PA11

MULTI JET FUSION

A BIO-DERIVED POWDER WITH EXCEPTIONALLY HIGH DUCTILITY AND IMPACT STRENGTH

A cost-efficient thermoplastic material used for creating functional and final parts across a diverse range of industries. PA11 offers impressive mechanical properties making it an ideal material for use in high load and high stress applications.

WHY CHOOSE PA11?

- High elongation at break
- High impact resistance
- Excellent resistance to chemicals, especially hydrocarbons, aldehydes, ketones, mineral bases and salts, alcohols, fuels, detergents, oils and fats
- Thermoplastic material delivering optimal mechanical properties
- Impact resistance and ductility
- Designed for production of final parts for a variety of industries
- Reliably produces functional prototypes and final parts with fine detail and dimensional accuracy

HOW DOES PA11 MINIMISE WASTE?

- 100 percent renewable raw material from vegetable castor oil for reduced environmental impact
- Reuse surplus powder batch after batch to minimise waste
- Consistent performance with up to 70 percent surplus powder reusability
- Non-hazardous component materials

HOW DOES MULTI JET FUSION TECHNOLOGY WORK?

- HP Multi Jet Fusion (MJF) is a powder-bed technology that is faster than comparable single point processes
- MJF technology uses a liquid fusing agent to create layers of PA11
- A detailing agent is used to create fine detail and to provide a smooth surface
- The part is created layer by layer using PA11 powder, liquid agents and heat
- The finished parts are cooled and cleaned

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TECHNICAL SPECIFICATIONS

	MEASUREMENT	VALUE	METHOD
GENERAL PROPERTIES	POWDER MELTING POINT (DSC)	202°C	ASTM D3418
	PARTICLE SIZE	54 µm	ASTM D3451
	BULK DENSITY OF POWDER	0.48 g / cm^3	ASTM D1895
	DENSITY OF PARTS	1.05 g / cm^3	ASTM D792
	RELATIVE DENSITY	99.99%[A]	-
	TYPICAL PART ACCURACY	IT GRADE 13	ISO 286
	RECOMMENDED WALL THICKNESS	1 - 20mm	HP DESIGN GUIDELINES MJF PA11
	MINIMUM HOLE DIAMETER	1mm	
	MINIMUM SHAFT DIAMETER	10mm	
	MINIMUM SLIT BETWEEN WALLS OR EMBOSSED DETAILS	0.5mm	
	MINIMUM PRINTABLE FEATURES	0.1mm	
	SURFACE ROUGHNESS λ_s = 8µm, GAUSS FILTER	R_a ~ 19 - 6	ISO 997
	COLOUR OF PARTS	BLACK, GREY	-

	MEASUREMENT	VALUE		METHOD
		XY	Z	
MECHANICAL PROPERTIES[B]	TENSILE STRENGTH[C], MAX LOAD	54 MPa	54 MPa	ASTM D638
	TENSILE MODULUS[D]	1700 MPa	1800 MPa	
	ELONGATION AT YIELD[E]	25 %	20 %	
	ELONGATION AT BREAK[F]	40 %	25 %	
	FLEXURAL STRENGTH (@ 5%)	70 MPa	70 MPa	ASTM D790
	FLEXURAL MODULUS	1800 MPa	1800 MPa	
	IMPACT STRENGTH[G] (@ 3.2 mm, 23° C)(kJ/m^2)	7.0	4.5	ASTM D256 Test Method A
	SHORE HARDNESS (D)	80	80	ASTM D2240

	MEASUREMENT	VALUE		METHOD
		XY	Z	
THERMAL PROPERTIES	HEAT DEFLECTION TEMPERATURE[H] (@ 0.45 MPa, 66 psi)	185°C	185°C	ASTM D648 Test Method A
	HEAT DEFLECTION TEMPERATURE[H] (@ 1.82 MPa, 264 psi)	54°C	54°C	

	MEASUREMENT
CERTIFICATIONS	USP CLASS I-VI AND US FDA GUIDANCE FOR INTACT SKIN SURFACE DEVICES[I], RoHS, REACH, PAHs, STATEMENT OF COMPOSITION FOR TOY APPLICATIONS

For detailed datasheet refer https://www.hp.com/us-en/printers/3d-printers/materials.html

References:

A. Research article: A Comprehensive Investigation on 3D Printing of Polyamide 11 and Thermoplastic Polyurethane via Multi Jet Fusion (mdpi.com)

B. The following technical information should be considered representative of averages or typical values and should not be used for specification purposes. These values are with FW TATDAG_15_18_11.69 and have been obtained from a sample of specimens printed in plots with 6% packing density. Separation between specimens in the plot was 10 mm. Modulus has been calculated using the slope of the regression line between 0.05% and 0.25% strain measured with an automatic extensometer during the entire test. Cross-section dimension obtained using a micrometer with round ends. Conditioning according to ASTM D618 Procedure A: 48 hours after printing and unpacking of the parts at 23°C/73°F and 50% RH. Orientations defined according to ASTM F2971

C. Tensile strength typical variation (95% of parts) falls within the 50-58 MPa range. Test results realised under the ASTM D638 with a test rate of 10 mm/min, specimens type V. Tensile strength is the capacity of a material to withstand tension loads.

D. Tensile modulus typical variation (95% of parts) falls within the 1500 to 2200 MPa range. Test results realised under ASTM D790 Procedure B at a test rate of 13.55 mm/min. Tensile modulus (also Young's Modulus or E) is a mechanical property that measures the stiffness of a solid material. It defines the relationship between stress and strain in a material in the linear elasticity regime. Since thermoplastics have a very short linear elasticity zone, it is calculated as the slope of the stress-strain curve very close to zero.

E. Elongation measures the deformation that a part undergoes given a certain stress. For thermoplastics, it is typically expressed as a percentage (%) of the deformed amount versus the original part length.

F. Elongation at break is the deformation corresponding to the fracture point of the part.

G. Impact strength measures the impact resistance of a material or the amount of energy absorbed by a material during fracture associated with its toughness. There are two standard methods to measure impact strength: the Izod and the Charpy. Notched and un-notched specimens are used on the specific pendulum testers to determine the impact strength and the notch sensitivity.

H. Heat deflection temperature is defined as the temperature at which a standard test bar deflects a specified distance under a load. It is used to determine short-term heat resistance. It is determined at different loads, for example, 1.8MPa (264 psi), which helps to determine maximum service temperature of parts, and 0.46Mpa, which provides an estimate of the service temperature a given polymer can withstand. Other settings like speed of the temperature increase or even part design will significantly influence the final thermal performance of the part.

I. Based on HP internal testing, June 2017, HP 3D600 Fusing and Detailing Agents and HP 3D High Reusability PA 11 powder meet USP Class I-VI and US FDA's guidance for Intact Skin Surface Devices. Tested according to USP Class I-VI including irritation, acute systemic toxicity, and implantation; cytotoxicity per ISO 10993-5, Biological evaluation of medical devices part 5: Tests for in vitro cytotoxicity; and sensitisation per ISO 10993-10, Biological evaluation of medical devices Part 10: Tests for irritation and skin sensitisation. It is the responsibility of the customer to determine that its use of the fusing and detailing agents and powder is safe and technically suitable to the intended applications and consistent with the relevant regulatory requirements (including FDA requirements) applicable to the customer's final product. For more information, see hp.com/go/biocompatibilitycertificate/PA11.

To receive baseline costs for rapid prototyping, upload your design files using the online portal at www.bowman3D.com

To discuss production volume 3D printing, speak to our specialist team:

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