Manufactured Home Energy Audit User's Manual

Developed for the US DOE Weatherization Assistance Program by

Center for Buildings and Thermal Systems
National Renewable Energy Laboratory
Golden, Colorado
September 1997

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Acknowledgements

The Manufactured Home Energy Audit (MHEA) was prepared for the U.S. Department of Energy (DOE) Weatherization Assistance Program. The National Renewable Energy Laboratory (NREL), Center for Buildings and Thermal Systems, developed the software. We would like to acknowledge the considerable contribution of the MHEA working group during the development of MHEA. This group reviewed and commented on preliminary versions of the software. Members of the MHEA working group were:

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In particular, we wish to acknowledge Sue Cadenhead, Arun Vohra, and Elaine Mader, MHEA project managers for the DOE Weatherization Assistance Program. Members of the NREL MHEA development team were:

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Forward

What is the Manufactured Home Energy Audit?

The Manufactured Home Energy Audit (MHEA) is a software tool that predicts manufactured home energy consumption and recommends weatherization retrofit measures. It was developed to assist local weatherization agencies working with the U.S. Department of Energy (DOE) Weatherization Assistance Program. Whether new or experienced, employed within or outside the Weatherization Assistance Program, all users can benefit from incorporating MHEA into their manufactured home weatherization programs. DOE anticipates that the state weatherization assistance programs that incorporate MHEA into their programs will find significant growth in the energy and cost savings achieved from manufactured home weatherization.

The easy-to-use MHEA displays a colorful, graphical interface for entering simple inputs and provides understandable, usable results. The user enters information about the manufactured home construction, heating equipment, cooling equipment, and weather site. MHEA then calculates annual energy consumption using a simplified building energy analysis technique. Weatherization retrofit measures are evaluated based on the predicted energy savings after installation of the measure, the measure cost, and the measure life. Finally, MHEA recommends retrofit measures that are energy and cost effective for the particular home being evaluated.

MHEA evaluates each manufactured home individually and takes into account local weather conditions, retrofit measure costs, and fuel costs. The recommended package of weatherization retrofit measures is tailored to the home being evaluated. More traditional techniques apply the same package of retrofit measures to all manufactured homes, often the same set of measures that are installed into site-built homes. Effective manufactured home weatherization can be achieved only by installing measures developed specifically for manufactured homes. The unique manufactured home construction characteristics require that each of these measures is evaluated separately in order to devise a package of measures that will result in high energy and dollar savings.

MHEA stands apart from other building energy analysis tools in many ways. Calculations incorporated into the computer code specifically address manufactured home heating and cooling load trends. The retrofit measures evaluated by MHEA are all applicable to manufactured homes. Help messages describe common manufactured home weatherization practices as well as provide hints on how to install retrofit measures. These and other features help make MHEA easy to use when evaluating energy consumption and the effects of weatherization retrofit measures for manufactured homes.

The National Renewable Energy Laboratory has developed MHEA for the U.S. Department of Energy Weatherization Assistance Program. Many energy consumption and economic calculations resemble those found in the Computerized Instrumented Residential Audit written by Lawrence Berkeley National Laboratory and the National Energy Audit written by Oak Ridge National Laboratory. The calculations are similar in structure but have been altered to more accurately represent manufactured home unique energy use characteristics. Most importantly, MHEA helps meet the DOE Weatherization Assistance Program goals to increase client comfort and use federal dollars wisely.

Orienting the User

MHEA has five main components: file, inputs, run, view, and setup. These components are also listed as the main menu items displayed at the top of all MHEA screens. Project files (where information about the manufactured homes that you are evaluating is stored in the computer memory) are managed by using the options available within the **File** menu. You may create new project files, open existing project files, copy or delete project files, and print project file inputs and results.

All data describing the manufactured home construction and heating/cooling equipment are entered within the **Inputs** menu. You may also enter general comments and utility bill data under the **Inputs** menu.

Choose one of the options within the **Run** menu to activate MHEA calculations. You may evaluate the manufactured home energy consumption and effects of installing retrofit measure either with or without adjusting the results according to utility bill data.

After you have run the calculations, display the results by selecting one of the options under the **View** menu. The comments and a summary of the input data are also displayed by selecting the appropriate **View** menu options.

Finally, you may select a weather location, adjust the default values displayed on the input screens and used in MHEA calculations, specify retrofit measure and fuel costs, and determine which retrofit measures will be evaluated by revising the parameters included with the **Setup** menu options.

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MHEA Flow Chart

Quick Start

Install MHEA onto your computer by following the directions outlined below. More detailed information for installing MHEA is given in Section 1.2, Installing MHEA.

Your computer must be an IBM® or compatible computer with an 80286 or higher processor to run MHEA. Your hard drive must have at least 2 MB (5 MB suggested) of available space, and your computer must have at least 640K of RAM. The video display must be VGA, and you must be using MS-DOS® version 4.2 or later.

To install MHEA, insert the MHEA diskette into either the A: or B: drive and type the commands listed below. Then follow the instructions that appear on your screen.

c:	<ENTER>	
a:\installa	<ENTER>	if installing from the A: drive
b:\installb	<ENTER>	if installing from the B: drive

If you have a previous version of MHEA installed on your computer, either remove that version from your computer or install the new version into a separate directory. Refer to Section 1.2.2, Reinstalling MHEA, and Section 1.2.3, Installing MHEA into Nondefault Directories.

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MHEA is a MS-DOS® application, not a Microsoft Windows® application. MHEA can be run from Windows® as a MS-DOS® application, but depending on the computer configuration, MHEA may run slower when operated through Windows®.

1.0 Getting Started

In the Getting Started chapter you will learn about the computer equipment you will need, how to install the software, and how to move through MHEA. This chapter is especially useful if you are unfamiliar with MHEA or if you are new to using computers.

1.1 Equipment You Will Need

To use MHEA, you will need at a minimum the equipment listed in section 1.1.1, Minimum Requirements. Section 1.1.2, Recommended Requirements, lists recommended equipment that will help make using MHEA easier for you.

1.1.1 Minimum Requirements

- Computer - IBM® or compatible computer with an 80286 processor or higher
- Hard Disk Drive - hard disk with at least 2 MB (5 MB suggested) of available space
- Floppy Disk Drive
- Memory - at least 640K of RAM
- Video Display - VGA monitor (640 x 480 pixel resolution)
- Operating System - MS-DOS® version 4.2 or later

1.1.2 Recommended Requirements

- Mouse - a Microsoft Mouse or compatible mouse is highly recommended
- Printer - MHEA is compatible with many common printer types

1.2 Installing MHEA

This section describes how to install MHEA, both onto computers where you have not previously installed the software (Section 1.2.1) and onto computers where an older version of the software already exists (Section 1.2.2). You will also learn how to install MHEA into non-default directories.

1.2.1 Installing MHEA for the First Time

If you are installing MHEA onto a computer that does not already have an existing version of the software on it, follow the instructions for installing MHEA for the first time.

Note Check if MHEA has been installed onto your computer by typing at the c:\ prompt

dir/s mhea.exe <ENTER>

To install MHEA for the first time

1. Access the hard drive on which you want to load the software. Usually this is the C drive. If a prompt such as C:\ is not on your screen, type

c: <ENTER>

Note If a prompt such as C:\<directory name> appears on your screen, type the following command to reduce the prompt back to just C:\.

cd c: <ENTER>

Warning Do not install MHEA until you see the appropriate directory name at the C prompt. If a prompt such as C:\<directory name> is on your screen when you initiate the installation procedure, you will install MHEA into the MS-DOS® directory whose name is indicated by the prompt.

Note Refer to section 1.2.3, Installing MHEA onto Nondefault Directories, for directions on how to install MHEA into a directory other than the MHEA default directory.

2. Insert MHEA diskette into the floppy disk drive on your computer. Be sure to note if you are installing the software from your A: or B: floppy disk drive.
3. Type one of the commands listed below depending on which drive you are using to install MHEA.

If you are installing MHEA from the A: drive, type

a:\installa <ENTER>

If you are installing MHEA from the B: drive, type

b:\installb <ENTER>

4. The software will now begin creating directories and inflating files.

If you successfully followed all four steps, you have completed installation of MHEA.

1.2.2 Reinstalling MHEA

If you have a previous version of MHEA on your computer, follow the instructions for reinstalling MHEA.

Note Check if MHEA has been installed onto your computer by typing at the c:\ prompt

dir /s mhea.exe <ENTER>

To reinstall MHEA

1. Access the hard drive on which a previous version of the MHEA is stored. Usually this is the C drive. If a prompt such as C:\ is not on your screen, type

c: <ENTER>

Note If a prompt such as C:\<directory name> appears on your screen, type the following command to reduce the prompt back to just C:\.

cd c: <ENTER>

Warning Do not install MHEA until you see the appropriate directory name at the C prompt. If a prompt such as C:\<directory name> is on your screen when you initiate the installation procedure, you will install MHEA into the MS-DOS® directory whose name is indicated by the prompt.

2. Access the directory where the software is stored. The default directory name is MHEA. Type the following command so that a prompt such as C:\MHEA appears on your screen.

cd MHEA <ENTER>

Note If MHEA was installed within a directory, then change to that directory before typing the above command. For example, type **cd <directory name>** <ENTER> so that the prompt C:\<directory name> appears on your screen. Now type **cd MHEA** <ENTER>. (Note that the directory name will be an 8 or less character name you previously indicated.) The prompt on your screen should now be C:\<directory name>\MHEA.

3. Erase all files in MHEA directory and in the SYSTEM subdirectory (A SYSTEM subdirectory is automatically created when you install MHEA). Three methods for completing this task are outlined below.

Method A.

At a prompt such as C:\MHEA, type the following commands

erase *.* <ENTER>

y <ENTER> (answer Yes when you are asked if you wish to erase all files in MHEA directory)

cd system <ENTER> (open the SYSTEM subdirectory and change the screen prompt to C:\MHEA\SYSTEM)

erase *.* <ENTER>

1.2.3 Installing MHEA into Non-default Directories

If you would like to install MHEA into a directory other than the MHEA default directory, complete the following steps.

1. Create the directory into which you want to install MHEA. From a MS-DOS® prompt such as C:\ type:

mkdir <directory name> <ENTER>

Note The directory name must have eight or less characters.

Note You may also create a directory using a utility software package such as Windows® or Norton Utilities®. Refer to instructions for that utility.

2. Open the directory you just created. Type:

cd \<directory name> <ENTER>

3. A prompt such as C:\<directory name> should appear on your screen. Follow instructions for installing MHEA for the first time (step 2, Section 1.2.1) or reinstalling (step 4, Section 1.2.2) MHEA.

Warning Do not install MHEA until you see the appropriate directory name at the C prompt. If a prompt similar to that shown in step 3 does not appear on your screen when you begin the installation procedure, you will not have installed MHEA into the directory that you have just created.

Note MHEA creates a subdirectory called MHEA within the directory you defined.

1.3 Navigating Through MHEA

There are four methods for entering data and selecting options within MHEA. It is the quickest and easiest to use a mouse. You can also move around the software using your keyboard. If you anticipate using MHEA often, it is highly recommended that you investigate the opportunities for acquiring a mouse if you do not already have one.

1.3.1 Using Your Mouse

Once in MHEA, use your mouse to move the black arrow, or pointer, around the screen. Point the arrow to the menu item, check box, editable field, or button you wish to activate. The box will be highlighted (either dark red or black on color monitors or solid on mono-color monitors) when the cursor is in the correct location. Click the left mouse key to select a menu item, place a check mark,

open an editable field, or select a button. Figure 1-1 shows a typical mouse with left and right mouse keys.

Note Refer to Section 1.5, Understanding MHEA Screens, for more information about menu items, check boxes, editable fields, buttons, and other items.

Figure 1-1 Typical Mouse with Left and Right Keys

1.3.2 Using Your Keyboard

There are three keyboard methods for working through MHEA. Although some users may prefer to control the cursor using the keyboard instead of the mouse, you will probably find that keyboard control requires more time and coordination than does using the mouse.

1.3.2.1 *ALT/Letter Key Method (also known as "Hot Keys")*

One letter is underlined in all descriptions for menu items, check boxes, and buttons. To select a menu item, place a check mark, or select a button, hold down the ALT key at the same time you press the letter that is underlined. To access the editable fields, press the ENTER key or the TAB key repeatedly until you have placed the cursor in the box you wish to enter a value. Figure 1-2 shows the location of the ALT, ENTER, and TAB keys on a typical keyboard. The cursor will appear as a blinking short line in the active editable field.

Note On some computers, the ENTER key may not always work to select menu items or activate options. If this occurs, use the ALT/Letter key method described above instead of the ENTER key to select menu items or activate options.

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Figure 1-2 Typical Keyboard Showing the ALT, ENTER, and TAB Keys

1.3.2.2 *ARROW Key Method*

Use the up, down, left, and right ARROW keys to move the black arrow on the screen to the next menu item, check box, editable field, or button (see Figure 1-3). Press ENTER to select the menu item, place a check mark, or select a button. To enter a value in an editable field, point the black arrow to the appropriate editable field, press ENTER, and type the input.

Note On some computers, the ENTER key may not always work to select menu items or activate options. If this occurs, use the ALT/Letter key method described above instead of the ENTER key to select menu items or activate options.

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Figure 1-3 Typical Keyboard Showing the ALT, ENTER, and ARROW Keys

1.3.2.3 SHIFT/ARROW Method

Note The SHIFT/ARROW method is the slowest of the three keyboard movement methods.

Hold the SHIFT key at the same time you hold the ARROW key for the direction you want to move the black arrow pointer on the screen (see Figure 1-4). Move the arrow to highlight the menu item, check box, editable field, or button you would like to activate. The highlighted item will be either dark red or black on color monitors or black on mono-color monitors. Press the ENTER key to select a menu item, place a check mark, enter information in an editable field, or select a button.

Note On some computers, the ENTER key may not always work to select menu items or activate options. If this occurs, use the ALT/Letter key method described above instead of the ENTER key to select menu items or activate options.

Figure 1-4 Typical Keyboard Showing the ALT, SHIFT, ENTER, and ARROW Keys

1.4 Running MHEA

In this section, you will learn how to begin using MHEA as well as how to leave MHEA and return to MS-DOS®.

1.4.1 Starting MHEA

In order to enter data, run the calculations, review results, and print projects from MHEA, you must first start the software. If the software has been installed onto your computer, follow the steps outlined in this section to begin using MHEA.

1. Access the hard drive on which the software has been installed. Usually this is the C drive. If a prompt such as C:\ is not on your screen, type

c: <ENTER>

Note If a prompt such as C:\<directory name> appears on your screen, type the following command to reduce the prompt back to just C:\.

cd c: <ENTER>

2. Access the directory where the software is stored. This directory will be titled MHEA and in most cases will be located on your C drive. Type the following command so that a prompt such as C:\MHEA appears on your screen.

cd mhea <ENTER>

Note If MHEA was installed within a directory, then open that directory before typing the above command.

3. Start the software by typing the starting command

mhea <ENTER>

4. A "Welcome to MHEA" screen will appear. Refer to Section 1.4.2, The About Screen, to learn more about the software options that can be accessed from this screen. To leave the "Welcome to MHEA" screen and continue using the software, select the Continue button.

1.4.2 The About Screen

The "About" screen provides brief information about MHEA (see Figure 1-5). It lets you read instructions on how to use MHEA and perform a preliminary energy consumption/square foot/degree-day calculation for the home. This screen automatically appears when you begin using MHEA. You may also access it by selecting the About submenu option found within the **Help** main menu item (see Section 2.5.2, About).

At the bottom of the About screen are three buttons. Select the Instructions button to display brief instructions on how to move through the software using a mouse or the keyboard; enter descriptive data about the manufactured home, then evaluate the results calculated by MHEA; print a project file; and customize MHEA using **Setup** menu options. Because the instructions cannot fit onto one screen, you must use the scroll bar on the right side of the screen to view all the instructions. See Section 1.5.5, Scroll Bars, for information about using this feature. Select the Okay button at the bottom of the Instructions screen to leave the instructions and return to the About screen.

The Estimate button allows you to perform an estimate of the home fuel consumption per square foot of the home floor area per degree-day (see Figure 1-6). Some users may find this feature useful as a guideline for determining if a particular manufactured home consumes sufficient energy to justify weatherization. It may also act as an indicator of unusual energy consumption in a particular manufactured home.

Figure 1-5 The "About" Screen

To calculate an energy use ratio, follow the steps listed below.

1. Enter the manufactured home length and width (in feet), the home addition length and width (in feet), and the annual energy use (in MBtu). The annual energy use may be an estimated value or you may choose to enter an actual use based on utility bill data.
2. Click on the Select a Weather Site button to pick a city near the location of the manufactured home. Refer to section 4.7, Choose a City, for more information on how to select a weather site.
3. Place a check in the Include Cooling Degree-Day check box if you want the energy use ratio to include both heating and cooling degree-days. If only heating degree-days are to be included in the energy use ratio, then leave the box blank or remove an existing check mark. See section 1.3, Navigating Through MHEA, for instructions on how to place and remove check marks.
4. After you have entered the required data on the Composite Energy Use Ratio Screen, select the Calculate button. MHEA will initiate the energy use ratio calculation. When the calculation is completed, the base 65 heating and cooling degree-days for the weather site you selected and the energy use ratio will appear near the bottom of the Composite Energy Use Ratio screen.
5. Select the Continue button located at the bottom of the Composite Energy Use Ratio screen to leave this screen and return to the About screen.
6. Select the Continue button located at the bottom of the About screen to leave this screen and continue working with the MHEA software.

Note A Composite Energy Use Ratio is an estimated value and should be used to identify homes with sufficient energy use to justify weatherization or as an indicator of unusual energy use conditions which may require special attention.

Note Each weatherization agency must determine what an appropriate energy use/square foot/heating degree-day ratio is to justify weatherization of the manufactured home.

Note Ratios calculated using the Estimate Energy User Ratio screen are not stored by MHEA and cannot be accessed for future reference.

welcome

Composite Energy Use Ratio
(Btu/square foot/degree-day)

Manufactured Home Addition

Length (ft.): 0.00 Length (ft.): 0.00

Width (ft.): 0.00 Width (ft.): 0.00

Annual Energy Use (MBtu): 0.0

Select Weather Site Location:

260

Calculate

Base 65 Heating Degree Days: 0

Base 65 Cooling Degree Days: 0

Energy Use Ratio: 0.00

Btu/sf/HDD

Note: A Composite Energy Use Ratio should only be used to identify homes with sufficient energy use to justify weatherization or a high ratio indicating unusual energy use conditions which may require special attention.

Ok Cancel

For Help press the RIGHT mouse button or F1. Audit File Name

Figure 1-6 The "Estimate Energy User Ratio" Screen

1.4.3 Quitting MHEA

To leave MHEA and return to MS-DOS®, you may use any of the commands listed below.

Method A

With your mouse, highlight the menu option **Quit** located at the top center of the screen and press the left mouse key.

If you made changes to the audit since you last saved the file, MHEA will ask if you would like to save those changes before quitting. Choose the **Okay** button to save the file and exit the program, or press the **Cancel** button to exit without saving. Choose the **Okay** or **Cancel** button by highlighting the button with your mouse and then pressing the left mouse button.

Method B

Simultaneously hold the **ALT** and **Q** keys on your computer.

If you made changes to the audit since you last saved the file, MHEA will ask if you would like to save those changes before quitting. Choose the **Okay** button by pressing **ALT** and **O** to save the file and exit the program, or press the **Cancel** button, by pressing **ALT** and **C**, to exit without saving.

Method C

With the left and right **ARROW** keys on your keyboard, highlight the menu option **Quit** located at the top center of your screen and press the **ENTER** key on your keyboard.

If you made changes to the audit since you last saved the file, MHEA will ask if you would like to save those changes before quitting. Using the **ARROW** keys on your keyboard, highlight the **Okay** button to save the file and exit the program, or the **Cancel** button to exit without saving then press the **ENTER** key on your keyboard.

Method D

Simultaneously hold the **SHIFT** key and one of the **ARROW** keys on your keyboard until you have highlighted the word **Quit** located in the top center of your screen then press the **ENTER** key on your keyboard.

If you made changes to the audit since you last saved the file, MHEA will ask if you would like to save those changes before quitting. Choose the **Okay** button to save the file and exit the program, or press the **Cancel** button to exit without saving. Do this by simultaneously holding the **SHIFT** and **ARROW** keys on your keyboard until the **Okay** or **Cancel** button in the question box is highlighted, then press the **ENTER** key on your keyboard.

Note The MHEA screen must be blank before you can quit the software, except for the border and the menu items listed along the top of the screen.

Refer to section 1.3, *Navigating Through MHEA*, for more information on how to move the cursor to highlight and pick items in MHEA.

1.4.4 Saving MHEA Project Files

You need to save your work. Computer memory is temporarily allocated when you create a new audit (see Section 3.1.1, New) in a subdirectory called "projects." To save an audit in your computer's permanent memory, select the Save/Copy submenu within the File menu and complete the submenu screen. As you update the audit, you will need to save the file for future use (see Section 3.1.3, Save/Copy Audit).

1.5 Understanding MHEA Screens

Understanding features incorporated into the screens and message boxes you see while working through MHEA will help you enter data and evaluate results more efficiently. A menu bar and a status bar appear on all screens. All screens and message boxes have buttons. Most have editable fields and check boxes, and some have scroll bars. You will learn about these features in this section (see Figure 1-7).

The screenshot shows the 'General Information' screen of the MHEA software. The window has a menu bar at the top with 'File', 'Input', 'Run', 'View', 'Quit', 'Setup', and 'Help'. The title bar says 'MHEA 2.89'. The screen is divided into several sections with input fields, checkboxes, and buttons. The 'Client Information' section includes fields for Client Name, Address, City, State, Zip Code, Audit Date, Auditor, and Job No. The 'Home Dimensions' section includes fields for Length, Width, and Interior Wall Height. The 'Outdoor Water Heater Closet' section has checkboxes for 'Yes' and 'No'. The 'Wind Shielding' section has checkboxes for 'Well Shielded', 'Normal', and 'Exposed'. The 'Other Costs' section includes fields for Health & Safety, Repair, and Miscellaneous costs, and a checkbox for 'Include Other Costs in SIR'. The 'Home Leakiness' section has checkboxes for 'Tight', 'Medium', and 'Loose'. The 'Blower Door Tests at 50 Pa' section includes fields for Pre-Duct Sealing and Post-Duct Sealing. At the bottom right are buttons for 'Okay', 'Cancel', and 'Defaults'. Arrows point from labels below to specific elements: 'Editable Field' points to the 'Client Name' field, 'Check Box' points to the 'No' checkbox under 'Outdoor Water Heater Closet', and 'Button' points to the 'Okay' button.

Editable Field Check Box Button

Figure 1-7A Typical MHEA Screen with Buttons, Editable Fields, and Check Boxes

Figure 1-7B Typical MHEA Screen with Scroll Bar

1.5.1 Menu Bar

The menu bar is located at the top of MHEA background screen (see Figure 1-8). It contains the following headings: The **File**, **Inputs**, **Run**, **View**, **Quit**, **Setup**, and **Help**. Each menu has a pull-down submenu list. You can view the submenus by selecting a menu heading using any of the methods described in Section 1.3, *Navigating Through MHEA*.

The menu bar is always visible while you are using MHEA. In order to select any of the menu items, you must first clear displayed screens or message boxes. To clear a screen or box, press the **Okay** or **Cancel** buttons.

MHEA version number is displayed at the far right of the menu bar.

Note Menu headings are often referred to as "main menu items" throughout this manual.

Figure 1-8 Typical MHEA Screen Showing Main Menu, Submenu, and Version Number

1.5.2 Buttons

Buttons are the gray boxes that contain a word or phrase. They look slightly taller than the screen. When you select the button, it appears as though you have pressed it into the screen.

Every screen or message box has an **Okay** button located either in the lower right corner or the lower center of the screen or message box (see Figure 1-9). Most screens and message boxes also have **Cancel** buttons at similar locations, and all the **Inputs** and **Setup** screens will have a **Default** button. Several other buttons you will see include **Reset Defaults**, **Add**, **Delete**, **Next**, **Previous**, and buttons specific to an individual screen.

