

Part Cost Comparison >>

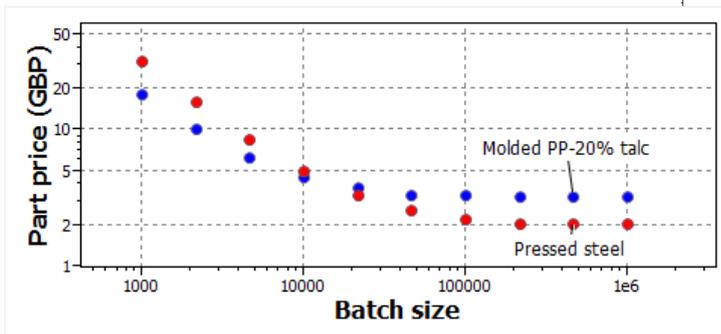
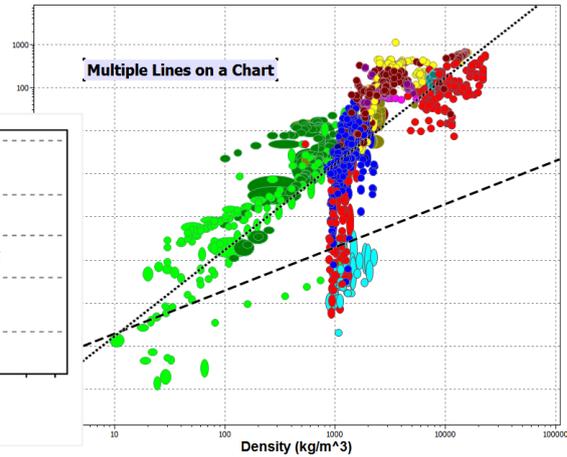


Chart Annotation >>



**Streamlined
Process Selection >>**

Limit

Properties Apply Clear

Click on the headings to show/hide selection criteria

Material compatibility

- Ceramics
- Composites
- Foams
- Glasses
- Metals - ferrous
- Metals - non-ferrous
- Natural materials
- Polymers - thermoplastics
- Polymers - thermosets

Shape

- Circular prismatic
- Non-circular prismatic
- Flat sheet
- Dished sheet
- Solid 3-D
- Hollow 3-D

Economic compatibility

Relative tooling cost

Relative equipment cost

Labor intensity

Economic batch size (units)

Physical and quality attributes

Process characteristics

Cost model and defaults

**More Data for
Real Case Studies >>**

Galling resistance (adhesive wear)

Excellent

Notes

Graphite lubricates, improving resista

**Supporting Independent
Learning >>**

CES 2016 EDUPACK Student Resources

- Table of Performance Indices
- Case Studies
- Video Tutorials
- Getting Started Guide
- Selection Methodology
- Phase Diagrams
- Crystallography
- Material Properties
- Teach Yourself

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1 Introduction

CES EduPack is a world-leading resource that supports and enhances the teaching of materials, engineering, design and sustainability. It combines a comprehensive database of materials and process information, powerful materials software tools, and a range of supporting textbooks, lectures, projects, and exercises (see more at www.teachingresources.grantadesign.com).

Each year we coordinate improvements to CES EduPack based on the feedback we get from people who use it. You can help by submitting a feature request via the software. You can also see what we are working on next and give feedback on [prototypes here](#).

These Release Notes detail the enhancements made to CES EduPack 2016 compared with the previous release, CES EduPack 2015.

To install CES EduPack 2016, please follow the instructions in the [Installation Quickstart Guide](#).

To get started quickly follow [this link](#).

If you have any problems, questions or feedback, please contact us at Granta:

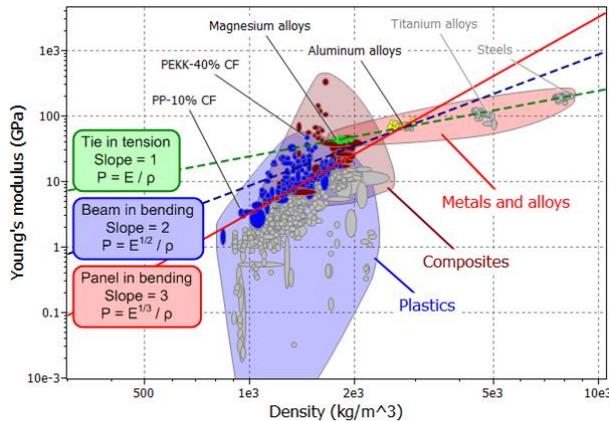
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2 Summary of Key Enhancements

