EnerWorks Solar Thermal Water Heating Appliances

Thermal Energy Controller and Thermal Energy Monitor

Owner Manual

EnerWorks Inc.
252 Hamilton Crescent
Dorchester, Ontario
N0L 1G4
Canada

Telephone: 519-268-6500
Toll-free: 1-877-268-6502
Fax: 519-268-6292
Web: www.enerworks.com
E-mail: info@enerworks.com

C US
232023

FCC ID: VFC070501
IC: 7193A070501

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

FCC Information to Users @ FCC 15.105

For Class B Unintentional Radiators:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna;
- Increase the separation between the equipment and receiver;
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- Consult the dealer or an experienced radio/TV technician for help.

Warning to Users @ FCC 15.21

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Warning: To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Part number: LAA300

Revision 1.1
2008,06,09

EnerWorks

Table of Contents

Disclaimer: All examples are only for demonstration purposes and do not necessarily reflect actual performance of your appliance.

1.0 Introduction

The EnerWorks Thermal Energy Controller and Thermal Energy Monitor work together to display how much money, energy, and carbon dioxide you are saving by installing an EnerWorks Solar Water Heating Appliance. Your commitment to the environment is now demonstrable – you can be green and show it off, too!

The Thermal Energy Controller is a control unit that is integrated into the Energy Pack, performing control functions while also monitoring performance. Using wireless transmission, the Thermal Energy Controller sends information to the Thermal Energy Monitor. The Thermal Energy Monitor then displays these data so that you can observe the performance of the system from anywhere in your home.

So that a household is never without hot water, a backup or "auxiliary" tank must be in place in case there is not enough solar energy to meet the demand of the household. The four major fuels for water-heating in North America are electricity, natural gas, propane, and oil.

Thermal Energy Controller

Thermal Energy Monitor

Energy Pack mounted on a solar storage tank

2.0 Outputs menu

The Thermal Energy Monitor displays the outputs menu. This is the view that shows your savings in money, energy, carbon dioxide, etc., and is the default view on the Thermal Energy Controller (located on the Energy Pack). Pressing the up and down buttons on either unit scrolls through the displays. On the Thermal Energy Controller, pressing and holding the enter button for five seconds will set the current display item as the default display item.

Enter button

Up button

The Thermal Energy Monitor will turn off its screen after ten minutes of inactivity.

Down button

2.1 Savings displays

Each of the values in this section displays information for certain ranges of time:

- The  calendar page means that the current display is for today (readings as of midnight).
- The  calendar page means that the current display is for this month (readings as of the first day of the month).
- The  calendar page means that the current display is for this year (as of January 1).
- The  (sigma) symbol means that the current display is cumulative from the time that the system was commissioned.

2.1.1 Economic savings

The default display item is "cumulative money saved". Below is an example of the display (see figure 2.1.1). The sigma symbol (Σ) indicates "cumulative", meaning that the value being displayed is the total from the time that the appliance was commissioned. The piggy bank ( ) indicates money savings. The value ($392.8 in figure 2.1.1) is the amount saved to date, based on the amount of energy delivered by the appliance multiplied by the fuel rate for the auxiliary water tank (see section 3.3.3).

Figure 2.1.1

To view the money savings for other time periods, press the down button.

2.1.2 Carbon dioxide offset CO_2

Pressing the up button from cumulative money saved will display "daily carbon dioxide offset" (see figure 2.1.2). This is the amount of carbon dioxide (CO_2) – in tonnes or tons, depending on units of measure chosen (see section 3.2) – not emitted into the atmosphere because the water was heated by solar energy instead of a fossil fuel. Your pre-existing or previous water heater uses/used fossil fuels or electricity (which is normally generated using a mix of fossil fuels) to heat water. CO_2 is produced by burning fossil fuels.

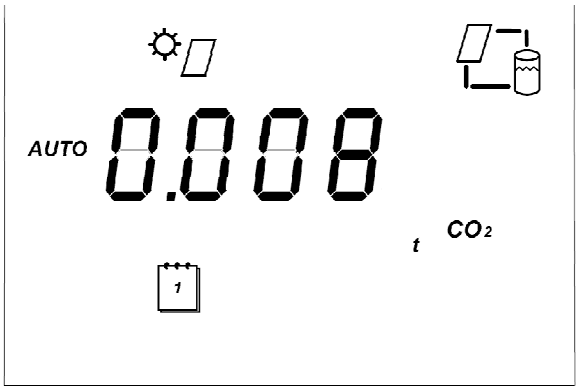

Figure 2.1.2

The CO_2 value is based on the amount of energy produced by the appliance and the fuel type for the auxiliary water tank (see section 3.3.4), and represents the amount of CO_2 emissions prevented by displacing the burning of fossil fuels. Figure 2.1.2 is an example of what the screen looks like (using tonnes as the unit of measurement) after a day's worth of energy is produced by the system.

Pressing the up button again will show monthly ( ) carbon dioxide offset; press again for yearly ( ), and once more for cumulative ( ).

2.1.3 Household hot water used

Pressing the up button from cumulative carbon dioxide offset will display "daily household hot water used" (see figure 2.1.3). This is the volume – in US gallons or litres, depending on units of measure chosen (see section 3.2) – drawn for domestic hot water use as read by the flow sensor on the cold-water supply from mains. Figure 2.1.3 is an example of a reading (using US gallons as the unit of measurement).

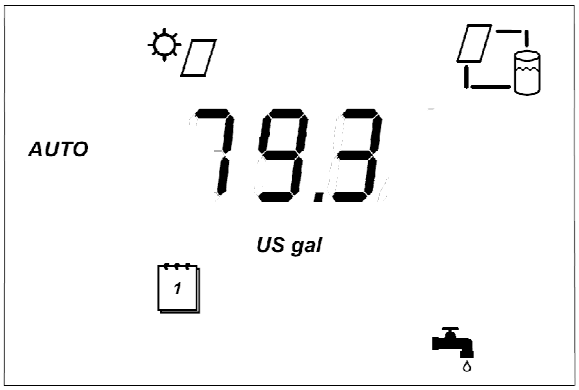

Figure 2.1.3

Pressing the up button again will show monthly ( ) household hot water used; press again for yearly ( ), and once more for cumulative ( ).

2.1.4 Water saved by displacing electricity generation

Pressing the up button from cumulative water used will display either "instantaneous power" (see section 2.2.8) or "daily water saved by displacing electricity generation" (see figure 2.1.4). Water saved by displacing electricity generation is only available when the fuel for the auxiliary water heater is electricity, and will show before instantaneous power. It can be displayed in US gallons or litres, depending on units of measure chosen (see section 3.2).

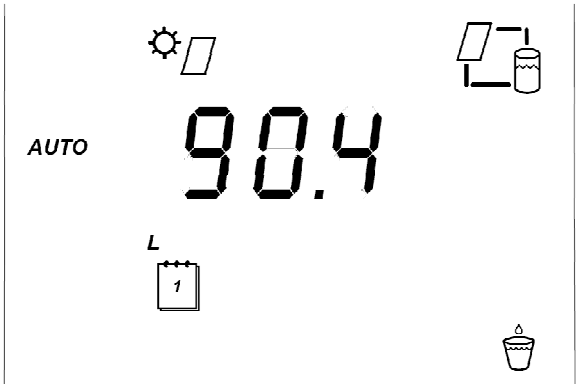

Figure 2.1.4

The production of electricity requires water (see section 3.3.5). As fresh water resources become more scarce and sensitive, it is important to use water

wisely, including directing it away from electricity generation. Water saved by displacing electricity generation is the volume of water that is not used because of the amount of electricity that is offset by the EnerWorks hot-water appliance. Figure 2.1.4 is an example of a reading (using litres as the unit of measurement).

