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PREMIUM STEEL & METALS
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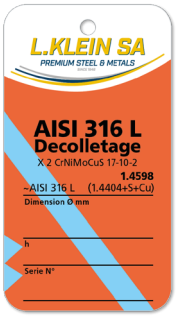

AISI 316L DECOLLETAGE

1.4598 / AISI ≈ 316L – Free machining austenitic stainless steel 1.4404 Grade with S and Cu additions

Distinctive feature and main attributes

This free machining austenitic stainless steel of type 1.4404 exhibits a fair corrosion resistance in spite of its 0.10 – 0.20% S addition to improve its machinability. Its Cu addition of 1.30 – 1.80% improves further its machinability, stabilizes its austenitic structure and improves its basic corrosion resistance, up to the resistance of the AISI 316 (1.4310) austenitic stainless steel grade, this in spite of the presence of numerous MnS inclusions impairing its pitting corrosion resistance. Its sensitization is restricted to long exposure in the critical temperature range of 650 – 450°C only. In spite of the presence of numerous MnS inclusions, this steel can still be satisfactorily welded. Its other alloying elements have contents similar to those of the CHRONIFER® Special 04 AISI 316L (1.4404) grade. This steel cannot be thermally hardened, but can be strengthened by cold working.

Use and application range

This steel has numerous uses in many industrial branches. Like in fine mechanical engineering, mechatronic, and components for movements in the watch industry.

Norms

Material No.	1.4598
EN 10088-3:2005	X2CrNiMoCuS17-10-2
DIN / AFNOR	X2CrNiMoCuS17-10-2
AISI / SAE	316L (+S+Cu)
JIS	SUS 316 LF

Chemical composition (% wt)

C	*Si*	*Mn*	*P*	*S*	*Cr*
max. 0.030	max. 1.00	max. 2.00	max. 0.045	0.10 – 0.20	16.5 – 18.5

Ni	*Mo*	*Cu*	*N*	*Fe*
10.0 – 13.0	2.00 – 2.50	1.30 – 1.80	max. 0.10	balance

Dimensions and tolerances

Standard: Bars 3 m (+50 / 0 mm), coils for Escomatic
Strength UTS: 650 – 950 MPa
- **Bars Ø < 0.7 – 17 mm:** ISO h8
- **Bars Ø ≥ 2.00 mm:** ISO h6 (h7)
- **Wires Ø 0.80 – 3.00 mm:** ISO fg7, coils for Escomatic
- **Out of roundness:** max. ½ diameter tolerance

Other tolerances on request

Executions and delivery conditions

Standard: Bars 3 m (+50 / 0 mm), coils for Escomatic
- **Bars Ø ≥ 2.00 mm:** cold drawn, groundpolished, Ra max. (N5), **Bar ends:** pointed, chamfered
- **Bars Ø < 2.00 mm:** Surface condition: cold drawn
- **Wires Ø < 3.00 mm:** cold drawn, coils for Escomatic

Other executions on request

Availability

Standard dimensions on stock: see product range

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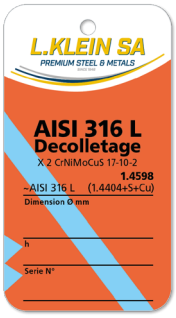

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Cutting conditions

Machinability: fair to medium, better in the cold worked condition
Cutting speed: $V_c \approx 50 - 60$ m / min
Lubricant-coolant fluid: individual choice
The optimal cutting conditions depend on the machine tool, the cutting tools, the chip dimensions, the lubricant-cooling fluid, as well as the tolerances and surface the roughness to be achieved.

PREN

The use of computed PREN (Pitting Resistance Equivalent Number) as indicators of the pitting corrosion resistance of free machining stainless steels with S additions are not valid, such as for this free machining austenitic stainless steel.

Forming

Warm: forging: 980 – 1'150°C, quenching / rapid cooling
- If the forging temperature should drop below 900°C, a preventive 1'040 – 1'070°C solution anneal is recommended to fully recover all capabilities of this steel.

Cold: no limitation, see Figure 1, page 3

Annealing

Solution anneal: 1'040 – 1'080°C, quenching or rapid cooling
- A 10 – 15% cold working reduction is recommended prior to a solution anneal in order to reduce the risk of a too fast and uncontrolled grain growth.

