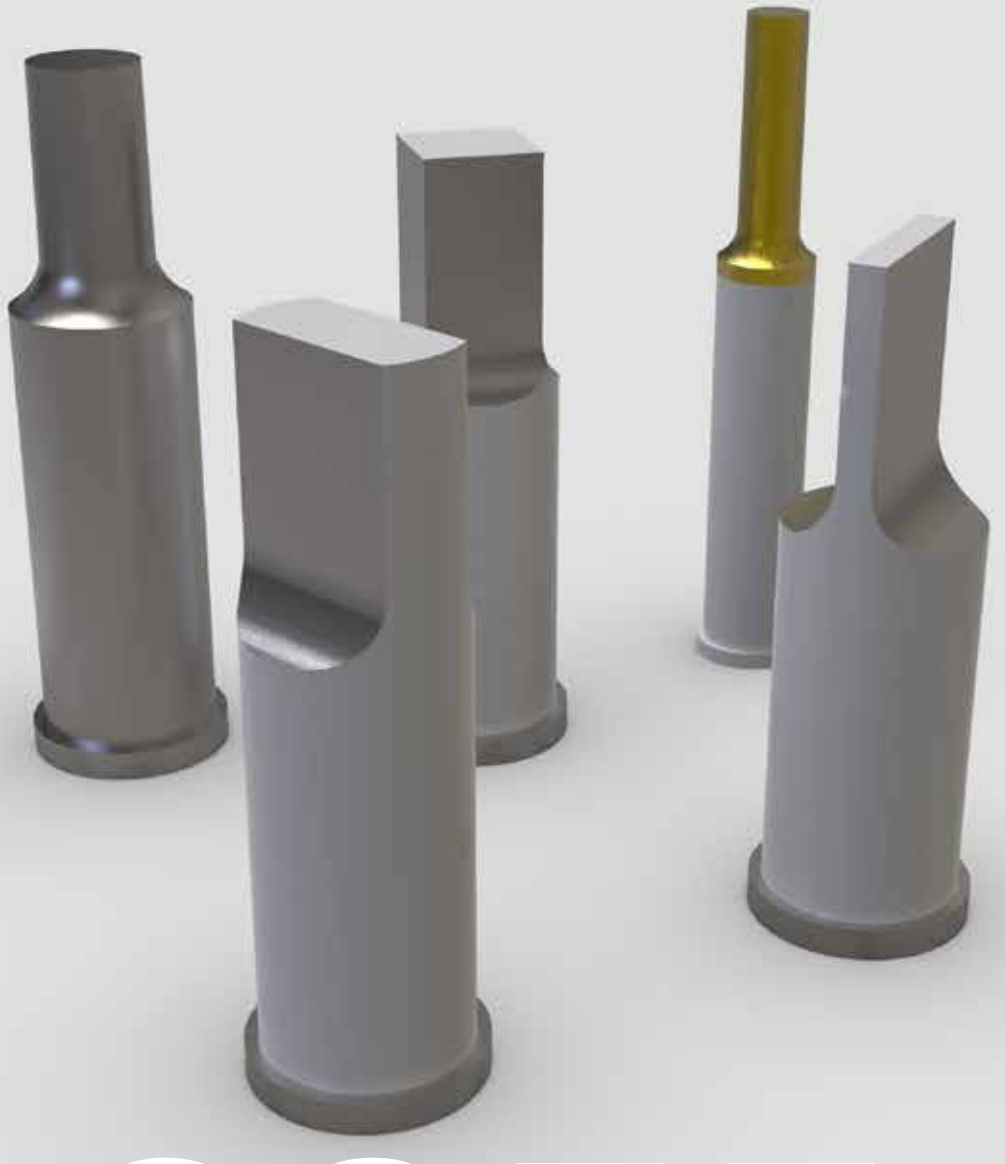
TG Steels



2355

PRIME

High toughness cold and hot work tool steel with high shock resistance

2355 PRIME;

- is a medium alloyed steel with a high toughness after a simple heat treatment.
- is very good for surface hardenings such as laser hardening and induction hardening.
- can be used either for cold work or hot work applications.
- has a good weldability *(easy for maintenance of the tools)*
- can be hardened up to 58 HRC with a simple heat treatment.

