GE Additive

Spectra H v1.0 Highly Alloyed Tool Steel

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Parameters for the Arcam EBM Spectra H v1.0

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

Cold work tool steel

Cold work tool steels are, as opposed to hot work tool steels, used when the components to be machined are in cold condition. This puts high requirements on hardness, wear resistance and ductility on the cutting tool material while retaining good machinability. To achieve the desired set of properties the cold work tool steels have a higher alloying content than the hot work tool steels. Together with appropriate heat treatments a hardness of > 60 HRC can be reached. Typical applications for cold work tool steels can be found in Cutting tools, Cold forging, Cold extrusion, Deep drawing, Blanking and punching or Powder pressing.

Arcam EBM Spectra H v1.0 Highly Alloyed Cold Work Tool steel

The Highly Alloyed Cold Work Tool steel process runs at a powder bed temperature of around 850° C. This allows for the unique possibility of additive production with this highly crack-prone alloy class.
Presented properties are for a representative type of Cold Work tool steel chemistry. With the correct combination of parameter set and heat treatments both lower and higher alloying degrees are possible.
Especially for complex geometries this makes EBM a highly competitive alternative to Powder Metallurgy by enabling a significant reduction in lead time of the tool itself.

Spectra H v1.0 Highly Alloyed Tool Steel

This material is developed to Development level (D-material), see “Arcam EBM Maturity Levels” section. The parameter set has been partially developed for a limited range of geometries, chemistries and applications as proof of concept. The parameter set needs further optimization to suit the specific needs for individual applications. The mechanical properties can be tailored with the applied heat treatment. This will depend on the powder chemistry used where both higher and lower alloying degrees than those presented are possible.

POWDER AND CHEMISTRY

- Powders from three separate powder suppliers have been tested, see powder chemistries in Table 1 below
- GE Additive can provide recommendations to fit your application
- Powder size distribution for all powders: 45-150 µm
- Chemistry of powder and built material not limited to the below chemistry
- No or very low evaporation of elements allows for high C-content material processing

Table 1 – chemistries of evaluated powder materials

	Element	C	Si	Mn	Cr	Mo	V	W
Vendor A	(wt.-%)	1.39	0.40	0.34	4.59	3.56	3.7	-
Vendor B	(wt.-%)	1,21	0,68	0,31	4,58	4,53	4,04	5,57
Vendor C	(wt.-%)	1,30	0,66	0,28	3,86	4,80	2,99	6,10

MACHINE CONFIGURATION

- Arcam EBM Spectra H v1.0
- EBM Control 5.5.33

AVAILABLE PARAMETERS

- Development level (D-material) parameter set available, see section “Arcam EBM Maturity Levels”

MATERIAL PROPERTIES

- In general, as-built microstructure and material properties depend strongly on applied process temperature
- As-built condition may not be suitable for end-use
- The final microstructure and mechanical properties depend strongly on the applied heat treatment
- Properties such as ductility, impact toughness or hardness can be tailored according to application requirements
- Typical values for hardness available in Table 2 below. Results based on all three evaluated powders and one single heat treatment. Note that these can be further optimized with modifications to the parameter set, heat treatment or powder chemistry.

Table 2 – typical hardness values achievable with evaluated powder materials

Component state	Typical hardness [HRC]
As-built condition	~57
After heat treatment	~63

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MICROSTRUCTURE

- The Arcam EBM Highly Alloyed Tool Steel as-built material in general exhibits a very fine and homogeneous microstructure. The fine dispersed carbides are well distributed within the equiaxed grains.
- Grain size is depending on process parameters.
- Depending on the process temperature, different carbide types can occur as visible in the following figures.

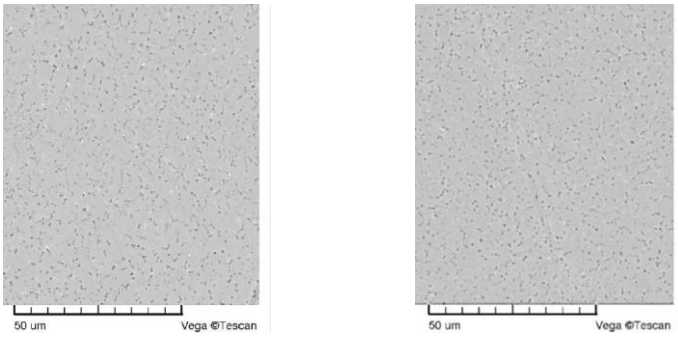

Figure 1 - As-built microstructure in vertical (left) and horizontal (right) build direction of Vendor A powder. Primary VC finely distributed in the matrix can be observed.

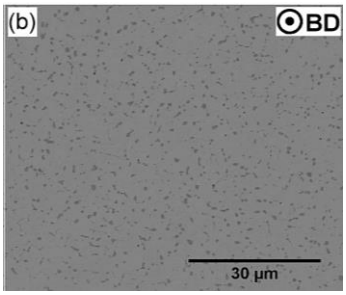

Figure 2 - A fine and homogeneous microstructure is achieved showing a VC content of about 8 vol.-% in Vendor A powder after HT.

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