Select the **Okay** button to accept the screen being displayed and continue working on other parts of MHEA. For example, after you have made changes to an input or a setup screen, select the **Okay** button to save the changes. When a warning message appears on the screen, select the **Okay** button after reading the message to accept the condition described in the message and return to MHEA. If you do not want to store information you revised while most recently viewing an input or setup screen or if you do not want to accept a condition described in a warning message, select the **Cancel** button. Finally, the **Default** button will change the inputs shown on the screen to those stored as MHEA default data. Refer to sections 1.6, *Interpreting MHEA Warning Messages*, and 1.3, *Navigating Through MHEA*, to learn more about warning messages and selecting buttons.

Figure 1-9 Typical MHEA Screen Showing Buttons

Help messages describing the function of each button are accessed by highlighting the button and pressing the right mouse key or the F1 key on your keyboard. Learn more about help messages by reading Chapter 2.0, Using On-Line Help.

1.5.3 Check Marks

You will find many screens have lists of options with a column containing square boxes for each option to the left of the list (see Figure 1-10). Select an option by placing a check mark in the square box next to the appropriate option. Place a check by highlighting one of the square boxes and pressing ENTER or using any of the keyboard selection methods described in Section 1.3, Navigating Through MHEA.

You may choose only one option in most option lists. You do not need to remove existing check marks before placing a new check mark. If you decide to select a different option than one that is checked, highlight and select the box next to the new option using any of the methods described in Section 1.3, Navigating Through MHEA.

There are two methods for handling the situation when you have accidentally placed a check mark in a list where you do not want to select any of the options and you cannot remove the check. The first is to ignore the mistake. The software compares data inputs to be sure that all data combinations make sense. If you accidentally place a check mark where it should not be, a message will

come onto the screen telling you about the mismatch and that the unintended checked option will be ignored during the calculations. The second method is to select the Defaults button in the lower right corner of the input screen. MHEA will erase everything you have entered on the screen and the screen returns to its original form. You may then reenter all information for the screen.

Figure 1-10 Typical MHEA Screen Showing Check Boxes

Several screens such as the Candidate Measures setup screen and Files to Print screen let you place multiple check marks and uncheck selected options. Place check marks as you do for all other screens using either the mouse or keyboard. Remove check marks on these screens by reselecting the item for which you want to remove the check mark.

1.5.4 Editable Fields

Editable fields are those locations in MHEA where you enter characters from the keyboard (see Figure 1-11). Usually these characters are numbers. Some fields may require letters or any other keyboard character. To enter a character, select the field using mouse or keyboard methods described in Section 1.3, Navigating Through MHEA. After you have entered the appropriate characters, the software will remember what you have typed when you move on to a new screen entry location.

Editable Fields

Figure 1-11 Typical MHEA Screen Showing Editable Fields

You may use edit controls from your keyboard to enter and revise information in the editable field. For example, you may use the delete key or backspace key to remove characters you wish to change. You may make changes before leaving the field for the first time, or you may return to the screen at a later time to correct characters that were previously entered.

Note You cannot use the ALT/Letter key method for accessing editable fields. Refer to Section 1.3, Navigating Through MHEA, for more information on other methods for moving the cursor using the mouse and keyboard controls.

1.5.5 Scroll Bars

Scroll bars appear on screens when they contain more information than can fit onto the one screen (see Figure 1-12). The scroll bar is located vertically along the right side of the screen. The easiest method for sliding the scroll bar up and down is to use the mouse. With the mouse, point the cursor to the light gray portion of the scroll bar. When you have pointed the cursor to a correct location, the light gray portion will become dark gray. While holding down the left mouse key, pull the now dark gray portion down (or push up). When you release the left mouse key, the screen will adjust to the new position.

Figure 1-12 Typical MHEA Screen Showing a Scroll Bar

You may also use the mouse to click onto either of the two down arrows at the bottom of the scroll bar or to the up arrows at the top of the scroll bar. Click onto the arrow with a line along the base to move to the beginning (up arrow) or the end (down arrow) of the screen. Click once on the arrow without the line along the base to move the screen up one line (up arrow) or down one line (down arrow). If you point the cursor to an arrow without a line along the base and hold the left mouse key, the screen will scroll up or down line-by-line until you release the left mouse key.

You can move through these extended screens by using the up and down arrows on your keyboard. Press and hold the up or down ARROW key on your keyboard until the screen has moved up or down the number of lines you wish it to move.

You may also move the text up or down one screen at a time by pressing the page up or page down keys on your keyboard.

1.5.6 Status Bar

The status bar is located at the bottom of the MHEA background screen (see Figure 1-13). The status bar indicates how to access help messages and shows the name of the audit file you are presently working in. The status bar is always visible while you are using MHEA.

Figure 1-13 Typical MHEA Screen Showing the Status Bar

1.6 Interpreting MHEA Warning Messages

MHEA may display warning messages (see Figure 1-14). These messages are not fatal. They simply request an action that you must complete before the software can continue operating.

These warning messages inform you of two things: 1) that you have entered a value that is either outside a typical range or is unacceptably large or small; and 2) that you have neglected to perform a function needed for proper operation of MHEA. Informing you that the value you entered is beyond a recommended or acceptable range is known as range checking. If the value is outside a typical range, MHEA will display a message asking if you would like to change the value. If you choose to leave the value as it was entered, select the Okay button on the message screen, otherwise select the Cancel button to change the value. On the other hand, if you have entered a value that is beyond an acceptable range, a message will appear instructing you to change the value. MHEA will not continue until you have entered an acceptable value.

The second type of warning messages, those that indicate you neglected to perform a function needed for proper operation of MHEA, explain what you need to do to continue using MHEA. For example, the messages may appear if you have not created or opened a project file before you tried to enter data or if you attempt to view results before you have run the calculations.

Figure 1-14 Typical MHEA Warning Message

1.7 Printing from MHEA

MHEA can send information to most printer types. It automatically identifies the printer that is connected to the computer you are using when you send a file (or files) to the printer. To print files, select the Print submenu item from the **File** submenu list. A screen titled Check Files to Print will appear (see Figure 1-15). Using your mouse, highlight the file name you wish to print and click the left mouse button to select the file. A check will appear in the column to the left of the file titles for the files you have selected to be printed. You may also select files using your up/down arrow keys to highlight a file name and pressing the ENTER key to place the check mark. You may select multiple files. To deselect a file, highlight the file name (with the mouse or the arrow keys) and click the left mouse button or press the ENTER key to remove the check mark. Finally, select the Okay button to activate the printer.

Figure 1-15 The "Check Files to Print" Screen

2.0 Using On-Line Help

Help messages are available throughout MHEA. These messages provide definitions of data input requirements, hints for locating input information, retrofit measure descriptions, suggested methods for installing retrofits, and other useful information. This chapter will cover how to access the help messages and to use the available help to the best of your advantage.

2.1 Where to Find Help

Help messages exist for every menu item, button, check box, and editable field in MHEA. You can read help messages at any time while you are working with the software. When you exit the help message screen, MHEA will return your cursor to the point where you called the message.

2.2 How to Access Help

This section discusses two methods for viewing help messages. Start MHEA on your computer and follow one of the two methods outlined in this section to practice accessing several help messages.

2.2.1 Accessing Help from MHEA User Screens

Display any MHEA screen to practice the procedure summarized in this section. It is recommended that you display an input screen because of the many help messages available for these screens.

1. Highlight the menu item, button, check box, or editable field for which you would like to read the corresponding help message. Move the cursor to the item in question by using the techniques described in Section 1.3, Navigating Through MHEA.
2. Press the right mouse key or the F1 key on the keyboard to display the help message.

NOTE If you attempt to access help without having an item highlighted, a general message titled "Help on Using MHEA" will appear.

2.2.2 Accessing Help from MHEA Help Menu

Follow the steps outlined in this section to access Help messages from within the **Help** menu item (see Figure 2-1).

1. MHEA **H**elp menu contains several submenus. To display the submenus, select the word **H**elp on the main menu bar (located at the far right of the main menu bar) using any of the cursor movement options described in Section 1.3, Navigating Through MHEA.
2. A list of **H**elp options will appear. These are **H**elp submenu items. To view help messages, select the first submenu, whose title is Help Topics.
3. A list of help message titles will appear. Scroll through this list until you have reached the message you wish to read (see Section 1.5.5, Scroll Bars).
4. Select the message you wish to read either by highlighting the message title with your mouse and pressing the left mouse key or by highlighting the title with the ARROW keys and pressing the ENTER key on your keyboard.

Figure 2-1 **H**elp Submenu Options

2.3 Understanding the Help Screen

All the help screens will all have the same screen format (see Figure 2-2). MHEA displays the message inside a dialog box. The title of the help message is displayed in the border at the top of the box. Inside the bottom border are buttons with the words Index, Back Up, Okay, <<Prev, and Next>>. Within the border along the right side of the box are Up and Down arrow buttons.

Figure 2-2 Typical MHEA Help Screen

Index

If you select the Index button, an alphabetical listing of help message titles will be displayed. Select a title either using your mouse or the keyboard (see Section 1.3, Navigating Through MHEA). You may use the scroll bar to view portions of the title list that will not fit into the screen (see Section 1.5.5, Scroll Bars). After you have selected a message title, you may view the message by selecting the Okay button on the Index screen. If you choose not to view a help message, select the Cancel button on the Index screen. MHEA will then return to the help message you were viewing when you selected the Index button.

Back-Up

Select the Back-Up button to view the help message that is stored immediately before the message that is currently on the screen. Each help message has an assigned storage location in MHEA. You may back through the messages as many times as you wish until you have reached the first message stored by MHEA. The message titled "Help on Using MHEA" (the message that is accessed by pressing the right mouse key or the F1 key when you have not highlighted an item for which to access help) is the first help message MHEA stores. Because there are no messages before this one, you will not be able to activate the Back-Up button when this first message is displayed.

Okay

When you have finished reading a message select the Okay button. You will return to the screen from which you called the help message.

<<Prev

This abbreviation means previous. Select the <<Prev button to view the help message stored immediately before the message currently on the screen. Each help message has an assigned storage location in MHEA. You may back through the messages as many times as you wish until you have reached the first message in MHEA help message storage.

Next>>

Select the Next>> button to view the help message stored immediately after the message that is currently on the screen. Each help message has an assigned storage location in MHEA. Move forward through the messages until you have reached the last message in MHEA help message storage.

Up/Down

If the help message is longer than can be shown on one screen, you may view the remaining portion of the message by selecting the Up and Down buttons. When selected, these buttons will move the message screen up or down by one page, where the portion of the message that you see on the screen is the same as one page. If the message will fit onto one screen, you will not be able to activate the Up and Down buttons.

Some help messages include a simple graphic to give further information than what is included in the text. These graphics will appear when the help message is displayed.

NOTE Select buttons either by highlighting them with your mouse and pressing the left mouse key or by using any of the keyboard cursor movements described in Section 1.3, Navigating Through MHEA.

2.4 How to Exit Help

All help message screens will have an Okay button at the bottom center of the screen (see Figure 2-3). Select this button to close the help message and return to the screen that you were viewing when you accessed help.

The Index submenu contains an alphabetized list of the MHEA help message. Use any of the cursor movement options described in Section 1.3, Navigating Through MHEA, to highlight and select the help message you would like to see. After reading the message, select Okay to return to the index screen. The list of message titles is longer than can fit onto one screen. Use the scroll bar on the right side of the screen to view the entire list. See Section 1.5.5, Scroll Bars, for information about using this feature.

2.5.1 Index

MHEA Help menu contains several submenus. To display the submenus, select the word **Help** on the main menu bar (located at the far right of the main menu bar) using any of the cursor movement options described in Section 1.3, Navigating Through MHEA. These **Help** menu options offer additional guidance for using MHEA and are especially useful to new MHEA users.

2.5 Other MHEA Help Options

Figure 2-3 Typical MHEA Help Screen Showing Location of the Okay Button

2.5.2 About

The "About" screen displays a brief description of MHEA software (see Figure 2-4).

Figure 2-4 The "About" Screen

You may access the About screen by selecting the About submenu option found within the **Help** main menu item. A description about the Instructions and Estimate features is given in Section 1.4.2, "The About Screen."

3.0 Performing an Audit

From this chapter, you will learn how to evaluate retrofit measures for a manufactured home using MHEA. You will become familiar with using the main menu items, submenu items, and input data screens, and viewing the results.

CD-RH07-A0342503

Figure 3-1 MHEA Flow Chart

3.1 Managing Project Files Using the File Menu

Use the submenu options available from within the **File** menu to create, open, copy, delete, and print project files (see Figure 3-2). This section describes how to use each of the **File** submenu items in order to manage your project files.

The MHEA **File** menu contains several submenus. To display the submenus, select the word **File** on the main menu bar (located at the far left of the top menu bar) using any of the cursor movement options described in Section 1.3, Navigating Through MHEA.

NOTE When you create a new project file, MHEA assigns space in the computer memory to store the data you enter (projects directory), the calculated results (results directory), and adjusted setup data. You will need to save the project file using the Save/Copy feature (Section 3.1.3).

NOTE You may create, open, save, close, copy, delete, or print project files at any time while you are working within MHEA. If you are entering data about one manufactured home and you decide to switch to another, simply return to the **File** menu and choose one of the submenu items. All information you entered in the project file you leave will need to be stored.

Figure 3-2 File Submenu Options

3.1.1 New

When you are ready to describe a manufactured home for the first time, you must identify a location in the computer memory to store information about this home. Follow the steps outlined in this section to create a new audit.

1. From the **File** submenu list, select New. Use any of the methods described in Section 1.3, Navigating Through MHEA, to select the submenu item.
2. A screen with the title "New Audit File" will appear (see Figure 3-3). Your cursor should automatically be in the editable field next to the title "Client Name." Enter the name of the client who lives in the manufactured home you are evaluating. The client name is not required. However, it is recommended that you enter a name so that you are able to more quickly recognize which home data is stored within the eight-character project file identifier (see step 4). The name you enter will automatically appear in the Client Name editable field on the "General Information" screen (accessed from within the **Inputs** menu).

Figure 3-3 The "New Audit File" Screen

3. Move your cursor to the other editable field shown on this screen using any of the methods described in Section 1.3, Navigating Through MHEA.
4. Enter a project file identifier that is eight or less characters long in the "File Name" field. The project file identifier will mark the computer memory storage location for all the project files.
5. When you are satisfied with the Client Name and the File Name, accept the information by selecting the Okay button located at the bottom left of the New Audit File screen. If you decide you do not want to create a new audit, select the Cancel button (located bottom right of the New Audit File screen). All information you have entered onto the New Audit File screen will be ignored if you select the Cancel button. After having selected the Okay or Cancel button, MHEA will return to a screen showing only the **File** submenu items.

NOTE You may edit both the House Description and the File Name before you select the Okay button. If you wish to change an audit file name, refer to Section 3.1.3, Save/Copy. You may change the client name from within the "General Information" screen (accessed from within the **Inputs** menu).

NOTE When you create a new project file, MHEA assigns space in the computer memory to store the data you enter (projects directory), the calculated results (results directory), and adjusted setup data. You will need to save the project file using the Save/Copy feature (Section 3.1.3).

3.1.2 Open

After you have created a project file, you may return at a later time to make changes, review or rerun the calculations, or print file information. The three steps below summarize how to open an existing project file using the Open submenu item.

1. From the **File** submenu option list, select Open. Use any of the methods described in Section 1.3, Navigating Through MHEA, to select the submenu item.
2. A screen with the title "Select Audit File" will appear (see Figure 3-4). This screen contains a list of existing project files. Scroll through the project files until you have highlighted the one you wish to open. Select this project file by pressing ENTER so that it also appears in the narrow box near the top of the Select Audit File screen. Refer to Section 1.5.5, Scroll Bars, for more information on how to scroll through the project file list.

Figure 3-4 The "Select Audit File" Screen

3. Select the Okay button (located at the bottom center of the "Select Audit File" screen) to open the project file. If you decide you do not wish to open a project file, select the Cancel button (located at the bottom center of the "Select Audit File" screen). After having selected the Okay or Cancel buttons, MHEA will return to a screen showing only the **File** submenu items.

NOTE When you open and make changes to an existing project file, all the new information is not stored as you enter the data. You will need to store the file using the Save/Copy feature (Section 3.1.3).

3.1.3 Save/Copy

The Save/Copy submenu option permits you to save a project file or copy one with a new name. You will need to use this feature to save any changes that you may have made to your audit.

You may find the Save with New Name option especially useful if you have two manufactured homes that are nearly identical. After having entered data about the first home, copy the project file to a new name, open the new file using the Open submenu, and make the necessary changes to reflect the characteristics of the second home.

Follow the five-step procedure below to save or copy a project file.

1. Open a project file using the Open submenu option described in Section 3.1.2. MHEA saves the project file you have open when you select the Save/Copy submenu.
2. From the **File** submenu option list, select Save/Copy. Use any of the methods described in Section 1.3, Navigating Through MHEA, to select the submenu item.
3. A screen with the title "Save or Save with New Name" will appear (see Figure 3-5). Your cursor should automatically be in the editable field next to the title "File Name." Enter a project file identifier that is eight or less characters long. The "Directory" portion of the screen will display the directory to which you are saving the file ("projects\" is the default directory).
4. If you wish to overwrite an existing file with the same file name, place a check mark in the Yes box in the "Overwrite OK?" portion of the screen. If you do not wish to overwrite the existing file, check the No box. If you checked No, then enter a new file name in the "File Name" field.
5. Select the Okay button (located at the bottom center of the "Save/Copy" screen) to save the project file. If you decide you do not wish to save the project file, select the Cancel button. After having selected the Okay or Cancel button, MHEA will return to a screen showing only the **File** submenu items.

WARNING Remember to open the copied project file name before you begin to make changes (see Section 3.1.2, Open). If you do not open the new project file, you may accidentally make changes to the original project file. The project file name that you have opened is displayed at the bottom of your computer screen in the status bar (see Section 1.5.6, Status Bar). Check that you are working in the correct project file before you begin to make revisions.

NOTE You may change the client name by revising the name on the "General Information" screen (found within the **Inputs** menu). The new name will be saved with the copied project file name when you save the revised audit.

Figure 3-5 The “Save or Save with New Name” Screen

3.1.4 Close

If you wish to close the audit that is currently open, select the Close submenu option in the **File** menu. If you have not saved your audit since you last made changes, MHEA will suggest that you do so. Choose **Okay** to close the audit without saving it, or select the **Cancel** button to ignore.

3.1.5 Delete

If you decide you no longer want to store information about a particular manufactured home, you can remove the information from your computer’s memory by using the Delete submenu option. Delete project files by following the four steps below.

1. From the **File** submenu option list, select Delete. Use any of the methods described in Section 1.3, Navigating Through MHEA, to select the submenu item.
2. The “Check Files to Erase” screen will appear (see Figure 3-6). This screen contains a list of existing project files. Scroll through the project files until you have highlighted the files you wish to delete. Select these project files so that a check mark appears next to the files that you wish to delete.

Figure 3-6 The “Delete” Screen

3. Select the Okay button to delete the project files. If you decide you do not want to delete the project files, select the Cancel button. After having selected the Okay or Cancel button, MHEA will return to a screen showing only the **File** submenu items.

WARNING Be sure you no longer need the audit information before you decide to delete the project file. When you delete an audit, you have permanently removed the project file from the computer memory.

3.1.6 Printer Setup

MHEA automatically identifies the printer to which your computer is attached. You do not need to identify a new printer if you change printers.

3.1.7 Print

You may print results, comments, and input summaries from the Print submenu. When you select this submenu, a list of the items you may print appears. Scroll through this list, place a check mark next to the screens you want to print (see Section 1.5.5, Scroll Bars, and Section 1.3, Navigating Through MHEA), and select the Okay button to print.

3.1.8 DOS Shell

In order to go to a DOS screen while in MHEA, select the DOS Shell option in the **File** menu. This option will allow you to be in a DOS shell while still running the MHEA software. When you wish to return to the program, type **exit**.

NOTE Be sure that you are in the "c:\mhea\" directory when you type **exit** to return to the program.

3.2 Enter Input Data Using the Inputs Menu

All data describing the manufactured home construction, heating equipment, and cooling equipment are entered on the description screens contained in the **Inputs** menu (see Figure 3-7). You may access the description screens by opening the **Inputs** menu (second menu heading from the left on the top menu bar) to display all submenu items. Select submenu items to view the description input screens.

Submenu items are described individually in this section of the manual in the order that they appear.

Figure 3-7 **Inputs** Submenu Options

3.2.1 General Information

Enter miscellaneous home data on the "General Information" screen (see Figure 3-8). The screen displays record-keeping information about the individual manufactured

home as well as information related to several of the construction description screens described in Section 3.2.2, Construction. Record-keeping information is not required to successfully run MHEA. Required inputs on the "General Information" screen are the home dimensions, water heater closet location, wind shielding, and either the home leakiness or the blower door test results.

Figure 3-8 The "General Information" Screen

Client Name

The client name will automatically be forwarded from the "New Audit File" screen (found within the **File** submenu). If you did not enter a client name on the New Audit File screen or if you wish to change the client name, you may do so by entering a new name in the client name editable field on the General Information screen. The new name will appear next to the eight-character audit file name that is listed when you select the Open or Delete screens found within the **File** submenu. The client name will also appear on the results screens.

Client Address

Enter the address of the manufactured home. The client address entry is optional. It is not needed for the calculations but is available to help with your record keeping. The client address will appear on the results screens.

City, State

Enter the city and state where the manufactured home is located. The city and state entry is optional. It is not needed for the calculations but is available to help

with your record keeping. The city and state entry will appear on the results screens.

Zip Code

Enter the postal zip code where the manufactured home you are evaluating is located. The zip code entry is optional. It is not needed for the calculations but is available to help with your record keeping. The zip code will appear on the results screens.

Audit Date

The date you create the audit file will automatically appear in the Audit Date editable field. You may change this date by selecting this editable field with your mouse or keyboard cursor movements and typing in the new date. The audit date entry is optional. It is not needed for the calculations but is available to help with your record keeping. The audit date will appear on the results screens.

Auditor

Enter an identification of the person who performed the evaluation of the manufactured home. The auditor entry is optional. It is not needed for the calculations but is available to help with your record keeping. The auditor will appear on the results screens.

Job No.

Enter the job identification number assigned to the audit according to your record-keeping system. The job number entry is optional. It is not needed for the calculations but is available to help with your record keeping. The job number will appear on the results screens.

Length (ft)

Enter the length of the home in feet (see Figure 3-9). Manufactured home lengths are typically in the range of 40 feet to 80 feet. The home length is the length of the living space. Do not include the length of the towing tongue that extends out from one end of the manufactured home.

Width#(ft)

Enter the width of the home in feet (see Figure 3-9). Manufactured home widths are typically in the range of 12 feet to 30 feet.

Interior Wall Height (ft)

Enter in feet the height of the home as measured from the floor to the ceiling in the interior of the home (see Figure 3-9). Measurements should be taken along an exterior wall of the home. The interior height of manufactured homes is typically 7 feet.

Occasionally, a manufactured home will have a change in ceiling height or floor level. If there is a cathedral ceiling, enter the interior wall height at the low section of the cathedral ceiling as though the ceiling was flat. MHEA will calculate the additional wall area resulting from the cathedral ceiling based on

information provided on the "Roof/Ceiling" screen (see Section 3.2.2.5). If there is a step in the floor level and there is not a corresponding step in the flat-ceiling height, enter the average interior wall height for the home. Also, enter the average interior wall height if the flat ceiling has a step height change but not a corresponding change in the floor level.

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Figure 3-9 Manufactured home Dimensions

Outdoor Water Heater Closet

Indicate whether or not the water heater is housed in an unconditioned closet with an exterior access. If an outdoor closet exists, the calculations will not include it in the conditioned portion of the home. The wall, floor, and ceiling areas of the home are adjusted to account for a "30 X 30" inch water heater closet.

Wind Shielding

Place a check next to the option that best describes how well the manufactured home is shielded. A correction factor is included in the infiltration calculation for the relative amount of external wind shielding. A well-shielded home may be surrounded by thick vegetation, in a small valley that seldom experiences windy conditions, or closely surrounded by other homes and buildings. A normally shielded home may be one that is found in a typical manufactured home housing park where there are surrounding homes and some surrounding vegetation. An exposed home has no surrounding vegetation or buildings to protect it from the wind.

Health & Safety (\$)

Enter health and safety expenses that must be included with the overall weatherization retrofit cost. If the additional costs are to be applied to individual retrofit measures, adjust the material, labor, and other costs for the retrofit measures under the Measure Costs option within the **Setup** main menu item (see Section 4.1, Update Measure Costs).

