GE Additive

13 Al

22 Ti | 24 Cr | 26 Fe | 27 Co | 28 Ni | 29 Cu

M2 Series 5 Cobalt Chrome Balanced+

Premium+ Parameter for Concept Laser M2 Series 5

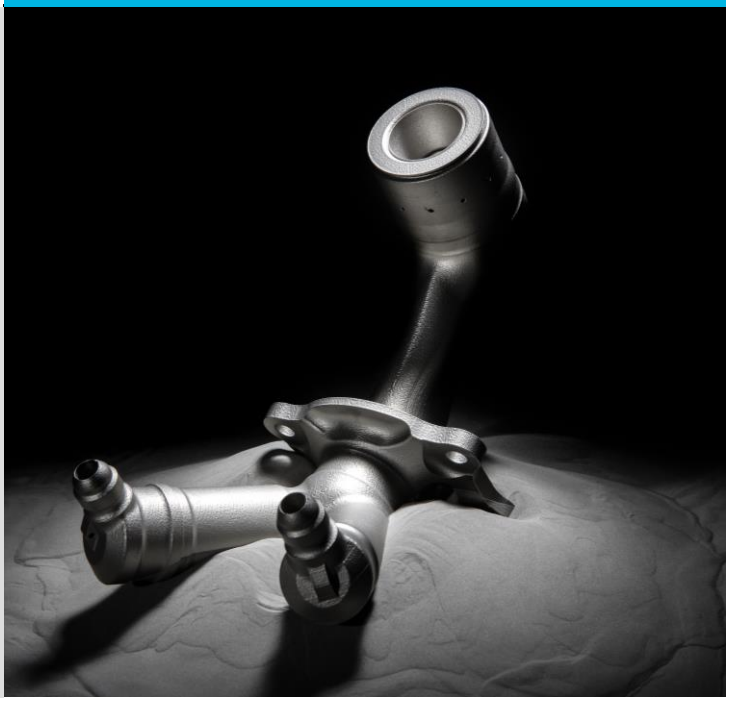
Data in this material datasheet represents material built with 50µm layer thickness and in a Nitrogen atmosphere on a Concept Laser M2 Series 5 single laser or dual laser machine, and requires build plate heating. Values listed are typical.

Cobalt Chrome

Parts are fabricated from cobalt chrome alloys like ASTM F75 CoCr when excellent resistance to high temperatures, corrosion and wear is critical. It is an appropriate selection where nickel-free components are required, such as in orthopedic and dental applications due to the hardness and bio-compatibility necessary for long-term performance. Cobalt chrome alloys are used in additive manufacturing to print parts that often benefit from hot isostatic pressing (HIP), which combines high temperatures and pressures to induce a complex diffusion process that strengthens grain structures, producing fully dense metal parts.

M2 Series 5 Cobalt Chrome Balanced+

This is the machine and parameter developed for the fuel nozzle and other aerospace applications. We have worked closely together with our customers optimizing around speed and productivity, part to part and machine to machine consistency, reliability, uptime and quality control. Thousands of development hours and rigorous testing resulted in unprecedented productivity while offering excellent surface finish, feature resolution, mechanical strength, fatigue capability, and buildability. This is why the parameter is named Balanced+, delivering the best of productivity and performance.



M2 Series5 Cobalt Chrome Balanced+

With appropriate approval* Cobalt Chrome can be used for aerospace, orthopedic, and dental applications.

Data in this material datasheet represents material built with 50µm layer thickness and in a Nitrogen atmosphere on a Concept Laser M2 Series 5 single laser or dual laser machine, and requires build plate heating.
Values listed are typical.

POWDER CHEMISTRY

Cobalt Chrome (CoCrMo) powder chemical composition according to ASTM F75.

MACHINE CONFIGURATION

- Concept Laser M2 Series 5 (Single Laser or Dual Laser)
- Nitrogen Gas
- Stainless steel recoater blade

