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# AM Schema & Data Importation

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**GRANTA MI Discussion (NEA + AWE)**

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# AM Schema: Needs & Benefits

## AM Needs

- Traceable, digital data capture for entire part optimization and life cycles
- Method for validating virtual data
- Standards (MMPDS, ASTM, ISO, MatML)



## How Granta Supports AM

- Proven enabling technology, collaborative platform
- Experience in implementing best practices for managing complex material-process pedigree and data
- MDMC expertise in materials, manufacturing, and data management
  - Granta MI – Industry consulting projects in Europe and US
  - Membership – Network of corporate, government & academic funded projects

# MDMC AM Working Group



## Leverage core expertise of MDMC members

- Materials, manufacturing, data management
- Software infrastructure and networks

## Focus

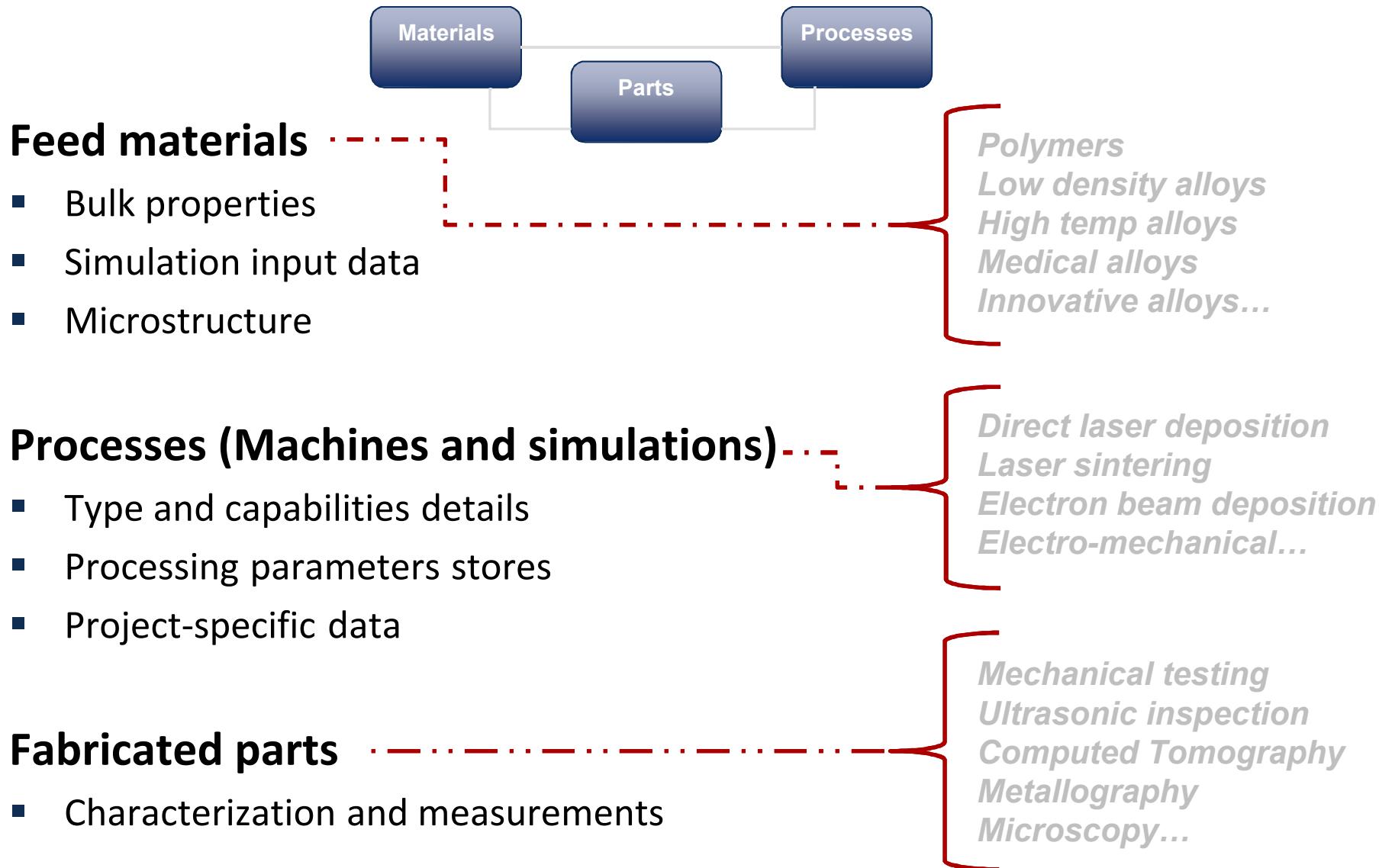
- Schema development
- Software & network integration
- Standards
- Interfacing with AM initiatives

