



Standard Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing¹

This standard is issued under the fixed designation F2971; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice describes a standard procedure for reporting results by testing or evaluation of specimens produced by additive manufacturing (AM). This practice provides a common format for presenting data for AM specimens, for two purposes: (1) to establish further data reporting requirements, and (2) to provide information for the design of material property databases.

1.2 The values stated in SI units are required for all additive manufacturing related standards. However, when this standard is used in combination with any test method or equipment specified in inch-pound units the results should be reported with mathematical conversions to SI units immediately following in parentheses. The conversions shall be provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D638 Test Method for Tensile Properties of Plastics

E8M Test Methods for Tension Testing of Metallic Materials [Metric] (Withdrawn 2008)³

F2792 Terminology for Additive Manufacturing Technologies⁴

F2921 Terminology for Additive Manufacturing—Coordinate Systems and Test Methodologies

F2924 Specification for Additive Manufacturing Titanium-6

¹ This practice is under the jurisdiction of ASTM Committee F42 on Additive Manufacturing Technologies and is the direct responsibility of Subcommittee F42.01 on Test Methods.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

Aluminum-4 Vanadium with Powder Bed Fusion

3. Terminology

3.1 *Definitions*—shall be in accordance with Terminologies F2792 and F2921.

4. Significance and Use

4.1 Due to variables unique to each AM process and piece of equipment, it is critical to standardize descriptions used to report the preparation, processing, and post processing of specimens produced for tests or evaluation. The intent of this practice is to consistently document the materials and processing history associated with specimens undergoing test or evaluation. The level of detail for the documentation will match the application.

4.2 This practice establishes minimum data element requirements for reporting of material and process data for the purpose of:

4.2.1 Standardizing test specimen descriptions and test reports,

4.2.2 Assisting designers by standardizing AM materials databases,

4.2.3 Aiding material traceability through testing and evaluation,

4.2.4 Capturing property-parameter-performance relationships of AM specimens to enable predictive modeling and other computational approaches.

5. Requirements

5.1 This section specifies the data and information required to be reported for test specimens built using AM.

5.1.1 *Materials and Process Reporting Requirements*—The following materials and processes information must be reported for test specimens built using AM:

5.1.1.1 All standard material specifications used. Information from these specifications should include, as minimum:

(1) Description and preparation of feedstock materials required for AM operations.

(2) Procedure for using or re-using feedstock material.

5.1.1.2 A description of all non-standard processes used or deviations, or both, from process standards used.

5.1.1.3 All standard process specifications used. Information from these specifications should include, as a minimum:

(1) All processes used to produce the specimen from feedstock material.

(2) Placement and orientation of the test specimen in the build chamber.

5.1.1.4 A description of all non-standard processes used or deviations, or both, from process standards used.

5.1.2 *Test and Inspection Reporting Requirements*—The following test and inspection information must be reported for test specimens built using AM:

5.1.2.1 All standard test and inspection methods used. Information from these standards test methods should include, as a minimum:

(1) The shape and dimensions of the test specimens, with tolerances specified.

(2) The test plan. Note: this can be incorporated in the materials and process specifications.

(3) Test procedures.

(4) Non-destructive inspection procedures and results.

5.1.2.2 A description of all non-standard test methods used or deviations, or both, from standard test methods used.

5.1.2.3 *Post Processing Reporting Requirements*—If post processing was performed on the test specimens and is not included in 5.1.1 or 5.1.2, then it must be reported. Post processing may include, but is not limited to support removal, stress relief, part consolidation, heat treatment, and surface finishing.

6. Keywords

6.1 additive manufacturing; reporting requirements; test methods; test specimens

ANNEX

(Mandatory Information)

A1. FORMAT AND REQUIREMENTS TABLE

A1.1 See [Table A1.1](#).

