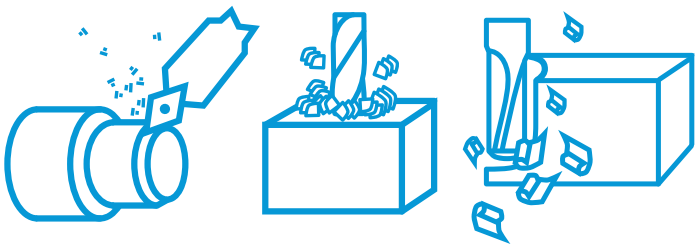
PRODEC®
Datasheet - Stainless steel bar optimized for improved machinability

General characteristics

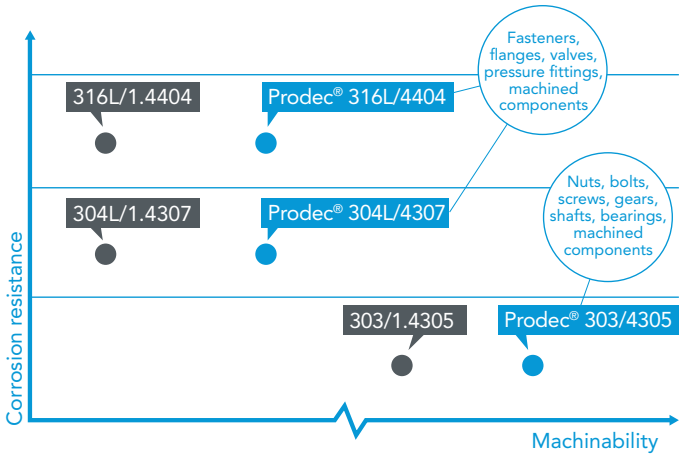
Stainless steel grades optimized for improved machinability with longer tool life and enhanced quality.



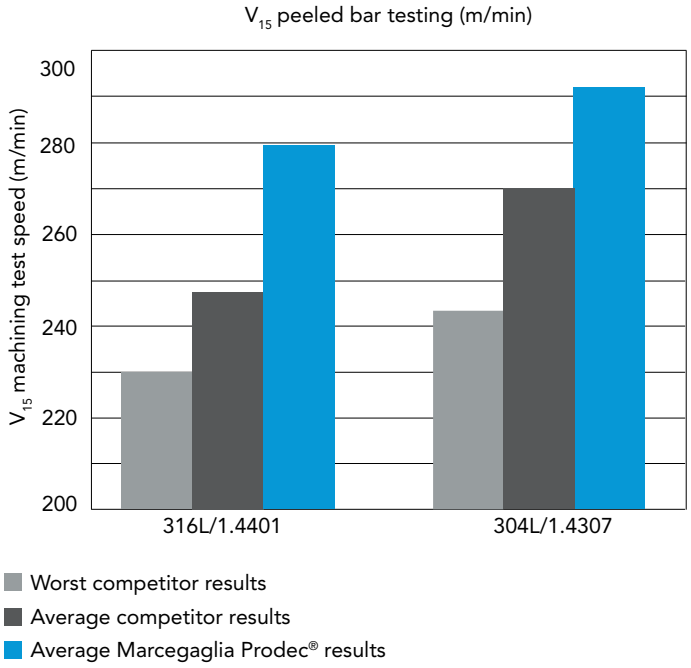
Product name	Typical applications	Product forms
Prodec® 304L/4307 A version of 304L/4307 with improved machinability. Improves productivity with faster machining, longer tool life, better dimensional tolerances, superior machined surface quality, and improved yields compared to conventionally produced 304L/4307.	• Fasteners • Flanges and valves • Pressure fittings • Machined components	Bar Wire rod Billet
Prodec® 316L/4404 A version of 316L/4404 with improved machinability. Improves productivity with faster machining, longer tool life, better dimensional tolerances, superior machined surface quality, and improved yields compared to conventionally produced 316L/4404.	• Fasteners • Flanges and valves • Pressure fittings • Machined components	Bar Wire rod Billet
Prodec® 303/4305 For applications that use 303/1.4305. This product gives you faster machining, longer tool life, better tolerances, superior machined surface quality, and reduced scrap losses compared to conventionally produced 303/1.4305.	• Nuts, bolts, and screws • Gears • Shafts • Bearings • Machined parts for process equipment	Bar Wire rod Billet

Product performance comparison

Corrosion resistance vs machinability



Bar – faster machining with Prodec®



Testing done with Marcegaglia Prodec® and 7 European competitors' bars with improved machinability in grades 316L/4404 and 304L/4307. The tool used for testing was a CNMG 2015 cemented carbide insert.

Bar – cost savings with Prodec®

		Standard 316L/4404	Prodec® 316L/4404	Improvement	
Cutting speed	m/min	92	137	45	
Processing time/component	min	16.9	7.7		54%
Total machining cost/component	€	23.1	10.6	12.6	55%
Productivity increase	%				54%
Savings/component	€			12.6	

A cost saving example for rough turning a 6» diameter Prodec® 316L/4404 peeled bar with a cemented carbide tool.