Pressing the up button again will show monthly (31) water saved by displacing electricity generation; press again for yearly (365), and once more for cumulative (Σ). Pressing up from the cumulative value will display instantaneous power (see section 2.2.8).

2.1.5 Solar energy delivered

Pressing the up button from minimum hot-outlet temperature (see section 2.2.7) will show "daily energy delivered", which is the amount of solar energy delivered by the EnerWorks appliance today (see figure 2.1.5).

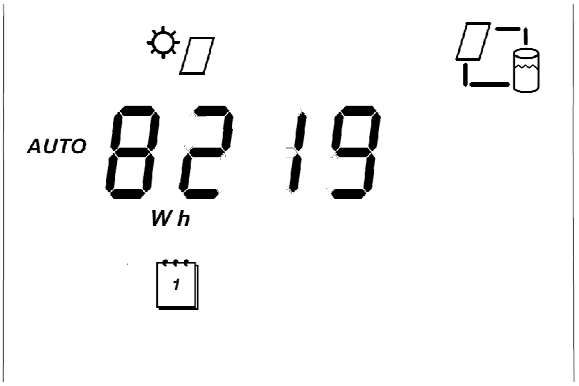

Figure 2.1.5

Energy production is based on the amount of power (see section 2.2.8) generated over a period of time, given in units of thermal Watt-hours (Wh_{th}). For simplification the display truncates the "th" subscript. Figure 2.1.5 is an example of a daily delivery, 8 219 Wh (or 8.219 kWh).

Pressing the up button again will show monthly (31) solar energy delivered; press again for yearly (365), and once more for cumulative (Σ).

2.1.6 Auxiliary energy consumed – Space-Saver™ Appliance

Pressing the up button from cumulative energy produced (see section 2.1.5) will display "daily equivalent energy offset for auxiliary fuel" (see section 2.1.7) for the EnerWorks High Performance Appliance. Since the EnerWorks Space-Saver™ Appliance uses electricity within the same tank as the solar storage, the Thermal Energy Controller and Thermal Energy Monitor for these single-tank appliances will show "daily auxiliary energy consumed" first (see figure 2.1.6) with equivalent energy offset for auxiliary fuel following.

In the Space-Saver™ appliance, the water is heated by both solar and an auxiliary fuel source (electricity). The Thermal Energy Controller monitors thermal energy produced by solar and the electric energy consumed by the appliance. Energy used is based on the amount of power consumed over a period of time, given in the units of Watt-hours (Wh) but can also be given in British thermal units (BTU) by changing preferences in the programming menu (see section 3.3).

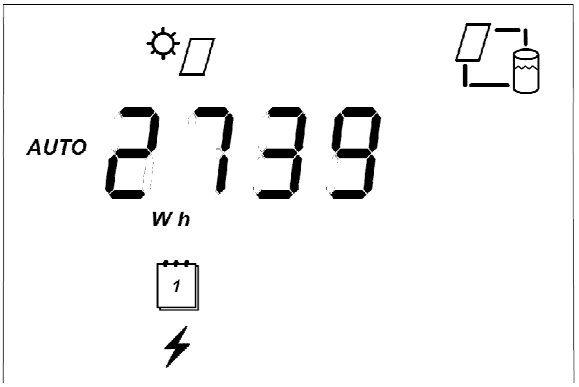

Figure 2.1.6

The power delivered to the heating element in the tank will not be constant; however, the Thermal Energy Controller must assume that the power supply is constant because it does not have a power meter hooked up to it. This results in an overestimation of the electricity usage. Since the electric energy is used to figure out how much solar energy is being produced, **the amount of solar energy will be underestimated**.

Below is an example of a daily electricity consumption, 2 739 Wh (or 2.739 kWh). The lightning bolt ( ) – representing electricity as the auxiliary fuel – blinks on this screen, indicating that it is showing the amount of energy consumed by the heating element.

Pressing the up button again will show monthly ( ) auxiliary energy consumed; press again for yearly ( ), and once more for cumulative ( ). Pressing up from the cumulative value will display daily equivalent energy offset for auxiliary fuel (see section 2.1.7).

2.1.7 Equivalent energy offset for auxiliary fuel

Pressing the up button from cumulative energy produced (see section 2.1.5) will display "daily equivalent energy offset for auxiliary fuel" on the EnerWorks High Performance Appliance (see figure 2.1.7). Since the EnerWorks Space-Saver™ Appliance uses electricity within the same tank as the solar storage, the Thermal Energy Controller on these

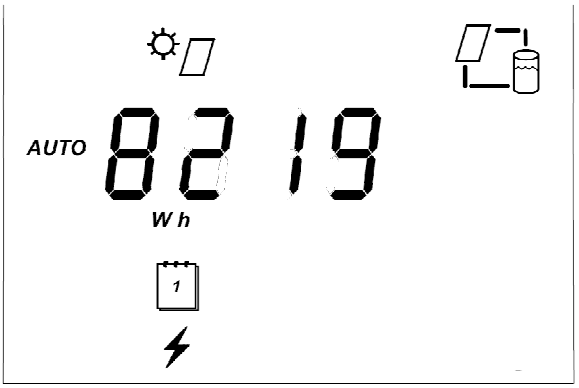

Figure 2.1.7

single-tank appliances will show "daily auxiliary energy consumed" first with the daily equivalent energy offset for auxiliary fuel following.

Depending on the auxiliary fuel type, this screen will show how much of that fuel has been offset by solar. The four possible fuel types for a High Performance Appliance are electricity, natural gas, propane, and oil. The Space-Saver™ Appliance can only be supplemented with electricity.

For example, if the daily production from solar is 8219 Wh, then the daily amount of electricity saved will also be 8219 Wh (see figure 2.1.7). The lightning bolt ( ) – representing electricity as the auxiliary fuel – does not blink on this screen, indicating that it is showing the fuel-equivalent amount of energy offset by solar.

This value is actually under-represented for a High Performance Appliance since the calculations don't include efficiencies in the auxiliary water heater.

Pressing the up button again will show monthly ( ) equivalent energy offset for auxiliary fuel; press again for yearly ( ), and once more for cumulative ( ). Up from cumulative shows "daily money saved" (see section 2.1.1).

2.1.8 Solar energy delivered to secondary application

If your appliance is configured to supply solar energy to a secondary application such as heating your pool or your home, the Thermal Energy Controller keeps track of the amount of solar energy produced for the secondary application.

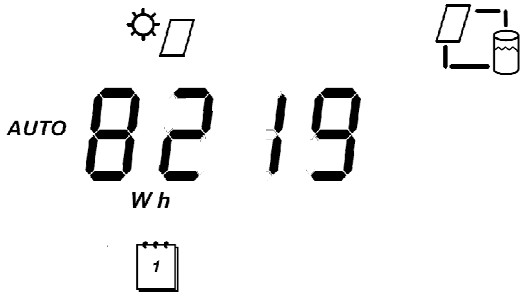

Figure 2.1.8

Pressing the up button from cumulative solar energy delivered (see section 2.1.5) for a High Performance appliance or cumulative auxiliary energy required (see section 2.1.6) for a Space-Saver™ appliance will show "daily energy delivered to secondary application" (see figure 2.1.8).

