



Advanced Databases in Ansys Granta EduPack software

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Cellular structures



Composites



Sandwich structures



Multi-layers



Part cost estimator



Battery Designer

Learning objectives for this lecture unit

Ansys software mentioned

- Ansys Granta EduPack™, a teaching software for materials education

Intended Learning Outcomes

Knowledge and Understanding	Knowledge about the Advanced Databases
Skills and Abilities	Ability to find advanced material properties and use them in a structured way alongside advanced tools
Values and Attitudes	Appreciation of the complexity of advanced industrial applications

Resources

- White Papers: White Papers describing databases available via the [Ansys Education Resources](#) webpage
- Software: [Ansys Granta EduPack](#)
- A number of *Advanced Industrial Case Studies* available via the [Ansys Education Resources](#) webpage

Outline of the lecture unit



- **Available databases and tools**
- **The advanced level**
- **Database overview and subsets**
- **External and temperature dependent data**
- **Sustainability**
- **Advanced Ansys Granta EduPack software tools and capabilities**
- **Advanced Industrial Case Studies**

Advanced databases and tools







Advanced















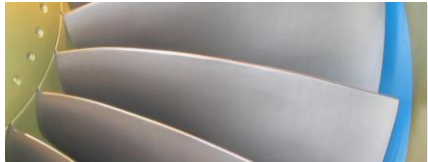

















Level 3 Standard Database

Extra data in:

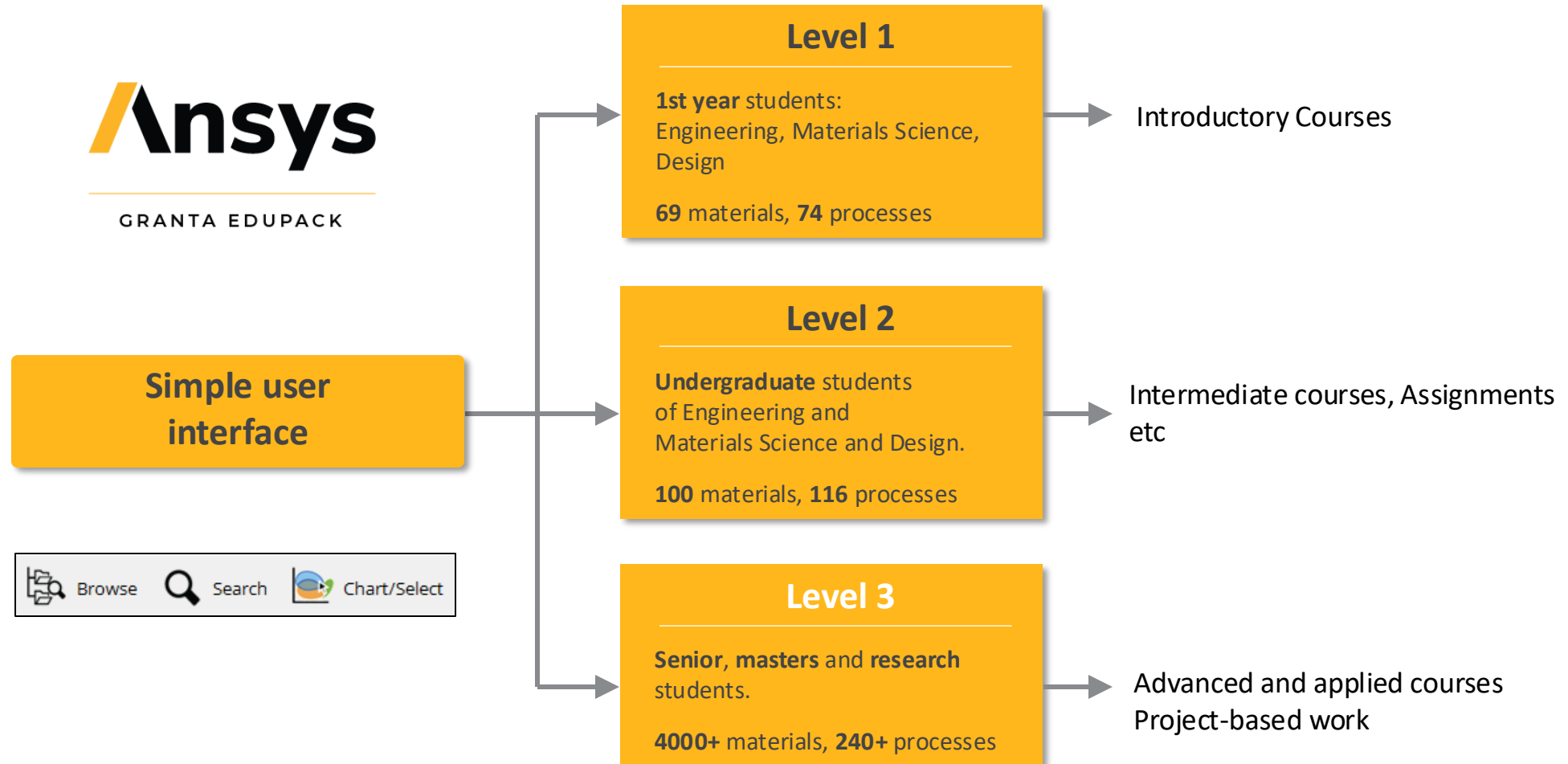
- Bioengineering
- Polymer
- Aerospace
- Eco Design
- Sustainability

Tools Available:

- Eco Audit 
- Enhanced Eco Audit 
- Synthesizer 
- Engineering Solver 
- Find Similar 
- Comparison Tables 

	Standard	 Eco Audit		
	Bioengineering	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Polymer	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Aerospace	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Eco Design	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Sustainable Development	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	

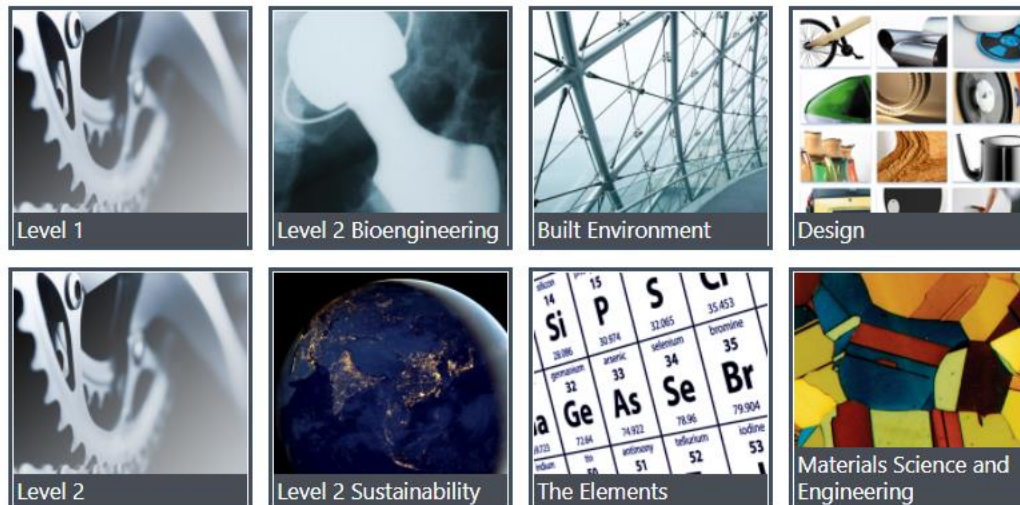
Ansys Granta EduPack software level structure



Ansys Granta EduPack software 2025R1 Databases

[▶ quick start](#) [★ what's new](#) [+ add database](#)

Introductory



Advanced



What Databases do you have?