NOTE It is the responsibility of the weatherization agency conducting the audit to determine what the health and safety issues are. MHEA is a tool to help determine cost-effective weatherization retrofit measures. It cannot indicate health and safety concerns.

Repair (\$)

Enter repair costs that must be included with the overall weatherization retrofit cost. If the additional costs are to be applied to individual retrofit measures, adjust the material, labor, and other costs for the retrofit measures under the Measure Costs option within the **Setup** main menu item (see Section 4.1, Update Measure Costs).

Miscellaneous (\$)

Enter the various expenses that cannot be classified as health and safety or repair expenses. If the additional costs are to be applied to individual retrofit measures, adjust the material, labor, and other costs for the retrofit measures under the Measure Costs option within the **Setup** main menu item (see Section 4.1, Update Measure Costs).

Include Other Costs in SIR

Place a check next to the Include Other Costs in the savings-to-investment ratio (SIR) check box if you want all “Other Costs” to be included in the retrofit savings-to-investment ratio calculations. If the box is not checked, “Other Costs” will appear in the cost results summary but not be applied to the cumulative cost of the retrofit package.

NOTE If “Other Costs” are significant and included in the SIR calculations, they may have the effect of eliminating some measures from consideration due to a high fixed cost to implement a package of measures.

Home Leakiness

If you are unable to conduct a blower door test of the home, you can check an approximation of the home leakiness. A tight home will show no evidence of air movement around windows, doors, wall sockets, and other wall, ceiling, and floor penetrations. A medium-tight home will show some evidence of air movement around these penetrations. Finally, a loose home will have dust around windows and floor, wall, and ceiling penetrations. MHEA assumption for tight-, medium-, and loose-home infiltration rates may be adjusted using the Defaults submenu within the main menu item **Setup** (see Section 4.5.2, Default Parameters).

NOTE It is highly recommended that a blower door test be conducted on all homes. Visual approximations of home leakage could result in inaccurate program calculations. Blower door tests will also ensure that the home infiltration rate is not below the minimum rate recommended for occupant safety.

Pre-Duct Sealing (cfm)

Enter the single-point blower door test value at 50 Pa of pressure measured before duct sealing or other infiltration reduction efforts have been completed. This value will be used to calculate the effect of infiltration on the energy usage of the manufactured home. The pre-duct-sealing input is required only if you have not checked a home leakiness option.

Post-Duct Sealing (cfm)

Enter the single-point blower door test value at 50 Pa of pressure measured after completing duct sealing or other infiltration reduction efforts. This value will be used to calculate the effect of infiltration on the energy usage of the manufactured home. The post-duct-sealing input is not required. However, MHEA will more accurately estimate the energy savings associated with the duct-sealing retrofit if a blower door test value is entered.

3.2.2 Construction

Enter construction characteristics of the manufactured home on the description screens available within the Construction submenu. Each screen represents a different section of the manufactured home.

NOTE You may open the manufactured home construction description screens in any order to enter information about the home. You do not necessarily need to start with the screen that is listed first and move down sequentially. It is recommended that you complete the screens in a logical order so that you do not overlook any screens. The software calculations will run only if all construction description screens are completed. If you have neglected to complete a required construction description screen before you try to run MHEA calculations, a warning message will appear asking you to enter the missing information before continuing with the calculations.

3.2.2.1 Floor

The "Floor" input screen contains information about the manufactured home floor/belly section (see Figure 3-10). The screen is divided into four sections. These sections are general floor information, floor wing description, floor belly (center) description, and general belly information (see Figure 3-11).

Floor Joist Direction

The floor joist is the wood framing that supports the interior floor. Enter the direction the floor joists are installed. Lengthwise floor joists are installed parallel to the long dimension (length) of the home (see Figure 3-12). Widthwise

floor joists are installed parallel to the short dimension (width) of the home. The floor joist direction is needed to calculate more accurately the volume of the belly section, and indicates where a central air supply duct is located (between joists or below joists), and to calculate more accurately the insulating value (R-value) of the floor.

Figure 3-10 The "Floor" Screen

Figure 3-11 Section of a Typical Manufactured home Floor

CD-RH07-A0342507

Lengthwise floor joists

Widthwise floor joists

CD-RH06-A0342508

Figure 3-12 Lengthwise and Widthwise Floor Joists

Batt/Blanket Direction

Indicate if batt/blanket insulation exists and if it does exist, the direction in which it is installed. Batt/blanket insulation that has been installed lengthwise is parallel to the long dimension (length) of the home. Insulation that has been installed widthwise is parallel to the short dimension (width) of the home. The insulation direction is needed to calculate more accurately the R-value of existing batt/blanket insulation that is attached to the flooring or floor joist. Place a check next to the option indicating the insulation location as the Batt/Blanket Insulation Location input on "Floor" input screen.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Skirt

Indicate whether or not a skirt exists around the exterior of the home. Research has shown that skirting only protects the manufactured home belly from exposure to the wind. If skirting exists, MHEA adjusts the exterior R-value to account for the absence of wind when the total R-value of the floor/belly section is calculated.

Floor Joist Size

The floor joist is the wood framing that supports the interior floor. Manufactured homes are typically constructed using standard wood framing. Sometimes, the floor joist size is different in the wing section than in the belly (center) section. Indicate the dimensions of the floor joists in both the wing and belly sections. MHEA needs this information to calculate the floor R-value and the volume of the floor/belly section.

NOTE The nominal dimensions (those dimensions you measure with your tape measure) are less than the standard dimensions listed. For example, a 2" x 4" board will actually have the dimensions of 1-3/4" x 3-1/2". The options listed in MHEA are the standard dimensions used by the U.S. lumber industry.

Insulation Type/Thickness

Enter the amount of existing batt/blanket and loose-fill insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist. Occasionally, the insulation existing in the wing section is different than that located in the belly section. Enter the amount of existing insulation for both sections.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers of either glass or cellulose blown into the floor section of the home. MHEA uses the existing insulation thickness to calculate the floor/belly R-value and to calculate the volume in the floor/belly section that is available for additional insulation.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Batt/Blanket Insulation Location

Indicate where the batt/blanket insulation is located in the floor/belly section (see Figure 3-13). If the batt/blanket insulation is attached to the underside of the flooring, then check the attached to flooring entry. If the insulation is attached to the underside of the floor joists, then check the attached to floor joist entry. Finally, insulation that is draped below the underside of the floor joists (only attached around the perimeter of the belly section) is described as draped below floor joist in MHEA. Enter the batt/blanket insulation location for both the wing and belly sections.

Insulation Attached to Flooring

Insulation Attached to Floor Joists

Insulation Draped Below Floor Joist
(Belly Section Only)

CD-RH06-A0342510

Figure 3-13 Batt/Blanket Insulation Location

MHEA assumes that insulation in the wing section will either be attached to the underside of the flooring or will be attached to the underside of the floor joists (where the belly wrap is stapled to the floor joists). The draped below floor joist option is only available for the belly description.

NOTE If you indicated that no batt/blanket insulation exists (entry at center top of "Floor screen"), then MHEA will not permit you to enter a batt/blanket insulation location.

NOTE MHEA assumes that all loose insulation is located at the bottom of the floor/belly section and that it is sitting on top of the belly wrap.

Condition of Belly

From your observation, enter the condition of the existing belly wrap. A belly wrap in good condition does not have any tears, holes, or other opening in the belly wrap and is tightly attached around the entire perimeter of the home. An average belly wrap condition has some small tears, holes, or other openings in the belly wrap or may not be well attached to the perimeter of the home. A belly wrap with large tears, holes, or other openings or is not well attached to the home perimeter is in poor condition. MHEA needs the belly wrap condition to calculate the effectiveness of existing insulation in the floor/belly section and to slightly adjust the cost of installing floor/belly section retrofit measures.

Belly Cavity Configuration

Enter the configuration of the belly center cavity (see Figure 3-14). Manufactured home belly cavities are described as being square, rounded, or flat. The belly cavity is the deep section that runs the length of the home and usually houses the main supply air duct. A square cavity configuration has vertical sides and a horizontal base. (Usually, the main iron support beams act as the vertical sides.) For a rounded belly cavity configuration, the belly wrap is draped in the middle portion of the home. Usually, the wrap is draped between the main iron support beams of the home. A flat belly cavity configuration is one in which there is no center belly section lower than the belly wing section. This type of belly is often found on homes where the main air supply duct is located between lengthwise floor joists or where the main supply air duct is located in the roof section.

Maximum Depth of Belly Cavity (in.)

Enter the maximum depth of the belly (in inches) as measured from the underside of the flooring to the lowest part of the belly. MHEA uses this input to calculate the volume of the floor/belly section to determine how much insulation can be added as a floor/belly retrofit measure.

CD-RH06-A0342509

Figure 3-14 Typical Manufactured home Belly Configurations

3.2.2.2 Wall

The "Wall" input screen contains information about the manufactured home wall section (see Figure 3-15).

Wall Stud Size

The wall stud is the wood framing between the interior and exterior manufactured home walls. Manufactured homes are typically constructed using standard wood framing. MHEA needs this information to calculate the wall R-value and the volume of the wall section.

Figure 3-15 The “Wall” Screen

NOTE The nominal dimensions (those dimensions you measure with your tape measure) are less than the standard dimensions listed. For example, a 2” x 4” board will actually have the dimensions of 1-3/4” x 3-1/2”. The options listed in MHEA are the standard dimensions used by the U.S. lumber industry.

Insulation Type Thickness

Enter the amount of existing insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers, made either of glass or cellulose, blown into the wall section of the home. Foam core insulation may also exist in the wall section. This type of insulation is a rigid foam typically 1/4” thick found either between the wall studs and the interior wall or the wall studs and the exterior wall. MHEA uses the existing insulation thickness to calculate the wall R-value and to calculate the volume in the wall section that is available for additional insulation.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Orientation of One Long Wall of Home

The orientation of one long wall is the direction one wall faces. Indicate this orientation by checking the north, south, east, or west orientation box. MHEA can determine the directions other walls face from just one input. The home orientation is needed to calculate solar loads on the home.

Wall Ventilation

A manufactured home wall may be intentionally or unintentionally ventilated. A ventilated wall has a space for air to flow between the exterior and interior wall materials. One technique to determine if a wall is ventilated is to check if the wall insulation is dirty inside the wall cavity. Pull up slightly on the lower end of an exterior wall panel to check for dirty insulation. If a wall is ventilated, the insulation will be dirty. MHEA degrades the wall R-value for ventilated walls. A correction factor is incorporated to account for this degradation.

Carport/Porch Roof Dimensions

A carport/porch roof is a shelter that has no walls and extends out from one wall of the manufactured home (see Figure 3-16). Often, the home occupant will park a car under this shelter or use it to shade an outdoor sitting area. Indicate the length (in feet) and width (in feet) of this carport/porch roof. The roof length is the dimension parallel to the manufactured home. If no carport/porch roof exists, then enter a length and width of zero feet. Because a carport/porch roof shades one manufactured home wall, the size and orientation are needed in the home solar gains calculations.

CD-RH08-A0342511

Figure 3-16 Carport/Porch Roof Dimensions

Carport/Porch Roof Orientation

The orientation of the carport/porch roof is the side of the manufactured home to which the roof is attached. Indicate this orientation by checking the north, south, east, or west orientation box. Because a carport/porch roof shades one manufactured home wall, the size and orientation are needed in the home solar gains calculations.

3.2.2.3 Window

Describe window types, sizes, shading, and orientation on the "Window" input screens (see Figure 3-17). You may enter information about several different windows by using the Edit buttons, located at the top right of the "Window" input screen. The description you are viewing and the total number of descriptions you have entered are displayed at the top left of the "Window" input screen.

Edit Buttons

You may enter information about several window types by using the Edit buttons located at the top right corner of the screen. Only one window type may be described on a screen. If there are windows of different sizes, shading, glazing, or description, you must enter data about those windows on other screens.

Add

Select the Add button to create additional window descriptions. The add feature is useful for describing several window types and sizes. For example, if both jalousie and awning windows exist in a home, enter data about these windows on two or more description screens.

Delete

To delete a window description, select the Delete button while the description is displayed on the screen.

WARNING The window description that is currently displayed will be removed from the computer memory when you select the Delete button. Be careful that you are deleting the correct description.

View Buttons

You can view window description screens by selecting View buttons. You can find this feature useful if you have entered more than one window description and you want to move between these descriptions. Changes can be made to the window description screens you have accessed from the View buttons.

Next

Select the Next button to move through the screen descriptions in ascending order. For example, if screen 1 of 3 descriptions is displayed and you click the Next button, screen 2 of 3 descriptions will appear.

Previous

Select the Previous button to move through the screen descriptions in descending order. For example, if screen 2 of 3 descriptions is displayed and you click the Previous button, screen 1 of 3 descriptions will appear.

Figure 3-17 The "Window" Screen

Description

The window description is the type of window found in the manufactured home (see Figure 3-18).

Window Type

Jalousie windows are constructed of several horizontal panes (about 6 inches wide) that all open at the same angle when a crank near the bottom of the window is turned. Jalousie windows are always single pane. Often, very large gaps between the glass panes exits resulting in high infiltration rates through the window.

Awning windows are hinged at the top or side of the window so that when opened (usually by turning a crank), the glass angles out from the home exterior. The glass either angles down or to the side, depending on where the window is hinged to the home.

Slider windows usually have two panes of glass and either one or both panes slide past the other when the window is opened. Both horizontal and vertical slider windows are found in manufactured homes.

Fixed windows are sealed in the window frame and cannot be opened.

Door windows are sealed in the window frame of a door and cannot be opened.

Jalousie

Awning

Vertical Slider

CD-RH08-A0342512

Horizontal Slider

Skylight

Fixed

Door

Sliding Glass Door

Figure 3-18 Typical Manufactured home Window Types

Sliding glass doors are large windows that extend to the floor of the home and can be opened to enter or exit the home.

Skylights are glass or plastic windows in the ceiling of the home.

Glazing Type

Window glazing is the type and number of glass or plastic panes that make up a window.

Single-glazed windows have one plate of glass in the window frame.

Double-glazed windows have two plates of glass in the window frame.

Single-glazed windows with a glass storm window have a single pane of window glass with a second (usually removable) single pane of glass installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window.

Double-glazed windows with a glass storm window are two panes of window glass with an additional (usually removable) single pane of glass installed at the one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window.

Single-glazed windows with a plastic storm window have a single pane of window glass with a second (usually removable) single pane or sheet of plastic installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window. Plastic storm window panes are rigid plastic panes held in a plastic, metal, or vinyl frame. Plastic storm window sheets are flexible plastic sheets held onto the window either with magnets around the outer edge of the plastic sheets or by a frame securely attached to the window frame.

Double-glazed windows with a plastic storm window are two panes of window glass with an additional (usually removable) single pane or sheet of plastic installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window. Plastic storm window panes are rigid plastic panes held in a plastic, metal, or vinyl frame. Plastic storm window sheets are flexible plastic sheets held onto the window either with magnets around the outer edge of the plastic sheets or by a frame securely attached to the window frame.

NOTE If the existing storm window is on the exterior side of the window, the window should be considered as not having a storm window. Typical manufactured home construction includes very leaky windows. The main benefit of storm windows is to prevent outside air from entering the home around the window frame. Storm windows installed on the exterior side of the window usually do not prevent air from leaking around a manufactured home window frame.

Dimensions

Enter in inches the length and height of the window you are describing.

Interior Shading

Interior shading affects both the insulating value of the window/window shading combination as well as the solar loads on the home. Interior shading devices are interior window coverings that prevent sunlight from entering the manufactured home. Drapes are heavy curtains that hang in loose folds over the window. Blinds or shades are lightweight window coverings that hang flat over the window. Both venetian blinds and roller shades are in this category. Indicate drapes with shades if the occupant has both on the window. Interior shading devices affect the amount of heat that is gained or lost through the manufactured home windows. They also slightly affect the window insulating value (U-value).

NOTE Indicate that interior shading exists only if the devices are used most of the time. If the occupant usually has the shading devices pulled away from the window, indicate that no interior shading exists.

Exterior Shading

Exterior shading devices are methods of shading a window from the outside of the home. The solar load on the home is reduced because of exterior shading devices. Low-E film is a reflective film applied to the exterior surface of glass window panes by the window manufacturer. A sun screen is a mesh screen that is installed or hung on the exterior side of a window. An awning is a device that is mounted above a window and extends out from the exterior of the home. It is usually constructed of aluminum, fiberglass, or fabric. A carport/porch roof is a shelter that has no walls and extends out from one wall of the manufactured home (see Figure 3-16). Often, the home occupant will park a car under this shelter or use it to shade an outdoor sitting area. Indicate which of these exterior shading devices exist. If there is no exterior window shading, check the None box.

Number of Windows for Each Orientation

Indicate the number of windows on each wall of the manufactured home that fit the description shown on each description screen. For example, if several windows were located on each of the manufactured home walls, your screen would look like Figure 3-17.

WARNING Do not enter information about windows on the portion of a wall shared with an addition. MHEA assumes all window descriptions are exposed to the outside. The portion of a wall shared with an addition is not exposed to the outside. If you describe a window on such a wall, MHEA will incorrectly include the window in the solar gains and wall R-value calculations.

Describe door types, sizes, and orientation on the "Door" input screens (see Figure 3-19). You may enter information about several different doors by using the Edit buttons, located at the top right of the "Door" input screen. The number of the description you are viewing and the total number of descriptions you have entered is displayed at the top left of the Door input screen.

Figure 3-19 The "Door" Screen

Edit Buttons

You may enter information about several door types by using the Edit buttons located at the top right corner of the screen. Only one door type may be described on a screen. If there are doors of different sizes or description, you must enter data about those doors on other screens.

Add

Select the Add button to create additional door descriptions. The add feature is useful for describing several door types and sizes. For example, if both wood and vinyl doors exist in a home, enter data about these doors on two or more description screens.

Delete

To delete a door description, select the Delete button while the description is displayed on the screen.

WARNING The door description currently displayed will be removed from the computer memory when you select the Delete button. Be careful that you delete the correct description.

View Buttons

You may view door description screens by selecting View buttons. You may find this feature useful if you have entered more than one door description and you wish to move between these descriptions. Changes may be made to the door description screens you have accessed from the View buttons.

Next

Select the Next button to move through the screen descriptions in ascending order. For example, if screen 1 of 3 descriptions is displayed and you click the Next button, screen 2 of 3 descriptions will appear.

Previous

Select the Previous button to move through the screen descriptions in descending order. For example, if screen 2 of 3 descriptions is displayed and you click the Previous button, screen 1 of 3 descriptions will appear.

Description

The door description identifies the type of door found in the manufactured home.

Wood, hollow-core doors are constructed of two lightweight panels of wood separated by a cardboard core.

Wood, solid-core doors are constructed of a solid piece of wood.

Standard manufactured home doors are constructed of a metal, vinyl, or fiberglass skin with a solid insulating core (such as polyurethane). Most manufactured home doors are this type.

Storm Door

A storm door is a lightweight door installed outside of the manufactured home door. It is usually constructed of aluminum with a large portion of the door holding a screen, glass, or plastic window. Storm doors have very little impact on the energy consumption of a manufactured home other than to improve the insulating value (R-value) of the manufactured home door slightly. Indicate whether or not a storm door exists.

Dimensions

Enter in inches the length and width of the door you are describing.

Number of Doors for Each Orientation

Indicate the number of doors on each wall of the manufactured home that fit the description shown on each description screen. For example, if a wall had two standard manufactured home doors on the south wall, your screen would look like Figure 3-19.

WARNING Do not enter information about doors on the portion of a wall shared with an addition. MHEA assumes all door descriptions are exposed to the outside. The portion of a wall shared with an addition is not exposed to the outside. If you describe a door on such a wall, MHEA will incorrectly include the door in the solar gains and wall R-value calculations.

3.2.2.5 Ceiling

Enter information describing the roof/ceiling section of the manufactured home on the "Roof Ceiling" screen (see Figure 3-20).

Roof Type

Based on the roof type you indicate, MHEA can calculate the volume of the roof/ceiling section (see Figure 3-21). All information for roof construction for each type is contained within MHEA calculations.

Flat roofs have an interior surface (interior ceiling) and an exterior surface (exterior roof) attached directly to either side of the wood framing, similar to wall construction. MHEA assumes the ceiling and roof are separated by 2" x 6" framing.

Figure 3-20 The "Roof/Ceiling" Screen

Flat Roof

Bowstring Roof

Pitched Roof

Figure 3-21 Typical Manufactured home Roof Configurations

Bowstring roofs have a lightweight exterior roofing material (usually aluminum) that is stretched over the roof frame structure. The roof has a slight curve with the highest point in the middle of the home width. MHEA uses the home width and assumes a bowstring roof is 8 inches high at the center to calculate the volume of a bowstring roof section.

Pitched roofs are sloped to a higher peak point. When viewing the home width from the outdoors, the roof line creates a triangle. Pitched roofs are also often shingled, unlike flat and bowstring roofs. MHEA uses the width of the home and the assumed value for the roof pitch to calculate the volume of a pitched roof section.

NOTE In some cases, there will be a second roof constructed over the original manufactured home roof. Enter construction information describing the original manufactured home roof since it is under this roof that insulation may be added. Enter the roof color of the second exterior roof.

Insulation Type Thickness

Enter the amount of existing batt/blanket, loose fill, and rigid insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers of either glass or cellulose that are blown into the roof/ceiling section of the home. Rigid insulation is a foam insulation typically a few inches thick found either directly under the roofing material or directly above the ceiling surface. MHEA uses the existing insulation thickness to calculate the roof/ceiling section R-value and to calculate the volume in the roof/ceiling section that is available for additional insulation.

WARNING Be careful to enter the correct insulation thickness if the insulation thickness is greater than the roof/ceiling section height (i.e., the thickness of the insulation if it were not compressed into the ceiling/roof section). Compressed insulation has a changing R-value depending on how much it is compressed. The noncompressed thickness should be entered so that MHEA can calculate the correct R-value.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Roof Color

The color of the roof affects how solar energy impacts the heating and cooling loads of the home. A light/reflective roof appears white or light gray and a dark roof is black, dark brown, or other dark color.

Percent Cathedral Ceiling

Enter the approximate floor area that is below an elevated portion of the ceiling (cathedral ceiling). For example, if a cathedral ceiling is above the living room and the living room floor area is about one third the total home floor area, the percent cathedral ceiling is about 33%.

Orientation of Cathedral Ceiling Step Wall

Some manufactured home ceilings slope up to the top of a short wall (see Figure 3-22). This short wall then steps vertically down to the average home height. This configuration is known as a cathedral ceiling with a step wall. Enter the orientation that the step wall faces if one exists. If the ceiling configuration is not a cathedral ceiling with a step wall, then check the box next to the No Step Wall entry.

Figure 3-22 Manufactured home Cathedral Ceiling Step Wall

3.2.3 Equipment

Enter information about the manufactured home heating and cooling equipment on the description screens available within the Equipment submenu. Each screen asks for data about the manufactured home primary and secondary heating and cooling equipment.

NOTE You may open the manufactured home equipment description screens in any order to enter information about the home. You do not necessarily need to start with the first screen listed and move down sequentially. It is recommended that you do complete the screens in a logical order so that you do not overlook any screens. The software calculations will run only if all equipment description screens have at a minimum been opened and accepted with the **Okay** button.

3.2.3.1 Heating

Describe the equipment used to heat the manufactured home on the heating equipment description screens. Some homes have more than one heating system. The occupants may add a second heating system because the primary system is unable to satisfactorily heat the home. Describe the primary heating system on the screen that appears when you select the Heating submenu item (see Figure 3-23), and describe the secondary heating system on the screen you access by selecting the

Secondary Equipment button found on the "Primary Heating Equipment" input screen.

Figure 3-23 The "Primary Heating Equipment" Screen

NOTE Enter information on the "Primary Heating Equipment" screen, describing the heating system that will become the primary heating system after weatherizing the manufactured home. In some cases, this primary system may supply only a small portion of the needed heat before weatherization has been completed.

NOTE If the existing furnace condition is such that products of combustion are allowed to enter the home, the situation is a health and safety issue that must be resolved before weatherization retrofit measures are installed into the home. After weatherizing, it is recommended to again test for combustion products in the living space.

NOTE If an operating, standard manufactured home central heating system exists but is unable to satisfactorily heat the home, check that the duct system is sealed and that the furnace is operating correctly.

