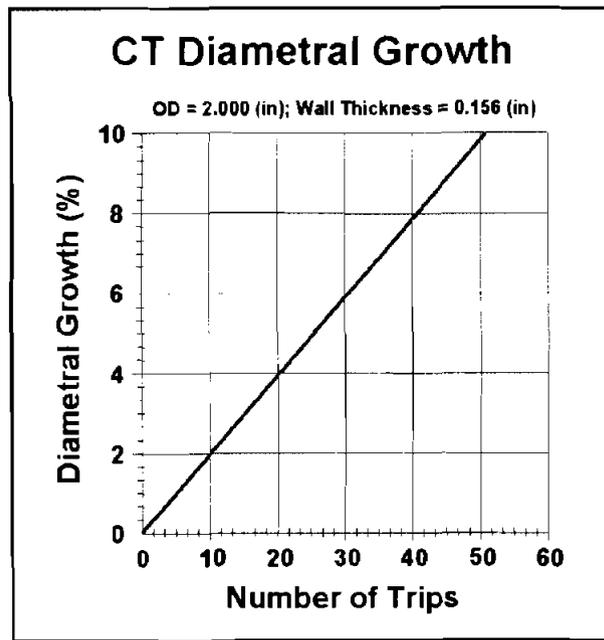


CTGROWTH

COILED-TUBING DIAMETRAL GROWTH MODEL

Version 1

USER'S MANUAL



**DEA 67
PHASE II**

**MAURER ENGINEERING INC.
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CTGROWTH

COILED-TUBING DIAMETRAL GROWTH MODEL

Version 1

User's Manual

By

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APPENDIX A — Common Problems and Solutions

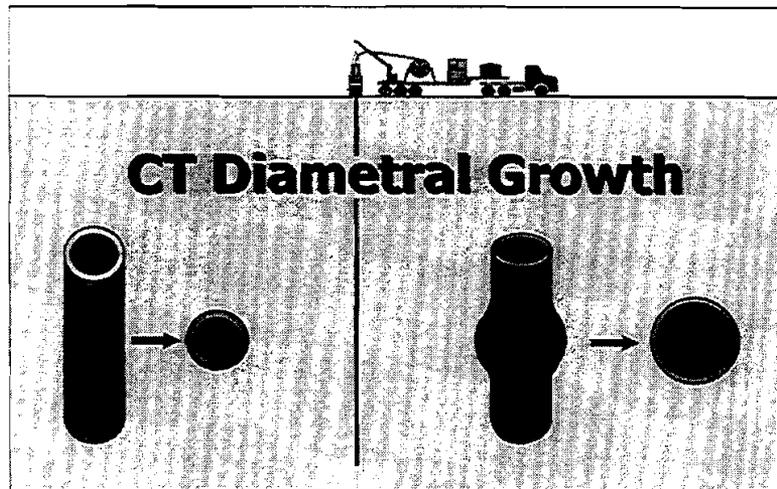
1. Introduction

Note: Go to Section 2.5 for a **Quick Tour** of major features and functions of CTGROWTH.

1.1 BACKGROUND

CTGROWTH was developed by Maurer Engineering Inc. under sponsorship of the joint-industry project DEA-67 *To Develop and Evaluate Coiled-Tubing and Slim-Hole Technology*. This model is part of a complete coiled-tubing analysis suite, and will be incorporated into the integrated package CTPRO in the future. CTGROWTH is written in Visual Basic 5 for use with IBM-compatible computers. It runs in Microsoft Windows 95 or later versions.

Coiled tubing (CT) has an unusual consideration with respect to engineering design in that it is *plastically deformed* during routine usage. Each trip into a well is accompanied by three bend/straighten cycles. CT is 1) straightened (unbent) as it is spooled off the reel, 2) bent onto the gooseneck, 3) straightened as it comes off the gooseneck toward the injector, and then travels into the well. (Only rarely will CT be plastically deformed while in the well.) On the trip out of the well, the three bending events are repeated in reverse order. After a number of trips in and out of the well (typically tens to hundreds), a string of CT will fail due to fatigue. The number of cycles before failure is related to CT metallurgy, equipment dimensions, and other factors, and can be predicted and tracked with the MEI program CTLIFE.



Plastic deformation of CT can also be accompanied by *diametral growth* ("ballooning") whereby the OD of the CT increases slightly with each trip into the well. Internal pressure during bending is required for this to occur, and the impact is greatest at pressures greater than about 2000 psi. CT diametral growth causes incompatibilities with deployment equipment (the CT will not fit through the stripper bushings), and continuous use could cause severe mechanical damage to the CT. Accurate predictions of diametral growth are necessary for both safety and reliability.

Chapter 1. Introduction

It is important to recognize that, while plastic fatigue and diametral growth are related phenomena, there is no direct correlation between these two failure mechanisms. Fatigue limits, diametral growth limits, or a combination of the two may dictate when a particular string is retired.

Theoretical Basis

MEI developed CTGROWTH to meet the industry need for a reliable model for predicting CT diametral growth. The program was developed based on Halliburton's growth model and test data from Precision Tube Technology. Halliburton developed their growth model based on full-scale test data of CT generally larger than 2-in. OD. Precision Tube Technology measured diametral growth on a standard fatigue test fixture for CT smaller than 2-in. OD. For both the Halliburton and Precision Tube Technology tests, the CT was rotated at regular intervals as diametral growth accumulated.

In addition, Quality Tubing's fatigue data were used as another calibration reference. CTGROWTH is related to MEI's CTLIFE model for estimating CT fatigue life. CTLIFE was developed based on data from Quality Tubing and Halliburton. Quality Tubing recorded the growth at fatigue failure for a full series of fatigue tests. A check against these data was also performed for fine-tuning CTGROWTH.

A comparison of test results and CTGROWTH predictions shows good agreement for OD growth up to 10% above nominal OD. A typical criterion applied in the field is to retire a string (or section of a string) when growth exceeds 6% over nominal OD. Based on these practical considerations, **CTGROWTH predicts OD growth only up to 10%**. For predictions of growth greater than 10%, please contact MEI.

1.2 FEATURES OF CTGROWTH

CTGROWTH 1 is a new release in the leading-edge suite of CT operations design software developed by MEI. The "look and feel" of the program is user-friendly and intuitive. Convenient icons and tabs can be used to quickly navigate through the program. Data-file management is simple, and options for customizing graphics and producing professional-style printouts are included.

Another significant feature is a **complete Help system**. Descriptions and instructions are provided for every input and output screen by clicking  or pressing [F1]. The Help system is also context sensitive to allow intuitive navigation by pointing and clicking the mouse on the area of the screen where the user's question originates. Most of the information provided in the User's Manual is also contained in the Help system.

CTGROWTH runs in the Microsoft Windows 95 and Windows NT environments. *As a true 32-bit application, the program is not compatible with Windows 3.x.* It is assumed that the user is familiar with basic operation in the Windows 95 environment. For comprehensive information about Windows, the reader is directed to other texts.