Stress relieving anneal: The machining of cold worked materials can be slightly improved after 200 – 400°C stress relieving heat treatment.

Sensitization

The temperature range of 650 – 450°C should be avoided as it leads to sensitization and the formation and precipitation of a σ (Sigma) phase. The formation of σ (Sigma) phase leads to brittleness; drop of ductility and corrosion resistance. In such case, a 1'040 – 1'070°C / quenching / rapid cooling solution anneal is recommended.

Hardening Strengthening

- This steel cannot be thermally hardened
- This steel can be strengthened by cold working
- Cold deformation forms ferromagnetic α (alpha) martensite, see Figure 1, page 3

Microstructures

Delivery conditions, hot rolled: Annealed austenite
Machining and polishing: Cold formed wires and bars: Cold deformed austenite

Polishing

Adapted to all modes and techniques of polishing.; Electropolishing: adapted
- This CHRONIFER Special 04 steel can contain traces of δ (Delta) Ferrite.
- δ (Delta) Ferrite appears in relief after electropolishing
- In case of (Sigma) Phase formation or of sensitization, a 1'040 – 1'070°C solution anneal is recommended in order to fully recover the polishing ability and capability and the corrosion resistance of this steel.
- σ (Sigma) Phase will appear in relief after electropolishing. more info

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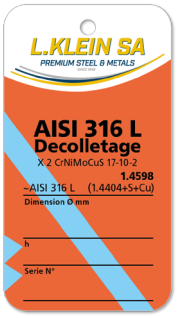

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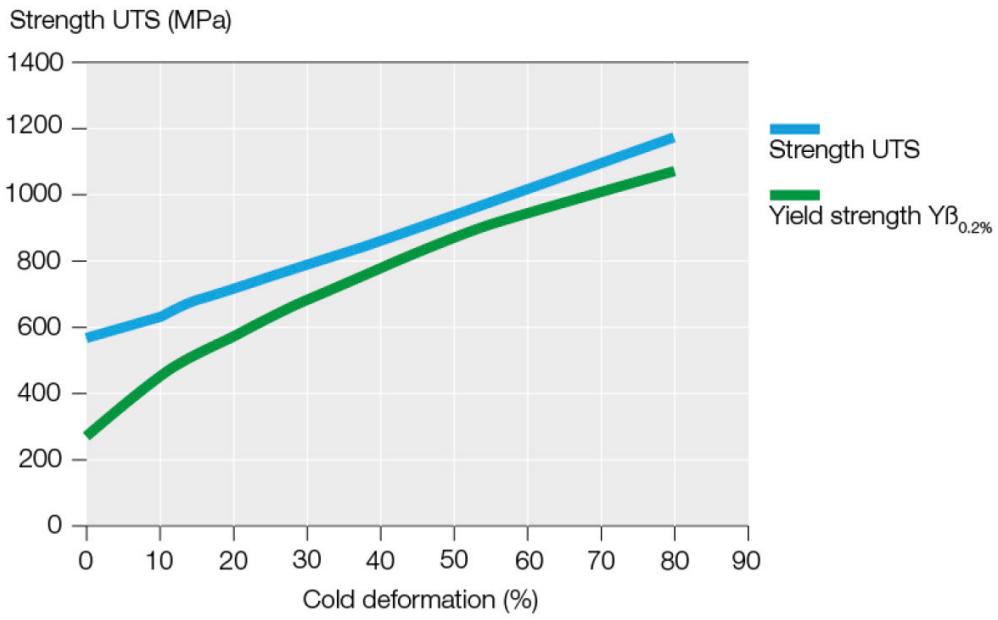
Welding Feasible, but the numerous MnS inclusions can impair welding.

Laser marking The HAZ Zone (Heat Affected Zone) of a normal laser marking should not significantly influence its local microstructure. more info

Superficial oxidation A thermal oxidation forms colored oxides or scaling on the surface. These muss be eliminated, is it chemically by pickling or by mechanical means like grinding. Colored surface oxidation and / or scaling can massively reduce the corrosion resistance.

