EESy Solutions

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Welcome

EESy Solutions is a newsletter developed to provide news, tips, and tricks relating to Engineering Equation Solver. **EESy Solutions** is provided at no cost to all registered users of EES. Did you miss any of the previous issues? These and other goodies can be downloaded from our new web site: www.fchart.com.

Visit our Web Site (www.fchart.com)

The new F-Chart Software website is easier to navigate and more attractive than its predecessor. In addition, a variety of useful items can be downloaded free such as the latest copy of the manual, new examples, external programs, and a demonstration copy of FEHT (our finite-element analysis program). For international users, there are a French and Spanish manual and example problems in German.

WCB/McGraw-Hill Academic License

New academic versions of EES are now exclusively distributed by WCB/McGraw-Hill. Academic versions of EES are provided at no cost to educational departments that adopt any of the following WCB/McGraw-Hill textbooks.

Cengel Y.A. and Boles M.A., *Thermodynamics: An Engineering Approach* 3rd ed., 1998, ISBN 0-07-011927-9

Cengel Y.A., *Heat Transfer: A Practical Approach*, 1998, ISBN 0-07-011505-2

Wark, K. and Richards, D.E., *Thermodynamics* 6th ed., 1999, ISBN 0-07-068305-0

White, F.M., *Fluid Mechanics*, 4th ed. 1999, ISBN 0-07-069716-7

Educational site licenses can also be obtained from WCB/McGraw-Hill independent of any textbook adoption. The McGraw-Hill EES web site provides additional information.

www.mhhe.com/engcs/mech/ees/index.mhtml

F-Chart Software continues to support and distribute the commercial and professional versions of EES.

What's New?

The last official update for the Windows version of EES was in April 1998 with version 4.750. The current version is 4.934. There have been over 180 new versions developed during the last year. Many of the releases were for minor bug fixes but there have been some very significant enhancements to EES as well. Here is a short description of the most important changes.

Check Units Command

The Check Units command that has been added to the Calculate menu will check the dimensional and unit consistency of all equations appearing the Equations window. For example, suppose that you enter F = m*a {Newton's Law}. Working in English units, you specify F (force), m (mass), and a (acceleration) to have units of lb_f, lb_m, and ft/s^2, respectively. If you apply the Check Units command, EES will respond with a message indicating that the terms F and m*a differ by a conversion factor of 32.17 lb_m-ft/lb_f-s^2. If you had mistyped the equation so that it read F = m / a, EES would indicate that the terms F and m / a have inconsistent dimensions. This command provides a very powerful and easy to use debugging aid.

Tool Bars for the Plot and Diagram Windows

The drawing capabilities for the Plot and Diagram windows have been improved by the addition of tool bars on floating palettes. The tool bar provides buttons to add text, lines, arrows, square or rounded corner rectangles, and circles thereby giving EES drawing capabilities similar to those in a simple drawing program. Right clicking on any text or graphic item brings up a dialog window in which the properties of that item can be modified. The new drawing capabilities make it easy to create a legend box on plot windows with an opaque white background. Multiple text and/or graphic items can be selected at one time and aligned with the align button provided on the tool bar. Text and graphic items in a Plot window can be copied to the clipboard and pasted into other Plot windows.

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Plot Window Improvements
In addition to the tool bars, there have been a number of other major improvements to the plotting capabilities in EES. With these enhancements, EES has become one of the best engineering plotting programs available for computers operating under the Windows operating system.

✓ EES now provides bar plots and contour plots in addition to X-Y plots. The New Plot Window command displays a submenu with the three plot types. The Contour Plot option generates lines or color bands indicating the path of a fixed value of the contour variable (Z) in X-Y space. A contour plot requires three-dimensional data for construction. The data may be provided in either of two formats from the Parametric, Lookup or Arrays tables.

✓ Plots printed from EES have always been printed at the precision of the printer - generally 300 or 600 dots per inch. However, in previous versions, when a plot was copied to another application, such as a word processor, and then printed, it often did look as good as when it was directly printed from EES. The reason for this loss of quality is that the plot was copied to the clipboard with the precision of the screen (96 to 120 dots per inch) which is far less than the precision of the printer. Now the Copy Plot command puts both a picture and a high-precision bitmap image of the plot. The Paste Special command in most applications allows the format of the plot to be selected during a Paste operation. The high-precision bitmap is produced at the precision of the printer and all of the quality of the printed plot is maintained. With this capability, publication-quality plots can be copied from EES into other applications.

