



TG Steels

2358
PRIME

High toughness cold work tool steel for forming and heavy blanking

2358 PRIME;

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

Applications

2358 PRIME can be used for car body dies, forming dies, deep drawing dies, blanking and forming segments and also in segmented molds.

2358 PRIME is suitable for fast die making.

2358 PRIME can be used for punches with heavy or complex geometry.

2358 PRIME can be used for shearing blades, cutting blades and tread rolls.

2358 PRIME is the ideal alternative for high carbon steels with lower toughness such as 2080 PRIME.

Designation

| Werkstoff Nr | ISO | China GB | JIS Japan | UK | AISI USA | Russia Gost | AFNOR | Other / Special |
|--------------|-------------|----------|-----------|----|----------|-------------|-------|-----------------|
| 1.2358 | 60CrMoV18-5 | - | - | - | - | - | - | - |

and 2379 PRIME and also when weldability and polishability associated with a high hardness are required.

Main properties

- Good through-hardenability
- Very good surface hardening
- High toughness
- High wear resistance

Chemical composition (*typical*)

| C | Mn | Si | P | S | Cr | Mo | V |
|------|------|------|--------|---------|------|------|------|
| 0.60 | 0.80 | 0.35 | ≤ 0.03 | ≤ 0.005 | 4.50 | 0.50 | 0.25 |

Structure

Because of the moderate carbon content and the medium chromium content the structure of the 2358 PRIME is fine and homogeneous without precipitation or alignments of carbides.

Hardness at the time of delivery

Annealed for 240 HB max.

Physical properties

| | | | |
|---|--------|--------|--------|
| Temperature | 20°C | 350°C | 500°C |
| Volumic mass kg/m ³ | 7800 | 7750 | 7700 |
| Young Modulus N/mm ² | 210000 | 200000 | 188000 |
| Thermal conductivity W/m.K | 20 | 25 | 26 |
| Coefficient of linear expansion 10 ⁻⁶ /K | 11.5 | 11.9 | 13.5 |



Heat treatment

SOFT ANNEALING

Temperature: 820 - 850°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 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 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: 950 - 980°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.

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 ultrafine carbides improving a lot the wear resistance without modification of the toughness. This treatment is optional for common applications.

QUENCHING MEDIUM

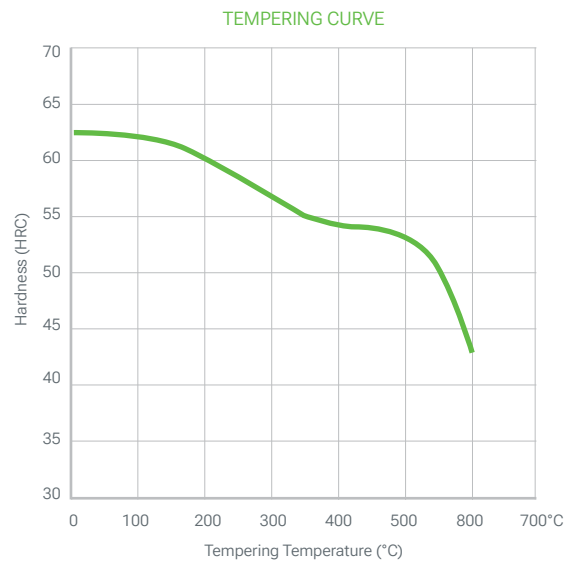
Oil at 80°C, vacuum (*pressure > 6 bars*), salt bath 500 - 550°C.

To ensure good toughness, treatment with oil or salt

bath is preferable. After quenching the hardness is 60 - 62 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*).



Surface treatment

NITRIDING

2358 PRIME is not recommended to be nitride since the nitriding temperature of the 2358 PRIME is quite low.

PVD, CVD

2358 PRIME 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

2358 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 ($R_t \leq 20 \mu\text{m}$, 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 2358 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 | |

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 2358 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

2358 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.