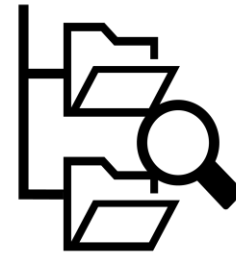


Level 3 Standard database

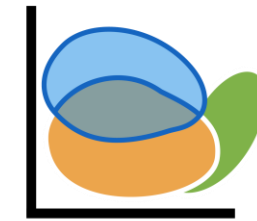
Data:

- Material Universe
 - More than 4,200 Materials and 240 Process records
 - More than 60 engineering properties for each
- Around 100 records for automotive alloys
 - Aluminum alloys (2008.2036, 5182, 6111)
 - Magnesium alloys (AE44, AM60, AS41)
 - High-strength steels (Dual phase/HSLA/Mn-B)
 - Automotive composites (Polyester and Polyamide matrix)

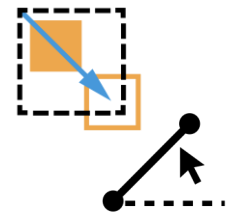
Standard Level 3 EduPackTools:



Reliable data



Charting tools



Materials selection tools



Teaching Resources



Eco Audit Tool

Subsets

All major material classes including: fibers, particulates, foams and biomaterials

Engineering materials – suitable for most design and build projects.

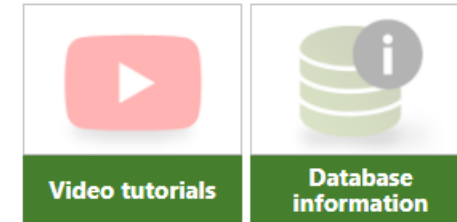
Magnetic materials with remanence, saturation induction, coercive force etc.

500+ Hardwoods, softwoods, tropical, palms, particleboard, fiber board, and plywood

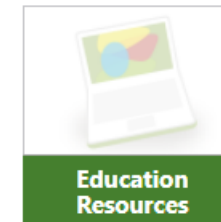
2. Filter by subset



More information



More resources





Level 3 Bioengineering database

Data:

- Additional biological materials and data (4200+ materials and 240+ processes total)
- Data for Medical grades, Medical trade-names, and Sterilizability
- Link to ASM Medical Materials online data
 - Biomedical response data with medical device application information (Orthopaedic, Cardiovascular, Neurological)
- Bio-related subsets
 - Biological, Natural and Biological materials, Bio-derived, Bio-polymers, Bio-medical, Bioceramics
- Information on Medical devices, including over 100 FDA examples linked to relevant materials

Also available in Level 2

Tools:



Standard Level 3
Tools



ASM Medical
Materials



Enhanced
Eco Audit



Comparison
Table



Synthesizer
Tool



Engineering
Solver



Find
Similar



Level 3 Polymer database

Data:

- MaterialUniverse – 970+ polymer records
 - Includes ChemRes data for resistance to chemical environments.
- Global Polymers Plastics
 - 105,000+ datasheets for commercial polymer grades from suppliers Meeting ASTM or ISO standards.

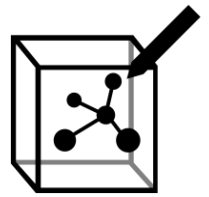
Tools:



Standard Level 3
Tools



Enhanced
Eco Audit



Synthesizer
Tool



Comparison
Table

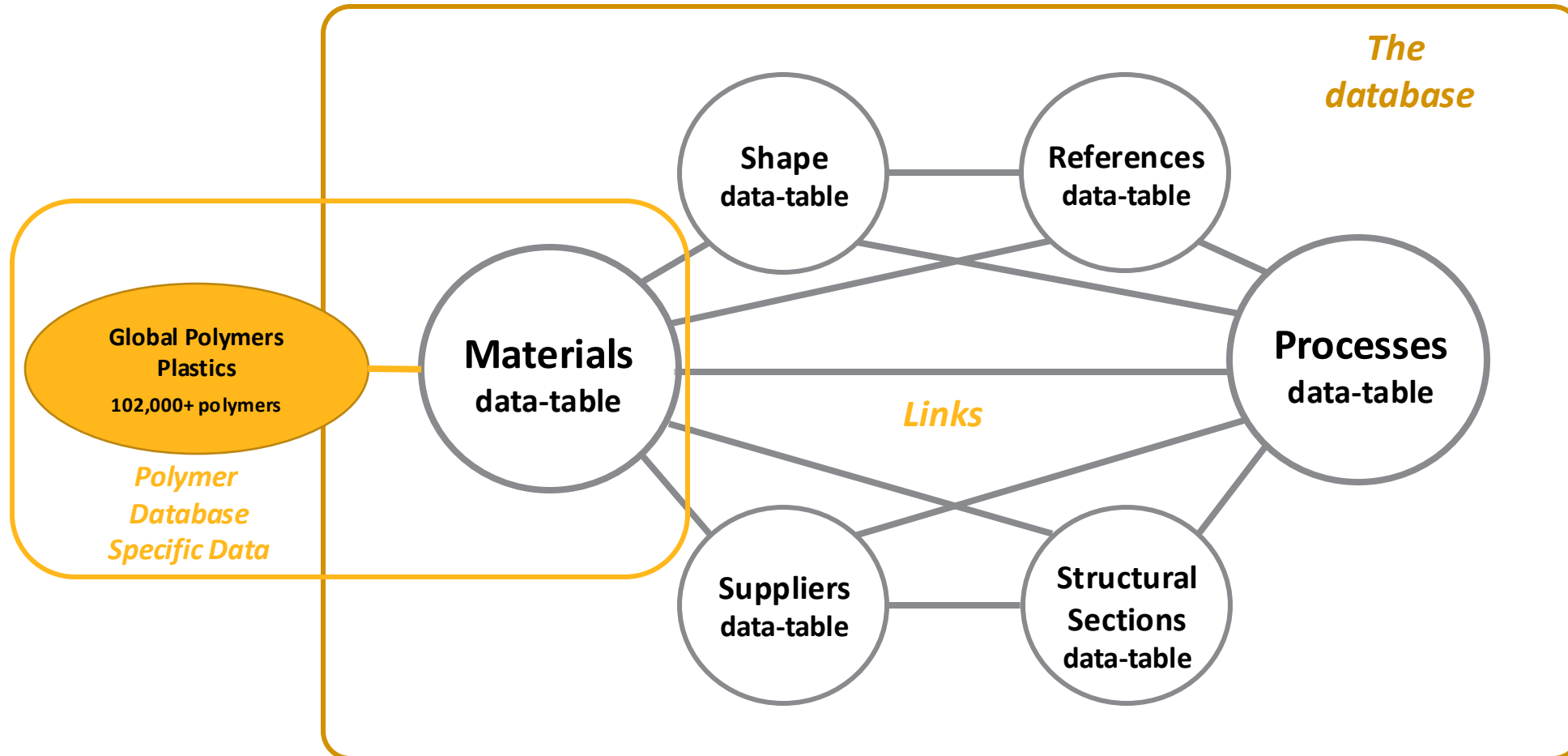


Find
Similar



Engineering
Solver

Granta EduPack Polymer Database structure



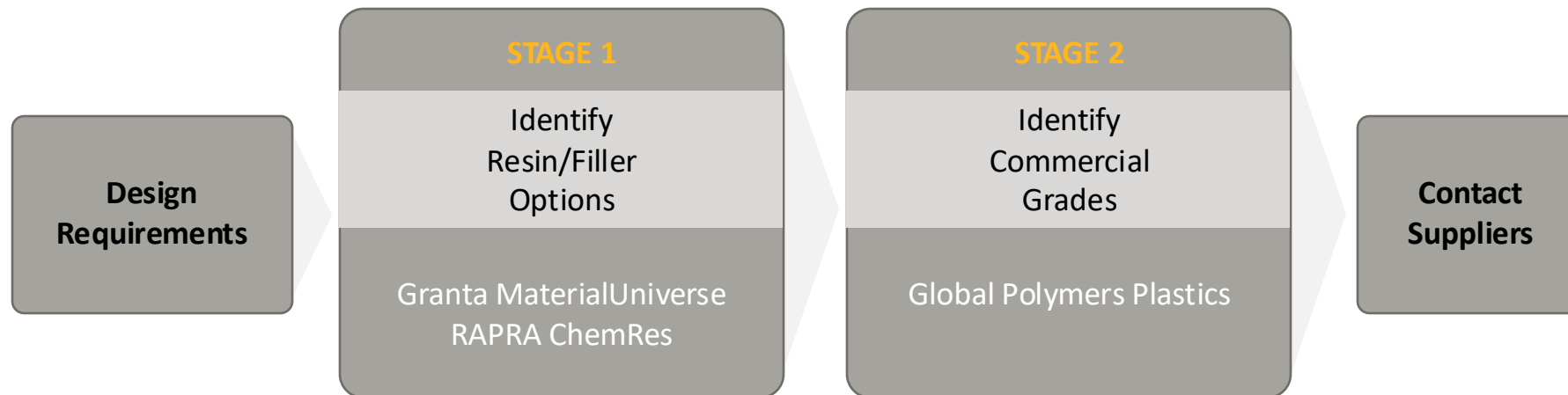
Using the Polymer modules

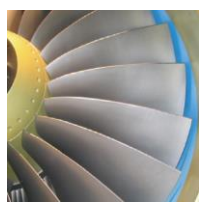
- **MaterialUniverse**

Designed for primary, broad materials selection. Enables generic candidates (resin and filler type) to be easily identified.

- **Global Polymers Plastics**

Once the resin and filler type are known these can be used to find specific commercial grades and possible vendors.





Level 3 Aerospace database

Data:

- Materials Data Tables (*Material Universe*)
 - Additional 'Aerospace Materials' subset with 950+ records with many showing temperature dependent mechanical properties from the MMPDS database
- MMPDS – Metals (*formerly MIL-HDBK-5*)
2500+ records of statistically-derived design data for aerospace alloys, temperature dependent properties, fatigue curves, and corrosion rankings.
- *MIL-HDBK-17* – Composites
950+ records of test data for polymer matrix, metal matrix, and ceramic matrix composites.

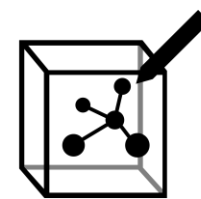
Tools:



Standard Level 3
Tools



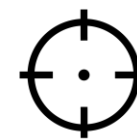
Enhanced
Eco Audit



Synthesizer
Tool



Comparison
Table

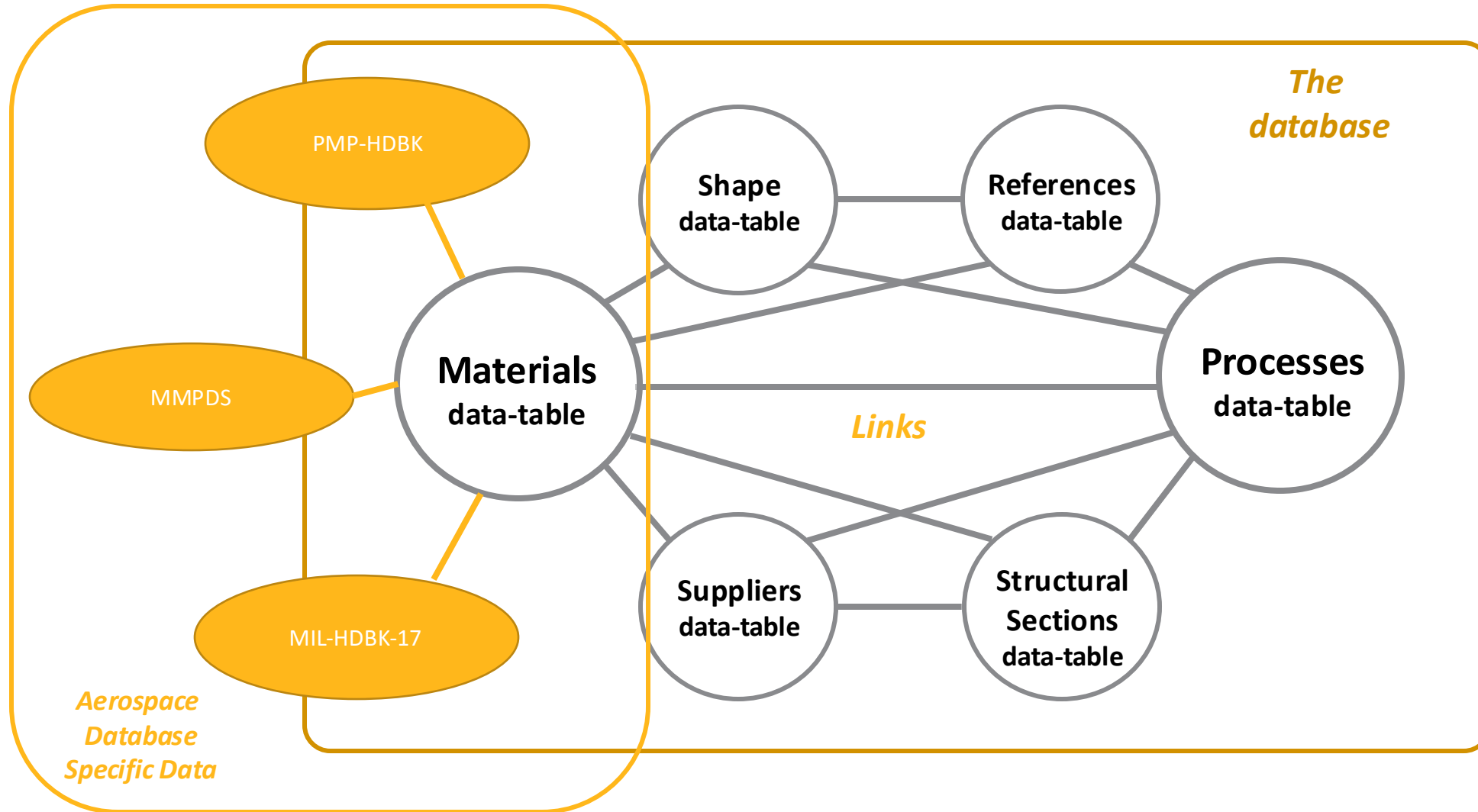


Find
Similar



Engineering
Solver

Granta EduPack Aerospace database structure

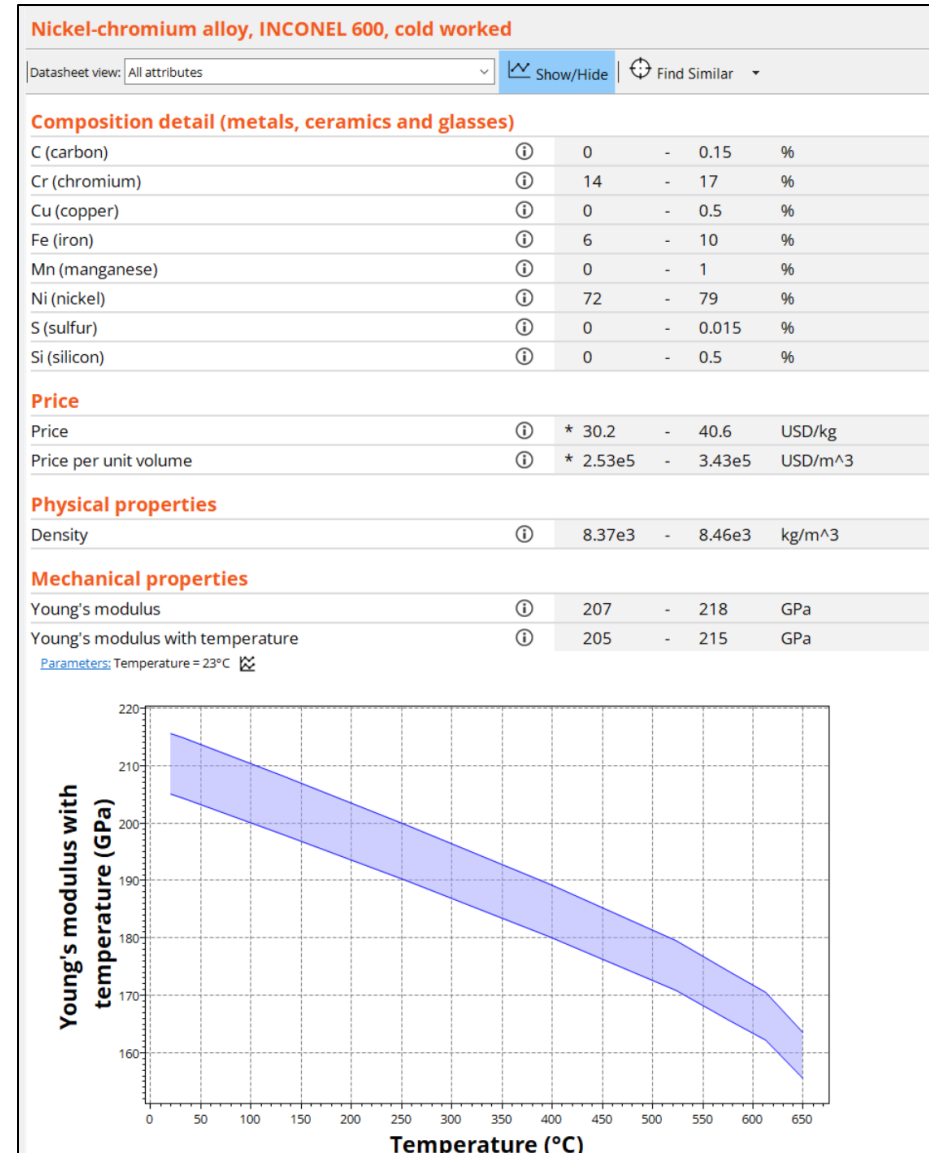


Materials Universe – Aerospace subset

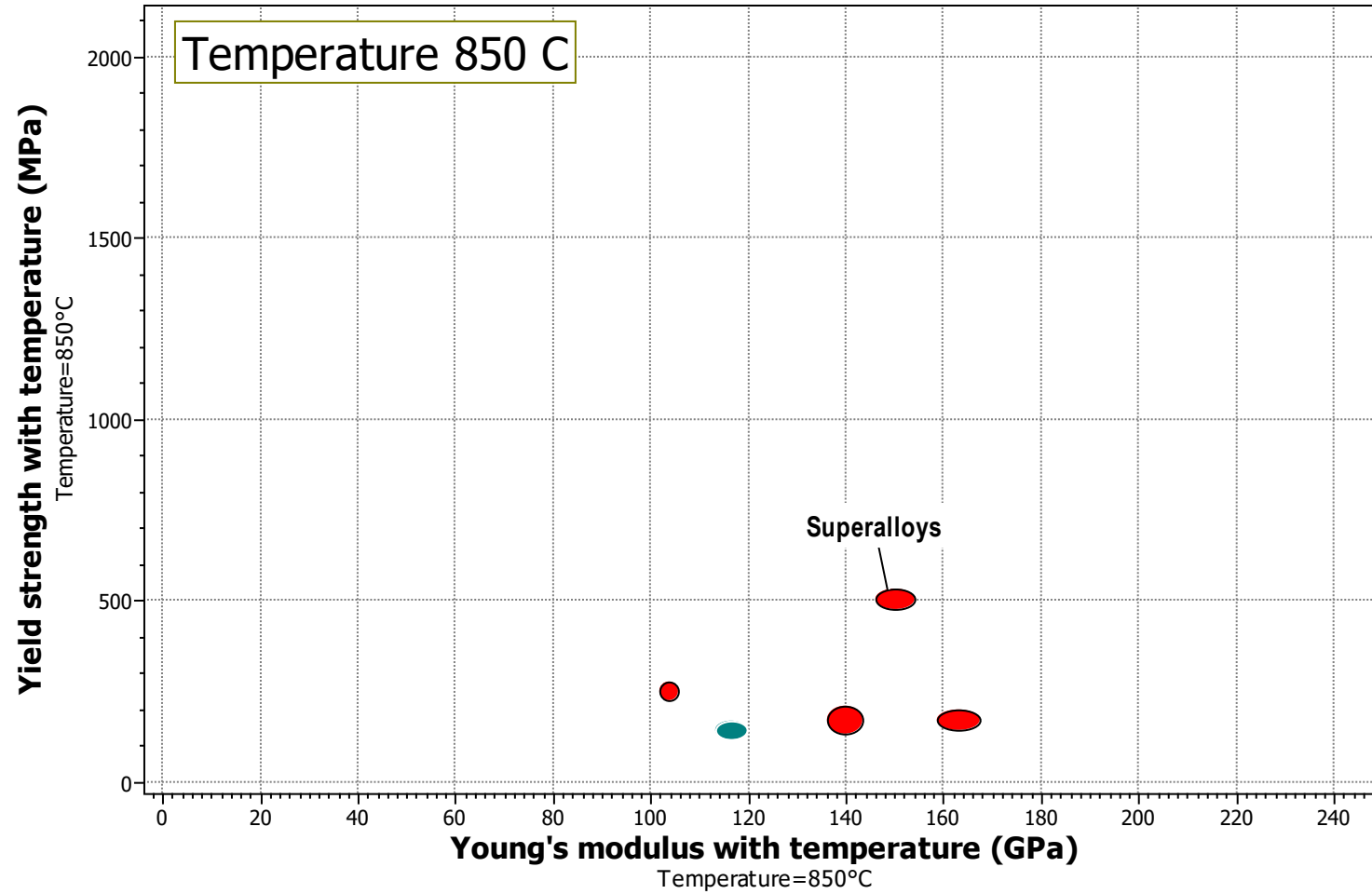
Each material in the Aerospace subset links to the MMPDS (metals) or MIL-HDBK-17 (composites) tables.