Applications

2355 PRIME can be used for cold or hot working blanking dies, punches, and all kinds of tools requiring a high level of toughness.

2355 PRIME can be used for cold and hot working shearing blades, cutting blades, chisels.

Main properties

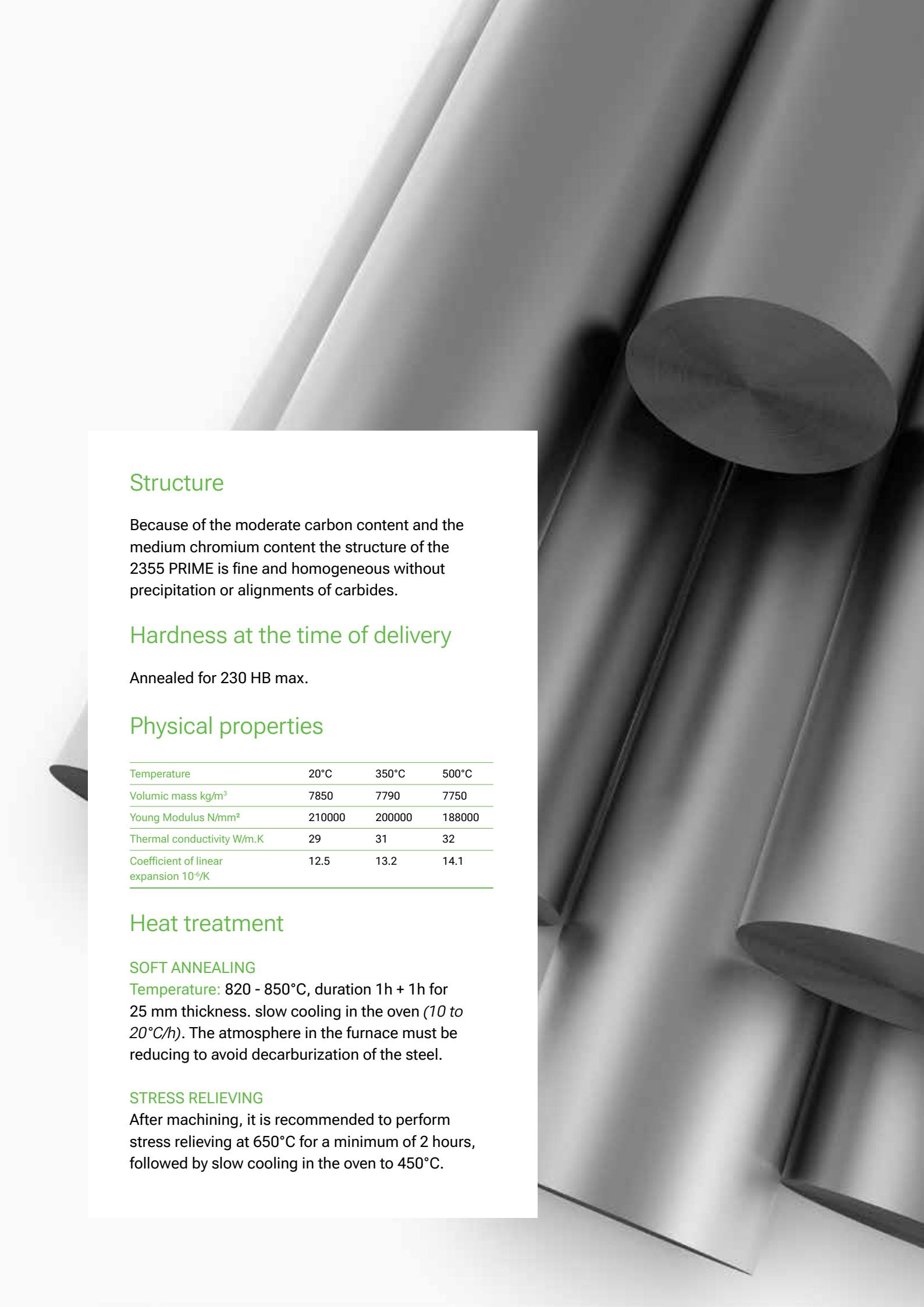
- Very good toughness
- Very good shock resistance
- Good cutting properties
- Good wear resistance

