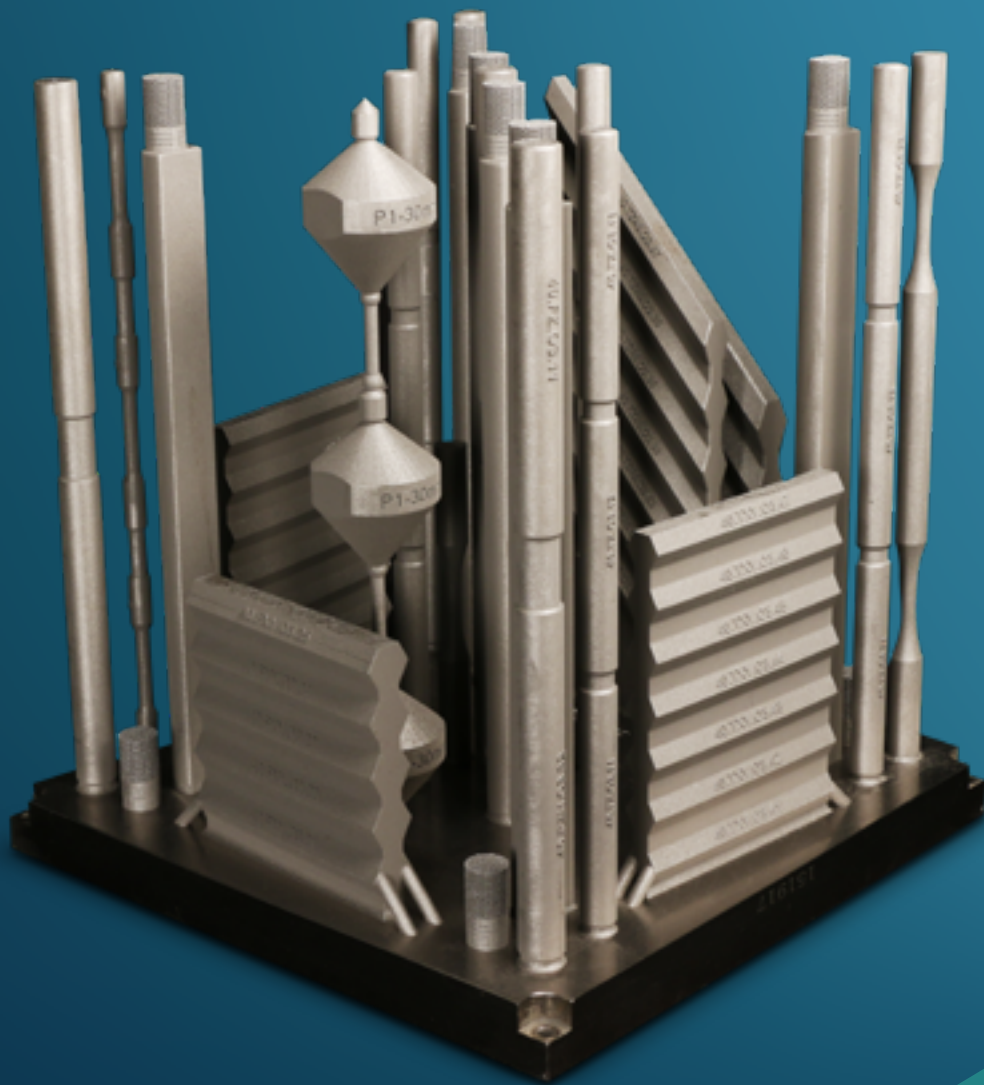


Titanium Material Property Dataset

Mechanical property data suitable for allowables generation,
machine and process qualification



Introduction

3D Systems has generated a high-fidelity dataset including a wide range of mechanical and material properties for LaserForm Ti Gr23 (Ti-6Al-4V ELI) printed on the DMP Flex 350.

This dataset is available for purchase by users and customers of the 3D Systems DMP Flex 350 machine fleet.

The data may be useful to:

Accelerate machine, material, and part qualification for critical applications.

Perform a delta qualification for new machines to demonstrate equivalence to the dataset.

Add to internal datasets for Laser Powder Bed Fusion of Metals (PBF-LB/M) process qualification.



