SAND2015-3796PE

Exceptional service in the national interest

Sandia National Laboratories

GRANTA MATERIAL INTELLIGENCE

AM Schema & Data Importation

Jonathan D. Madison Org. 1814

Sandia National Laboratories, Albuquerque NM

GRANTA MI Discussion (NEA + AWE)

May 5th, 2015

U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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

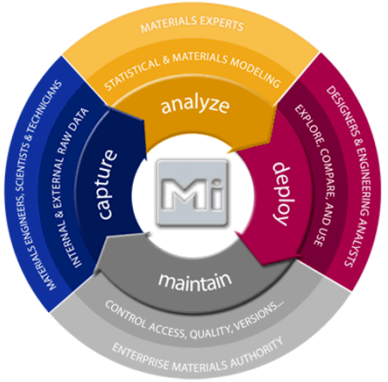
MDMC AM Working Group

Sandia National Laboratories

Leverage core expertise of MDMC members

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

MDMC.net



Focus

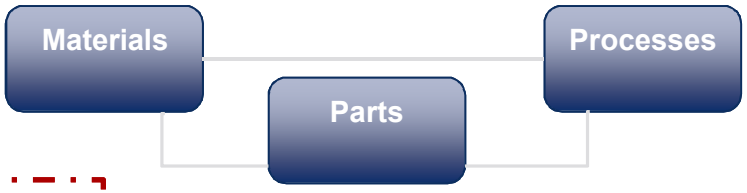
- Schema development
- Software & network integration
- Standards
- Interfacing with AM initiatives

BOEING
Honeywell
UTC Aerospace Systems
Pratt & Whitney
A United Technologies Company
LOCKHEED MARTIN
NORTHROP GRUMMAN

U.S.ARMY
ARL
NASA
OAK RIDGE National Laboratory

and others….

Schema Requirements



Feed materials

- Bulk properties
- Simulation input data
- Microstructure

Polymers
Low density alloys
High temp alloys
Medical alloys
Innovative alloys…

Processes (Machines and simulations)

- Type and capabilities details
- Processing parameters stores
- Project-specific data

Direct laser deposition
Laser sintering
Electron beam deposition
Electro-mechanical…

Fabricated parts

- Characterization and measurements

Mechanical testing
Ultrasonic inspection
Computed Tomography
Metallography
Microscopy…

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
	Eco	Fracture Toughness	Chemical Analysis and Composition	Substrate	Heat Treatment
	Cost	Fatigue Crack Growth		Quality of Welding Consumables	HIP
	Safety and Handling	Surface Roughness Requested		Build Alarms	Machining
	General Information	Other Requested Properties		Themes Used	Laser Polishing
	Requirements	Final Part Details		Powder Build Parameters	Other Post Processing
	Composition	Quality Assurance		Wire Build Parameters	
	Physical Properties	Key Benefits		Laser Properties	
	Further Information			Electron Beam Properties	
				Arc Properties	
				In-Process Rolling	
				In-Process Analysis	

GRANTA MI AM Schema v 1.0.0

Sandia National Laboratories

GRANTA Mi

Read Mode
Edit Mode

Home | Optimize | Substitute | Substances | Reports

Quick Search
Advanced Search

Help
Settings
Admin

Tools

Contents

Mi:Additive Manufacturing Template 1.0.0

- Projects
- Reports
- Part Design
- Machines
- Machine Calibration
- Materials
- Material Batches
- AM Builds
- Parts
- Post Processing
- Testing Series
- Test Data: Tensile
  - Subset:Test Data: Tensile (Default)
  - Mechanical benchmark Testing 1.20
  - Sandia Laser Engineered Net Shaping
- Test Data: Compression
- Test Data: Creep
- Test Data: FCG
- Test Data: Fatigue
- Statistical Data: Tensile
- 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 attibutes values