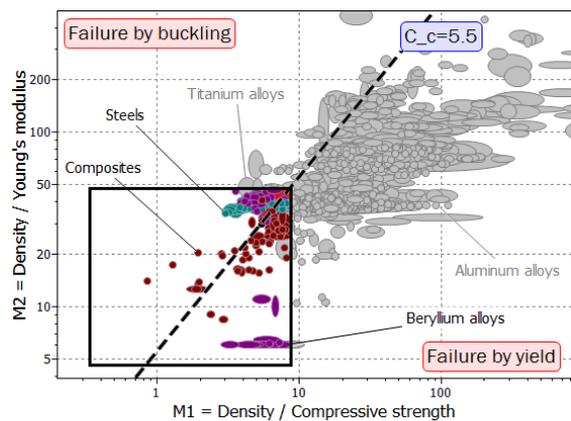
Chart Annotation

Whether you want to help explain concepts to students in class, or to demonstrate how you made a decision in a report, the ability to put multiple lines and curves and boxes on a chart, including lines that are not for selection, will help you make your point.

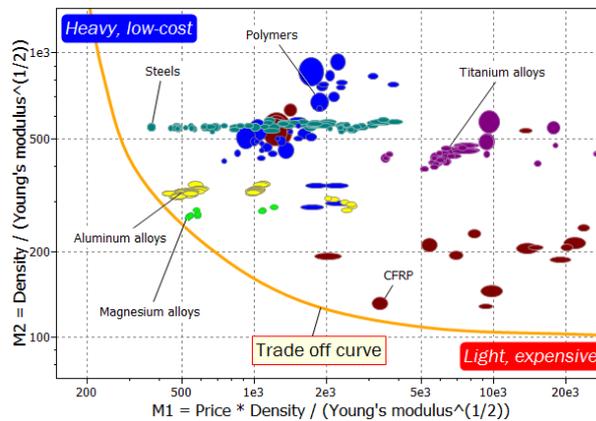
- Create charts from Mike Ashby's textbooks with multiple lines on a chart, trade-off curves and coupling lines.



Display Lines



Coupling Lines



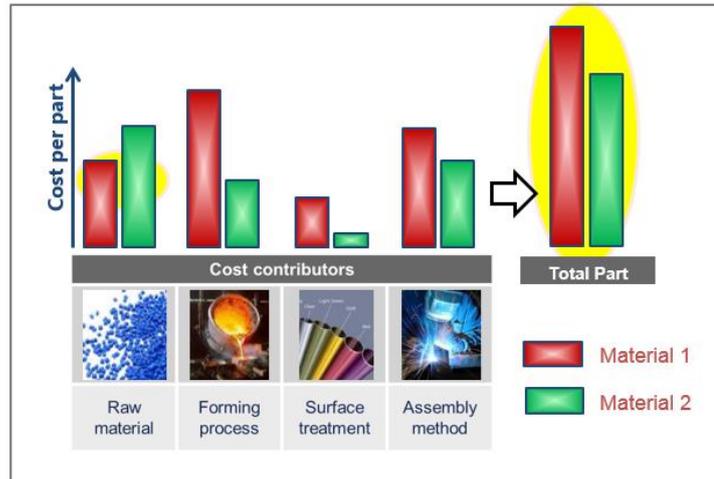
Trade-off curves

- Larger default settings for axes and labels so that the charts look better from the front of a lecture theatre. (You can change these in Settings).
- Available in all Editions.

Part Cost Estimator

When designing a part there is often more than one combination of material and process that will achieve your goals. Cost is always a consideration. CES EduPack includes price information

for materials and uses a cost model to estimate relative costs of processes. However, in real life, what is needed is to understand a series of processes applied to a material to create a part. Working with industry, Granta Design has created a model for doing this, enabling part cost to be quickly estimated in the early stages of conceptual design, when multiple materials are under consideration and details of the design have yet to be fixed.