The dataset applies to LaserForm Ti Gr 23 printed on the DMP Flex 350

This document summarizes:

- Sources of variation included in the dataset.
- Observed effects of main process variables on mechanical properties.
- A subset of the test results including room temperature tensile compared to reference values in literature.

The full dataset includes raw data for:

SAMPLE TYPE	HEAT TREATMENT	TEST TEMPERATURE(S) [C]	**TEST SPECIFICATION
*Tensile	All HIPed	Approx. -170, RT, 200, 250, 500	ASTM E8
Fatigue	All HIPed	RT	ASTM E466, ASTM E606
Pin-bearing	All HIPed	RT	ASTM E238
Shear	All HIPed	RT	ASTM B769
Compression	All HIPed	RT	ASTM E9
Witness Coupon	Half HIPed, Half Non-Heat Treated	RT	-

*3 orientations (XY, Z, Z45), multiple locations in X, Y, and Z

**Samples machined and tested by Nadcap accredited external testing partners

Sources of Variation Included in the Dataset

3 Powder lots



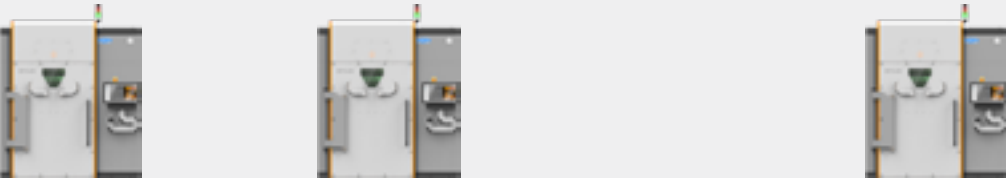
Powder lot to powder lot variation
*LaserForm Ti Gr 23,
Ti-6Al-4V (ELI)*

2 Manufacturing sites



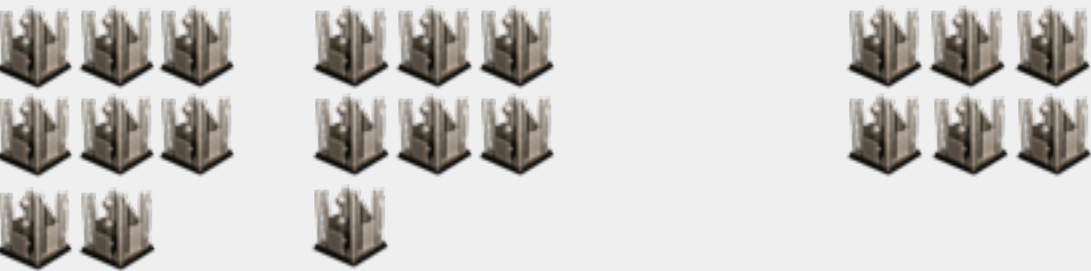
Facility to facility variation
AS/EN 9100 Production Sites

3 Machines



Machine to machine variation
DMP Flex 350

21 Total builds



Tensile/fatigue plates rotated from 0, 90, 180, 270 degrees for gas flow, plate location, and optics variation

400

Tensile samples

515

Total samples



Dataset includes tensile, fatigue, pin-bearing, shear, compression, chemistry, microstructure, and more
Samples machined and tested by Nadcap accredited external testing partners

Project Notes

- 3D Systems generated a large dataset of mechanical properties that captures main variables inherent to Laser Powder Bed Fusion of Metals (PBF-LB/M)
 - Samples were HIPed, removed from the build plate, then machined and tested by Nadcap accredited external testing partners
 - Results showed no practical difference due to main variables, indicating a stable process window
- Printed material tested in the dataset is comparable or better than typical properties for wrought, mill-annealed Ti-6Al-4V (AMS 4911) at temperatures from cryogenic to 500°C
- The full dataset is useful for allowables generation, as well as machine and process qualification efforts specifically for the DMP Flex 350 platform.