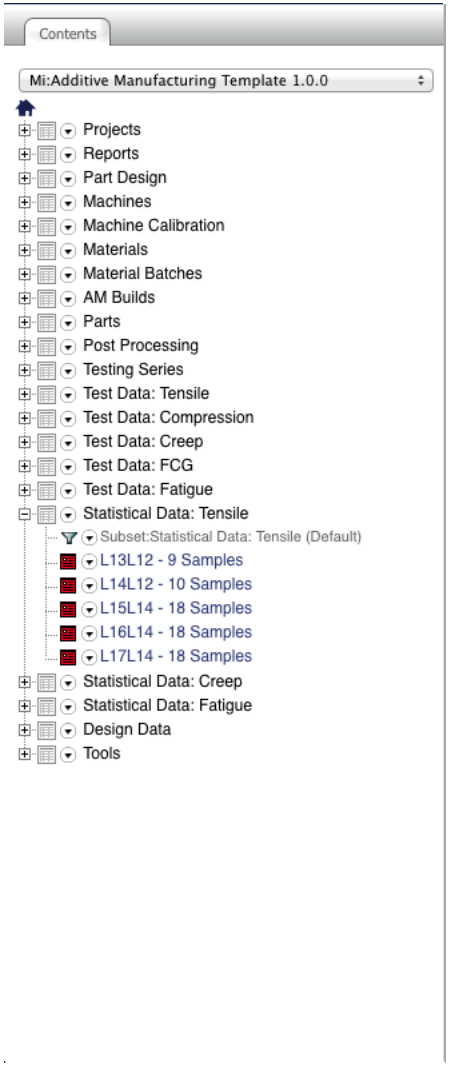
Create a comparison report
This tutorial shows how to create a tabular comparison report

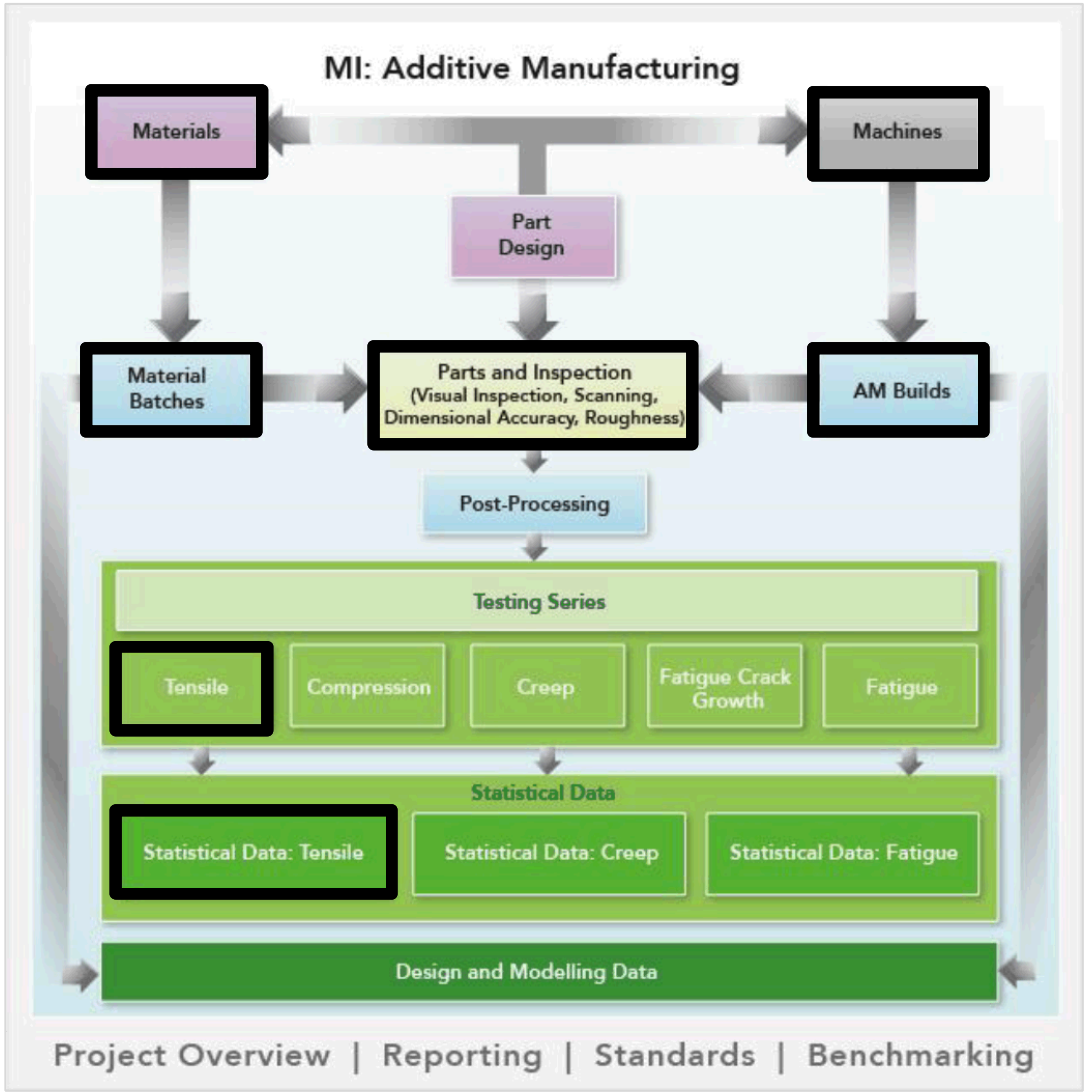
Create a X-Y chart
This tutorial shows how to create a bubble chart

