

4418

Technical Data Sheet

SCHMOLZ + BICKENBACH
Providing special steel solutions



Chemistry

Typical Analysis %	C	Si	Mn	P	S	Cr
Min.						15.00
Max.	0.06	0.70	1.50	0.040	0.030	17.00
	Ni	Mo	N			
Min.	4.00	0.88	0.020			
Max.	6.00	1.50				

Description

- **Ugitech's 4418** high strength, low carbon martensitic/austenitic stainless steel with 16% Cr, 5% Ni and 1% Mo.
- **Ugitech 4418** is specifically designed to combine high mechanical strength and toughness, with improved corrosion resistance compared to the traditional martensitic and martensitic precipitation grades. This grade exhibits very good erosion-corrosion resistance or cavitation encountered in hydraulic or flow applications as well as excellent properties in elevated and cryogenic temperatures.
- **Ugitech 4418** is usually supplied in two heat treat or temper conditions—QT760 and QT900. It is not really used in the annealed condition.
- **Ugitech's 4418** delivers heat to heat consistency that is unsurpassed in the industry. Once an optimum set-up has been established, machinists can take advantage of increased machine efficiency rates and the ability to run "lights out production". Also, crashes due to hard spots are a thing of the past. **4418** can provide a significant competitive advantage for shops that demand efficient, high volume and reliable production.

Applications

- Valves
- Shafting
- Bolting
- Oil and Gas Parts
- Automotive
- Marine
- Highly stressed fittings and pumps
- Engineered parts for refrigeration/Cryogenics
- Valve Gate components
- Pins

Classification

Martensitic hardenable stainless steel.

Available Forms

Cold drawn bars, Turned bars, Ground bars

Please inquire for additional information on available forms.

Characteristics

- EN 10088-3
1.4418
X4CrNiMo16-5-1
- ASTM A484

Mechanical Properties (Typical)

QT900

Cold Drawn Bars (1" and under)	
Tensile Strength	135-165 ksi (950—1150 MPa)
Yield Strength(0.2)	105 ksi (750 MPa) Minimum
Elongation	16% Minimum
Reduction of Area	45% Minimum
Hardness	HRC 30 - 38
Turned Bars (Over 1")	
Tensile Strength	130 - 160 ksi (900-1100 MPa)
Yield Strength(0.2)	105 ksi (750 MPa) Minimum
Elongation	16% Minimum
Reduction of Area	45% Minimum
Hardness	HRC 28- 36

Elevated Temperature Tension Properties

(HR/Quench & Tempered-QT900/Turned)

Temperature (°C)	Tensile Strength KSI (Mpa)	Yield Strength KSI (Mpa)	Elongation (%)
20	144 (993)	124 (854)	20
100	135 (930)	123 (850)	20
350	135 (930)	116 (800)	12

Cryogenic Impact Strength

HR/Quench & Tempered-QT900/Turned)

Temperature (°C)	Energy-KV (J)
20	130
0	120
-20	120
-40	100

Typical Physical Properties (Typical)

Density: 0.278 lbs/in³ (7.7 g/cm³)

Round bar weight per ft (lbs): 10.48 X (1/2 bar diameter in inches)²

Hexagonal bar weight per ft (lbs): 2.89 X (bar diameter in inches)²

Square bar weight per ft (lbs): 3.34 X (bar diameter in inches)²

Mean Coefficient of Linear Expansion: 68-392 °F (20-200 °C) = 6.0 x 10⁻⁶ in/in/°F (10.8 x 10⁻⁶ cm/cm/°C)

Modulus of Elasticity in Tension: 29.0 x 10⁶ psi (200,000 MPa)

Thermal Conductivity: 8.6 Btu/ft/hr/°F (15.0 W/m/°C) @68°F (20°C)

General Note

Note: All statements regarding the properties or utilization of the materials or products mentioned are for the purposes of description only. Guarantees regarding the existence of certain properties or a certain utilization are only valid if agreed upon in writing.