Important technical features of the CTGROWTH Coiled-Tubing Diametral Growth Model include:

- Calculates CT fatigue cycles with reference to a standard CT fatigue test fixture
- Calculates CT fatigue trips in/out of a well with reference to a standard wellsite rig-up
- Checks the burst pressure criterion for a given CT and warns the user if it is exceeded
- Calculates diametral growth (up to 10%) for CT cycled on a bending machine
- Calculates diametral growth (up to 10%) for CT cycled at the well site

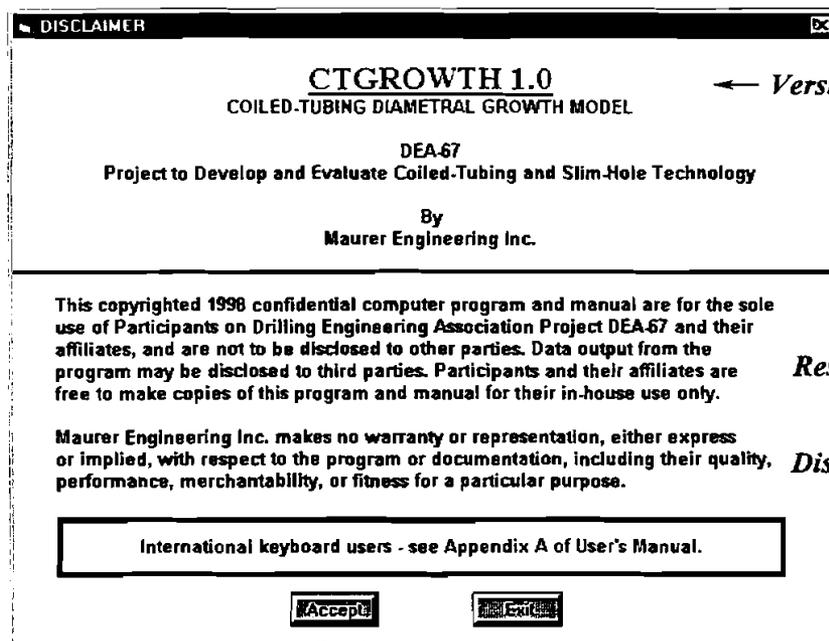
- Sensitivity analyses allow the user to evaluate the impact of changes in CT OD, wall thickness, material grade, internal pressure, and bending geometry on diametral growth
- Provides a choice of systems of units, including English, SI (metric), or any user-specified custom combination

The Output Window provides a number of informative graphs and reports that may be printed or stored to a disk.

1.3 COPYRIGHT AND DISCLAIMER

This software and manual are copyrighted (©1998) by Maurer Engineering Incorporated. The copyright agreement and usage restrictions are described on the Licensing window that is accessed under the **H**elp menu by selecting "About..." → "Licensing..." (see below). **By selecting [Accept] at the bottom of this screen, the user signifies that he agrees to abide by the restrictions as presented.** No warranty or representation, either express or implied, is given with respect to this program and documentation, including their quality, performance, merchantability, or fitness for a particular purpose.

CONFIDENTIAL



Usage
Restrictions
Disclaimer

Chapter 1. Introduction

COMMON

2. Getting Started

2.1 HARDWARE AND SYSTEM REQUIREMENTS

CTGROWTH is written in Microsoft Visual Basic® version 5. It runs in Microsoft Windows 95 or Windows NT (or later versions). As a 32-bit application, WELOPT is **not** compatible with Windows 3. The minimum hardware requirements are:

- IBM-compatible machine with 80486 processor
- Hard disk (about 10 megabytes of storage space required)
- Mouse
- VGA or compatible display

2.2 INSTALLING CTGROWTH

Program Disks

CTGROWTH is shipped on two 3½-inch disks (or one CD). The CTGROWTH executable file (CTGROWTH10.EXE) should be placed in a new folder (default "C:\MEI\CTGROWTH") along with the example data file CTtest1.CG1. All of these procedures will be accomplished during the set-up procedure described below.

Backup Disks

It is recommended that the original disks be kept as a backup set and stored in a safe location, and that work disks be made from them. In Windows 95, run Windows Explorer, double-click "My Computer", single-click the icon for your floppy drive, and select "Copy Disk" from the File menu.

Installation

The following procedure will install CTGROWTH from the floppy drive onto the working directory of the hard disk (e.g., copy from A: floppy drive onto hard drive directory C:\MEI\CTGROWTH).

1. Choose **Run...** from the **Start** menu. Then type "A:SETUP."
2. Follow the on-screen instructions.

After set up, a new folder ("MEI Applications") may be created (depending on your choice during installation) with the shortcut to CTGROWTH and other MEI programs.

Note: To move other previously installed MEI applications into this folder, select **Start** → **Settings** → **Taskbar...** → **Start Menu** → **Programs** → **Advanced**. Then double-click "Programs" to display the folders in your **Programs** menu. Drag and drop shortcuts to other MEI programs into the **MEI Applications** folder.

2.3 UNINSTALLING CTGROWTH

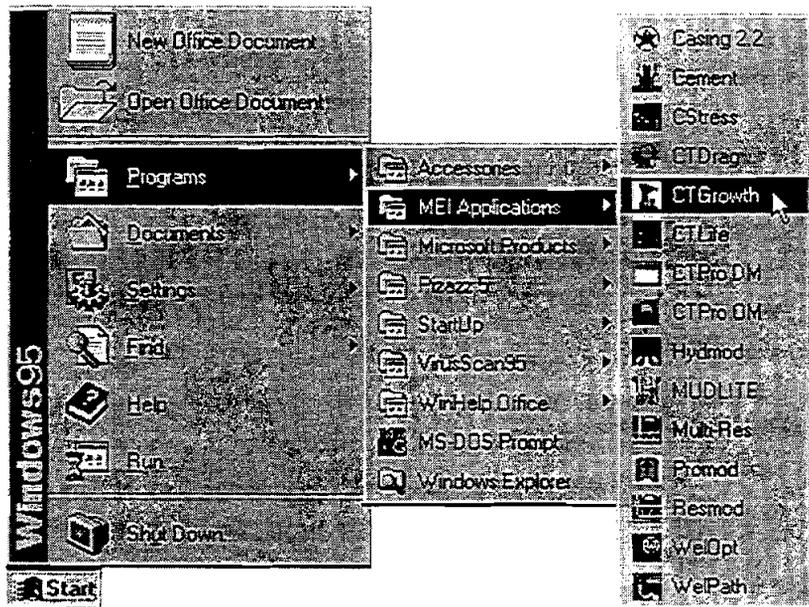
Should it ever be necessary to remove CTGROWTH from your computer, access the Windows **Add/Remove Programs** feature (rather than simply deleting the CTGROWTH folder). This feature is activated by running **Start → Settings → Control Panel → Add/Remove Programs** and selecting CTGROWTH from the list of programs currently installed on your computer.

Using this procedure clears the library registry in the Windows system folder and erases the corresponding library files that are not stored in the CTGROWTH directory.

2.4 RUNNING CTGROWTH

To launch CTGROWTH, select it from the **MEI Applications** program group under the Program Menu (or other program group you assigned during setup).

