

DAMASTEEL® DS95X™ AUSTENITIC DAMASCUS PATTERNED STEEL

PRODUCT INFORMATION

Damasteel's austenitic Damascus patterned steel is a stainless, powder based steel with the two alloys 304L and 316L. They are both variations of the 18 percent chromium – 8 percent nickel alloy and can be considered for a wide variety of applications where one or more of the following properties are important:

- High corrosion resistance
- Ease of fabrication
- Excellent formability
- High purity and cleanliness

Each alloy represents a good combination of formability and corrosion resistance. This combination of properties is the reason for the extensive use of these steels. These alloys are used in a variety of products for use in specific conditions. Some examples of their uses are in flatware cutlery, jewelries, watches and other applications where corrosion resistance and aesthetics are important.

Grade	Etch color	C	Si	Mn	Cr	Mo	Ni
316L	Bright	≤0,03	≤0,75	≤2,0	17	2-2,5	11
304L	Dark	≤0,03	≤0,75	≤2,0	18	-	9

Table 1. Nominal chemical compositions in wt-% of the constituent alloys

Mechanical and physical properties

Damasteel's austenitic Damascus patterned steel has high to very high corrosion resistance. As opposed to the martensitic alternative, this steel cannot be hardened by any heat treatment.

Bar and plate material delivered from Damasteel has the following approximate mechanical and physical values at 20°C.

Yield strength, Rp 0,2	280	MPa	Young's modulus	200	GPa
Tensile strength, Rm	585	MPa	Poisson's ratio	0,3	-
Elongation, A5	45	%	Thermal conductivity	15	W/m·K
Hardness	165	HV	Heat capacity	500	J/kg·K
Density	7,9	kg/dm ³	Electrical resistivity	0,73	μ·Ω·m

Table 2. Mechanical and physical properties of Damasteel austenitic Damascus patterned steel (DS95X™) in annealed condition.

Corrosion resistance

The 304L exhibits excellent resistance to a wide range of atmospheric, chemical, textile, petroleum and food industry exposures. 316L is usually regarded "marine grade stainless steel" and has even better corrosion resistance than 304L. This makes Damasteels austenitic Damascus patterned steel suitable for most common applications.

Hot working

Hot working temperature 950-1160 °C (1740-2120 F). No hot working process should be performed under 930 °C (1700 F).

Stainless steels has a higher, almost double deformation resistance compared to low alloyed carbon steels. Hand forging is therefore only possible on relatively small dimensions.

A good control of the heating temperature is needed and an electric or gas fired furnace is recommended. Avoid carburizing atmosphere in the furnace.

Long heating times at temperatures above 850°C (1560 F) leads to scale formation. After hot working, a rapid cooling in water will prevent carbide precipitation in the grain boundaries and the risk of pitting is reduced.

Heat treatment

Annealing temperature 1060°C (1940 F) with rapid cooling in water, oil or air depending on dimension.

If the material has been cooled too slowly after a hot forming or a welding operation, quench annealing should be performed. Undesirable grain structures will then be dissolved and any residual stresses will be released.

Cold working

Like the conventional austenitic stainless steels these grades can be formed and fabricated by a full range of cold working operations. The cold working ductility is good and any cold working operations will lead to deformation hardening and increase the strength and the hardness of the material.

Welding

Austenitic stainless steels possess excellent weldability but the material can change shape due to release of residual stresses while welding. Welding electrodes and filler metal of 316L type should be used to ensure best results.

Machining

As with the conventional austenitic stainless steels, Damasteel's austenitic stainless Damascus patterned steel has some specific machinability properties.

- Low tensile strength but a strong work hardening
- Tendencies for buildup of material on the tool edge
- Tough and stringy chips
- Generally, machining with lower cutting speed and higher feed rate

Grinding and polishing

Normal grinding and polishing procedures for austenitic stainless can be used also for the Damascus patterned steel.

Grinding wheel recommendation:

Silicon Carbide, 46 grit, soft, open density, ceramic bonded. (C46J6V)

- Speed: 35 m/sec
- Feed: 0.01-0.05 mm/stroke

Speed of the work piece may be 1/60 of the grinding speed.

Etching

To make the pattern in our steel visible, an etching has to be made. Depending on desired result, different acids and acids mixtures can be used. In the table below are a few suggestions.