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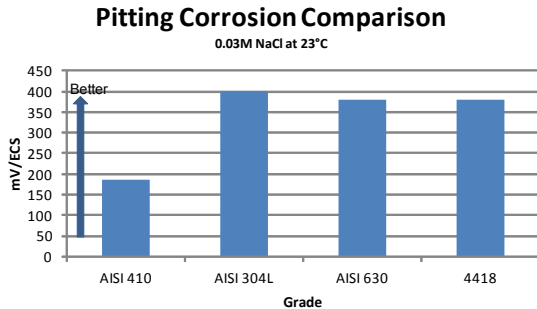


Corrosion Resistance

Ugitech 4418 has similar corrosion behavior as AISI 304. Its high percentage of nickel, chromium, and molybdenum and its low carbon give this grade good atmospheric corrosion resistance. The salt marine atmosphere resistance is equivalent to AISI 630.

Pitting Corrosion

The pitting corrosion of **4418** is equivalent to AISI 304L (with 0.02% sulfur) and AISI 630 when pitting potentials were measured in a 0.02M NaCl solution at 23° C.



The pitting resistance of 4418 is equivalent to AISI 630 and 304L with 0.02% S.

Intergranular Corrosion

The structure of **4418** makes this grade insensitive to Intergranular corrosion.

Stress Corrosion

Ugitech 4418 resists stress corrosion cracking for more than 720 hours at ambient temperature when exposed to a 4.5 pH solution with 10% H₂S. Test conditions used—NACE TM0177 for AISI 630 grades.

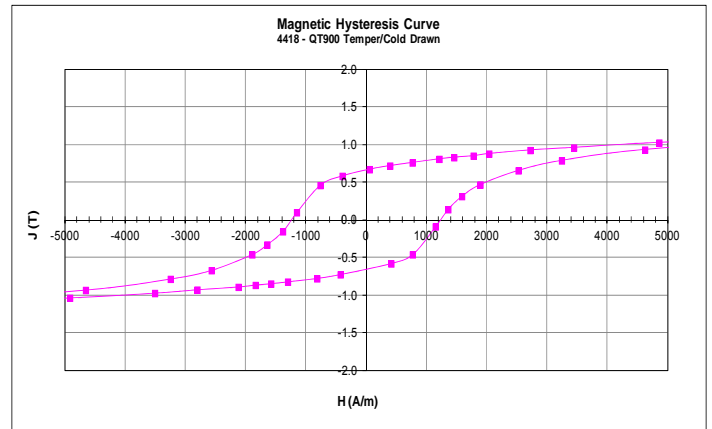
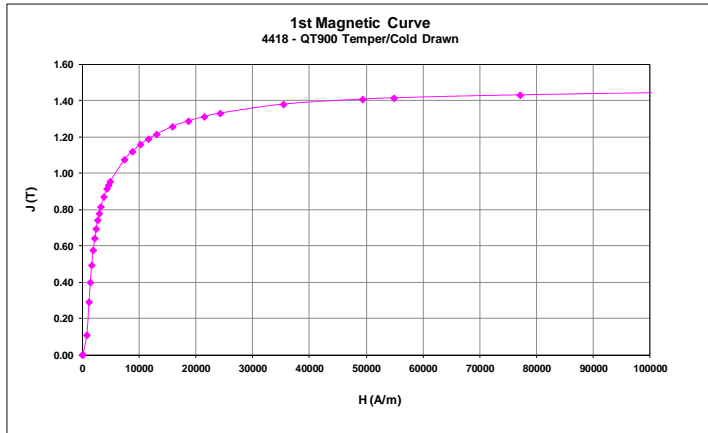
Environment	Behavior
Nitric Acid	●●●○
Humidity	●●●●
Phosphoric Acid	○RESTRICTED○
NaCl (Saline Mist)	●●●○
Sulfuric Acid	○RESTRICTED○
Seawater	○RESTRICTED○
Acetic Acid	●●○○
Petroleum	○RESTRICTED○
Sodium Carbonate	●●○○

It is important to note, maintaining corrosion resistance at weld zones will require cleaning and passivation.