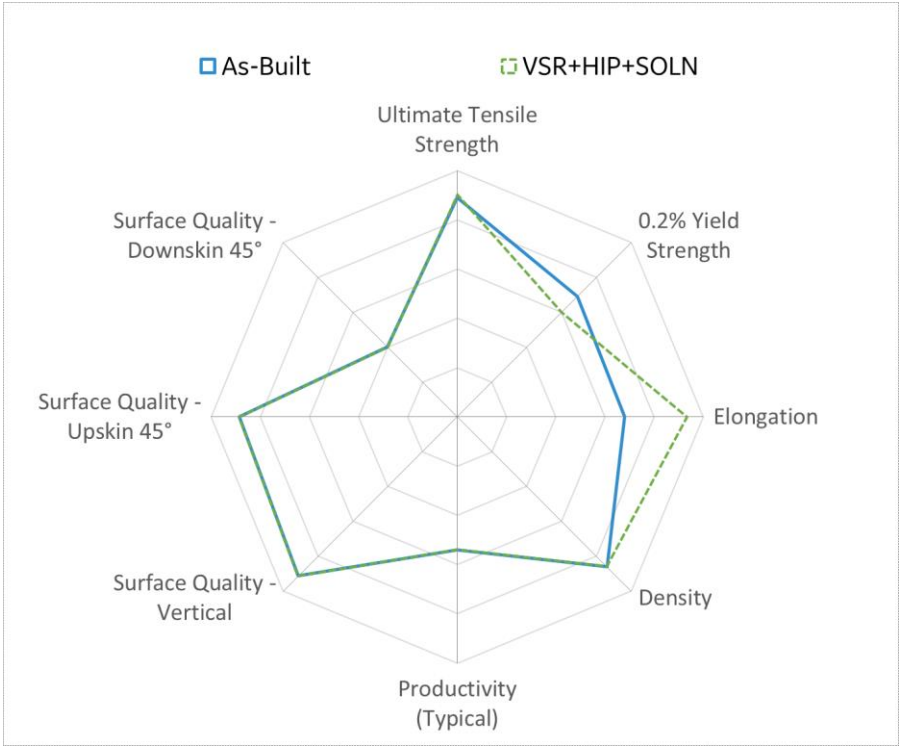
AVAILABLE PARAMETERS

- **Balanced+ Parameter 86** 50 µm layer thickness, steel recoater

THERMAL STATES

1. As-Built
2. Vacuum Stress Relief + Hot Isostatic Press + Solution (VSR+HIP+SOLN)
   VSR: 1052°C, 2 hrs in vacuum; HIP: 1204°C, 3-5 hrs, 100 MPa minimum; SOLN: 1190°C, 1 hr in vacuum

THERMAL STATE COMPARISON



Spider Plot is generated by normalizing typical material data (containing both horizontal and vertical data) against a range defined for each material family. For **Cobalt Alloys,** the ranges are as follows: UTS: 0-1450 MPa, 0.2%YS: 0-1150 MPa, Elongation: 0-60%, Density: 95-100%, Productivity: 5-30 cm³/hr, and Surface Quality (all): 40-5 µm.

TYPICAL BUILD RATE

Parameter 86

	(cm³/h)
Typical build rate* w/coating[1]	16.2
Theoretical melting rate** bulk per Laser[2]	18.0

[1]Measured by using standard Factory Acceptance Test layout
[2]Calculated (layer thickness x scan velocity x hatch distance)

PHYSICAL DATA AT ROOM TEMPERATURE

	Surface Roughness - Overhang (µm)		
	45°	60°	75°
Upskin	9	7	7
Downksin	26	15	7

	Surface Roughness (µm)
H	--
V	8

	Porosity (% Density)		Hardness (HV10)		Poisson's Ratio	
Thermal State	H	V	H	V	H	V
As-Built	99.93	99.93	408	408	--	--
VSR+HIP+SOLN	--	--	--	--	0.352	0.352

HORIZONTAL **Thermal State**	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (m/m/°C)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIP+SOLN	12.2	11.5×10^{-6}	3.2×10^{-6}	452

VERTICAL **Thermal State**	Thermal Conductivity (W/m•K)	Coeff. Of Thermal Expansion (m/m/°C)	Thermal Diffusivity (m^2/s)	Specific Heat (J/K•kg)
As-Built	--	--	--	--
VSR+HIL+SOLN	12.2	11.5×10^{-6}	3.2×10^{-6}	452

TENSILE DATA

Tensile testing done in accordance with ASTM E8 and ASTM E21

Temperature: RT

	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	--	185	--	795	--	1290	--	16.1	--	--
VSR+HIP+SOLN	230	225	695	685	1320	1300	45.3	46.3	34.0	35.0

Temperature: 538°C

	Modulus of Elasticity (GPa)		0.2% Yield Strength (MPa)		Ultimate Tensile Strength (MPa)		Elongation (%)		Reduction of Area (%)	
Thermal State	H	V	H	V	H	V	H	V	H	V
As-Built	--	--	--	--	--	--	--	--	--	--
VSR+HIP+SOLN	180	175	375	365	1200	1185	50.0	51.1	37.0	37.1

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.