✓ Multiple variables can be plotted at one time.

✓ EES allows up to 10 plot windows. A 'fly-out' menu is provided in the Windows menu to select the desired plot window. In the new release, each plot window is displayed as the mouse moves over the plot window menu items so that it is easier to identify and select the plot window that you wish to work with.

✓ EES has always allowed the size of the plot to be specified by the user. However, up to recently, the size of the symbols remained constant so that the relative size of the symbols was reduced as the size of the plot increased. Now, the symbol size scales with the plot size. The symbol size can be directly specified by double-clicking (or right-clicking) on the plot window. In addition, the user can now control the frequency of the plot symbols. Instead of being drawn on each point, the symbols can be placed every n points where n is controlled by the user.

✓ Text items and lines can be aligned with respect to each other as well as copied and pasted to other plots.

Residual Window Debugging Improvements
Experienced EES users know that the Residuals window provides a wealth of information. Aside from displaying the absolute and relative values of the residuals (i.e., the difference between left and right sides of the equation) the Residuals window also provides the block number and the order in which the equations are solved. A further enhancement in this release is that the Residuals window now indicates which variables are determined by the equation(s) in each block by displaying the variables in bold font. This capability makes it easier to see the order in which EES is determining the values. It is also possible to see if the equations attempt to redefine variables that are fixed making it much easier to diagnose ill-defined problems.

String Variables
String variables in EES are identified by the $ character at the end of the variable name. A string variable, for example, FILE$, holds string information that can be used in place of a string constant. The most common uses are for file and fluid property names, but there are many other uses as well, particularly when used with the Diagram window. In this release, string data can be entered into the Lookup table. The format style for the Lookup table column must be set to String by clicking in the column header and selecting String as the style type. String data are retrieved from the Lookup table using the new Lookup$ function. In addition the following

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string functions have been added to facilitate operations with string functions.

CONCAT$ - concatenates two string variables
COPY$- returns a substring within the string
lowercase$ - returns a lowercase equivalent string
STRING$ - converts a numerical value to a string
STRINGPOS - returns the position of a substring
STRINGVAL - converts a string to a number
UPPERCASE - returns the uppercase of the string

Array Range Notation

A shorthand notation for array variables has been implemented to facilitate passing of array variables to internal and external Functions and Procedures and Modules. A range of array variables can be indicated by separating the first array index value from the last index value by two decimal points. For example, X[1..5] can be used in place of X[1], X[2], X[3], X[4], X[5]. This shorthand notation is supported for two dimensional array variables as well. Since all EES statements must be 255 or fewer characters, this notation is the only way to pass long argument lists. The notation can be used in the arguments of function calls and CALL statements, in Function, Procedure and Module statements and in $Common directives. Up to 1000 arguments may now be supplied in a CALL statement.

Support for Arrays in Variable Information

The Variable Info dialog now provides a Show Array Elements checkbox control when one or more arrays are present in the Equations window. When this control is selected, all array elements appear in the Variable Info dialog and the guess value, bounds, display format, and units can be set for each individual element as before. However, when the control is not selected, all arrays elements are represented by a single entry. For example, X[ ] represents all array elements with parent name X. If any of the characteristics for the array are changed, that change is applied to ALL array elements. For example, changing the units for X[ ] will result in the units being set for all elements in array X. However, other characteristics, such as the bounds and units, would not be affected. In addition, the array name can be changed by editing the name in the first column of the Variable Info dialog. If an array name is changed, that change is applied to all array elements. The change occurs in the Equations window, all tables, and the Diagram window.

Diagram Window Improvements

✓ A tool bar has been added to Diagram window and to the child Diagram windows (Professional version – see below) to allow graphic objects (text, lines/arrows, rectangles, and ellipses) to be created and manipulated.