Each record has all the attributes of the 'All bulk materials' subset, as well as additional temperature dependant functional data.

It allows materials comparisons and selection on a database with no holes.



Temperature dependence





Level 3 Eco design database

Data:

- Eco Design Level 3 Database – 4200+ materials and 240+ Processes.
- Useful attributes for Eco Design
 - Eco Properties – Energy use, Water usage, CO₂, Traceable CO₂ and Embodied Energy (where available)
 - Geoeconomic data – Criticality, Abundance, reserves etc.
 - Hazard data – REACH, SIN List, RoHS, Food Contact

Tools:



Standard Level 3
Tools



Enhanced
Eco Audit



Synthesizer
Tool



Comparison
Table



Find
Similar



Engineering
Solver

Examples of additional data

Recycling and end of life			
Recycle	i	✓	
Functional recycle	i	✓	
Climate change (CO2-eq), recycling	i	* 1.22	- 1.34 kg/kg
Embodied energy, recycling	i	* 15.5	- 17.1 MJ/kg
Recycle fraction in current supply	i	28	%
Combust for energy recovery	i	✗	
Landfill	i	✓	
Biodegrade	i	✗	
Possible substitutes for principal component i			
Aluminum substitutes for copper in various products, such as electrical power cables, electrical equipment, automobile radiators, and cooling/refrigeration tubing. Titanium and steel are used in heat exchangers, and steel is used for artillery shell casings. Optical fiber substitutes for copper in some telecommunications applications. Plastics also substitute for copper in water pipe, plumbing fixtures, and many structural applications.			
Geo-economic data for principal component			
Principal component	i	Copper	
Typical exploited ore grade	i	2.52	- 2.78 %
Minimum economic ore grade	i	0.3	- 5 %
Abundance in Earth's crust	i	27	- 70 ppm
Abundance in seawater	i	2e-4	- 0.003 ppm
Annual world production, principal component	i	1.85e7	tonne/yr
Reserves, principal component	i	6.9e8	tonne
Main mining or production areas i			
Chile, 28%			
Peru, 12%			
China, 8%			
Congo, 6%			
Zambia, 6%			
Australia, 5%			
Russia, 4%			
United States, 4%			
Mexico, 4%			
Canada, 3%			
Kazakhstan, 3%			
Poland, 2%			
Other countries, 15%			

Healthcare & food		
Food contact	i	Conditional
Notes		
Copper alloys can only be used with food if the pH is higher than 6.		
Restricted substances risk indicators		
RoHS 2 (EU) compliant grades?	i	✓
EU REACH Candidate List indicator (0-1, 1 = high risk)	i	0
SIN List indicator (0-1, 1 = high risk)	i	0
Critical materials risk		
Contains >5wt% critical elements?	i	Yes



Level 3 Sustainability database

Data:

- Nations of the world - attribute per country.
- Legislation and regulation - representative legal framework around technological decisions
- Power Systems-Storage, Power Systems-Generation, and Battery Cells datatables

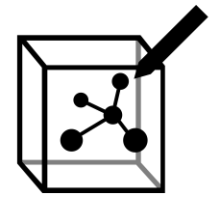
Tools:



Standard Level 3
Tools



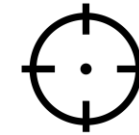
Enhanced
Eco Audit



Synthesizer
Tool



Comparison
Table



Find
Similar



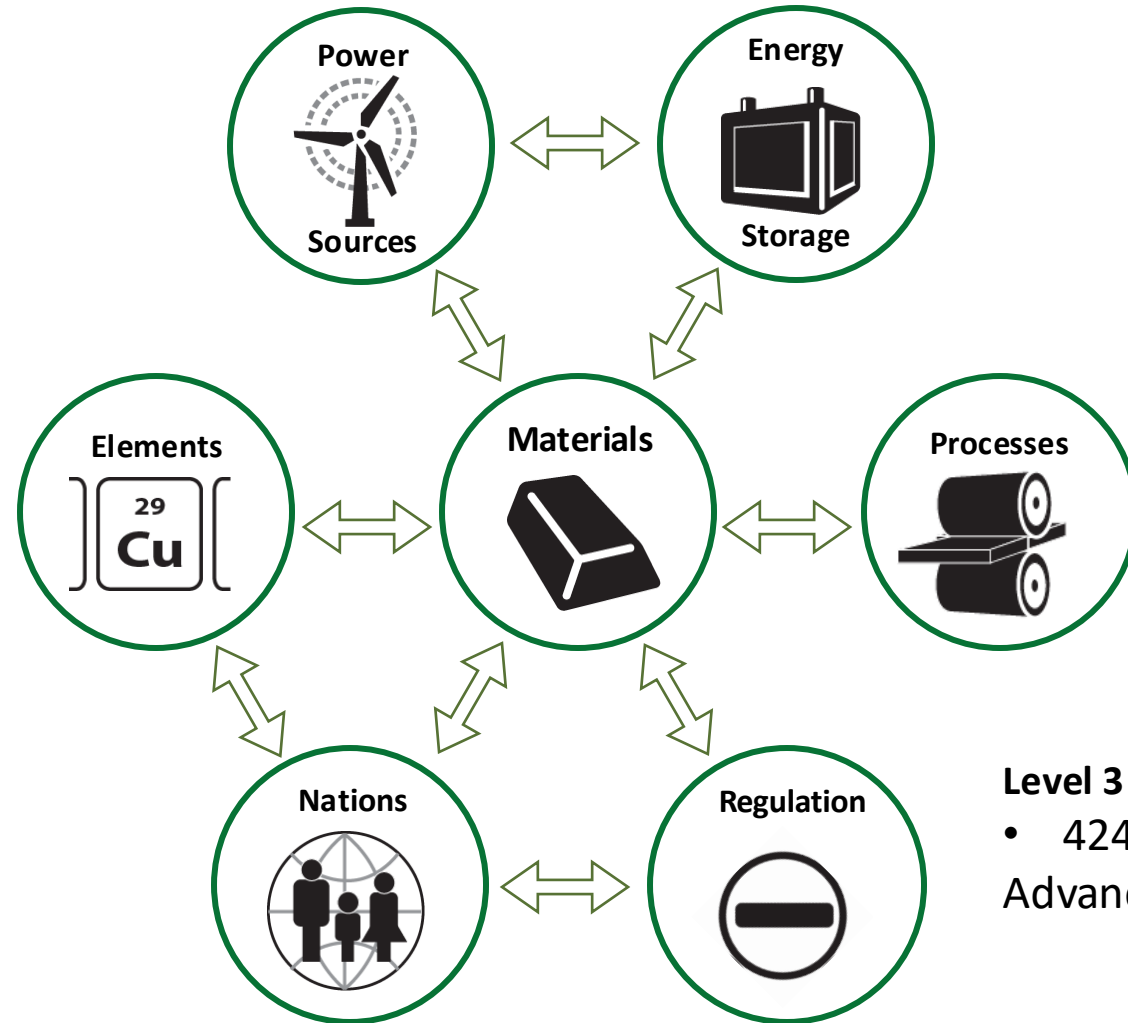
Engineering
Solver

Also available at Level 2

Sustainability database



Level 2 Sustainability
• 100 Materials
Teach the concepts



Level 3 Sustainability
• 4243 Materials
Advanced Projects

Analysis of Materials Systems

Advanced databases and tools







Advanced

































Level 3 Standard Database

Extra data in:

- Bioengineering
- Polymer
- Aerospace
- Eco Design
- Sustainability

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	Aerospace	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Eco Design	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	
	Sustainable Development	 Eco Audit	 Solver	 Comparison Table
		 Synthesizer	 Find Similar	



Enhanced Eco Audit

Ability to include cost analysis during audit

Home Product

Eco Audit Project

Product definition Report

New Open Save Compare with...

Product information

Name: Product

Include cost analysis

Material, manufacture and end of life

[How do I use my own materials or processes?](#)

Components

Qty.	Component name	Material	Recycled content	Mass (kg)	Primary process	Secondary process	% removed	End of life	% recovered

Joining and finishing

Name	Process	Amount	Unit

Transport

Use

Report

Summary chart

Detailed report

Image: Note:

Browse...

Clear

Can use custom records for both materials and processes

More elements to consider during manufacturing, such as secondary processes and % material recovered

Can consider the impact of additional joining and finishing steps

Find Similar Tool

Nearness Settings

- Composition overview
- Composition detail (metals, ceramics and glasses)
- Price
 - 100% when: Identical
 - Weighting factor: 1
- Physical properties
 - Density: 100% when: Identical, Weighting factor: 1
- Mechanical properties
 - Young's modulus: 100% when: Identical, Weighting factor: 1
 - Yield strength (elastic limit): 100% when: Identical, Weighting factor: 1

Buttons: Clear All, Defaults, OK, Cancel

Records similar to: Aluminum, 2014A, T6

Select records to add to comparison table:

Name	Nearnes...
<input checked="" type="checkbox"/> Aluminum, 2014A, T6	100
<input checked="" type="checkbox"/> Aluminum, 7149, T73	91
<input type="checkbox"/> Aluminum, 2618A, T6	91
<input type="checkbox"/> Aluminum, 7049, T73	91
<input type="checkbox"/> Aluminum, 7050, T74	91
<input type="checkbox"/> Aluminum, 7475, T61	91
<input type="checkbox"/> Aluminum, 7075, T651	91
<input type="checkbox"/> Aluminum, 2519, T87	91
<input type="checkbox"/> Aluminum, 7050, T7452	91
<input type="checkbox"/> Aluminum, 2124, T851	91
<input type="checkbox"/> Aluminum, 2297, T87	91
<input type="checkbox"/> Aluminum, 7075, T76510/1	90
<input type="checkbox"/> Aluminum, 7249, T7452	90
<input type="checkbox"/> Aluminum, 7175, T73511	90
<input type="checkbox"/> Aluminum, 2195, T8	90
<input type="checkbox"/> Aluminum, 2618, T6	90
<input type="checkbox"/> Aluminum, 2618, T61	90
<input type="checkbox"/> Aluminum, 7475, T74	90

Buttons: Comparison..., Selection Project...

Creates selection project
Filters data

COMPARISON - MATERIALUNIVERSE

Buttons: All Data, Project Data, Ranges, Averages, # Values, % Change, Highlight % Change > 10, Apply

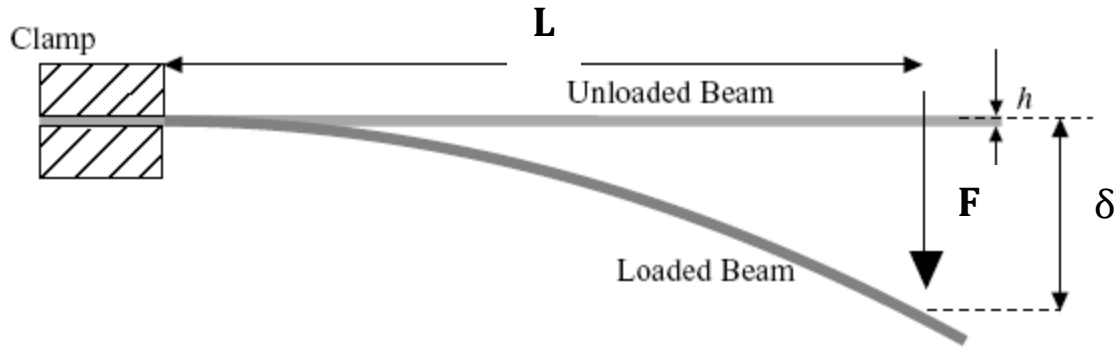
	Aluminum, 2014A, T6	Aluminum, 7149, T73
General information		
Condition	T6	T73 (Solution heat-treated and overaged or stabilized)
UNS number	A92014A	A97149
EN name	AW-2014A (AlCu4SiMg(A))	EN AW-7149 (EN AW-Al Zn8MgCu(A))
Composition overview		
Material family	Metal (non-ferrous)	Metal (non-ferrous)
Base material	Al (Aluminum)	Al (Aluminum)
Composition detail (metals, ceramics and glasses)		
Al (aluminum) (%)	90.8 - 95	86 - 89.5 ↓
Cr (chromium) (%)	0 - 0.1	0.1 - 0.22
Cu (copper) (%)	3.9 - 5	1.2 - 1.9 ↓
Fe (iron) (%)	0 - 0.5	0 - 0.2
Mg (magnesium) (%)	0.2 - 0.8	2 - 2.9 ↑
Mn (manganese) (%)	0.4 - 1.2	0 - 0.2 ↓
Ni (nickel) (%)	0 - 0.1	0
Si (silicon) (%)	0.5 - 0.9	0 - 0.15 ↓
Ti (titanium) (%)	0 - 0.15	0 - 0.1
Zn (zinc) (%)	0 - 0.25	7.2 - 8.2 ↑
Other (%)	0 - 0.15	0 - 0.15
Price		
Price (USD/kg)	11.7 - 13.9	5.82 - 8 ↓
Price per unit volume (USD/m^3)	32800 - 39200	16500 - 22900 ↓
Physical properties		



