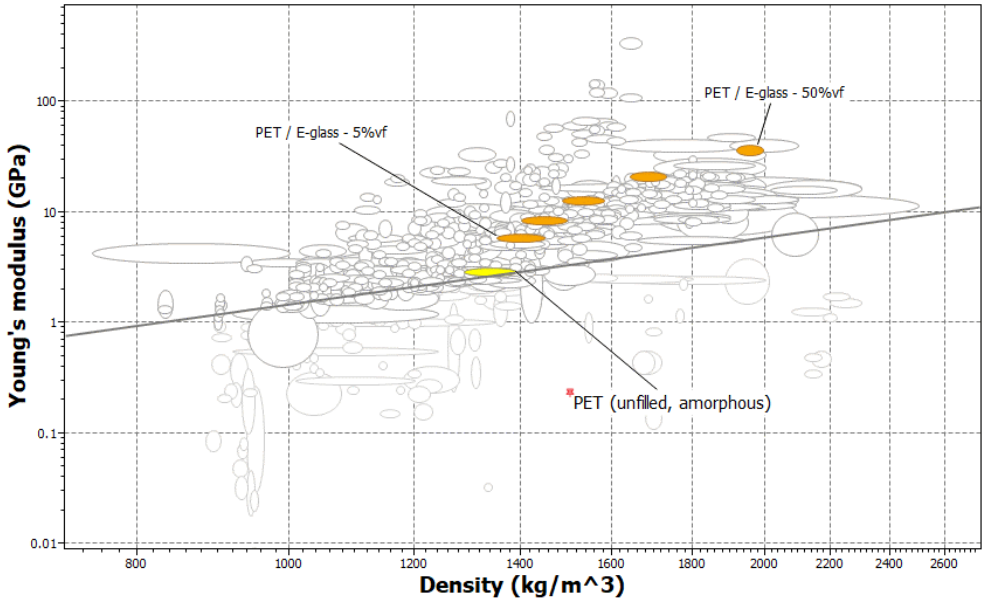
Ansys

GRANTA SELECTOR

Getting Started with Granta Selector

Synthesizer Tool



1 About these exercises

The Getting Started exercises provide an overview of the key tools and features in *Granta Selector*, and form a set of tutorials to help you familiarize yourself with the software. You can choose whether to work through them in order, or complete only the exercises relevant to you. They are intended for use with *Granta Selector 2021 R2*, and may not work correctly with earlier or later versions of *Granta Selector*.

There are also Quick Start Videos provided online to teach you about *Granta Selector*. The exercises can be used independently of the videos, or alongside them, to test and check your knowledge.

These exercises will guide you through estimating the properties of hybrid materials and battery modules, and the overall cost of a product with the Synthesizer tool.

1.1 Document conventions

In this document:

❖ Each step of the exercises is shown on a gold background, like this.

More detailed instructions appear below the main instruction.

Text on elements in the software (such as buttons, dialogs and tabs) appears in bold, **like this**. The names of records, datatables, and documents are emphasised *like this*. Words and numbers that you type as you follow the instructions appear in monotype, `like this`.

2 Introduction to the Synthesizer Tool

The Synthesizer tool is designed for use in the early stage of product development, and enables you to compare the performance of hybrid materials with other materials in the *MaterialUniverse* database.

It consists of three types of model:

- *Hybrid models,* for estimating the performance of novel materials and structures .
- *Part Cost Estimator,* for calculating the cost of a component based on the material and process chain.
- *Battery Designer,* for estimating the performance of battery module and pack designs based on the materials, battery cell type, and thermal management system used.

2.1 Exercises

Exercise 1: Sandwich Panel Model

Hybrid materials and structures combine the benefits of two or more materials to produce new materials that exhibit unique combinations of properties. For example, both composite materials and sandwich panels are commonly used to create strong, lightweight structures.

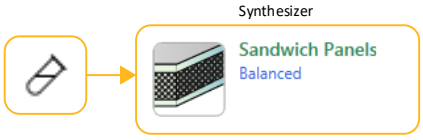
❖ Make a bubble chart of Young's modulus (E) against Density (ρ) using *MaterialUniverse: All bulk materials*

See Exercise 6 in *Getting Started with Granta Selector: Browse, Search & Chart* for detailed instructions.

