



Senvol Indexes

Data sets for additive manufacturing material characterization

Data Set Available for Purchase

This Senvol Index is a data set of the Arcam (AP&C) Ti6Al4V material processed on the Arcam A2X machine.

| Material Used | Machine Used | Manufacturing | Testing |
|----------------------|--------------|--|---|
| Arcam (AP&C) Ti6Al4V | Arcam A2X | All test specimens were manufactured at an AS9100 certified facility | All test specimens were tested at a NADCAP and A2LA accredited facility |

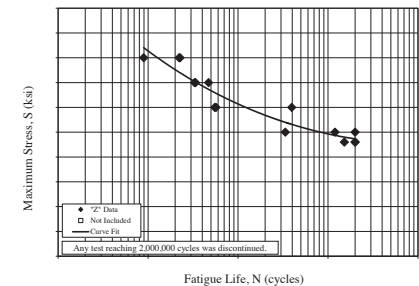
This Senvol Index includes data on: (A) Test Specimen Properties, (B) Process Parameters, and (C) Feedstock Properties.

Test Specimen Properties

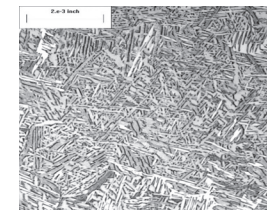
Material property test results reported are:

| Test Procedure | Standard | Total # of Tests |
|--------------------------------------|--------------|------------------|
| Tensile | ASTM E8 | 48 |
| Tensile Modulus | ASTM E111 | 16 |
| High Cycle Fatigue (5 stress levels) | ASTM E466 | 64 |
| Hardness | ASTM E18 | 48 |
| Compression | ASTM E9 | 48 |
| Double Shear | ASTM B769 | 48 |
| Coefficient of Thermal Expansion | ASTM E831 | 4 |
| Metallographic | ASTM E112/E3 | 48 |
| Density | ASTM B311 | 4 |
| Chemistry (O & N Content) | ASTM E1409 | 12 |
| Chemistry (H Content) | ASTM E1447 | 12 |
| Chemistry (Spectroscopy) | ASTM E2371 | 12 |

Example S/N Curve:



Example Microstructure Image:

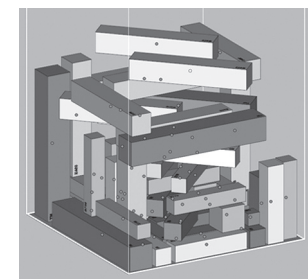


Process Parameters

Process parameters were documented for the test specimens that were built. Examples of the 75+ parameters include:

- Locations on the build plate (3 locations)
- Orientation of part (4 orientations)
- Process theme / machine parameters
- Software version
- Build start temperature
- Hot isostatic pressure post-processing parameters

Image of AM Build (Without Supports):



Feedstock Properties

The specific feedstock used was tested. Examples of the feedstock characteristics reported include:

- Powder lot
- Particle size distribution (ASTM B214)
- Chemical composition (e.g. ASTM E1409, E1941)

Example of Test Results:

| Element | Required | Measured | Testing Method | Status |
|---------------|-----------|------------|----------------|------------|
| Aluminum (Al) | 5.50-6.75 | ██████████ | ASTM E2371 | Conforming |
| Vanadium (V) | 3.50-4.50 | ██████████ | ASTM E2371 | Conforming |
| Iron (Fe) | <0.3 | ██████████ | ASTM E2371 | Conforming |
| Oxygen (O) | <0.2 | ██████████ | ASTM E1409 | Conforming |
| Carbon (C) | <0.08 | ██████████ | ASTM E1941 | Conforming |
| Nitrogen (N) | <0.05 | ██████████ | ASTM E1409 | Conforming |
| Hydrogen (H) | <0.015 | ██████████ | ASTM E1447 | Conforming |
| Yttrium (Y) | <0.005 | ██████████ | ASTM E2371 | Conforming |
| Others, each | <0.10 | ██████████ | ASTM E2371 | Conforming |
| Others, total | <0.40 | ██████████ | ASTM E2371 | Conforming |
| Titanium (Ti) | Remainder | ██████████ | ASTM E2371 | Conforming |

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