Energy production is based on the amount of power (see section 2.2.8) generated over a period of time, given in units of thermal Watt-hours (Wh_{th}).

For simplification the display truncates the "th" subscript. Figure 2.1.8 is an example of a daily delivery, 8 219 Wh (or 8.219 kWh).

Pressing the up button again will show monthly (31) solar energy delivered; press again for yearly (365), and once more for cumulative (Σ).

2.1.9 Water used by secondary application

If your appliance is configured to supply solar energy to a secondary application such as heating your pool or your home, the Thermal Energy Controller keeps track of the amount of water used by the secondary application.

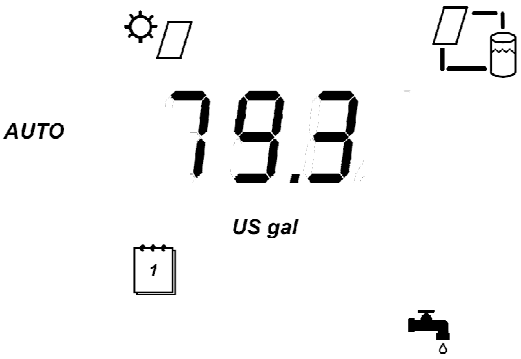

Figure 2.1.9

Pressing the up button from cumulative household hot water used (see section 2.1.3) will display "daily hot water used by secondary application" (see figure 2.1.9). This is the volume – in US gallons or litres, depending on units of measure chosen (see section 3.2) – drawn from domestic hot water as read by the flow sensor on the cold-water supply from mains. Figure 2.1.9 is an example of a reading (using US gallons as the unit of measurement).

Pressing the up button again will show monthly (31) household hot water used; press again for yearly (365), and once more for cumulative (Σ).

2.2 Reading displays

The readings that follow show the status of the EnerWorks appliance.

2.2.1 ΔT (temperature difference)

The ΔT ("delta-T") value is the temperature difference between the solar collector (see section 2.2.2) and the temperature at the bottom of the storage tank (see section 2.2.3). When this difference reaches 10 °C (18 °F), the appliance will begin to collect solar energy.

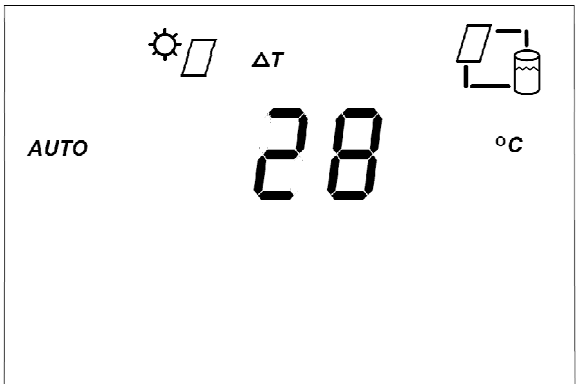

Figure 2.2.1a

Figure 2.2.1a is an example of when the system would be operating with ample solar energy, indicated by the sun shining on the solar collector ( ).

Should the difference drop below 5 °C (9 °F), the appliance will turn off until the difference reaches 10 °C (18 °F).

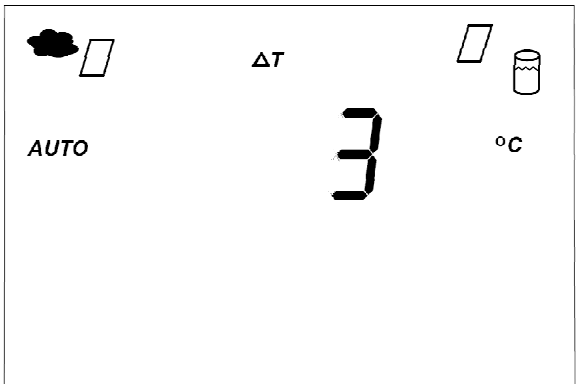

Figure 2.2.1b

Figure 2.2.1b is an example of the system turned off because there is not enough solar energy, indicated by the cloud with the solar collector ( ).

Note: the cloud does not mean that the actual weather is cloudy, just that there is not enough solar energy for energy collection.

Pressing the up button will display the temperature of the collector (see section 2.2.2).

2.2.2 Collector temperature

The collector temperature is measured by a temperature sensor installed in one of the solar collectors. It is used with the storage temperature (see section 2.2.3) to determine ΔT (see section 2.2.1). In the example, the reading is 154 °F.

Pressing the up button will display the temperature of the water at the bottom of the solar storage tank (see section 2.2.3).

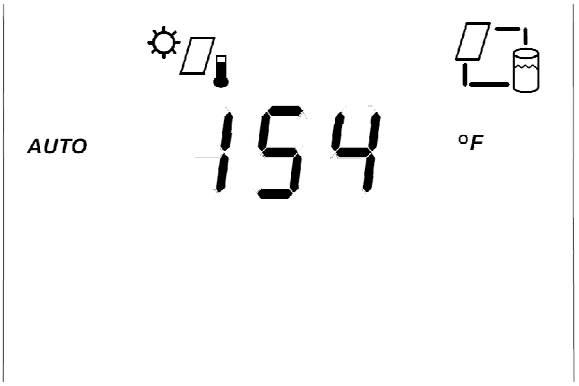

Figure 2.2.2

2.2.3 Storage temperature

The storage temperature is measured at the bottom of the solar storage tank. It is used with the collector temperature (see section 2.2.2) to determine ΔT (see section 2.2.1). In the example, the reading is 31 °C.

Pressing the up button will display the maximum collector temperature.

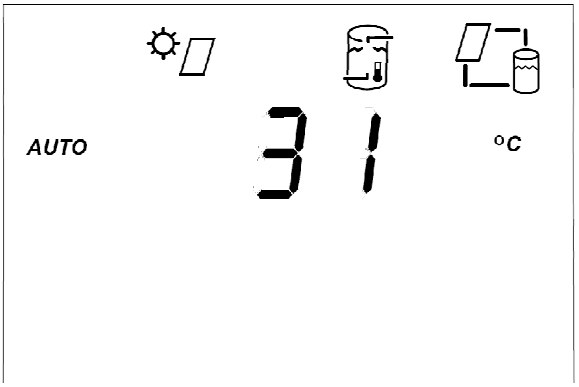

Figure 2.2.3

2.2.4 Maximum/minimum control temperatures

MAX
MIN

For collector and storage temperatures, the historical maxima and minima are stored in memory. These values are for informational purposes (interest, maintenance, etc.) and are not used in any calculations. The recorded values can be cleared using the reset function (see section 3.4).

From "storage temperature", pressing the up button shows "maximum collector temperature", followed by "minimum collector temperature", then "maximum storage temperature", and finally "minimum storage temperature". The four following screens show examples of readouts (max. collector 193 °F, min. collector 40 °F, max. storage 57 °C, min. storage 11 °C).