❖ Use the **Sandwich Panels** model to create synthesized records for a family of hybrid materials

Click **Synthesizer** on the toolbar (or click **Tools > Synthesizer** on the menu bar).

Select the **Sandwich Panels – Balanced** model.



❖ Set the **Source Record** values

Face-sheet: *Aluminum, 6061, wrought, T6*
Core: *Polymethacrylimide foam (rigid, 0.200)*

Click **Browse** and locate the records in the tree.

❖ Use the default values for **Model variables** and **parameters**, and set the following **Record naming** values:

Face-sheet: Al
Core: Rohacell1

❖ **Create** the synthesized records

Click **Create** and then **Finish**. The new synthesized records will be shown in the Results list and on the Chart Stage.

Note: The Help in the Synthesizer dialog opens further information about the current model type, including details of the calculations used.

❖ Plot an **Index line** corresponding to a lightweight, stiff panel in bending $E_f^{1/3}/\rho$

Click **Index line**, enter a slope of 3, and **Maximize the index**.

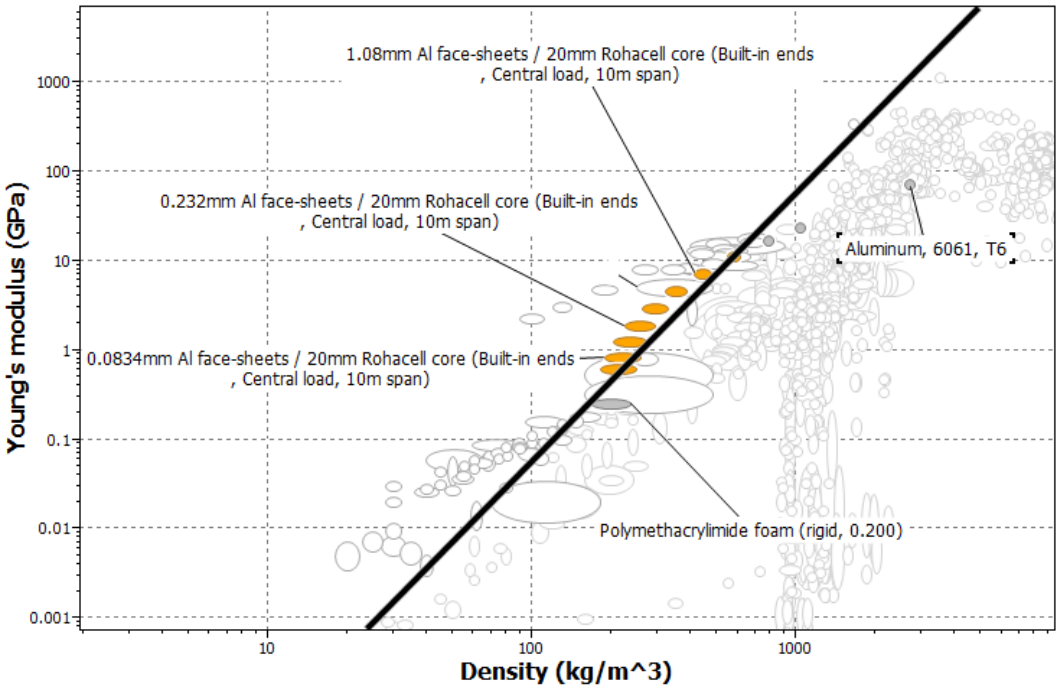
❖ Add labels to the source records and some of the synthesized records

You can select individual records on the chart and drag to place a label.

