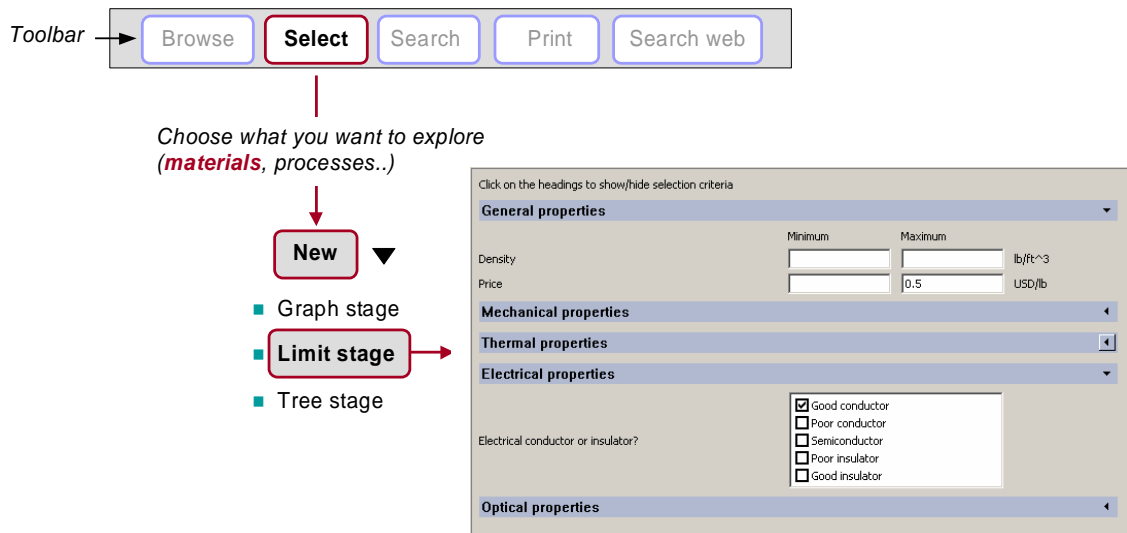


Selecting Exercises

Complete the following “selecting” exercises to practice using the Cambridge Engineering Selector software.

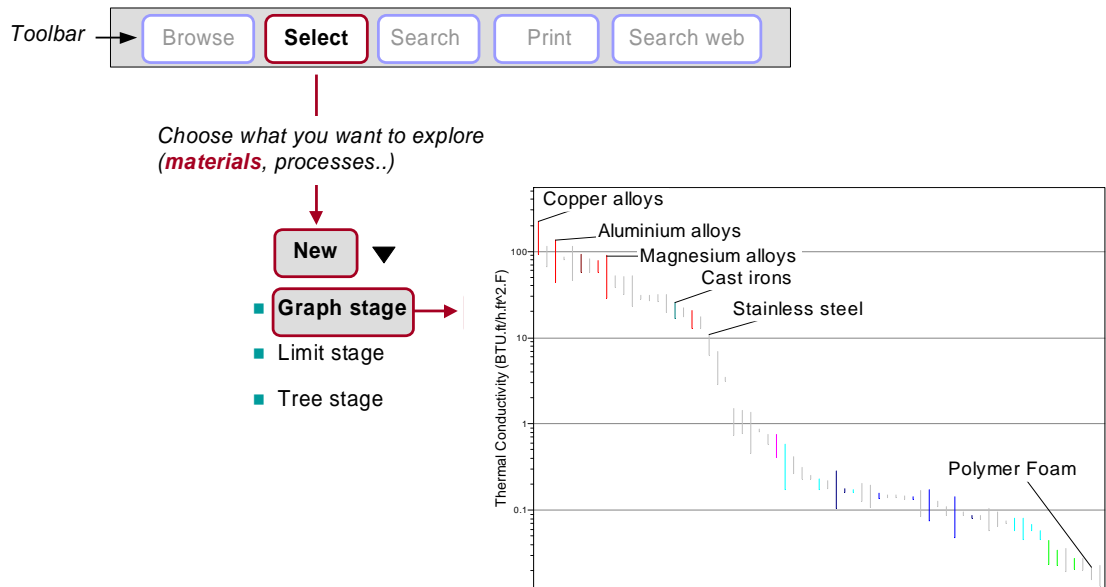
There are three selection tools: *GRAPH*, *LIMIT* and *TREE*. We will start with the *LIMIT STAGE* tool. It lets you find materials or processes that meet requirement that you enter in a Limit Stage



3.1 Find materials that cost less than \$0.5/lb and are good electrical conductors. To do this you must set the system to Level 1 Materials (click on CHANGE, just below the word SETTINGS at the top of the selection window if necessary to allow you to change the settings). Then enter the limit on price and the constraint that the material must be a good conductor. Then click APPLY at the top of the screen. The materials that do not meet the constraints are deleted from the RESULTS window on the left, leaving those that do.