✓ The Diagram window now has two modes of operation: development and application mode. The development mode is active when the tool bar is visible. Objects in the Diagram window can be moved, modified, or deleted in development mode. The entire window can be resized. However, the input variable edit boxes and drop-down lists are disabled in development mode. When the tool bar is hidden, the Diagram window is in application mode. In application mode, the graphic objects cannot be moved or modified. The Diagram window will accept user input and, after calculations are completed, the values of output variables will be displayed.

✓ Ctrl-D is a keyboard shortcut for the Diagram window. If the Diagram window is not in front, Ctrl-D brings it to the front. Otherwise, Ctrl-D toggles the visibility of the tool bar. Shift-Ctrl-D toggles the visibility of the tool bar in all Diagram windows.

✓ A Calculate button can now be placed on the Diagram window to more conveniently initiate calculations involving input and output variables in the Diagram window. The button is enabled with a check box control in the Add Diagram Text dialog which appears whenever Diagram window text is added or modified.

✓ A plot window access button has been added to the Diagram window toolbar. When clicked, the plot window access button displays a small dialog in which the desired plot window and button caption can be entered. A button with this caption then appears on the Diagram window and it can be dragged to the desired location if the tool bar is visible. Clicking this button when the tool bar is hidden will display the Plot window.

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Miscellaneous Improvements
- ✓ Mouse wheel scrolling is now supported.

- ✓ A Directories Tab has been added to the Preferences dialog in the Options menu. Default directories for opening and saving files can now be specified. A directory, in addition to the USERLIB directory, can now be specified from which library files are preloaded when EES starts.

- ✓ A green 'go' triangle is displayed in the upper left cell of the Parametric table. Clicking the left mouse button in this triangular area will initiate the Parametric Table calculations for the rows indicated below the triangle without first presenting the Solve Table dialog window.

- ✓ If EES detects that a solution is constrained, the DEBUG window will display the variables and equations that are involved. Clicking on a variable will open the Variable Info dialog where the lower or upper bound on the variable value can be changed.

- ✓ Subscripts and superscripts in comments are displayed in the Formatted Equations window.

- ✓ EES now will display unmatched left or right parentheses in bold during input.

- ✓ The maximum number of rows in the Parametric and Lookup tables has been increased to 9000 from the former limit of 6500. There is no limit to the number of rows in the Professional version.

into another specified text file without ever appearing on the screen. The macro capability can also be controlled by dynamic data exchange (DDE) commands.

- ✓ Hot links can be placed in the Diagram window which, when clicked, bring up *child Diagram windows* having all of the same capabilities as the main Diagram window. Figures can be created (either with the tool bar drawing commands or pasted from another application) and placed in the main and child Diagram windows. Input and output variables can be superimposed on the figures in all Diagram windows to create forms.

- ✓ The Make Distributable program command creates a special purpose version of EES which that will run one to five pre-selected problems. EES, the problems, and all supporting files are placed in a single executable file which can be freely distributed to others. They do not need to own EES to run the calculations or to create/ change/view the plots and tables.

- ✓ The Variable Info dialog now allows variable information to be read from or saved to a file. The variable information file has a .VAR filename extension, but it is a text file that can be opened in a word processor or spreadsheet. The .VAR file can be used to store your common variables with their guess values, limits, and units so that they do not have to be reentered each time you create a new problem.

- ✓ The maximum number of runs allowed in the Parametric table is unlimited

Professional Version

The Professional version of EES was formally released in June, 1998. The Professional version of EES provides the following capabilities in addition to those provided by the Commercial version:

- ✓ A series of EES instructions (called a *macro*) can be recorded with the Build Macro command in the File menu. EES can later be started from the Windows Run command or from a different program to replay all of the instructions in the Macro file. Used in this manner, EES can be directed to solve a set of equations in a specified text or EES file and put the solution

Short Course Announcement

A short course entitled "Modeling and Design of Vapor Compression Systems" will be offered at the Herrick Laboratories, Purdue University on June 1-4, 1999. The course instructors are James Braun, Eckhard Groll and Sanford Klein. The course objectives are to provide the background, steady-state, and unsteady-state models, and optimization capabilities for vapor compression systems. EES will be used extensively. For more information, contact:

Cynthia Quillen, Purdue University,
Tel. (765) 494-6078; Fax: (765) 494-0787;
quillen@ecn.purdue.edu