Heating Equipment Type

Indicate the home heating equipment type. Usually, the heating equipment type is listed on the heating equipment nameplate.

Natural gas furnaces direct the hot combustion gases resulting from burning natural gas through a heat exchanger to heat cooler indoor air. These furnaces have a burner, an air duct to bring combustion air from the outside into the furnace closet, and an exhaust duct to release combustion gases to the outdoors.

Electric furnaces heat air by pulling air over electric resistance heating panels. This furnace type differs from combustion-type furnaces in that there are no burners or ducts for combustion air supply or exhaust.

Electric heat pumps typically remove heat from outdoor air, raise the temperature of this air, and deliver it to the manufactured home. Usually air-to-air heat pumps are found in manufactured homes. Electricity powers heat pumps so there are no burners or ducts for combustion air supply or exhaust. When operating in the heating mode, these heat pumps extract heat from outdoor air in order to heat indoor air. Air-to-air heat pumps cannot perform satisfactorily in very cold climates.

Propane furnaces direct the hot combustion gases resulting from burning propane gas through a heat exchanger to heat cooler indoor air. These furnaces have a burner, an air duct to bring combustion air from the outside into the furnace closet, and an exhaust duct to release combustion gases to the outdoors.

Oil furnaces direct the hot combustion gases resulting from burning fuel oil through a heat exchanger to heat cooler indoor air. These furnaces have a burner, an air duct to bring combustion air from the outside into the furnace closet, and an exhaust duct to release combustion gases to the outdoors.

Kerosene furnaces direct the hot combustion gases resulting from burning kerosene gas through a heat exchanger to heat cooler indoor air. These furnaces have a burner, an air duct to bring combustion air from the outside into the furnace closet, and an exhaust duct to release combustion gases to the outdoors.

Coal-burning furnaces are not standard to manufactured homes. Because someone other than the manufacturer installed this furnace into the manufactured home, many types of coal-burning furnaces may exist. The furnace should be installed so that adequate combustion air is brought in from the outdoors and the products of combustion are completely removed from the living space. It is recommended that you conduct tests to ensure that combustion gases are not in the living space.

Wood-burning heating systems are most often a supplement to the central manufactured home heating system and are not a standard manufactured home feature. They are typically fireplaces installed after the manufactured home left the factory. Often, when these fireplaces were installed, sufficient combustion air was not also provided. When the occupant operates the fireplace with all the windows and doors in the manufactured home closed, the combustion air is drawn in through all cracks in the home, creating drafts, and often results in the occupant feeling colder than he would without operating the fireplace. It is recommended that you conduct tests to ensure that combustion gases are not in the living space and that you ensure adequate combustion air is able to enter the space.

If the occupant does not have a heating system in the manufactured home, enter None as the heating equipment type.

Capacity

Enter the rated input capacity (found on the equipment nameplate) for natural gas, electric, propane, oil, and kerosene furnaces. Enter the rated output capacity for heat pumps. Capacity input for coal and wood systems is not required.

Average Indoor Temperature

Enter the average indoor temperature during the heating season for day and night in degrees Fahrenheit. In most cases, enter the day and night thermostat setpoint temperatures. If the thermostat is not working properly or if there is no thermostat, enter approximate values based on measurements taken or from information gained from occupant interviews.

Heating Duct Location

Enter the location of the main supply air duct for the heating system. Usually, manufactured homes will have a single duct that runs along the center of the home or two ducts, each running along the length of the home and connected by a cross duct. The main supply duct will be located under the floor or above the ceiling. In some cases, there will not be an existing main supply air duct. If the existing supply air duct has been disconnected from the central heating system and there are no plans to reconnect it, then indicate that there is no existing main supply air duct.

Heating Duct Insulation Location

Enter the location of the main supply air duct insulation. Insulation may be located only on the top of the duct, only on the bottom of the duct, or wrapped completely around the duct. Ductboard is a rigid insulation used to either insulate ducts or to create a plenum that is used as a duct. Indicate that the insulation is around the duct if ductboard is used.

Percent of Total Heat Supplied (%)

If there are two heating systems in the home, estimate the amount of heat supplied by the primary heating system. Enter this value as a percent of the total heat supplied by both the primary and secondary heating systems. The software assumes that the primary system supplies 100% of the required heat unless you indicate otherwise. MHEA will not permit you to open the secondary heating equipment screen unless a value less than 100% is entered.

Secondary Equipment

Click the button labeled "Secondary Equipment" to access the secondary heating equipment description screen. Secondary equipment is used by the occupant to supply heat that cannot be supplied by the primary heating system. Inputs on the "Secondary Heating Equipment" screen are identical to those on the "Primary Heating Equipment" screen, except that the Average Indoor Temperature and the Percent of Total Heat Supplied inputs are not required (see

Figure 3-24A). MHEA assumes the indoor temperatures are the same for both the primary and secondary systems and MHEA calculates the percent of total heat supplied by the secondary system based on the input entered on the "Primary Heating Equipment" screen. Note that the Secondary Heating Equipment screen can only be accessed if the primary heating equipment supplies less than 100% of the required heat.

Replacement Equipment

Click the button labeled "Replacement Equipment" to access the "Replacement Heating Equipment" description screen. A screen similar to the "Primary Heating Equipment" screen will appear (see Figure 3-24B). Use this screen to specify the equipment you plan to install if replacing the heating system is part of the retrofit package. MHEA assumes the indoor temperatures are the same as those you entered on the Primary Heating Equipment screen. If replacing the heating equipment is required then place a check in the appropriate box under "Replacement Heating Equipment." Also, indicate if the costs associated with replacing the heating equipment should be included with the home retrofit costs.

Figure 3-24A The "Secondary Heating Equipment" Screen

Figure 3-24B The "Replacement Heating Equipment" Screen

3.2.3.2 Cooling

Describe the equipment used to cool the manufactured home on the Cooling Equipment description screens. Some manufactured homes have more than one cooling system. Usually, a second cooling system is added by the occupants because the primary system is unable to satisfactorily cool the home. Describe the primary cooling system on the screen that appears when you select the Cooling submenu item (see Figure 3-25), and describe the secondary cooling system on the screen you access by selecting the Secondary Equipment button found on the "Primary Cooling Equipment" input screen (see Figure 3-26). Notice that the primary and secondary cooling equipment screens are nearly identical.

NOTE Enter information on the "Primary Cooling Equipment" screen describing the cooling system that will become the primary heating system after weatherizing the manufactured home. In some cases, this primary system may supply only a small portion of the needed cooling before weatherization has been completed.

NOTE If an operating, standard manufactured home central cooling system exists but is unable to satisfactorily cool the home, check that the duct system is sealed and that the cooling system is operating correctly.

File Inputs Run View Quit Setup Help MHEA 1.14

Primary Cooling Equipment

Cooling Equipment Type:

☐ Evaporative Cooler

☒ Central Air Conditioner

☐ Room Air Conditioner

☐ Heat Pump

☐ None

Cooling Duct Location:

☒ Floor

☐ Ceiling

☐ None

Cooling Duct Insulation Location:

☐ Above Duct

☐ Below Duct

☐ Around Duct

☒ No Insulation

Rated Total Capacity (Btuh): 45000

Rated COP: 3.0

Average Indoor Temperature:

Day (F): 72

Night (F): 72

Approx. Area of Home Cooled by Room Air Conditioner (%):

Secondary Equipment

Ok Cancel Defaults

For Help press the RIGHT mouse button or F1. Audit File Name: MANI

Figure 3-25 The "Primary Cooling Equipment" Screen

File Inputs Run View Quit Setup Help MHEA 1.14

Primary Cooling Equipment

Cooling Equipment Type:

☐ Evaporative Cooler

☐ Central Air Conditioner

☒ Room Air Conditioner

☐ Heat Pump

☐ None

Cooling Duct Location:

☐ Floor

☐ Ceiling

☒ None

Cooling Duct Insulation Location:

☐ Above Duct

☐ Below Duct

☐ Around Duct

☒ No Insulation

Rated Total Capacity (Btuh): 5000

Rated COP: 2.0

Approx. Area of Home Cooled by Room Air Conditioner (%): 0.0

Ok Cancel Defaults

For Help press the RIGHT mouse button or F1. Audit File Name: MANI

Figure 3-26 The "Secondary Cooling Equipment" Screen

Cooling Equipment Type

Indicate the home cooling equipment type.

Evaporative coolers usually are a rectangular box mounted on the roof of the home. Air is cooled when it is pulled through wetted pads before being blown into the home from one central supply air location. There is no ductwork with evaporative coolers.

Central air conditioners have a cooling coil located inside the home (often with the central furnace unit) and a condenser found outdoors near the home. Central air-conditioning systems distribute cool air through ducts, usually the same ducts through which heated air is supplied to the home.

Room air conditioners are either installed in a window or mounted through an exterior wall. This type of air conditioner is designed to cool only one room of the home. There is no ductwork with room air conditioners.

Electric heat pumps remove heat from one substance and delivers the heat to a second substance. Usually air-to-air heat pumps are found in manufactured homes. When operating in the cooling mode, these heat pumps remove heat from the air inside the home and deliver the heat to the outdoors. Note that heat pumps cannot perform satisfactorily in very hot climates.

If the occupant does not have a cooling system in the manufactured home, enter None as the cooling equipment type.

Rated Total Capacity

Read the energy input from the nameplate attached to the cooling equipment. No capacity input is allowed if the cooling equipment is an evaporative cooler or if no cooling equipment exists.

Rated Coefficient of Performance COP

Read the equipment-rated COP from the nameplate attached to the cooling equipment. If the COP is not included on the nameplate, look up the COP in a cooling equipment blue book or other literature that includes typical COP values for various cooling equipment types and ages.

Average Indoor Temperature

Enter the average indoor temperature during the cooling season for day and night in degrees Fahrenheit. If a thermostat exists, enter the day and night thermostat setpoint temperatures. If the thermostat is not working properly or if there is no thermostat, enter approximate values based on measurements taken or from information gained from occupant interviews.

Cooling Duct Location

Enter the location of the main supply air duct for the cooling system. Usually, manufactured homes will have a single duct that runs along the center of the home or two ducts, each running along the length of the home, connected by a cross

duct. The main supply duct will be located under the floor or above the ceiling. In some cases, there will not be an existing main supply air duct.

Cooling Duct Insulation Location

Enter the location of the main supply air duct insulation. Insulation may be located only on the top of the duct, only on the bottom of the duct, or wrapped completely around the duct. Ductboard is a rigid insulation used to either insulate ducts or to create a plenum that is used as a duct. Indicate that the insulation is around the duct if ductboard is used.

Approximate Area of Home Cooled by Room Air Conditioner (%)

Enter the approximate home floor area (in percent) cooled by the room air conditioner. For example, if a room air conditioner cools the living room and the living room floor area is about one-third the total home floor area, the approximate home area cooled by the room air conditioner is 33%. If there is no existing room air conditioner, then do not enter a value in this box.

Secondary Equipment

Click the button labeled "Secondary Equipment" to access the Secondary Cooling Equipment description screen. Secondary equipment is used by the occupant to supply cooled air that cannot be supplied by the primary cooling system. Inputs on the "Secondary Cooling Equipment" screen are identical to those on the "Primary Cooling Equipment" screen except the Average Indoor Temperature inputs are not required. MHEA assumes the indoor temperatures are the same for both the primary and secondary systems.

3.2.4 Manufactured home Additions

Additions are defined as any add-on structure that is conditioned by the manufactured home heating and cooling systems (see Figure 3-27). Additions cannot be separated from the manufactured home (for example, by closing the door to an entrance vestibule). Additions that are part of the living space must be included in the energy calculations of the home. If the addition can and usually is separated from the manufactured home, it should not be included when evaluating weatherization retrofit measures for the manufactured home.

NOTE You may open the "Manufactured home Addition" description screens in any order to enter information about the addition. You do not necessarily need to start with the screen that is listed first and move down sequentially. It is recommended that you complete the screens in a logical order so that you do not overlook any screens. If there is not an addition, then you do not need to work through these screens.

CD-RH06-A0342515

Figure 3-27 Typical Manufactured home Addition

3.2.4.1 Addition Floor

Enter information describing the floor section of the addition on this screen (see Figure 3-28). You will notice that the "Addition Floor" screen is very similar to the "Floor" screen found from within the Construction submenu (see Section 3.2.2.1).

The screenshot shows the 'Addition Floor' screen with the following fields and options:

- General:** (Tab selected)
- Addition Floor:** (Title)
- Floor Dimensions:**
 - Length (ft): 0.00
 - Width (ft): 0.00
- Floor Joist Direction:**
 - ☐ Lengthwise
 - ☒ Widthwise
- Batt/Blanket Direction:**
 - ☐ Lengthwise
 - ☐ Widthwise
 - ☒ No Batt/Blanket Insulation
- Skirt:**
 - ☒ Yes
 - ☐ No
- Floor Joist Size:**
 - ☐ 2"x4"
 - ☒ 2"x6"
 - ☐ 2"x8"
- Insulation Type/Thickness:**
 - Batt/Blanket (in): 0.00
 - Loose Fill (in): 0.00
- Batt/Blanket Insulation Location:**
 - ☐ Attached to Flooring
 - ☐ Attached to Floor Joist
- Depth available for added insulation (in):** 0.00
- Buttons:** Okay, Cancel, Defaults
- Footer:** For Help, press the RIGHT mouse button or F1 | Audit File Name: MAN1

Figure 3-28 The "Addition Floor" Screen

Floor Dimensions

Enter the dimensions of the addition floor (see Figure 3-29). The floor length is the dimension parallel to the wall shared with the manufactured home and the floor width is the dimension perpendicular to the wall shared with the manufactured home.

NOTE In order for MHEA to recognize that there is an addition, you must enter floor dimensions. If you complete other addition description screens but do not enter floor dimensions, MHEA will assume that an addition does not exist.

CD-RH06-A0342516

Figure 3-29 Manufactured home Addition Dimensions

Floor Joist Direction

The floor joist is the wood framing that supports the interior floor (see Figure 3-30). Enter the direction the floor joists are installed. Lengthwise floor joists are installed parallel to the long dimension (length) of the addition. Widthwise floor joists are installed parallel to the short dimension (width) of the addition. The floor joist direction is needed to calculate more accurately the volume of the addition floor section and to calculate more accurately the R-value of the floor.

Widthwise Addition Floor Joists

Lengthwise Addition Floor Joists

CD-RH06-A0342517

Figure 3-30 Manufactured home Addition Floor Joist Direction

Batt/Blanket Direction

Indicate if batt/blanket insulation exists and if it does exist, the direction in which it is installed. Batt/blanket insulation that has been installed lengthwise is parallel to the long dimension (length) of the addition. Insulation that has been installed widthwise is parallel to the short dimension (width) of the addition. The insulation direction is needed to calculate more accurately the R-value of existing batt/blanket insulation that is attached to the flooring or floor joist. Place a check next to the option indicating the insulation location as the Batt/Blanket Insulation Location input on the "Addition Floor" input screen.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Skirt

Indicate whether or not a skirt exists around the exterior of the addition. Research has shown that skirting only protects the addition floor from exposure to the wind. If skirting exists, MHEA adjusts the exterior air R-value to account for the absence of wind when the total R-value of the floor section is calculated.

Floor Joist Size

The floor joist is the wood framing that supports the interior floor. Additions are typically constructed using standard wood framing. Indicate the dimensions of the floor joists. MHEA needs this information to calculate the floor R-value and the volume addition floor section.

NOTE The nominal dimensions (those dimensions you measure with your tape measure) are less than the standard dimensions listed. For example, a 2" x 4" board will actually have the dimensions of 1-3/4" x 3-1/2". The options listed in MHEA are the standard dimensions used by the U.S. lumber industry.

Insulation Type/Thickness

Enter the amount of existing batt/blanket and loose-fill insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist. Enter the amount of existing insulation.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers of either glass or cellulose blown into the floor section of the addition. MHEA uses the existing insulation thickness to calculate the floor R-value and to calculate the volume in the floor section that is available for additional insulation.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Batt/Blanket Insulation Location

Indicate where the batt/blanket insulation is located in the addition floor. If the batt/blanket insulation is attached to the underside of the flooring, then check the attached to flooring entry. If the insulation is attached to the underside of the floor joists, then check the attached to floor joist entry.

NOTE If you indicated that no batt/blanket insulation exists (entry at center of

Addition Floor screen), then MHEA will not permit you to enter a batt/blanket insulation location.

Depth Available for Added Insulation

Enter in inches the depth of space available for added insulation in the addition floor section. This information is needed when MHEA calculates retrofit measures to be installed in the addition.

3.2.4.2 Addition Wall

The "Addition Wall" input screen contains information about the addition walls (see Figure 3-31).

Figure 3-31 The "Addition Wall" Screen

Addition Orientation

The addition orientation is the same orientation as the manufactured home wall to which the addition is attached. Indicate this orientation by checking the north, south, east, or west orientation box. The addition is assumed to be rectangular based on the floor dimensions entered on the "Addition Floor" input screen. The addition orientation is needed to calculate solar loads on the addition.

Interior Wall Height

Enter the height in feet of the addition walls. Because additions are usually constructed by the occupant, they are often uniquely designed. If the walls are of

varying height, enter the maximum and minimum wall heights. If the walls are all the same height, enter the same value in both the maximum and minimum height entry boxes.

Wall Configuration

Enter the approximate wall configuration by checking the appropriate box. The ceiling slopes down from the interior wall (wall shared with the manufactured home) to the opposite exterior wall if the maximum wall height is at the interior wall. The maximum wall height is the center of the addition if, from the interior of the addition, the ceiling peaks along the center of the addition and slopes down towards the exterior walls that are perpendicular to the manufactured home. Finally, an addition with a flat ceiling has walls that are all the same height. MHEA will only accept a flat ceiling wall configuration if the minimum and maximum wall heights are the same.

Wall Stud Size

The wall stud is the wood framing that is between the interior and exterior addition walls. Additions are typically constructed using standard wood framing. MHEA needs this information to calculate the wall R-value and the volume of the wall section.

NOTE The nominal dimensions (those dimensions you measure with your tape measure) are less than the standard dimensions listed. For example, a 2" x 4" board will actually have the dimensions of 1-3/4" x 3-1/2". The options listed in MHEA are the standard dimensions used by the U.S. lumber industry.

Insulation Type Thickness

Enter the amount of existing insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers, made either of glass or cellulose, blown into the wall section of the addition. Foam core insulation may also exist in the wall section. This type of insulation is a rigid foam typically 1/4" thick found either between the wall studs and the interior wall or the wall studs and the exterior wall. MHEA uses the existing insulation thickness to calculate the wall R-value and to calculate the volume in the wall section that is available for additional insulation.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

Wall Ventilation

An addition wall may be intentionally or unintentionally ventilated. A ventilated wall has a space for air to flow between the exterior and interior wall materials. The wall insulation is dirty inside ventilated walls. Pull up slightly on the lower end of an exterior wall panel to check for dirty insulation. If a wall is ventilated, the wall R-value is degraded. MHEA incorporates a correction factor to account for this degradation.

3.2.4.3 Addition Window

Describe window types, sizes, shading, and orientation on the "Addition Window" input screens (see Figure 3-32). You may enter information about several different windows by using the Edit buttons, located at the top right of the "Addition Window" input screen. The description you are viewing and the total number of descriptions you have entered are displayed at the top left of the "Addition Window" input screen.

Figure 3-32 The "Addition Window" Screen

Edit Buttons

You may enter information about several window types by using the Edit buttons located at the top right corner of the screen. Only one window type may be described on a screen. If there are windows of different sizes, shading, glazing, or description, you must enter data about those windows on other screens.

Add

Select the Add button to create additional window descriptions. The add feature is useful for describing several window types and sizes. For example, if both jalousie and awning windows exist in a home, enter data about these windows on two or more description screens.

Delete

To delete a window description, select the Delete button while the description is displayed on the screen.

WARNING The window description that is currently displayed will be removed from the computer memory when you select the Delete button. Be careful that you are deleting the correct description.

View Buttons

You may view window description screens by selecting View buttons. You may find this feature useful if you have entered more than one window description and you wish to move between these descriptions. Changes may be made to the window description screens you have accessed from the View buttons.

Next

Select the Next button to move through the screen descriptions in ascending order. For example, if screen 1 of 3 descriptions is displayed and you click the Next button, screen 2 of 3 descriptions will appear.

Previous

Select the Previous button to move through the screen descriptions in descending order. For example, if screen 2 of 3 descriptions is displayed and you click the Previous button, screen 1 of 3 descriptions will appear.

Description

The window description is the type of window found in the addition (see Figure 3- 18).

Jalousie windows are constructed of several horizontal panes (about 6 inches wide) that all open at the same angle when a crank near the bottom of the window is turned. Jalousie windows are always single pane. Often, very large gaps between the glass panes exists, resulting in high infiltration rates through the window.

Awning windows are hinged at the top or side of the window so that when opened (usually by turning a crank), the glass angles out from the addition exterior. The glass either angles down or to the side, depending on where the window is hinged to the home.

Slider windows usually have two panes of glass and either one or both panes slide past the other when the window is opened. Both horizontal and vertical slider windows are found in additions.

Fixed windows are sealed in the window frame and cannot be opened.

Door windows are sealed in the window frame of a door and cannot be opened.

Sliding glass doors are large windows that extend to the floor of the addition and can be opened to enter or exit the addition.

Skylights are glass or plastic windows in the ceiling of the addition.

Glazing Type

Window glazing is the type and number of glass or plastic panes that make up a window.

Single-glazed windows have one plate of glass in the window frame.

Double-glazed windows have two plates of glass in the window frame.

Single-glazed windows with a glass storm window have a single pane of window glass with a second (usually removable) single pane of glass installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window.

Double-glazed windows with a glass storm window are two panes of window glass with an additional (usually removable) single pane of glass installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window.

Single-glazed windows with a plastic storm window have a single pane of window glass with a second (usually removable) single pane or sheet of plastic installed at one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window. Plastic storm window panes are rigid plastic panes held in a plastic, metal, or vinyl frame. Plastic storm window sheets are flexible plastic sheets held onto the window either with magnets around the outer edge of the plastic sheets or by a frame securely attached to the window frame.

Double-glazed windows with a plastic storm window are two panes of window glass with an additional (usually removable) single pane or sheet of plastic installed at the one inch or so from the window pane. MHEA assumes that the storm window (second, removable pane) is installed on the interior side of the window. Plastic storm window panes are rigid plastic panes held in a plastic, metal, or vinyl frame. Plastic storm window sheets are flexible plastic sheets held onto the window either with magnets around the outer edge of the plastic sheets or by a frame securely attached to the window frame.

NOTE If the existing storm window is on the exterior side of the window, the window should be considered as not having a storm window. Typical addition construction includes very leaky windows. The main benefit of storm windows is to prevent outside air from entering the addition around the window frame. Storm windows installed on the exterior side of the window usually do not prevent air from leaking around a addition window frame.

Dimensions

Enter in inches the length and height of the window you are describing.

Interior Shading

Interior shading affects both the insulating value of the window/window shading combination as well as the solar loads on the addition. Interior shading devices are interior window coverings that prevent sunlight from entering the addition. Drapes are heavy curtains that hang in loose folds over the window. Blinds or shades are lightweight window coverings that hang flat over the window. Both venetian blinds and roller shades are in this category. Indicate drapes with shades if the occupant has both on the window. Interior shading devices affect the amount of heat that is gained or lost through the manufactured home windows. They also slightly affect the window insulating value U-value.

NOTE Indicate that interior shading exists only if the devices are used most of the time. If the occupant usually has the shading devices pulled away from the window, indicate that no interior shading exists.

Exterior Shading

Exterior shading devices are methods of shading a window from the outside of the addition. The solar load on the addition is reduced because of exterior shading devices. Low E-film is a reflective film applied to the exterior surface glass window panes by the window manufacturer. A sun screen is a mesh screen that is installed or hung on the exterior side of a window. An awning is a device that is mounted above a window and extends out from the exterior of the home. It is usually constructed of aluminum, fiberglass, or fabric. A carport/porch roof is a shelter that has no walls and extends out from one wall of the addition. Often, the home occupant will park a car under this shelter or use it to shade an outdoor sitting area. Indicate which of these exterior shading devices may exist. If there is no exterior window shading, then check the None box.

Number of Windows for Each Orientation

Indicate the number of windows on each wall of the addition that fit the description shown on each description screen.

