# DATA SHEET

## LASER MELTING MATERIAL STAINLESS STEEL 316L (1.4404)

DMLM

### Process specification

| | |
|---|---|
| Powder description | Stainless steel powder |
| Layer thickness | 50 µm |
| Laser power | 200 W |
| Additive manufacturing system | AM250 |

### Material description

SS 316L-0410 alloy is an austenitic stainless steel which comprises iron alloyed with chromium of mass fraction up to 18%, nickel up to 14% and molybdenum up to 3%, along with other minor elements. The alloy is an extra-low carbon variation on the standard 316 alloy.

Due to its low carbon content, SS 316-0410 is resistant to sensitisation (carbide precipitation at grain boundaries) and displays good welding characteristics. It also has low stress to rupture and tensile strength at high temperatures.

### Applications

- Plastic injection and pressure die-casting moulds
- Medical implants
- Surgical tools
- Maritime components
- Spindles and screws
- General engineering

### Material Properties

- High hardness and toughness
- High corrosion resistance
- Good machine-ability
- Can be highly polished

### Generic data - wrought material

| | |
|---|---|
| Density | 7.99g/cm$^3$ |
| Thermal conductivity | 16.2 W/mK |
| Melting range | 1371 °C to 1399 °C |
| Coefficient of thermal expansion (see note 1) | 16 10-6K-1 |

## Powder composition / Percent by mass

| Fe | Cr | Ni | Mo | Mn | Si | N | O | P | C | S |
|---|---|---|---|---|---|---|---|---|---|---|
| Balance | 16.00 to 18.00 | 10.00 to 14.00 | 2.00 to 3.00 | <2.00 | <1.00 | <0.10 | <0.10 | <0.045 | <0.03 | <0.03 |

## Mechanical properties of additively manufactured components

| | As built | HIP treated *(See note 2)* |
|---|---|---|
| **Ultimate tensile strength (UTS)** (See note 3) | | |
| Horizontal direction (XY) | 683 MPa ±3 MPa | 614 MPa ±1 MPa |
| Vertical direction (Z) | 588 MPa ±3 MPa | 577 MPa ±2 MPa |
| **Yield strength** *(see note 3)* | | |
| Horizontal direction (XY) | 571 MPa ±6 MPa | 236 MPa ±8 MPa |
| Vertical direction (Z) | 492 MPa ±12 MPa | 236 MPa ±8 MPa |
| **Elongation at break** *(see note 3)* | | |
| Horizontal direction (XY) | 46% ±1% | 58% ±2% |
| Vertical direction (Z) | 54% ±5% | 65% ±9% |
| **Modulus of elasticity** *(see note 3)* | | |
| Horizontal direction (XY) | 179 GPa ±16 GPa | 166 GPa ±19 GPa |
| Vertical direction (Z) | 158 GPa ±8 GPa | 171 GPa ±23 GPa |
| **Hardness (Vickers)** *(see note 4)* | | |
| Horizontal direction (XY) | 224 HV0.5 ±6 HV0.5 | |
| Vertical direction (Z) | 244 HV0.5 ±6 HV0.5 | |
| **Surface roughness ($R_a$/$R_z$)** *(See note 5)* | | |
| Horizontal direction (XY) | 5 µm to 7 µm | |
| Vertical direction (Z) | 5 µm to 6 µm | |

Note 1 In the range of 0 °C to 100 °C.

Note 2 HIP conditions: Temp. 1120 °C ±10 °C, pressure 1030 bar ±50 bar, time 4 hr.

Note 3 Tested at ambient temperature by Nadcap and UKAS accredited independent laboratory. Test ASTM E8. Machined prior to testing.

Note 4 Tested to ASTM E384-11, after polishing.

Note 5 Tested to JIS B 0601-2001 (ISO 97). As built after bead blasting.

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