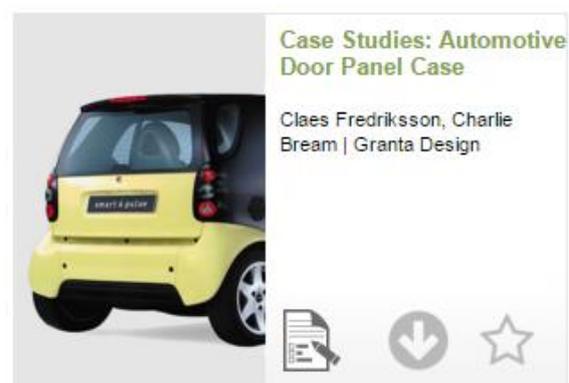
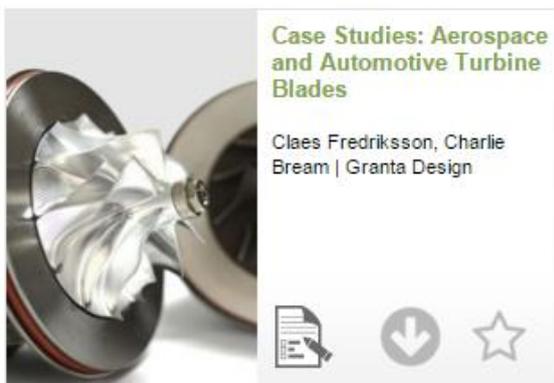
This first release of the model considers one material and up to two shaping processes (it does not yet include machining). The feedback from Industry so far is that it is very useful, particularly for cross-class material comparison, but we are keen to hear how it can be improved in the future for teaching.

- This Part Cost Estimator model is available in the Synthesizer, a tool available in the Advanced Editions of CES EduPack: Aerospace, Polymer, Eco Design and Sustainable Development.

More Data for Real Case Studies

Quick access to up-to-date, reliable data is essential to carry out design and build projects, to reverse engineer a product, or to find a substitute material for a redesign. The MaterialsUniverse has been enhanced and Reference Databases updated.

- [Additional Advanced, Industrial Case Studies](#) have been added to the Teaching Resources Website to support learning.



Find these and more at
[>>](http://www.teachingresources.grantadesign.com)

Streamlining Process Selection

Choosing processes depends primarily on answering three questions. Do they apply to the material you are using? Can they make the shape, or give the finish, you want? Are they economical? A redesign of the ProcessUniverse records makes it easier to review this information quickly and to use the limit stage to enter selection criteria on all three factors.

- This is implemented in Level 2 so that student's first learning selection methodology need not yet understand how to use a Tree Stage.

Limit

Properties Apply Clear

Click on the headings to show/hide selection criteria

▼ **Material compatibility**

Ceramics	<input type="checkbox"/>
Composites	<input type="checkbox"/>
Foams	<input type="checkbox"/>
Glasses	<input type="checkbox"/>
Metals - ferrous	<input type="checkbox"/>
Metals - non-ferrous	<input type="checkbox"/>
Natural materials	<input type="checkbox"/>
Polymers - thermoplastics	<input type="checkbox"/>
Polymers - thermosets	<input type="checkbox"/>

▼ **Shape**

Circular prismatic	<input type="checkbox"/>
Non-circular prismatic	<input type="checkbox"/>
Flat sheet	<input type="checkbox"/>
Dished sheet	<input type="checkbox"/>
Solid 3-D	<input type="checkbox"/>
Hollow 3-D	<input type="checkbox"/>

▼ **Economic compatibility**

Relative tooling cost	<input type="text"/>
Relative equipment cost	<input type="text"/>
Labor intensity	<input type="text"/>
Economic batch size (units)	<input type="text"/> <input type="text"/>

▶ **Physical and quality attributes**

▶ **Process characteristics**

▶ **Cost model and defaults**

Economic factors are always important in design. The Process Cost Model that generates the relative cost index, which enables you to consider both material and processing costs, has been enhanced to include the discount rate so you can take account of the opportunity cost of the money invested in capital equipment.

Supporting Independent Learning

Whether you are catching up on something you missed, revising a topic from last year, or reading ahead, it is good to have clear, accurate and engaging resources. In addition to the student resources already available, we now have overviews of each materials class, and descriptions of Materials Properties with questions and answers with which you can test yourself.

- These can be found in the Student Resources page of the Help Menu.