3.2.4.4 Addition Door

Describe door types, sizes, and orientation on the "Addition Door" input screens (see Figure 3-33). You may enter information about several different doors by using the Edit buttons, located at the top right of the "Addition Door" input screen. The description you are viewing and the total number of descriptions you have entered is displayed at the top left of the "Addition Door" input screen.

Figure 3-33 The "Addition Door" Screen

Edit Buttons

You may enter information about several door types by using the Edit buttons located at the top right corner of the screen. Only one door type may be described on a screen. If there are doors of different sizes or description, you must enter data about those doors on other screens.

Add

Select the Add button to create additional door descriptions. The add feature is useful for describing several door types and sizes. For example, if both wood and vinyl doors exist in a home, enter data about these doors on two or more description screens.

Delete

To delete a door description, select the Delete button while the description is displayed on the screen.

WARNING The door description that is currently displayed will be removed from the computer memory when you select the Delete button. Be careful that you are deleting the correct description.

View Buttons

You may view door description screens by selecting View buttons. You may find this feature useful if you have entered more than one door description and you wish to move between the descriptions. Changes may be made to the door description screens you have accessed from the View buttons.

Next

Select the Next button to move through the screen descriptions in ascending order. For example, if screen 1 of 3 descriptions is displayed and you click the Next button, screen 2 of 3 descriptions will appear.

Previous

Select the Previous button to move through the screen descriptions in descending order. For example, if screen 2 of 3 descriptions is displayed and you click the Previous button, screen 1 of 3 descriptions will appear.

Description

The door description is the type of door found in the addition.

Wood, hollow-core doors are constructed of two lightweight panels of wood separated by a cardboard core.

Wood, solid-core doors are constructed of a solid piece of wood.

Standard manufactured home doors are constructed of a metal, vinyl, or fiberglass skin with a solid insulating core (such as polyurethane).

Storm Door

A storm door is a lightweight door that is installed outside of the addition door. This door is usually constructed of aluminum with a large portion of the door holding a screen, glass, or plastic window. Storm doors have very little impact on the energy consumption of a manufactured home other than to improve the R-value of the manufactured home door slightly. Indicate whether or not a storm door exists.

Dimensions

Enter in inches the length and width of the door you are describing.

Number of Doors for Each Orientation

Indicate the number of doors on each wall of the addition that fit the description shown on each description screen.

3.2.4.5 Addition Ceiling

Enter information describing the roof/ceiling section of the addition on the "Addition Ceiling" screen (see Figure 3-34).

Figure 3-34 The "Addition Roof/Ceiling" Screen

Roof/Ceiling Joist Size

The roof/ceiling joist is the wood framing that supports the interior ceiling and the exterior roof. Additions are typically constructed using standard wood framing. Indicate the dimensions of the roof/ceiling joists. MHEA needs this information to calculate the roof/ceiling R-value and the volume addition roof/ceiling section.

WARNING The nominal dimensions (those dimensions you measure with your tape measure) are less than the standard dimensions listed. For example, a 2" x 4" board will actually have the dimensions of 1-3/4" x 3-1/2". The options listed in MHEA are the standard dimensions used by the U.S. lumber industry.

Roof Color

The color of the roof affects how solar energy impacts the heating and cooling loads of the addition. A light/reflective roof appears white or light gray and a dark roof is black, dark brown, or other dark color.

Insulation Type Thickness

Enter the amount of existing batt/blanket, loose-fill, and rigid insulation. By entering a value greater than 0 inches, you are implying that the insulation exists. If you enter a thickness of 0 inches, MHEA assumes that insulation of that type does not exist.

Batt/blanket insulation is fibrous insulation formed into very long pads of various thickness. Loose-fill insulation is typically fibers of either glass or cellulose blown into the roof/ceiling section of the addition. Rigid insulation is a foam insulation typically a few inches thick found either directly under the roofing material or directly above the ceiling surface. MHEA uses the existing insulation thickness to calculate the roof/ceiling R-value and to calculate the volume in the roof/ceiling section that is available for additional insulation.

WARNING Be careful to enter the correct insulation thickness if the insulation thickness is greater than the roof/ceiling section height (i.e., the thickness of the insulation if it were not compressed into the ceiling/roof section). Compressed insulation has a changing R-value depending on how much it is compressed. The noncompressed thickness should be entered so that MHEA can calculate the correct R-value.

NOTE You may view and, if necessary, adjust the R-value MHEA assigns to all insulation types from within the Defaults submenu located under the **Setup** main menu. Refer to Section 4.5.2, Default Parameters, for more information.

3.2.5 Billing Data

Enter actual billing data for the energy sources consumed by the manufactured home on the screens that become available when you select the billing data submenu item (see Figure 3-35). If the calculations are evaluated using the data you enter on the billing data screens, MHEA will adjust the results to more accurately represent the energy consumption of the particular manufactured home you are auditing.

After you have selected the Billing Data submenu item, a second submenu will appear on your screen. Select the Electricity submenu to enter information about monthly electrical consumption. If the manufactured home heating systems are combustion-type systems, select the Primary Heating Fuel submenu to enter billing data about the fuel used by the home primary and secondary heating systems.

Use any of the methods described in Section 1.3, Navigating Through MHEA, to select menu items and enter data for the billing data screens.

Figure 3-35 Billing Data Submenu Tree

NOTE The billing data adjustment feature applies only to those situations where the fuel consumption is known. In most cases, monthly utility bills will record this information. If a bulk fuel such as fuel oil, propane, wood or other fuel is used, then the manufactured home occupant may be able to help determine when and how much fuel was purchased or restocked.

You are not required to enter the manufactured home billing data before running the MHEA calculations. Adjusting the calculation results based on actual recorded energy use is an optional MHEA feature.

3.2.5.1 *Electricity*

Enter billing data on the screen that is available by selecting the Electricity submenu option (see Figure 3-36).

Month

Enter the number of the first month in the bill year. The months are numbered beginning with January = 1, February = 2, and so on. You may begin with any month. You must enter a full year's utility bill data.

Day

Enter the day of the month the billing data is recorded. If the utility records billing information on the 15th day of each month, enter 15 in the Day column.

Month	Day	# of Days	kWh	DD
1	15	31	0	0
2	15		0	0
3	15		0	0
4	15		0	0
5	15		0	0
6	15		0	0
7	15		0	0
8	15		0	0
9	15		0	0
10	15		0	0
11	15		0	0
12	15		0	0

Base Temperature for DD Values: 65

Calculate Base Load

Base Load Units: kWh/Month

Calculated Base Load: 0

Self-determined Base Load: 0

Okay Cancel

For Help press the RIGHT mouse button or F1. Enter Name: RES1

Figure 3-36 The "Electric Utility Bill Data" Screen

of Days

Enter the number of days in the first billing month. For example, if the first billing month extends from January 15 to February 15, enter 31 in the number of days editable field.

kWh

Enter the monthly electricity consumption as recorded by the utility. This information should be entered in units of kWh.

Degree-Days (DD)

Enter the degree-days as they are recorded by the utility for the billing period you are evaluating. This is not a required entry. The degree-days are shown on the results screen for your information only and do not affect the calculations. MHEA uses degree-days calculated from weather data for an "average" year. You may be interested in comparing the degree-days used in MHEA calculations with those that actually occurred for the year you entered utility bill information, especially if the information you entered was for an unusually warm or cold year.

NOTE Degree-day entries are optional. They are not required to complete MHEA energy consumption and economic calculations.

Base Temperature for Degree-Days

Enter the base temperature for which degree-days are to be calculated. A degree-day is the difference between a base mean daily temperature and the actual mean

daily temperature. Heating degree-days occur when the actual mean daily temperature is less than the base temperature. Cooling degree-days occur when the actual mean daily temperature is greater than the base temperature. Typically, 65°F is considered an appropriate base temperature for most climates.

Calculate Base Load

After you have entered monthly energy consumption information, select this button to estimate a base load. A base load is the average monthly energy consumption that is required to meet constant loads for water heating, cooking, lighting, and other internal loads. MHEA subtracts the base load from the monthly electricity consumption to estimate the electricity consumed by the heating and cooling systems.

Base Load

The base load is the energy required to operate the domestic hot water heater, lights, cooking, clothes washing, and to operate other household appliances that are used throughout the year. For example, if the heating equipment uses natural gas and an electric cooling system exists, the electric base load can be estimated by averaging the monthly electricity consumption during the winter months.

NOTE If you have calculated the base load by some method other than an MHEA base load estimate or if you have measured the base load, you may enter that value in the Self-Determined Base Load editable field (bottom of the "Billing Data" screen). If a self-determined base-load value has been entered, MHEA will use this value in the calculations and not the value obtained by selecting the Calculate Base Load button.

Base-Load Units

The units associated with the base load calculated by MHEA are displayed in the Base Load Units view box. The units will be kWh.

Calculated Base Load

MHEA displays the calculated base load in the Calculated Base Load view box. You must select the Calculate Base Load button (see description above) to initiate MHEA base load calculation.

Self-Determined Base Load

Enter a base load that you have obtained from a calculation, measurement, or some other means other than that provided with MHEA. A base load is the average monthly energy consumption that is required to meet constant loads for water heating, cooking, lighting, and other internal loads. Be sure to enter a base load only for electricity and not include a base load for other fuels. MHEA subtracts the base load from the monthly electricity consumption to estimate the electricity consumed by the heating and cooling systems.

NOTE It is recommended that you enter a self-determined base-load value if the manufactured home has operating electric heating and cooling systems. Because electricity is used in both the heating and cooling seasons, MHEA may overestimate the base load from the information provided on the "Billing Data" screens. This high base-load estimate may translate to lower (Savings to Investment) SIR values calculated for the recommended weatherization measures.

NOTE If a self-determined base load value has been entered, MHEA will use this value in the calculations and not the value obtained by selecting the Calculate Base Load button.

3.2.5.2 Heating

Enter billing data on the screens that are available by selecting the Primary Heating Fuel submenu option of the manufactured home heating system. Use this screen when the heating system(s) is a combustion-type system (see Figure 3-37).

Month	Day	# of Days	Therms	HDD
1	15	31	500	0
2	15		500	0
3	15		400	0
4	15		300	0
5	15		200	0
6	15		75	0
7	15		75	0
8	15		75	0
9	15		200	0
10	15		300	0
11	15		400	0
12	15		500	0

Base Temperature for DD Values: 65

Calculate Base Load

Base Load Units: Therms/Month

Calculated Base Load: 0

Self-determined Base Load: 0

Okay Cancel

Figure 3-37 The "Primary Heating Fuel" Screen

Month

Enter the number of the first month in the bill year. The months are numbered beginning with January = 1, February = 2, and so on. You may begin with any month. You must enter a full year's utility bill data.

Non-monthly bulk fuel deliveries such as liquefied petroleum gas (LPG) may be entered on this screen as well. Enter information (month, day, amount, etc.) for the first delivery to be considered on the first row. Enter information about the second (next in chronological order) delivery in the next row. Continue in this manner for additional deliveries. MHEA interprets the first zero entry for month or day as the end of a billing information data you are entering. If you enter bulk fuel data that spans a partial year, MHEA will adjust the annual results based on that partial period only.

If secondary fuel records are to be considered, you will need to convert this information to energy units and bill periods consistent with primary fuel billing data and add the two data sets together.

Day

Enter the day of the month the billing data is recorded. If the utility records billing information on the 15th day of each month, enter 15 in the Day column.

of Days

Enter the number of days in the first billing month. For example, if the first billing month extends from January 15 to February 15, enter 31 in the number of days editable field.

Therms/kWh

Enter the monthly energy consumption as recorded by the utility. If the heating system is natural gas, enter the consumption on the natural gas heating screen in units of therms. Energy units (e.g., gallons of propane) for other heating fuels will need to be converted into therms.

Heating Degree-Days (HDD)

Enter the heating degree-days as they are recorded by the utility for the billing period you are evaluating. This is not a required entry. The degree-days are shown on the results screen for your information only and do not affect the calculations. MHEA uses degree-days calculated from weather data for an "average" year. You may be interested in comparing the degree days used in MHEA calculations with those that actually occurred for the year you entered utility bill information, especially if the information you entered was for an unusually warm or cold year.

NOTE Heating degree-day entries are optional. They are not required to complete MHEA energy consumption and economic calculations.

Base Temperature for DD

Enter the base temperature for which degree-days are to be calculated. A degree-day is the difference between a base mean daily temperature and the actual mean daily temperature. Heating degree-days occur when the actual mean daily temperature is less than the base temperature. Cooling degree-days occur when

the actual mean daily temperature is greater than the base temperature. Typically, 65°F is considered an appropriate base temperature for most climates.

Calculate Base Load

After you have entered monthly energy consumption information, select this button to estimate a base load. A base load is the average monthly energy consumption that is required to meet constant loads for water heating, cooking, lighting, and other internal loads. MHEA subtracts the base load from the monthly energy consumption to estimate the energy consumed by the heating system.

Base Load

The base load is the energy required to operate the domestic hot water heater, lights, cooking, clothes washing, and to operate other household appliances that are used throughout the year. For example, if the heating equipment uses natural gas, the base natural gas load can be estimated by averaging the monthly natural gas consumption during the summer months.

NOTE If you have calculated the base load by some method other than MHEA base-load estimate or if you have measured the base load, you may enter that value in the Self-Determined Base Load editable field (bottom of the "Billing Data" screen). If a self-determined base load value has been entered, MHEA will use this value in the calculations and not the value obtained by selecting the Calculate Base Load button.

NOTE MHEA's determination of a base load is of limited accuracy with bulk fuel data since seasonal and monthly trends are not known. Provide a "user-determined" base-load value to override MHEA's value, if additional base-load information is available.

Base-Load Units

The units associated with the base load calculated by MHEA are displayed in the Base Load Units view box. The units will be either therms/month or kWh/month.

Calculated Base Load

MHEA displays the calculated base load in the Calculated Base Load view box. You must select the Calculate Base Load button (see description above) to initiate MHEA base-load calculation.

Self-Determined Base Load

Enter a base load that you have obtained from a calculation, measurement, or some other means than that provided with MHEA. A base load is the average monthly energy consumption required to meet constant loads for water heating, cooking, lighting, and other internal loads. Be sure to enter a base load only for the power source for which billing data has been entered. MHEA subtracts the

base load from the monthly energy consumption to estimate the energy consumed by the heating system.

NOTE It is recommended that you enter a self-determined base-load value if the manufactured home has operating electric heating and cooling systems. Because electricity is used in both the heating and cooling seasons, MHEA may overestimate the base load from the information provided on the "Billing Data" screens. This high base-load estimate may translate to lower SIR values calculated for the recommended weatherization measures.

NOTE If a self-determined base-load value has been entered, MHEA will use this value in the calculations and not the value obtained by selecting the Calculate Base Load button.

3.2.6 Comments

Use the comment screen to record miscellaneous information. Open this screen by selecting the Comments option from within the **Inputs** menu. Type new information or edit existing comments using the keyboard. The comments already entered may be displayed, but not edited, by selecting the Comments submenu found within the **View** main menu. Select the Print submenu found within the **File** main menu to print the comments (see Figure 3-38).

Figure 3-38 The "Edit Comments" Screen

3.3 Edit the Input Data

You may reenter the input screens at any time to revise the input data. For example, you may decide some time after you initially entered the description data to adjust the input files. To do this, open the project file to be revised using the Open submenu item found within the **File** menu (see Section 3.1.2, Open) and go to the screen or screens you want to update. After you have made your changes, select the Okay button on the screen to store your changes. Then rerun the calculations so that the changes are included in the calculation results.

3.4 Perform Energy Use and Cost Analysis

After entering all the required input data, select the **Run** menu item (center of Main Menu Bar) to activate the program calculations (see Figure 3-39). Select either the Run with Weather or the Run with Billing Data from the **Run** submenu list to initiate MHEA calculations. You may use any of the methods described in section 1.3, Navigating Through MHEA, to select the **Run** menu and submenu items.

If information is missing or if a required input screen was not completed, MHEA will display a message asking for the missing data before the calculations are initiated.

You may view the results at any time without rerunning the program calculations. If you changed any of the input or setup data, then you must rerun the calculations to update the results. Results may be viewed by selecting the **View** menu item.

Figure 3-39 **Run** Menu Options

3.4.1 Run with Weather

Select the Run with Weather submenu option to initiate MHEA calculations using weather data for the city you specified on the Weather Data screen (see Section 4.7, Choose a City).

3.4.2 Run with Billing Data

Select the Run with Billing Data submenu option to initiate MHEA calculations that will use the utility billing information you entered on the "Billing Data" screens (see Section 3.2.5, Billing Data).

NOTE When you enter billing data and have MHEA calculate a base-load usage, MHEA may not be able to identify a unique base-level value. If a warning message appears (see Figure 3-40), you should review the utility data and supply your best estimate in the "self-determined base load" box on the billing data entry screen. Also note that if you have entered electric utility bill information for both heating and cooling, you should supply your best "self-determined base load" estimate separately for the heating and cooling seasons.

The screenshot shows the 'Heating Utility Bill Data' window in the MHEA 1.25 software. A central 'NOTICE' dialog box is displayed with the text: 'Base load determination is ambiguous. You may want to provide an user-determined value.' Below the text is an 'OK' button. The background window contains several input fields for billing data. On the left, there is a table with columns for Month, Day, # of Days, Therms, and HDD. The table has 10 rows, each with input boxes containing the number 0. To the right of the table, there are fields for 'Base Temperature for DD Values:' (0), 'Base Load' (0), 'Therms/Month' (0), 'Calculated Base Load' (0), and 'Self-determined Base Load' (0). At the bottom right, there are 'OK' and 'Cancel' buttons. The top of the window has a menu bar with 'File', 'Inputs', 'Run', 'View', 'Quit', 'Setup', 'Help', and 'MHEA 1.25'. The bottom status bar reads: 'For Help press the RIGHT mouse button on FILE - Audit File Name: MHEA26-2'.

Month	Day	# of Days	Therms	HDD
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Figure 3-40 MHEA Run Message Screen

3.5 View the Reports

You may display a summary of the input data, energy and economic calculation results, and comments on the computer screen by selecting submenus from within the View main menu item (see Figure 3-41). Select the menu and submenu items using any of the methods described in Section 1.3, Navigating Through MHEA.

NOTE You cannot edit information on any of the screens displayed in the View menu. You must reopen input and setup screens to revise the information. After revising input and setup data, rerun the calculations to include the new information.

Figure 3-41 View Menu Options

3.5.1 Inputs

The data you entered on the input screens are displayed in a condensed form when you select the Input submenu option found within the View main menu. You can only view the display. You cannot change the data on these screens. Reopen the appropriate input screen if changes are necessary (see Section 3.3, Edit the Input Data).

The View Inputs screen has a scroll bar along the right side of the screen so you can view all the input information (see Section 1.5.5, Scroll Bars). Activate the scroll bar using either the mouse or the keyboard as was described in Section 1.3, Navigating Through the MHEA.

3.5.2 Results

Display the energy use and cost analysis calculation results by selecting the Results submenu found within the View main menu item. The calculation results are divided between four screens: the "Savings", "Savings-to-Investment Ratio", "Costs", "Billing", and "Sizing" screens. Each of these screens is described in more detail in Sections 3.5.2.

All results screens have a scroll bar along the right side of the screen. If there is more information than can be displayed in one screen, use the methods for activating the scroll bar that were described in Section 1.5.5, Scroll Bars, to view the entire results screen.

On the "Savings", "SIR", and "Costs" results screens, the recommended retrofit measures are listed according to their SIR, with the retrofit having the highest SIR listed first. There are two exceptions to this ordering. It is assumed by MHEA that duct sealing and furnace replacement are completed before other retrofits are installed and that general air sealing is always completed after all other retrofits have been installed. The duct-sealing and furnace replacement retrofits, if applied, are then always listed first, regardless of how their SIR values compare to the SIR value of the next retrofit listed. The same is true for general air sealing except this retrofit, if applied, is always listed last. Because of this ordering, there could be some cases where the duct sealing and furnace replacement retrofits have SIR values less than those of the next retrofit measure listed, and the general air sealing retrofit could have a SIR value larger than the previous retrofit measure listed.

3.5.2.1 Savings

The cumulative annual energy and cost savings of the recommended retrofit measures for the manufactured home being evaluated are shown on the "Annual Savings" results screen (see Figure 3-42). Cumulative reporting of the results means that the effects of all retrofit measures listed up to the measure you are interested in are considered. For example, the energy and cost savings for the second measure on the list are calculated assuming the first measure has been installed. The results reported for the third measure on the list assume that the first and second measures are also both installed, and so on.

File Inputs Run Quit Setup Help MHEA-138

1 ANNUAL SAVINGS 1

Client Name: Doe, Jane
 Address: 1 Mobile Home Way
 Mobile Home, State 12345
 Weather Site: Denver, CO
 Audit Date: 7/1/1997
 Auditor: JRW
 Job Number: 123456789

Cumulative Annual Savings

Recommended Measures	Heating (MMBtu)	Heating (\$)	Cooling (kWh)	Cooling (\$)	Total (MMBtu)	Total (\$)
Seal Ducts	1.4	36	0	0	1.4	36
Belly Cellulose Loose	23.1	579	0	0	23.1	579
Plastic Storm Windows	24.1	603	0	0	24.1	603
Wall Fiberglass Batt	33.1	827	-41	-4	32.9	824
Roof Fiberglass Loose	36.2	906	-41	-4	36.1	902
General Air Sealing	45.8	1147	-41	-4	45.7	1143

Annual Consumption

	Heating (MMBtu)	Cooling (kWh)
Pre-Weatherization	70.3	162

Okay

For Help press the RIGHT mouse button or F1. Audit File Name: TEST

Figure 3-42 The "Annual Savings" Screen

Savings for each measure are given near the end of the "Annual Savings" screen. Sum the savings for a particular measure with the savings of previous measures and you will have calculated the cumulative savings value for that particular measure listed earlier on the Annual Savings screen. For example, to find the cumulative savings for the second measure, sum the savings for the first and second measures. To find the cumulative savings for the third measure, sum the savings for the first, second and third measures, and so on.

Finally, a message at the end of the "Annual Savings" screen indicates if, according to MHEA calculations, the heating load is larger than the capacity of the manufactured home furnace. Months in which the heating equipment cannot meet the load are reported by number, where 1 = January, 2 = February, and so on. During the months the heating equipment cannot meet the heating load, the heating equipment is operating essentially continuously throughout the month. If no month numbers are given, then the heating equipment capacity is either equal to or greater than the heating load.

3.5.2.2 SIR

SIRs for the recommended retrofit measures are shown on this results screen (see Figure 3-43). The recommended measure's individual annual savings, installation costs, and SIR values are given as well as the cumulative values of these results. You will notice that the cumulative annual savings column is identical to the Total \$ column on the "Savings" screen (see Section 3.5.2.1, Savings). The retrofit measure individual costs are the sum of the material, labor, and other costs for the particular

measure. You may view the costs breakdown on the "Costs" results screen (See Section 3.5.2.3). You may adjust retrofit measure costs by revising the information on the "Measure Cost" setup screen (see Section 4.1, Update Measure Costs).

Cumulative reporting of the results means that the effects of all retrofit measures listed up to the measure you are interested in are considered. For example, the energy savings, costs, and SIR values for the second measure on the list are calculated assuming the first measure has been installed. The results reported for the third measure on the list assume that the first and second measures are also both installed, and so on.

SAVINGS-TO-INVESTMENT RATIOS

Client Name: Doe, Jane
 Address: 1 Mobile Home Way
 Mobile Home, State 12345
 Weather Site: Denver, CO
 Audit Date: 7/1/1997
 Auditor: JRM
 Job Number: 123456789

Recommended Measures	Measure			Cumulative		
	Savings (\$/year)	Costs (\$)	SIR	Savings (\$/year)	Costs (\$)	SIR
----- (Other Costs Not Included in SIR Calculations) -----						
Seal Ducts	36	96	1.6	36	96	1.6
Belly Cellulose Loose	543	210	35.2	579	306	24.7
Plastic Storm Windows	24	18	16.3	603	324	24.2
Wall Fiberglass Batt	221	387	7.1	824	711	14.9
Roof Fiberglass Loose	79	234	3.8	902	946	12.2
General Air Sealing	241	55	60.2	1143	1001	14.8
----- MHEA v1.38, 5/97 -----						

Ok

For Help press the RIGHT mouse button or F1 | Audit File Name: TEST

Figure 3-43 The "Savings-to-Investment Ratios" Screen

3.5.2.3 Costs

The material quantity, cost breakdown, and cumulative costs for each of the recommended retrofit measures are shown on this results screen (see Figure 3-44). Material quantity unit abbreviations are explained in Table 3.1. Costs for each measure are divided between material costs, labor costs to install the measure, other costs associated with the measure (if you indicated on the "General Information" input screen to include these costs), and the sum of these three categories. The cumulative total costs are also displayed.