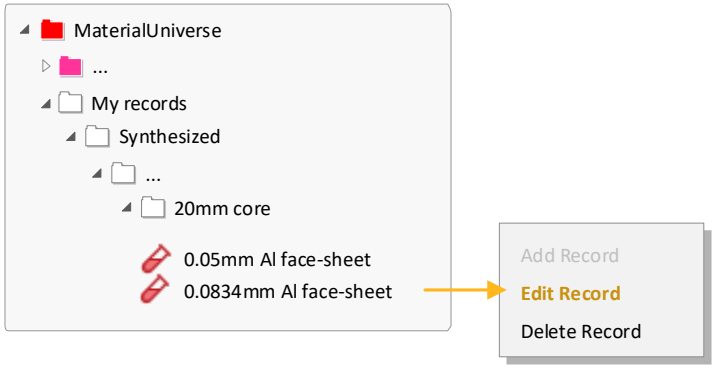
You can also add labels from the **Results** list: select one or more records in the list, right-click and select **Label** on the shortcut menu, then drag the labels where you want them on the chart.

Click **Highlight synthesized records** to help you identify the records on the chart.

Use the **Zoom** controls and to zoom in to the area of interest on the chart.



Synthesized records appear on the Browse tree under **My Records**. They can be edited or deleted in a similar way to User-defined records, by right-clicking and selecting **Edit Record** or **Delete Record**.



Exercise 2: Comparing materials and process costs

The **Part Cost Estimator** is a synthesizer model that calculates the total cost of a component based on the material and processing costs.

❖ Use the **Part Cost Estimator** to compare the cost of a component manufactured in two different ways: as an injection molded polymer, and as a rolled and pressed metal.

Start the Synthesizer Tool by clicking **Synthesizer** on the toolbar and in the dialog, select **Cost – Part cost estimator**.

❖ Set the **Component details**:

Material:	*PP (copolymer, 20% talc)*
Value of scrapped material:	10%
Part mass:	6.4
Part length:	10
Batch size:	1000 - 1E6
Number of values:	10

Note: For this exercise, the units of part mass and part length do not matter.

❖ Set the **Primary Shaping Process** values:

Primary process:	*Injection molding (thermoplastics)*
Availability:	Custom form
Part complexity:	Standard

Use the default values for *load factor*, *overhead rate*, and *capital write-off time*.

❖ Set the **Record naming** values:

Material:	`PP`
Primary process:	`molded`

❖ **Create** the new records.

Click **Create**. Keep the Part Cost Estimator window open.

The new synthesized records will be shown in the Results list and on the Chart Stage.

❖ Add another material process.

In the Part Cost Estimator window, click **Previous** and set the **Component details** for another material processing chain:

Material: *YS170 (hot rolled) high strength steel*
Part mass: 10

Use the default values for *scrap material value*, *part length*, *batch size*, and *number of values* (retained from the first material processing chain input).

❖ Set the **Primary Shaping Process** values:

Primary process: *Hot shape rolling*

Use the default values for the other properties.

❖ Set the **Secondary shaping process**.

Select **Include secondary process**, and enter the following value:

Secondary process: *Press forming*

Use the default values for *part complexity*, *amount of scrap*, and *scrap recycled*.

❖ Set the **Record naming** values:

Material: `Steel`
Primary process: `rolled`
Secondary process: `pressed`

❖ Click **Create** and then **Finish** to create the synthesized records and close the Part Cost Estimator.

Synthesized records created using Part Cost Estimator are appended to the *MaterialUniverse* tree under **My records > Synthesized > Part cost estimator**.

❖ Create a bubble chart to compare the two material processing chains.