Magnetic and Electrical Properties

Typical Magnetic Properties:

Magnetic Saturation - 13,000 to 15,000 G (1.3 to 1.5 T)



Magnetic curves for 4418, tempered 560° C and cold drawn.

Electrical Resistivity

Solution treated: 32 μΩ - in (800 μΩ - mm) @ 68°F (20°C)

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Hardenability (Cold Working)

4418 can be cold formed, however this grade calls for special care because of the high strength and high work hardening rate of the grade. Tools must be very rigid and high powered. **4418** may need intermediate annealing after extreme cold deformation.

Tempering is recommended after cold working > 5%. Tempering or full treating should be done after extensive forming.

Welding

4418 can be readily welded with conventional arc welding methods (GTAW, SMAW, etc) and by most other welding processes (spot, seam, laser, etc). **4418** is easier to weld than most martensitic stainless steels due to its nickel and low carbon content. The low carbon martensite with the finely dispersed residual austenite yields an excellent HAZ toughness in the as welded condition. Plus the welds in **4418** are only slightly susceptible to cracking. It is generally not necessary to preheat the parts prior to welding, but can vary with application. Preheating to 212°F - 395°F (100°C - 200°C) is suggested for very thick section or when there is a stress concentration at the weld zone after cooling.

A 4418 filler metal can be used when the properties of the weld metal must have the same mechanical properties as the base metal. A post weld heat treatment at 1075°F - 1110°F (580°C - 600°C) is recommended. Austenitic weld metal, such as A316LM or A317LT can be used when the weld metal does not need to be at the same mechanical properties. Post weld heat treatment is not necessary.

MIG Welding - A slightly oxide shielding gas such as Ar + 1-2% CO₂ can be chosen to avoid a high oxygen content in the weld metal and ensure good impact properties.

Machinability

The key to **Ugitech's 4418** lies in the production process. Careful control of alloy content and distribution of metallurgical phases results in better tool life, improved surface finish, and excellent chip control across a wide range of cutting conditions.

The table on the following page, in conjunction with the Machinability guidelines, provides a useful guide for initial set-up. To realize the optimal potential of either grade, contact your local application engineer. A review of your current set-up will allow specific recommendations adapted to 4418 in any condition.

All stainless steels are not created equal! Unlock the potential of 4418 as your competitive advantage.

Forging (Hot Working)

The following conditions are recommended for forging 4418

- Heat between 2100°F - 2155°F (1150°C - 1180°C)
- Forge in the range of 1650°F - 2155°F (900°C - 1180°C)
- After forging, cool in air.

It is recommended 4418 be fully heat treated after forging.

The forging behavior of 4418 is similar to AISI 304.

Heat Treatment

4418 can be heat treated as follows:

- Austenitize - Heat to 1740°F - 1920°F (950°C - 1050°C)
- Quench in oil (air quenching allowed for thin cross-sections)
- **QT900** - 1090°F - 1145°F (590°C - 620°C) for 8 hours followed by oil or air cooling. Tempering can follow two 4 hour cycles at temperature, each followed by an oil or air cool.

Notes:

- 1) Tempering should be performed immediately after the quenching to avoid quench cracks.
- 2) To avoid embrittlement, heat and cool through the 785°F - 1022°F (420°C - 550°C) temperature range as quickly as possible.

Machinability Table Guidelines

1. The machining table values are initial suggestions and can vary depending on machine and cutting conditions.
2. The use of coated carbide tooling is highly suggested for this grade.
3. Tooling grades in parenthesis denotes alternate tooling.
4. When using coated tools, speeds and feeds should be increased by 10-15%.
5. Drill speeds were developed for 140° angle drills with a split point or equivalent.
6. Drilling conditions are valid for hole depths up to 4 times drill diameter
7. Speeds and feeds given above apply to highly rigid equipment. Reductions may be necessary on cross-slide operations or less rigid equipment.
8. The use of C5 or better carbides is highly suggested. Reduce speeds by 25-40% when using C1-C3 carbides
9. The use of inserts with positive rake angles are suggested to reduce cutting forces for low powered, multispindle, or older machinery (i.e.-CCMT, VBMT, DCMT)
10. Carbide insert grades found to work well with **Ugitech's 4418** are SECO TP2500, and Sandvik's GC2025 or GC1125