**MDMC**.net



and others....

# Schema Requirements



# Schema Inclusion



# Granta MI, AM Schema Layout Headings

- Currently Includes 800+ attributes

Layout Headings - Granta AM Schema v1.01					
Machines	Materials	Part Design	Material Batches	Builds	Parts
General Information	General Information	General Information	Project Information	Project Information	Project Information
Calibration	General Properties	Original Design	General Batch Information	General Information	Part Information
Machine Specifications	Composition overview	Re-Design	Manufacturing	Build Information	Part Specifications
Material	Bulk Mechanical Properties	Dimensions	Material Quality	General Build Parameters	Samples
Machine Properties	Bulk Thermal Properties	General Material Properties	Particle Properties and Size Distribution	Build Atmosphere	Visual Inspection
Build Environment	Bulk Electrical Properties	Processing	Interstitial contamination	Material Used	Accuracy Testing
Laser Properties	Biological	Static Tensile Properties	Flowability	Support	NDT Testing
Electron Beam Properties	Chemical	High-cycle fatigue properties	Wire Properties	Filament Information	Post Processing
Further Information	Eco	Fracture Toughness	Chemical Analysis and Composition		Heat Treatment
	Cost	Fatigue Crack Growth			Quality of Welding Consumables
	Safety and Handling	Surface Roughness Requested			HIP
	General Information	Other Requested Properties			Build Alarms
	Requirements	Final Part Details			Machining
	Composition	Quality Assurance			Themes Used
	Physical Properties	Key Benefits			Laser Polishing
	Further Information				Powder Build Parameters
					Other Post Processing
					Wire Build Parameters
					Laser Properties
					Electron Beam Properties
					Arc Properties
					In-Process Rolling
					In-Process Analysis

# GRANTA MI AM Schema v 1.0.0

GRANTA MI

Read Mode  
Edit Mode

Home   Optimize   Substitute   Substances   Reports

Quick Search   Advanced Search

Help   Settings   Admin

Contents

Mi:Additive Manufacturing Template 1.0.0

- Projects
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  - Sandia Laser Engineered Net Shaping
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- Statistical Data: Creep
- Statistical Data: Fatigue
- Design Data
- Tools

## Mi:Additive Manufacturing Template

Home   Map   Importing Data   **Tutorials**

### Mi:Viewer tutorials

Get started by watching these tutorials.

They describe step-by-step how to perform simple actions in MI:Viewer such as browse the tree, searching a material or reporting in a table format.

Note: To view the tutorials, Flash plug-in must be installed on your web-browser.