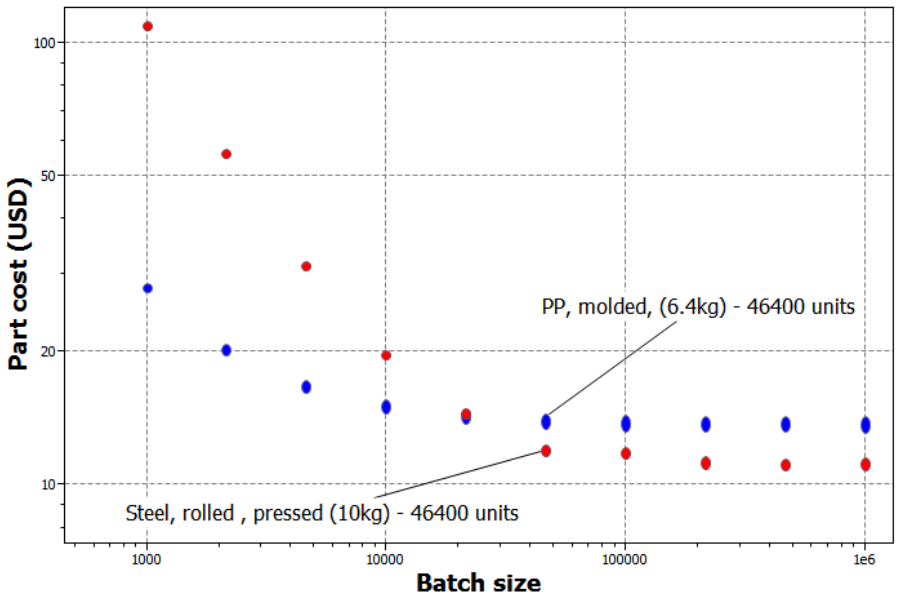
Click **Chart/Index** and set the following x- and y-axis values:

Category: *Part cost estimator*
X-Axis Attribute: *Batch size*
Y-Axis Attribute: *Part cost*

❖ Change the record color for easy comparison of the two processing chains.

On the *MaterialUniverse* browse tree, navigate to **My records > Synthesized > Part cost estimator**.

Right-click the *PP, molded* subfolder, click **Record color**, and select a color to change the record color for all records in that folder.



Exercise 3: Battery Designer

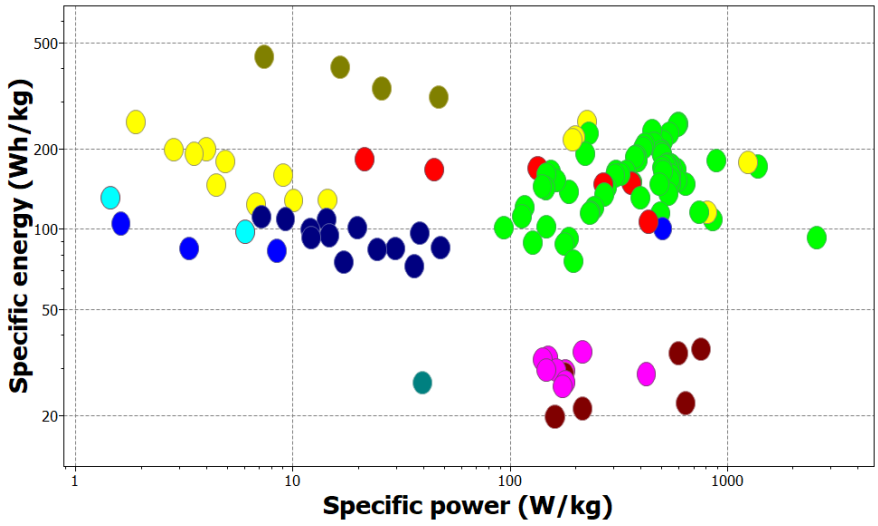
Battery Designer is a Synthesizer model that estimates the performance of battery module and pack designs based on the materials, battery cell type, and thermal management system used.

❖ Create a bubble chart to compare individual battery cells.

On the **Chart/Select** panel, **Select from:** *Battery Cells: All Cells*.

Click **Chart/Index** and set the following x- and y-axis values:

Category: *General*
X-Axis Attribute: *Specific power*
Y-Axis Attribute: *Specific energy*



Charts of *Specific power* against *Specific energy* are also known as Ragone plots.

By default, this will display all cells in the *Battery Cells* table, as well as any synthesized Module and Pack records in the Selection Project.

❖ Use the **Battery Designer** to estimate the performance of an example multi-cell module configuration.

Click **Synthesizer** on the toolbar. In the dialog, select *Battery Designer - Cell to Module (by number of cells)*.

❖ Under **Module**, enter the name and battery cell type.

Name: `Test Module 1`

Battery Cell: *Lithium-ion (NCA) Cylindrical 3500 mAh*

❖ Set the **Number of cells** and target **Discharge Current:**

Number of cells in series: 10

Number of cells in parallel: 2

Discharge current: 7A

❖ Select a custom **Configuration**.

