CES EduPack™ 2014

CES EduPack User Manual and Getting Started Guide

April 2014

GRANTA
MATERIAL INSPIRATION

4 Getting Started with CES EduPack

The following exercises give an overview of CES EduPack and will teach you how to use the core functionality. The exercises in Chapter 5 go into further detail and explore some of the software's more specialized features. There is also comprehensive help file within the software that gives more detailed guidance, as well as case studies with loadable project files.

4.1 Brief Description of CES EduPack

The main tools in CES EduPack are:

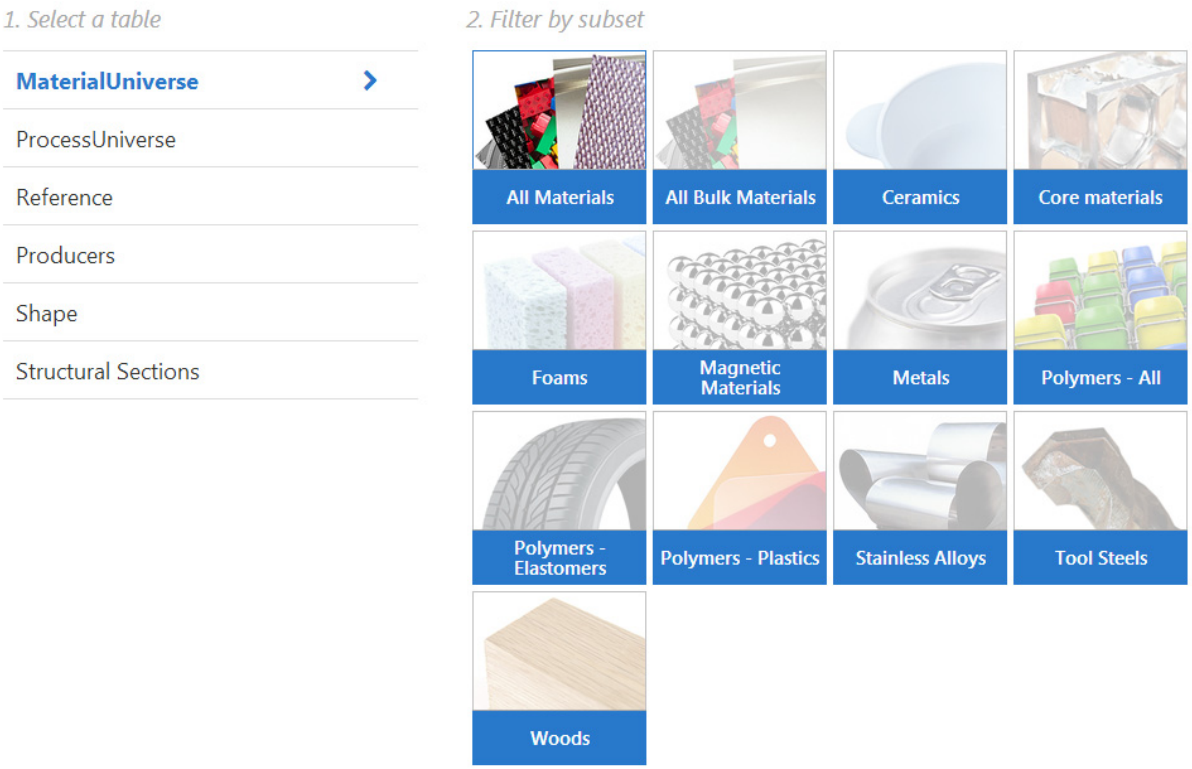
- BROWSE Explore the database and retrieve records via a hierarchical index or tree.
- SEARCH Find information via a full-text search of records.
- SELECT The central hub of CES EduPack, used to apply the Rational Material Selection methodology. A powerful selection engine that identifies records that meet an array of design criteria and enables trade-offs between competing objectives.
- CHART Create charts and add formatting and labels to illustrate your point.

The following exercises cover the use and functionality of these tools.

4.2 Browsing and Searching

Exercise 1 Opening the Database

If you have more than one database installed, CES EduPack will show the Databases dialog. The following exercises use the **MaterialUniverse** and **ProcessUniverse** tables, which are part of every Granta database.