Products and dimensions

Metric	
Round bar	**Offering (mm)**
Cold drawn	6–25.4
Centerless ground	6–25.4
Peeled	28–90
Black bar	28–90

Metric	
Hexagon and square bar	**Offering (mm)**
Hexagon	8–25.4
Square	8–22.23

Chemical composition

The chemical composition is given as % by mass.

Grade family	Marcegaglia name	EN	ASTM		PRE	Typical chemical composition, % by mass					
			TYPE	UNS		C	Cr	Ni	Mo	N	Others
A	Prodec® 304L/4307	1.4307	304L	S30403	18	0.02	18.1	8.1	–	–	–
A	Prodec® 316L/4404	1.4404	316L	S31603	24	0.02	17.2	10.1	2.1	–	–
A	Prodec® 303/4305	1.4305	303	S30300	17	0.05	17.2	8.1	–	–	0.3S

Chemical compositions and PRE calculations are based on Marcegaglia typical values.

Pitting Resistance Equivalent is calculated using the following formula: PRE = %Cr + 3.3 x %Mo + 16 x %N

Surface finish and other factors determine the actual corrosion resistance of a particular product.

Corrosion resistance

Although improvements in machinability have been associated with reduced corrosion resistance in the past, the Prodec® treated products have shown corrosion resistance within the range typically expected from comparable stainless steel products.

Prodec® 304L/4307 is a versatile, general-purpose stainless steel with good resistance to atmospheric corrosion, many organic and inorganic chemicals, as well as foods and beverages. It has also been used in vacuum-processing equipment and specialized instruments where high integrity is essential.

Prodec® 316L/4404 provides improved resistance to pitting and crevice corrosion in environments containing chlorides and other halides.

Prodec® 303/4305 is resistant to mildly corrosive environments. In order to achieve the best possible corrosion resistance, all Prodec® 303/4305 parts should be chemically treated to remove sulfides from the final surface.

Mechanical properties

Metric					
Marcegaglia name	**Product form**	**Min. yield strength $R_{p0.2}$ (MPa)**	**Tensile strength R_m (MPa)**	**Elongation A_5 (%)**	**Hardness (HBW) max.**
Prodec® 304L/4307	Hot rolled bar	175	500–700	45/35	215
	Cold drawn bar	400/380/175	600-930/600-930/500-830	25/25/30	–
Prodec® 316L/4404	Hot rolled bar	200	500–700	40/30	215
	Cold drawn bar	400/380/200	600-930/580-930/500-830	25/25/30	–
Prodec® 303/4305	Hot rolled bar	190	500–750	35	230
	Cold drawn bar	400/400/190	600-950/600-950/500-850	15/15/20	–

Minimum values for Hot rolled bars and Cold drawn bars according to EN 10088-3.5) HB max

Physical properties

Metric						
Marcegaglia name	**Density [kg/dm³]**	**Modulus of elasticity at 20 °C [GPa]**	**Coefficient of thermal expansion 20–100 °C [10^{-6}/K]**	**Thermal conductivity at 20 °C [W/(m*K)]**	**Thermal capacity at 20 °C [J/(kg*K)]**	**Electrical resistivity at 20 °C [Ω*mm²/m]**
Prodec® 304L/4307	7.9	200	16.0	15	500	0.73
Prodec® 316L/4404	8.0	200	16.0	15	500	0.75
Prodec® 303/4305	7.9	200	16.0	15	500	0.73

Values according to EN 10088-1.

Imperial						
Marcegaglia name	**Density [lbm/in³]**	**Modulus of elasticity [psi]**	**Coefficient of thermal expansion 68-212 °F [µin/(in* °F)]**	**Thermal conductivity [Btu/(hr*ft* °F)]**	**Thermal capacity [Btu/(lbm* °F)]**	**Electrical resistivity [µΩ*in]**
Prodec® 304L/4307	0.285	$29 * 10^6$	8.89	8.7	0.119	28.74
Prodec® 316L/4404	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Prodec® 303/4305	0.285	$29 * 10^6$	8.89	8.7	0.119	28.74

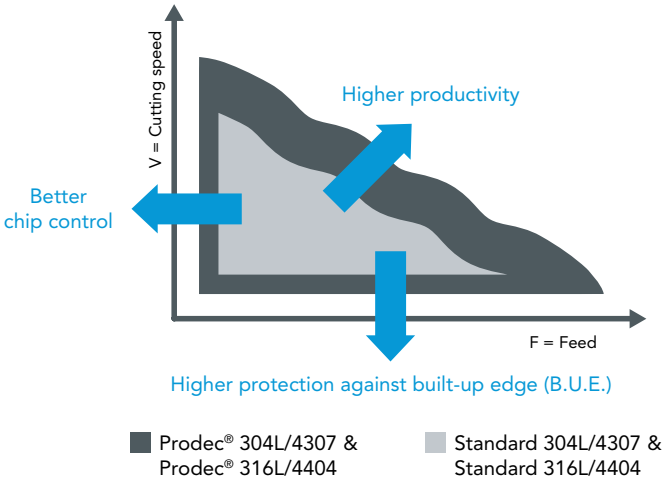
Values according to EN 10088-1.

