Briefing Document:
GRANTA Materials Data for Simulation

Abstract—Finding the right materials property data for simulation can be time-consuming and costly. GRANTA Materials Data for Simulation dataset is a new license option available with ANSYS Mechanical® and ANSYS Electronics Desktop® that provides broad coverage of materials types and key property data that is useful for structural and electromagnetic analysis. Get instant access to the materials data you need and apply it easily to your ANSYS simulations. In this briefing document you will find:

- An article from ANSYS Advantage Magazine, providing an overview of the dataset and other options to get materials data for simulation
- An FAQ explaining GRANTA Materials Data for Simulation
- A list of the materials types covered in the dataset
- An example record

ANSYS ADVANTAGE Magazine

MATERIALS

Take Simulation to the Next Level with Accurate Materials Data

Finding the right materials property data for simulation can be time-consuming and costly. Accurate simulations require accurate property data. Engineers need a reliable data source and to avoid introducing errors as data is transformed and input. These challenges are addressed with a new materials data set, embedded within ANSYS Mechanical and ANSYS Electronics Desktop, providing access to richer data and tools to connect managed corporate material intelligence.

By **Beth Harlen**, Technical Marketing Communications Specialist

Simulation can do incredible things in the world of product development. Simulation models can refine and validate products in development, ensuring that they are optimized for manufacturability, durability, sustainability and other factors that affect the product life cycle. Assuming, that is, analysts have access to accurate materials inputs, and can be assured of their pedigree — for example, through traceability back to the source test data.

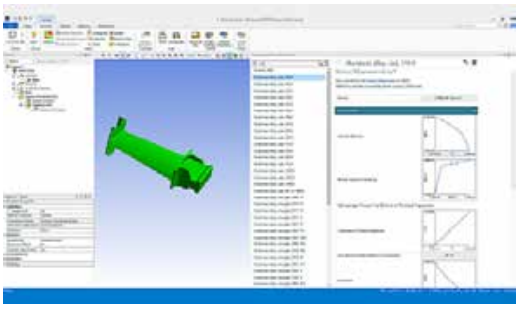
Without validated and consistent materials data, simulation is hindered by design restrictions, errors, delays and costs. Through the acquisition by ANSYS of Granta Design, a Cambridge University spinoff that provides materials information and related software, new opportunities exist for improving the accuracy of engineering simulations and analyses.

Different companies need different solutions to the problem of efficiently finding materials data. A starting point is to have a good set of reliable, easily accessed data that is valid for many simulations. "ANSYS GRANTA Materials Data for Simulation puts validated materials input data right at users' fingertips within their ANSYS simulation tools," says Stephen Warde, who heads the product management and marketing team at ANSYS Granta. "Taking this one step further — which is especially relevant for larger enterprises — ANSYS GRANTA MI helps companies ensure they are making best use of proprietary, in-house materials data along with more in-depth reference information."

VALIDATED MATERIALS DATA AT YOUR FINGERTIPS

Materials Data for Simulation is a dataset of over 700 materials — including metals, plastics, polymers, composites, magnetic materials, ceramics and more — with properties specifically chosen to support ANSYS simulations. It supports multiphysics workflows by making the same, consistent data available through ANSYS Mechanical and ANSYS Electronics Desktop, so engineers analyzing both structural and electromagnetics issues can benefit from consistent, validated materials.

The Materials Data for Simulation dataset provides the material property data needed for structural and electromagnetic analysis. Room-temperature



A dataset of over 700 materials — including metals, plastics, polymers, composites, magnetic materials, ceramics and more — is available through ANSYS Mechanical.

< Access consistent, validated materials data within the ANSYS Electronics Desktop user environment.

materials properties of the following types are available for all 700+ materials:

- Linear, isotropic elastic (Young's modulus and Poisson's ratio)
- Thermomechanical (thermal expansion coefficient)
- Thermal (thermal conductivity and specific heat capacity)

Where relevant, users will also find electrical and magnetic properties for many materials, e.g., electrical conductivity, dielectric constant, dissipation factor, magnetic coercivity and permeability, core loss, and B-H curves.