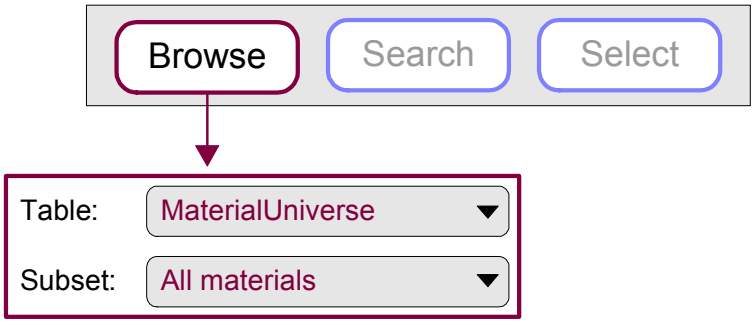
The Edition Homepage will open, showing a list of the available tables and a graphic for each subset. Click on a subset name to show its description. Use the information icon next to the database name to show a detailed description.

• Swap between the available subsets and see how they have different applications and data
*Click on a subset in the Edition Homepage to select it. The information displayed is for the currently-selected subset. Notice that the **Browse** tree in the left pane updates to the currently selected subset.*

• Change to the PROCESSUNIVERSE table
*Click on ProcessUniverse and notice that the **Browse** tree in the left pane updates to show the new table.*

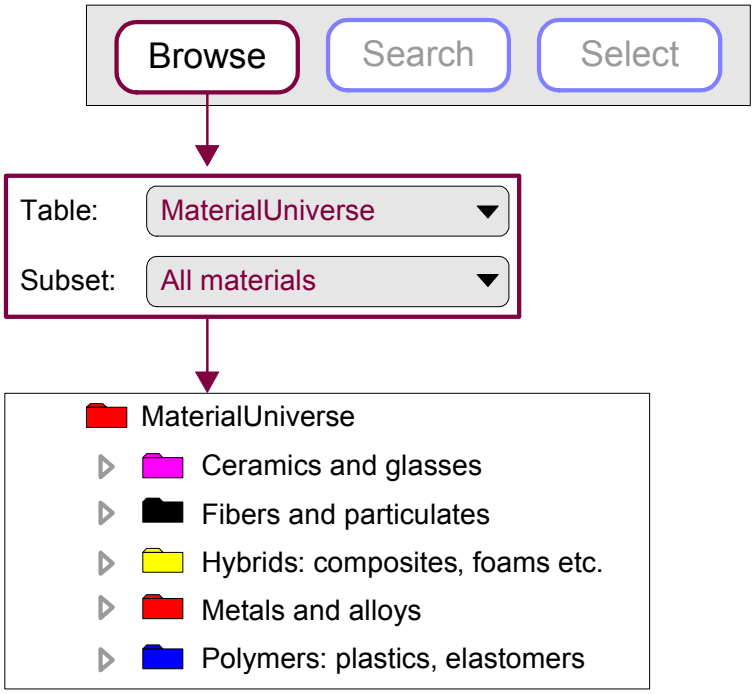
• CLOSE the HOMEPAGE
*Click on the cross at the top of the Homepage tab. This page can be reopened at any time from **View** menu - **Home**.*

• Change to the MATERIALUNIVERSE table
*With the Homepage closed, navigate to different tables using the **Table** drop-down in the **Browse** pane.*



There are also links to online resources, for both students and educators, from the homepage.

Exercise 2 Browse Materials



Select the **Table** MaterialUniverse and the **Subset** All materials.

• Find a record for STAINLESS STEEL

• Find a record for CONCRETE

• Open the GENERIC record for POLYPROPYLENE
Generic records are records at the folder level and give general information on the material, rather than data on a specific variant. Generic records have their own icon . *Double-click to open.*

• Open a POLYPROPYLENE record
Double-click on the record name in the tree

Click on hyperlinked attribute names. In Level 1 and Level 2 databases, this will bring up a Science Note, giving details of the underlying science and calculations for the attribute. In Level 3 databases, this will bring up the design note, which provides background information on properties, test notes, and selection guidelines. From a design note, there will also be a link to the corresponding Science Note.