TABLE A1.1 Format and Requirements Table

A		Report Header Requirement		
		Data Element	Format	Supporting Information
B	Material	Material Specification	Unique Alpha/Numeric Designation	Materials Specification meeting the requirements of this practice
C	Process Standard	Process Specification	Unique Alpha/Numeric Designation	Contains applicable materials, materials loading, processing, and post processing information for the sample
D	Test Plan or Specification	Document or Document Designation	Unique Alpha/Numeric Designation	Contains specific deviations or exceptions from existing test standards, ad hoc, or custom test methods used to produce the data
A		Data Field Requirements		
		Data Element	Format	Supporting Information
E	Test Process	Test Plan/Standard or Process	Unique Alpha/Numeric Designation	Units, Specific Test Configuration, and Reporting Options, Sample Preparation, and Sample Conditioning
F	Sample Orientation	Coordinates	X,Y,Z and Degrees	Per Terminology F2921

APPENDIXES

(Nonmandatory Information)

X1. ADDITIVE MANUFACTURING SAMPLE REPORT CORRESPONDING TO DETAILED MATERIALS AND PROCESS SPECIFICATIONS (DETAILED)

X1.1 *Explanation*—This sample report is included to illustrate the way this practice may be implemented.

X1.2 *Report of Testing – Tension Properties of FDM*—Prepared in accordance with Practice F2971. See [Table A1.1, A](#).

X1.3 *Material 79M000155*—Specification Plastic Filament, Rapid Prototype, Fused Deposition Material. See [Table A1.1, B](#).

X1.4 *Process 79P010030*—Process Specification for Fused Deposition Modeling. See [Table A1.1, C](#).

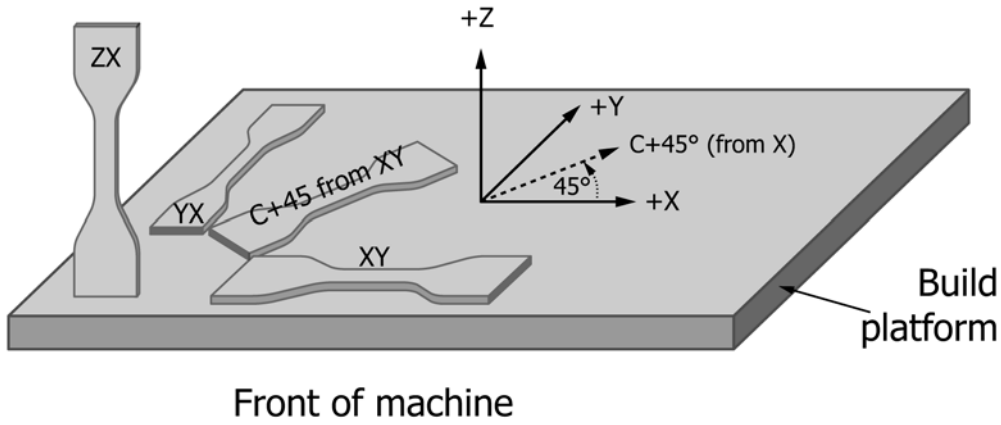


FIG. X1.1 Build Platform

X1.5 *Testing Performed*—Test Method D638 Tensile. All values are measured after at least 48 h storage at 23°C/50 % relative humidity. All properties are measured on injection molded samples. All samples are prepared and tested in accordance with ASTM standards. See Table A1.1, D.

X1.5.1 *Tensile Properties*—The typical tensile specimens for baseline properties shall be fabricated from the FDM filament in accordance with Test Method D638 and tested in accordance with 4.5.4 of 79P0100030 to meet the minimum requirements shown in Table X1.1. See Fig. X1.1 and Fig. X2.1 for a description of the orientations and configurations. Terminology F2921 contains information on standard additive manufacturing terminology and can be used for reference. See Table A1.1, D.

X1.6 *Table of Values – Tension Yield in Pounds per Square Inch (PSI) (SI = MPa)*—Tension Testing of Plastics – Test Method D638 and per instructions of Laboratory Evaluation Plan 2011-3455645.

TABLE X1.1 Minimum Tensile Strength at Room Temperature (72°F)^A

Terminology F2921	Orientation	S-Basis (ksi)
	XY or YX	#(#)
	C+45 from XY	#(#)
	ZX or ZY	#(#)

^ASee Table A1.1, D.