Table 3-1 Abbreviations Found on the Costs Results Screen

Abbreviation	Definition
ea.	each
sf.	square feet
bg.	bags of insulation
ui.	united inch (window measurement)

NOTE A united inch (ui.) is the method used by MHEA for measuring the size of a window. It is equivalent to the length plus the width of the window. If the size of a window is 24"x36", it's equivalent dimension will be 60 ui.

COST BREAKDOWN

Client Name: Doe, Jane
 Address: 1 Mobile Home Way
 Mobile Home, State 12345
 Weather Site: Denver, CO
 Audit Date: 7/1/1997
 Auditor: JRW
 Job Number: 123456789

Recommended Measures	Material Quantity	Costs			Cumulative	
		Material (\$/Measure)	Labor (\$/Measure)	Other (\$/Measure)	Total (\$/Measure)	Total Cost (\$)
(Other Costs Not Included in SIR Calculations)						
Seal Ducts	1 ea	36	60	0	96	96
Belly Cellulose Loose	19 bg	46	64	100	210	306
Plastic Storm Windows	13 sf	16	2	0	18	324
Wall Fiberglass Batt	656 sf	171	216	0	387	711
Roof Fiberglass Loose	10 bg	34	100	100	234	946
General Air Sealing	1 ea	30	25	0	55	1001

MHEA v1.38, 5/97

OK

For Help, press the RIGHT mouse button or F1. Audit File Name: TEST

Figure 3-44 The "Cost Breakdown" Screen

Cumulative reporting of the results means that the effects of all retrofit measures listed up to the measure you are interested in are considered. For example, the total costs for the second measure on the list are calculated assuming the first measure has been installed. The results reported for the third measure on the list assume that the first and second measures are also both installed, and so on.

Material, labor, and other costs for each measure may be adjusted by accessing the "Measure Costs" submenu found within the **Setup** main menu item (see Section 4.1, Update Measure Costs).

3.5.2.4 Billing

The billing information you entered on the "Billing Input" screen (billing period, actual consumption, and degree-days) and MHEA predicted monthly energy consumption and degree-days are displayed on the "Billing Comparison" results screen (see Figure 3-45). For your information, the percent difference between the actual and the predicted total consumption is also shown.

NOTE If you adjust the billing data after MHEA has completed its calculations using a previous set of billing data, you must rerun the calculations to include the adjusted billing data.

Period End Date	Days in Period	Consumption (Therms)		Degree Days (Base 65 F)	
		Actual	Predicted	Actual	Predicted
1/15	31	425	150	0	1070
2/15	31	425	149	0	1097
3/15	28	332	109	0	855
4/15	31	225	80	0	732
5/15	30	127	29	0	435
6/15	31	0	7	0	227
7/15	30	2	0	0	80
8/15	31	0	0	0	47
9/15	31	125	0	0	134
10/15	30	227	14	0	329
11/15	31	325	64	0	658
12/15	30	427	120	0	928
Total	365	2638	721	0	6590
Percent Difference		-72.7%			

Period	Days in Period	Actual	Predicted	Actual	Predicted
--------	----------------	--------	-----------	--------	-----------

Figure 3-45 The "Billing Comparison" Screen

3.5.2.5 Sizing

MHEA provides an estimate of the output of the heating equipment size that will meet heating requirements for the home described by the audit data (see Figure 3-46). Sizing calculations are based on the method outlined by "Manual J: Load Calculation for Residential Winter and Summer Air Conditioning," (Seventh Addition, 1986) published by and used with the permission of the Air Conditioning Contractors of America.

Manual J heating load calculations use a simple temperature difference approach for conduction, natural infiltration, and duct heat losses. The indoor temperature is assumed to be 70° F and the outdoor design temperature varies with location.

Conduction heat loss is the sum of thermal conductance of all components of the home's envelope multiplied by the design temperature difference. Infiltration and duct heat loss are the product of each respective estimated air exchange rate and the design temperature difference.

MHEA differs from the standard Manual J calculations in the following ways: (1) the thermal resistance of various building components is taken from specific construction details in the audit rather than from generalized tables published in Manual J; (2) calculations are done on the home as a whole, rather than room-by-room; and (3) duct losses are based on a factor determined for the home as a whole, rather than by zone.

Duct losses, when ducts are present, are based on Manual J Table 7A for insulated or uninsulated ducts in unheated spaces with supply air temperatures up to 120° F.

The sizing report summarizes the estimated heat loss contribution of various building components before and after weatherization. The design temperature and duct loss factors used in the calculations are reported in the notes which follow the summary table.

MHEA Heating Sizing Report Project Name: DEMO

Client Name: MHEA Audit Sample
Address: 123 AnyStreet
Anytown, USA 12345
Weather Site: Chicago, IL
Audit Date: 08/29/1997
Auditor: R.E. Duce
Job Number: 12345

Modified Manual-J Heating System Sizing Estimate **

	Pre-Weatherization (Btu / Hour)	Post-Weatherization (Btu / Hour)
Wall	18413	6242
Floor	8888	5969
Roof	18479	3628
Windows	6682	3341
Doors	314	279
Infiltration	7547	2620

Okay

Help Press the F1 key, mouse button or F1 Audit File Name: DEMO

Figure 3-46 The "Sizing Comparison" Screen

3.5.3 Comments

The Comments submenu found within the **View** main menu item displays text you have entered on the "Comments" screen accessed from within the **Inputs** main menu.

The Comments screen is viewed by selecting the "Comments" option within the **View** main menu. You cannot edit comments while displaying the Comments screen from within the **View** main menu. To revise the text shown on this screen, open the Comments screen from within the **Inputs** menu (see Section 3.2.6, Comments).

4.0 Customizing MHEA Parameters Using the Setup Menu

In this chapter, you will learn how to review and adjust data used for the program calculations by selecting submenus under the **Setup** main menu item. Cost information, program default values, candidate weatherization retrofit measures, and weather information are all parameters you may customize in MHEA. You may revise these parameters either for a particular project file or for all project files you evaluate.

If you decide to change **Setup** screen values for all project files, enter the updated information on the appropriate screens and select the **Reset Default Data** button located in the lower left corner of the **Setup** screens. After selecting this button, all the values you revised will be automatically applied to all future project files you evaluate. The default information will not change until you readjust the values and again select the **Reset Default Data** button.

You may revise **Setup** screen values for a particular project and not for all project files evaluated in the future. Update information on the appropriate screen and select the screen **Okay** button. The changes you have made to the **Setup** screen will be remembered by the program for the particular project file that you have open when the setup screen changes are made. You do not need to revise the setup screens every time you want to reevaluate that project file. The revisions will also not affect other project files you are evaluating. This feature is especially useful if, for example, there is an extra one-time cost associated with a particular retrofit measure that should not be included when that retrofit measure is evaluated in other project files.

4.1 Update Measure Costs

The "Retrofit Measure Cost Data" screens contain cost information for all retrofit measures evaluated by MHEA (see Figure 4-1). You may revise the estimated life of the measure and the material, labor, and extra costs for each measure. Use any of the methods described in Section 1.3, Navigating Through MHEA, to edit the "Measure Cost" screen.

NOTE You may permanently change the default values on the **Setup** screens by selecting the **Reset Default Data** button located in the lower left corner of all **Setup** screens. After selecting this button, MHEA will use the revised default data when evaluating all future project files until you change it again. If you wish to change the default data for one project file only, select the **Okay** button (located in the lower right corner of the **Setup** screens). The revisions you have made will be stored with the project file you had open when the setup screen changes were made. You do not need to change the **Setup** information every time you want to evaluate that particular project file.

File Inputs Run View Quit Setup Help MHEA 1.24

Retrofit Measure Cost Data

SCREEN 1 OF 4 VIEW

Retrofit Description	Life (yr)	Units	Material Cost (\$/Unit)	Labor Cost (\$/Unit)	Extra Cost (\$/Measure)
Wall Fiberglass Batt	20	SF	0.26	0.33	0.00
Wall Cellulose Loose	20	SF	0.24	0.34	100.00
Wall Fiberglass Loose	20	SF	0.18	0.44	100.00
Belly Cellulose Loose	20	SF	0.24	0.34	100.00
Belly Fiberglass Loose	20	SF	0.18	0.44	100.00
Roof Cellulose Loose	20	SF	0.22	0.39	100.00
Roof Fiberglass Loose	20	SF	0.15	0.44	100.00
Add Skirting	5	SF	0.05	0.05	0.00

For Help, press the RIGHT mouse button or F4 | Audit File Name: BLDGBASE

Figure 4-1 The "Retrofit Measure Cost Data" Screen

There are more retrofit measures than can be displayed on one screen. The retrofit measures have been divided into groups, and each group is displayed on separate screens. In the top left corner of each screen is a message that shows which screen out of the total number of "Cost Data" screens you are viewing. For example, if you are viewing the first screen that appears when you select the Measure Costs submenu, the message will say, "Screen 1 of 4." You may move through the screens by using the View buttons located in the top right corner of the "Cost Data" screens.

View Buttons

You may view other "Cost Data" screens by selecting View buttons. Changes may be made to "Cost Data" screens you have accessed using the View buttons.

Next

Select the Next button to move through the screens in ascending order. For example, if screen 1 of 4 is displayed and you click onto the Next button, screen 2 of 4 will appear.

Previous

Select the Previous button to move through the screens in descending order. For example, if screen 2 of 3 is displayed and you click onto the Previous button, screen 1 of 3 will appear.

Retrofit Description

The Retrofit Descriptions, listed in the left column of the "Cost Data" screens, are short phrases describing each measure that MHEA can evaluate. You cannot alter this text.

Life

This is the expected length of time a measure is effective before wear, weather, or other damage usually occurs and the measure should be replaced. These values are listed in the second column of the "Cost Data" screens. Because MHEA calculates savings-to-investment ratios over a 20-year period, you cannot enter values for measure life of more than 20 years or less than 0 years. Enter the value as a whole number of years. For example, if a retrofit measure has an expected life of 5-1/2 years, enter either 5 or 6 years.

Units

The unit of measurement for each measure is listed in the Units column. You cannot revise these abbreviations. Abbreviations used on the "Cost Data" screens are given in Table 4-1.

Table 4-1 Abbreviations Found in the Cost Data Setup Screen

Abbreviation	Definition
ea.	each
sf.	square feet
ui.	united inch (window measurement)

NOTE A united inch (ui.) is the method used by MHEA for measuring the size of a window. It is equivalent to the length plus the width of the window. If the size of a window is 24"x36", it's equivalent dimension will be 60 ui.

NOTE Loose insulation costs are to be entered on a per square foot basis where the square footage refers to the gross area of the wall, roof, or belly. For example, if wall insulation is to be added to an 8 ft. x 60 ft. wall (total wall area is 480 ft²) and if the material cost is \$50, then the cost per square foot is \$0.104/ft². MHEA assumes 24-pound bags of insulation where the bag volume is 7.5 ft³/bag for cellulose and 15 ft³/bag for fiberglass. Because the costs are entered on a per square foot basis, MHEA converts the calculated bags of insulation to an equivalent square feet number assuming an insulatable cavity depth of 3, 9, and 8 inches for wall, belly, and roof, respectively.

Material Cost

This column contains estimated costs to purchase the materials for a retrofit measure. To revise this information, enter the new cost in dollars and cents per unit measurement. For example, if a retrofit has a unit measurement of square feet, the cost entered should be equivalent to \$XX.XX/sq. ft.

Labor Cost

The cost of labor to install the retrofit measure is shown in the Labor Cost column. To revise this information, enter the new cost in dollars and cents per unit measurement. For example, if a retrofit has a unit measurement of square feet, the cost entered should be equivalent to \$XX.XX/sq. ft.

Extra Cost

The far right column on the "Cost Data" screen contains extra costs for each measure. Extra costs are those other than material and labor costs that are associated with a particular retrofit measure. These costs may include setup or repair costs necessary for the retrofit measure installation (for example, the cost of operating the equipment to blow loose insulation into the floor, wall, or roof sections of the manufactured home). Note that the costs should be entered in dollars and cents per measure. Added costs will be applied only to the corresponding retrofit measure during MHEA calculations.

4.2 Revise Fuel Costs

Adjust the fuel costs assumed by MHEA by selecting the Fuel Cost submenu option found within the **Setup** menu (see Section 1.3, Navigating Through MHEA and see Figure 4-2). The fuel costs that are initially stored with MHEA are national average values. You may wish to update these costs to reflect local fuel prices.

Natural Gas (1000 cf)	#2 Fuel Oil (gallons)	Electricity (kwh)	Propane (gallons)	Wood (cord)	Coal (ton)	Kerosene (gallons)
5.2635	1.199	8.8854	1.879	128	126	1.299

Buttons: Back, Quit, Save, Cancel

Status Bar: For help press the RIGHT mouse button or F1 | Audit File Name: DEM01-23

Figure 4-2 The "Fuel Costs" Screen

Enter the fuel prices in dollars per unit of fuel. For example, enter a cost for natural gas in \$/1,000 cubic feet.

NOTE Natural gas quantities are typically reported as per 1,000 cubic feet or as therms. These are equivalent units of measurement. 1,000 cubic feet = 1 therm.

NOTE You may permanently change the default values on the **Setup** screens by selecting the **Reset Default Data** button located in the lower left corner of all **Setup** screens. After selecting this button, MHEA will use the revised default data when evaluating all future project files until you change it again. If you wish to change the default data for one project file only, select the **Okay** button (located in the lower right corner of the **Setup** screens). The revisions you have made will be stored with the project file you have open when the setup screen changes were made. You do not need to change the **Setup** information every time you want to evaluate that particular project file.

4.3 Adjust Fuel Escalation Rates

The fuel escalation rates as determined by the U.S. Department of Energy are displayed on this screen (see Figure 4-3). DOE issues new fuel escalation rate values annually.

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
	1.02	1.04	1.05	1.07	1.09	1.12	1.15	1.19	1.22	1.26	1.29	1.32	1.35
Year	13	14	15	16	17	18	19	20	21	22	23	24	25
	1.38	1.41	1.44	1.49	1.52	1.55	1.58	1.60	1.63	1.66	1.68	1.71	1.73

See Figure 4-3 The "Fuel Escalation Rates" Screen

NOTE You may permanently change the default values on the **Setup** screens by selecting the **Reset Default Data** button located in the lower left corner of all **Setup** screens. After selecting this button, MHEA will use the revised default data when evaluating all future project files until you change it again. If you wish to change the default data for one project file only, select the **Okay** button (located in the lower right corner of the **Setup** screens). The revisions you have made will be stored with the project file you had open when the setup screen changes were made. You do not need to change the **Setup** information every time you want to evaluate that particular project file.

Select a Fuel Type

Press the **Select Fuel Type** button to list the heating fuel types that can be evaluated by MHEA (see Figure 4-4). Select a fuel type by highlighting the desired fuel using either your mouse or keyboard (see Section 1.3, Navigating Through MHEA). When you leave the selection list (by pressing the **Okay** button located at the bottom of the **Select the Fuel Type** box), MHEA will return to the "Fuel Escalation Rates" screen with the fuel you have selected listed as the **Current Fuel Type**.

Figure 4-4 The "Select the Fuel Type" Screen

Enter the escalation rates for all 25 years for the fuel type you have selected. Year 0 is the current year. Year 1 is the next year. Year 2 is two years from the current year and so on. For example, if the current year is 1997, year 1 is 1998, year 2 is 1999, and so on.

4.4 Select Candidate Measures

Choose the retrofit measures to be included with MHEA calculations by placing a check mark by those measures to be evaluated (see Figure 4-5). Remove the check mark from a checked box or add a check mark to an empty box by highlighting the appropriate check box and pressing the left mouse key or enter. You may also use the CTRL/letter or ALT /letter key method (see Section 1.3, Navigating Through MHEA). All checked measures are considered during MHEA calculations.

The retrofit measures listed on the "Candidate Measures" screen are described in more detail in Appendix B, Retrofit Measures.

4.5 Change MHEA Defaults

Adjust MHEA default values to more accurately reflect characteristics of the housing stock you are evaluating. Select the Default Values submenu to make changes either to the input screen defaults or to the values used during MHEA calculations see Section 1.3, Navigating Through MHEA.

NOTE You may permanently change the default values on the **Setup** screens by selecting the Reset Default Data button located in the lower left corner of all **Setup** screens. After selecting this button, MHEA will use the revised default data when evaluating all future project files until you change it again. If you wish to change the default data for one project file only, select the Okay button (located in the lower right corner of the **Setup** screens). The revisions you have made will be stored with the project file you had open when the setup screen changes were made. You do not need to change the **Setup** information every time you want to evaluate that particular project file.

4.5.1 Input Screen Defaults

Adjust default values appearing on the Inputs screens by selecting the **Inputs** option from the second submenu list that appears when you select the Default Values submenu (see Figure 4-6). Choose the input screen you wish to alter (see Figure 4-7). On all input screens, you may adjust all but one set of input defaults. Make the appropriate changes by placing check marks and entering new information in the editable fields. When you are satisfied with the new defaults, select the Reset Default Data button located in the lower right corner of each input screen.

Figure 4-7 The "Wall Defaults" Screen

File Inputs Run View Quit
Setup Help MHEA 2.89

For help press the RIGHT mouse button or F1. Audit File Name: <None>

Reset Default Data Cancel

Measure Costs

Wall Defaults

Generation of one long wall for home

North South East West

Insulation type thickness

Batt/Blanket (in): 0.00

Loose Fill (in): 0.00

Foam Core (in): 0.00

West East South North

Caprot/Porch

Length (ft): 0.0

Width (ft): 0.0

Root Dimensions

North South East West

Foot of Japetion

Wall Stud Size

2"x2" 2"x3" 2"x4" 2"x6"

✓

Wall Ventilation

✓ Ventilated

Not Ventilated

Reset Default Data Cancel

Figure 4-6 The Inputs Default Values Submenu Tree

File Inputs Run View Quit
Setup Help MHEA 2.89

For help press the RIGHT mouse button or F1. Audit File Name: <None>

Measure Costs

Fuel Costs

Fuel Escalation Rates

Candidate Measures

Cost Values

Install Weather Data

Remove Weather Data

Choose Weather File

General

Equipment

Additions

Floor

Window

Door

Ceiling

4.5.2 Default Parameters

Adjust default values used in internal MHFA calculations by selecting the **Parameters** option from the second submenu list that appears when you select the **Default Values** submenu (see Figure 4-8).

Figure 4-8 The Parameters Default Values Submenu Tree

There are more default parameters than can be displayed on one screen. The default parameters have been divided into groups, and each group is displayed on separate screens (see Figure 4-9). In the top left corner of each screen is a message that shows which screen out of the total number of "Default Parameters" screens you are viewing. For example, if you are viewing the first screen that appears when you select the Parameters submenu, the message will say, "Screen 1 of 11." You may move through the screens by using the View buttons located in the top right corner of the "Default Parameters" screens.

View Buttons

You may view other "Default Parameters" screens by selecting View buttons. Changes may be made to "Default Parameters" screens you have accessed using the View buttons.

Next

Select the Next button to move through the screens in ascending order. For example, if screen 1 of 10 is displayed and you click onto the Next button, screen 2 of 10 will appear.

Previous

Select the Previous button to move through the screens in descending order. For example, if screen 2 of 10 is displayed and you click onto the Previous button, screen 1 of 10 will appear.

Parameter	Description	Units	Value
0	Real Discount Rate	%	3.11
1	Minimum Acceptable SIR	Factor	1.00
2	Free heat from interior sources - Day	Btu/h	2400.00
3	Free heat from interior sources - Night	Btu/h	1000.00
4	Length of day for thermostat setback	Hours	16.00
5	Thermostat setback amount	Degrees F	5.00
6	Duct sealing distribution loss reduction	%	50.00
7	Duct insulation dist. loss reduction	%	10.00

Figure 4-9 The "Default Parameters" Screen

Parameter Description

Text that describes default calculation parameters used by MHEA is listed in the left column of the "Default Parameters" screens. You cannot alter this text.

Parameter Units

The units for the default calculation parameters are listed in the second column on the "Default Parameters" screens. You cannot alter this text.

Value

The default value for each parameter is listed in the far right column on the "Default Parameters" screens. These are the values you adjust to more accurately reflect the housing stock you are evaluating.

Real Discount Rate

The real discount rate adjusts the economic calculations for inflation. DOE annually determines the discount rate to be used. An unaltered rate may be used for weatherization economic evaluations for up to 5 years. A higher rate than that determined by DOE may be used if the adjusted rate is within the range of 3% to 10%. For more information, refer to section 440.21 (i) of the DOE rule, titled

"Weatherization Assistance Program for Low-Income Persons" approved in March 1993.

Minimum Acceptable SIR

Enter the minimum acceptable SIR value to be used during MHEA economic evaluation. The minimum acceptable SIR value for retrofit measures interactive effect is 1 according to the DOE rule, "Weatherization Assistance Program for Low-Income Persons" approved in March 1993.

Free Heat from Interior Sources-Day, Night

Free heat is the heat resulting from activities taking place within the home. MHEA initially assumes a daytime free heat daytime load of 2,400 Btuh from occupant activities that include cooking, hot water use, appliance use, and lighting. The MHEA assumed free heat nighttime heat load is 1,000 Btuh for occupants at rest, miscellaneous appliances that operate continuously (electric clocks, etc.) and lighting.

Length of Day for Thermostat Setback

MHEA assumes that if an automatic setback thermostat is in use, the length of a day is 16 hours. If the occupants adjust the nighttime thermostat setting for something other than 8 hours, adjust the length of day value used in the setback thermostat calculations.

Thermostat Setback Amount

MHEA assumes an automatic setback thermostat adjusts the indoor temperature by +/- 5° F. For example, during the heating season, MHEA assumes the nighttime indoor temperature will be 5° F lower at night than during the day. This 5° F assumption is adjusted by revising the Thermostat Setback Amount default parameter.

Duct-Sealing, Duct Insulation Distribution Loss Reduction

The duct distribution loss is the supply air lost to the outside through holes in the duct that does not reenter the living space. The percent reduction in the duct distribution loss because of duct sealing or insulating around the ducts is the Duct Sealing, Duct Insulation Distribution Loss Reduction. Insulating around the ducts usually is a result of filling the belly or roof cavity with loose insulation.

Batt/Blanket, Loose, Rigid, Foamcore Insulation R-Value Per Inch

Enter the R-value per inch for the insulation to be used in MHEA energy calculations. This value is used to evaluate the insulating effect of existing insulation described on the input screens as well as the insulating effect of new insulation added during weatherization. Note that rigid insulation is typically found in the roof section and that foamcore insulation is typically found in the wall sections of the manufactured home.

Door U-Value-Wood with Solid Core, Wood with Hollow Core, Standard Manufactured Home Door

Enter the U-value for the door. This value is used to evaluate the insulating effect of the existing doors described on the input screens. If the existing doors do not fit this or the other door descriptions, enter the appropriate U-value for the door type chosen to represent the existing manufactured home door and note the difference on the "Comment" screen (see Section 3.2.6, Comments). Note that MHEA assumes a standard manufactured home door has a solid core and a vinyl or fiberglass skin.

U-Value of Replacement Door

Enter the U-value for a replacement manufactured home door. This value is used to evaluate the insulating effect of the replacement doors.

Interior Ceiling R-Value: Summer, Winter

Enter the R-value of the interior ceiling components for the summer and winter seasons. The ceiling components may simply include the ceiling material and the surface resistance of the air. Refer to literature related to approximating R-values of building components for further detail.

Interior Floor R-Value: Summer, Winter

Enter the R-value of the interior floor components for the summer and winter seasons. The floor components may simply include the flooring material, floor covering, and the surface resistance of the air. Refer to literature related to approximating R-values of building components for further detail.

Interior Wall R-Value: Summer, Winter

Enter the R-value of the interior wall components for the summer and winter seasons. The wall components may simply include the interior wall material and the surface resistance of the air. Refer to literature related to approximating R-values of building components for further detail.