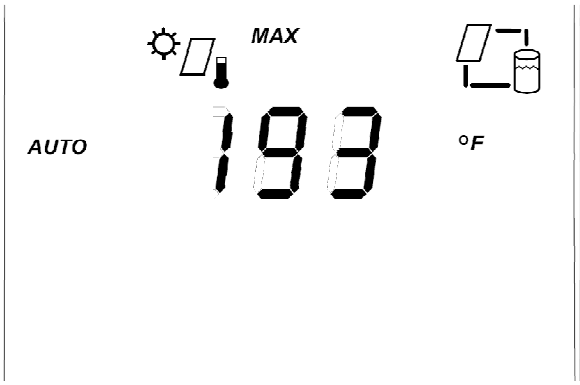

Figure 2.2.4a

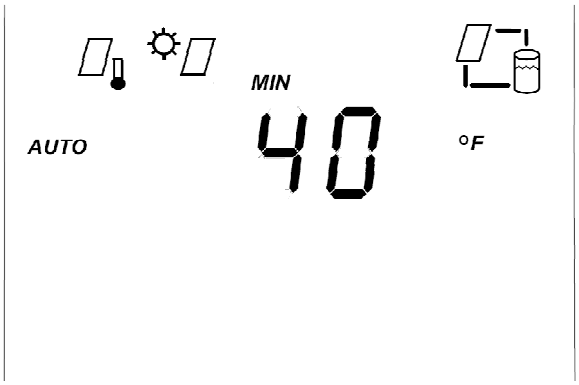

Figure 2.2.4b

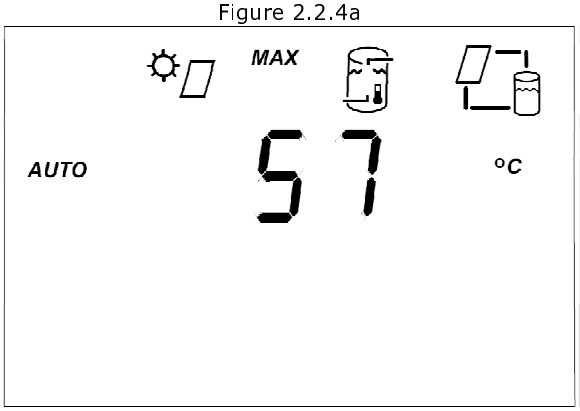

Figure 2.2.4c

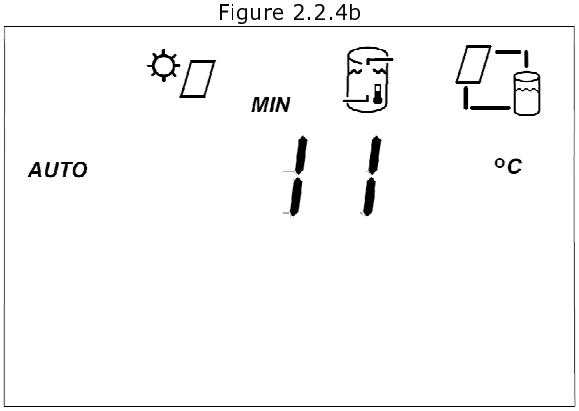

Figure 2.2.4d

Pressing the up button from minimum storage temperature displays the current reading of the temperature of the cold-water supply from mains.

2.2.5 Temperature of cold-water supply from mains water

The flow sensor on the mains water inlet also contains a temperature sensor. This temperature and the temperature of the hot water being delivered (see section 2.2.6) are used for calculating energy production. An example of the mains reading can be seen in figure 2.2.5 (reading 14 °C).

Pressing the up button moves on to the hot-outlet temperature.

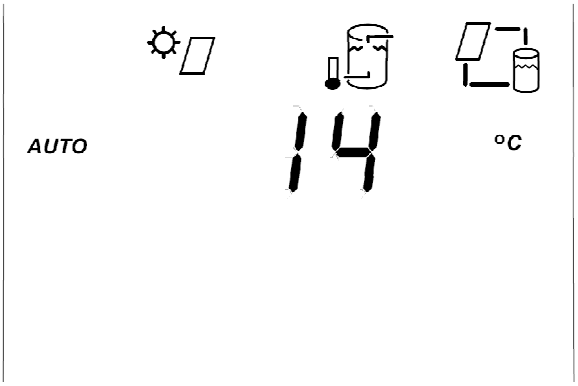

Figure 2.2.5

2.2.6 Temperature of hot-water outlet to household

A temperature sensor mounted on the hot-water outlet from the tank measures this temperature. This temperature and the temperature of the cold-water supply from mains (see section 2.2.5) are used for calculating energy production. An example of the hot-outlet reading can be seen in figure 2.2.6 (reading 62 °C).

Pressing the up button will display the maximum temperature of cold-water supply from mains.

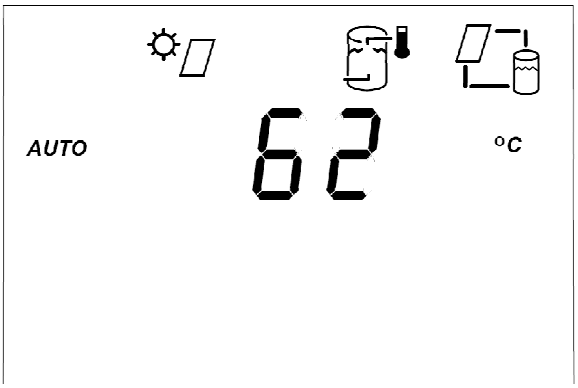

Figure 2.2.6

2.2.7 Maximum/minimum energy temperatures

For the mains and hot-outlet temperatures, the historical maxima and minima are stored in memory. These values are for informational purposes (interest, maintenance, etc.) and are not used in any calculations. The recorded values can be cleared using the reset function (see section 3.4).

From "hot-outlet temperature", pressing the up button shows "maximum temperature of cold-water supply from mains", followed by "minimum temperature of cold-water supply from mains", then "maximum temperature of hot-water outlet to household", and finally "minimum temperature of hot-water outlet to household". The four following screens show examples of readouts (max. mains 30 °C, min. mains 7 °C, max. hot 67 °C, min. hot 48 °C).

