Material data sheet

DirectMetal 20 for EOSINT M 270

A number of different materials are available for use with EOSINT M 270 systems, offering a broad range of e-Manufacturing applications. DirectMetal 20 is a special powder mixture which has been developed and optimized especially for processing on EOSINT M 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.

Description, application

DirectMetal 20

DirectMetal 20 is a very fine-grained bronze-based, multi-component metal powder. The resulting parts offer good mechanical properties combined with excellent detail resolution and surface quality. The surfaces can be easily post-processed by shot-peening and can be polished with very little effort. The specially developed powder mixture contains different components which expand during the building process, partially compensating for the natural solidification shrinkage and thereby enabling a very high part accuracy to be achieved.

This material is ideal for most prototype injection moulding tooling applications (DirectTool) and for many functional metal prototype applications (DirectPart). It offers a very high speed so is also suitable for larger tools and parts. It also offers a broad window of usable process parameters, e.g. a wide range of achievable mechanical properties and build speeds. Standard parameters use 20 µm layer thickness for the skin and 60 µm layers for the core. Areas built with core parameters have a porous structure, but still have good strength, and any remaining surface porosity can be closed by shot-peening.

Parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required. Unexposed powder can be reused.

Typical applications:

- injection moulds and inserts for moulding up to tens or even hundreds of thousands of parts in standard thermoplastics using standard injection parameters
- direct manufacture of functional metal prototypes.

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Technical data

General process data

Minimum recommended layer thickness	20 µm 0.8 mil
Typical achievable part accuracy [1]	± 20 – 50 µm 8 – 20 mil
Accuracy specification for qualification [2]	± (0.07 % + 50 µm) ± (0.07 % + 20 mil)
Min. wall thickness [3]	0.2 mm 0.008 in
Surface roughness	
- as built	R_a 9, R_z 40 – 50 µm R_a 0.35, R_z 1.6 – 2.0 mil
- after shot-peening	R_a 3, R_z 15 µm R_a 0.12, R_z 0.6 mil
- after polishing	R_z up to < 1 µm < 0.04 mil
Volume rate [4]	
- standard core parameters	25 mm³/s 5.5 in³/h
- standard skin parameters	9.2 mm³/s 2.0 in³/h

[1] Based on users' experience of dimensional accuracy for typical geometries, e.g. ± 20 µm when parameters can be optimized for a certain class of parts or ± 50 µm when building a new kind geometry for the first time.

[2] Valid for EOS standard qualification part and procedure

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

[4] Volume rate is a measure of build speed during laser exposure. DirectMetal parts are typically build using Skin & Core strategy, in some cases using inner and outer skins. The average volume rate for a particular part is therefore geometry-dependent. The total build speed depends on the average volume rate, the recoating time (related to number of layers) and other factors such as DMLS-Start settings.

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Physical and chemical properties of parts

Material composition	bronze-based matrix containing Ni
Density in skin areas	7.6 g/cm³ 0.27 lb/in³
Density in core areas	6.3 g/cm³ 0.23 lb/in³
Remaining porosity (min.) [5]	8 %

Mechanical properties of parts

Tensile strength (MPIF 10) [6]	400 MPa 58 ksi
Yield strength [6]	200 MPa 29 ksi
Transverse rupture strength (MPIF 41) [6]	700 MPa 101 ksi
Young's modulus	80 GPa 11.6 msi
Hardness [7]	110 HB, 115 HV (≅ 65 HRB)

[5] Any remaining surface porosity can be closed by shot-peening.

[6] Mechanical properties including strength can vary according to orientation, depending on the material and parameters used. The quoted values are measured parallel to the building plane (X or Y direction), which typically gives the best properties.

[7] Brinell hardness measurement (HB) according to DIN EN ISO 6506-1, abbreviated to HBW 2,5 / 62,5. Vickers hardness measurement (HV) according to DIN EN ISO 6507-1. Values in parentheses are converted in accordance with DIN 50150, which is applicable to cast steels and therefore only gives an indication for laser-sintered materials. Note that depending on the measurement method used, the measured hardness value can be dependent on the surface roughness and can be lower than the real hardness. To avoid inaccurate results, hardness should be measured on a polished surface.

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Thermal properties of parts

Coefficient of thermal expansion	18 x 10^{-6} m/m°C 32 x 10^{-6} in/in°F
Thermal conductivity	30 W/mK 208 Btu/(h ft² °F/in)
Maximum operating temperature	400 °C 750 °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, (outer) skin areas and test samples built in horizontal 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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