**Browse a database**  
This tutorial shows how to browse a table within a database, and open a datasheet

**Perform a text search**  
This tutorial shows how to perform a text search

**Perform a search based on attribute values**  
This tutorial shows how to perform a search based on attributes values

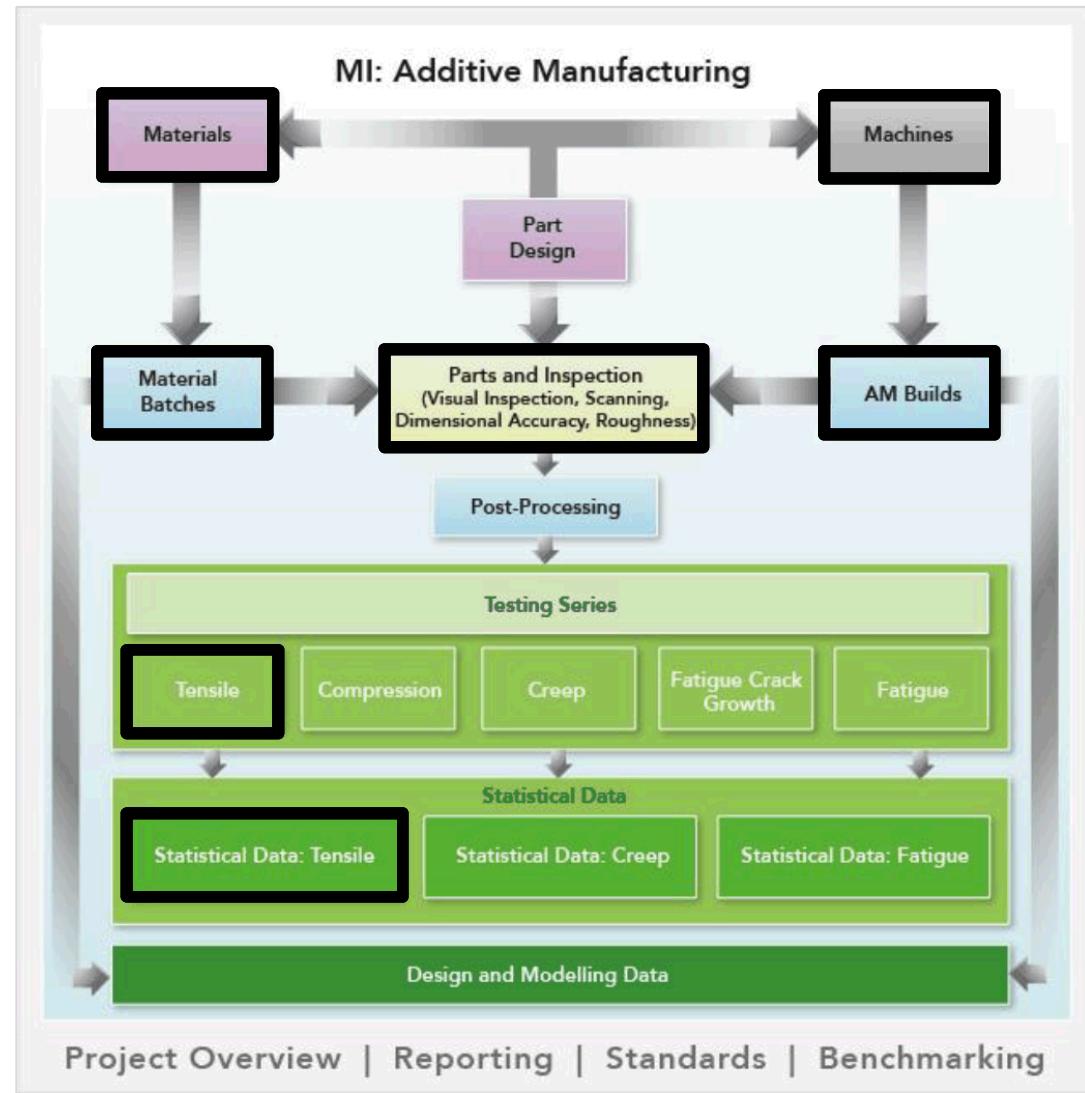
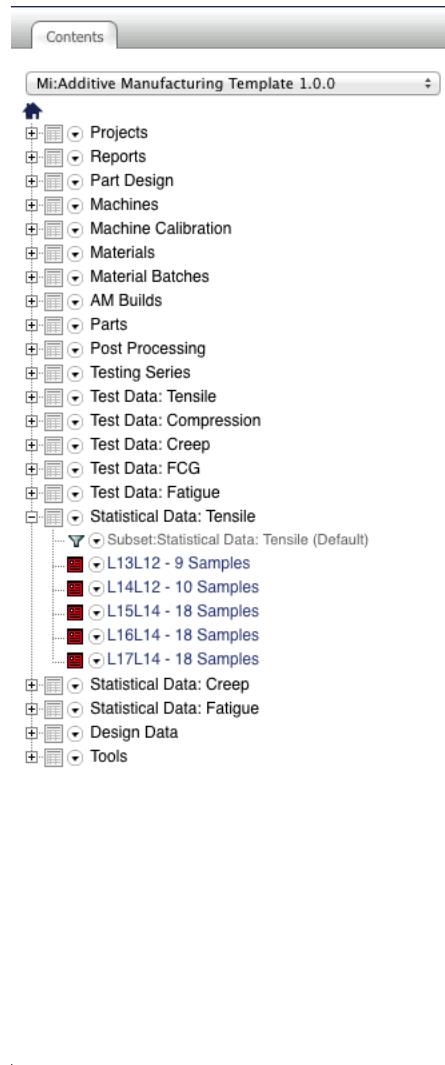
**Create a comparison report**  
This tutorial shows how to create a tabular comparison report