The design and operation of the input windows in CTGROWTH are described in Chapter 3. Output windows and features are discussed in Chapter 4. For assistance with the program, contact MEI using information presented in Chapter 5. Common problems and solutions are described in Appendix A.



2.5 QUICK TOUR OF CTGROWTH

The following quick tour will give the new user a rapid overview of the basic structure, features and functions of CTGROWTH version 1.

Install:

1. Start Windows 95
2. Insert CTGROWTH Disk 1 in drive A:
3. Choose **Run...** from the Start Menu.
4. Type **A:SETUP** and press Enter. Follow the on-screen instructions.

Run:

5. Launch CTGROWTH. Select CTGROWTH from the **MEI Applications** folder under **Start Menu** → **Programs**.

Input:

6. In the Main Window, choose “Open File...” from the **File** menu (or click ).
7. From the Project File Open dialog box, select “CTTest.CG1” in the file list box, and click OK.
8. Click the “Full-Scale Cycling” tab. Examine the CT parameters on the page. Click on the drop-down boxes and change any parameters desired.
9. Click [Calculate] on the lower right section of the page (or click the run icon ). The progress of the calculation will be displayed on the right end of the icon toolbar.

Output:

10. After the Output Window is opened, an informational text message is displayed within the graph area that indicates the number of bending cycles the current string can withstand before fatigue failure. Fatigue failure for this example is predicted to occur *after* the CT diametral growth reaches 10%; therefore, growth will be presented in the output graphs up to 10%. (If fatigue failure is predicted to occur *before* the CT diametral growth reaches 10%, growth will be presented in the output graphs only up to the point of fatigue failure.)
11. Review the graph and table in the Output window that display diametral growth per trip into the well.
12. Click  to print out the graph and tabulated results.
13. Click [Sensitivity Analysis] or  to analyze the sensitivity of diametral growth to changes in tubing OD, wall thickness, material grade, pressure and bending radius.
14. Double-click any graph to enlarge it to full screen. Double-click again to restore the multiple-graph display. Click  to print a copy of the active graph.
15. Click  to return to the Input window. Change any parameter by pulling down the options in the drop-down box. Click the run icon  to calculate growth based on the new parameters.
16. Finally, click  to return to the Input window. Click “Exit” from the **File** menu or  in the upper right corner of the screen to close the program.

Chapter 2. Getting Started

MEMO

3. Input

3.1 REQUIRED INPUT DATA

Data input is very simple for modeling CT diametral growth. Required data include tubular geometry and metallurgy, gooseneck radius and spool diameter (or bending fixture radius), and internal pressure. An option is also provided to document any specific project (company name, well description, date, etc.). Documentation data will be printed along with any output graphs and tables.

Project Information:

1. Project description (company name, project name, well location, etc.) (optional)

Tubular Data:

2. Tubing OD, wall thickness, material grade (yield strength), and Young's Modulus

Cycling Parameters:

3. If trips into a well is the reference environment, reel diameter and gooseneck radius are required. If cycling is referred to the standard bending test fixture, the bending form radius is required.

Internal Pressures:

4. CT internal pressure. (If an external pressure is present, differential pressure should be used. This would rarely be the case since bending normally occurs with the CT exposed to the atmosphere.)

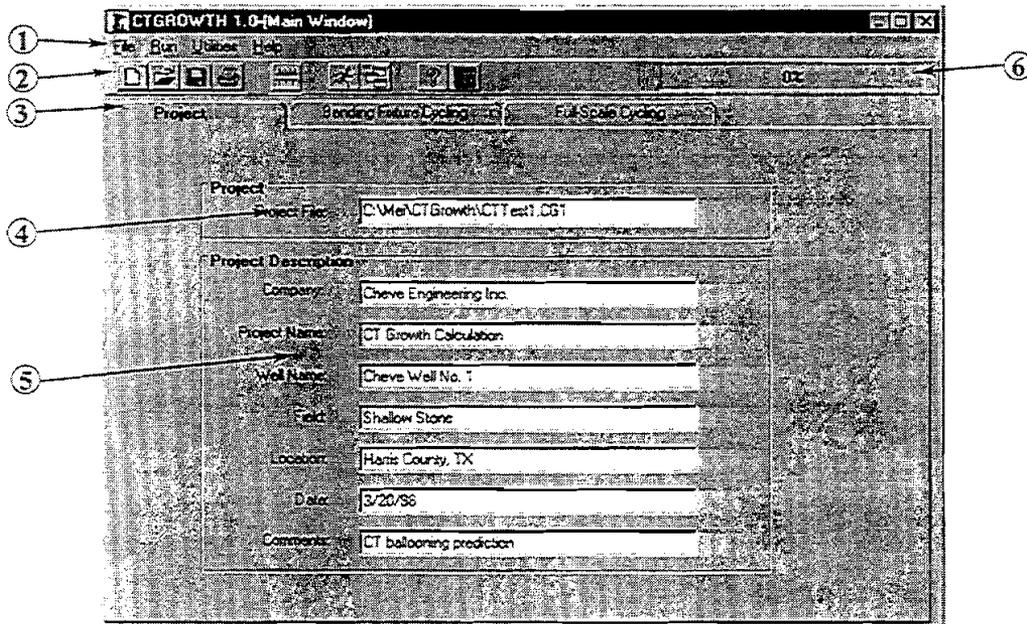
Data can be entered and displayed in English or metric units, or in a custom combination of units defined by the user and stored on disk.

3.2 INPUT WINDOW

In the Input window of CTGROWTH, there are three different pages for input data. Each is accessed by clicking on its tab below the icon tool bar. Functions and parameters on each screen are described in the sections which follow.

Chapter 3. Input

3.2.1 Project Page



① **Menu Bar.** The function of the pull-down menus in CTGROWTH is similar to that in other Windows applications. A description of all functions and features is presented later in this chapter in section 3.2.4.

② **Tool Bar.** Tool-bar icons can be used to quickly access commonly used functions. The icons are shortcuts for menu options. The functions of the icons are:



New Project. Clears all input data.



Open File. Activates the open file window.



Save. Saves all input data to the current file name. If the project is new, will automatically activate the *Save As...* window.



Print. Activates the print options window.



Run. Initiates calculations. Same as [Calculate]. Progress can be monitored on the Status Bar.



Output. Goes to output screens without recalculating. Not active if the calculations have not yet been performed.



Units. Opens the Units Selection window (see Section 3.2.4). The user can select English, SI, or any custom combination of units.



Help. Opens the Help system for CTGROWTH keyed to the currently displayed window. Same as [F1]. Alternatively, select "Help Topics..." from the **H**elp menu to open Help at the table of contents.



Calculator. Causes the Windows utility calculator to pop up.

