Material data sheet (provisional data)

# EOS NickelAlloy IN718 for EOSINT M 270 Systems

A number of different materials are available for use with EOSINT M systems, offering a broad range of e-Manufacturing applications. EOS NickelAlloy IN718 is a heat resistant nickel alloy powder which has been optimized especially for processing on EOSINT M 270 systems. Other materials are also available for EOSINT M systems, and further materials are continuously being developed - please refer to the relevant material data sheets for details.

This document provides a brief description of the principle applications, and a table of technical data. For details of the system requirements please refer to the relevant information quote.

## 1 Description, application

EOS NickelAlloy IN718 is a nickel based heat resistant alloy in fine powder form. Its composition corresponds to Inconel™ 718, UNS N07718, AMS 5662, AMS 5664, W.Nr 2.4668, DIN NiCr19Fe19NbMo3. This kind of precipitation-hardening nickel-chromium alloy is characterized by having good tensile, fatigue, creep and rupture strength at temperatures up to 700°C. 718 alloy has also outstanding corrosion resistance in various corrosive environments.

This material is ideal for many high temperature applications such as gas turbine parts, instrumentation parts, power and process industry parts etc. Material also possess excellent cryogenic properties and potential for cryogenic applications.

Standard processing parameters use full melting of the entire geometry, typically with 20 µm layer thickness. Parts built from EOS NickelAlloy IN718 can be easily post-hardened to 40-47 HRC (370-450HB) by precipitation-hardening heat treatments. In both as-built and age-hardened states the parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required. Unexposed powder can be reused.

Typical applications:

- Aero and land based turbine engine parts
- Rocket and space application components
- Chemical and process industry parts
- Oil well, petroleum and natural gas industry parts

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## 2 Technical data

### General process data

| | |
|---|---|
| Minimum recommended layer thickness | 20 µm<br>1.6 mil |
| Typical achievable part accuracy [1] | |
| - small parts [1] | ± 40 – 60 µm<br>16 - 24 mil |
| - large parts | ± 0.2 % |
| Heat treatments and dimensional stability | |
| Shrinkage due to: | |
| - solution anneal at 980 °C + air (/argon) cooling | tbc |
| - ageing at 720 °C 8 hours + 620 °C 8 hours | tbc |
| Min. wall thickness [2] | 0.3 - 0.4 mm<br>8 - 20 mil |
| Surface roughness | |
| - after shot-peening | Ra 4 - 6,5 µm, Ry 20 - 50 µm<br>Ra 0.16 – 0.25, Rz 0.78 – 1.95 mil |
| - after polishing | Rz up to < 0.5 µm<br>Rz up to < 0.02 mil<br>(can be very finely polished) |
| Volume rate [3] | |
| - standard parameters (full density) | 2 mm³/s |

[1] Based on users' experience of dimensional accuracy for typical geometries, e.g. ± 40 µm when parameters can be optimized for a certain class of parts or ± 60 µm when building a new kind of geometry for the first time.

[2] Mechanical stability is dependent on geometry (wall height etc.) and application

[3] Volume rate is a measure of build speed during laser exposure. The total build speed depends on the average volume rate, the recoating time (related to the number of layers) and other factors such as DMLS-Start settings.



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## Physical and chemical properties of parts

| | |
|---|---|
| Material composition | Ni (50-55 wt-%)<br>Cr (17.0-21.0 wt-%)<br>Nb (4.75-5.5 wt-%)<br>Mo (2.8-3.3 wt-%)<br>Ti (0.65-1.15 wt-%)<br>Al (0.20-0.80 wt-%)<br>Co (≤ 1.0 wt-%<br>Cu (≤ 0.3 wt-%)<br>C (≤ 0.08 wt-%)<br>Si, Mn (each ≤ 0.35 wt-%)<br>P, S (each ≤ 0.015 wt-%)<br>B (≤ 0.006 wt-%)<br>Fe (bal) |
| Relative density with standard parameters | approx. 100 % |
| Density with standard parameters | 8.2 $g/cm^3$<br>0.296 $lb/in^3$ |



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## Mechanical properties of parts (room temperature)

| | As built | After solution anneal and age hardening per AMS 5662 [4] | After solution anneal and age hardening per AMS 5664 [5] |
|---|---|---|---|
| Ultimate tensile strength [6] | | min. 1276 MPa (185 ksi) | min. 1241 MPa (180 ksi) |
| | typ. 980 ± 50 MPa (142 ± 7 ksi) | typ. 1400 ±100 MPa (203 ± 15 ksi) | typ. 1384 ±100 MPa (201 ± 15 ksi) |
| Yield strength (Rp 0.2 %) [6] | | min. 1034 Mpa (150 ksi) | min. 1034 MPa (150 ksi) |
| | typ. 634 ± 50 MPa (92 ± 7 ksi) | typ. 1150 ±100 MPa (167 ± 15 ksi) | typ. 1239 ±100 MPa (180 ± 15 ksi) |
| Elongation at break [6] | 31 % ± 3 % | min. 12 % | min. 12 % |
| | | typ. 15 % ± 3 % | typ. 18 % ± 3 % |
| Young's modulus [6] | | 170 GPa ± 20 GPa (26.5 msi ± 3 msi) | |
| Hardness | approx. 30 HRC (287HB) | approx. 47 HRC (446 HB) | approx. 43 HRC (400 HB) |

[4] Heat treatment procedure per **AMS 5662**: Step1. *Solution Anneal* at 980°C for 1 hour, air (/argon) cool. Step 2. *Ageing treatment;* hold at 720°C 8 hours, furnace cool to 620°C in 2 hours, hold at 620°C 8 hours, air (/argon) cool.

[5] Heat treatment procedure per **AMS 5664**: Step1. *Solution Anneal* at 1065°C for 1 hour, air (/argon) cool. Step 2. *Ageing treatment;* hold at 760°C 10 hours, furnace cool to 650°C in 2 hours, hold at 650°C 8 hours, air (/argon) cool

[6] According to ISO 6892:1998.


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## Thermal properties of laser-sintered parts

| | |
|---|---|
| Coefficient of thermal expansion | tbc |
| Thermal conductivity | tbc |
| Maximum operating temperature for parts under load | 650 °C<br>1200 °F |
| Oxidation resistance up to (according to literature) | 980 °C<br>1800 °F |

The quoted values refer to the use of these materials with EOSINT M 270 systems according to current specifications (including the latest released process software PSW and any hardware specified for the relevant material) and operating instructions. All values are approximate. Unless otherwise stated, the quoted mechanical and physical properties refer to standard building parameters and test samples built in vertical orientation. They depend on the building parameters and strategies used, which can be varied by the user according to the application.
The data are based on our latest knowledge and are subject to changes without notice. They are provided as an indication and not as a guarantee of suitability for any specific application.




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