

## METAL SOLUTIONS

# EOS NickelAlloy IN939

## Material Data Sheet

**EOS NICKELALLOY IN939**

## Excellent High Temperature Performance with Corrosion Resistance

EOS NickelAlloy IN939 is a nickel-chromium alloy which provides an outstanding balance of high temperature strength, corrosion and oxidation resistance, fatigue performance and creep strength at temperatures up to 850 °C (1560 °F). Parts built from EOS NickelAlloy IN939 can be hardened after manufacture by application of precipitation-hardening heat treatments

**MAIN CHARACTERISTICS**

- Excellent mechanical properties
- Excellent corrosion and oxidation resistance
- High tensile, fatigue, creep and rupture strength at temperatures up to 850 °C (1 560 °F)
- Maintains good ductility in age-hardened condition
- Crack-free in as-built condition and resistant to strain-age cracking

**TYPICAL APPLICATIONS**

- Industrial gas turbines (vanes, blades, heat-shields)
- Microturbines
- Turbochargers
- Instrumentation parts
- Power industry parts
- Process industry parts

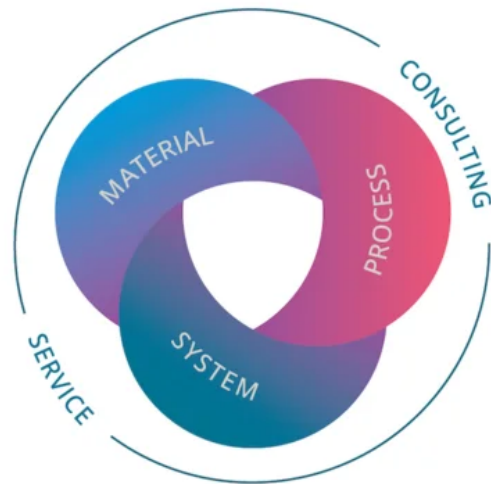
# The EOS Quality Triangle

EOS uses an approach that is unique in the AM industry, taking each of the three central technical elements of the production process into account: the system, the material and the process. The data resulting from each combination is assigned a Technology Readiness Level (TRL) which makes the expected performance and production capability of the solution transparent.

EOS incorporates these TRLs into the following two categories:

- Premium products (TRL 7-9): offer highly validated data, proven capability and reproducible part properties.
- Core products (TRL 3 and 5): enable early customer access to newest technology still under development and are therefore less mature with less data.

All of the data stated in this material data sheet is produced according to EOS Quality Management System and international standards



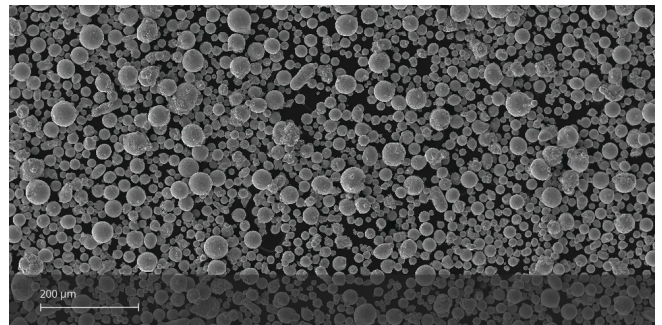
## POWDER PROPERTIES

EOS NickelAlloy IN939 has the following chemical composition.

### Powder Particle Size

GENERIC PARTICLE SIZE DISTRIBUTION

20 - 55  $\mu\text{m}$



SEM micrograph of EOS NickelAlloy IN939 powder

# HEAT TREATMENT

## Description

The as-built microstructure of additively-manufactured IN939 consists of gamma phase ( $\gamma$ ) and primary carbides. Heat treatment is required for the material to reach the desired microstructure and part properties through precipitation of the gamma prime ( $\gamma'$ ) strengthening phase. EOS has developed a short, AM-optimized 3-step heat treatment (14 hours at temperature), which results in similar or better properties than the commonly used 4-step heat treatment (50 hours at temperature). The gamma prime ( $\gamma'$ ) volume fraction after heat-treatment is in the range of 30 to 40 %.

## Steps

### Solution treatment:

Step 1: The purpose of this treatment is to homogenize the gamma matrix: Hold at 1190 °C for 4 hours followed by fast air / argon cooling.

**Aging treatment:** The purpose of aging steps is the precipitation and growth of gamma prime ( $\gamma'$ ) and carbides.

Step 2: Hold at 1000 °C for 6 hours, followed by fast air / argon cooling.

Step 3: Hold at 800 °C for 4 hours, followed by cooling in still air / argon.

## HEADQUARTERS

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Status as of 03.09.2024. Subject to technical modifications. EOS is certified according to ISO 9001.

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