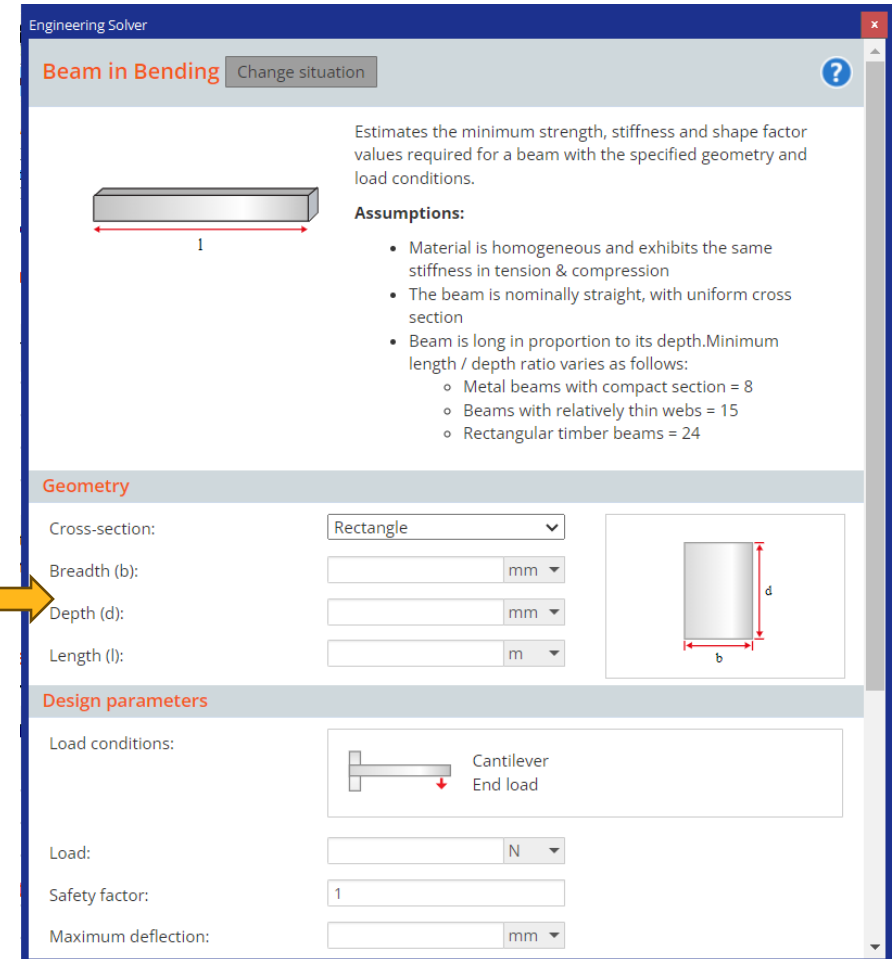
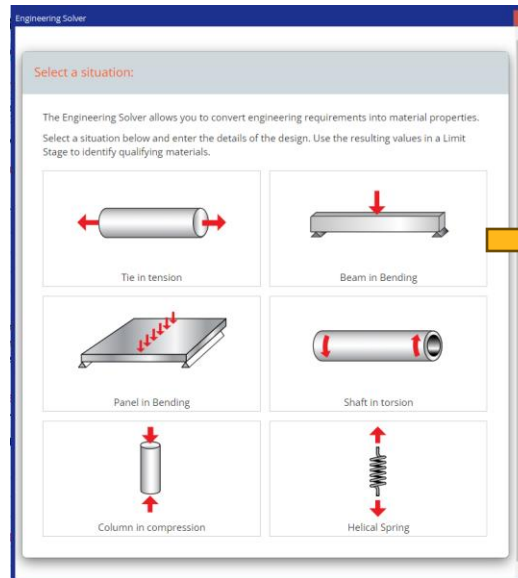
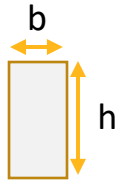
The Engineering Solver (1)

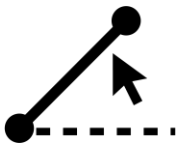
Basic equations from:
'Roark's formulas of stress and strain'

Engineering / Design



Materials?
Min Strength
Min Stiffness





Performance Index finder



Chart/Index

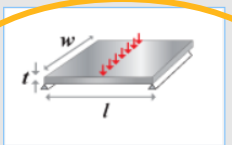
To plot a performance index, click here and choose the model that best fits your function and loading.

Chart Stage

X-Axis Y-Axis

Single or Advanced Property Performance Index Finder [What is a performance index?](#)

Component Definition

Function and Loading:  Panel in bending

Component Notes: Panels, equipment casings, unsupported horizontal surfaces, vehicle bodywork...

Free Variables: thickness

Fixed Variables: length, width

Limiting Constraint: stiffness

Optimize: cost

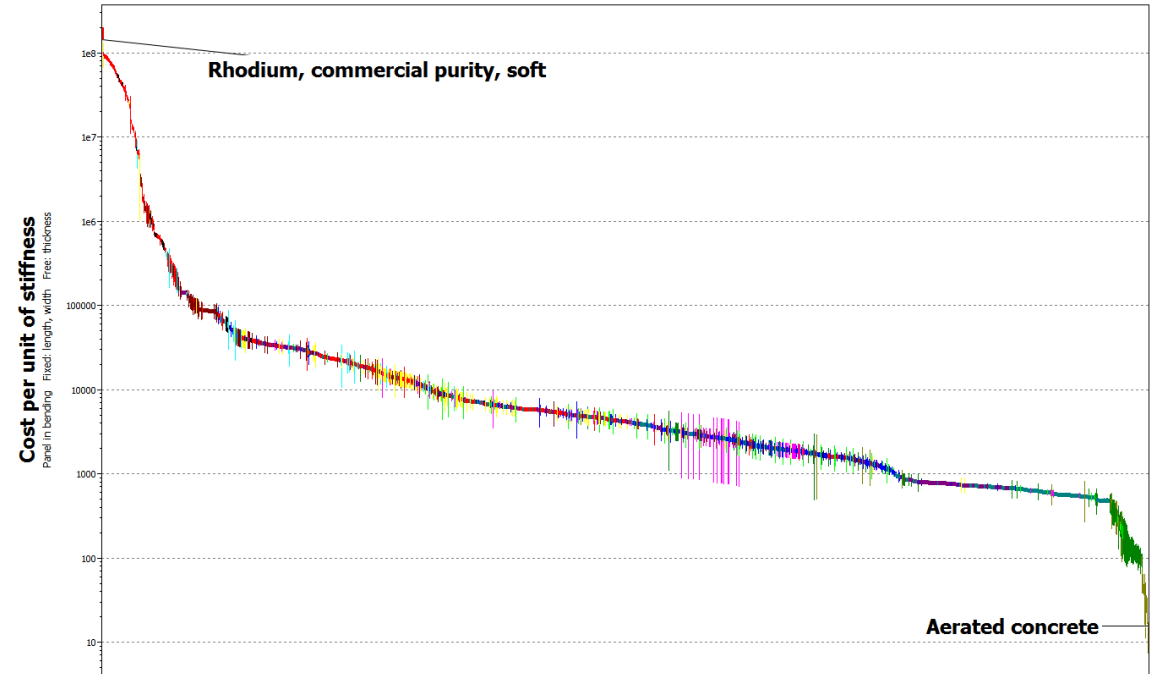
Performance Index: $\frac{C_m \cdot \rho}{E_f^{\frac{1}{3}}}$

Axis Settings

Axis Title: Cost per unit of stiffness

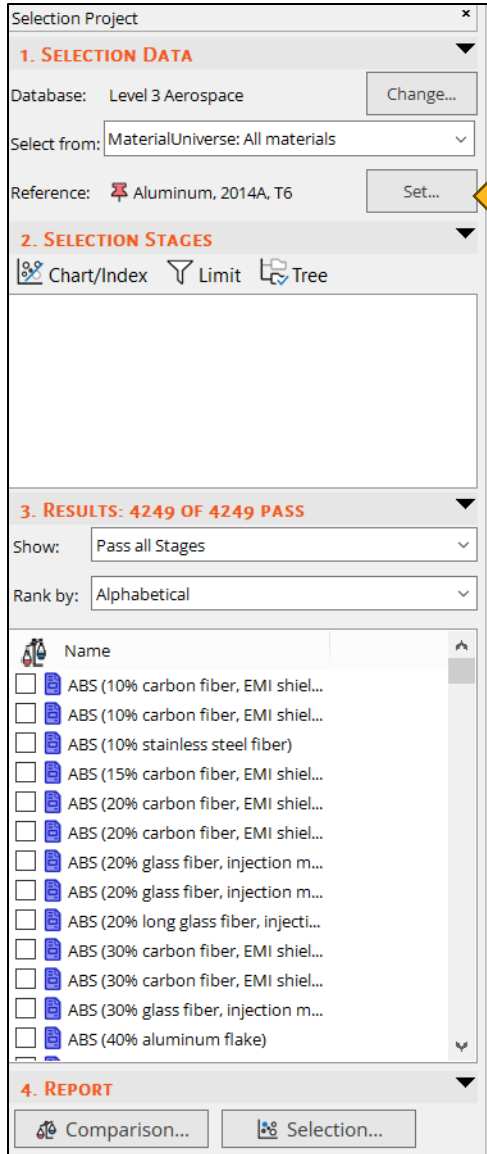
Absolute values Relative values

Then choose the **Limiting constraint** and the property you want to **optimise** - the 'performance index' is automatically generated and plotted.

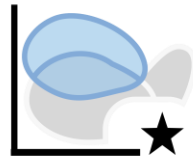
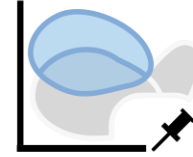




Reference Materials



Set reference material here for use in Comparison Tables and easier identification in charts via the “Highlight Reference Record” button



Favorite records are also easier to identify on charts via the “Highlight Favorite Record” button



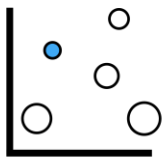
Comparison Table

- Compare all properties
- Highlight differences in performance
- Identify 'Gotchas'

COMPARISON - MATERIALUNIVERSE

All Data Project Data ↔ Ranges Averages # Values % Change Highlight % Change > 10 Apply

	Aluminum, 2014A, T6	Aluminum, 7149, T73
General information		
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UNS number	A92014A	A97149
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Other (%)	0 - 0.15	0 - 0.15
Price		
Price (USD/kg)	11.7 - 13.9	5.82 - 8 ↓
Price per unit volume (USD/m ³)	32800 - 39200	16500 - 22900 ↓
Physical properties		



Reporting tool

Selection Project

1. SELECTION DATA

Database: Level 3 Aerospace Change...

Select from: MaterialUniverse: All materials

Reference: Aluminum, 2014A, T6 Set...

2. SELECTION STAGES

Stage 1: Young's modulus (GPa)

3. RESULTS: 4196 OF 4249 PASS

Show: Pass all Stages

Rank by: Alphabetical

Name

- ABS (10% carbon fiber, EMI shiel...
- ABS (10% carbon fiber, EMI shiel...
- ABS (10% stainless steel fiber)
- ABS (15% carbon fiber, EMI shiel...
- ABS (20% carbon fiber, EMI shiel...
- ABS (20% carbon fiber, EMI shiel...
- ABS (20% glass fiber, injection m...
- ABS (20% glass fiber, injection m...
- ABS (20% long glass fiber, injecti...
- ABS (30% carbon fiber, EMI shiel...
- ABS (30% carbon fiber, EMI shiel...
- ABS (30% glass fiber, injection m...
- ABS (40% aluminum flake)

4. REPORT

Comparison... Selection...

To create a report automatically, click Selection.

Project Summary

1 of 4 100%

SELECTION REPORT Page 1 of 4

SUMMARY [Stage Details](#)

1. SELECTION DATA

Database	Level 3 Aerospace
Table	MaterialUniverse
Subset	All materials
Reference	Aluminum, 2014A, T6

2. SELECTION CRITERIA (SUMMARY)

Stage	Attribute	Constraints
1	Young's modulus (GPa)	

3. SELECTION RESULTS

Records passing: All Stages 4196 of 4249

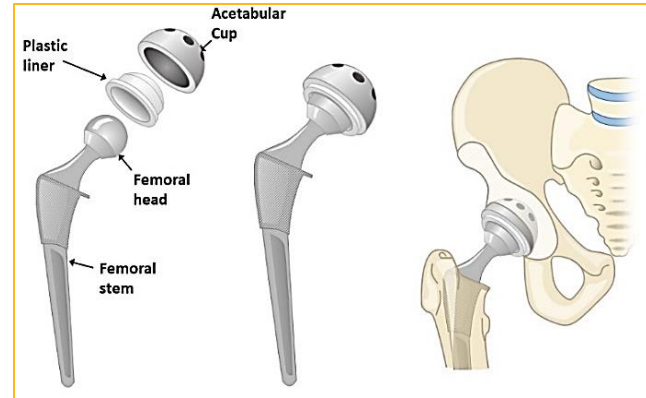
Ranked by: Alphabetically

Ranked order: Low to high

1	ABS (10% carbon fiber, EMI shielding, conductive)
2	ABS (10% carbon fiber, EMI shielding, conductive, flame retarded)
3	ABS (10% stainless steel fiber)
4	ABS (15% carbon fiber, EMI shielding, conductive)
5	ABS (20% carbon fiber, EMI shielding, conductive)
6	ABS (20% carbon fiber, EMI shielding, conductive, flame retarded)


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Level 3 Industrial Case Study

Electric Cars: Sustainability and Eco Design



Claes Fredriksson, Fernando Coelho, and Luca Petruccelli

Ansys Education Division

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