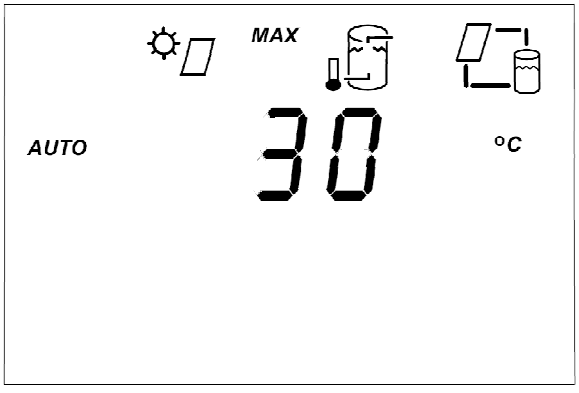

Figure 2.2.7a

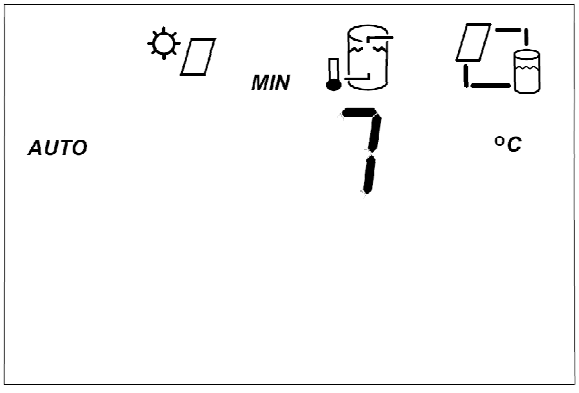

Figure 2.2.7b

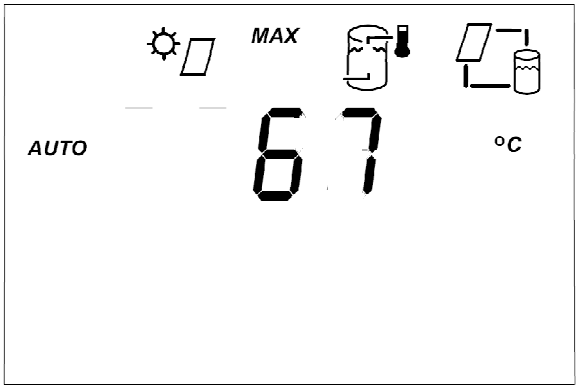

Figure 2.2.7c

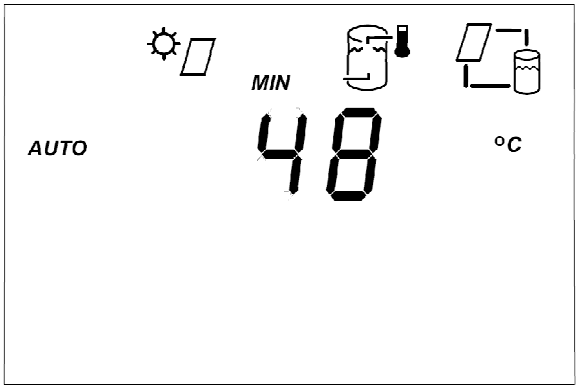

Figure 2.2.7d

Pressing the up button from minimum hot-outlet temperature will go to the current reading of the daily solar energy delivered (see 2.1.5).

2.2.8 Instantaneous power

Pressing the up button from cumulative household hot water used (see section 2.1.3) will display either "instantaneous power" or "daily water saved by displacing electricity generation" (see section 2.1.4). Water saved by displacing electricity generation is only available when the fuel for the auxiliary water heater is electricity, and will show before instantaneous power.

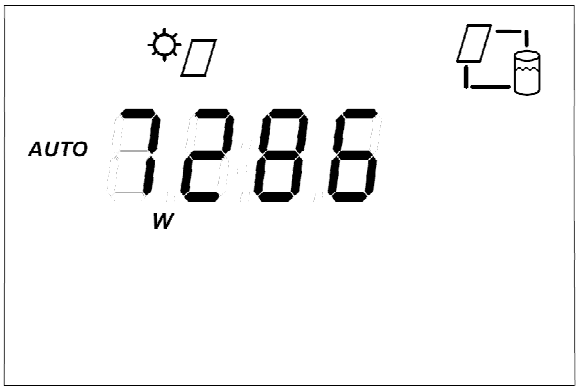

Figure 2.2.8

Instantaneous power is read when there is a draw of hot water in the household. The amount of power being produced by the EnerWorks appliance is determined by a formula that uses the volume of water, the cold-inlet temperature (mains water) (see section 2.2.5), and the hot-outlet temperature (hot water to the auxiliary tank in a pre-heat appliance; hot water to domestic use in single-tank appliance) (see section 2.2.6). As power is accumulated over a time period, it is converted into an energy value.

Figure 2.2.8 is an example of a reading when there is a hot-water draw in the household.

Pressing the up button again will move on to time and date (see section 2.3).

2.2.9 Radiation

As an option, your appliance could have a pyronameter (radiation sensor) installed. The current radiation value can be viewed on the Thermal Energy Monitor and Thermal Energy Controller. The display follows the maximum hot-outlet temperature (see section 2.2.7). In figure 2.2.9, the pyronameter is reading 1053 W/m² (1.053 kW/m²), which is a good reading for a clear, sunny day.

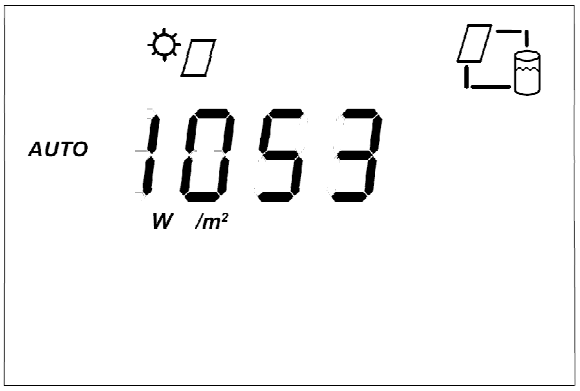

Figure 2.2.9

The sun icon ( ) blinks to indicate that this is the radiation value. Pressing the up button will display the maximum radiation value.

2.2.10 Maximum/minimum radiation MAX MIN

As an option, your appliance could have a pyronameter (radiation sensor) installed. The historical maxima and minima radiation values can be viewed on the Thermal Energy Monitor and Thermal Energy Controller. These values will be lost if power to the Thermal Energy Controller is disconnected. The recorded values can be cleared using the reset function (see section 3.4).

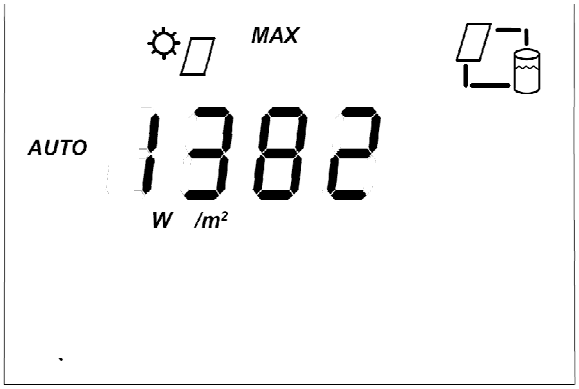

Figure 2.2.10a

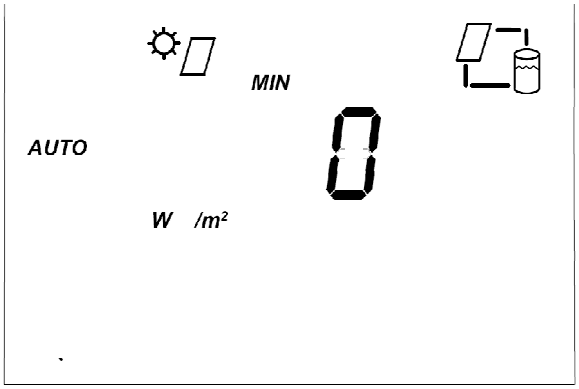

Figure 2.2.10b

The sun icon ( ) blinks to indicate that these are radiation values. Pressing the up button from minimum radiation will go to daily solar energy delivered (see section 2.1.5).

2.2.11 ΔT (temperature difference) for secondary application

If your appliance is used for a secondary application, such as heating your pool or your home, the Thermal Energy Controller needs to know when to supply solar energy to it. The ΔT ("delta-T") value is the temperature difference between the solar collector (see section 2.2.2) and the temperature of the cold inlet (see section 2.2.12). When this difference reaches a preset value, the appliance will begin to divert solar energy to the secondary application.