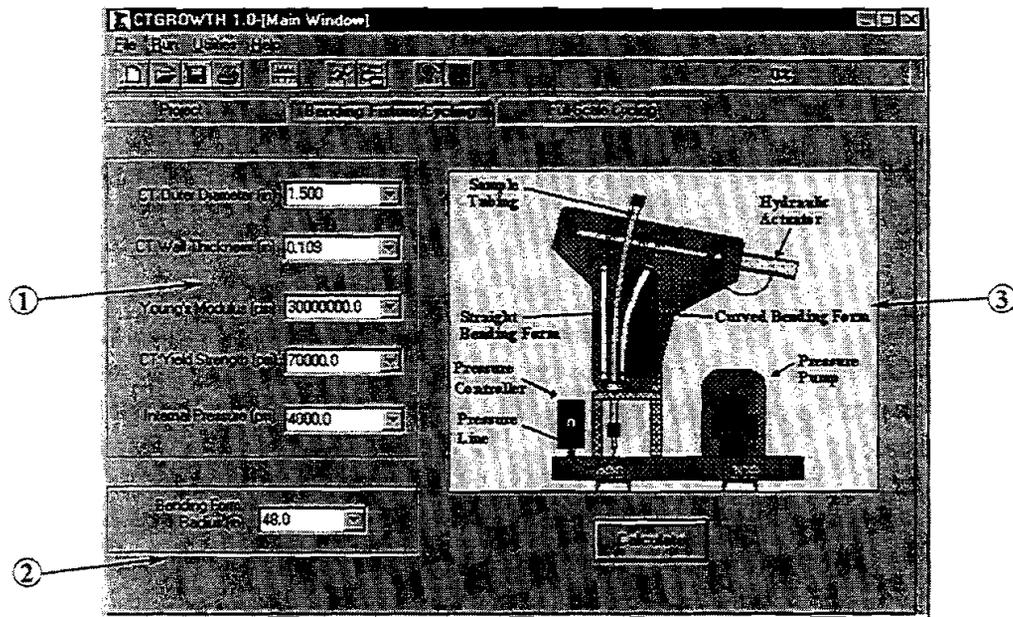
- ③ **Page Tabs.** Switching between the three input screens for entering or checking data is simple – just click on the corresponding tab.
- ④ **Project File.** The project file currently in use is displayed. CTGROWTH files are automatically assigned the extension .CG1.
- ⑤ **Project Description.** These data provide specific information about the project to identify the company, project name, well location, date, and miscellaneous comments. This information will be printed in a heading block in all printouts of graphs and tables. Any or all of these items may be left blank if desired. The function of the program will not be affected. The maximum string length for each entry is 50 characters.
- ⑥ **Calculation Status Bar.** After the input data are entered, the calculation is launched by clicking the run icon  or the [Calculate] button. Prior to beginning the calculations, the program automatically checks the data for errors. Errors include parameters that are outside the allowable range as specified in Section 3.3. As the calculations are performed, the ongoing status is displayed in this bar with a percentage complete indicator.

3.2.2 Bending Fixture Cycling Page

Two basic options are provided for analyzing CT growth. The first option, **Bending Fixture Cycling**, is provided for users interested in laboratory analysis of growth, correlation to other laboratory data, etc. Growth is described with direct reference to the standard CT fatigue test fixture (these fixtures are operated by CT manufacturers and other companies). The bending radius of the curved form on the test fixture is required input. In addition, results are presented as bending cycles that represent *a single bend/straighten cycle* as measured in the laboratory.

The second option, **Full-Scale Cycling** (next section), will be preferred by most users. This calculation option is based on full-scale rig geometry. Required input includes the reel diameter and the gooseneck radius. Output results are presented as trips in and out of the hole. Each bending trip represents *three bend/straighten cycles* as is normally considered for field operations (that is, two bending cycles at the gooseneck radius and one bending cycle at the reel diameter).

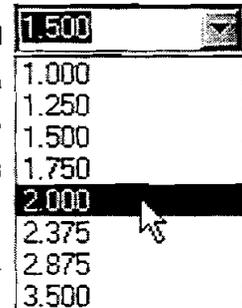
Chapter 3. Input



① **CT Parameters.** Data describing CT geometry and material properties are required prior to calculation. The most common options are provided for convenience in drop-down lists. Click on the arrow  to view the options provided. Otherwise, type in any desired value. The allowable range of values for each parameter is defined in Section 3.3.

② **Bending Radius.** Enter the desired bending radius as it applies to the standard CT bending machine.

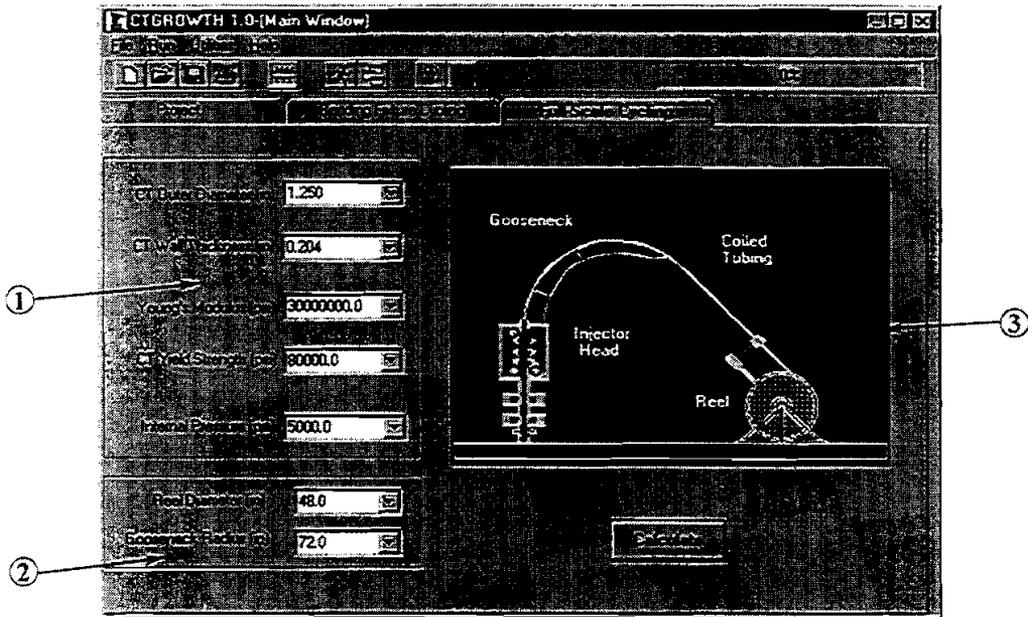
③ **Equipment Schematic.** Parameters required for calculating diametral growth and fatigue life are defined schematically for the user's reference.



3.2.3 Full-Scale Cycling Page

Two principal options are provided for analyzing CT growth. The first option, **Bending Fixture Cycling** (see previous section), is provided for users interested in laboratory analysis of growth, correlation to other laboratory data, etc. Growth is described with direct reference to the standard CT fatigue test fixture (operated by CT manufacturers and other companies). The bending radius of the curved form on the test fixture is required input. In addition, results are presented as bending cycles that represent *a single bend/straighten cycle* as measured in the laboratory.

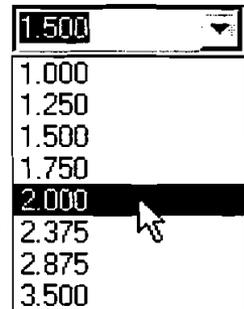
The second option, **Full-Scale Cycling**, will be preferred by most users. This calculation option is based on full-scale rig geometry. Required input includes the reel diameter and gooseneck radius. Output results are presented as trips in and out of the hole. Each bending trip represents *three bend/straighten cycles* as normally considered for field operations (that is, two bending cycles at the gooseneck radius and one bending cycle at the reel diameter).