Table of Indices

Case Studies

Video Tutorials

Getting Started Guide

Teach Yourself

Standard Solutions

How to write a paper

Data booklet

Charts booklet

FAQs

Once you graduate

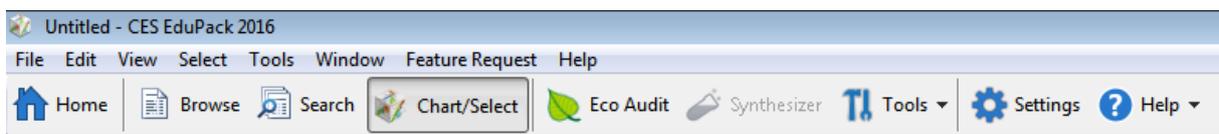
Usability Improvements

Engaged students learn more and are more enjoyable to teach. Enhancements have been made to make the use of CES EduPack even more intuitive, interactive and enjoyable. We hope that these improvements will lead the students to explore more and find all the resources and information available to them in CES EduPack.

It is not immediately clear from the text below which statements apply to which graphic. Maybe group the first 5 top-level changes together and place beneath the toolbar?

Chart function highlighted

Settings split from Tools



Home button added

Settings button clearer

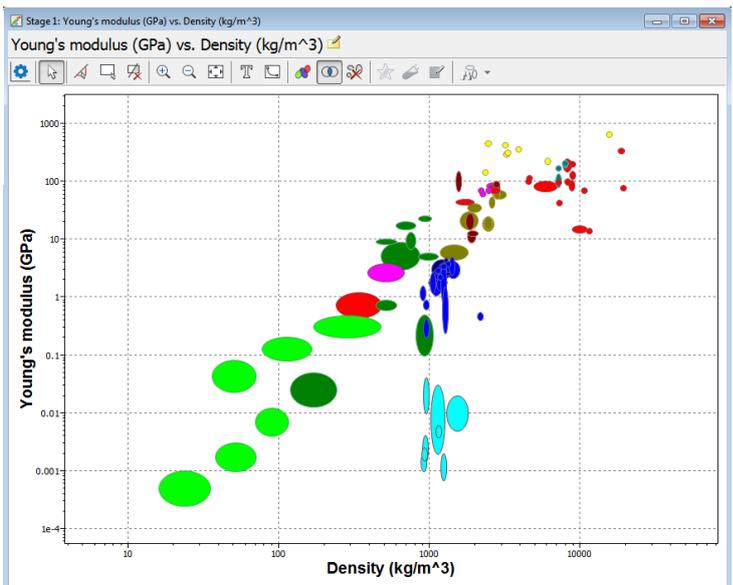
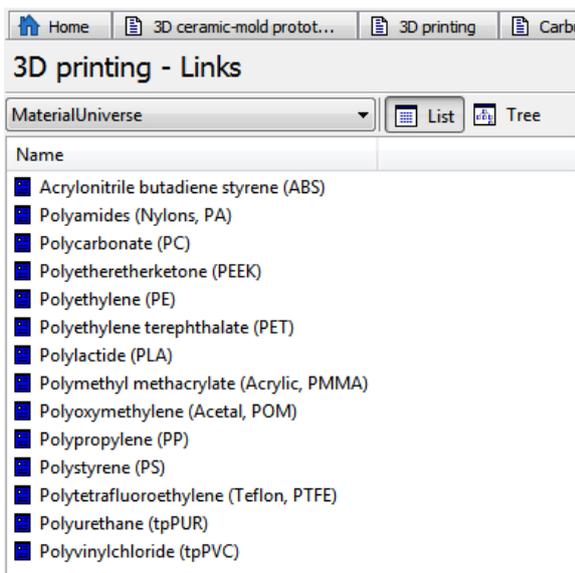
Annotation tools added

Links

- Reference
- ProcessUniverse
- Producers

More prominent links

Multiple tabs default open



Larger defaults for projecting in lectures

Acrylonitrile butadiene styrene (ABS)

Layout: Edu Level 1 Show/Hide

Polymers and elastomers > Polymers > Thermoplastics >

Description

Image

Caption

1. ABS pellets. © Shutterstock. 2. ABS allows detailed moldings, accepts color well, and is non-toxic and tough enough to survive the worst that children can do to it. © Gettyimages

The material

ABS (Acrylonitrile-butadiene-styrene) is tough, resilient, and easily molded. It is usually opaque, although some grades can now be transparent, and it can be given vivid colors. ABS-PVC alloys are tougher than standard ABS and, in self-extinguishing grades, are used for the casings of power tools.