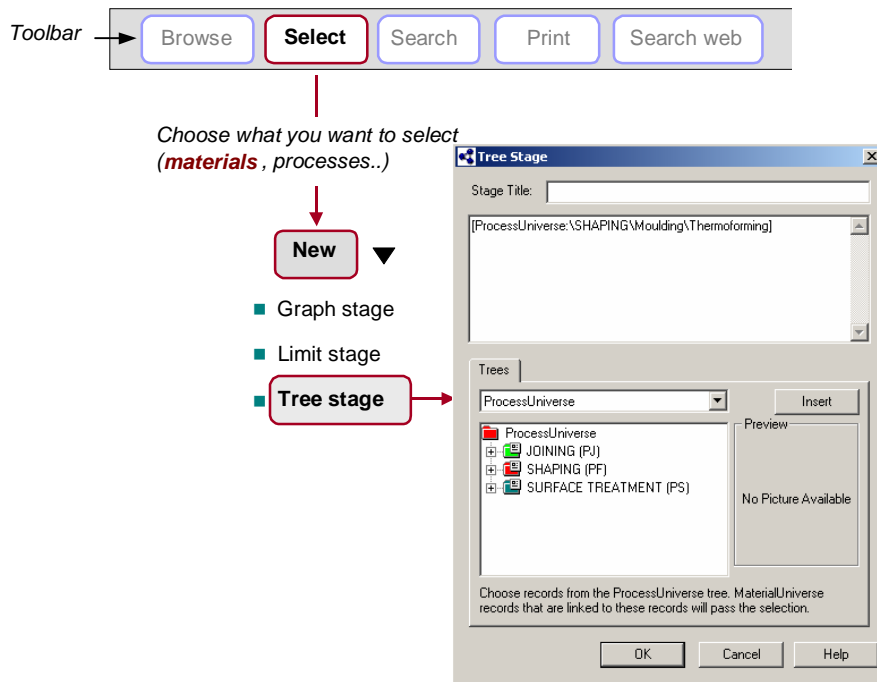
3.2 The property FRACTURE TOUGHNESS is a measure of how well a material resists fracture. A brittle material like glass has a low value of fracture toughness – around 1 in the units you will use. Steel used for armour has a very high value – over 100, in the same units. Many engineers, when designing with metals, avoid material with toughness less than 20. Use a Limit stage to find materials with a FRACTURE TOUGHNESS greater than 20 and that are GOOD ELECTRICAL INSULATORS.

Now we'll do a **GRAPH STAGE**. It lets you plot properties and to select those that lie in a chosen part of the plot.



3.3 If you want to make a high quality cooking pot to go on the top of a gas stove, you need a material with a high thermal conductivity that is also be cast to shape. The high conductivity is to spread the heat, and the castability is because heavy, cast pots hold their heat well when taken off the stove, keeping the contents warm. First make a Limit stage (as on the previous page) and select Processability: Castability at least 5. Then make a graph with thermal conductivity on the Y-axis. To do this first click on Select, then on New...Graph stage, as in the diagram. Select the Y-axis tab and find Thermal conductivity in the Attribute list and double click to select it. When you click OK you get the graph shown above. To make the materials that are not castable grey out, click on the little icon like two intersecting circles in the icon bar just above the graph. Use a box selection (the little box icon in the same icon bar) to select the materials with the highest thermal conductivities.

Now we'll do a **TREE STAGE**. A tree stage is essential if you want to find materials that can be processed in a particular way, or you want to limit the selection to just one class of material – just metals, for instance.



3.3 You want to make a casing for a mobile phone, exotic in color and design. It snaps onto the front of the phone, transforming it from a drab object to one of splendour. Research reveals that the shape is best made by thermoforming (a very cheap process for shaping polymer sheet into dished and curved shapes) and that the decoration is best applied by in-mold decoration that can be done at the same time as the thermoforming. Find materials that can be processed in this way.

To do this, make two Tree-selection stages. Go to Select – New...Tree stage. That brings up the Tree stage wizard. Under the word Trees, half way down the box, it says Material Universe. We want to impose constraints on processes, so first click on the down-arrow and change the Tree to Process Universe. Open *SHAPING* and find *Molding – Thermoforming* and double click to make it appear in the box above. The wizard window now looks like the one above (we have closed *SHAPING* again for clarity). Click OK and the number of materials in the Results window drops to 17 – these are materials that can be thermoformed. Repeat the job with a second, new, Tree stage, this time opening *SURFACE TREATMENT* and choosing *Painting and Printing– In mold decorating*. The results window now lists materials that can both be thermomolded and in-mold decorated.