Machining Operations	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
Cut-off or Part-Off	Cold Drawn	0.04 0.08 0.12	115 - 130 105 - 125 80 - 100	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003	M41 (T15)	220 - 430 205 - 395 190 - 365	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003	C6 C6 C6
	Annealed	0.04 0.12 0.25	110 - 135 95 - 115 80 - 100	0.002 - 0.003 0.002 - 0.003 0.002 - 0.004		234 - 485 220 - 450 205 - 415	0.002 - 0.003 0.002 - 0.003 0.003 - 0.004	C6 C6 C6
Drilling	All	0.063 0.125 0.250 0.500 0.750	55 - 80	0.0005 - 0.002 0.002 - 0.004 0.003 - 0.006 0.005 - 0.009 0.018 - 0.012	M2	145 - 300	0.0005 - 0.002 0.002 - 0.004 0.002 - 0.005 0.004 - 0.006 0.006 - 0.009	C5 - C6 or C1 - C2 TiN coated
Insert Drilling	All	0.50 - 0.75 0.75 - 1.00 1.00 - 2.50				130 - 500 180 - 500 200 - 520	0.0015 - 0.004 0.004 - 0.005 0.002 - 0.006	C7 C6 C5
Reaming	All	0.062 0.125 0.250 0.500 0.750 1.000	55 - 80	0.002 - 0.005 0.004 - 0.008 0.007 - 0.016 0.015 - 0.025 0.015 - 0.030 0.020 - 0.030	M2 (M42)	145 - 300	0.002 - 0.004 0.004 - 0.008 0.007 - 0.016 0.015 - 0.025 0.015 - 0.030 0.020 - 0.030	C5 - C6 or C3 TiN coated
Tapping	All	All	35 - 55		M2 - M7 TiN Coated			

The machining data presented within all tables and graphs represent typical working ranges based on field and laboratory research. Results will vary based on parts to be produced, equipment and tooling utilized, personnel operating the equipment and customer part specifications.

For additional information, contact Technical Support at the Corporate Office: (800) 323-1233.

1. The table values are initial suggestions and can vary depending on machine and cutting conditions.
2. The use of coated tools increases the tool life by 20-50 % using the same cutting parameters, or it increases the cutting conditions (speed) by 10 % to 15 % using the same tool wear.
3. Tooling grades in parenthesis denotes alternate tool material choice.
4. Drill speeds were developed using 118° including angle drills. Increase speeds 10-20 % with the use of 140° angle drills.
5. Drill cutting conditions are valid for hole depths up to 4 times diameter.
6. Machining speeds and feeds apply to highly rigid equipment. Reductions may be necessary on cross slide operations or less rigid equipment.
7. When using C1, C2 or C3 carbides, reduce speeds by 25 - 40 %.
8. Use aggressive tool chip breaking geometries.

SCHMOLZ + BICKENBACH USA, INC.
Phone 800.323.1233
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Heat Treatment
Phone 800.265.0862

SCHMOLZ + BICKENBACH CANADA, INC.
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www.schmolz-bickenbach.ca

Technical Data Sheet
304/304L UGIMA®

Comparable Standard:

Typical Analysis %	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N
Min.						18.00	8.00			
Max.	0.03	0.75	2.00	0.040	0.030	19.00	10.50	1.00	1.00	0.10

Description

» **304/304L UGIMA®** is the next generation of improved high machinability grades from Ugitech. The UGIMA® grades have redefined high machinability stainless steels, showing improvements over the original UGIMA® technology.

» **304/304L UGIMA®** is identical in every way to the standard 304/304L, except with respect to machinability. UGIMA® is a proprietary manufacturing process, developed by Ugitech, which has resulted in a product that dramatically increases productivity and tool life, and improves the surface finish on all types of machined parts.

» **304/304L UGIMA®** meets all industry specifications for Type 304/304L. **304/304L UGIMA®** delivers heat to heat consistency that is unsurpassed in the industry and that customers have come to expect. **304/304L UGIMA®** can provide a competitive advantage for shops that demand cost competitiveness and reliability. Once an optimum setup has been established, machinists can take advantage of the increased efficiency rates, especially during “lights-out” production.

Classification

General purpose corrosion resistant austenitic stainless steel (300 series). Oxidation resistance in continuous service to 1600 °F (870 °C), and intermittent service to 1450 °F (790 °C).

Characteristics

» AISI Types 304/304L
» UNS S30400/S30403
» ASTM A182L
» ASTM A193 Class 1
» ASTM A276L
» ASTM A314
» ASTM A320 Class 1
» ASTM A479L
» ASTM A484
» ASTM A580-Chemistry L
» ASTM F899
» ASME SA-182 Chemistry
» ASME SA-193 Class 1
» ASME SA-276
» ASME SA-479
» AMS 5639
» AMS 5647
» QQ-S-763 L
» NACE Standard MR0175
» S30400/30403
» EN 10088-3
  » 1.4301/1.4307
  » X5CrNi18-10/ X2CrNi18-9

Applications

» Food Processing Equip.
» Valves & Accessories
» Medical Equipment
» Dairy Equipment
» Machined Shafts
» Architectural Applications
» Fasteners
» Sensor Bodies