Run script ";"

GRANTA MI AM Schema v 1.0.0

Sandia National Laboratories





GRANTA MI AM Importers

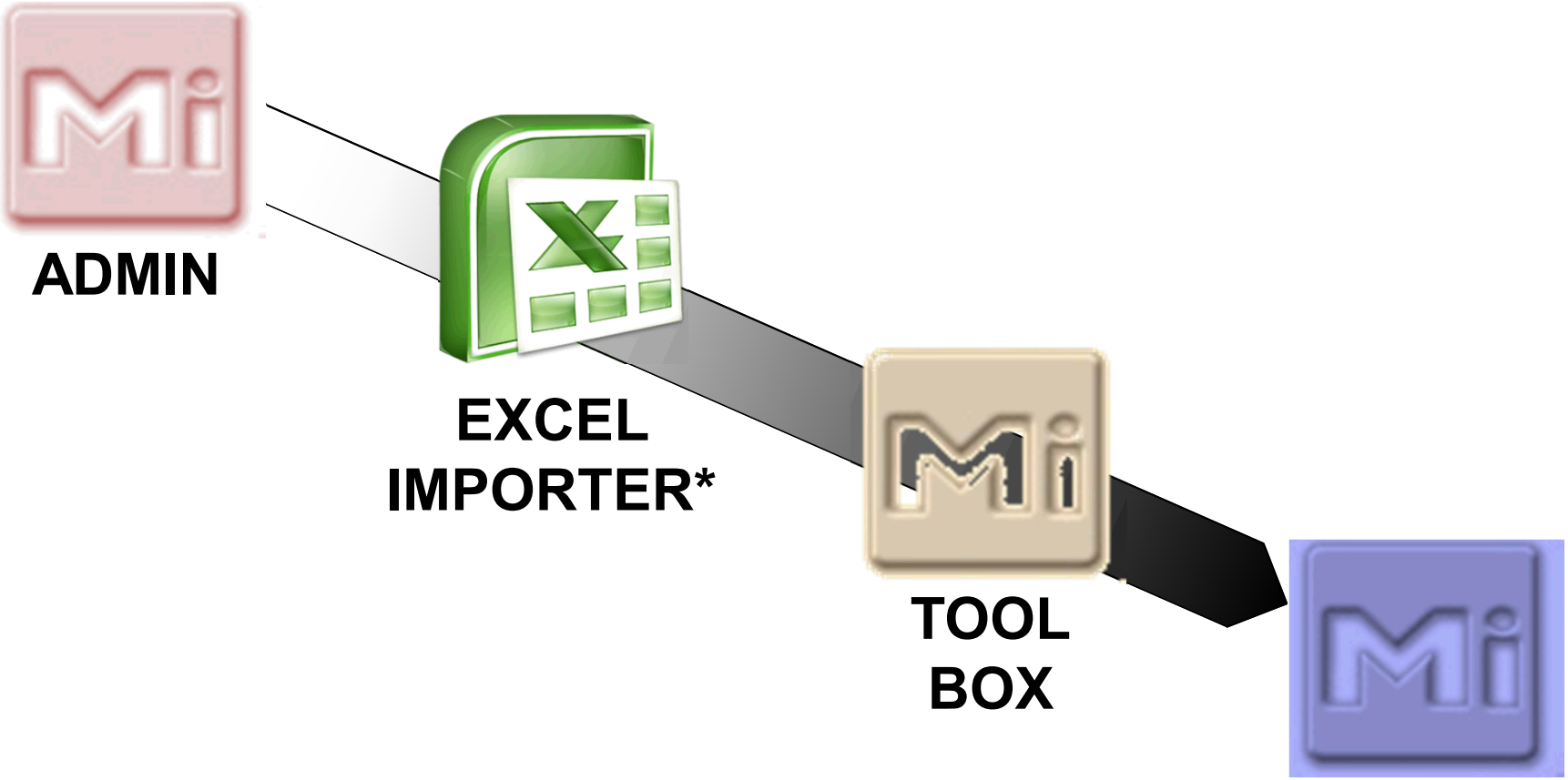
Sandia National Laboratories

~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