Chemical composition *(typical)*

C	Mn	Si	P	S	Cr	Mo	V
0.50	0.70	0.50	≤ 0.03	≤ 0.005	3.25	1.40	0.25

Designation

Werkstoff Nr	ISO	China GB	JIS Japan	UK	AISI USA	Russia Gost	AFNOR	Other / Special
1.2355 *(≈ 1.2357)*	50CrMoV13-15	5Cr3Mn1SiMo1V	SKD7	BH10	S7	-	-	-



Structure

Because of the moderate carbon content and the medium chromium content the structure of the 2355 PRIME is fine and homogeneous without precipitation or alignments of carbides.

Hardness at the time of delivery

Annealed for 230 HB max.

Physical properties

Temperature	20°C	350°C	500°C
Volumic mass kg/m^3	7850	7790	7750
Young Modulus N/mm²	210000	200000	188000
Thermal conductivity W/m.K	29	31	32
Coefficient of linear expansion 10^{-6}/K	12.5	13.2	14.1

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 2 steps.

- 1st preheating step:
  temperature: 450°C time: 30 s/mm of thickness
- 2nd preheating step:
  temperature: 800°C time: 30 s/mm of thickness

Recommended austenitizing temperature: 930 - 960°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.
The hardness after quenching is 59 - 61 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 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.

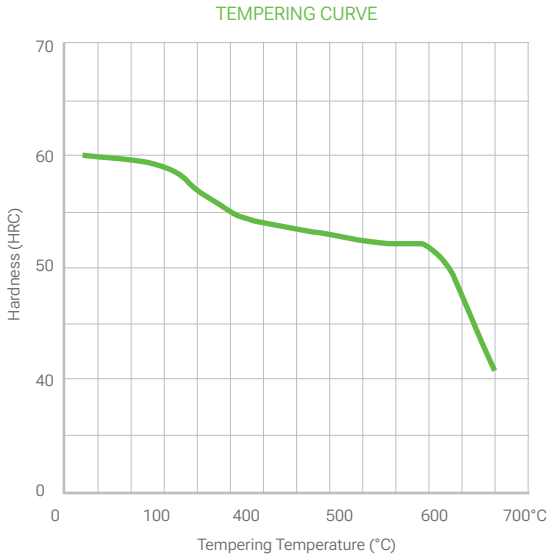
This treatment is optional for common applications.

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 optimal hardness for most of the uses is in the range 55 to 58 HRC with tempering temperatures in the range 150 to 250°C.



Surface treatment

NITRIDING

2355 PRIME is not recommended to be nitride since the nitriding temperature of the 2355 PRIME is quite low.

PVD, CVD

2355 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

2355 PRIME is perfectly suitable for polishing in the treated state and can be used for applications requiring a sufficient level of polish for translucent - transparent parts *(Rt ≤ 20 µm, CNOMO level 2, Rugotest N7).*

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.

Surface hardening

The surface of the 2355 PRIME can be hardened by induction, laser or torch heating.

By induction it is typically possible to achieve a surface hardness of the order of 62 HRC at a depth of 2 mm *(1 mm by laser).* This hardening must be followed by a low-temperature tempering to release the stresses induced by the treatment and to adjust the hardness.

By using an oxyacetylene torch with heating to 1000°C followed by air quenching, it is quite possible to obtain a surface hardness of 60 to 62 HRC.

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	130 - 170	170 - 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	

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 2355 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

2355 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 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 polishing to completely remove the white layer formed during the discharge machining process.

