

# EOS Aluminum AlSi10Mg



EOS Aluminum AlSi10Mg is a widely used alloy that combines light weight and good mechanical properties. Different heat treatments can be applied to modify properties for example to increase ductility and conductivity. The material has good thermal and electrical conductivity especially after heat treatment, In addition, gas tight parts can be manufactured with EOS Aluminum AlSi10Mg.

## Powder chemical composition

|            | Al       | Si   | Fe   | Cu   | Mn   | Mg   | Ni   | Zn   | Pb   | Sn   | Ti   |
|------------|----------|------|------|------|------|------|------|------|------|------|------|
| <b>Min</b> | Balanced | 9.0  | -    | -    | -    | 0.25 | -    | -    | -    | -    | -    |
| <b>Max</b> | Balanced | 11.0 | 0.55 | 0.05 | 0.45 | 0.45 | 0.05 | 0.10 | 0.05 | 0.05 | 0.15 |

## EOS Aluminum AlSi10Mg for EOS M 290 | 30 µm

High performance process with smooth and shiny surfaces. Process is developed to have high density with smooth vertical surfaces. T6 heat treatment enables excellent elongation with moderate strength and reduced anisotropy.

### Main Characteristics

- Good mechanical properties and low amount of defects
- Shiny and smooth surfaces on vertical areas
- Mechanical properties can be modified with heat treatment

|                        |                        |
|------------------------|------------------------|
| Layer thickness        | 30 µm                  |
| Volume rate            | 5.1 mm <sup>3</sup> /s |
| Minimum wall thickness | 0.4 mm                 |

## Mechanical properties

|                   | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] | Number of<br>samples |
|-------------------|-------------------------------|------------------------------|------------------------------|----------------------|
| <b>Vertical</b>   | 230                           | 460                          | 6.3                          | 261                  |
| <b>Horizontal</b> | 270                           | 450                          | 10.2                         | 108                  |

## Heat treated mechanical properties

|                   | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] | Number of<br>samples |
|-------------------|-------------------------------|------------------------------|------------------------------|----------------------|
| <b>Vertical</b>   | 250                           | 310                          | 11                           | 42                   |
| <b>Horizontal</b> | 260                           | 320                          | 11                           | 36                   |

## Thermal conductivity

|            | as manufactured<br>[W/m-K] | EOS T6<br>[W/m-K] | stress-relieved<br>[W/m-K] |
|------------|----------------------------|-------------------|----------------------------|
| Vertical   | 100                        | 165               | 160                        |
| Horizontal | 110                        | 155               | 165                        |

## Electrical conductivity

|            | as manufactured<br>[% IACS] | EOS T6<br>[W/m-K] | stress-relieved<br>[W/m-K] |
|------------|-----------------------------|-------------------|----------------------------|
| Horizontal | 25                          | 44                | 44                         |

## Fatigue strength

[MPa] as manufactured 110

HCF, ASTM E466-15, 20 million cycles, fully reversed  
High cycle fatigue testing performed on machined vertical and horizontal samples. No heat treatment.  
Aluminum alloys do not have fatigue limit. Actual fatigue values depend on sample geometry and specially surface finish.

## Coefficient of thermal expansion

| Temperature | 25-100°C               | 25-200°C               | 25-300°C               |
|-------------|------------------------|------------------------|------------------------|
| CTE         | 20*10 <sup>-6</sup> /K | 22*10 <sup>-6</sup> /K | 27*10 <sup>-6</sup> /K |

## Gas tightness

Typical gas tightness with helium leak test (2 mm wall thickness)

Standard EN 13185:2001

Typical leak level 10<sup>-6</sup>mbar l/s

## EOS Aluminum AlSi10Mg for EOS M 290 | 60 µm

Higher productivity process can be used where mechanical requirements are less demanding but where cost-efficiency is needed. The 60 µm EOS M 290 process has high resolution of fine features and buildability of thin walls.

Heat treatment can be used to affect mechanical properties.

### Main Characteristics

- Increased productivity of aluminum parts with EOS M 290
- Good mechanical properties
- Good buildability of challenging geometries

|                 |                         |
|-----------------|-------------------------|
| Layer thickness | 60 µm                   |
| Volume rate     | 10.5 mm <sup>3</sup> /s |

### Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 240                           | 440                          | 4                            |
| Horizontal | 250                           | 440                          | 7                            |

### Heat treated mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 250                           | 320                          | 8                            |
| Horizontal | 260                           | 320                          | 9                            |

## EOS Aluminum AlSi10Mg for EOS M 300-4 | 60 µm

Process consists of high productivity and good mechanical properties.