The data are collated and maintained by ANSYS and are based on proven sources, including the Granta Material Universe database and the JAHM simulation data set from JAHM Software, Inc.

"Every datasheet in the GRANTA Materials Data for Simulation dataset represents a generic materials type, rather than a specific product from a materials producer," Warde says. "This means that each record furnishes representative values for the properties offered by the available grades of the material. The goal is to support the early phases of design and to provide a wide-ranging reference source that supports simulation to obtain reliable results quickly."

LEVERAGE CORPORATE MATERIALS DATA

Completing the journey toward best practice requires organizations to think about two factors. First, what wider reference data sources are available to supplement the generic data available in GRANTA Materials Data for Simulation? The ANSYS GRANTA Selector software provides access to the complete Granta library of reference data, including rich sources of grade-specific data for metals and polymers. The software provides an array of tools to analyze this data and export it for use in simulation.

Secondly, and more strategically, how can organizations ensure best use of their own materials data – particularly where they have in-house expertise focused on analyzing test data to generate the materials models needed for simulation? Here the ANSYS GRANTA MI software can help, Warde explains.

"GRANTA MI is a dedicated materials information management system," he says. "It enables organizations to manage corporate materials data alongside the Granta library, creating a single source for materials data. Capture all of your test data, analyze that data to generate inputs for simulation, and make that input data available via an app within ANSYS Workbench, while ensuring all of this information remains linked for full traceability."

ANSYS GRANTA MI provides an enterprise-level solution to the wider "material intelligence" challenge.

MATERIAL IMPORTANCE

Materials data is critical to the success of simulation. However, users must make a point to ensure that data is validated, consistent and fully traceable. The process must begin with the right materials information.

"If materials input data are not reliable or simply are not available, simulations will never deliver on their true value," says Warde.

Through ANSYS GRANTA Materials Data for Simulation, users can access more than 700 material records directly within ANSYS products, saving costs, minimizing risk and improving their time to market. That value can be built on with a richer source of validated reference data via GRANTA Selector. Ultimately, GRANTA MI materials information management system enables the full life cycle of simulation-related data to be consistently and securely managed.

What is it?

A new dataset of materials property data providing broad coverage of materials types and key property data that is useful for structural and electromagnetic analysis. This version is available embedded within ANSYS Mechanical and ANSYS Electronics Desktop (where the data has been optimized for use with ANSYS Maxwell®).

What are the objectives?

To provide users of ANSYS software with instant access to ready-to-use materials data within their ANSYS simulation tools. To provide broad coverage of engineering materials in a single resource, with enough resolution to deliver useful data, while grouping similar material grades together for efficiency and speed when searching and using the data.

What is the nature of the data — will I find specific data on material grades in the database?

In order to meet these objectives, the records in the dataset are for "generic" materials. They describe a general type of material, providing "averaged" values of properties for material grades of that type. You will not find data for a specific grade. However, because the data has been carefully chosen to be representative, for most engineering materials you should find a record that is close to your grades of interest, with data that is sufficiently accurate for most simulation use cases.

What types of material are in it?

The listing below shows the main classes of material covered. For most of these classes, you will find data for multiple generic material types within that class. For example, there are over 60 aluminum alloys. Coverage of metals (over 350 records) and polymers (over 150 records) is particularly strong.

What properties are covered?