① **CT Parameters.** Data describing CT geometry and material properties are required prior to calculation. The most common options are provided for convenience in drop-down lists. Click on the arrow  to view the options provided. Otherwise, type in any desired value.

② **Bending Radius.** Enter the diameter of the CT reel and the radius of the rig gooseneck.

③ **Equipment Schematic.** Parameters required for calculating diametral growth and fatigue life are defined schematically for the user's reference.



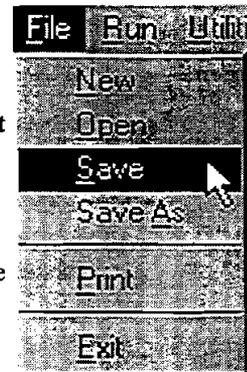
3.2.4 Input Window Menus

The menu system used in CTGROWTH is typical of Windows applications. Most functions are self-explanatory. There are four menus in the Input window of CTGROWTH: **File**, **Run**, **Utilities** and **Help**.

File Menu

The **File** menu contains commands for creating, retrieving, saving and printing input data. The functions of the individual menu options are:

1. "New" clears the Project page. CT parametric data are not affected.
2. "Open..." opens a dialog box for exploring the file system for input files with the extension ".CG1."



Chapter 3. Input

3. "Save" replaces the previous version of the input data file with the current modified data. No prompt is given before overwriting the previous version of the file.
4. "Save As..." saves the current version of the input data under a different name. A dialog box is opened to let the user specify the drive, directory, and name of the project file.
5. "Print" prints a form displaying all current input data and parameters.
6. "Exit" concludes the current session. CTGROWTH will prompt for saving the project file if data have been changed and not yet saved.

Run Menu

The **R**un menu is used to launch CTGROWTH calculations. Click "Start" after all input data are entered. CTGROWTH will check for errors in the data (e.g., parameters outside the allowable range (see Section 3.3), internal pressure greater than burst pressure ratings, etc.) prior to performing the calculations. The [Calculate] button or the run icon  can also be used to launch the calculations.

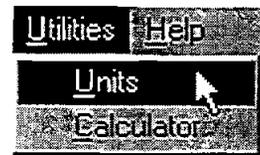
The Calculation Status Bar (located on the right end of the icon tool bar) will display the progress of the calculation (from 0 to 100% complete). After the calculations are completed, the Output window displaying the results will be loaded automatically.



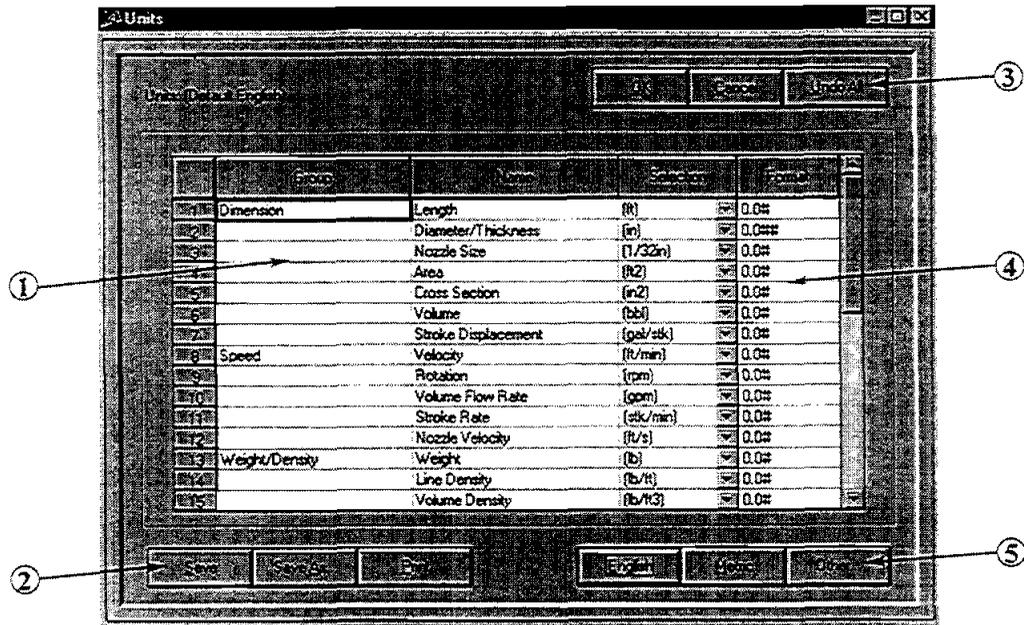
Utilities Menu

The **U**tilities menu includes:

1. "Units..." opens the Units selection window (see below). Same as .
2. "Calculator" opens the Windows utility calculator. Same as .



Units Selection Window



① **Units Table.** Physical parameters and currently assigned units for each quantity are displayed in the Units Table. The user cannot edit this table directly (indicated by the yellow background). Allowable options for each quantity are accessed by pulling down the drop-down box attached to each quantity.

② **Custom Units Control Buttons.** If any changes are made to the default English or SI systems of units by selecting another option from one or more pull-down boxes, the new custom system will need to be saved for future use. Use the [Save] button for new custom systems or updates to previously created systems. The [Save As...] button is used when a new combination of units is designed, and the user wishes to save it separately, rather than overwriting the previous custom system. Both save buttons will cause a save dialog box to pop up. Custom systems of units are stored as *.UNT files.

The [Print] button will print the Units Selection Table for documentation or reference. (This functions only after a save.)

③ **System of Units Selection Buttons.** These buttons select entire systems of units, which then appear in the table, and in CTGROWTH screens and graphs. The [Other] button will display the file names of the custom systems previously created and stored.

The name of the currently selected system of units is displayed in the upper left corner of the Units Selection Window ("Default English" in the figure above).

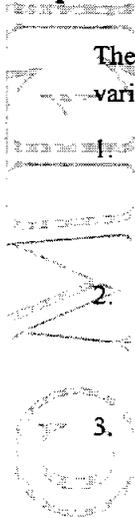
Chapter 3. Input

- ④ **Numeric Display Format Table.** The number of digits displayed for each parameter can be adjusted by the user. The number of zeroes after the decimal point for each quantity will be used as standard for the input entries and for printouts.

Within the decimal section of the number (which defines how many decimals are displayed), a zero denotes a “hard” digit (always displayed) and a “#” denotes a “soft” digit (displayed if required).

- ⑤ **Control Buttons.** These buttons control operations for the entire Units Selection window. [OK] accepts the current settings after any changes are made and then returns to the previous window. [Cancel] ignores any changes made since this Units window was activated and returns to the previous window. [Undo All] deletes all changes made since this Units window was activated, but stays in the Units window for further editing.

