



Q10plus v2.0 Ti6Al4V Grade 23

Parameters for the Arcam EBM Q10plus v2.0

Data in this material datasheet represents material built with 50 µm layer thickness and in a vacuum atmosphere. Values listed are typical.



Ti6Al4V – Grade 23

The high strength, low weight ratio and outstanding corrosion resistance inherent to titanium and its alloys has led to a wide and diversified range of successful applications demanding high levels of reliable performance. These can be found in surgery and medicine, aerospace, power generation, and several other major industries. The biocompatibility of all Ti6Al4V grades is excellent, especially when direct contact with tissue or bone is required. Ti6Al4V Grade 23 provide improved ductility and fracture toughness compared to the closely related Grade 5, often making this the grade of choice for medical applications.

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In the Arcam EBM Q10plus v2.0 machine the process runs at a powder bed temperature of around 700° C. The elevated powder bed temperature eliminates the need for post-build stress-relieving and allows the building of parts in multiple layers in the Z-direction which further increases productivity. The chosen layer thickness enables both high build speed and high resolution.

The machine parameter set includes settings for both solid and porous structures and is proven ready for medical device production out-of-the-box.



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This material is developed as a standard material according to Production level (P-material), see “Arcam EBM Maturity Levels” section. The process parameters have been developed to be applicable for a wide range of geometries and applications. The process parameters can be further optimized to suit the specific needs for individual applications. The parameters set fulfils ASTM F3001 standard both regards to chemical composition as well as mechanical properties.

POWDER

- Ti6Al4V Grade 23 powder chemical composition according to ASTM F136-02a / ASTM F3001. For additional information on Ti6Al4V Grade 23 powder, visit <https://www.advancedpowders.com/powders/titanium/ti-6al-4v-23>.
- Powder size distribution: 45-106 μm

MACHINE CONFIGURATION

- Arcam EBM Q10plus v2.0
- EBM Control 5.3.63

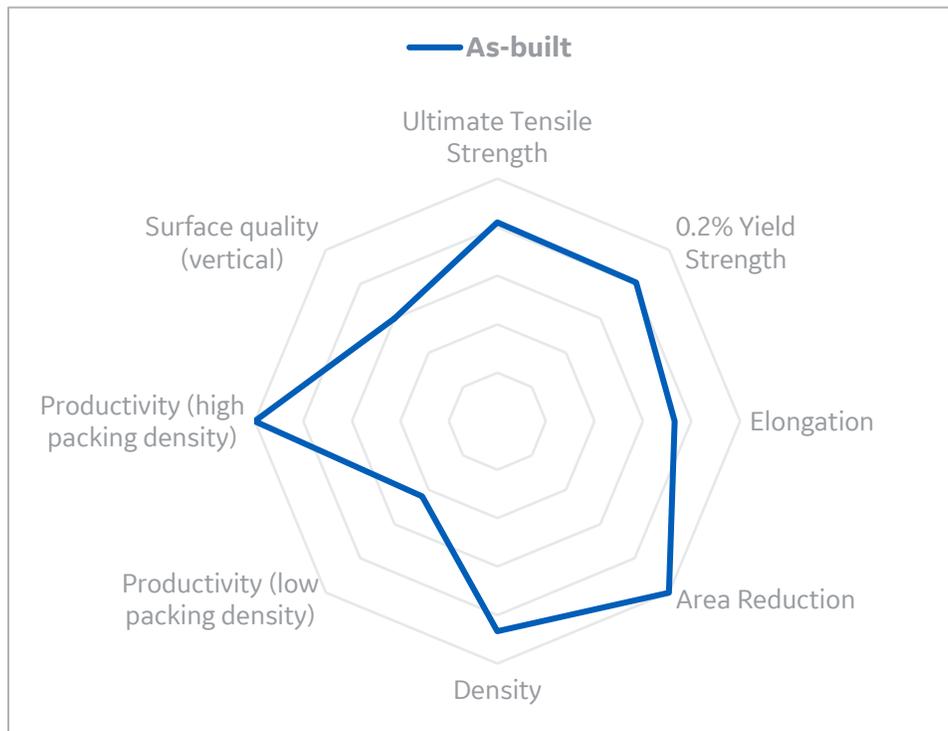
AVAILABLE PARAMETERS

- Parameter file: *PF Q10plus v2.0 Ti64 50 μm*

THERMAL TREATMENTS

1. As-Built

SPIDER PLOT



Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For Titanium Alloys, the ranges are as follows: UTS: 0-1200 MPa, 0.2%YS: 0-1100 MPa, Elongation: 0-20 %, Density: 99-100 %, Productivity: 5-30 cm^3/hr , Surface Quality (all): 50-4 μm