For structural analysis in ANSYS Mechanical

Room temperature models for all materials:

- Linear, isotropic elastic (Young's modulus & Poisson's ratio)
- Strength (tensile yield strength and tensile ultimate strength)
- Thermo-mechanical (thermal expansion coefficient)
- Thermal (thermal conductivity and specific heat capacity)
- Electrical (electrical resistivity)

Plasticity and fatigue models for metals:

- Bilinear isotropic hardening (tensile yield strength and tangent modulus)
- Life (S-N curve)

Multilinear plasticity for some metals:

- Multilinear isotropic hardening (stress-strain curve)

Temperature-dependent models for some materials:

- Including thermo-mechanical (thermal expansion coefficient)

Demonstration advanced properties for some plastics:

- Hyperelasticity (Mooney-Rivlin 2 parameter)

For low frequency electromagnetic field simulation in ANSYS Maxwell

Physical properties where relevant:

- Linear, Isotropic Elastic (Young's modulus & Poisson's ratio)
- Thermo-mechanical (thermal expansion coefficient)
- Thermal (thermal conductivity & specific heat capacity)

Electrical models for many materials:

- Conductivity, including some temperature-dependant curves
- Dielectric constant
- Dissipation factor

Magnetic models for many materials:

- Coercivity
- Core loss
- Permeability
- B-H curves

What additional producers' data are available with ANSYS Maxwell?

Users of ANSYS Maxwell will find an extra 500+ records for producer-specific grades of magnetic materials, enabling more exact analysis for key classes of electromechanical simulation. These include:

- B-H curves for all materials
- Core loss for many materials

Can I rely on the data? Where does it come from?

All of the data is compiled, checked and maintained by the expert ANSYS Granta Data Products team in Cambridge, UK. Founded by a leading figure in materials engineering in academia, Professor Mike Ashby, this spin-out team from Cambridge University is dedicated to ensuring useful, accurate materials data for ANSYS Granta customers. Given the averaged nature of generic materials data described above, you will not find references for a specific producers' datasheet or standard in the records. But the main sources for the data are:

- The Granta MaterialUniverse™ dataset, compiled initially at Cambridge University, and then at Granta Design (now ANSYS Granta), which draws from sources including supplier datasheets, handbook data, standards and specifications, and literature reviews
- The JAHM Curve Data from JAHM Software Inc., a widely respected source of property data for use in simulation
- The MagWeb database of magnetic materials (used in the additional producers' data available with ANSYS Maxwell)

Can I get further (grade-specific) materials data from ANSYS Granta?