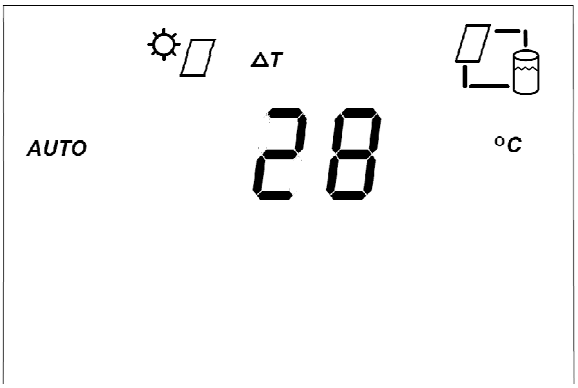

Figure 2.2.11a

Figure 2.2.11a is an example of when the system would be operating with ample solar energy for the secondary application, indicated by the sun shining on the solar collector ( ) and either the pool ( ) or house ( ) symbol.

Should the difference drop below a preset value, the appliance will stop delivering energy to the secondary application until the difference reaches its setpoint again.

Figure 2.2.11b is an example of the system turned off because there is not enough solar energy, indicated by the cloud with the solar collector ( ).

Note: the cloud does not mean that the actual weather is cloudy, just that there is not enough solar energy for energy collection.

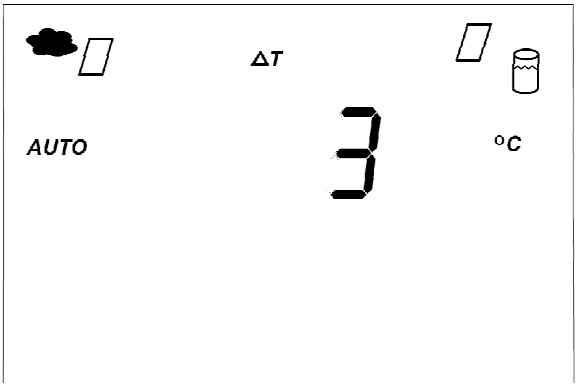

Figure 2.2.11a

Pressing the up button will display the temperature of the collector (see section 2.2.2).

2.2.12 Temperature of cold-water supply for secondary application

If your appliance is used also for a secondary application, such as heating your pool or your home, there is a temperature sensor on the cold inlet of the secondary application. This temperature and the temperature of the hot water being delivered (see section 2.2.13) are used for calculating energy production. An example of the mains reading can be seen in figure 2.2.12 (reading 63 °F).

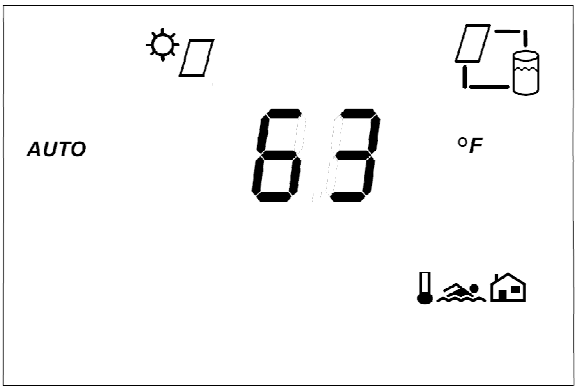

Figure 2.2.12

Pressing the up button moves on to the hot-outlet temperature for the secondary application.

2.2.13 Temperature of hot-water outlet to secondary application

If your appliance is used also for a secondary application, such as heating your pool or your home, there is a temperature sensor mounted on the hot-water outlet of the secondary application. This temperature and the temperature of the cold-water supply (see section 2.2.12) are used for calculating energy production. An example of the hot-outlet reading can be seen in figure 2.2.13 (reading 108 °F).

Figure 2.2.13

Pressing the up button will display the maximum temperature of the cold inlet for the secondary application.

2.2.14 Maximum/minimum energy temperatures

MAX
MIN

For the cold-inlet and hot-outlet temperatures on the secondary application, the historical maxima and minima are stored in memory. These values are for informational purposes (interest, maintenance, etc.) and are not

used in any calculations. The recorded values can be cleared using the reset function (see section 3.4).

From "hot-outlet temperature for secondary application", pressing the up button shows "maximum temperature of cold inlet", followed by "minimum temperature of cold inlet", then "maximum temperature of hot outlet", and finally "minimum temperature of hot outlet". The four following screens show examples of readouts (max. cold 88 °F, min. cold 45 °F, max. hot 138 °F, min. hot 91 °F).

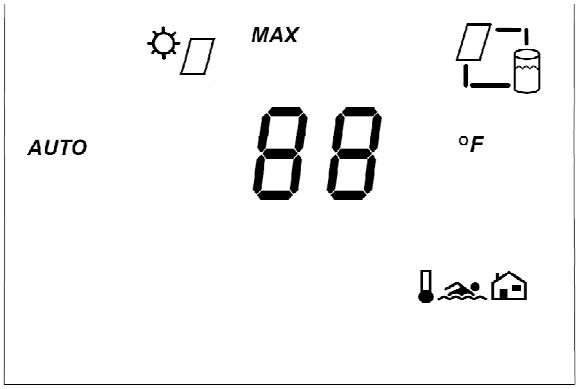

Figure 2.2.14a

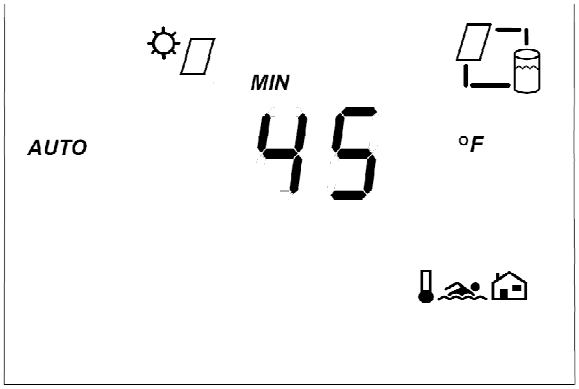

Figure 2.2.14b

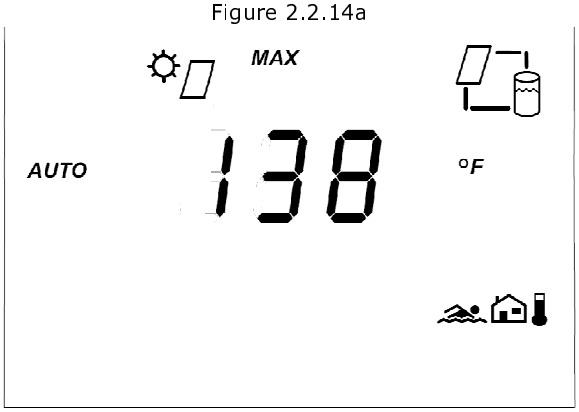

Figure 2.2.14c

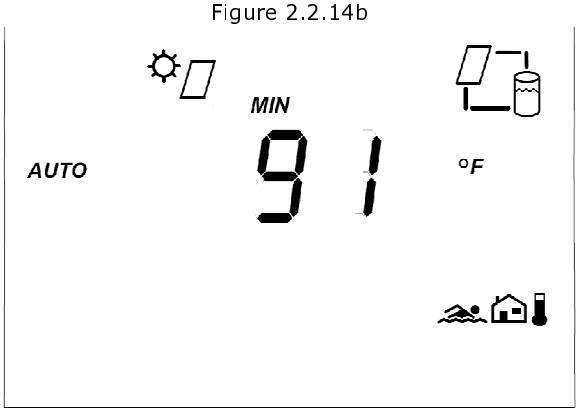

Figure 2.2.14d

Pressing the up button from minimum hot-outlet temperature will go to the current reading of the daily solar energy delivered (see 2.1.5).