Fabrication

Machining

Prodec® products enable higher machining speeds, longer tool life, and superior part quality with reduced total cost for finished parts.

Prodec® 304L/4307 and Prodec® 316L/4404 are special variants of standard Types 304 (UNS S30400) / 304L (UNS S30403) and 316 (UNS S31600) / 316L (UNS S31603) respectively with enhanced metallurgy for better machinability. The general rules for machining stainless steel also apply to the Prodec® grades. The difference is that Prodec® grades enable a longer tool life and/or tougher machining conditions. The machining window illustrated on the right gives a demonstration of this.



Machining guidelines

The cutting parameters in this guideline will work under normal cutting conditions. It is suggested to begin with cutting parameters in the ranges indicated in the tables and then to improve parameters by moving to higher or lower speed, feed or depth of cut until best performance is reached. It is possible to end up in a range somewhat outside the values indicated in the tables depending on the actual machine set-up.

Turning

- The machine and setup must be rigid
- Use shortest possible tool length
- Use coolant
- Use smallest possible nose radius to avoid vibrations

	Carbide Tooling				HSS Tooling		
Turning	**Depth of cut or width (mm)**	**Speed (m/min)**	**Feed (mm/rev)**	**Tool Grade**	**Speed (m/min)**	**Feed (mm/rev)**	**Tool Grade**
Finishing	-2	260–280	0.10	M10–15	50 [1]	0.10	T15
Medium	2–5	200–260	0.25	M10–25	35	0.25	T15
Roughing	5–10	50–220	0.40	M25–35	20	0.40	T15

[1] Coated tools

Milling

- Avoid cutting through holes/cavities
- Ensure good chip evacuation, recutting of chips may cause tool damage

	Carbide Tooling			HSS Tooling		
Milling	**Speed (m/min)**	**Feed (mm/rev)**	**Tool Grade**	**Speed (m/min)**	**Feed (mm/rev)**	**Tool Grade**
Face milling	150–250	0.08–0.30	M10–30	24–40	0.08–0.20	T15
Side milling	180–240	0.08–0.30	M10–30	24–40	0.08–0.20	T15
End milling	150–220	0.05–0.20	M10–30	24–40	0.025–0.15	T15
End milling [2]	50–100	0.05–0.20	M35	–	–	–

[2] Solid cemented carbide

Drilling – high speed steel twist drills

- Use coolant
- If possible use internal coolant through drill
- Use of cobalt high alloyed drills is preferred
- With PVD-coated HSS drills the cutting speed can be increased by 10%
- Use as short drill as possible

	HSS Tooling			
Drilling [3]	**Diameter (mm)**	**Speed (m/min)**	**Feed (mm/rev)**	**Rpm (rev/min)**
	1	10–12	0.05	3200–3800
	3	15–17	0.10	1600–1800
	5	17–20	0.12	1080–1270
	10	17–20	0.15	540–640
	15	17–20	0.20	360–430
	20	17–20	0.30	270–320
	30	17–20	0.30	180–220

[3] HSS-5%Co

Forming

Cold forming

Prodec® products can be readily formed and fabricated with the full range of cold forming operations.
They can be used in heading, drawing, bending, and upsetting. Cold forming operations will increase the strength and hardness of the material, and may leave it slightly magnetic.

Hot forming

Prodec® 303/4305, Prodec® 304L/4307, and Prodec® 316L/4404 can be forged in the 925–1200 °C/1700–2200 °F range. For maximum corrosion resistance, forgings should be annealed at a minimum temperature of 1030°C/1900 °F and then water quenched or rapidly cooled by other means after hot forming operations.

Welding

Prodec® 304L/4307 is readily weldable with the full range of conventional welding methods with the exception of oxyacetylene. AWS E308/ER308 or E308L/ER308L filler metals should be used, but molybdenum-containing austenitic stainless steel filler metals may also be considered. After welding, it may be necessary to fully anneal to restore the corrosion resistance lost by sensitization to intergranular corrosion when chromium carbides were precipitated in the grain boundaries in the weld heat-affected zone (HAZ).

Prodec® 316L/4404 is readily welded with the full range of conventional welding methods with the exception of oxyacetylene. AWS E316L/ER316L and other low-carbon filler metals with a molybdenum content higher than that of the base metal should be used.

Prodec® 303/4305 stainless steel is not recommended for applications requiring welding. When welding is necessary, AWS E312 filler metal may be considered. An alternative product for parts requiring welding is Prodec® 304L/4307.

Standards and approvals

The most commonly used international product standards are given in the table below.

Standards

- EN 10088-3
- EN 10088-5
- EN 10272
- ASME SA479
- ASTM A479/479M
- ASTM A276
- ASTM A555
- ASTM A493

Certificates and approvals

Marcegaglia Stainless Sheffield meets the most common certifications and approvals:

- AD 2000 Merkblatt
- Approval of Material Manufacturers
- Factory Production Control Certificate
- ISO 9001
- ISO 14001
- ISO 50001
- ISO 45001
- Pressure Equipment Directive (PED)

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