Figure 1
Strengthening
Cold working curves



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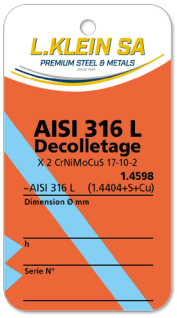

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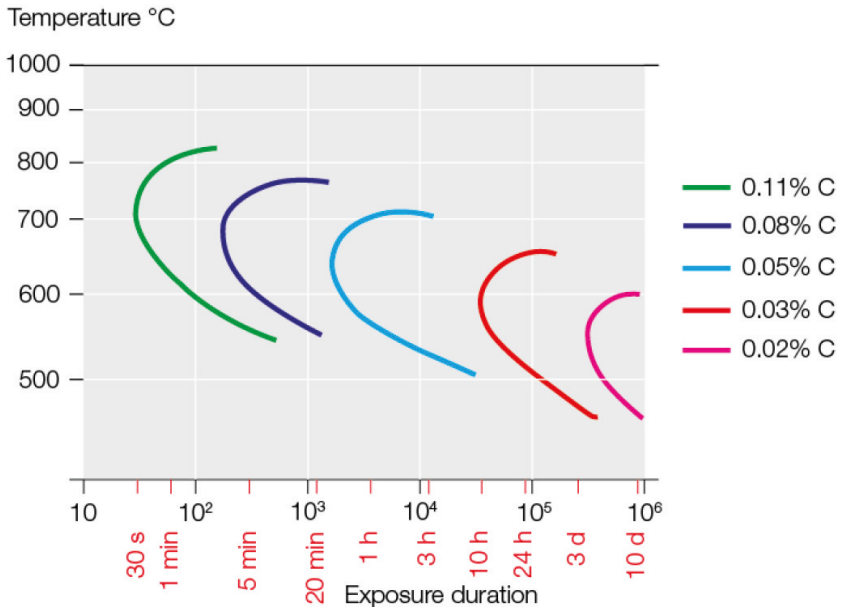
1.4404 Grade with S and Cu additions

Figure 2
Sensitization; TTT curves



Limitations

Figure 2 shows that this steel can be sensitized by long exposures in the temperature range of 450 – 650°C. This sensitization leads to the precipitation of detrimental intergranular carbides causing brittleness and intergranular corrosion. The intergranular carbides precipitated at the grain boundaries will be etched in relief by electropolishing.

Pickling and passivation

The pickling and passivation processes and the products used therefore, should always be adapted to the requirements of the pickling and passivation of austenitic stainless steels. Potential "Flash back" reactions staining the surface can always be avoided by applying a pickling process prior to passivation. more info
An additional passivation treatment is not needed after electropolishing.

Corrosion resistance

Optimal surface condition: Very clean, polished and passivized. more info

Elementary precautions

- The most elementary protection is to always keep the surfaces very clean, polished and passivized.
- The parts should always be very well cleaned (no usage residual) and dried.
- Only use adapted chlorine free disinfection, cleaning and washing products. more info

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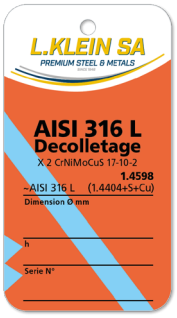

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Physical properties

Properties	Unit	Temperature (°C)				
		20	200	300	400	500
Density	g cm^{-3}	7.98				
Young modulus E	GPa	200	186	179	172	165
Shear modulus G	GPa	11.6				
Poisson Coefficient V		0.27 – 0.28				
Electrical resistance	Ω mm^2 m^{-1}	0.74				
Thermal expansion	m m^{-1} K^{-1} 10^{-6}	20 – 100°C 16.5	20 – 200°C 17.5	20 – 300°C 17.5	20 – 400°C 18.5	20 – 500°C 18.5
Thermal conductivity	W m^{-1} K^{-1}	15				
Specific heat	J kg^{-1} K^{-1}	500				
Melting range	1'370 – 1'400°C					
Magnetism annealed	Traces of δ (Delta) Ferrite **Relative permeability:** μr ≥ 1.003					
Magnetism cold worked	Traces of δ (Delta) Ferrite + Ferromagnetic α (Alpha) Martensite **Relative permeability:** μr ≥ 1.005					

Disclaimer: The information and data of this informative Data sheet are indicative only. They are not use instructions. The users must define and endorse them in each case.

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