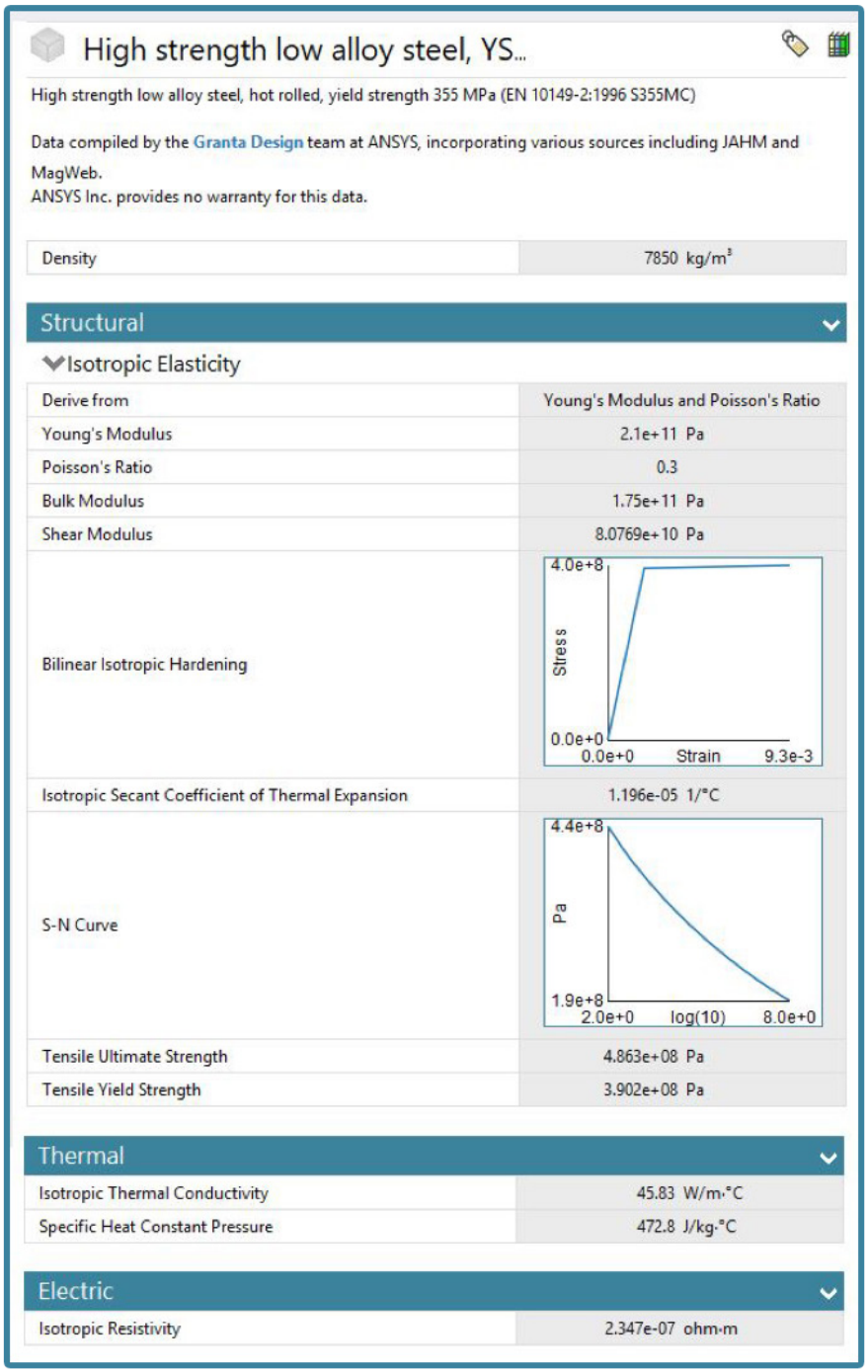
Yes. The ANSYS GRANTA Selector™ software provides access to the complete Granta library of reference data, including rich sources of grade-specific data for metals and polymers. The software provides an array of tools to analyze this data and export it for use in simulation. ANSYS GRANTA MI™ also provides access to this data within a system designed to manage all of your corporate materials information.

List of materials types covered

Metals	Polymers
Solders Steels (high, medium, low alloy) Low carbon steels Medium and high carbon steels Cast irons Coated steels Nickel alloys Iron alloys Microalloy and high strength steels Stainless steels (austenitic, ferritic, martensitic, and precipitation hardened) Tool steels Aluminum alloys Beryllium alloys Chromium alloys Cobalt alloys Copper alloys Lead alloys Magnesium alloys Tin alloys Titanium alloys Zinc alloys Precious metal alloys Refractory alloys Other metals	Thermoplastics, including: Engineering plastics Polyethylenes, PP ABS, PS PVC PET, PBT PMMA/acrylic POM/acetyl PC Polyamides/nylons PTFE Advanced engineering plastics PEEK PEI, PAI, PI PVDF PSU, PESU, PPSU PPS LCP Bio-based plastics Thermosets, including: Epoxy resins Phenolics Polyesters Elastomers/rubbers, including: Thermoplastic elastomers Thermoset elastomers
Ceramics	**Composites**
Technical ceramics Non-technical ceramics Semiconductors	Metal matrix composites Ceramic matrix composites PCB laminates
Foams	**Glasses**
Polymer foams, flexible Polymer foams, rigid	Technical glasses
Magnetic Materials	**Woods**
Hard magnets Soft magnets	Engineered woods
Fluids	**Honeycomb**
Gases (air, nitrogen…) Liquids (refrigerant, water…)	Expanded honeycomb Extruded honeycomb

An example record

The following record is for high-strength low alloy steel YS355, one of around 30 metals from the low alloy steel type in the list above.



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