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Machining Table

Ugitech 4418 - QT900 Condition

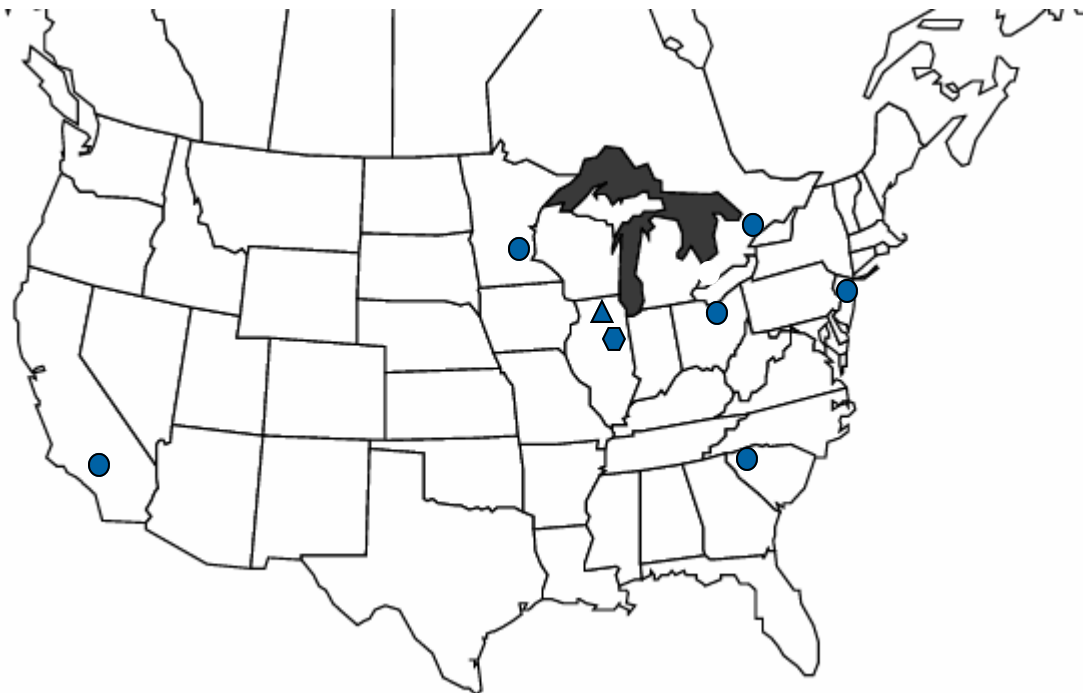
Machining Operation	Metallurgical Condition	Depth of cut Or width (inches)	HSS Tooling			Coated Carbide Tools		
			Cutting Speed SFPM	Feed (ipr)	Type of Tool	Cutting Speed SFPM	Feed (ipr)	Type of Tool
Turning	QT900/ Cold Drawn	0.04 0.08 0.12	40 - 70 40 - 65 35 - 75	0.004 - 0.010 0.004 - 0.012 0.005 - 0.015	M42 (T15)	295 - 660 195 - 595 160 - 430	0.004 - 0.010 0.004 - 0.012 0.005 - 0.015	C6/C7 C6 C5/C6
	QT900	0.04 0.08 0.12	50 - 85 45 - 70 40 - 65	0.004 - 0.010 0.005 - 0.012 0.008 - 0.025		330 - 690 195 - 595 165 - 430	0.004 - 0.010 0.007 - 0.012 0.010 - 0.025	C6/C7 C6 C5/C6
Milling ¹	QT900/ Cold Drawn	0.04 0.08 0.12	40 - 70 40 - 65 35 - 75	0.004 - 0.010 0.004 - 0.012 0.005 - 0.015	M42 (T15)	295 - 660 195 - 595 160 - 430	0.004 - 0.010 0.004 - 0.012 0.005 - 0.015	C6/C7 C6 C5/C6
	QT900	0.04 0.08 0.12	50 - 85 45 - 70 40 - 65	0.004 - 0.010 0.005 - 0.012 0.008 - 0.025		330 - 690 195 - 595 165 - 430	0.004 - 0.010 0.007 - 0.012 0.010 - 0.025	C6/C7 C6 C5/C6
Forming/ Grooving	QT900/ Cold Drawn	0.06 0.25 0.50	40 - 75 40 - 70 35 - 65	0.002 - 0.004 0.004 - 0.006 0.003 - 0.005	M42 (T15)	235 - 395 175 - 330 120 - 290	0.002 - 0.004 0.004 - 0.006 0.003 - 0.005	C6/C7 C6 C5/C6
	QT900	0.06 0.25 0.50	60 - 90 45 - 80 40 - 70	0.003 - 0.005 0.004 - 0.006 0.003 - 0.005		245 - 425 190 - 360 145 - 320	0.003 - 0.005 0.004 - 0.006 0.003 - 0.005	C6/C7 C6 C5/C6
Cut-off or Part-off	QT900/ Cold Drawn	0.04 0.08 0.12	35 - 75 35 - 70 30 - 60	0.001 - 0.004 0.0015 - 0.005 0.002 - 0.005	M42 (T15)	205 - 380 155 - 320 100 - 280	0.002 - 0.004 0.004 - 0.006 0.003 - 0.005	C6 C6 C6