Mechanical Properties (Typical)

Bars ≤ 0.500"	
Tensile Strength	90 - 115 ksi (620 - 795 MPa)
Yield Strength (0.2 %)	45 ksi (310 MPa) minimum
Elongation	30 % minimum
Reduction of Area	50 % minimum
Hardness	140 - 241 HB
Bars 0.500" ≤ 0.750"	
Tensile Strength	90 - 115 ksi (620 - 795 MPa)
Yield Strength (0.2 %)	30 ksi (206 MPa) minimum
Elongation	30 % minimum
Reduction of Area	50 % minimum
Hardness	140 - 241 HB
Bars 0.750" ≤ 1"	
Tensile Strength	90 - 125 ksi (620 - 861 MPa)
Yield Strength (0.2 %)	30 ksi (206 MPa) minimum
Elongation	30 % minimum
Reduction of Area	50 % minimum
Hardness	140 - 223 HB
Bars > 1"	
Tensile Strength	75 ksi (517 MPa)
Yield Strength (0.2 %)	30 ksi (206 MPa) minimum
Elongation	30 % minimum
Reduction of Area	50 % minimum
Hardness	140 - 223 HB

Available Forms Cold Drawn

Bars: Turned bars, Ground bars, SMQ™
Shapes: Round, Hexagonal, Octagonal, Square, Wire

SCHMOLZ + BICKENBACH GROUP

SCHMOLZ + BICKENBACH
Providing special steel solutions

Magnetic and Electrical Properties

Magnetic Permeability
Essentially non-magnetic in the annealed condition. Permeability increases upon cold work such as drawing or machining.

Typical Magnetic Permeability:
<1.1 at 10 % cold work.
Electrical Resistivity
29.1 μΩ - in (730 μΩ - mm) @ 68 °F (20 °C)

Typical Physical Properties	
Density	0.285 lbs/in^3 (7.9 g/cm^3)
Round bar weight per ft (lbs)	10.74 X (1/2 bar diameter in inches)^2
Hexagonal bar weight per ft (lbs)	2.96 X (bar diameter in inches)^2
Square bar weight per ft (lbs)	3.42 X (bar diameter in inches)^2
Mean Coefficient of Linear Expansion	68-212 °F (20-100 °C) = 28.8 x 10-6 in/in/ °F (16.0 x 10-6cm/cm/ °C) 68-392 °F (20-200 °C) = 29.7 x 10-6 in/in/ °F (16.5 x 10-6cm/cm/ °C) 68-572 °F (20-300 °C) = 30.6 x 10-6 in/in/ °F (17.0 x 10-6cm/cm/ °C) 68-752 °F (20-400 °C) = 32.4 x 10-6 in/in/ °F (18.0 x 10-6cm/cm/ °C) 68-932 °F (20-500 °C) = 32.4 x 10-6 in/ in/ °F (18.0 x 10-6cm/cm/ °C
Modulus of Elasticity in Tension	68°F (20 °C) - 29.01 x 10^6 psi (200,000 MPa) 212°F (100 °C) - 29.01 x 10^6 psi (200,000 MPa) 392 °F (200 °C) - 20.01 x 10^6 psi (200,000 MPa) 572 °F (300 °C) - 29.01 x 10^6 psi (200,000 MPa) 752°F (400 °C) - 29.01 x 10^6 psi (200,000 MPa) 932 °F (500 °C) - 29.01 x 10^6 psi (200,000 MPa)
Thermal Conductivity @68 °F (20 °C)	8.6 Btu/ft/hr/ °F (15.0 W/m/ °C) @68 °F (20 °C)

Corrosion Resistance

304/304L UGIMA® has excellent overall corrosion resistance. It is highly resistant to corrosion in rural and urban environments—except in the presence of moderate or large concentrations of chlorides or acids—and is used extensively in the food handling and processing industries where ease of cleaning and sterilization are important. **304/304L UGIMA®** maintains its corrosion resistance in natural media such as water, and with certain chemicals such as nitric acid, diluted organic solutions, and strongly oxidizing acids at room temperature. Due to its lower carbon content, **304/304L UGIMA®** is resistant to intergranular corrosion (carbide precipitation) after welding.

The corrosion resistance of a stainless steel depends on many factors related to the composition of the corrosive environment, pH, temperature, velocity, agitation, crevices, deposits, dissimilar metal contact, metallurgical condition, as well as the preparation of the surface.
The table here is for comparative purposes only and illustrates the performance in different environments. Consult your local SCHMOLZ + BICKENBACH USA metallurgist to discuss your application.

Optimum corrosion resistance requires that parts be smooth, and free from surface contamination such as cutting fluid and foreign particles. Under these conditions, parts will become passive in air. Should passivation be required, the following treatment should be followed:

» Solution: 25 % nitric acid at room temperature or at 120 °F (50 °C) for more rapid results.
» Treatment: Immerse for several hours at room temperature, or 25 - 40 minutes at 120 °F (50 °C) followed by a thorough rinsing to remove all residual solution.