Check the **Or custom configuration** checkbox.

Make sure the **Pre-defined module** checkbox is not selected.

❖ Set **Packaging** materials and dimensions:

Casing material:	*PC (high viscosity, molding and extrusion)*
Wall thickness:	`3 mm`
Insulation material:	*PC foam (rigid, closed cell, 0.65)*
Insulation thickness:	`3 mm`
Cell spacing:	`1 mm`

❖ Select a **Thermal management system (TMS)**

Cooling system type:	*Passive air cooling*

❖ Click **Create** and then **Finish** to create the synthesized record and close the Battery Designer.

Synthesized records created using **Battery Designer** are appended to the *Battery Cells* table under **My records > Synthesized > Modules.**

❖ Go back to the bubble chart.

The new Module record is now displayed on the Ragone plot.

❖ Now use the **Battery Designer** to create some Module records based on desired performance, and compare them to the existing Module.

Click  **Synthesizer** and select *Battery Designer - Cell to Module (by performance).*

❖ Enter the **Module** details:

Name:	`Test Module 2`
Battery Cell:	*Lithium-ion (NCA) Cylindrical 3500 mAh*

❖ Set the target **Performance**:

Should last for at least	`60-240 min`
Number of values:	`10`
with Current	`7 A`
and Voltage	`36 V`

❖ Select custom **Configuration**.

❖ Set the **Packaging** materials and dimensions:

Casing material:	*PC (high viscosity, molding and extrusion)*
Wall thickness:	3 mm
Insulation material:	*PC foam (rigid, closed cell, 0.65)*
Insulation thickness:	3 mm
Cell spacing:	1 mm

❖ Set the **Thermal management system (TMS)**

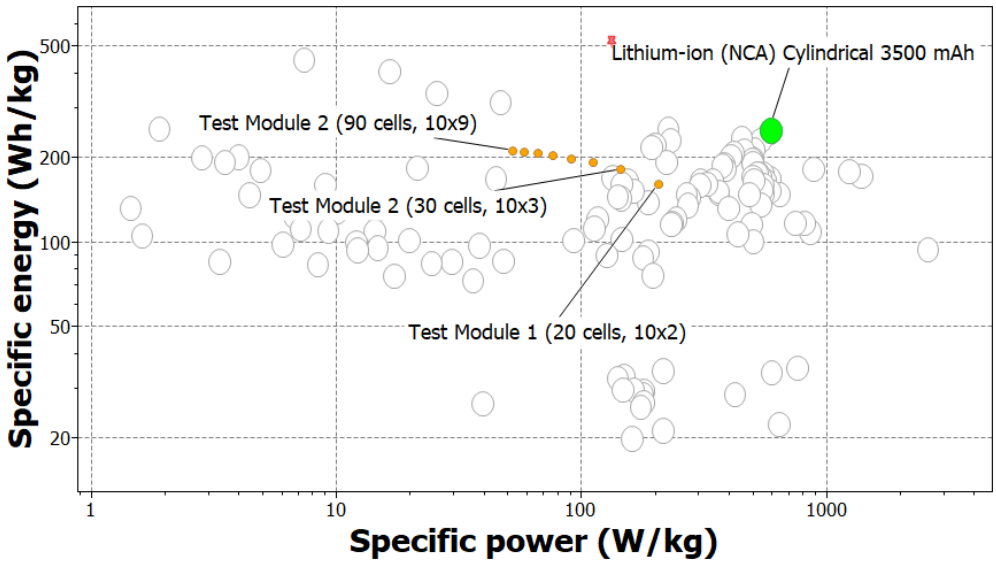
Cooling system type:	*Passive air cooling*

❖ Click **Create** and then **Finish**.

❖ Compare Module records using the bubble chart.

All the synthesized Modules can now be compared with each other and with individual cells.

You can also open Module datasheets to view other calculated properties associated with that module, for example predicted operating temperature and operating time.



To reproduce this chart:

- Set *Lithium-ion (NCA) Cylindrical 3500 mAh* as the Reference Record.
- Select **Highlight Synthesized Records** and **Highlight Reference Record** on the Chart toolbar.

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