2.2.15 Instantaneous power for secondary application

If your appliance is configured to supply solar energy to a secondary application such as heating your pool or your home, the Thermal Energy Controller keeps track of the amount of water used by the secondary application.

Pressing the up button from instantaneous power (see section 2.2.8) will display instantaneous power for secondary application. Instantaneous power is

read when there is a draw of water through the secondary application. The amount of power being produced is determined by a formula that uses the volume of water, the cold-inlet temperature (see section 2.2.12), and the hot-outlet temperature (see section 2.2.13). As power is accumulated over a time period, it is converted into an energy value.

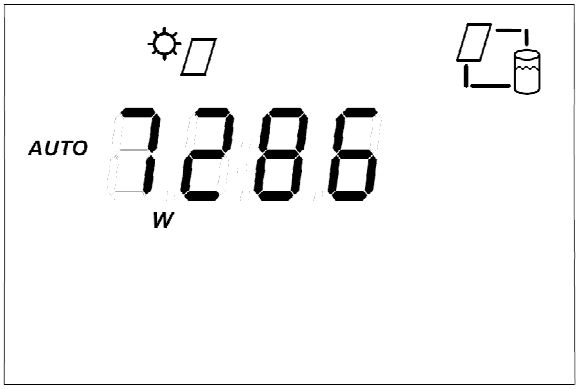

Figure 2.2.15

Figure 2.2.15 is an example of a reading when there is a hot-water draw in the household.

Pressing the up button again will move on to time and date (see section 2.3).

2.3 Time/date displays AM PM 1 31 365

Pressing the up button from instantaneous power will display the current time. The screen in figure 2.3a is showing twelve o'clock (noon).

Pressing the up button from the time will show the current year, then the current month, and finally the current day. The three screens below show each of the three (March 14, 2008):

Figure 2.3a

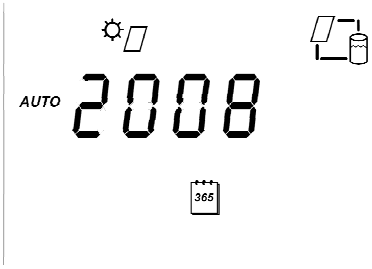

Figure 2.3b

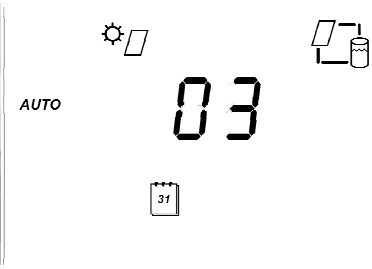

Figure 2.3c

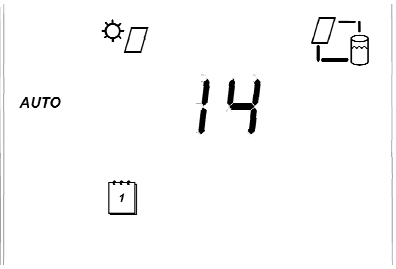

Figure 2.3d

Pressing the up button from the day will go into temperature information, starting with the "delta-T value" (see section 2.2.1).

3.0 Programming menu (Thermal Energy Controller)

PROG

Menu buttor

There are a number of settings that may need to be changed from time to time, such as the price of your auxiliary heating fuel or the type of units that are displayed on screen. These settings can be changed by using the programming menu on the Thermal Energy Controller.

Enter button

To get to the programming menu, press the menu button from any display on the outputs menu. The *PROG* icon will light up to indicate that you are in the programming mode. Pressing the menu button again from any display will return to the outputs menu and will not save the changes for the current item. Use the up and down buttons to toggle values, and press the enter button to accept the value for the current item and move to the next item.

Up button

Note that the status of the system will not be displayed while in programming mode.

Down buttor

3.1 Pump control *AUTO* *MAN*

The default mode for the pump is to run automatically based on temperature readings. If there is a temperature difference of 18 °F (10 °C) between the collector and the storage tank, and none of the temperatures are out of operating range, then the pump will run.

PROG
AUTO
MAN
✓ ✗

Figure 3.1

A pump set to run manually will run for fifteen minutes before reverting back to automatic mode. A pump turned off manually will not turn back on unless the setting is returned to automatic or it is manually turned on.

Pressing the up or down button will cycle between automatic (*AUTO*) and manual (*MAN*). If automatic is selected, the menu moves on to the next item. If manual is selected, pressing the up or down button will toggle between the ✓ and the ✗ symbols, representing "on" and "off" respectively. The diagram in figure 3.1 shows all of the segments that are visible for pump control.

Pressing the enter button will proceed to setting up the default units of measurement.

3.2 Default units of measurement

There are two choices for default units: US customary and metric (SI). This will affect all outputs and inputs on the controller, so if you already have your settings the way you like them, you can select "n.c." (no change) and the defaults will not be restored. The default will display "S.I." on the screen, and pressing the up or down button will cycle between this, "U.S.", and "n.c.". Press the enter button to accept and move on to fuel selection for the auxiliary heating source.

As the inputs that follow are configured, the units can be changed to whichever is preferred if "no change" wasn't selected.

3.3 Auxiliary fuel

So that a household is never without hot water, a backup or "auxiliary" tank must be in place in case there is not enough solar energy to meet the hot water demand of the household. The four major fuels for water-heating in North America are electricity, natural gas, propane, and oil.

3.3.1 Fuel type 

There are four fuels available to select from for the auxiliary heating fuel: electricity, natural gas, propane, and oil, represented by the icons above, respectively. All four are available for the EnerWorks High Performance Appliance, but only electricity is available for the Space-Saver™ Appliance.

The default fuel is electricity. For the High Performance Appliance, the up or down button will toggle between the four icons along with the associated default units. These units are likely used for billing purposes by the utility that supplies the fuel.

The defaults units are:

- kWh for electricity
- m^3 or 1000 ft^3 for natural gas
- L or US gal for propane and oil