Environment	Behavior
Nitric Acid	⬢⬢⬢⬡
Humidity	⬢⬢⬢⬡
Phosphoric Acid	⬢⬢⬡⬡
NaCl (Saline Mist)	⬢⬢⬢⬡
Sulfuric Acid	⬢⬢⬡⬡
Seawater	⬡⬡⬡⬡ Restricted
Acetic Acid	⬢⬢⬡⬡
Petroleum	⬡⬡⬡⬡ Restricted
Sodium Carbonate	⬢⬢⬢⬡

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

Heat Treatment

The heat treatment (annealing) that gives **304/304L UGIMA®** its optimum properties includes heating in the range of 1850 - 2000 °F (1000 - 1100 °C), followed by rapid cooling with forced air or water quenching.

Hardenability (Cold Working)

Not hardenable by heat treatment. Strength and hardness increases upon cold work such as drawing and forming.

Forging (Hot Working)

» Heat in the range of 2125 - 2300 °F (1170 - 1250 °C).
» Minimum forge temperature 1650 °F (900 °C).
» After forging, cool small parts rapidly (quench) in water—anneal large parts.

Welding

304/304L UGIMA® can be readily welded, without preheating, with or without filler metal using all welding methods except gas welding. If filler material is used, AWS E308L (Coated electrodes)/ER308L (manual TIG)/ER308Lsi (TIG or MIG) are recommended. Shielding gases Ar+103 % CO_2 or 1 - 2 % 0_2 are suggested. For welding purposes that provide a weak dilution (i.e. welding with no filler metal, TIG welding, etc...), heat input should be reduced in the order of 10 - 20 % as appropriate. No heat treatment is necessary after welding.

Machinability

The UGIMA® family of grades is the next generation of Ugitech's high machinability alloys. UGIMA® builds on the UGIMA® manufacturing process originally developed by Ugitech. The proprietary manufacturing process transforms the hard abrasive oxides normally present in stainless steels into highly specific oxides that are malleable and soft at machine cutting temperatures. At this point, they melt and coat the tool, providing a lubricious layer that reduces cutting temperature and friction. Coupled with precise control of the manufacturing processes, the UGIMA® alloys provide consistency heat to heat, increased productivity, reduced tool wear, improved surface finishes and excellent chip control.

Shops quickly recognize that **304/304L UGIMA®** does not machine like the standard type 304/304L. **304/304L UGIMA®** has provided gains against other high machinability 304/304L alloys, including our first generation **304/304L UGIMA®**. Productivity gains of up to 15 % and decreases in tool wear up to 40 % have been reported. The table on this page, in conjunction with the recommendations below it, provide a useful guide to setup. To realize the optimal capabilities of **304/304L UGIMA®**, contact your local SCHMOLZ + BICKENBACH USA application engineer.

Machining Operations	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	Cold Drawn	0.04 0.08 0.12	90 - 120 80 - 110 75 - 95	0.005 - 0.008 0.006 - 0.010 0.006 - 0.012	M2 - M3 (T15)	295 - 855 260 - 690 245 - 595	0.005 - 0.008 0.006 - 0.010 0.006 - 0.012	C7 C6 C6
	Annealed	0.04 0.08 0.12	95 - 125 95 - 120 85 - 105	0.005 - 0.008 0.006 - 0.010 0.006 - 0.012		325 - 1020 295 - 755 260 - 660	0.005 - 0.008 0.006 - 0.010 0.006 - 0.012	C7 C6 C6
Forming & Grooving	Cold Drawn	0.08 0.25 0.50 1.00 2.00	105 - 125 105 - 125 100 - 120 100 - 120 100 - 120	0.002 - 0.003 0.003 - 0.004 0.003 - 0.004 0.002 - 0.003 0.002 - 0.003	M2 - M3 (T15)	255 - 415 235 - 380 235 - 290 220 - 275 220 - 240	0.002 - 0.003 0.003 - 0.004 0.003 - 0.004 0.002 - 0.003 0.002 - 0.003	C6 C6 C6 C6 C6
	Annealed	0.08 0.25 0.50 1.00 2.00	115 - 135 110 - 125 105 - 125 105 - 125 105 - 125	0.003 - 0.004 0.003 - 0.004 0.003 - 0.004 0.002 - 0.003 0.002 - 0.003		270 - 450 255 - 410 255 - 305 255 - 290 220 - 260	0.003 - 0.004 0.003 - 0.004 0.003 - 0.004 0.002 - 0.003 0.002 - 0.003	C6 C6 C6 C6 C6
Shaving & Skiving	Cold Drawn	0.08 0.25 0.50 1.00 2.00	100 - 120 95 - 115 95 - 115 95 - 115 95 - 115	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003	M2 - M3 (T15)	245 - 295 230 - 280 230 - 280 210 - 265 195 - 230	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003	C6 C6 C6 C6 C6
	Annealed	0.08 0.25 0.50 1.00 2.00	105 - 125 105 - 120 100 - 115 100 - 115 100 - 115	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003		260 - 315 245 - 295 245 - 295 230 - 280 210 - 245	0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003 0.002 - 0.003	C6 C6 C6 C6 C6