Sandia National Laboratories



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

- Bulk Data Importers
- Text Importers

GRANTA MI Data Import Process

Sandia National Laboratories

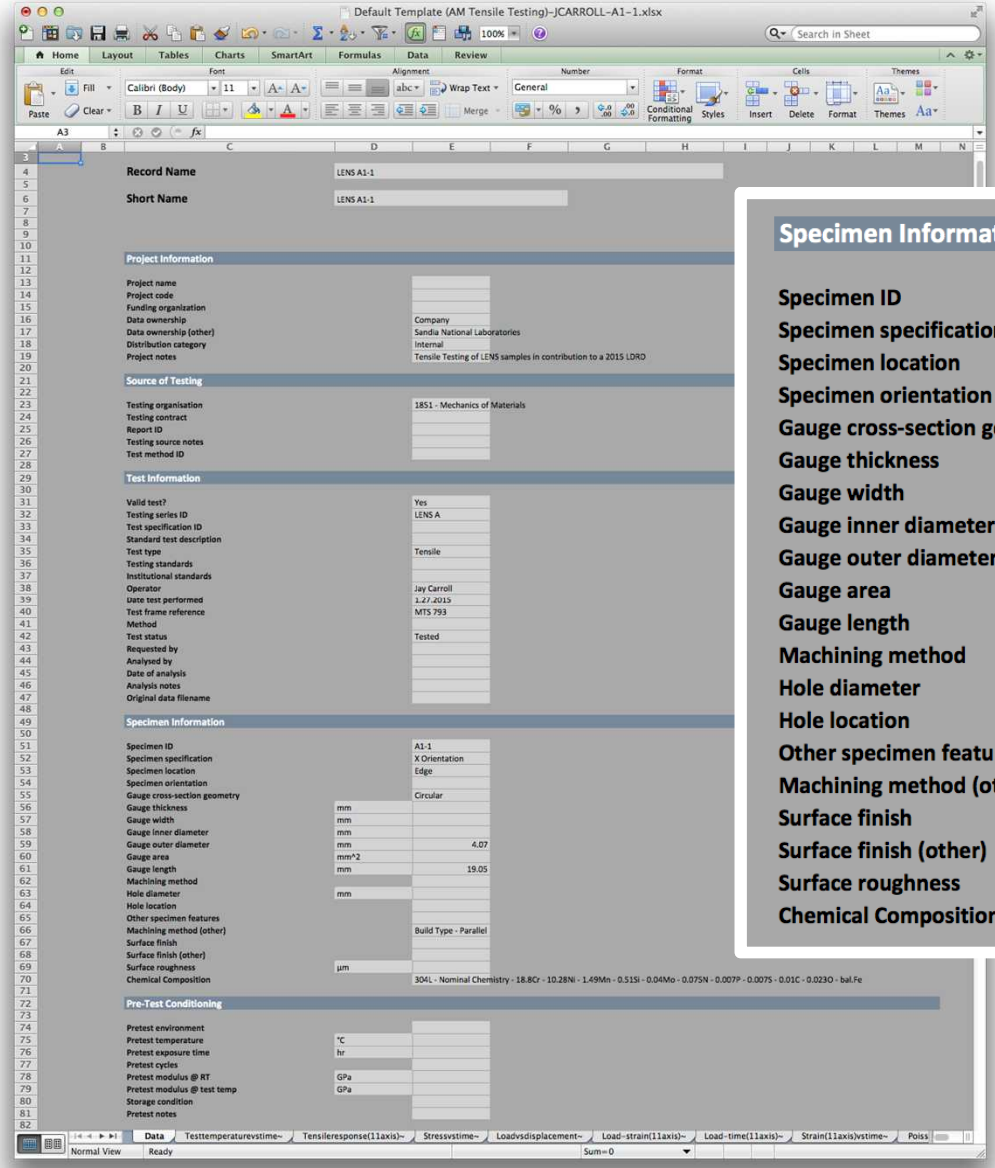
Suggested Process:

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

Sandia National Laboratories



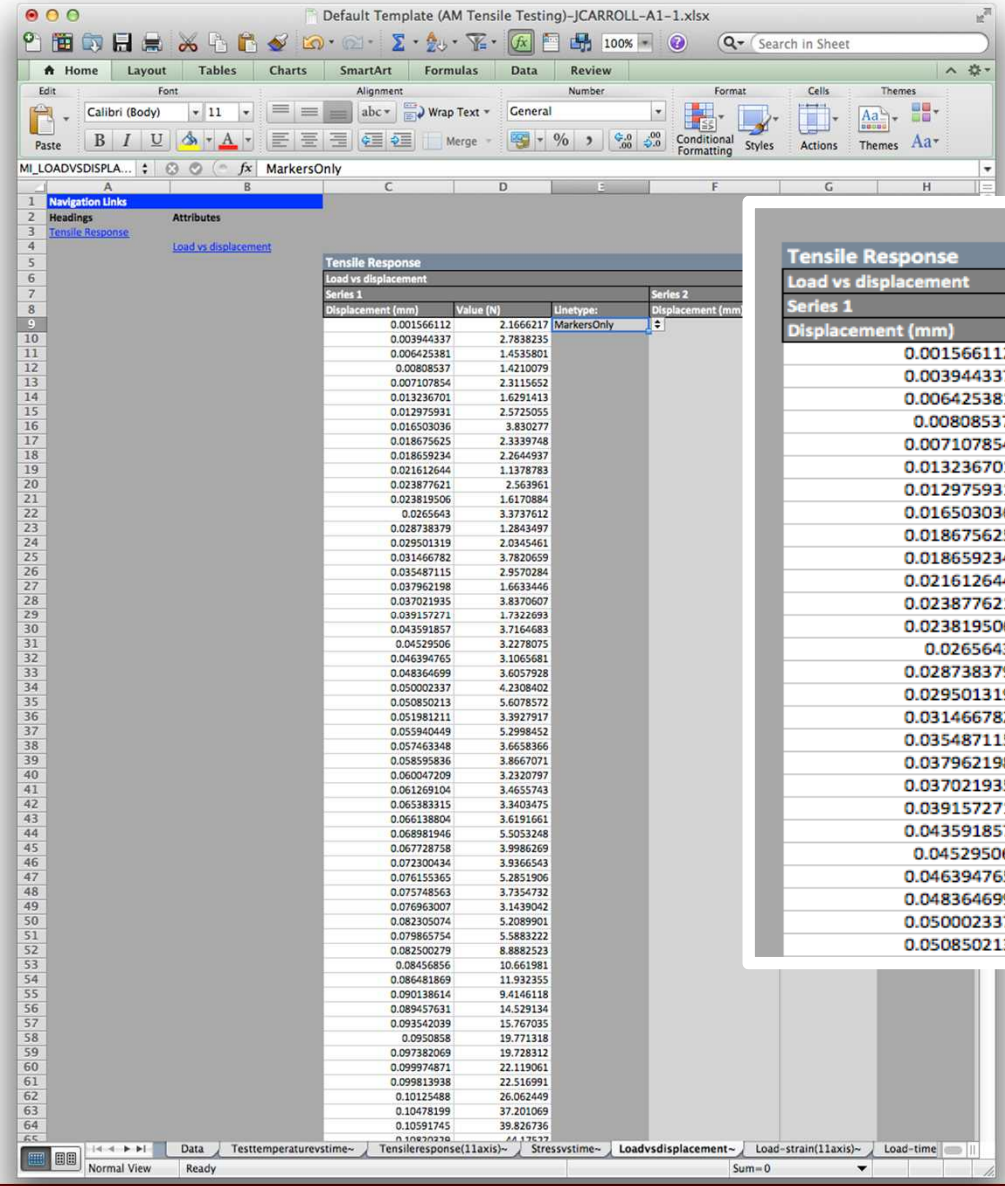
Specimen Information

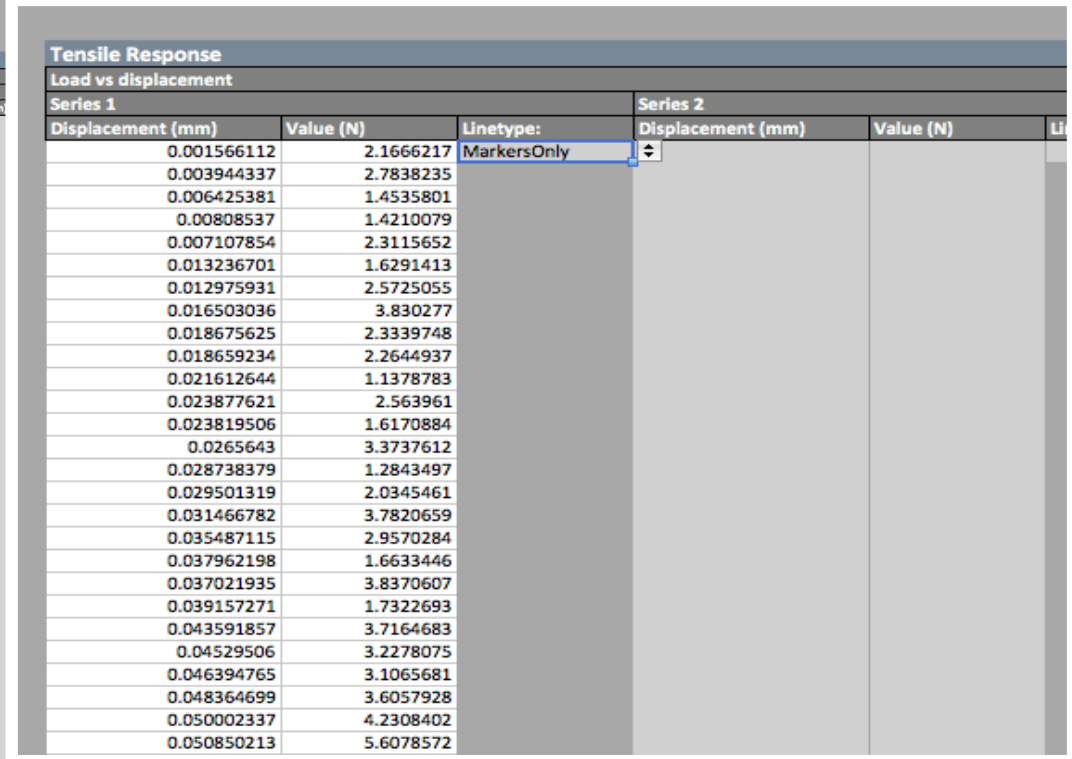
Specimen ID		A1-1
Specimen specification		X Orientation
Specimen location		Edge
Specimen orientation		
Gauge cross-section geometry		Circular
Gauge thickness	mm	
Gauge width	mm	
Gauge inner diameter	mm	
Gauge outer diameter	mm	4.07
Gauge area	mm^2	
Gauge length	mm	19.05
Machining method		
Hole diameter	mm	
Hole location		
Other specimen features		
Machining method (other)		Build Type - Parallel
Surface finish		
Surface finish (other)		
Surface roughness	µm	
Chemical Composition		304L - Nominal Chemistry

