CARPENTER ADDITIVE®

DATASHEET

PowderRange CCM®

Applicable specifications: ASTM F75

Associated specifications: ASTM F3213, UNS R31537, UNS R30075, ASTM F1537, ISO 5832-4, ISO 5832-12

Type analysis

Single figures are nominal except where noted.

Cobalt	Balance	**Chromium**	27.00–30.00 %	**Molybdenum**	5.00–7.00 %
Manganese	1.00 %	**Silicon**	1.00 %	**Iron**	0.75 %
Nickel	0.50 %	**Nitrogen**	0.25 %	**Tungsten**	0.20 %
Aluminum	0.10 %	**Carbon**	0.10 %	**Oxygen**	0.10 %
Titanium	0.10 %	**Phosphorus**	0.020 %	**Boron**	0.010 %
Sulfur	0.010 %				

Description

PowderRange CCM is a non-magnetic, cobalt-chromium-molybdenum alloy exhibiting high strength, corrosion resistance, wear resistance, and excellent biocompatibility. This alloy meets the low carbon wrought version of ASTM F 75 Cast Alloy. PowderRange CCM powder is produced by vacuum induction melting (VIM) followed by nitrogen gas atomization. It has excellent weldability in laser additive manufacturing processes and can be processed with either nitrogen or argon shielding gas.

PowderRange CCM exhibits high strength up to 1112 °F (600 °C) and maintains mechanical properties under a variety of corrosive environments. When specified with nickel content below 0.1%, PowderRange CCM is biocompatible. It can also be used in Magnetic Resonance Imaging (MRI) equipment, as it is non-magnetic. These properties make PowderRange CCM ideal for small biomedical devices where high strength and fatigue resistance are required.

Key Properties:

- High strength to 1112°F (600°C)
- Wear and erosion resistant
- Biocompatible and non-magnetic — suited for small biomedical devices

Markets:

- Energy
- Medical

Applications:

- Orthopedic and dental implants
- Medical fracture fixation devices
- Gas turbine nozzle and instrumentation devices
- Oil and gas tooling and instrumentation

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Powder properties

PART NUMBER	PowderRange CCM F	PowderRange CCM E
APPLICATION	L-PBF[1]	EB-PBF or DED[1]
MAXIMUM PARTICLE SIZE	Max 1 wt% > 53 μm[2]	Max 10 wt% > 106 μm[2]
MINIMUM PARTICLE SIZE	Max 10 vol% < 15 μm[3]	Max 10 wt% < 45 μm[2]
LSD PERCENTILE	D10, D50, D90[3], reported	
ATOMIZATION	Vacuum Induction Melted, Nitrogen Gas Atomized	
APPARENT DENSITY (G/CM³)	Measured according to ASTM B212[4] and reported	
HALL FLOW (S/50G)	Measured according to ASTM B213[5] and reported	

[1] ASTM/ISO 52900: Laser — Powder Bed Fusion (L-PBF), Electron-Beam Powder Bed Fusion (EB-PBF), Directed Energy Deposition (DED)
[2] ASTM B214 Standard Test Method for Sieve Analysis for Metal Powders
[3] ASTM B822 Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering
[4] ASTM B212 Standard Test Method for Apparent Density of Free-Flowing Metal Powders Using the Hall Flowmeter Funnel
[5] ASTM B213 Standard Test Method for Flow Rate of Metal Powders Using the Hall Flowmeter Funnel
Testing of powder will fulfill certification requirements to Nadcap Materials Testing and ISO/IEC 17025 Chemical, per relevant ASTM procedures

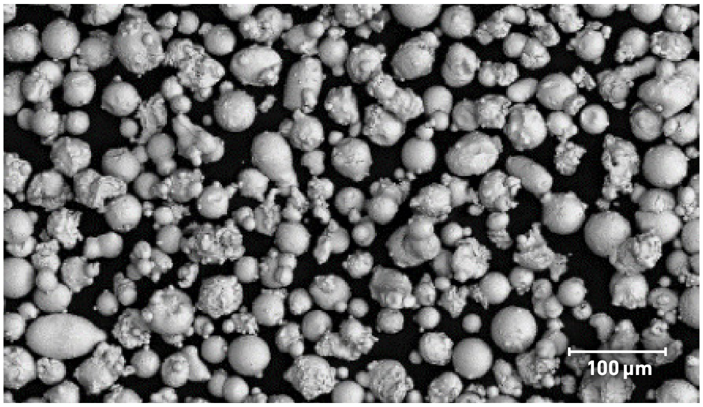

FIGURE 1 — SEM IMAGE OF TYPICAL POWDERRANGE CCM POWDER

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Additive manufacturing process guidance

ASTM F3213[6]	
Laser-Powder Bed Fusion (L-PBF) As-built	PowderRange CCM for additive manufacturing is compatible with all commercially available L-PBF equipment. To achieve mean, as-built density >99.9%, 20 to 60 μm layer thicknesses and Specific Energy ≥ 55 J/mm^3 is recommended.
Anneal Heat Treatment (ANN)	Standard solution heat treatment schedules can be applied to balance tensile and stress rupture mechanical properties. Example Anneal Treatment per ASTM F3213-17 section 12.1: Process under inert conditions at 2219°F (1215°C) for 2 hours followed by cooling at greater than 396°F/min (220°C/min) to 1004°F (540°C). Cool equivalent to air to room temperature. **Schedules better tailored to the AM process thermal history may be available. Please contact Carpenter Technology for information.**
Hot Isostatic Pressed condition (HIP/ANN)	We recommend HIP'ing as standard practice for microstructure homogenization; removal of residual spatter-induced voids, trapped gas porosity in powder and keyhole porosities; as well as to heal any shrinkage-induced micro-cracks in the material. **To achieve up to full density (100%):** Process components per ASTM F3213 section 13: minimum pressure of 14.5 ksi (100 MPa) at a temperature of approximately 2200°F (1204°C) for 240 minutes in argon.
Machinability	PowderRange CCM is difficult to machine in any heat-treated condition due to its extremely high work hardening rate, low thermal conductivity, and abrasive carbides and intermetallics in the microstructure. Tool geometry, rigidity, and adequate machine power are all extremely important considerations.

[6] *ASTM F3213: Additive Manufacturing – Finished Part Properties – Standard Specification for Cobalt-28 Chromium-6 Molybdenum via Powder Bed Fusion*

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Corrosion resistance

IMPORTANT NOTE:
The following 4-level rating scale (Excellent, Good, Moderate, Restricted) is intended for comparative purposes only and is derived from experiences with wrought product. Additive manufactured material may perform differently; corrosion testing is recommended. Factors that affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish, and dissimilar metal contact.

Nitric Acid	Excellent	**Sulfuric Acid**	Good
Phosphoric Acid	Good	**Acetic Acid**	Excellent
Sodium Hydroxide	Moderate	**Salt Spray (NaCl)**	Excellent
Sea Water	Good	**Humidity**	Excellent

For additional information, please contact your nearest sales office:

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The mechanical and physical properties of any additively-manufactured material are strongly dependent on the processing conditions used to produce the final part. Significantly differing properties can be obtained by utilizing different equipment, different process parameters, different build rates and different geometries. The properties listed are intended as a guide only and should not be used as design data.

The information and data presented herein are typical or average values and are not a guarantee of maximum or minimum values. Applications specifically suggested for material described herein are made solely for the purpose of illustration to enable the reader to make his/her own evaluation and are not intended as warranties, either express or implied, of fitness for these or other purposes. There is no representation that the recipient of this literature will receive updated editions as they become available.