Consistent Mechanical Properties Across All Main Process Variables

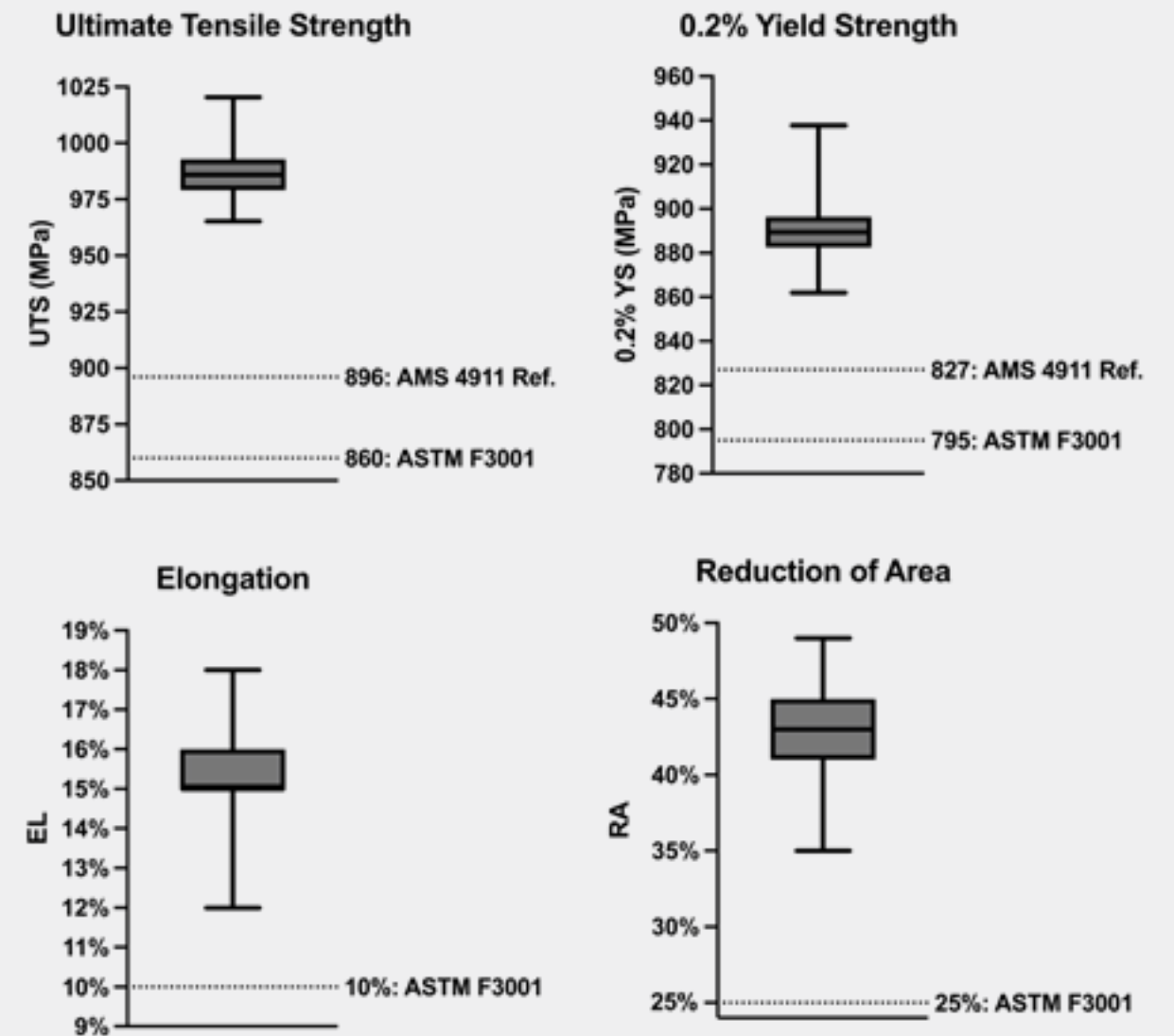
Mechanical Properties	Main Process Variables				
	Printer	Orientation	Plate Location	Z-Height	Powder Re-Use
UTS	✓	✓	✓	✓	✓
YS	✓	✓	✓	✓	✓
EL	✓	✓	✓	✓	✓

**No practical differences observed*

*Each main process variable was analyzed for effect on each mechanical property, and no significant effects were observed in the data

Summary of Room Temperature Tensile Data

A subset of the tensile data is shown graphically below. Reference values from ASTM F3001 and AMS 4911 are included for comparison purposes. This pooled data includes variation from machine-to-machine variability, powder lots, manufacturing site, part orientation, build plate location, Z-stacking, powder re-use, and more. The data is also comparable to historical 3D Systems data.



Talk to an Expert

Contact us to discuss mechanical property data for allowables generation, machine and process qualification

[Get in Touch](#)

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