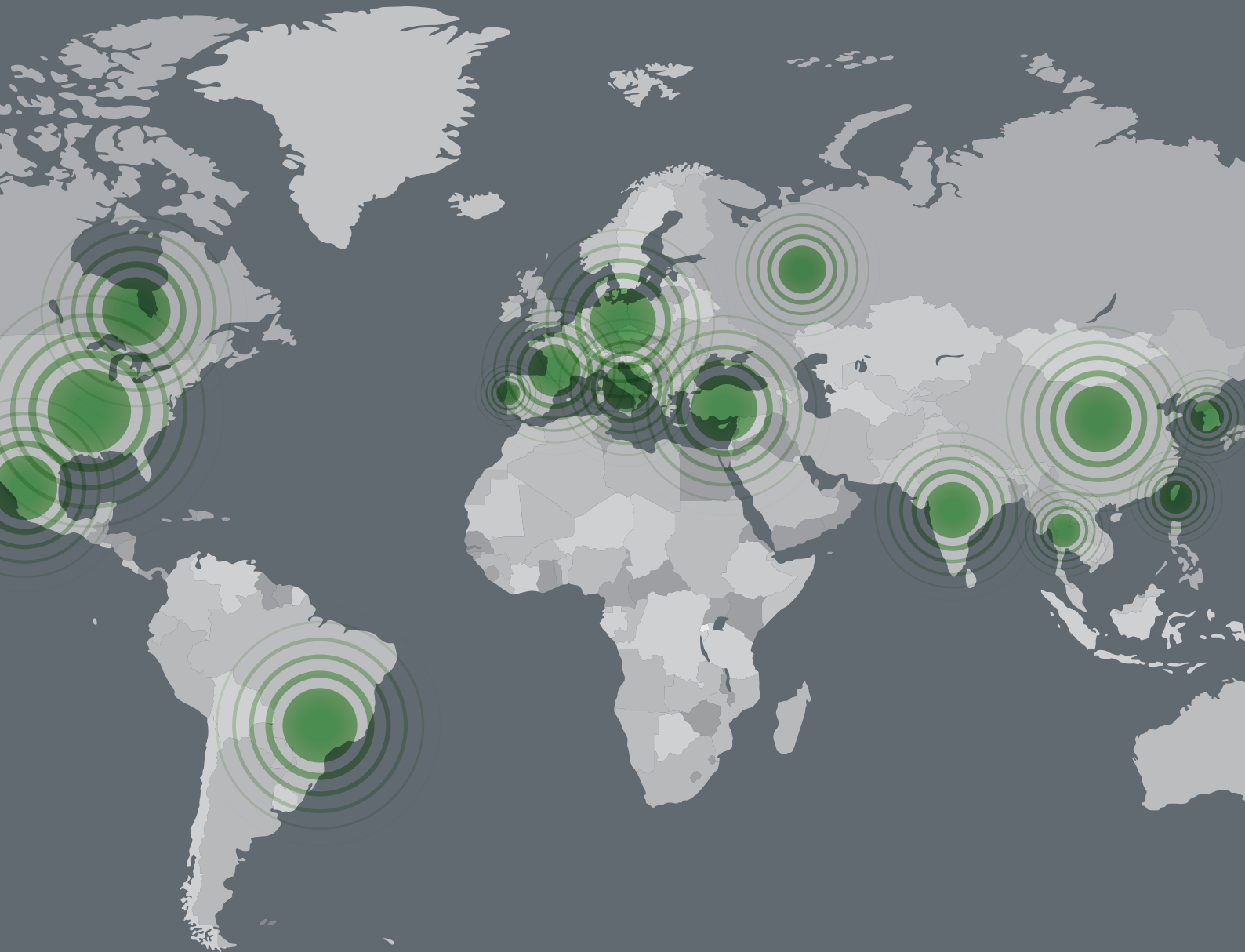
Welding

2358 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 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: 650°C, duration 1h + 1h for 25 mm of thickness. slow cooling in the furnace (*10 to 20°C/h*)



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