

# 316/316L Stainless Steel Bar

MAXIVAL®



**MVAPML** is a low-carbon austenitic stainless steel with Molybdenum. It has good general and pitting corrosion resistance as well as good intergranular corrosion resistance after welding processes. This grade is a Ca-treated stainless steel obtained by a special steel making practice whose aim is a calculated and precise control of non-metallic inclusions which are characterized by particular morphology and lubricating properties which are able to improve machinability. This results in lower tool wear and higher chip-breaking due to the formation of a layer between the tool and the chip.

## DESIGNATIONS

VALBRUNA	MVAPML
AISI	316/316L
W.N.	1.4401.14404
UNS	S31600/S31603
EN	X5CrNiMo17-12-2/X2CrNiMo17-12-2
BS	316S14/316S19

## DESIGN FEATURES

- Enhanced corrosion resistance compared to standard Cr-Ni grades
- Very good machinability
- Excellent formability and weldability
- Excellent impact strength

## CHEMICAL COMPOSITION

CHEMICAL ELEMENT	C	Mn	Si	P	S	Cr	Ni	Cu	Mo	N
MINIMUM VALUE %	-	-	-	-	-	16.5%	10%	-	2%	-
MAXIMUM VALUE %	0.03%	2%	0.75%	0.04%	0.03%	18%	12%	1%	2.5%	0.1%

## MECHANICAL PROPERTIES

Condition	Subtype	Rm [N/mm <sup>2</sup> ]	Rm [Ksi]	Rp0.2% [N/mm <sup>2</sup> ]	Rp0.2% [Ksi]	A5D [%]	HBW
Solution Annealed	A	515 - 700	75-102	205 min.	30 min.	40 min.	215 max.

## PHYSICAL PROPERTIES

Physical Property	SI / Metric Units	US / BS Imperial Units
Density	8 kg/dm <sup>3</sup>	0.289 lb/in <sup>3</sup>
Specific Thermal Capacity 20° C	500 J/(kg·K)	0.119 Btu/lb°F
Thermal conductivity 20° C	15 W/(m·K)	104.002 Btu in/ ft <sup>2</sup> h °F
Thermal expansion 20° - 100° C	16 (10 <sup>-6</sup> /K)	8.889 (10 <sup>-6</sup> /°F)
Electrical Resistivity 20° C	0.75 Ω·mm <sup>2</sup> /m	29.528 μΩin
Modulus of Elasticity 20° C	200 GPa	29007.548 ksi

## HEAT TREATMENT

Description of condition	Condition	Minimum temperature °C	Maximum temperature °C	Cooling
Solution Annealed	A	1040	1100	Water

## APPLICATIONS

MVAPML is suitable for the fabrication of many products such as flanges, valves, bolting, pump shafts, food /beverages industry equipment, storage tanks, many organic chemicals, and parts working in mild to medium corrosive environments.

## CORROSION RESISTANCE

MVAPML is resistant to fresh water, many organic chemicals and inorganic compounds, atmospheric corrosion, marine environments, as well as many products used in chemical processes, paper production equipment, rural applications and sterilizing solutions. In sea water, this grade is more resistance to pitting than type 304/304L grades such as MVAISL and similar. However, pitting and crevice corrosion may occur in environments if the chloride concentrations, pH and temperature are at determinate levels. As with other standard austenitic grades, MVAPML suffers from stress corrosion cracking about forty degrees (C°) above room temperature and above certain levels of stress and halogen concentrations. Strain hardened structures increase the risk of stress corrosion cracking. It should be noted that this grade, as for every kind of stainless steel, surfaces should be free of contaminant and scale, heat tint, and passivated for optimum resistance to corrosion.

## WELDABILITY

MVAPML has a different behavior when compared to standard grades of similar alloy composition due to its special steel making process because its Calcium –treated process influences the surface tension of liquid and the regular morphology and geometry of the fused (weld) zone. Using the correct filler may reduce or overcome the difficulties of geometry. MVAPML has a special chemical composition which helps to avoid solidification cracks in the fused-zone of autogenous welds due to a special Ferrite balance. In solid state joining such as Friction Welding, MVAPML may not provide a quality bond line.

## **COLD WORKING**

MVAPML is readily fabricated by cold working such as cold drawing and bending and allows a moderate amount of cold heading thanks to its Nickel content. Its structure after cold deformation is less hard than MVAISL. If heavy cold heading performance were required, Valbruna produces other grades for these purposes, such as APMR or APMRU, whose chemical balance provide the highest cold deformability and the lowest CWHF. These grades have a poor machinability due to a low Sulfur content.

## **MACHINABILITY**

MVAPML is not a Free Machining grade (FM) but rather an alloy with enhanced machinability characteristics. In terms of machinability, MVAPML stands between an intermediate position between standard and Free Machined grades but cannot compete with FM (such as AISI 303, EN 1.4305). MVAPML offers a lot of advantages in terms of productivity when compared to standard grades. The best performance are obtained when employing the correct machining parameters when using multi spindle and automatic screw machines. However, machinists should know that Austenitic grades are different from Ferritic and Alloy steels and require more rigid and powerful machines in addition to the correct choice of tools, coating and cutting fluids. The Austenite structure is prone to transform in to  $\alpha$ 'Martensite caused by strain hardening of the tool on the surface of the work piece. Even if MVAPML has a hardening factor lower than MVAISL, the knowledge of this behaviour must be correctly considered when a piece requires two or several cutting steps to be finished. The layer of  $\alpha$ 'Martensite is very hard and, if the subsequent turning or milling processes work on this hardened layer, a rapid tool wear could happen. The tool must work under this layer. MVAPML shouldn't be used for high polish-ability or mirror finishing processes.

## **HOT WORKING**

MVAPML is not specifically designed for hot working and is usually supplied as cold finished round, hexagonal, flat and square bars for machining processes. If a suitable level of machinability is desired on forged pieces (such as flanges, rolled rings, closed - die forgings) a special grade similar to MVAPML can be supplied. Valbruna produces a group of grades with different processes and with lower Ferrite. However, when open die forging large ingots and shapes, MVAPML has a good hot plasticity if suitable soaking and the right forging temperature are applied. No preheating is required. Small forgings can be cooled rapidly in air or water.

## **MELTING PRACTICES**

Argon Oxygen Decarburization