Help Menu



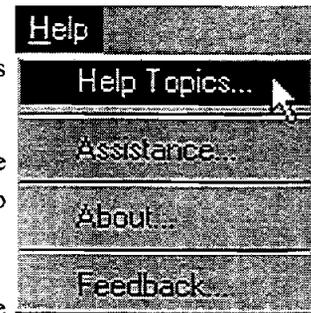
The **Help** menu provides assistance for running CTGROWTH and presents various parameters describing the user's computer.

1. “Help Topics...” launches the CTGROWTH Help system from the Table of Contents. Alternatively, clicking  or pressing [F1] opens the Help system directly on a description of the current screen.

2. “Assistance...” opens a pop-up box which displays MEI's address, phone number, e-mail address and other information. Use these contacts to obtain additional help with CTGROWTH.

3. “About...” opens the About pop-up box, which displays the version number of CTGROWTH along with hardware in the user's computer. Click “Licensing...” to view a summary of the restrictions for copying the program and manual, and the program disclaimer.

4. “Feedback...” opens a special screen form for documenting specific bugs, problems, etc. and communicating with MEI. The form can be printed for faxing or saved to disk and attached to an e-mail routed to mei@maureng.com.



3.3 PARAMETER LIMITS

CTGROWTH was developed based on Halliburton's growth model (which was itself based on full-scale test data for large CT 2-inch and above) and laboratory data from Precision Tube Technology for CT less than 2 inches. The model was also calibrated by comparison with a wide range of test data from Quality Tubing. For more discussion on the theoretical background, see "Theoretical Basis" in Section 1.1.

Limits are set within CTGROWTH for each of the input parameters. These limits are set by the program to avoid extrapolating the results to configurations significantly outside the range for which experimental data were available.

The maximum and minimum allowable values for each parameter are listed in the table.

ALLOWABLE PARAMETER VALUES		
PARAMETER	MINIMUM	MAXIMUM
CT OD (in./mm)	0.75 / 19.1	3.50 / 88.9
Wall Thickness (in./mm)	0.08 / 2.03	0.250 / 5.72
Young's Modulus (psi/kPa)	$18.5 \times 10^6 / 128 \times 10^6$	$35 \times 10^6 / 241 \times 10^6$
Yield Strength (psi/kPa)	70,000 / 482,650	100,000 / 689,500
Internal Pressure (psi/kPa)	1,000 / 6,895	7,000 / 48,265
Reel Diameter (in./mm)	48 / 1,219	240 / 6,096
Gooseneck Radius (in./mm)	72 / 1,829	180 / 4,572
Bending Form Radius (in./mm)	48 / 1,219	120 / 3,048

Chapter 3. Input

MEMORANDUM

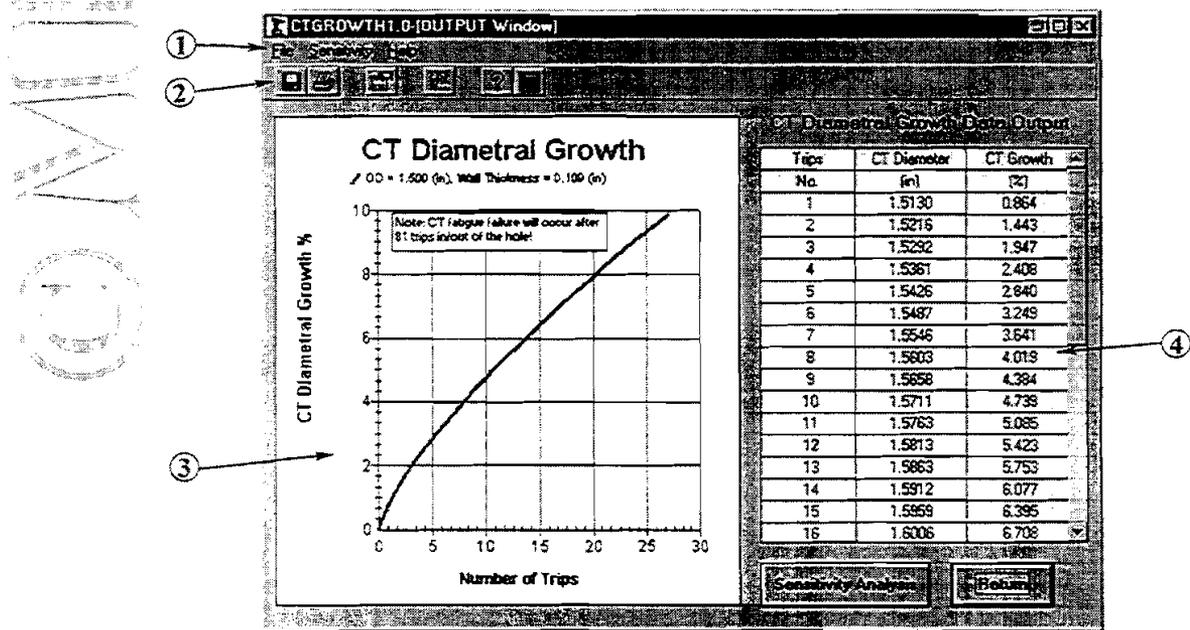
4. Output

4.1 MAIN OUTPUT WINDOW

CTGROWTH diametral growth calculations are summarized in the Main Output window. Presentation formats include a graph and a table. The uppermost value presented is based on the more restrictive of two limits. The primary limit is that *growth is not allowed to exceed 10% of nominal OD*. Many operators and service companies impose a limit of about 6% on CT growth based on equipment constraints (i.e., fitting the CT through the gripper blocks and stripper). Based on these considerations, CT growth of 10% was chosen as a practical upper limit for all analyses. Experimental data above 10% were also excluded from the correlations to allow a closer fit to data in the range of interest (0-10%).

The second limit applied to the output data presentations is fatigue failure. If the CT is predicted to fail from fatigue before the diameter grows by 10%, then *growth is shown only up to the point of fatigue failure*.

4.1.1 Output Graph and Table



- ① **Menu Bar.** The pull-down menus in CTGROWTH output are used to modify output presentation, export data, select options for graph design, and several other useful functions. A description of functions and features of the output menu is presented in Section 4.1.2.
- ② **Tool Bar.** Tool-bar icons can be used to quickly access commonly used functions from the menus. The functions of CTGROWTH's output window icons are:

Chapter 4. Output



Print. Prints the current graph and table.



Save. Saves the current graph and table to disk in metafile format.



Input Window. Returns to the Input window for reviewing and/or editing input data.



Sensitivity Analysis. Opens the Sensitivity Analysis window. See Section 4.2.

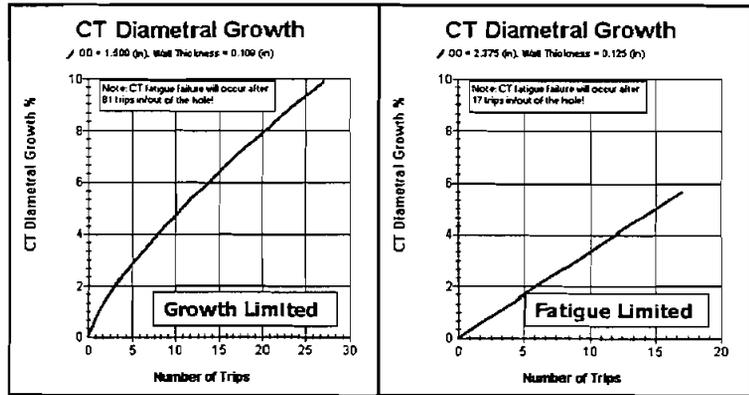


Help. Launches the CTGROWTH Help system keyed to the current screen. Same as [F1].