**Create a X-Y chart**  
This tutorial shows how to create a bubble chart



Run script ":"

# GRANTA MI AM Schema v 1.0.0

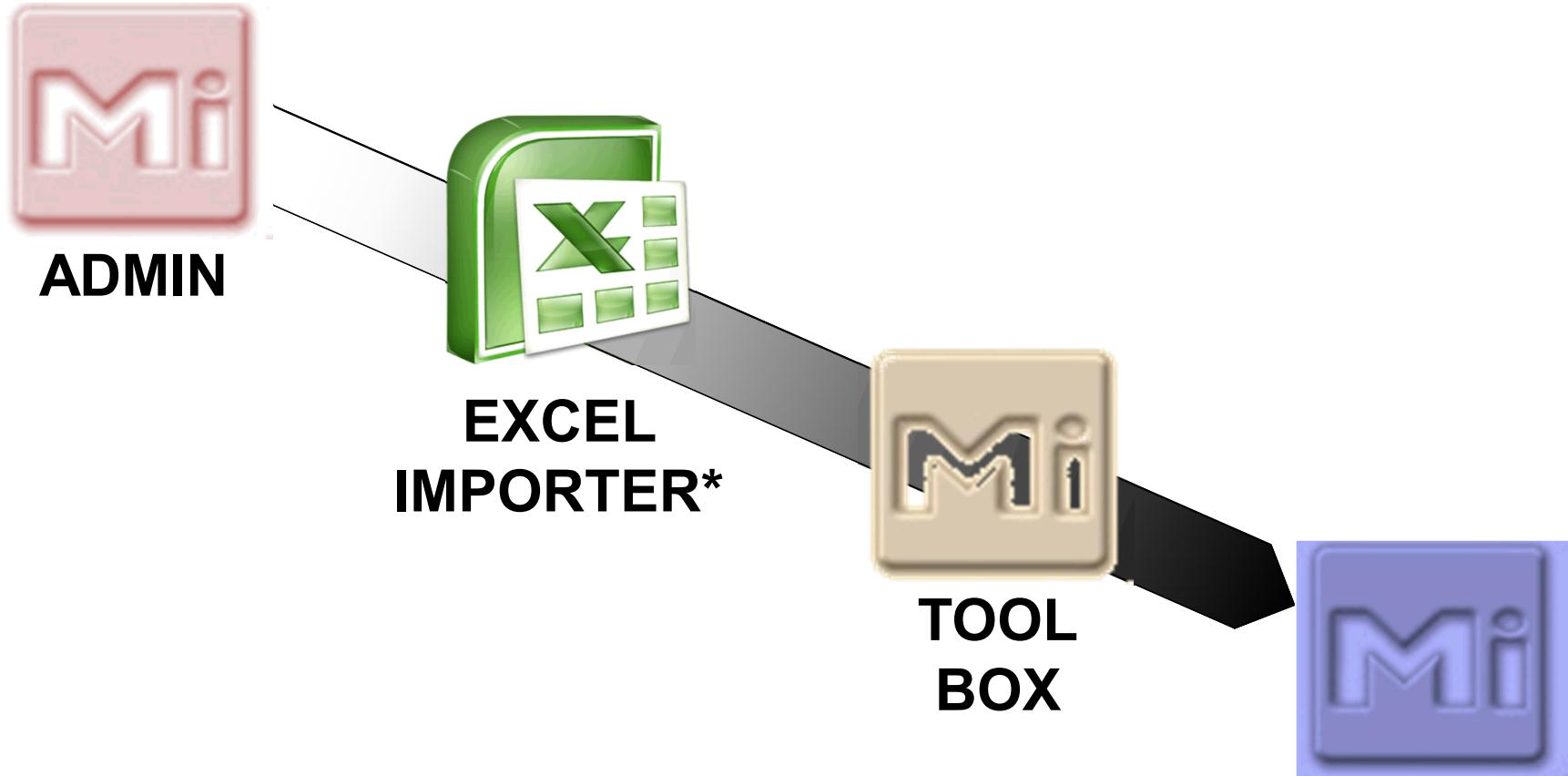


# GRANTA MI AM Importers

## ~20 Default Excel Individual Record Importers

- AM Tensile Testing
- Calibration
- Default Layout
- Design Data
- Material Batches
- Materials
- Part Design
- Parts
- Post Processing
- Projects
- Reports
- Statistical Data\_Creep
- Statistical Data\_Fatigue
- Statistical Data\_Tensile
- Test Data\_Compression
- Test Data\_Creep
- Test Data\_FCG
- Test Data\_HCF
- Testing Series
- Tools Layout

# GRANTA MI Data Import Workflow



\*Excel Importers are 1 of 3 data importing options supported in MI: Toolbox.

The other two are:

- Bulk Data Importers
- Text Importers

**VIEWER**

# GRANTA MI Data Import Process

## Suggested Process:

1. Create or utilize a previously created importer
2. Enter raw data into importer
3. Upload data into GRANTA MI via the data importer
4. Review the data with data producer, data consumer and project customer as a final step

- It is recommended that a person with a solid understanding of material properties and the materials system develop the importers as this is by far the most critical step. Populating a well-developed importer requires minimal skill and apriori knowledge but may be time consuming and tedious based on the desired level of detail. Very little to no skill is required to upload data into GRANTA via MI:Toolbox.

# GRANTA MI Sample Data Importer



The figure shows a Microsoft Excel spreadsheet titled "Default Template (AM Tensile Testing)-JCARROLL-A1-1.xlsx". The spreadsheet is organized into several sections:

- Record Name:** LENS A1-1
- Short Name:** LENS A1-1
- Project Information:**
  - Project name: LENS A1-1
  - Project code: LENS A1-1