### Main Characteristics

- Good mechanical properties and high productivity combined
- Heat treatment can be used to affect mechanical properties

|                 |                                   |
|-----------------|-----------------------------------|
| Layer thickness | 60 µm                             |
| Volume rate     | up to 4 x 10.5 mm <sup>3</sup> /s |

### Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] | Number of<br>samples |
|------------|-------------------------------|------------------------------|------------------------------|----------------------|
| Vertical   | 213                           | 398                          | 4                            | 160                  |
| Horizontal | 228                           | 377                          | 7                            | 160                  |

## Heat treated mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] | Number of<br>samples |
|------------|-------------------------------|------------------------------|------------------------------|----------------------|
| Vertical   | 250                           | 320                          | 11                           | 63                   |
| Horizontal | 258                           | 331                          | 11                           | 64                   |

## EOS Aluminum AlSi10Mg for EOS M 400 | 90 µm

High productivity process with moderate mechanical properties. EOS T6 heat treatment is recommended for parts where higher elongation properties are required.

### Main Characteristics

- High productivity
- Moderate mechanical properties
- Good buildability with uniform surface roughness

|                 |                         |
|-----------------|-------------------------|
| Layer thickness | 90 µm                   |
| Volume rate     | 27.8 mm <sup>3</sup> /s |

## Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 240                           | 380                          | 2                            |
| Horizontal | 260                           | 400                          | 3                            |

## Heat treated mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 230                           | 300                          | 5                            |
| Horizontal | 230                           | 300                          | 5                            |

## EOS Aluminum AlSi10Mg for EOS M 400-4 | 40 µm

High performance process with optimized quality and productivity. Good buildability with low surface roughness. EOS T6 heat treatment is recommended for parts where higher elongation properties are required.

### Main Characteristics

- High performance AlSi10Mg process for EOS M 400-4
- Optimized combination of mechanical properties and productivity
- Two-sided recoating reduces building time

|                        |                        |
|------------------------|------------------------|
| Layer thickness        | 30 µm                  |
| Volume rate            | 5.1 mm <sup>3</sup> /s |
| Minimum wall thickness | 0.4 mm                 |

### Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 230                           | 450                          | 5                            |
| Horizontal | 250                           | 440                          | 8                            |

### Heat treated mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 230                           | 300                          | 10                           |
| Horizontal | 250                           | 300                          | 10                           |

### Fatigue strength

[MPa] as manufactured 110

HCF, ASTM, E466-15, 10 million cycles, fully reversed

Aluminum alloys do not have fatigue limit. Actual fatigue values depend on sample geometry and specially surface finish.

## EOS Aluminum AlSi10Mg for EOS M 400-4 | 80 µm

This process parameter is developed specifically for fast and cost-efficient production of aluminum parts with similar mechanical properties as conventionally produced casting parts. EOS T6 heat treatment is recommended for parts where higher elongation properties are required.

### Main Characteristics

- Highest productivity of aluminum parts on the EOS M 400-4: Up to 261 cm<sup>3</sup>/h build rate
- Excellent buildability for challenging parts
- Two different parameter set options available for surface exposure

|                        |                             |
|------------------------|-----------------------------|
| Layer thickness        | 80 µm                       |
| Volume rate            | 4 x 18.1 mm <sup>3</sup> /s |
| Minimum wall thickness | 0.4 mm                      |
| Surface roughness      | R <sub>3</sub> = 15 µm      |

### Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 220                           | 360                          | 2                            |
| Horizontal | 250                           | 380                          | 2                            |

### Heat treated mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 210                           | 300                          | 6                            |
| Horizontal | 220                           | 310                          | 8                            |

## EOS Aluminum AlSi10Mg for EOS M 400-4 | 30 µm

Earlier generation AlSi10Mg M400-4 process. One-sided recoating enables optimizing powder usage in larger parts. EOS T6 heat treatment is recommended for parts where higher elongation properties are required.

|                 |                            |
|-----------------|----------------------------|
| Layer thickness | 30 µm                      |
| Volume rate     | 4 x 7.4 mm <sup>3</sup> /s |

### Mechanical properties

|            | Yield Strength<br>Rp0.2 [MPa] | Tensile Strength<br>Rm [MPa] | Elongation at break<br>A [%] |
|------------|-------------------------------|------------------------------|------------------------------|
| Vertical   | 230                           | 430                          | 3                            |
| Horizontal | 250                           | 400                          | 5                            |

\*Data provided by EOSGmbH