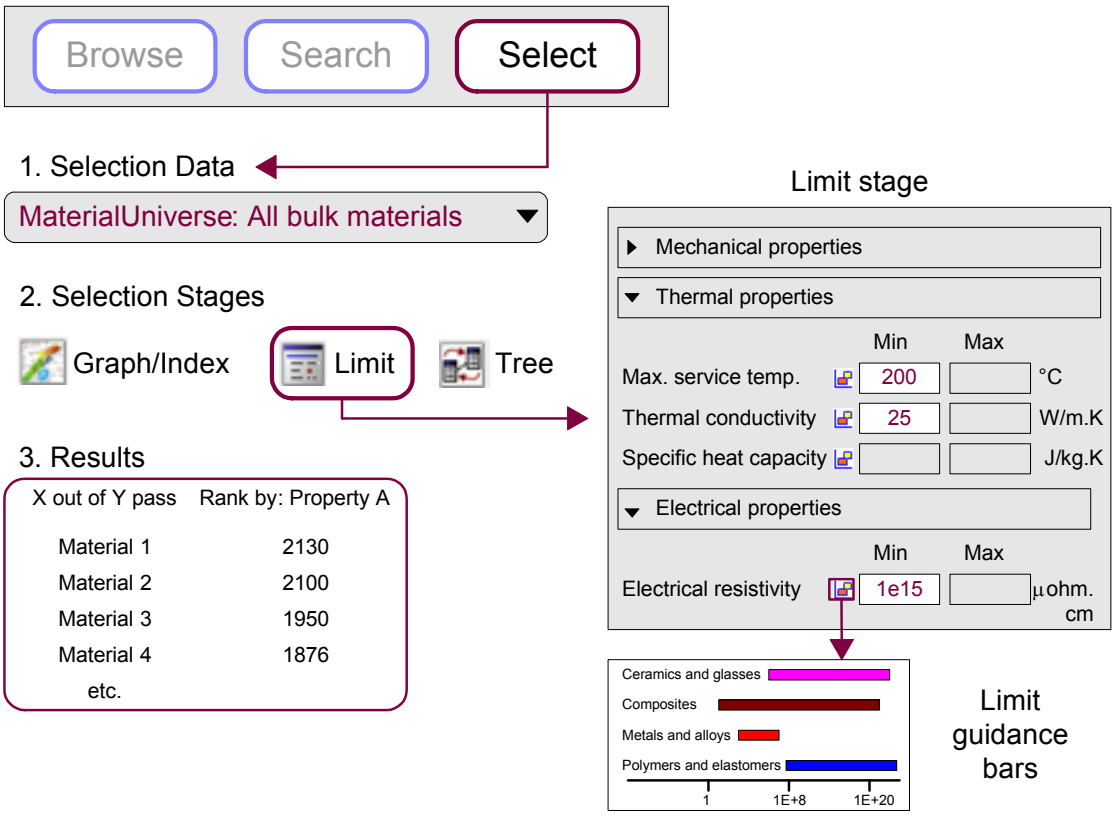
Right-click on the datasheet to see a context menu with further actions e.g., locate in Browse tree, copy the datasheet, print the datasheet, export the data to an FE package format.

4.3 Material Selection

Exercise 5 Selection Using a Limit Stage

• Find materials with:

MAX. SERVICE TEMPERATURE	> 200 °C
THERMAL CONDUCTIVITY	> 25 W/m.°C
ELECTRICAL RESISTIVITY	> 1e15 µohm.cm



*Use the limit bars for guidance on suitable values. Enter the limits – minimum or maximum as appropriate – and click **Apply**. If a reference record is set, its values for each property will be shown to the right of the min/max entry boxes.*
Example results: Aluminum nitride, Alumina, Silicon nitride.

Some properties have discrete values, rather than numeric ranges.