Composition (summary)

Block terpolymer of acrylonitrile (15-35%), butadiene (5-30%), and styrene (40-60%).

General properties

Density	1.01e3	- 1.21e3	kg/m ³
Price	* 2.5	- 3	USD/kg

List view default when few records linked

Clearer datasheets with prominent science notes

3 What's new in CES EduPack 2016?

What's New?—Detailed Descriptions

This section details all enhancements in the CES EduPack 2016 release, compared with the CES EduPack 2015 release.

Chart Annotation

- New Help Menu documentation on '**What is an index line?**', and '**Create Advanced Charts**' which provides an overview of index lines and performance indices, and how and when to apply them, as well as full details on how to create charts with display lines, trade-off curves and coupling lines, and why these might be useful
- New '**Index line**' tool for plotting material indices (replaces the previous gradient-line)—Includes option to specify whether to minimize or maximize the index
- New capability to add **multiple lines, curves and boxes** to charts
- New option to add **display lines** to charts. Set during the creation of index lines, or from the 'Properties...' option listed in the line right-click menu—Lines function in the same way as selection lines or boxes, except they do not apply any filtering to records on charts or in the results list
- New option to add **trade-off curves** to charts. Created using the Curve tool, and choosing points through which the curve should go, they do not do not apply any filtering to records on charts or in the results list
- New capability to change the **format of lines, curves and boxes**. Set from the 'Line format...' option listed in the line/box/curve right-click menu. Provides options to change line style, color, weight, and the option to set the new style as the default for the application
- **Enhanced Zoom tool**—includes new zoom out and autoscale options. Autoscale fits the graph to visible data and labels
- **Edited chart labels are remembered** for the project duration and saved in the project file
- **Chart labels for failing records are grayed out**—providing greater differentiation between passing and failing records
- **Updated chart stage toolbar**—New icons and tooltips provide greater clarity over function and use of tools
- Ability to **change envelope color on chart** without changing color of records—Accessed from envelope label right-click menu

Benefits:

- Illustrate the impact of function and multiple selection criteria on the choice of material candidates
- Greater support for users not familiar with index lines, performance indices and the systematic selection process

- Create coupling lines (combine display line with selection box) to study cases with multiple constraints, such as a column loaded in compression failing in either compression or buckling
- Point out where the trade-off curve lies in class
- Create charts similar to those in Mike Ashby's 'Material Selection in Mechanical Design' text
- Save time in creating charts for presentations and report

Part Cost

New **Part Cost Estimator**, available with the Synthesizer Tool (in advanced Editions) – provides a high-level indication of part cost based on minimal information about the component design. Ideal for early-stage/conceptual design when multiple materials are under consideration. Quick and easy to use in Design project classes.

- Incorporates an extended version of the ProcessUniverse cost model. Considers material and up to two shaping processes, part size and complexity, off-the-shelf and custom forms, recycling of manufacturing waste, batch size, overhead rate and amortization time
- Calculates:
 - **Part cost (currency and currency/kg)**
 - **Material, tooling and overhead costs**
 - **Contribution of material, primary and secondary process to final part cost**
- Calculated properties are listed on the synthesized material datasheet, and Limit stages under a new 'Part cost estimator' header at the bottom of the datasheet
- Results can be plotted and compared on charts, such as mass-cost trade-offs and part cost vs batch size
- Supported by updated prices in the MaterialUniverse, compiled using an enhanced version of Granta's price model – based on data from the world commodity markets

Benefits:

- Enables part cost to be **quickly estimated** in the early stages of conceptual design, when multiple materials are under consideration and details of the design have yet to be fixed
- **Students can try out different options** and understand trade-offs between cost, batch size and function in more detail
- Helps to identify the main contributors to the final part cost - understanding this will help the student make credible suggestions when they go into industry

Usability Improvements

The following enhancements have been made to make the use of CES EduPack even more intuitive, interactive and enjoyable to use.