  - Funding organization: Sandia National Laboratories
  - Data ownership: Internal
  - Data ownership (other): Tensile Testing of LENS samples in contribution to a 2015 LDRD
- Source of Testing:**
  - Testing organization: 1851 - Mechanics of Materials
  - Testing contract: 1851 - Mechanics of Materials
  - Report ID: 1851 - Mechanics of Materials
  - Testing source notes: 1851 - Mechanics of Materials
  - Test method ID: 1851 - Mechanics of Materials
- Test Information:**
  - Valid test?: Yes
  - Testing series ID: LENS A
  - Test specification ID: LENS A
  - Standard test description: Tensile
  - Test type: Tensile
  - Test standards: Jay Carroll, 1.27.2015, MTS 793
  - Test status: Tested
  - Tested by: Analyzed by: Date of analysis: Analysis notes: Original data filename:
- Specimen Information:**
  - Specimen ID: A1-1
  - Specimen specification: X Orientation
  - Specimen location: Edge
  - Specimen orientation: Circular
  - Gauge cross-section geometry: Circular
  - Gauge thickness: mm
  - Gauge width: mm
  - Gauge inner diameter: mm
  - Gauge outer diameter: mm
  - Gauge area: mm<sup>2</sup>
  - Gauge length: mm
  - Machining method: Hole diameter: mm
  - Hole location: Hole location: mm
  - Other specimen features: Build Type - Parallel
  - Machining method (other): Build Type - Parallel
  - Surface finish: Surface finish (other):
  - Surface finish (other):
  - Surface roughness: µm
  - Chemical Composition: 304L - Nominal Chemistry - 18.8Cr - 10.28Ni - 1.49Mn - 0.51Si - 0.04Mo - 0.075N - 0.007P - 0.007S - 0.01C - 0.023O - bal.Fe
- Pre-Test Conditioning:**
  - Pretest environment: °C
  - Pretest temperature: hr
  - Pretest exposure time: hr
  - Pretest cycle: GPa
  - Pretest modulus @ RT: GPa
  - Pretest modulus @ test temp: GPa
  - Storage condition: Poiss
  - Pretest notes: Poiss

