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# ECOPARTS

## ADDITIVE METAL SOLUTIONS

# EOS StainlessSteel 17-4PH

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**EOS StainlessSteel 17-4PH is a stainless steel powder intended for manufacturing parts on EOS metal systems with EOS DMLS processes.**

**This document provides information and data for parts built using EOS StainlessSteel 17-4PH powder EOS art.-no. 9011-0041 on the following system sp e cif ic ations:**

**DMLS® System: EOS M 290**
→ Ceramic blade (2200-3013)
→ Grid nozzle (2200-5501)
→ IPCM M extra Sieving Module with 75µm mesh size (200000315) recommended

**Manual sieve with 75µm mesh size (200000321) recommended; standard manual sieve with 80µm mesh possible**
→ Argon atmosphere

**Software: EOSYSTEM 2.5 or newer / EOSPRINT 1.5 or newer EOS Parameter Set: 17-4PH 40µm Stainless**
→ (Default Job: 17-4PH_040_StainlessM291_100)

## Description

Precipitation hardening steels are widely used in engineering applications, which require corrosion resistance and strength. Parts built from EOS StainlessSteel 17-4PH can be machined, shot-peened and polished in as-built or heat treated states. Solution annealing together with ageing treatment are necessary in order to achieve proper hardness and mechanical properties (ASTM A564 – 13). Due to the layerwise building method, the parts have a certain anisotropy which can be eased by solution annealing.

## Heat treatment

**Vacuum H900 heat treatment procedure:**
→ Solution annealing: Hold at 1040°C (1904°F) ±15°C (± 59°F) for 30 minutes, air cooling under 32°C (89°F).
→ Ageing: Hold at 480°C (896°F) for one hour, air cooling under 32°C (89°F).

**Atmospheric HT procedure (preferred atmosphere: Argon):**
→ Solution annealing: Hold at 1040°C (1904°F) ±15°C (± 59°F) for 30 minutes, air cooling under 32°C (89°F).
→ Ageing: Hold at 460°C (860°F) for one hour, air cooling under 32°C (89°F).

## Quality Assurance of EOS StainlessSteel 17-4PH powder material

The quality of the delivered EOS StainlessSteel 17-4PH powder lots is ensured by the Quality Assurance procedures which are part of EOS Quality Management System. The procedures include quality assurance of both the powder and process.

**Quality assurance of the powder product includes:**
→ sampling (ASTM B215)
→ sieving (ASTM B214)
→ particle size analysis (ASTM B822)
→ chemistry analyses (ASTM E2823/E1479/E1019)
→ apparent density (ASTM B212/B329/B417)

The quality of the process is assured with each delivered powder lots by building a quality assurance job with a qualified EOS M 290 system.

**Process quality is assured by:**
→ tensile tests (ISO6892, ASTM E8M)
→ density measurement (ISO3369)
→ hardness measurement (ISO 6508)
→ chemistry analysis of the solid part (ASTM 2823/E1479/E1019).

The results of the quality assurance tests are given in the lot specific Mill Test Certificates (MTC) according to EN-10204 type 3.1.

## Technical Data

### Powder properties

The chemical composition of the powder is in compliance with standards “F899 – 12b Standard Specification for Wrought Stainless Steels for Surgical Instruments” and “A564M – 13 Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes”.

| Material composition | Acc. to standard | |
|---|---|---|
| **Element** | **Min.** | **Max.** |
| Cr Ni Cu Si Mn C P S Nb | 15.0 | 17. 5 0 |
| + Ta | 0 | 5.00 |
| | 3.00 | 5.00 |
| | 3.00 | 1.00 |
| | – – – | 1.00 |
| | – – | 0.07 |
| | 0.15 | 0.040 |
| | | 0.030 |
| | | 0.45 |

### Particle size

| | |
|---|---|
| D50 [1] Particles | 36-44 µm approx. 1.4-1.7 · 10-3 inch |
| >53µm [2] | Max 6.0 wt.-% |
| Particles >63µm [2] | Max 1.0 wt.-% |
| Powder density Apparent density [3] | Mean 3.83 g/cm3<br>Mean 13.84 lbs/in3 |
| Tap density[4] | Mean 4.7 g/cm3<br>Mean 1.7 lbs/in3 |

[1] According to ASTM B822 [2] According to ASTM B214. According to ASTM B212, [3] ASTM B329 & ASTM B417. [4] According to ASTM B527.

## General process data

| | |
|---|---|
| **Layer thickness** | **40 µm<br>1.6 · 10–3 inch** |
| **Volume rate [5]** | **3.32 mm³/s (11.95 cm³/h)<br>0.73 in³/h** |

[5] The volume rate is a measure of build speed during laser exposure of the skin area. The total build speed depends on this volume rate and many other factors such as exposure parameters of contours, supports, up and downskin, recoating time, Home-In or LPM settings.

## Physical and chemical properties of parts1

The chemical composition of parts is in compliance with standards “F899 – 12b Standard Specification for Wrought Stainless Steels for Surgical Instruments” and “A564M – 13 Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes”. Composition complies the material composition in “powder properties” section. Part accuracy is adjustable by changing the “Beam Offset, X-, Y- and Z-Shrinkage”-parameters.

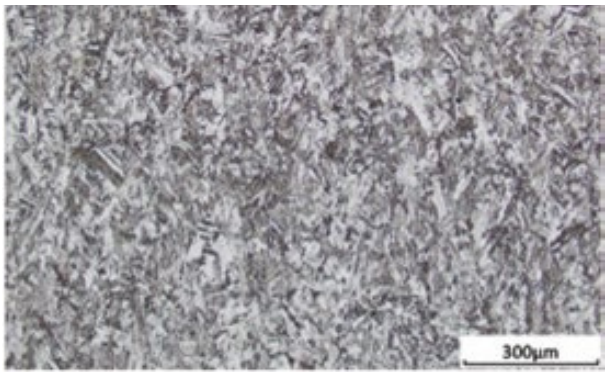
| | |
|---|---|
| Part density [6] | Mean 7.79 g/cm3<br>Mean 28.14 lbs/in3 |
| Part accuracy [7] | |
| Small parts | approx. ± 50 µm<br>approx. ± 1.1 · 10-3 inch |
| Min. wall thickness [8] | approx. 0.4 mm<br>approx. 0.016 inch |
| Typical shrinkage after HT (for parts 50mm) | 0.2% |

### Thermal expansion after atmospheric HT [9]

| | |
|---|---|
| 25 – 100°C | 10.4 10-6/K |
| 25 – 200°C | 11.0 10-6/K |
| 25 – 300°C | 11.4 10-6/K |
| 25 – 400°C | 11.8 10-6/K |
| 25 – 500°C | 12.0 10-6/K |

### Microstructure of heat treated parts

| | |
|---|---|
| Average porosity [10] | 0.030% |
| Average pore size [10] | 7.2 µm |
| N (number of samples) | 70 |




Atmospheric furnace (Atmospheric HT) was used to heat treat etched part.
Etchant: Marble’s reagent.
10 X magnification

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