1. Understanding which materials can be processed by a particular process, and which processes apply to a particular material, is very useful. We have had links between the materials and process datatables from almost the earliest editions of CES EduPack; this year we have made

them more prominent and made sure that when you click on them, you immediately see the records you are interested in.

- Updated link icon
 - Link defaults to list view unless there are more than 30 records
 - All folders automatically opened if the folder only has one record within it
2. The Science Notes, written by Professor Ashby, are a really great way for students to remind themselves of definitions or to learn more of the underlying reasons for the properties of materials. Some students were having difficulty in finding the link to them, so we have made them more obvious on the records.
 - Science Note “Further Information” icon added to the records
 3. Comparing more than one material or process is often useful. The default options now allow more than one record to be opened as separate tabs. This means you can flick back and forth, or tile the records to view side by side. (You can change this back to only allowing one record open in the tools menu.)
 - More than one datasheet open as default
 4. Easier to read, more modern-looking datasheets.
 - Lines to help students read across to the data
 - Updated color scheme
 5. Windows 10 support, touch screen support and basic compatibility with high DPI screens.
 - Testing up to 200% magnification
 - Text and images updated to enable scaling
 6. Revised Main and Charting Tool Bars to make it easier to find things.
 - Main Toolbar
 - Split Tools (Eco Audit, Synthesizer, Add Records, Favorites, Search Web) from Settings (Options to tailor datasheets, charts, etc.)
 - Added a Home button
 - Chart Toolbar
 - Updated Stage Setting icon
 - Added icon to delete all lines and boxes
 - Added icon to create a curve
 - Updated Zoom icons
 7. Two new Subsets in Level 3 databases, Natural Materials and Composites, to make it more obvious from the home pages that these materials are available.

Benefits:

- The easier the software is to use, the more students will explore and learn.

MaterialUniverse data

1. Updated **Material prices**—new prices are available for all 3,900+ materials in the MaterialUniverse. These have been generated using an enhanced version of Granta’s price model – based on data from the world commodity markets.

Benefits:

- Use up-to-date prices, reflecting current differences between material types and classes
- Apply in cost reduction initiatives
- Apply in trade-off studies, e.g., cost vs mass; plastic vs metal

2. Coverage of **engineering polymers extended**. Includes 43 new grades in the Level 3 databases, covering the following material types:

- 8 long fiber composites (PA66, epoxy SMC)
- 10 lubricated grades (PA66, PEI, PEEK)
- 13 fiber filled high performance polymers (PEI and PEEK)
- 12 conductive grades for EMI shielding (ABS, PA66, PEEK, epoxy)

Benefits:

- Provides extended coverage of these important polymer types that are commonly used in high performance applications and as replacements for metals

3. **Automotive Composites** and the processes used to shape them included. Includes three new composites and two new processes in the Level 3 databases:

- 3 Resin infused carbon fiber reinforced epoxy
 - Woven fabric reinforcement, bi-directional lay-up
 - Woven fabric reinforcement, quasi-isotropic lay-up
 - Unidirectional non-crimp fabric
- 2 high volume production processes
 - High Pressure RTM
 - Wet press molding

Benefits:

Provides extended coverage of these important composite types that are commonly used as lightweight replacements for metals and are increasingly being considered for structural automotive components

4. Coverage of processing techniques extended to include hydroforming and staking:

- 2 Metal forming processes
 - Sheet hydroforming
 - Tube hydroforming
- 2 Thermoplastic joining processes
 - Heat staking
 - Ultrasonic staking

Benefits:

- Extended coverage of metal forming and polymer joining processes

5. **Coverage of metals extended** to include the following alloys at Level 3:

- Bronze, CuAl10Ni5Fe4Mn1, C95800, cast (aluminum bronze)
- Carbon steel, AISI 12L14, as rolled
- Stainless steel, austenitic, AISI 316LVM, annealed
- Stainless steel, austenitic, AISI 316LVM, cold worked
- Stainless steel, austenitic, AISI 348, annealed
- Stainless steel, austenitic, AL-6XN, annealed
- Stainless steel, austenitic, Nitronic 60, annealed

Benefits:

- Extends coverage of metals to incorporate these widely used alloys

6. **New ‘Galling (adhesive wear)’ attribute** added at Level 3 for all metals—rated on a four-point scale between unacceptable and excellent. The Design Note, accessed by clicking on the property name, includes information on material and design factors that influence the final wear behaviour.