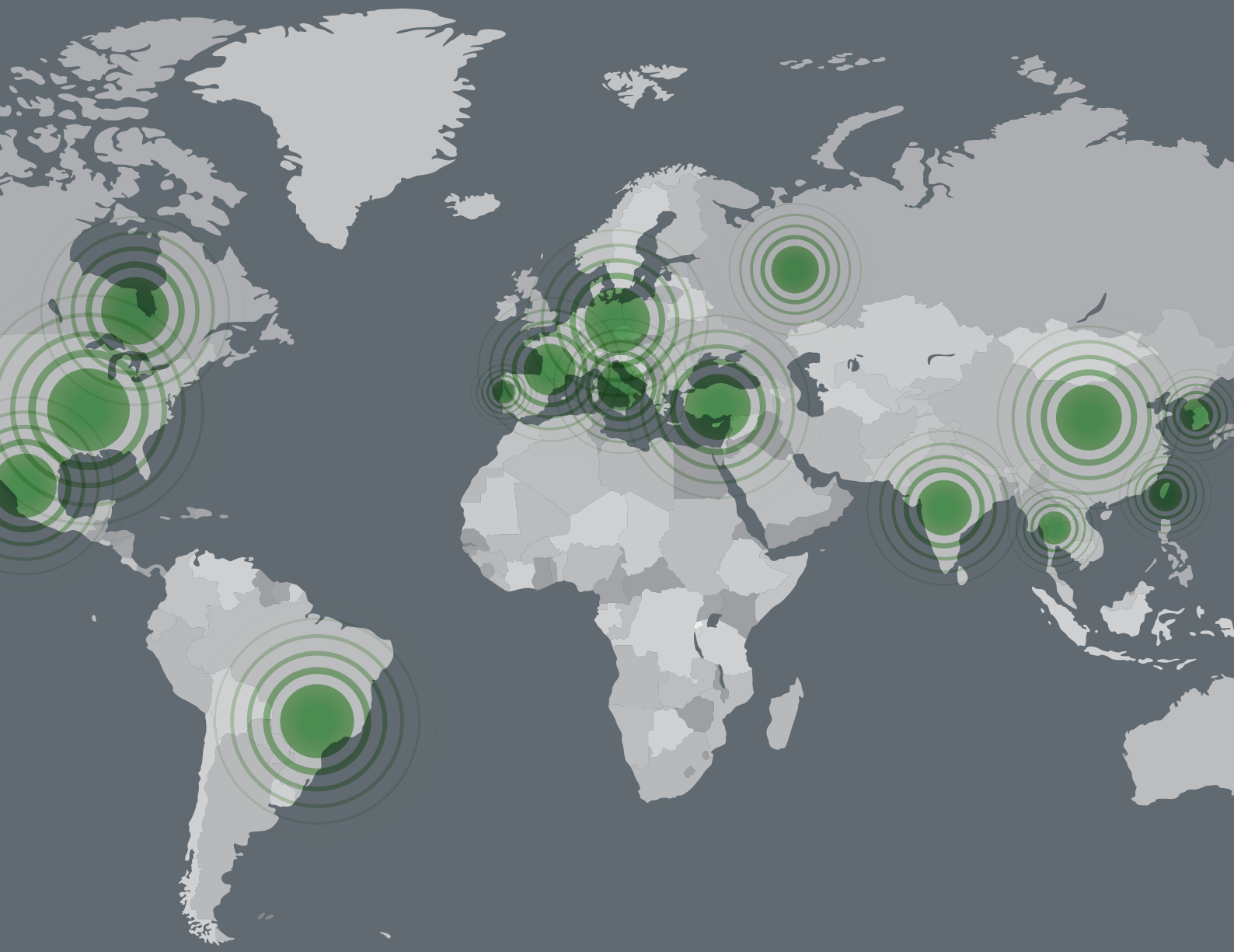
Welding

2355 PRIME could be welded either in the annealed condition *(better)* or in the heat treated condition.

- Method: TIG *(pure Ar protection)*
- Feeder wire: UTP A696
- 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 250°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).*



TG Steels

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