

Datasheet

Ferritic stainless steel

Osprey® 446

Osprey® 446 is a heat-resistant, ferritic stainless steel alloyed with chromium, characterized by good oxidation resistance and corrosion resistance at elevated temperatures.

UNS

S44600

AISI

446-1

EN Number

1.4749

DIN

1.4749

Powder designed for

Additive Manufacturing (AM)



Product description

Osprey® 446 is a heat-resistant, ferritic stainless steel alloyed with chromium, suitable for use in elevated temperatures and characterized by

- Good oxidation resistance at elevated temperatures
- Good corrosion resistance at elevated temperatures
- Good mechanical properties at elevated temperatures

With its good oxidation- and corrosion resistance in combination with good mechanical properties at elevated temperatures, Osprey® 446 can be used in applications such as furnace parts, steam generators and glass moulds. The grade can be used in a temperature up to 500 °C.

This metal powder is manufactured by induction melting under Vacuum Inert Gas Atomization (VIGA), producing a powder with a spherical morphology which provides good flow characteristics and high packing density. In addition, the powder has a low oxygen content and low impurity levels, resulting in a metallurgically clean product with enhanced mechanical performance.

Chemical composition (nominal), %

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| | |
|----|-----------|
| Fe | Bal. |
| Cr | 26.0-29.0 |
| Mn | < 1.5 |
| C | < 0.2 |
| Si | < 1.0 |
| P | < 0.040 |
| S | < 0.015 |
| N | 0.15-0.25 |

Powder characteristics and morphology

Powder for Additive Manufacturing

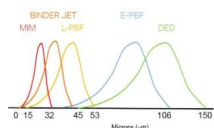
Osprey® metal powder for Additive Manufacturing is characterized by a spherical morphology and high packing density, which confer good flow properties. For powder bed processes these are essential when applying fresh powder layers to the bed to ensure uniform and consistent part build.

For blown powder processes, such as Direct Energy Deposition (DED), good flow ensures uniform build rates. Tight control of the particle size distribution also helps ensure good flowability. Low oxygen powders result in clean microstructures and low inclusion levels in the finished parts.

Particle size distribution

Powder for Additive Manufacturing

Osprey® metal powder for Additive Manufacturing is available in a wide range of particle size distributions that are tailored to the individual Additive Manufacturing systems. They can also be tailored to the particular requirements of the end application, both in terms of mechanical performance and surface finish.



| Process technology | Size (µm) |
|---|------------------------------|
| Binder jetting | ≤ 16, ≤ 22, ≤ 32, ≤ 38, ≤ 45 |
| Laser - Powder Bed Fusion (L-PBF) | 15 to 53 and 10 to 45 |
| Electron beam - Powder Bed Fusion (E-PBF) | 45 to 106 |
| Direct Energy Deposition (DED) | 53 to 150 |

Tailor-made particle size distributions are available on request. Contact us to discuss your specific requirements.

Mechanical properties

The table below displays typical mechanical properties for as-built powder bed fusion – laser beam evaluated in room temperature. Material properties are given in two material conditions, as built and heat treated. The heat treatment was performed by a solution treatment at 1060 °C for 20 minutes followed by quenching in water and annealing at 870 °C for 1 h followed by air cooling.

| Condition | Test temperature | Direction | Proof strength | Tensile strength | E-modulus | Elongation |
|---------------------|------------------|------------|-------------------|------------------|------------------|------------|
| | | | R _{p0.2} | R _m | | A |
| | | | MPa | MPa | MPa ¹ | % |
| L-PBF, as built | Room temp. | Horizontal | 954 | 1089 | 217 | 19.0 |
| L-PBF, as built | Room temp. | Vertical | 840 | 1033 | 187 | 18.9 |
| L-PBF, heat treated | Room temp. | Horizontal | 360 | 616 | 220 | 26.6 |
| L-PBF, heat treated | Room temp. | Vertical | 342 | 554 | 197 | 30.6 |
| L-PBF, heat treated | 500°C | Horizontal | 268 | 401 | 173 | 33.8 |
| L-PBF, heat treated | 500°C | Vertical | 263 | 387 | 140 | 35.4 |

1 x10³

| Condition | Test temperature | Direction | Proof strength | Tensile strength | E-modulus | Elongation |
|---------------------|------------------|------------|----------------|------------------|-----------|------------|
| | | | Rp0.2 | Rm | | A |
| | | | ksi | ksi | ksi1 | % |
| L-PBF, as built | Room temp. | Horizontal | 138 | 158 | 31.5 | 19.0 |
| L-PBF, as built | Room temp. | Vertical | 122 | 150 | 27.1 | 18.9 |
| L-PBF, heat treated | Room temp. | Horizontal | 52 | 89 | 31.9 | 26.6 |
| L-PBF, heat treated | Room temp. | Vertical | 50 | 80 | 28.6 | 30.6 |
| L-PBF, heat treated | 500°C | Horizontal | 38.9 | 58.2 | 25.1 | 33.8 |
| L-PBF, heat treated | 500°C | Vertical | 38.1 | 56.1 | 20.3 | 35.4 |

1 x103

Source: Sandvik and Uppsala University.

Physical properties

Wrought material data

Density: 7.7 g/cm³, 0.28 lb/in³

Thermal conductivity: 17 W/mK to 23 W/mK

Coefficient of thermal expansion: 10.0 10⁻⁶ K⁻¹

Melting point: 1290°C to 1350°C (2354°F to 2462°F)

Creep resistance

Creep resistance has been measured and the results are as follows:

| Condition | Stress | Time to rupture | Elongation at rupture |
|-----------|--------|-----------------|-----------------------|
| | MPa | h | % |
| Annealed | 10 | 2946 | 48 |
| Annealed | 9 | 5751 | 43 |
| Annealed | 8 | 7470 | 44 |
| Annealed | 7.7* | 10 000 | N/A |
| Annealed | 12.9* | 1000 | N/A |

*Extrapolated values based on the assumption that there is a linear relationship between log (stress) and log (time to rupture). Karlsson, D.et al.. Relationship between Microstructure, Mechanical Properties and Creep Behavior of a Cr-Rich Ferritic Stainless Steel Produced by Laser Powder Bed Fusion. *Alloys* 2022, 1, 263–276.

Testing

All Osprey® metal powders are supplied with a certificate of analysis containing information on the chemical composition and particle size distribution. Information on other powder characteristics is available upon request.

Packaging

A wide range of packaging options is available, from 5kgs plastic bottles to 250kg metal drums.

- 5 kg (11 lbs) Plastic bottles
- 6 kg (13 lbs) Plastic bottles
- 10 kg (22 lbs) Plastic bottles
- 20 kg (44 lbs) Metal cans
- 100 kg (220 lbs) Steel drums
- 150 kg (330 lbs) Steel drums
- 250 kg (551 lbs) Steel drums

All packaging materials are suitable for air, sea and road freight.

Contact us for more information and to discuss your packaging requirements.