Data Tab

GRANTA MI Sample Data Importer

Sandia National Laboratories



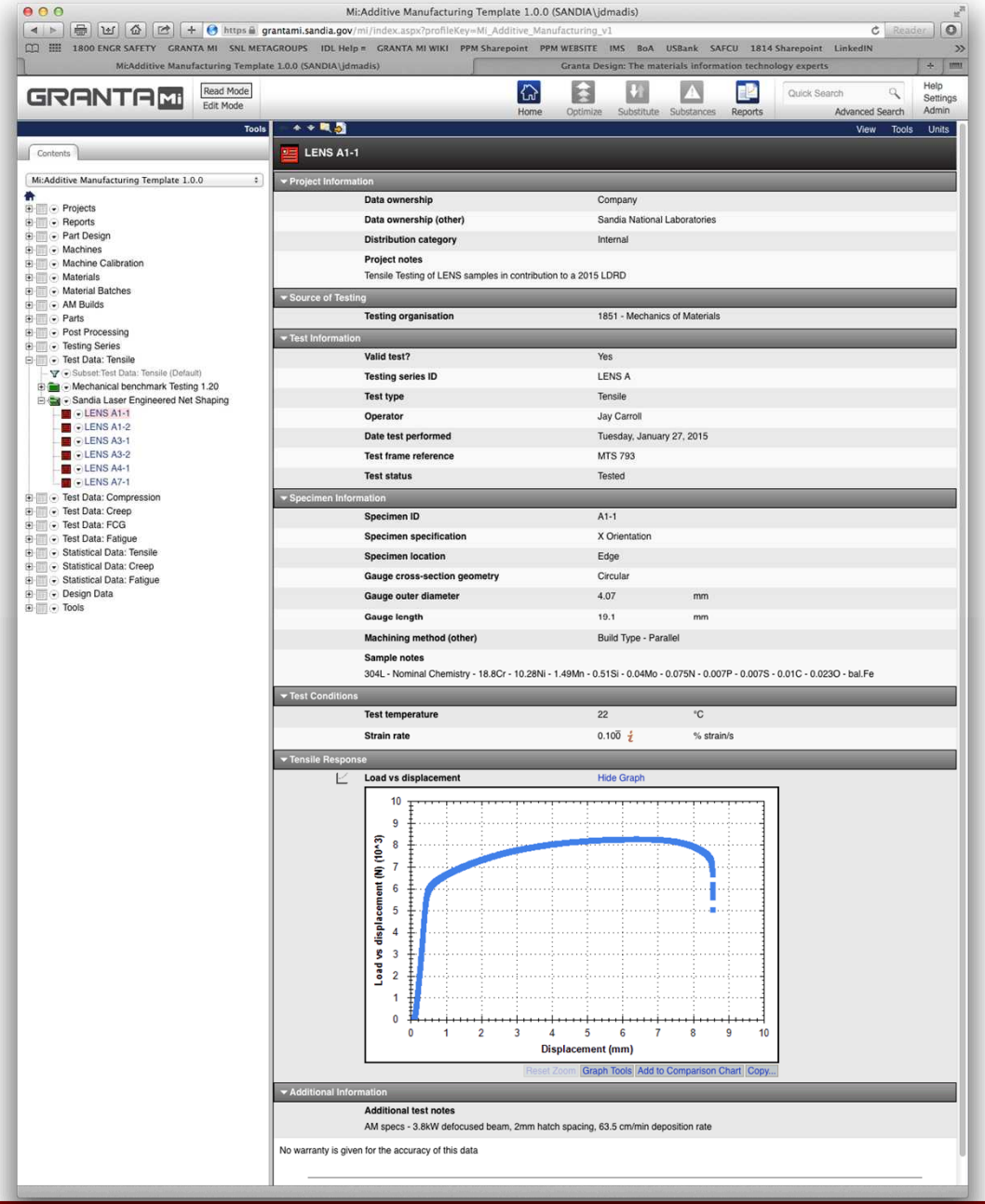


Tensile Response

Load vs displacement

Series 1			Series 2		
Displacement (mm)	Value (N)	Linetype:	Displacement (mm)	Value (N)	Li
0.001566112	2.1666217	MarkersOnly			
0.003944337	2.7838235				
0.006425381	1.4535801				
0.00808537	1.4210079				
0.007107854	2.3115652				
0.013236701	1.6291413				
0.012975931	2.5725055				
0.016503036	3.830277				
0.018675625	2.3339748				
0.018659234	2.2644937				
0.021612644	1.1378783				
0.023877621	2.563961				
0.023819506	1.6170884				
0.0265643	3.3737612				
0.028738379	1.2843497				
0.029501319	2.0345461				
0.031466782	3.7820659				
0.035487115	2.9570284				
0.037962198	1.6633446				
0.037021935	3.8370607				
0.039157271	1.7322693				
0.043591857	3.7164683				
0.04529506	3.2278075				
0.046394765	3.1065681				
0.048364699	3.6057928				
0.050002337	4.2308402				
0.050850213	5.6078572				

Load vs. Displacement Tab



Ex. SNL GRANTA MI AM TENSILE TEST RECORD

GRANTA MI Importer Helpful Hints

Sandia National Laboratories

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

Sandia National Laboratories

Interested in GRANTA MI at Sandia National Laboratories?

Send inquiries or data to :
- jdmadis@sandia.gov
- lmserna@sandia.gov
- rakarne@sandia.gov

GRANTA
MATERIAL INTELLIGENCE