PHYSICAL DATA AT ROOM TEMPERATURE

Q10plus v2.0 Ti64 50 μm

	Surface Roughness – Overhang [μm]			H	Surface Roughness S _a [μm]	
	45°	60°	75°		--	
	Upskin	Downskin			XZ 32, YZ 28	
	Porosity [% Density]		Hardness [HV30]	Poisson's Ratio		
	H	V		H	V	
Thermal State 1 As-Built	99.9	99.9	322	--	--	

TENSILE DATA AT ROOM TEMPERATURE

Tensile testing done in accordance with ASTM E8 and ASTM E21

	Modulus of Elasticity [GPa]		0.2% YS [MPa]		UTS [MPa]		Elongation [%]		Reduction of Area [%]	
	H	V	H	V	H	V	H	V	H	V
	Thermal State 1 As-Built	--	--	881	896	979	988	12.3	16.9	34.0

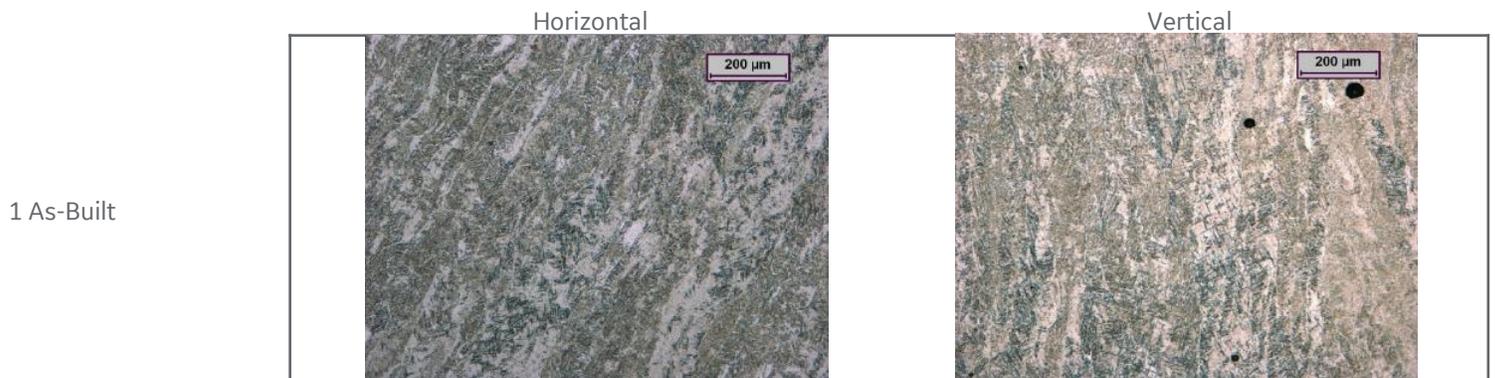
TYPICAL BUILD RATE

Typical build rate, low packing density ¹	13 [cm ³ /h]
Typical build rate, high packing density ²	34 [cm ³ /h]

¹Measured by using Factory Acceptance Test layout, door closed to door opened. Build rate varies with build lay-out, nesting of parts and process parameters among other factors.

²Measured as above on the Process Verification 1 layout.

SEM IMAGES



H: HORIZONTAL (XY) orientation
V: VERTICAL (Z) orientation

* All of the figures contained herein are approximate only. The figures provided are dependent on a number of factors, including but not limited to, process and machine parameters, and the approval is brand specific and/or application specific. The information provided on this material data sheet is illustrative only and cannot be relied on as binding.

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POWDER COMPOSITION

Element	ASTM F3001 requirement [wt.%]	Typical composition of solid material [wt.%]
Aluminum	5.50 – 6.50	6.15
Vanadium	3.50 – 4.50	3.99
Iron	Max 0.25	0.19
Oxygen	Max 0.13	0.12
Carbon	Max 0.08	0.016
Nitrogen	Max 0.05	0.015
Hydrogen	Max 0.012	<0.001
Yttrium	Max 0.005	<0.001
Other elements, each	Max 0.10	-
Other elements, total	Max 0.40	-
Titanium	Balance	Balance

ARCAM EBM MATURITY LEVELS

Development Material (D-material)

- Mechanical data available for limited build envelope and conforming to relevant industrial standards
- Capable of building complex geometries, mechanical data not guaranteed
- Offered to all customers as a general release

Production Material (P-material)

- Fully verified according to Arcam EBM Process Verification
- Mechanical data available for full build envelope and conforming to relevant industrial standards
- Capable of building a wide range of complex geometries, including typical applications for the relevant industries
- Offered to all customers as a general release

Industrialized Material (I-Material)

- Can be developed either with a P or D Material as a starting point
- Optimized for production for a customer with a specific application
- Can be developed by the customer, require appropriate training and time
- Development service to I material is offered by GE Additive AddWorks as fast track