	QT900	0.08 0.12 0.25	55 - 90 40 - 80 35 - 70	0.0015 - 0.004 0.002 - 0.004 0.003 - 0.005		225 - 410 175 - 350 130 - 310	0.003 - 0.005 0.004 - 0.006 0.003 - 0.005	C6 C6 C6
Threading	All	<20 Threads ≥20 Threads	15 - 30 25 - 45		M42 (T15)	45 - 110 60 - 130		C2/C5
Drilling ²	All	0.0625	30 - 60	0.001 - 0.002	T15 (TiN Coated)	115 - 200	0.001 - 0.002	C5 - C6 Or C3 TiN Coated
		0.125	30 - 70	0.0015 - 0.002		115 - 600	0.0015 - 0.002	
		0.25	40 - 80	0.0015 - 0.003		130 - 630	0.0015 - 0.003	
		0.5	50 - 90	0.0015 - 0.003		95 - 690	0.0015 - 0.003	
		0.75	55 - 100	0.002 - 0.004		95 - 725	0.002 - 0.004	
Boring ³	QT900/ Cold Drawn	0.04 0.08 0.12				275 - 510 175 - 425 140 - 330	0.003 - 0.008 0.004 - 0.010 0.004 - 0.012	C7 C6 C5
	QT900	0.04 0.08 0.12				310 - 390 195 - 360 165 - 295	0.003 - 0.008 0.004 - 0.010 0.004 - 0.012	C7 C6 C5
Reaming	All	0.0625	30 - 60	0.002 - 0.005	M42 (T15)	115 - 200	0.002 - 0.006	C5 - C6 Or C3 TiN Coated
		0.125	30 - 70	0.003 - 0.006		115 - 395	0.003 - 0.008	
		0.25	40 - 80	0.003 - 0.007		130 - 460	0.003 - 0.008	
		0.5	50 - 90	0.003 - 0.007		95 - 460	0.003 - 0.008	
		0.75	55 - 100	0.002 - 0.006		95 - 595	0.002 - 0.007	
Tapping	All	All	20 - 40		M2-M7 TiN Coated			

Notes:

- 1) Milling feed is inches per tooth using wither HSS of carbide mills
- 2) For drill depths ≤ times diameter
- 3) For setups with length of boring bar overhang to boring bar diameter ≤ 4
- 4) Feeds and speeds for cam and CNC operated machines.



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