	Acid	Chem. comp.	Blend (%)	Time (min)	Color 316L	Color 304L
I	<i>Aqua Regia</i> Hydrochloric acid 37 % Nitric acid 65 %	HCl HNO ₃	75 25	1	Bright grey	Light grey
II	RO-water Hydrochloric acid 37 % Ethanol 95 % Ferro chloride 30 % Copper(ii) chloride	H ₂ O HCl C ₂ H ₅ OH FeCl ₃ CuCl ₂	75 14 11 10 g/l 10 g/l	5	Light grey	Dark grey
III	RO-water Sulfuric acid 30 % Soap solution	H ₂ O H ₂ SO ₄	60 40 0,1	5-10	Light grey	Dark grey
IV	RO-water Sulfuric acid 30 % Perchloric acid 7 %	H ₂ O H ₂ SO ₄ HClO ₄	63 30 7	4-5	Light grey	Dark grey
V	RO-water Hydrochloric acid 37 % Nitric acid 65 %	H ₂ O HCl HNO ₃	- 80 20	3-10	Bright	Grey
VI	Hydrochloric acid 37 %	HCl	100	180 (3 h)	Bright	Light grey

Table 3. Etching suggestions with corresponding colors and relief of the different alloys

1. Grind the piece progressively up to desired grit, 600 or higher. Finish off with polishing if desired.
2. Clean and degrease the piece carefully.
3. Mix the etching acid in below ratios and remember to always pour the acid into the water
4. Immerse the piece in the mix and leave it for the time you choose. Longer soaking time will give a deeper etch.
5. Neutralize the piece by dipping it into water with bicarbonate

Beware of noxious fumes. Acids must be handled with great care.

Method number V and VI provide strong attack and deep relief

Products and dimensions

Damasteel has a standard product program that can be found on our website www.damasteel.com.

We supply austenitic Damascus patterned steel in following formats

- Round bars in selected sizes
- Flat bars in dimensions shown in below chart, see fig. 1.

BESPOKE PRODUCTS CAN BE SUPPLIED WITHIN THE LIMITS SHOWN IN CHART.

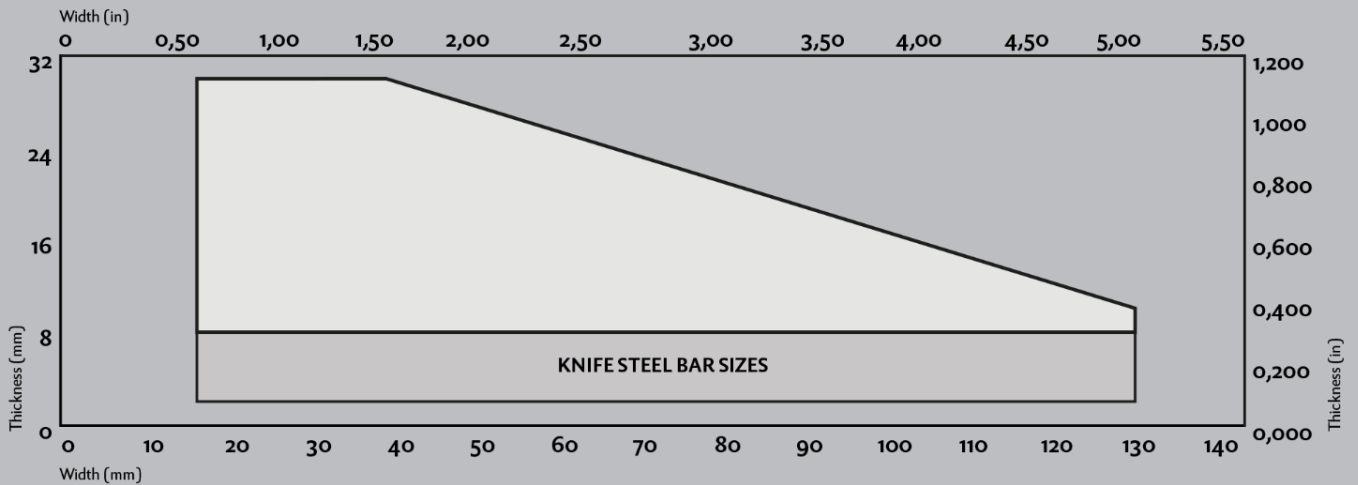


Figure 1: Size range

Even if it comes to creating customized patterns on our Damascus products or if you like dimensions outside our standard range either on our Damascus patterned steel grades (DS93X™, DS95X™, DS92X™, DS96X™) or our martensitic steels RWL34™ or Nitrobe77™ – do not hesitate to contact us.

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