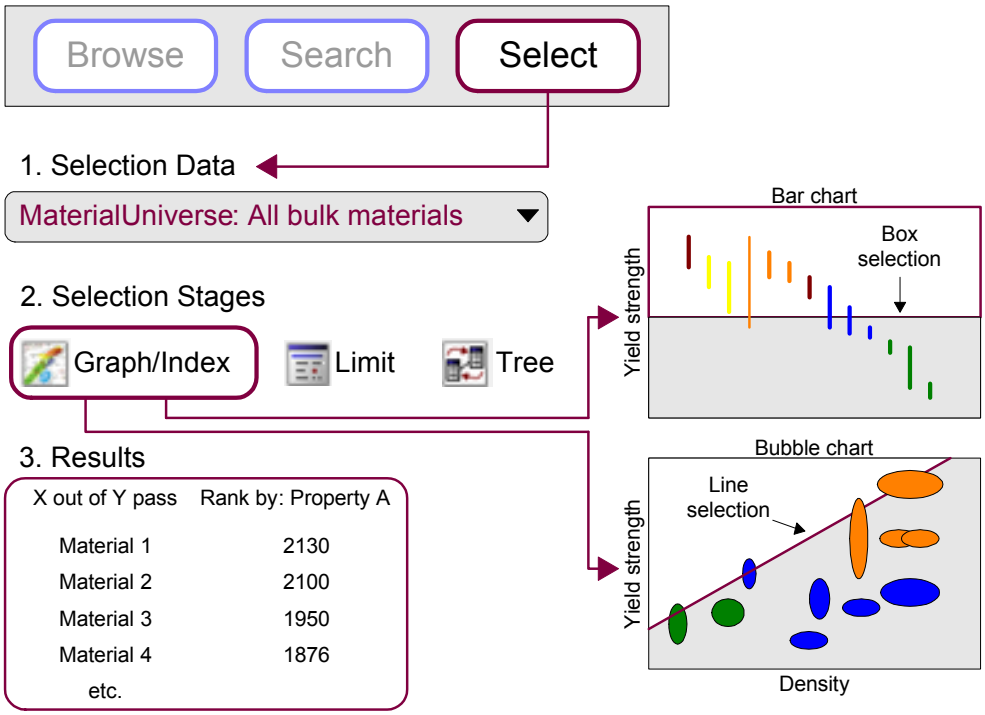
• Edit this limit stage and search for materials with non-opaque TRANSPARENCY.
*Under **Optical Properties**, refine by transparency using the drop-down and tick **Translucent**, **Transparent**, and **Optical quality**. Click **Apply**.*
Example results: Alumina (translucent) and Diamond.

• DELETE THIS STAGE

Exercise 6 Selection Using a Graph Stage

When plotted on a Graph Stage, records can also be filtered using the charting Box and Line Selection tools. This provides a more qualitative approach to filtering.

• Make a BAR CHART of YIELD STRENGTH (σ_y)
*Set the y-axis to **Yield strength (elastic limit)**.*



• Use a BOX SELECTION to find materials with high values of YIELD STRENGTH

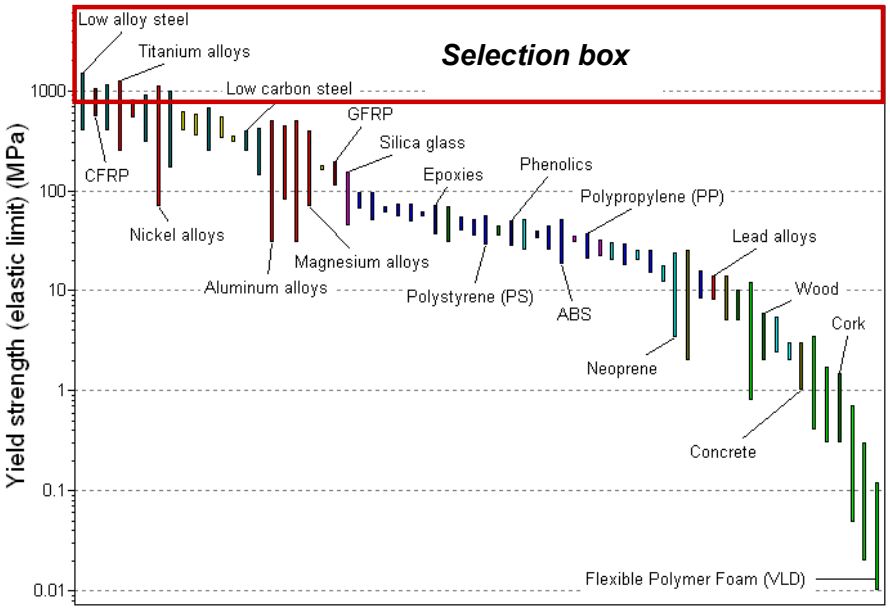
*Click **Box Selection** , then click-drag-release to define the box.*

