Certified Scalmalloy® (A)

Thoroughly developed print parameters and certification process support for APWORKS Scalmalloy material on 3D Systems DMP Flex 350 printers. Scalmalloy is the highest strength aluminum alloy processable by laser powder bed fusion.

3D Systems offers an optimized print parameter database license for Certified Scalmalloy (A) on the DMP Flex 350 metal 3D printer that can be applied using the integrated additive manufacturing workflow software, 3DXpert. 3D Systems' metal print parameters have been extensively developed, tested, and optimized in 3D Systems' part production facilities, which have the unique distinction of printing more than 1,000,000 challenging metal production parts in various materials, year over year. Based on a multitude of test samples, the properties listed below provide high confidence to the user in terms of job-to-job and machine-to-machine repeatability.

For companies looking to use the Scalmalloy brand name internally and externally on their DMP Flex 350 printers, 3D Systems offers a cost-effective standard service for smooth APWORKS certification through its Application Innovation Group (AIG).

Material Description

Scalmalloy is an aluminum alloy, with a chemical composition optimized for laser based powder bed fusion processes such as direct metal printing (DMP). Scalmalloy bridges the gap between traditional aluminum cast alloys (e.g., AlSi10Mg) and Ti Gr23, and provides a combination of high specific strength (strength-to-weight ratio), excellent corrosion resistance, and good thermal and electrical conductivity.

Within the aerospace, motorsports, semiconductor machinery, and transportation industries, Scalmalloy is used for its high strength-to-weight ratio, enabling customers to further reduce mass. The material is ideally suited for highly loaded, safety critical parts. Parts printed in Scalmalloy are corrosion resistant and can be chemically cleaned to meet the strict purity requirements of fluid flow applications.

CLASSIFICATION:

Scalmalloy is an approved material under the FIA regulations.

Mechanical Properties

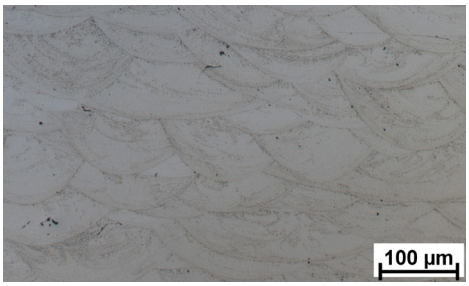
DMP FLEX 350 - LT 30[1,3,4,5]	TEST METHOD	METRIC	U.S.
		SR	SR
Ultimate tensile strength (MPa | ksi) Horizontal direction - XY Vertical direction - Z	ASTM E8	 520 ± 10 520 ± 15	 75 ± 2 75 ± 2
Yield strength Rp0.2% (MPa | ksi) Horizontal direction - XY Vertical direction - Z		 490 ± 10 490 ± 15	 71 ± 2 71 ± 2
Plastic elongation (%) Horizontal direction - XY Vertical direction - Z		 15.8 ± 2.7 15.8 ± 2.6	 15.8 ± 2.7 15.8 ± 2.6

DMP FLEX 350 - LT 60[2,3,4,5]	TEST METHOD	METRIC	U.S.
		SR	SR
Ultimate tensile strength (MPa | ksi) Horizontal direction - XY Vertical direction - Z	ASTM E8	 530 ± 10 520 ± 10	 77 ± 2 75 ± 2
Yield strength Rp0.2% (MPa | ksi) Horizontal direction - XY Vertical direction - Z		 500 ± 10 490 ± 10	 72 ± 2 71 ± 2
Plastic elongation (%) Horizontal direction - XY Vertical direction - Z		 14.0 ± 3.4 13.1 ± 3.0	 14.0 ± 3.4 13.1 ± 3.0

[1] Parts manufactured with standard parameters and protocols on a DMP Flex 350, Config B, using layer thickness 30 µm (LT30)
[2] Parts manufactured with standard parameters and protocols on a DMP Flex 350, Config B, using layer thickness 60 µm (LT60)
[3] SR is a heat treatment at 325 °C for 4 h, followed by air cooling (heat treatment advised by APWORKS)
[4] Tested according to ASTM E8 using round tensile test specimen type 4
[5] values based on average and 95% tolerance interval with 95% confidence

Thermal Properties

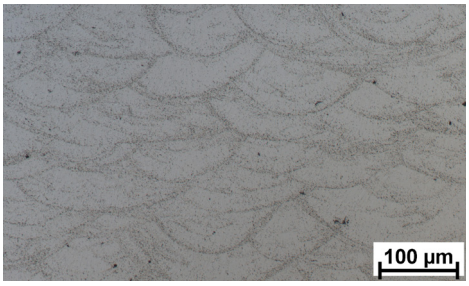
MEASUREMENT	CONDITION	METRIC	U.S.
		SR	SR
Thermal conductivity[6,7] (W/(m.K) | BTU·in/h·ft²·°F	at 20 °C / 68 °F	95-100	660-695
CTE - Coefficient of thermal expansion[8] (µm/(m.°C) | µ inch/(inch . °F))	in the range of 20 to 100 °C	Typical 23.5	Typical 13.1
Melting range[8] (°C | °F)		Typical 600 – 800	Typical 1110 – 1470



Microstructure without heat treatment (NHT)

Electrical Properties[6]

MEASUREMENT	CONDITION	METRIC	U.S.
		SR	SR
Electrical conductivity (10^6 S/m)	ASTM B193 at 20°C / 68°F	13-14	13-14



Microstructure after SR

Printed Part Properties[6]

DENSITY	TEST METHOD	METRIC	U.S.
Theoretical density[8] (g/cm³ | lb/in³)	Value from literature	2.67	0.096
Relative density (%), layer thickness 30 µm [9,10]	Optical method (pixel count)	≥ 99.6 Typical 99.8	≥ 99.6 Typical 99.8
Relative density (%), layer thickness 60 µm [9,10]	Optical method (pixel count)	≥ 99.5 Typical 99.7	≥ 99.5 Typical 99.7

SURFACE ROUGHNESS R_a [11,12]	TEST METHOD	METRIC	U.S.
Vertical side surface (µm | µin) Layer thickness 30 µm	ISO 25178	Typically, around 11	Typically, around 435
Vertical side surface (µm | µin) Layer thickness 60 µm	ISO 25178	Typically, around 13	Typically, around 510

To confirm the suitability of this material for your specific application, please contact the 3D Systems Application Innovation Group (AIG) (https://www.3dsystems.com). Once confirmed, Scalmalloy powder with reference SCALMA40B5 can be purchased directly from Toyal (https://www.toyalgroup.net/).

APWORKS

Toyal

3D SYSTEMS

www.3dsystems.com

[6] Parts manufactured with standard parameters and protocols on a DMP Flex 350, Config B using layer thickness 30 µm and 60 µm
[7] Thermal conductivity values are calculated by the Wiedemann-Franz law using the respective electrical resistivity values
[8] Values adopted from APWORKS material datasheet
[9] Minimum values based on 95% tolerance interval with a 95% confidence. Tested on specific 3DS density test coupons
[10] May deviate depending on specific part geometry
[11] Surface treatment performed with zirconia blasting medium at 2 bar
[12] Vertical side surface measurement along the building direction

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