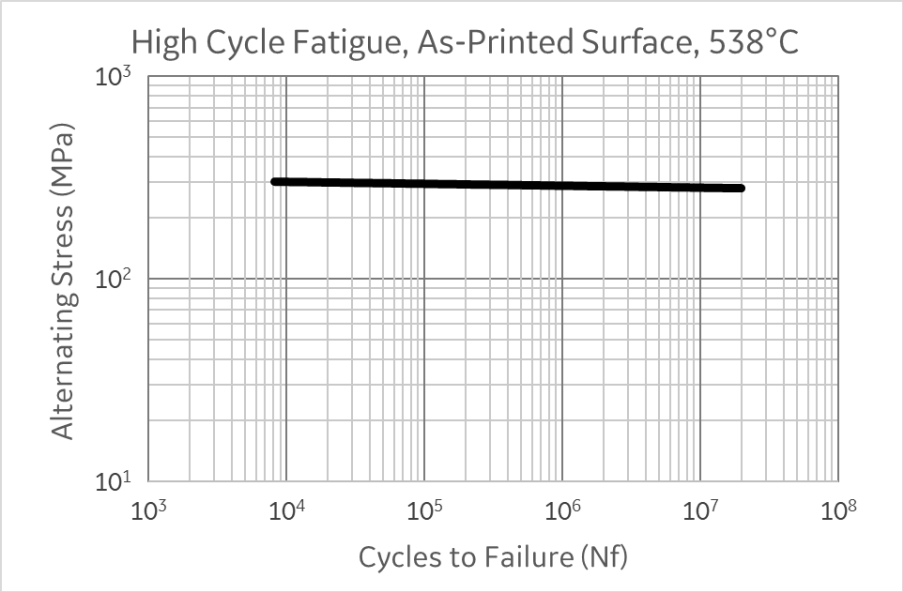
HIGH CYCLE FATIGUE DATA (LOAD-CONTROLLED)

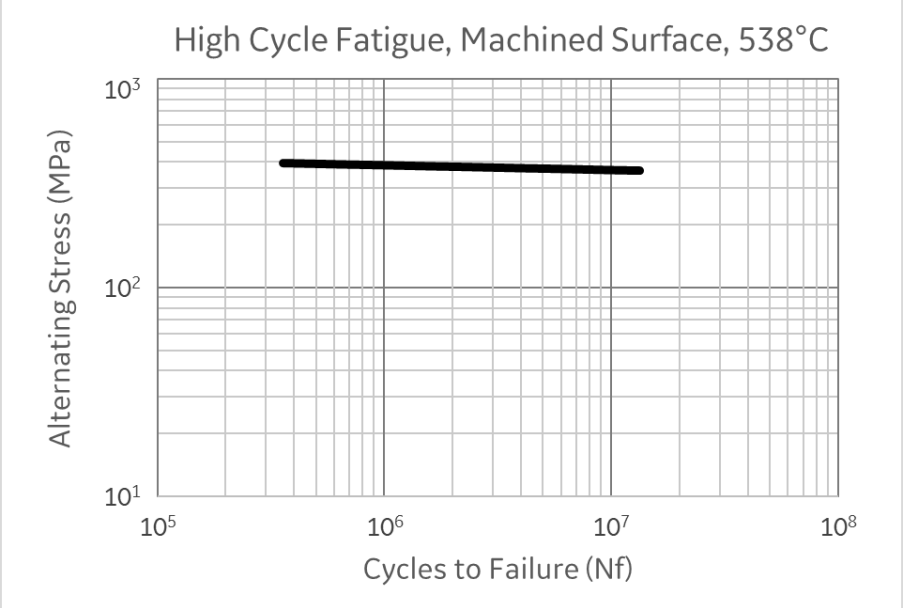
Parameter 86

HCF testing done in accordance with ASTM E466
Test Frequency: 60 Hz

R-Ratio: 0
Temperature: 538°C

	AS-PRINTED SURFACE Alt Stress at 10^7 cycles (MPa)		MACHINED SURFACE Alt Stress at 10^7 cycles (MPa)	
Thermal State	H	V	H	V
As-Built	--	--	--	--
VSR+HIP+SOLN	280	280	365	365





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