Benefits:

- Use for preliminary screening and comparison of materials for applications requiring galling resistance, such as bearings, gears, sheet forming and tooling

7. Revised and **updated PREN, Carbon equivalency and Price volatility** values—accounts for minor adjustments to compositional information made for the 2015 release

Benefits:

- Provide more accurate filtering and comparison based on these properties

8. Material Compatibility added to all processes—in order to streamline selection of processes at Level 2, where most students learn about selection, a property called Material Compatibility has been added to all the ProcessUniverse records. This enables students to use a limit stage to rule out processes that cannot be applied to the Material Class they have chosen.

- Science note included
- Other properties renamed or moved to make the layout clearer

Benefits:

- Quick selection of processes at Level 2 without using a Tree Stage.

9. Discount Rate added to ProcessUniverse Cost Model in Levels 2 and 3—the cost of opportunity, i.e. the amount of money that could have been earned in compound interest over the write off time had money not been invested in capital equipment is now included in the cost model.

- 5% default, but parameter can be changed

Benefits:

- Makes the model more realistic.

10. Polymer tradenames have been updated—this enables fast search for information on polymers where the tradename is known, helping students to find real materials datasheets and suppliers for materials they are proposing to use in a project. Applied to Level 3.

Benefits:

- Enable more realistic design projects.

11. Two new subsets added to Level 3 databases—while composites and natural materials have always been included in the database, having a subset enables them to be seen as an icon on the Level 3 home pages and so makes them easier to find.

Benefits:

- Help students find important sets of materials

CES EduPack Polymer Edition

1. Latest version of CAMPUS—includes the full dataset from the CAMPUS (Computer Aided Material Properties to Uniform standards). Includes the following updates:

- 6062 polymer records included

- Default values have been added to compositional attributes (polymer type, filler type, additional components and additives) to allow better filtering capability. For example, 'None' has been set as the default value for filler type, enabling filtering to account for unfilled grades (where no data is provided)

Benefits:

- Get access to the most up-to-date version of this comprehensive source of data on plastics and elastomers
- Search for polymers based on application, special characteristics, property profile, etc.

2. Latest version of Prospector Plastics (formerly IDES Plastics)—a global library of plastic and elastomer datasheets from UL Prospector. Includes the latest data for around 90,000 grades from 822 manufacturers and specialty compounders. The latest version includes:

- More than 1,000 new records
- **Default values** have been added to a number of properties (Filler/Reinforcement, additive, Forms, Appearance, Processing method and Nylon type) to allow better filtering capability. For example 'None specified' has been set as the default for 'Filler/Reinforcement', enabling filtering to account for unfilled grades (where no data is provided)
- Updated links to MaterialUniverse

Benefits:

- Access the most up-to-date version of this comprehensive source of plastics data
- Search for polymers based on key features, uses, etc.

CES EduPack Aerospace Edition

Latest version of MMPDS-09—The Metallic Materials Properties Development and Standardization (MMPDS) handbook (formerly known as MIL-HDBK-5) is the preeminent U.S. source for aerospace component design allowables relating to alloys and fasteners. MMPDS contains over 2,300 records of statistically-derived design data for aerospace alloys in various forms, thicknesses and heat treatments. The latest version includes:

- New records for the T8 temper for 2195 Aluminum Alloy
- New fatigue data for:
 - WE43C Magnesium Alloy
 - Ferrium M54 High Alloy Steel
- New stress-strain curves for:
 - WE43C Magnesium Alloy
 - 2050 Aluminum Alloy
 - 2099 Aluminum Alloy

- 7073 Aluminum Alloy
- E357 Aluminum Alloy
- New temperature dependent data for:
 - WE43C Magnesium Alloy

Benefits:

- Get access to the most up-to-date version of this critical source of design allowables for the global aerospace sector

CES EduPack Architecture Edition

Better images have been included for some standard materials in the Architecture Database.

Benefits:

- Help student understand and engage with materials.

4 Feedback

The Education Team at Granta Design would welcome your feedback on any improvements you would like to see in CES EduPack, its data, or documentation.

Please send your ideas by using the **Feature Request** button on the main CES EduPack menu.

Alternatively, email support@grantadesign.com.

www.grantadesign.com

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5 Acknowledgements

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