Calculator. Pops up the Windows utility calculator.

- ③ **Graph of CT Growth.** Results of calculations for the current input parameters are displayed graphically. If the calculation was launched from the **Bending Fixture Cycling** page (see Section 3.2.2), the x-axis parameter will be *cycles* (one bend/straighten sequence). If the calculation was launched from the **Full-Scale Cycling** page (see Section 3.2.3), the x-axis will be *trips* (one complete trip in/out of the hole consisting of three bend/straighten sequences).



The **maximum y-axis value** is set based on the fatigue limit or the growth criterion of 10%. If fatigue failure is predicted to occur *after* the CT diametral growth reaches 10%, growth will be presented in the output graphs only up to 10%. If fatigue failure is predicted to occur *before* the CT diametral growth reaches 10%, growth will be presented in the output graphs only up to the point of fatigue failure.

- ④ **Table of CT Growth.** Tabulated output from CTGROWTH is presented for evaluation. If the calculation was launched from the **Bending Fixture Cycling** page (see Section 3.2.2), the independent parameter will be *cycles* (one bend/straighten sequence). If the calculation was launched from the **Full-Scale Cycling** page (see Section 3.2.3), the first column will be *trips* (one complete trip in/out of the hole consisting of three bend/straighten sequences).

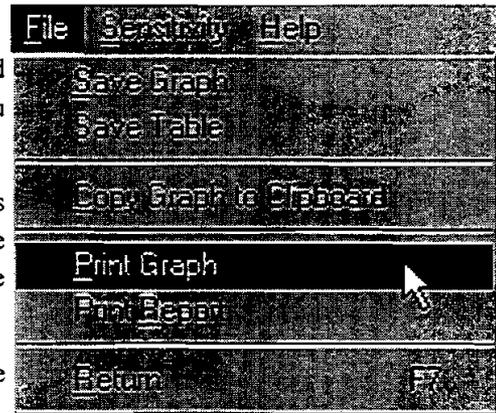
4.1.2 Output Window Menus

The menu system design used in CTGROWTH is similar to other Windows applications. Several of the most commonly used menu functions can be easily accessed through the tool bar icons (see previous section). There are three menus in the Main Output window of CTGROWTH: **F**ile, **S**ensitivity, and **H**elp.

File Menu

The **File** menu contains commands for printing, exporting, and saving output data. The functions of the individual menu options are:

1. "Save Graph..." opens a dialog box. The user specifies the drive, directory, and the name of the image file. The image of the graph is written to disk as a metafile (*.WMF).
2. "Save Table..." opens a dialog box for saving the tabulated results. The user can specify the drive, directory, and the name of the image file (extension .out). The table is written to disk in ASCII format with space delimiters.
3. "Copy Graph to Clipboard" copies the output graph to the Clipboard in metafile (*.WMF) format.
4. "Print Graph" prints a high-quality image of the main output graph at the full resolution of the printer. CTGROWTH offers the option of printing in color. After a print job is launched, a second box will pop up for selecting a color printer.
5. "Print Report" prints a complete summary of the output data including input data, a graph of CT growth with bending cycles, and a table of results.
6. "Return" is used to transfer back to the Input window for reviewing or modifying input data. If, after reviewing input data, you wish to return to the Output window without making any changes to the input data, click the  icon. This saves time by not launching the calculation sequence if no data were changed.



Sensitivity Menu

The **Sensitivity** menu is used to launch the Sensitivity Analysis window for analyzing the impact of changes in all critical parameters (see Section 4.2). Same as .

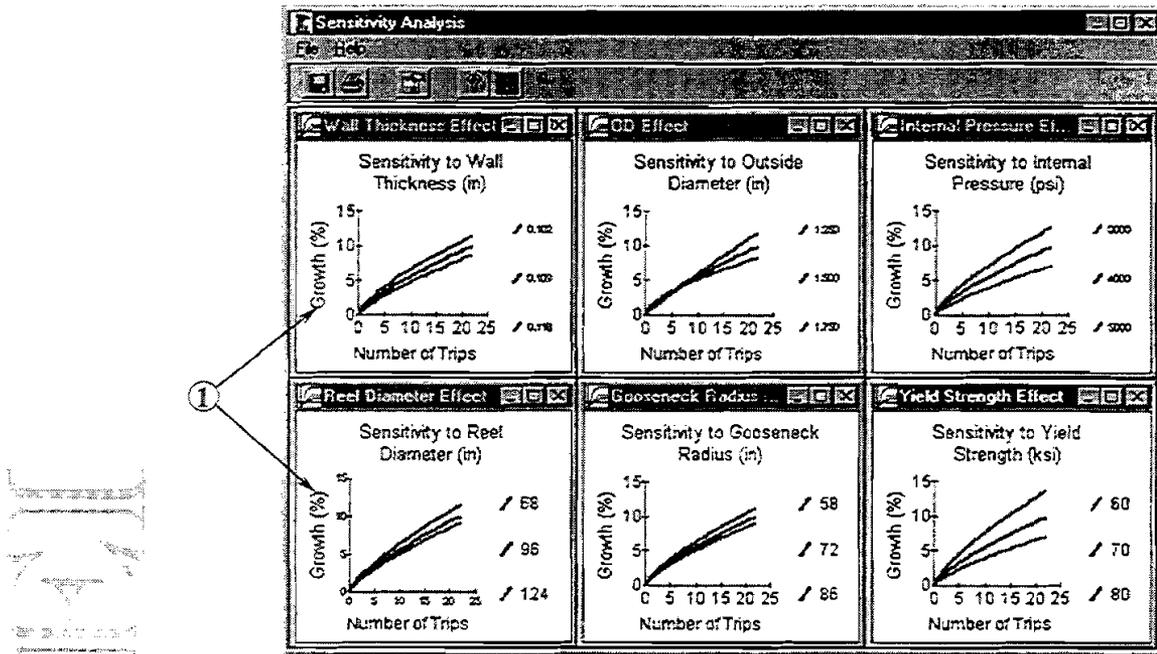


Help Menu

The **Help** menu provides assistance for running CTGROWTH. "Help Topics..." launches the CTGROWTH Help system from the Table of Contents. Alternatively, clicking  or pressing [F1] opens the Help system directly on a description of the current screen.



4.2 SENSITIVITY ANALYSIS WINDOW



The Sensitivity Analysis window is used for evaluating the effects on CT growth of relatively small changes in tubing OD, wall thickness, material grade, internal pressure, and bending radius. These analyses will indicate the parameters that have the largest influence on CT growth as well as the most efficient approach(es) for decreasing growth. This window is accessed by clicking [Sensitivity Analysis] at the bottom of the main Output window or the  icon.

