SANDVIK

OSPREY® 316L FOR ADDITIVE MANUFACTURING AND BINDER JETTING

DATASHEET

GENERAL DESCRIPTION

Osprey® 316L is an austenitic stainless steel with good corrosion resistance. The mechanical properties presented are based on a standard Laser - Powder Bed Fusion (L-PBF) process with an increased layer thickness at 60 microns, which provides an efficient build speed. Similarly, the Binder Jet Additive Manufacturing (AM) process provides a high productivity AM process to produce large components, compared to Metal Injection Moulding (MIM), for a wide range of applications based on Osprey® 316L. The mechanical properties presented are based on material printed by a commercially available binder jet process, incorporating debinding and sintering. The 316L powder is based on a fine 90% less than 22 micron size distribution, which is identical to powder used in MIM. The provided is based on 316L material sintered, in hydrogen, over a range of temperatures from 1310 to 1410°C, with optimum temperature at 1390°C, which produce material with low levels of porosity (<1%).

The mechanical properties of Osprey® 316L differ based on the AM process, where L-PBF offered increased tensile strength, but a lower elongation compared to Binder Jet, which has comparable mechanical properties to MIM.

CHEMICAL COMPOSITION

Chemical composition (nominal), wt%

C	Si	Mn	P	S	Cr	Ni	Mo
≤0.030	≤1	≤2	≤0.045	≤0.03	16-18	10-14	2-3

MECHANICAL PROPERTIES

Metric units

Condition	**Direction**	**Proof strength**	**Tensile strength**	**E-modulus**	**Elongation**	**Hardness**
		$R_{p0.2}$	R_m		A	HV
		MPa	MPa	MPa[1)]	%	
L-PBF As built	Horizontal	573±4	695±1	196±10	35±1	200±10
L-PBF As built	Vertical	507±3	645±2	196±9	42±1	221±5
Binder Jet As sintered		200±5	500±15	160±20	60±3	130±40

[1)] x10^3

Imperial units

Condition	Direction	Proof strength	Tensile strength	E-modulus	Elongation	Hardness
		$R_{p0.2}$	R_m		A	HV
		ksi	ksi	ksi[1)]	%	
L-PBF As built	Horizontal	84±0.6	101±0.1	28.4±1.5	35±1	200±10
L-PBF As built	Vertical	74±0.4	94±0.3	28.6±1.3	42±1	221±5
Binder Jet As sintered		29±0.7	73±2.2	23.2±2.9	60±3	130±40

[1)] $x10^3$

PHYSICAL PROPERTIES

Wrought material
Density: 7.99 g/cm³, 0.29 lb/in^3
Thermal conductivity: 16.2 W/mK
Melting range: 1371°C to 1399°C; (2500°F to 2550°F)
Coefficient of thermal expansion[1)]: 16 $10^{-6}K^{-1}$

[1)] In the range of 0 °C to 100 °C; (32°F to 212°F)

CORROSION RESISTANCE

General corrosion
Osprey® 316L has good resistance to:

- Organic acids at high concentrations and temperatures, with the exception of formic acid and acids with corrosive contaminants
- Inorganic acids, e.g. phosphoric acid, at moderate concentrations and temperatures, and sulfuric acid below 20% at moderate temperatures. The steel can also be used in sulfuric acid of concentrations above 90% at low temperature
- Salt solutions, e.g. sulfates, sulfides and sulfites

Intergranular corrosion
Sandvik 316L has a low carbon content and therefore better resistance to intergranular corrosion than other steels of type ASTM 316.

Pitting and crevice corrosion
Resistance of these types of corrosion improves with molybdenum content. Sandvik 316L has substantially higher resistance to attack than steels of type ASTM 304.

Stress corrosion cracking
Austenitic steels are susceptible to stress corrosion cracking. Stress corrosion cracking may occur if the steel is simultaneously exposed to the following:

- Tensile stresses
- Certain solutions, particularly those containing chlorides
- Temperatures above 60°C (140°F)

Such service conditions should therefore be avoided. Conditions when plants are shut down must also be considered, as the condensates which are then formed can develop a chloride content that leads to both stress

corrosion cracking and pitting.

Gas corrosion
Sandvik 316L can be used in:

- Air up to 850°C (1560°F)
- Steam up to 750°C (1380°F)

In flue gases containing sulphur, the corrosion resistance is reduced. In such environments Sandvik 316L can be used at temperatures up to 600-750°C (1110-1380°F) depending on service conditions. Factors to consider are whether the atmosphere is oxidizing or reducing, i.e., the oxygen content, and whether impurities such as sodium and vanadium are present.