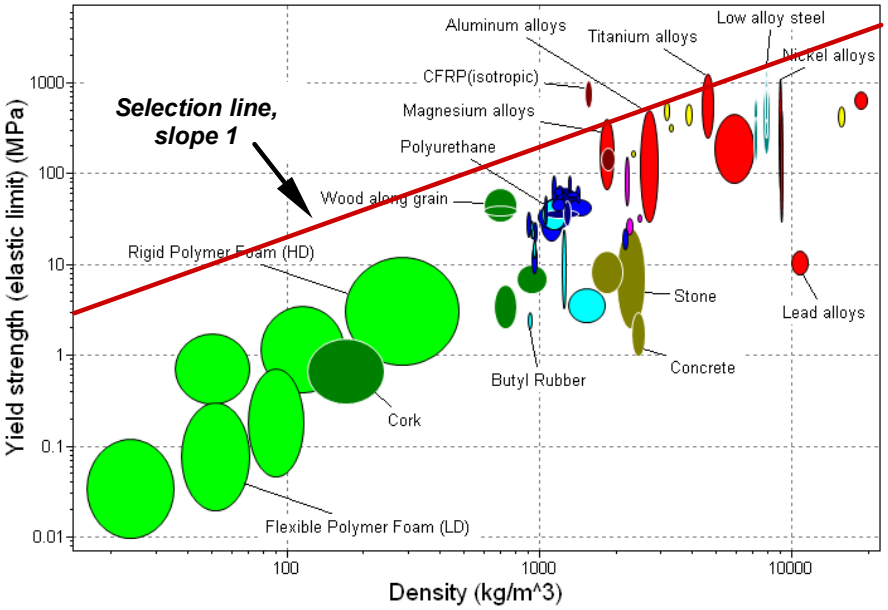
• Add DENSITY (ρ) to the other axis
*Either: highlight Stage 1 in Selection Stages, right-click and choose **Edit Stage** from the menu; or double-click the axis to edit.*

• Use a BOX SELECTION to find materials with high STRENGTH and low DENSITY

• Use a LINE SELECTION to find materials with high values of the specific strength σ_y / ρ

*Click **Gradient-Line Selection** , then enter slope in the dialog, in this case 1. Click on the graph to position the line through a particular point. Click above or below the line to select an area, in this case above the line for high values of σ_y / ρ. Drag the line upwards to refine the selection to fewer materials.*





• Rank the results by specific strength (YIELD STRENGTH / DENSITY)
Rank by Stage 1: Performance Index and click on results column to reverse the order.

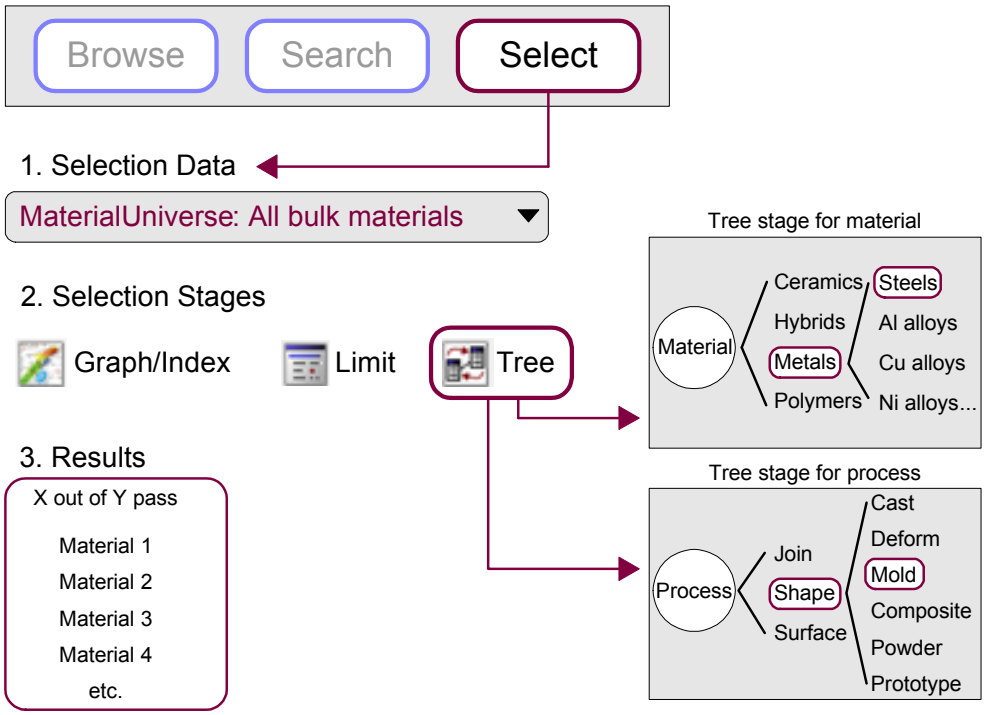
Example results: CFRP, Titanium alloys, Magnesium alloys.