**Specimen Information**

**Specimen ID**

**Specimen specification**

**Specimen location**

**Specimen orientation**

**Gauge cross-section geometry**

**Gauge thickness**

**Gauge width**

**Gauge inner diameter**

**Gauge outer diameter**

**Gauge area**

**Gauge length**

**Machining method**

**Hole diameter**

**Hole location**

**Other specimen features**

**Machining method (other)**

**Surface finish**

**Surface finish (other)**

**Surface roughness**

**Chemical Composition**

**Data Tab**

## Data Tab

# GRANTA MI Sample Data Importer

Default Template (AM Tensile Testing)-JCARROLL-A1-1.xlsx

Navigation Links

Headings

Attributes

Tensile Response

Load vs. displacement

**Tensile Response**

**Load vs. displacement**

Displacement (mm)	Value (N)	Linetype:	Displacement (mm)	Value (N)	Linetype:
0.001566112	2.1666217	MarkersOnly	0.001566112	2.1666217	MarkersOnly
0.003944337	2.7838235		0.003944337	2.7838235	
0.006425381	1.4535801		0.006425381	1.4535801	
0.00808537	1.4210079		0.00808537	1.4210079	
0.007107854	2.3115652		0.007107854	2.3115652	
0.013236701	1.6291413		0.013236701	1.6291413	
0.012975931	2.5725055		0.012975931	2.5725055	
0.016503036	3.830277		0.016503036	3.830277	
0.018675625	2.3339748		0.018675625	2.3339748	
0.018659234	2.2644937		0.018659234	2.2644937	
0.021612644	1.1378783		0.021612644	1.1378783	
0.023877621	2.563961		0.023877621	2.563961	
0.023819506	1.6170884		0.023819506	1.6170884	
0.0265643	3.3737612		0.0265643	3.3737612	
0.028738379	1.2843497		0.028738379	1.2843497	
0.029501319	2.0345461		0.029501319	2.0345461	
0.031466782	3.7820659		0.031466782	3.7820659	
0.035487115	2.9570284		0.035487115	2.9570284	
0.050002337	4.2308402		0.037962198	1.6633446	
0.050850213	5.6078572		0.037021935	3.8370607	
0.051981211	3.3927917		0.039157271	1.7322693	
0.055940449	5.2988452		0.043591857	3.7164683	
0.057463348	3.6658366		0.04529506	3.2278075	
0.058595836	3.8667071		0.046394765	3.1065681	
0.060047209	3.2320797		0.048364699	3.6057928	
0.061269104	3.4655743		0.050002337	4.2308402	
0.065383315	3.3403475		0.050850213	5.6078572	
0.066138804	3.6191661		0.051981211	3.3927917	
0.068981946	5.5053248		0.055940449	5.2988452	
0.067728758	3.9986269		0.057463348	3.6658366	
0.072300434	3.9366543		0.058595836	3.8667071	
0.076155363	5.2851906		0.060047209	3.2320797	
0.075748563	3.7354732		0.061269104	3.4655743	
0.076963307	3.1439042		0.065383315	3.3403475	
0.082305074	5.2089901		0.066138804	3.6191661	
0.079865754	5.5883222		0.068981946	5.5053248	
0.082500279	8.8882533		0.067728758	3.9986269	
0.08456856	10.661981		0.072300434	3.9366543	
0.086481869	11.932355		0.076155363	5.2851906	
0.090138614	9.4146118		0.075748563	3.7354732	
0.089457631	14.529134		0.076963307	3.1439042	
0.093542039	15.767035		0.082305074	5.2089901	
0.0950858	19.771318		0.079865754	5.5883222	
0.097382069	19.728312		0.082500279	8.8882533	
0.099974871	22.119061		0.08456856	10.661981	
0.099813938	22.516991		0.086481869	11.932355	
0.10125488	26.062449		0.090138614	9.4146118	
0.10478199	37.201069		0.089457631	14.529134	
0.10591745	39.826736		0.093542039	15.767035	
0.108202329	44.17527		0.097382069	19.728312	