① **Sensitivity Graph Windows.** The results of the sensitivity analyses are presented for review and comparison in six tiled subwindows. **Double-click** on any graph to enlarge it to full screen. The windows include:

1. **Wall Thickness.** CT growth for the current wall thickness is compared to CT growth with wall thickness 0.007 inches above and below the selected thickness (same nominal CT OD).
2. **Internal Pressure.** CT growth with the current internal pressure is compared to CT growth with 1000 psi above and below the current pressure. When the selected input pressure is less than 2000 psi, the lower bounding curve will not be displayed because the model is based on test data from 1000 to 7000 psi. The same applies to input pressures above 6000 psi, for which case no upper bounding curve is displayed.
3. **Yield Strength.** The impact of material yield strength is shown for three strengths: the current yield, and 10,000 psi above and below the current yield.
4. **OD.** The selected CT OD is shown along with ODs 0.25 inches smaller and larger (with the same wall thickness).
5. **Bending Radius.** The current bending radius (either the bending form radius for bending fixture cycle calculations, or the gooseneck radius and reel diameter for full-scale trip calculations) is compared to radii 14 inches (356 mm) above and below the current radius.

5. Getting Help

5.1 CONTACTING MEI

For additional assistance with operation or application of CTGROWTH, contact:

Dr. Steve Yang or Chad Gao
Maurer Engineering Inc.
2916 West T.C. Jester Boulevard
Houston, Texas 77018-7098 U.S.A.

Telephone: (713) 683-8227

Fax: (713) 683-6418

E-mail: mei@maureng.com

5.2 REPORTING PROBLEMS

CTGROWTH version 1 has been carefully checked before its release; however, software bugs are a fact of life. Please report any bugs you find and describe the input parameters and conditions selected when the problem occurred. *Please check Appendix A first to determine whether the solution to your problem is described there.*

MEI is also very appreciative of your comments and suggestions for improving CTGROWTH. Let us know if there are additional features you would like to see added to the program. Though it may not be feasible to incorporate every suggestion into the next version, many important improvements have been made to MEI programs based directly on suggestions from users.

Please use the form on the next page to report bugs in the program, as well as suggestions on improving the function and usefulness of CTGROWTH.

Chapter 5. Getting Help

© M E I

Bug Report/Enhancement Suggestion Form

Name: _____ Company: _____
Address: _____ City: _____ State: _____
Phone No.: _____ Fax No.: _____
E-mail: _____ Date: _____

Bug/Problem Report

Enhancement Suggestion

Program Name and Version Number: _____

Bug/Problem Description or Suggested Enhancement: _____

Other Comments: _____

Data/Parameters Causing Bug

Will be mailed on diskette Will be faxed

Attached

None

Operating System

MS-DOS Version No.: _____

MS-Windows Version No.: _____ (Win 3.1/Win 95)

OS2 _____

MS-Windows NT Version No.: _____

Other _____

Please mail, fax, or e-mail to:

Mr. Lee Chu
MAURER ENGINEERING INC.
2916 West T.C. Jester
Houston, TX 77018-7098
Ph: 713/683-8227 • Fax: 713/683-6418
E-mail: mei@maureng.com

Chapter 5. Getting Help

COMMENTS

Appendix A — Common Problems and Solutions

Specific problems related to installing and running MEI software are described in this section. These problems have been reported by multiple users and are often related to computer settings and file locations.

A.1 INTERNATIONAL KEYBOARD SETTINGS

“Type Mismatch” Error

All computer software developed at Maurer Engineering Inc. is written using the U.S. Keyboard format. Under this numeric standard, the 1000 separator is a comma, and the decimal separator is a period. Thus, the number **one thousand, two hundred and thirty-four and 22/100** is written as

1,234.22

Numbers input into MEI programs are stored in this format.

Problems have occurred for some of our clients who use the International Keyboard format, as is common in certain countries in Europe and South America. Here, the same number would be written

1.234,22

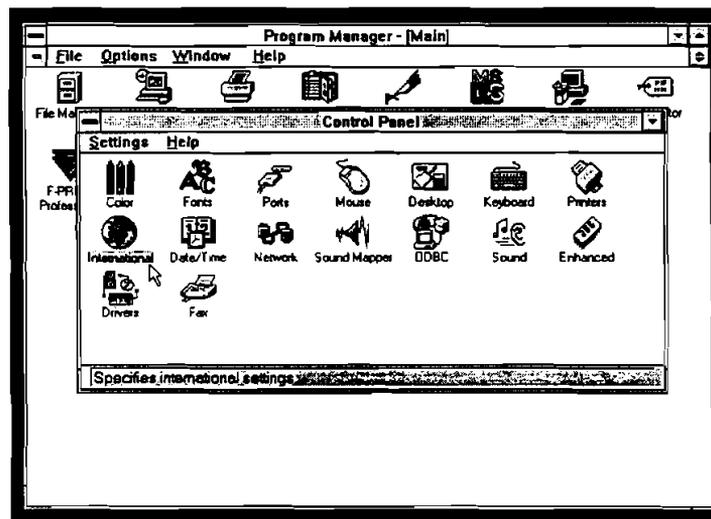
where the 1000 separator is a period, and the decimal separator is a comma.

Users with the International Keyboard format find that their computers garble input data being loaded into MEI programs. Often, a “Type Mismatch” error halts the program.

This problem can be readily solved by changing the Windows numbers format from International to U.S. format. This can be accomplished as follows:

In Windows 3.x

1. Select the “Control Panel” icon from the **Main** menu screen. This is done by pointing the mouse to this icon and double clicking. This brings up the “Control Panel” menu screen, as shown below.



A.3 PRINTER SELECTION

MEI programs support a wide range of monochrome and color printers. However, most programs written in Visual Basic 3 (16-bit) do not provide options within the program for selecting individual printers. All print jobs are sent to the current Windows default printer.

Changing Printers

If you wish to switch to a special printer, **assign that printer as the Windows default printer before running the MEI program**. The default printer is selected under the Printers control window. This window is accessed in Windows 95 by selecting **Start** → “Settings” → “Printers”. After the Printers window is open, click once on the printer of interest to highlight it. Then, select “Set as Default” from the **File** menu.

Network Printers

Some users have experienced problems when trying to send output from MEI software to network printers. Most difficulties can be addressed by **modifying the printer port entry**. If a network printer will not print from an MEI program, follow these steps:

1. Select **Start** → “Settings” → “Printers”; then double-click the network printer icon.
2. Select “Properties” from the **Printer** menu. Select the “Details” tab from the Properties window (see figure).
3. Place the cursor on the entry in the text box under **Print to the following port:**. Copy the text string by pressing *control+C*.
4. Click the “Capture Printer Port...” button.
5. Select “LPT2” or “LPT3” under the **Device** pull-down menu.
6. Click the **Path:** text box; then paste the text string into the box by pressing *control+V*. Click <OK> to close the “Capture Printer Port” window.
7. On the “Details” window, pull down the list of options under the **Print to the following port:** box. Select the new entry (that you just created) with “LPT2” or “LPT3” followed by the text string copied and pasted.
8. Select <OK> and close all printer windows.

This procedure should allow printing to a network printer, provided that printer is also selected as the Windows default printer.