• DELETE ALL STAGES

Using a Tree Stage, records can be filtered based on their links to records in other data tables, or based on the database hierarchy (tree).

Exercise 7 Selection Using a Tree Stage

• Find materials that can be MOLDED
*In the Tree Stage window, select ProcessUniverse, navigate to **Molding**, and click **Insert** followed by **OK**.*



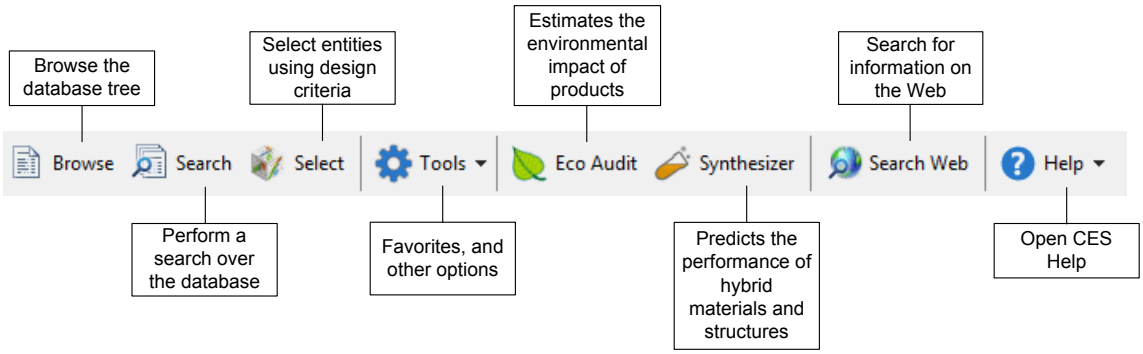
• DELETE THIS STAGE

• Find processes to join STEELS
*Select Processes: Joining processes. In the Tree Stage window, select MaterialUniverse, expand **Metals and alloys** in the tree, select **Ferrous**, and click **Insert** followed by **OK**.*

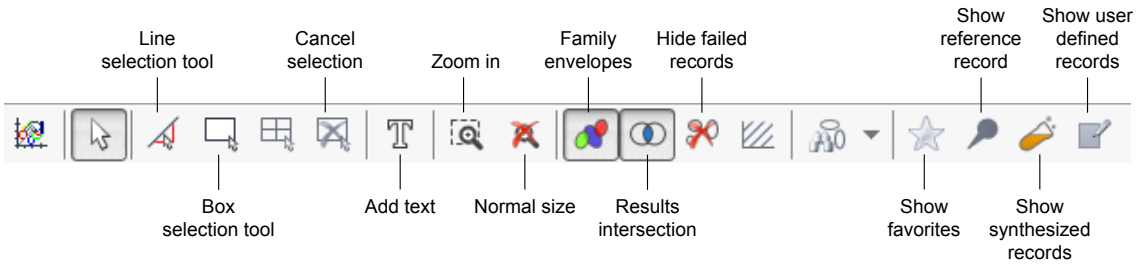
• DELETE THIS STAGE

5 Toolbars and General Information

Standard Toolbar



Graph Stage Toolbar



File Types

*.gbd	Granta Database file
*.ces	CES EduPack Project file
*.cet	Selection Template file
*.frl	Favorites file
*.prd	Eco Audit Product Definition file

Physical Constants and Conversion of Units

Absolute zero temperature	-273.2°C
Acceleration due to gravity, g	9.807 m/s^2
Avogadro's number N_A	6.022×10^{23}
base of natural logarithm, e	2.718
Boltzmann's constant, k	1.381×10^{-23} J/K
Faraday's constant, k	9.648×10^4 C/mol
Gas constant, $\overline{R}$	8.314 J/mol/K
Plank's constant, h	6.626×10^{-34} Js
Velocity of light in a vacuum, c	2.998×10^8 m/s
Volume of perfect gas at STP	22.41×10^{-3} m^3/mol