Orientation	Location (mm)	Sample Set 1	Sample Set 2	Sample Set 3 ^A
XY	-150,0,7	#(#)	#(#)	#(#)
	-75,0,7			
	0,0,7			
	75,0,7			
	150,0,7			
XY	-150,0,7	#(#)	#(#)	#(#)
	-75,0,7			
	0,0,7			
	75,0,7			
	150,0,7			
C+45 from X ^B	-100,0,7	#(#)	#(#)	#(#)
	-50,0,7			
	0,0,7			
	50,0,7			
	100,0,7			
ZX	-150,-150,82.5	2845(3000)	2945(3000)	2899(3000)
	-150,150,82.5			
	0,0,82.5			
	150,-150,82.5			
	150,150,82.5			

^ASee Table A1.1, E.

^BSee Table A1.1, F.

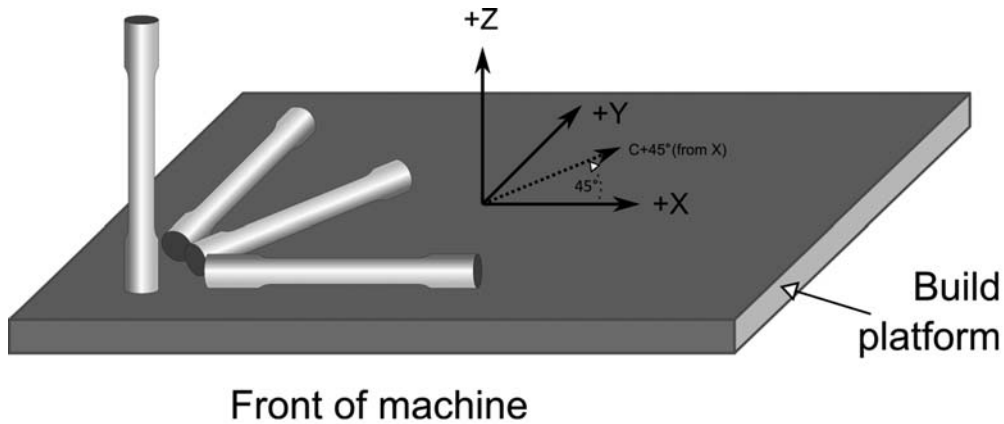


FIG. X2.1 Build Platform

X2. ADDITIVE MANUFACTURING SAMPLE REPORT CORRESPONDING TO COMMERCIAL MATERIALS AND PROCESS SPECIFICATIONS (COMMERCIAL SPECIFICATION)

X2.1 *Report of Testing – Tension Properties of Additive Manufacturing Titanium-6 Aluminum-4 Vanadium with Powder Bed Fusion*—Prepared in accordance with F2971. See **Table A1.1, A**.

X2.2 *Material Designation: ASTM F2924-12 B*

X2.3 *Process: XYZ Laser Sintering Machine Model 1, Control Parameter Configuration 1–1 2013*—See **Table A1.1, C**.

X2.4 *Testing Performed*—ASTM **E8M** Tensile. All samples are prepared and tested in accordance with ASTM standards. See **Table A1.1, D**.

X2.5 *Coupon Configuration*—Test specimens with gage length five times the diameter (**E8M**) specimen configuration 3 (small-size specimens proportional to standard). Build to 0.20 oversize, and machine to standard machine finish. See **Table A1.1, D**.

X2.6 *Table of Values – Tension Yield in Pounds per Square Inch (PSI) (SI = MPa)*

Orientation	Location (mm)	Sample Set 1	Sample Set 2	Sample Set 3 ^A
X	-100,100,5	#(#)	#(#)	#(#)
	100,100,5			
	0,0,5			
C+45 from X	-100,-100,5	#(#)	#(#)	#(#)
	100,-100,5			
	-100,100,5			
Z ^B	100,100,5	#(#)	#(#)	#(#)
	0,0,5			
	-100,-100,5			
Z ^B	100,-100,5	#(#)	#(#)	#(#)
	-100,100,25			
	100,100,25			
Z ^B	0,0,25	#(#)	#(#)	#(#)
	-100,-100,25			
	100,-100,25			

TABLE X2.1 Minimum Tensile Strength at Room Temperature (72°F)^A

Orientation per Terminology F2921	S-Basis (ksi)
X or Y	#(#)
C+45 from X	#(#)
Z	#(#)

^ASee **Table A1.1, D**.

^ASee **Table A1.1, E**.

^BSee **Table A1.1, F**.

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