Outside Wall R-Value: Summer, Winter

Enter the R-value of the outside wall components for the summer and winter seasons. The wall components may simply include the exterior wall material and the surface resistance of the air. Refer to literature related to approximating R-values of building components for further detail.

Window U-Value: Summer, Winter

Enter the U-value of the windows with no storm windows for the summer and winter seasons. Refer to manufacturer's literature or literature related to approximating window U-values for further detail.

Window U-Value with Glass Storm: Summer, Winter

Enter the U-value of the windows with a glass storm for the summer and winter seasons. Refer to manufacturer's literature or literature related to approximating window U-values for further detail.

Window U-Value with Plastic Storm: Summer, Winter

Enter the U-value of the windows with a plastic storm for the summer and winter season. Refer to manufacturer's literature or literature related to approximating window U-values for further detail.

Skylight U-Value: Summer, Winter

Enter the U-value of the skylights with no storms for the summer and winter seasons. Refer to manufacturer's literature or literature related to approximating skylight U-values for further detail.

Skylight U-Value with Glass Storm: Summer, Winter

Enter the U-value of the skylights with a glass storm for the summer and winter seasons. Refer to manufacturer's literature or literature related to approximating skylight U-values for further detail.

Skylight U-Value with Plastic Storm: Summer, Winter

Enter the U-value of the skylights with a plastic storm for the summer and winter seasons. Refer to manufacturer's literature or literature related to approximating skylight U-values for further detail.

Window Shading R-Value, Blinds or Shades, Drapes, Drapes and Shades

Enter the R-value of the interior window covering. Refer to manufacturer's literature or literature related to approximating R-values of interior window shading devices for further detail.

Ratio of Awning Depth to Window Height

Enter the ratio of the exterior window awning depth to the height of the window (depth/height). The depth of the awning is the distance the awning extends from the exterior of the manufactured home. This value is used to calculate the shading effect of the awning on the window.

Sun Screen Solar Transmittance Reduction: Summer, Winter

Enter the percent reduction of solar transmittance in the summer and winter due to an exterior window sun screen. The solar transmittance is the fraction of solar energy that travels through the window into the living space of the manufactured home. Refer to manufacturer's literature or literature related to sun screen solar transmittance for further detail.

Heating Efficiency: Natural Gas, Electric, Heat Pump, Propane, Oil, Kerosene, Coal, Wood

Enter the heating efficiency of the heating equipment. The heating efficiency is the fraction of heat supplied to the living space by the equipment after fuel is consumed to produce the heat. The efficiency entered should be for the heating equipment only and not take into account the air supply system.

NOTE the electric furnace is 100% efficient as long as it is located in the living space of the manufactured home. If the electric furnace is located in a closet with an exterior access, the heating efficiency should be derated.

NOTE The heating efficiency of a heat pump is analogous to the heating coefficient of performance (COP). For example, if the heating COP is 2, the efficiency is 200%. The COP can be calculated from the heat pump seasonal performance factor (HSPF) by dividing the HSPF value by 3.413.

Tune-Up Heating Efficiency: Natural Gas, Oil, Propane, Kerosene, Coal, Wood

Enter the heating efficiency of the heating equipment after a system tune-up. The heating efficiency is the fraction of heat supplied to the living space by the equipment after fuel is consumed to produce the heat. The efficiency entered should be for the heating equipment only and not take into account the air supply system.

Replacement Heating Efficiency: Natural Gas, Oil, Propane, Kerosene

Enter the heating efficiency of the replacement heating equipment. The heating efficiency is the fraction of heat supplied to the living space by the equipment after fuel is consumed to produce the heat. The efficiency entered should be for the heating equipment only and not take into account the air supply system.

Cooling System Fan Power

Enter the fan power of the cooling system fan. This value is used in the equipment cooling capacity and equipment energy consumption calculations.

Evaporative Cooler Actual Saturating Efficiency

Enter the actual saturating efficiency of the evaporative cooler. Refer to manufacturer's literature or literature describing evaporative cooler operation for actual saturating efficiency values.

Saturating Efficiency for Evaporative Tune-Up

Enter the saturating efficiency after a tune-up has been performed on an evaporative cooler.

Saturating Efficiency for Evaporative Replacement

Enter the saturating efficiency of a replacement evaporative cooler. The manufacturer's literature should help indicate the new evaporative cooler saturating efficiency.

Home Leakiness Parameter: Tight, Medium, Loose

Enter the infiltration value assumed by MHEA for a manufactured home of tight, medium, and loose construction. This value will be used to evaluate the home energy consumption and the benefits of infiltration reduction measures. The home leakiness is indicated on the "General Information Input" screen (see section 3.2.1, General Information).

Target Post-Retrofit Home Infiltration

Enter infiltration rate to which you plan to bring the manufactured home after installing a package of retrofit measures. MHEA will use this value when calculating the effectiveness of the general air-sealing retrofit measure.

Spending Limit for Package of Measures

Enter the maximum amount of money, in dollars, to be spent on a package of measures to retrofit the home. If the costs exceed this value a message will appear in the "Costs" screen found in the **Results** menu.

4.6 Install/Remove Weather Data

You must install weather data onto your computer in order to run MHEA. If you choose a city (see Section 4.7, Choose a City) that has not been installed and try to run MHEA you will be asked to install that city's weather data.

Install Weather Data

Select the Install Weather Data submenu from the **Setup** menu. MHEA will then ask you to insert the MHEA disk into the floppy disk drive. Press **Okay** if the disk is in the drive or press **Cancel** if it is not. After inserting the MHEA disk into drive A: and selecting the **Okay** button the software will again ask you if the disk has been inserted into the floppy disk drive. If it has, select the **Okay** button again and the "Check Weather Files to Install" screen (see Figure 4-10) will then appear. Use the left mouse button to click on the cities that you would like to install. A check mark will appear next to those cities. Press the **Okay** button if cities that you wish to install have check marks next to them. Press the **Cancel** button if you do not wish to install any weather files.

NOTE The Chicago, Illinois, weather file (chicagil.wx) is installed as the default weather file when you install the software (see Section 1.2).

WARNING You can only install weather files from a disk located in your A: drive. If you do not have a disk for your A: drive, copy the files weather.exe and weather.lst onto a disk that is properly formatted for your A: drive or contact the DOE Weatherization Assistance Program.

Remove Weather Data

Select the Remove Weather Data submenu from the **Setup** menu. The "Check Files to Erase" screen will appear. Use the left mouse button to click on the cities that you would like to remove. A check mark will appear next to those cities. Press the **Okay** button if cities that you wish to remove have check marks next to them. Press the **Cancel** button if you do not wish to remove any weather files.

4.7 Choose a City

Select the Choose Weather File submenu to choose a city for which weather data will be used during MHEA calculations (see Figure 4-11). Use any of the methods described in Section 1.3, Navigating Through MHEA, to select the submenu item and then to choose a city.

Figure 4-11 The "Weather Data Site" Screen

Select a State

Press the **Select a State** button to access a list of states (see Figure 4-12). Scroll through the list (see Section 1.5.5, Scroll Bars) until the state you wish to select is listed on the screen. Highlight the state with your mouse or from the keyboard and press either the left mouse button or the ENTER key. The state you have selected will appear in the bar at the top of the state list. Accept this state by selecting the **Okay** button on the "Select a State" screen. The state you have selected will now appear in as the current state on the "Weather Data Site" screen.

Select a City

Press the **Select a City** button to access a list of cities in the state you previously selected. Scroll through the list (see Section 1.5.5, Scroll Bars) until the city you wish to select is listed on the screen. Highlight the city with your mouse or from the keyboard and press either the left mouse button or the ENTER key. The city you have selected will appear in the bar at the top of the city list. Accept this city by selecting the **Okay** button on the "Select the City" screen. The city you have selected will now appear as the current city on the Weather Data Site screen.

Figure 4-12 The “Select the State” Screen

NOTE You may permanently change the default values on the **Setup** screens by selecting the **Reset Default Data** button located in the lower left corner of all **Setup** screens. After selecting this button, MHEA will use the revised default data when evaluating all future project files until you change it again. If you wish to change the default data for one project file only, select the **Okay** button (located in the lower right corner of the **Setup** screens). The revisions you have made will be stored with the project file you had open when the setup screen changes were made. You do not need to change the **Setup** information every time you want to evaluate that particular project file.

NOTE MHEA assigns Chicago, Illinois, as the default city when you initially install MHEA. If you select a different city in one project file, and then open a new audit, Chicago will be restored as the default city, unless you press the **Reset Default Data** button.

NOTE You must install the weather data you wish to use. All the cities that are available in the weather data files are listed when you view the city selection. The information for these cities is not on your computer unless you install this data (see Section 4.6, **Install/Remove Weather Data**).

Appendix A

Glossary

Addition - Manufactured home additions are add-on structures conditioned by the home heating and cooling systems. Additions cannot be separated from the manufactured home (for example, by closing the door to an entrance vestibule). Additions that are part of the living space must be included in the energy calculations of the home. If the addition is usually separated from the manufactured home, it should not be included when evaluating weatherization retrofit measures for the home.

ARROW Keys - ARROW keys are keys on your computer keyboard that move the cursor in the direction of the arrow printed on the key.

Base Load - The base load is the energy required to operate the domestic hot water heater, lights, cooking, clothes washing, and other household appliances that are used throughout the year. For example, if the heating equipment uses natural gas, the base electricity load can be estimated by averaging the monthly electricity consumption during the winter months.

Button - Buttons appear on all MHEA screens. Buttons are gray boxes surrounded by a border so that they appear as though they are slightly taller than the computer screen. When a button is selected, the border changes so that it seems as though the button has been pushed into the screen. All MHEA screens have an Okay button, used to accept the conditions on the screen and continue working in other parts of MHEA. Several other buttons that appear on MHEA screens include the Cancel, Defaults, Reset Defaults, and buttons specific to an individual screen.

Check Mark - Many MHEA input and setup screens have lists of options. An option is selected by placing a check mark in the box or column next to the appropriate option. Place a check mark by using the mouse or any of the keyboard methods described in Section 1.3, Navigating Through MHEA.

Click - Click refers to pressing a mouse button (one of the two or three buttons at the top of an MS-DOS®-compatible mouse).

Cursor - The cursor is the black arrow that appears on all MHEA screens. Point the arrow to the location where data is to be recorded (by placing a check mark or entering information into an editable field) or to select a button. Refer to Section 1.3, Navigating Through MHEA, to learn how to move the cursor using either the mouse or the keyboard.

Editable Field - An editable field is a location on an MHEA input or setup screen where numbers, letters, or other characters can be typed.

Energy Consumption - Energy consumption is the energy used by the occupants of a manufactured home. This energy is either electricity supplied by a utility or fuel that is burned in the home (i.e., natural gas, wood, etc.). Occupants consume energy to heat and cool their homes, cook, heat water, power lights, and other uses.

ENTER Key - The ENTER key is located at the right end of the third row of keys of the letter pad on a computer keyboard. This key is pressed when using keyboard methods to place the cursor (see Section 1.3, Navigating Through MHEA).

File - **File** is the main menu item listed first on the MHEA menu bar. Project files are managed from the submenu items available within the **File** menu. For more information about the **File** submenu options, refer to Section 3.1, Manage Project Files Using the **File** Menu.

Floppy Disk Drive - The floppy disk drive is where you insert a diskette into your computer. You must have a floppy disk drive to install MHEA software. If a computer has only one floppy disk drive, it is usually identified as the A drive. If the computer you are using has two floppy disk drives, be sure to note how the one you are using to install MHEA is identified (usually identified as the A drive or the B drive) before you begin the installation procedure (see Section 1.2, Installing MHEA).

Graphic Display - The graphic display is the monitor attached to your computer. MHEA requires that you have a VGA monitor.

Hard Disk Drive - The hard disk drive is where information is stored within your computer. MHEA is stored on the hard drive after you have installed it from a diskette. All project files are also stored on the hard drive. On most computers, the hard drive is identified as the C drive. Be sure to check how the hard drive on your computer is identified before installing MHEA software.

Help - **Help** is the main menu item listed last on the MHEA menu bar. The submenu options available from the **Help** menu include: Help Topics, all the help messages that are included with MHEA; Instructions, a brief summary of how to use MHEA; and About, a short description of MHEA and a quick energy use/square foot/heating degree-day calculation. In future versions of MHEA, a tutorial will be available to help new MHEA users become familiar with the software. See Chapter 2.0, Using On-Line Help, for more information about the **Help** submenu options..

Inputs - **Inputs** is the main menu item listed second on the MHEA menu bar. All information describing the manufactured home construction, the heating and cooling equipment, and utility bill data, is entered on the screens that are available from the **Inputs** submenu options (see Section 3.2, Enter Input Data Using the Inputs Menu).

Input Screens - Input screens are the MHEA displays where you enter information about the manufactured home construction, the heating and cooling equipment, and utility bill data (see Section 3.2, Center Input Data Using the Inputs Menu).

Memory - Memory refers to how information is stored in your computer.

Menu Bar - Main menu headings are displayed in the menu bar. The menu bar is located at the top of the MHEA background screen. Refer to section 1.5.1, Menu Bar, for more information about the menu bar.

Menu Item - Menu items are the main headings displayed in the menu bar. Select menu items to enter descriptive information about the manufactured home, run

MHEA calculations, view the calculation results, and adjust setup information. Refer to Chapters 3, Performing an Audit, and 4, Customizing MHEA Parameters Using the **Setup** Menu, for more information about what is available from within each menu item.

MHEA - Manufactured Home Energy Audit. The name of the software tool designed to recommend weatherization retrofit measures for manufactured homes. MHEA evaluates energy use and analyzes the effect of installing weatherization retrofit measures in order to prioritize the most effective measures recommended for installation.

Manufactured home - A manufactured home is constructed in a factory and has a permanent chassis as part of the frame so that it can be easily moved. Manufactured homes are constructed either as one unit (usually less than 20 feet wide) or as two long units (each unit is usually less than 20 feet wide) that are attached at the center after the two parts have been moved separately to the site the home will occupy.

Monitor - A computer monitor is the device on which images are displayed.

Mouse - A computer mouse is a device used to move a cursor around the screens that are displayed while using MHEA. A MS-DOS®-compatible mouse will have two or three keys located at the top of the mouse. Rest your hand on the large part of the mouse so that your middle fingers can access these keys. Move the mouse with your hand so that the cursor moves to the desired location on the screen. For more information on how to use the mouse, see Section 1.3.1, Using Your Mouse.

Operating System - The operating system is the software on your hard drive that controls all executions that occur while you are using your computer. MHEA requires the operating system to be MS-DOS®, version 4.2 or later.

Quit - Quit is the main menu item listed fifth on the MHEA menu bar. When you are ready to leave MHEA software and return to the operating system, select the **Quit** menu item and answer Okay to the question that immediately appears on the screen.

Printer - The printer is the device to which MHEA sends information to be printed. MHEA can send information to most commonly used printer types.

Project File - A project file is the location in the computer memory where information about a manufactured home is stored. The MHEA user names the project file when information about a home is entered for the first time. Both input data and calculation results are stored in this project file.

Results - Results is the main menu item listed fourth on the MHEA menu bar. MHEA calculation results are displayed on the screens that appear when you select the Results submenu options.

Run - Run is the third item listed on the MHEA main menu bar. Initiate MHEA calculation procedures by selecting the appropriate **Run** submenu item. See Section 3.4, Perform Energy Use and Cost Analysis, for more information about how to evaluate data in a MHEA project file.

Screen - An MHEA screen is the information displayed on your computer monitor when you select menu and submenu items.

Scroll Bars - Scroll bars appear on screens that contain more information than can fit onto a screen the size of your computer monitor. Use the scroll bars to move the screen up and down. Refer to Section 1.5.5, Scroll Bars, for information about using the scroll bars.

Select - To select an item on an MHEA screen means to place a check mark, access an editable field, or activate a button. To select an item, use any of the mouse or keyboard methods described in Section 1.3, Navigating Through MHEA.

Setup - **Setup** is the main menu item listed seventh on the MHEA menu bar. Parameters needed to execute MHEA calculations can be adjusted by accessing the screens that appear when you select the **Setup** submenu items. Refer to Chapter 4, Customizing MHEA Parameters Using the **Setup** Menu, for more information about how to use the **Setup** submenu screens.

SHIFT Key - The SHIFT key is located at the far left and right ends of the second row of the letter pad on your computer keyboard. You will need these keys if you use the keyboard while working through MHEA (see Section 1.3.2, Using your Keyboard).

Status Bar - The status bar is located at the bottom of the MHEA background screen. Directions on how to access help messages and the name of the project file you are working in are displayed in the status bar (see Section 1.5.6, Status Bar).

Submenu - Submenu items are the options that appear when you select main menu items.

View - **View** is the fourth main menu item on the MHEA menu bar. Access the screens available from the **View** submenu items to display summaries of the project file inputs, calculation results, and comments entered on the comment screen. You cannot edit screens access through the **View** submenu. Return to the Input screens and rerun the calculations to revise the information shown on the **View** screens.

VGA - VGA refers to the type of monitor you have attached to your computer hard drive. A VGA monitor is required to operate MHEA software.

Weatherization Retrofit Measures - Weatherization retrofit measures are the changes made to a manufactured home to make it more energy efficient. MHEA evaluates weatherization retrofit measures based on the existing home construction conditions (described on the Input screens), the local weather conditions, and the cost of retrofit measures. Recommended retrofit measures are then listed according to their savings-to-investment ratios. Refer to Section 3.5.2, Results, and Appendix B, Retrofit Measure Descriptions, for more information about weatherization retrofit measures evaluated by MHEA.

Appendix B

Retrofit Measure Descriptions

Descriptions of the retrofit measures that are evaluated by MHEA are summarized in this appendix. Recommended methods for installing retrofit measures are given in some cases. Each weatherization agency will have its own methods for installing retrofit measures. Those methods outlined in this appendix are not necessarily the only or best methods for effective weatherization.

Seal Ducts

It is very common to find leaks in manufactured home supply air ducts. Leaks are typically found where the supply duct connects to the furnace, at the junction between the air delivery plenum and the vertical floor register sleeves, where the vertical duct sleeves penetrate the subfloor/ceiling, and at the end of the supply duct run. These leaks can be found using a flashlight and mirror aimed from a supply register. Another method for finding leaks is to use a pressure pan and blower door. Leak locations can be isolated by successively sealing off sections of the duct with temporary air blocks while observing blower door readings. Openings can be sealed using silicone caulk or mastic. Large holes can be sealed with rigid foam or a combination of mastic, mesh tape, sheet-metal patches, and screws.

Many manufactured homes return air to the furnace through a register in the furnace closet door. Some manufactured homes have return air either through ducts or through open plenums in the floor or ceiling. Typically, such systems are extremely leaky. Return air systems are also unnecessary because of the small volume of manufactured homes. MHEA calculations assume the return air registers in the floor and the return air chase at the furnace are sealed during the duct-sealing procedure. MHEA also assumes that a register is installed in the furnace closet door and a 1 to 1-1/2 inches clearance between the bottom of the bedroom and bathroom doors and the floor or carpet is added to accommodate return air flow to the furnace as part of this procedure.

Duct leaks have a large effect on home energy consumption, both when the furnace fan is on and off. When the furnace fan is on, heated distribution air leaks out into the underfloor (roof) space and then to the outside environment, decreasing the overall efficiency of the heating distribution system furnace. When the fan is off, extra infiltration leakage paths exist from the underfloor (roof) area through the ducts and then through the air registers into the living space.

General Air Sealing

Manufactured homes, especially those constructed prior to the 1976 Housing and Urban Development manufactured home construction standards, are

inherently leaky. Leakage locations typically are: water heater closets with exterior access; furnace flue and combustion air duct penetrations through the rodent barrier, floor, and ceiling; evaporative cooler chase penetration through the ceiling; doors and windows that do not seal properly when closed; kitchen vent fans; and damaged rodent barriers.

While sealing an exterior water heater closet, insulation should be installed wherever possible including the common wall, the outside wall, and the door of the closet. Note that the exterior door should be sealed as well. Redirect combustion air from the register in the exterior door to a combustion air duct installed in the floor of the closet that pulls air in from under the belly of the home. Sealing and insulating can be accomplished with 1/8-inch hardboard and silicone or, for the less accessible areas, 6-mil polyethylene sheet or insulating aluminized foil and construction adhesive. Large openings can be stuffed with batt insulation and sealed with an insulating foil membrane. Wrap water pipes to avoid freezing. **BE SURE THERE IS ADEQUATE COMBUSTION AIR AVAILABLE FROM THE OUTSIDE IF THE WATER HEATER IS FUELED BY GAS OR OIL.**

Penetrations through the ceiling and floor from the furnace flue and those from combustion air ducts can be sealed using a silicone caulk. Covering the opening in the ceiling with an interior plastic cover may stop evaporative cooler chase leaks. Covers are commercially available or can be constructed in the same manner as interior plastic storms. This type of cover is simple to remove and store during the cooling months when the evaporative cooler is in use. Install a similar cover used for evaporative cooler chases over a room air conditioner (inside the home). Do not cover the portion of the room air conditioner that extends outdoors unless the inside portion is also covered. Also, check that the perimeter of the room air conditioner is sealed tightly.

Inexpensive window repairs include installing ludwig clips to tightly close the panes of jalousie or awning-type windows, replacing the window-operating mechanisms, replacing the panes, repairing or replacing damaged seals at awning and jalousie pane edges with weather stripping, rerouting cables (such as TV or other cables) through the floor or walls (and seal new opening), and sealing cracks between the window trim and the interior wall with silicon acrylic caulk.

Seal leaks around doors by replacing damaged, missing, or degraded weather stripping on door flanges. Repair or adjust latch plates if damaged. Damaged plates prevent tight sealing of the door. Replace the door if there is a damaged door flange. A damaged flange prevents a pressure fit of the weather stripping upon closure. Replace damaged window with rigid insulation sheathed in manufactured home siding.

Ensure that the kitchen vent fans are operating properly and that they are sealed shut when the fan is turned off.

A damaged rodent barrier allows outside air to enter the floor section. When this occurs, any insulation that may exist in the floor section essentially has no effect. All damage to the rodent barrier should be repaired before insulation is added to the belly.

Wall Insulation-Batt Fiberglass

Add 3-1/2 inches of fiberglass batt insulation to walls.

This retrofit measure is evaluated if the insulatable space in the walls is 1 inch or greater. A recommended method of stuffing batt insulation into the wall cavity is listed below.

- 1) Ensure interior paneling is tightly fastened to the wall frame.
- 2) Remove bottom two rows of screws from exterior siding and look inside the wall cavity to see where wiring is located.
- 3) Cut vinyl-backed fiberglass batts or unfaced fiberglass insulation batts and flexible plastic sheeting approximately 8 inches longer than the length of the cavity to be stuffed.
- 4) Sandwich the insulation between the vinyl backing/plastic sheeting and a sheet metal insulation "stuffer", fold the insulation (and plastic sheeting) over the top of the stuffer, push the insulation up into the cavity with the vinyl backing/plastic sheeting facing the interior paneling.

Note that the wiring location may be such that stuffing batt insulation is not possible (for example, if the wiring passes through the center of the wall studs).

Wall Insulation-Loose Cellulose

Fill walls with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the insulatable space in the walls is 2 inches or greater. Adding loose insulation will increase the R-value of the walls. If the siding is metal, check that the interior paneling is secured, remove the bottom row of exterior siding screws, and use a flexible fill tube to fill each cavity between the interior paneling and the existing insulation starting at the top of the wall and working down. If the exterior siding is wood, then drill a hole in each cavity approximately 1 foot from the bottom of the wall and use a flexible-fill tube (8 feet long, 1 to 2 inches in diameter) to fill the cavity, starting at the top of the wall and working down. Be careful not to damage electrical boxes and wire located in the walls while filling the cavities with loose insulation.

Wall Insulation-Loose Fiberglass

Fill walls with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the insulatable space in the walls is 2 inches or greater. Adding loose insulation will increase the R-value of the walls. If the siding is metal, check that the interior paneling is secured, remove the bottom row of exterior siding screws, and use a flexible-fill tube to fill each cavity between the interior paneling and the existing insulation starting at the top of the wall and working down. If the exterior siding is wood, then drill a hole in each cavity approximately 1 foot from the bottom of the wall and use a flexible-fill tube (8 feet long, 1 to 2 inches in diameter) to fill the cavity, starting at the top of the wall and working down. Be careful not to damage electrical boxes and wire located in the walls while filling the cavities with loose insulation.