Angle, θ	1 rad	57.30°
Density, ρ	1 lb/ft^3	16.03 kg/m^3
Diffusion coefficient, D	1 cm^3/s	1.0×10^{-4} m^2/s
Energy, U	See below	
Force, F	1 kgf 1 lbf 1 dyne	9.807 N 4.448 N 1.0×10^{-5} N
Length, l	1 ft 1 inch 1 Å	304.8 mm 25.40 mm 0.1 nm
Mass, M	1 tonne 1 short ton 1 long ton 1 lb mass	1000 kg 908 kg 1107 kg 0.454 kg
Power, P	See below	
Stress, σ	See below	
Specific Heat, Cp	1 cal/gal.°C 1 Btu/lb.°F	4.188 kJ/kg.°C 4.187 kJ/kg.°C
Stress Intensity, K_{1c}	1 ksi $\sqrt{in}$	1.10 $MN/m^{3/2}$
Surface Energy, γ	1 erg/cm^2	1 mJ/m^2
Temperature, T	1°F	0.556°K
Thermal Conductivity, λ	1 cal/s.cm.°C 1 Btu/h.ft.°F	418.8 W/m.°C 1.731 W/m.°C
Volume, V	1 Imperial gall 1 US gall	1.546×10^{-3} m^3 3.785×10^{-3} m^3
Viscosity, η	1 poise 1 lb ft.s	0.1 $N.s/m^2$ 0.1517 $N.s/m^2$

Conversion of Units - Stress and Pressure

	MPa	dyn/cm^2	lb/in^2	kgf/mm^2	bar	long ton/in^2
MPa	1	10^7	1.45 x 10^2	0.102	10	6.48 x 10^{-2}
dyn/cm^2	10^{-7}	1	1.45 x 10^{-5}	1.02 x 10^{-8}	10^{-6}	6.48 x 10^{-9}
lb/in^2	6.89 x 10^{-3}	6.89 x 10^4	1	703 x 10^{-4}	6.89 x 10^{-2}	4.46 x 10^{-4}
kgf/mm^2	9.81	9.81 x 10^7	1.42 x 10^3	1	98.1	63.5 x 10^{-2}
bar	0.10	10^6	14.48	1.02 x 10^{-2}	1	6.48 x 10^{-3}
long ton/in^2	15.44	1.54 x 10^8	2.24 x 10^3	1.54	1.54 x 10^2	1

Conversion of Units - Energy

	J	erg	cal	eV	Btu	ft lbf
J	1	10^7	0.239	6.24 x 10^{18}	9.48 x 10^{-4}	0.738
erg	10^{-7}	1	2.39 x 10^{-8}	6.24 x 10^{11}	9.48 x 10^{-11}	7.38 x 10^{-8}
cal	4.19	4.19 x 10^7	1	2.61 x 10^{19}	3.97 x 10^{-3}	3.09
eV	1.60 x 10^{-19}	1.60 x 10^{-12}	3.38 x 10^{-20}	1	1.52 x 10^{-22}	1.18 x 10^{-19}
Btu	1.06 x 10^3	1.06 x 10^{10}	2.52 x 10^2	6.59 x 10^{21}	1	7.78 x 10^2
ft lbf	1.36	1.36 x 10^7	0.324	8.46 x 10^{18}	1.29 x 10^{-3}	1

Conversion of Units - Power

	kW (kJ/s)	erg/s	hp	ft lbf/s
kW (kJ/s)	1	10^{-10}	1.34	7.38 x 10^2
erg/s	10^{-10}	1	1.34 x 10^{-10}	7.38 x 10^{-8}
hp	7.46 x 10^{-1}	7.46 x 10^9	1	15.50 x 10^2
ft lbf/s	1.36 x 10^{-3}	1.36 x 10^7	1.82 x 10^{-3}	1

Options for Preferred Currency and Units

Settings	Database Options	
	Preferred Currency	**Preferred Unit System**
<Automatic>	The Regional Setting from the operating system for currency is used to view data. This will appears as <Automatic - *Regional Currency*>, e.g. <Automatic - GBP>.	The Regional setting from the operating system for unit system is used to view data. This will appear as <Automatic - *Regional Units*> e.g. <Automatic - Metric>.
<None>	Data is displayed using the same currency as it is stored with in the database.	Attribute data is displayed using the same units as the data is stored with in the database.
Named setting	Named currency is used to display data.	Named unit system is used to display data.

5.1 Legal and Acknowledgments