Load vs. Displacement Tab

Mi:Additive Manufacturing Template 1.0.0 (SANDIA\jdmadis)

1800 ENGR SAFETY GRANTA MI SNL METAGROUPS IDL Help GRANTA MI WIKI PPM SharePoint PPM WEBSITE IMS BoA USBank SAFCU 1814 SharePoint LinkedIn

Granta Design: The materials information technology experts

GRANTA MI Read Mode Edit Mode

Tools

Contents

LENS A1-1

Project Information

- Data ownership: Company
- Data ownership (other): Sandia National Laboratories
- Distribution category: Internal
- Project notes: Tensile Testing of LENST samples in contribution to a 2015 LDRD

Source of Testing

- Testing organisation: 1851 - Mechanics of Materials

Test Information

- Valid test?: Yes
- Testing series ID: LENST A
- Test type: Tensile
- Operator: Jay Carroll
- Date test performed: Tuesday, January 27, 2015
- Test frame reference: MTS 793
- Test status: Tested

Specimen Information

- Specimen ID: A1-1
- Specimen specification: X Orientation
- Specimen location: Edge
- Gauge cross-section geometry: Circular
- Gauge outer diameter: 4.07 mm
- Gauge length: 19.1 mm
- Machining method (other): Build Type - Parallel
- Sample notes: 304L - Nominal Chemistry - 18.8Cr - 10.28Ni - 1.49Mn - 0.51Si - 0.04Mo - 0.075N - 0.007P - 0.007S - 0.01C - 0.023O - bal.Fe

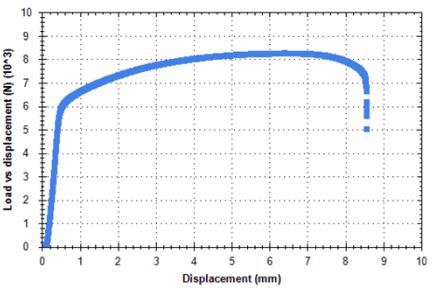
Test Conditions

- Test temperature: 22 °C
- Strain rate: 0.100 % strain/s

Tensile Response

Load vs displacement

Hide Graph



Additional Information

Additional test notes: AM specs - 3.8kW defocused beam, 2mm hatch spacing, 63.5 cm/min deposition rate

No warranty is given for the accuracy of this data

# Ex. SNL

# GRANTA MI

# AM TENSILE

# TEST RECORD

# GRANTA MI Importer Helpful Hints

## Excel Importer Functionality

- Importers download in units **GRANTA MI: Viewer** is currently using
- **MI: Toolbox** and **MI: Admin** function on Windows/PC
- You do not need to fill out every field for your importers to function properly
- Importers are self-linking via cell attributes
- To access the attributes list you must “unlock” and “unhide” the necessary excel sheets
- GRANTA MI Default templates typically hide the following sheets:
  - Attribute Lookup
  - Export Lookup
  - Parameter Lookup
  - Import Options

## Best Practices

- Interview data producers, data customers and data end-users BEFORE attempting to create your own importer.
- While the learning curve can be somewhat steep when beginning to utilize MI data importers, gaining a firm grasp of their functionality will pay dividends in the future



Interested in GRANTA MI at Sandia National Laboratories?

Send inquiries or data to :

[jdmadis@sandia.gov](mailto:jdmadis@sandia.gov)  
[lmserna@sandia.gov](mailto:lmserna@sandia.gov)  
[rakarne@sandia.gov](mailto:rakarne@sandia.gov)

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