Belly Insulation-Loose Cellulose

Fill belly with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the depth of the existing insulation in the belly section is less than the average belly depth. The benefit from filling the belly with loose insulation is threefold: 1) the R-value of the floor section is increased; 2) if the duct is located under the floor, the duct distribution loss is decreased (resulting in an increased furnace delivery efficiency); and 3) the floor of the manufactured home remains warm in the winter, increasing occupant comfort. Be sure to repair holes in the belly, repair openings in the floor, and seal the duct (if located under the floor) before blowing insulation into the belly section. Also, be careful that there is at least 2 inches of insulation under pipes located in the belly section and do not insulate above water pipes. Finally, insulate the belly below the bathtub to help retain heat in the bath water.

Typically, insulation is blown into the belly through holes cut in the belly wrap. If necessary, reinforce the belly with lath strips and long screws. Reinforcing the belly will also reduce the volume, resulting in fewer bags of insulation needed to fill the belly section.

Belly Insulation-Loose Fiberglass

Fill belly with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the depth of the existing insulation in the belly section is less than the average belly depth. The benefit from filling the belly with loose insulation is threefold: 1) the R-value of the floor section is increased; 2) if the duct is located under the floor, the duct distribution loss is decreased (resulting in an increased furnace delivery efficiency); and 3) the floor of the manufactured home remains warm in the winter, increasing occupant comfort. Be sure to repair holes in the belly, repair openings in the floor, and seal the duct (if located under the floor) before blowing insulation into the belly section. Also, be careful that there is at least 2 inches of insulation under pipes located in the belly section and do not to insulate above water pipes. Finally, insulate the belly below the bathtub to help retain heat in the bath water.

Typically, insulation is blown into the belly through holes cut in the belly wrap. If necessary, reinforce the belly with lath strips and long screws. Reinforcing the belly will also reduce the volume, resulting in fewer bags of insulation needed to fill the belly section.

Roof Insulation-Loose Cellulose

Fill roof with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the existing insulatable space in the roof section is greater than 2 inches. The benefit from filling the roof with loose insulation is twofold. The R-value of the roof section is increased and if the duct is located above the ceiling, the duct distribution loss is decreased (resulting in an increased furnace delivery efficiency). Be sure to repair holes in the roof, repair openings in the ceiling, and seal the duct (if located above the ceiling) before blowing insulation into the roof section. If necessary, also reinforce the ceiling of the home with rosettes or wood lath strips and long screws before blowing insulation into the roof section. Typically, insulation is blown into the roof section through holes cut between the roof joists in either the roof or the ceiling.

Roof Insulation-Loose Fiberglass

Fill roof with loose insulation.

Caution:

Use a fill tube that minimizes buildup of static electricity and discharge it frequently.

This retrofit measure is evaluated if the existing insulatable space in the roof section is greater than 2 inches. The benefit from filling the roof with loose insulation is twofold. The R-value of the roof section is increased and if the duct is located above the ceiling, the duct distribution loss is decreased (resulting in an increased furnace delivery efficiency). Be sure to repair holes in the roof, repair openings in the ceiling, and seal the duct (if located above the ceiling) before blowing insulation into the roof section. If necessary, also reinforce the ceiling of the home with rosettes or wood lath strips and long screws before blowing insulation into the roof section. Typically, insulation is blown into the roof section through holes cut between the roof joists in either the roof or the ceiling.

Add Skirting

Install exterior skirting.

This retrofit measure is evaluated only if no exterior skirting exists. The benefit from installing exterior skirting is to slightly increase the R-value of the floor section. Exterior skirting typically does not significantly decrease the energy consumption of the home.

White Coat Roof

An elastomeric, low-emmissivity roof-coating retrofit measure is applied only to homes with either a bowstring roof or flat roof, dark roof color, and which have an existing cooling system. The benefit is to decrease the solar load on the roof, which in turn decreases the home cooling load. This retrofit measure is commonly installed in cooling climates.

Replace Exterior Doors

This retrofit measure is evaluated only if the existing door is not a standard manufactured home door. The benefit assigned to this measure is to increase the R-value through the door. Typically, replacing manufactured home doors does not significantly reduce the overall heating and cooling loads. If the door flange is damaged so that a tight seal around the closed door cannot be made, then the door may need replacing. This is a situation that cannot be detected by MHEA. Replacing the door under this circumstance is a judgment made by the auditor and installed under the general air-sealing retrofit measure or as a home repair.

Add Exterior Storm Doors

This retrofit measure is evaluated only if there is not an existing storm door. The effect of adding a storm door is to slightly increase the R-Value of the storm door/manufactured home door combination. Storm doors seldom significantly affect the energy consumption of the manufactured home.

Replace Windows

Replace single-glaze windows.

The advantage of replacing single-glazed windows with double-glazed windows is evaluated for this retrofit measure. The measure is not applied to sliding glass door or door windows. The benefit is to decrease the window U-value and to decrease the solar transmittance (which in turn decreases the solar load).

Add Plastic Storm Windows

Add interior plastic film storm windows.

This retrofit measure is evaluated if storm windows do not exist. The U-value of the storm window/window combination is decreased when this retrofit measure is applied. MHEA assumes that interior plastic film storm windows are used only during the heating-dominated months. Interior plastic storms may either be purchased or can be fabricated using a acrylic window film cut to the size of the window and held in place with magnetic strips or Velcro™.

Add Glass Storm Windows

Add interior glass storm windows.

This retrofit measure is evaluated if storm windows do not exist. The U-value of the storm window/window combination is decreased when this retrofit measure is applied. MHEA assumes that interior glass storm windows are used only during the heating-dominated months.

Add Awnings

Add exterior window awnings.

This retrofit measure is applied to all windows without existing awnings except north-facing windows. The measure increases the shade on the windows, which decreases the solar load.

Add Shade Screens

Add exterior fabric mesh window sun screen shades.

This retrofit measure is applied to all windows without existing sun shades. The measure increases the shade on the windows, which decreases the solar load.

Setback Thermostat

Install automatic setback thermostat.

This retrofit measure is evaluated if the indoor day/night temperature difference is less than 5° F and the heating night temperature is greater than 60° F or the cooling night temperature is less than 80° F. The retrofit measure is only applied if the heating and/or cooling systems are controlled from a central thermostat. The night heating thermostat setpoint is decreased by 5° F and the cooling night thermostat setpoint is increased by 5° F with this retrofit measure. If an automatic setback thermostat is installed, it is advised that you instruct the occupant as to how to properly set and operate the thermostat.

Tune-up Heating System

Tune-up heating system, natural gas, oil, propane, kerosene.

Caution:

Work should only be conducted by qualified personnel.

Identifying opportunities for increasing furnace delivery efficiency and safety can be accomplished quickly by trained personnel. For example, comparing the air temperature at the return air intake and the closest heating register for 5 minutes with the fan on can help determine potential problems. Excessive heat rise may indicate insufficient air flow because of a dirty or faulty blower, a clogged filter, duct blockage, or an oversized fuel jet. A small heat rise may indicate duct leaks, undersized blower, dirty filter, needed adjustment or replacement of fan on/off switches, needed adjustment of the thermostat anticipator, and in the case of combustion furnaces, a clogged fuel line or faulty fuel valve.

Servicing a manufactured home furnace should include but is not limited to cleaning out duct blockage and repairing duct leaks (if not already completed as a duct-sealing retrofit measure), cleaning the blower, cleaning the heat exchanger (check for cracks), replacing the filter, replacing or adjusting fan on/off switches, and adjusting the thermostat anticipator. Refer to state weatherization office guidelines for servicing furnaces.

Typical sealed combustion furnaces found in manufactured homes will have a combustion air duct that either supplies combustion air from underneath the furnace through a duct that penetrates the belly and floor or supplies combustion air to the top of the furnace by way of a downdraft air channel fabricated as part of the flue. Check that the combustion air inlets are properly sealed. No other combustion air sources are needed if the combustion path is sealed properly and if the heat exchanger is in good condition.

For health and safety reasons, it is recommended that basic safety checks for carbon monoxide, spillage, backdrafting, flame color, and cracked heat exchangers are done after any work on a combustion furnace has been completed.

Tune-up heating system, electric, heat pump.

Identifying opportunities for increasing furnace delivery efficiency and safety can be accomplished quickly by trained personnel. For example, comparing the air temperature at the return air intake and the closest heating register for 5 minutes with the fan on can help determine potential problems. Excessive heat rise may indicate insufficient air flow because of a dirty or faulty blower, a clogged filter, or duct blockage. A small heat rise may indicate duct leaks, undersized blower, dirty filter, needed adjustment or replacement of fan on/off switches, or needed adjustment of the thermostat anticipator.

Servicing a manufactured home furnace should include but is not limited to cleaning out duct blockage and repairing duct leaks (if not already completed as a duct-sealing retrofit measure), cleaning the blower, replacing the filter, replacing or adjusting fan on/off switches, and adjusting the thermostat anticipator. Refer to state weatherization office guidelines for servicing furnaces.

Replace Heating System

This retrofit measure is evaluated if the existing primary heating system is not fueled by coal or wood. The efficiency of the system is increased with a new furnace. Because of the high cost of a new furnace, this retrofit measure is typically not recommended.

Evaporative Cooling

Replace DX cooling system with evaporative cooler.

This retrofit measure evaluates the benefit of replacing an existing DX cooling system with an evaporative cooler if the existing primary cooling equipment is a central system or a room air conditioner with a COP of less than 3.5. In dry climates, an evaporative cooler can be quite comfortable. Usually, an evaporative cooler consumes only about 25% of the energy consumed by central air conditioners.

Tune-up Cooling System

This retrofit measure is applied to all cooling systems. The cooling capacity of the cooling equipment is increased as a result of tuning the system. Evaporative cooler tune-ups may include cleaning the fan blades, scraping scale off the louvers in the cooler cabinet, cleaning the water trough, replacing the motor with a high-efficiency motor, change out pump controls, and add new pads. DX system tune-ups may include cleaning the coils, filters, fan blades, grilles, motors, compressors, and

controls as well as adding a few drops of 20 weight electric motor oil to the motor and fan bearings. If the cooling equipment supplies air through the heating-supply duct, check that the damper that prevents heated air from flowing into the cooling equipment during the winter operates properly.

Replace Cooling System

This retrofit measure is evaluated if the existing primary cooling system is a central air conditioner, heat pump, or room air conditioner. The cooling capacity of the system is increased with a new air conditioner. Because of the high cost of a new air conditioner, this retrofit measure is typically not recommended.

Appendix C

Common Questions

Q - I installed MHEA but nothing happens when I type MHEA to start the software.

A - Be sure that you are in the correct directory before typing the MHEA command to start the software. The software installation procedure creates a directory called MHEA. A prompt such as C:\MHEA must appear on your screen before you type the command MHEA. If you have installed the software into a directory other than the default directory, then a prompt such as C:\<directory name>\MHEA must be on your screen before typing the command MHEA. If you had a previous version of the software on your computer before installing a new MHEA version, you may have accidentally installed the software into an existing directory that is named MHEA. If this is the case, you should have a prompt on your screen such as C:\MHEA\MHEA on your screen before typing the MHEA command. Refer to section 1.2, Installing MHEA, and Section 1.4.1, Starting MHEA, for more detail on how to install and start MHEA software.

Q - When I ran MHEA calculations for the first time after installing the software, a message appeared saying "Could not find weather data." What does this mean?

A - When you initially install MHEA software, there is not a default weather data location. You must go into the Weather Data submenu item found within the **Setup** menu and select a state and city. After choosing a weather data location, select the **Reset Defaults Data** button to make that city the default city. After a default city has been identified, you are not required to complete the "Weather Data Site" screen before running calculations for future project files unless you wish to change the weather data location. See Section 4.7, Choose a City, to learn more about selecting a weather data location. Also, refer to Section 1.3, Navigating Through MHEA, to learn how to work through the MHEA "Weather Data Site" screen.

Q - My mouse does not work with MHEA but it does work with all my Windows® applications.

A - MHEA is an MS-DOS® application. Your mouse may be configured correctly for Windows® but not configured correctly for MS-DOS®. Refer to your MS-DOS® user manual to learn how to configure your mouse for MS-DOS® applications.

Q#- Is there anything I can do to reduce the calculation time for MHEA?

A - The time that it takes MHEA to complete its calculations can be significantly effected by the setup of your computer. In general, you should be sure that disk caching is enabled if it is available on your system. Seek assistance from your

local computer staff if you are unsure how to determine if this feature is available to you. Eliminating retrofit options that are not considered in your region from the candidate measure list is also beneficial.

Request of the User

Any piece of software is improved by user comments. We do want to hear from you if you have suggestions or questions. However, certain kinds of problems related to the configuration of your computer are difficult to diagnose at a distance and are best handled locally at your site. If you are having problems making MHEA work with your mouse, for example, but you are unsure how to correct the problem, we encourage you to refer to the user manuals that came with your computer and to consult with your onsite computer support staff.

Manufactured Home Energy Audit Field Data Input Worksheet

General Information

Client Name:		Audit Date:
Client Address:		Auditor:
City, State:		Job No.:
Zip Code:		
Home Dimensions Length(ft): Width (ft): Interior Wall Height (ft):	Outdoor Water Heater Closet ☐ Yes ☐ No	Wind Shielding ☐ Well Shielded ☐ Normal ☐ Exposed
Other Costs Health & Safety (\$): Repair (\$): Miscellaneous (\$):	Home Leakiness ☐ Tight ☐ Medium ☐ Loose	Blower Door Test at 50 Pa Pre-Duct Sealing (cfm): Post-Duct Sealing (cfm):
☐ Include Other Costs in SIR		

Floor

Floor Joist Direction ☐ Lengthwise ☐ Widthwise	Batt/Blanket Direction ☐ Lengthwise ☐ Widthwise ☐ No Batt/Blanket Insulation	Skirt ☐ Yes ☐ No
Floor <u>Wing</u> Description:		
Floor Joist Size ☐ 2" x 4" ☐ 2" x 6" ☐ 2" x 8"	Insulation Type/Thickness (in): Batt/Blanket: Loose Fill:	Insulation Location ☐ Attached to Flooring ☐ Attached to Floor Joist
Floor <u>Belly</u> (Center) Description		
Floor Joist Size ☐ 2" x 4" ☐ 2" x 6" ☒ 2" x 8"	Insulation Type/Thickness (in): Batt/Blanket: Loose Fill:	Insulation Location ☐ Attached to Flooring ☐ Attached to Floor Joist ☐ Draped Below Floor Joist
Condition of Belly ☐ Good ☐ Average ☐ Poor	Belly Cavity Configuration ☐ Square ☐ Rounded ☐ Flat	Maximum Depth of Belly Cavity (in):

Manufactured Home Energy Audit Field Data Input Worksheet

Wall

JOB NO.: _____

Wall Stud Size ☐ 2" x 2" ☐ 2" x 3" ☐ 2" x 4" ☐ 2" x 6"	Insulation Type/Thickness (in): Batt/Blanket: Loose Fill: Foam Core:	Orientation of One Long Wall ☐ North ☐ South ☐ East ☐ West
Wall Ventilation ☐ Ventilated ☐ Not Ventilated	Carport/Porch Roof Dimensions Length (ft): Width (ft):	Carport/Porch Roof Orientation ☐ North ☐ South ☐ East ☐ West

Roof/Ceiling

Roof Type ☐ Flat ☐ Bowstring ☐ Pitched	Insulation Type/Thickness (in): Batt/Blanket: Loose Fill: Rigid Insulation:
Roof Color ☐ Light/Reflective ☐ Dark	Orientation of Cathedral Ceiling Step Wall ☐ North ☐ South ☐ East ☐ West ☐ No Step Wall
Percent Cathedral Ceiling (%):	

Manufactured Home Energy Audit

Field Data Input Worksheet

JOB NO.: _____

Window

Description ☐ Jalousie ☐ Awning ☐ Slider ☐ Fixed ☐ Door Window ☒ Sliding Glass Door ☐ Skylight	Glazing Type ☐ Single ☐ Double ☐ Single w/Glass Storm ☐ Double w/Glass Storm ☐ Single w/Plastic Storm ☐ Double w/Plastic Storm	Dimensions Width (in): Length (in):
Interior Shading ☐ Drapes ☐ Blinds or Shades ☐ Drapes w/Shades ☐ None	Exterior Shading ☐ Low E Film ☐ Sun Screen ☐ Awning ☐ Carport/Porch Roof ☐ None	Number of Windows for Each Orientation North: South: East: West:

Window

Description ☐ Jalousie ☒ Awning ☐ Slider ☐ Fixed ☐ Door Window ☐ Sliding Glass Door ☐ Skylight	Glazing Type ☐ Single ☐ Double ☐ Single w/Glass Storm ☐ Double w/Glass Storm ☐ Single w/Plastic Storm ☐ Double w/Plastic Storm	Dimensions Width (in): Length (in):
Interior Shading ☐ Drapes ☐ Blinds or Shades ☐ Drapes w/Shades ☐ None	Exterior Shading ☐ Low E Film ☐ Sun Screen ☐ Awning ☐ Carport/Porch Roof ☐ None	Number of Windows for Each Orientation North: South: East: West:

Manufactured Home Energy Audit Field Data Input Worksheet

JOB NO.: _____

Doors

Description ☐ Wood, Hallow Core ☐ Wood, Solid Core ☐ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☒ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West:

Doors

Description ☐ Wood, Hallow Core ☐ Wood, Solid Core ☒ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☒ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West:

Doors

Description ☐ Wood, Hallow Core ☐ Wood, Solid Core ☐ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☐ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West:

Manufactured Home Energy Audit Field Data Input Worksheet

JOB NO.: _____

Heating Equipment

Heating Equipment Type ☐ Natural Gas Furnace ☐ Electric Furnace ☐ Electric Heat Pump ☐ Propane Furnace ☐ Oil Furnace ☐ Kerosene Furnace ☐ Coal Burning ☐ Wood Burning ☐ None	Heating Duct Location ☐ Floor ☐ Ceiling ☐ None Heating Duct Insulation Location ☐ Above Duct ☐ Below Duct ☐ Around Duct or Ductboard ☐ No Insulation
Btu Capacity (kBtuh):	Percent of Total Heat Supplied (%):
Thermostat Setpoints: Day (F): Night (F):	

Secondary Heating Equipment

Heating Equipment Type ☐ Natural Gas Furnace ☐ Electric Furnace ☐ Electric Heat Pump ☐ Propane Furnace ☐ Oil Furnace ☐ Kerosene Furnace ☐ Coal Burning ☐ Wood Burning ☐ None	Heating Duct Location ☐ Floor ☐ Ceiling ☐ None Heating Duct Insulation Location ☐ Above Duct ☐ Below Duct ☐ Around Duct or Ductboard ☐ No Insulation
Btu Capacity (kBtuh):	

**Manufactured Home Energy Audit
Field Data Input Worksheet**

JOB NO.: _____

Replacement Heating Equipment

Heating Equipment Type ☐ Natural Gas Furnace ☐ Electric Furnace ☐ Electric Heat Pump ☐ Propane Furnace ☐ Oil Furnace ☐ Kerosene Furnace ☐ Coal Burning ☐ Wood Burning ☐ None	Heating Duct Location ☐ Floor ☐ Ceiling ☐ None Heating Duct Insulation Location ☐ Above Duct ☐ Below Duct ☐ Around Duct or Ductboard ☐ No Insulation
Btu Capacity (kBtuh):	
Replacement Heating Equipment ☐ Required ☐ Not Required	Replacement Costs Included with Home Retrofit Costs: ☐ Yes ☐ No

Manufactured Home Energy Audit Field Data Input Worksheet

JOB NO.: _____

Cooling Equipment

Cooling Equipment Type ☐ Evaporative Cooler ☐ Central Air Conditioner ☐ Room Air Conditioner ☐ Heat Pump ☐ None	Cooling Duct Location ☐ Floor ☐ Ceiling ☐ None
	Cooling Duct Insulation Location ☐ Above Duct ☐ Below Duct ☐ Around Duct or Ductboard ☐ No Insulation
Rated Total Capacity (Btuh): Rated COP:	Approximately Area of Home Cooled by Room Air Conditioner (%):
Average Indoor Temperatures: Day (F): Night (F):	

Secondary Cooling Equipment

Cooling Equipment Type ☐ Evaporative Cooler ☐ Central Air Conditioner ☐ Room Air Conditioner ☐ Heat Pump ☐ None	Cooling Duct Location ☐ Floor ☐ Ceiling ☐ None
	Cooling Duct Insulation Location ☐ Above Duct ☐ Below Duct ☐ Around Duct or Ductboard ☐ No Insulation
Rated Total Capacity (Btuh): Rated COP:	Approximately Area of Home Cooled by Room Air Conditioner (%):

Manufactured Home Energy Audit Field Data Input Worksheet

Addition Floor

JOB NO.: _____

	Floor Dimensions Length (ft): Width (ft):	
Floor Joist Direction ☐ Lengthwise ☐ Widthwise	Batt/Blanket Direction ☐ Lengthwise ☐ Widthwise ☐ No Batt/Blanket Insulation	Skirt ☐ Yes ☐ No
Floor Joist Size ☐ 2" x 4" ☐ 2" x 6" ☐ 2" x 8"	Insulation Type/Thickness Batt/Blanket (in): Loose Fill (in):	Batt/Blanket Insulation Location ☐ Attached to Flooring ☐ Attached to Floor Joist

Addition Wall

Addition Orientation ☐ North ☐ South ☐ East ☐ West	Interior Wall Height Maximum Height (ft): Minimum Height (ft):	Wall Configuration ☐ Maximum Wall Height at Interior Wall ☐ Maximum Wall Height in Center of Addition ☐ All Walls Same Height
Wall Stud Size ☐ 2" x 2" ☐ 2" x 3" ☐ 2" x 4" ☐ 2" x 6"	Insulation Type/Thickness Batt/Blanket (in): Loose Fill (in): Foam Core (in):	Wall Ventilation: ☐ Ventilated ☐ Not Ventilated

Addition Roof/Ceiling

Roof/Ceiling Joist Size: ☐ 2" x 4" ☐ 2" x 6" ☐ 2" x 8"	Roof Color ☐ Light/Reflective ☐ Dark
Insulation Type/Thickness Batt/Blanket (in): Loose Fill (in): Rigid Insulation (in):	

Manufactured Home Energy Audit

Field Data Input Worksheet

JOB NO.: _____

Addition Window

Description ☐ Jalousie ☐ Awning ☐ Slider ☐ Fixed ☐ Door Window ☒ Sliding Glass Door ☐ Skylight	Glazing Type ☐ Single ☐ Double ☐ Single w/Glass Storm ☐ Double w/Glass Storm ☐ Single w/Plastic Storm ☐ Double w/Plastic Storm	Dimensions Width (in): Length (in):
Interior Shading ☐ Drapes ☐ Blinds or Shades ☐ Drapes w/Shades ☐ None	Exterior Shading ☐ Low E Film ☐ Sun Screen ☐ Awning ☐ Carport/Porch Roof ☐ None	Number of Windows for Each Orientation North: South: East: West:

Addition Window

Description ☐ Jalousie ☐ Awning ☐ Slider ☐ Fixed ☐ Door Window ☐ Sliding Glass Door ☐ Skylight	Glazing Type ☐ Single ☐ Double ☐ Single w/Glass Storm ☐ Double w/Glass Storm ☐ Single w/Plastic Storm ☐ Double w/Plastic Storm	Dimensions Width (in): Length (in):
Interior Shading ☐ Drapes ☐ Blinds or Shades ☐ Drapes w/Shades ☐ None	Exterior Shading ☐ Low E Film ☐ Sun Screen ☐ Awning ☐ Carport/Porch Roof ☐ None	Number of Windows for Each Orientation North: South: East: West:

Manufactured Home Energy Audit Field Data Input Worksheet

JOB NO.: _____

Addition Doors

Description ☐ Wood, Hollow Core ☐ Wood, Solid Core ☐ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☐ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West:

Addition Doors

Description ☐ Wood, Hollow Core ☐ Wood, Solid Core ☐ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☐ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West:

Addition Doors

Description ☐ Wood, Hollow Core ☐ Wood, Solid Core ☐ Metal, Vinyl, or Fiberglass Skin with Solid Core	Storm Door ☐ Yes ☐ No
Dimensions Width (in): Height (in):	Number of Doors for Each Orientation North: South: East: West: