Technical Data Sheet
UGIDRILL 13

Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	P	S	N
0,17 - 0,20	≤ 1,0	≤ 1,0	1,0 – 2,0	12,5 – 13,5	1,8 - 2,2	≤ 0.04	< 0,01	0,05 - 0,10

12-02-2023 – REV 00

General presentation

UGIDRILL 13 is a martensitic stainless steel with a high molybdenum content and containing nickel. It offers a good compromise between corrosion resistance and hardness, the maximum value of which can exceed 550 HV after hardening. It also has a good aptitude for cold processing after softening.

UGIDRILL 13 is a stainless steel perfectly suited for manufacturing self-drilling screws hardened by quenching and tempering at low temperature on cold-formed parts.

Designation

Material designation

Europe		USA	Japan –	World – ISO
4057Mo	X18CrMoNi13-2-1		NSSC 550	

Microstructure

The microstructure of UGIDRILL 13 in quenched and tempered condition is predominantly martensitic

Microstructure of UGIDRILL 13 in +QT condition

Mechanical properties

Condition	Yield stress	Tensile strength	Elongation	Reduction of Area
	Rp0,2% (MPa)	Rm (MPa)	A (%)	Z (%)
Wire rod, according to annealing T°	550 - 620	800 - 900	15 - 30	60 - 70
Drawn wire in +QT condition (1050 / 200°C)	1180	1750	10	40
Bars Ø ≥ 20 mm in +QT condition (1050 / 200°C)	1300	1790	15	

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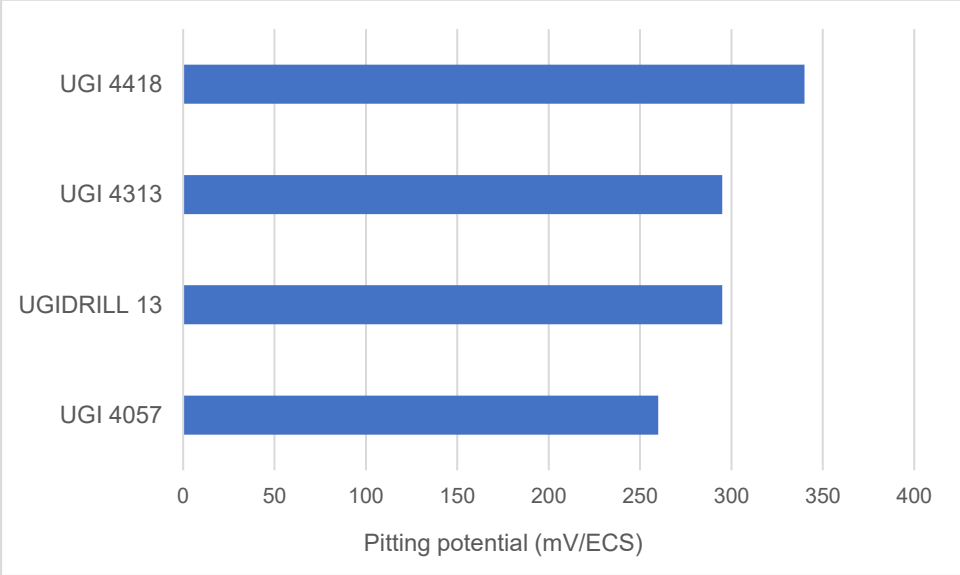
Physical properties

Temperature (°C)	Density	Elastic modulus	Thermal conductivity	Expansion coefficient From 20 to 100°C	Electrical resistivity
	(kg/dm³)	(GPa)	(W/m.K)	(10^{-6}·K^{-1})	(µΩ.mm)
20	7,75	194	30	11,5	0.72

Corrosion resistance

UGIDRILLL13 has a good resistance to corrosion in most standard natural environments, due to its high molybdenum content and its very low sulfur content. Its low chromium content does not allow it to be used in the most aggressive environments such as seawater or in mineral acid manufacturing processes.
Pitting potential measurements were carried out in accordance with the ISO 15158 operating standard; the figure below shows a comparison with martensitic grades with 12.5% chromium, such as 1.4313, and 15% chromium, such as 1.4057 and 1.4418.



Comparison of pitting potentials with other martensitic stainless grades

UGIDRILL 13 has better resistance to localized pitting corrosion than 1.4057, due to its lower sulfur and higher molybdenum content.
The salt spray test was carried out according to the ISO 9227 operating standard (NaCl 5% by weight; 35°C; pH6.6); with a surface machined and then mechanically polished to have a low roughness (Ra < 0.2 µm), good resistance can be obtained: 1000 hours without appearance of red rust. Moreover, on finished products such as screw heads, durability of 3000 hours without the appearance of red rust has been measured. The surface condition of the tested parts is a very influential parameter in this type of test.

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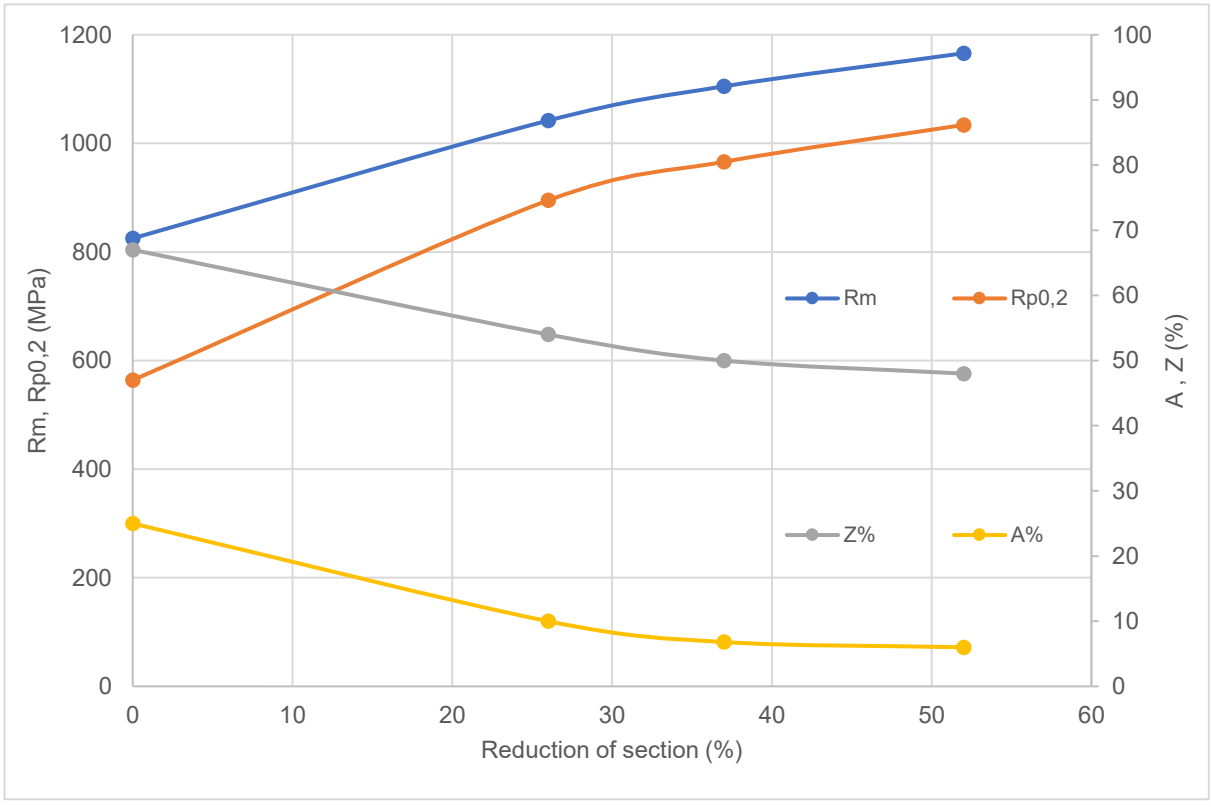
Hot transformation

The incipient melting temperature of the UGIDRILL 13 grade is at temperatures above 1350°C. The grade has a correct forgeability in the temperature range of 950°C to 1220°C. It is recommended to heat between 1180°C-1220°C and to remain above 950°C during hot forming, followed by air cooling. After hot transformation, a softening heat treatment is recommended.
Finally, the high temperature flow stress of UGIDRILL 13 is close to that of grade EN 1.4057 between 900 and 1300°C.

Cold transformation

The curves below show the evolution of the tensile strength (Rm), the yield strength (Rp0.2%), the elongation (A) and the striction (Z) as a function of the reduction rate during the drawing operation from a wire rod of 5.5 mm diameter having undergone an annealing.



Hardening curves of UGIDRILL 13 annealed

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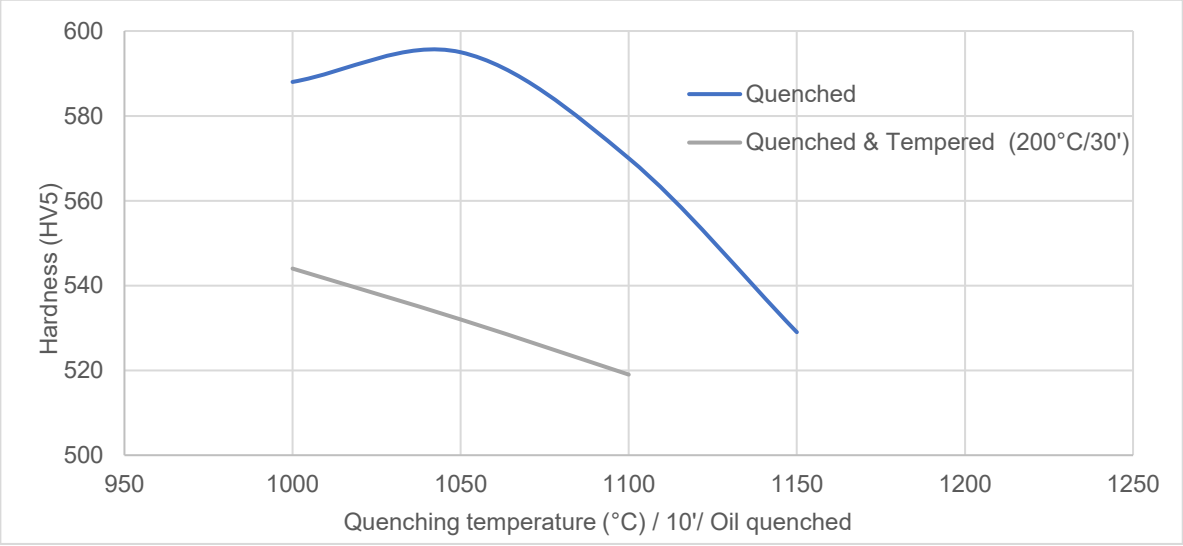
Heat treatment

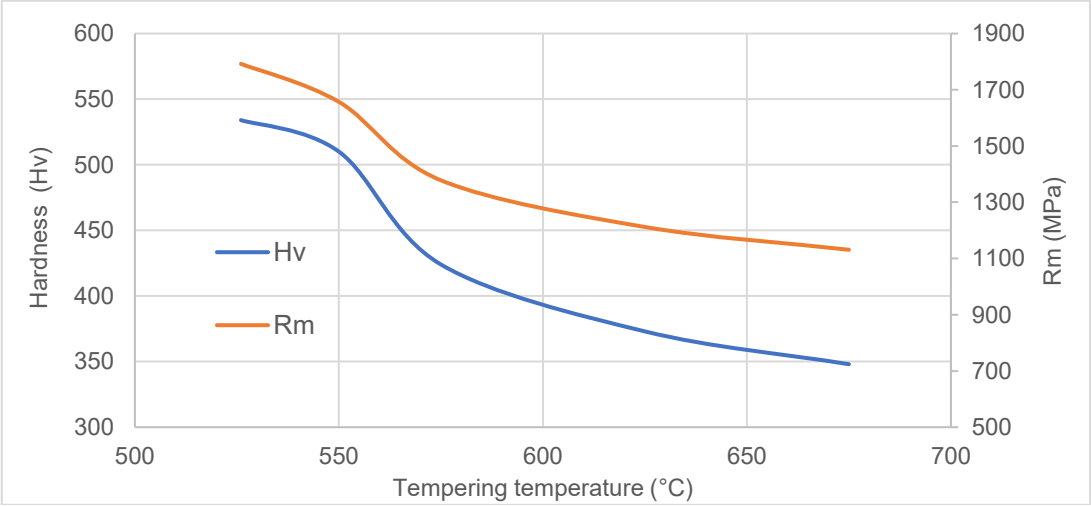
— For maximum softening, the grade must be treated between 750 and 880°C with holding for several hours followed by very slow cooling. This makes it possible to obtain hardness values between 220 and 290 HV depending on the needs of the application.

— For maximum hardening, UGIDRILL 13 is best quenched at 1050°C in oil or air.

— Depending on the desired hardness, tempering can be performed at different temperatures. In the following figures, the hardening and tempering curves show the accessible hardness levels as a function of the hardening and tempering temperature.



Hardening curves of the UGIDRILL 13



Tempering curves of UGIDRILL 13 (bars Ø ≥ 20 mm)

Machinability

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— The machinability of UGIDRILL13 is close to that of a UGIMA® 4057 without matching it.
— The absence of UGIMA® oxides and a significantly lower S, and therefore sulfide, content on UGIDRILL13 has a direct impact on the grade's chip breaking. The difference between the two grades is however limited by the presence of molybdenum up to about 2% which increases the work hardenability of the chips during formation and therefore their ability to fragment.
— On the other hand, in terms of productivity at identical tool wear, UGIDRILL13 is very clearly inferior to UGIMA® 4057. This difference, which depends both on cutting operations, tools and cutting conditions, is about - 20 to - 25%.
— Of course, the cutting conditions are to be adapted to the delivery condition and the level of mechanical characteristics of the bars to be machined. The higher the hardness, the more it will be appropriate to reduce the feed rate to limit the efforts on the tool, while guaranteeing a good chip splitting (especially in operations with confined chips such as drilling). It is important to avoid reducing cutting speeds too much to avoid increasing the specific cutting forces (pressure on the tool); on the contrary, it is necessary to favor cutting speeds that are high enough to heat the metal at the tool tip and thus soften it.

Surface treatment

- To obtain good corrosion resistance, the surface must be free of chromium and iron oxides or ferrous contamination.
- Pickling with hydrochloric acid or sulfuric acid followed by rinsing the parts with water can be used (for precise conditions: please contact us).
- After pickling, we recommend passivation of the parts with nitric acid; in the case of minor ferrous pollution, passivation alone is sufficient (for precise conditions: contact us).
- In all these cases, using the baths at room temperature will require treatment times of several tens of minutes.

Available products

Product	Shape	Surface finish	Tolerance	Dimensions
Bar	Round	Hot rolled	12 – 13	20 – 75 mm
		Turned and polished	9 – 11	20 – 75 mm
		Drawn	8 – 9	3 – 32 mm
Wire rod	Round	Pickeled		5,0 – 32 mm
Drawn wire	Round			1,0 - 16.0 mm

Other sizes: contact us

Applications

— Self-drilling screws
— Applications requiring high mechanical properties and good corrosion resistance.