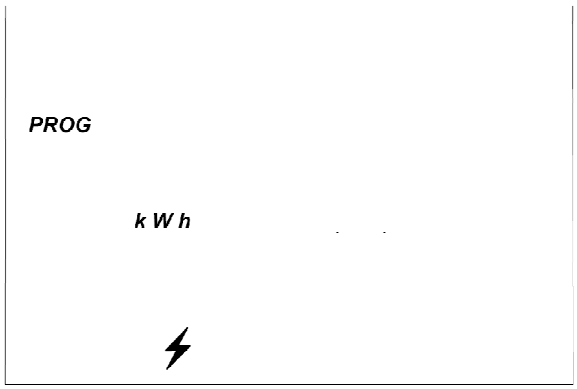

Figure 3.3.1a

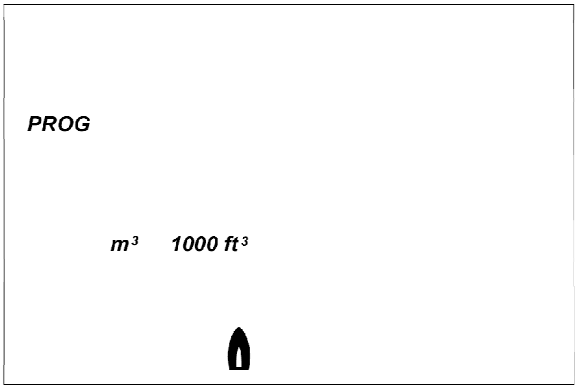

Figure 3.3.1b

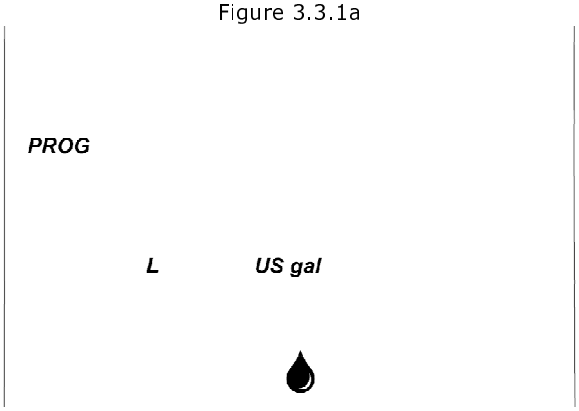

Figure 3.3.1c

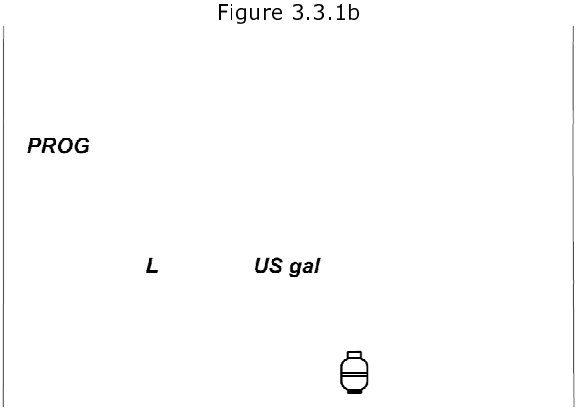

Figure 3.3.1d

Pressing enter will select the fuel type. The next screen allows you to select a different billing unit if required.

3.3.2 Units for auxiliary fuel

Although there are default units for the fuel type, the following are available for each fuel type:

- Electricity: kWh, MMBTU
- Natural gas: m³, 1000 ft³, GJ, MMBTU
- Propane/Oil: L, US gal

In order to convert therms (100 000 BTU) into MMBTU (1 000 000 BTU), multiply by 10. Example: $1.00/therm = $10.00/MMBTU.

To convert therms into 1000 ft³ (10 000 BTU), divide by 10. Example: $1.00/therm = $0.10/1000 ft³.

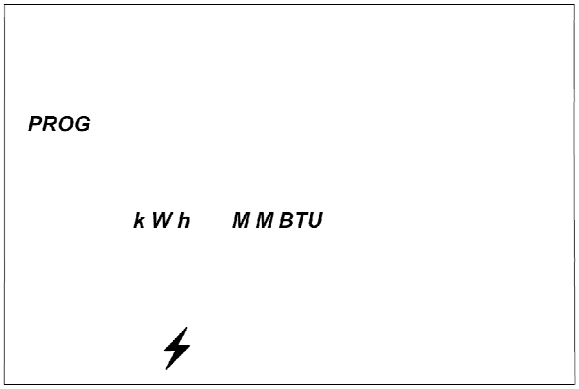

Figure 3.3.2a

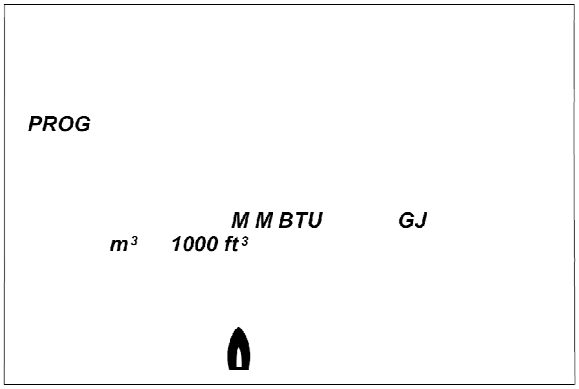

Figure 3.3.2b

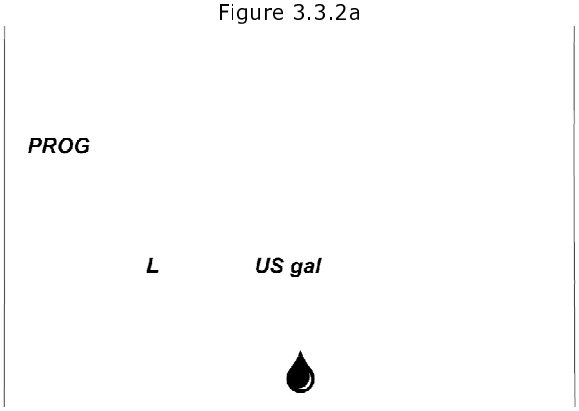

Figure 3.3.2c

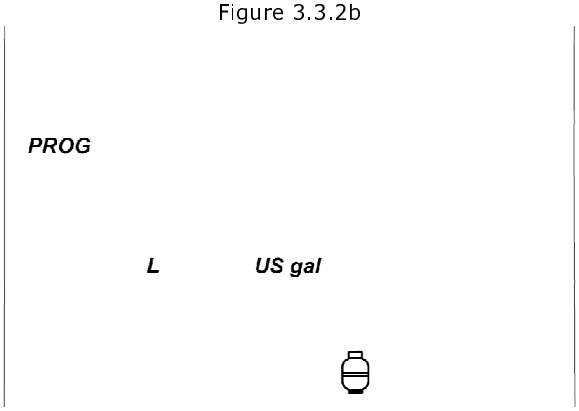

Figure 3.3.2d

The icon for the fuel type will blink on this screen, indicating that you are to select the unit type by pressing the up and down buttons. Pressing enter will select the units and then move on to entering the price of fuel.

3.3.3 Price of auxiliary fuel

After selecting the auxiliary fuel and its unit, the Thermal Energy Controller will ask for the price of fuel. This is used to determine how much money is being saved based on the fuel displaced by solar. The best way to obtain the household's final price of fuel is to take the monthly bill's total (includes taxes, delivery, and other charges) and divide by the usage for that month.

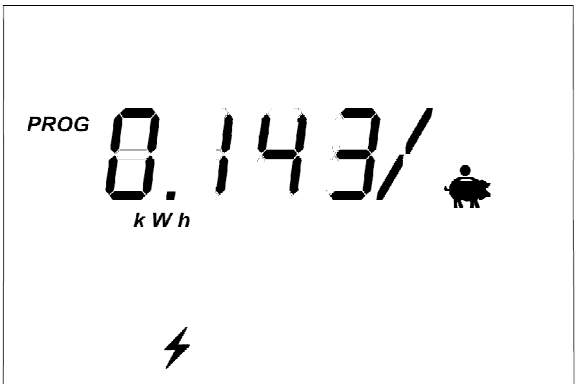

Figure 3.3.3

Figure 3.3.3 is an example for electricity (14.3 ¢/kWh). To get your local fuel price, contact your utility or visit the EnerWorks Web site.

Pressing enter will save the fuel price. For fuels other than electricity, the next screen will ask if you want to reset the recorded maximum and minimum values (see section 3.4). Otherwise, more configuration is required for electricity.

3.3.4 Generation mix of electricity ⚡ %

Now that the price of electricity has been set, the generation mix has to be entered to calculate the amount of carbon dioxide being offset. The other three fuels have built-in CO_2 emission rates.

There are ten fuel types for which percentages need to be set. They are listed below with the associated number that appears on the screen:

0. coal
1. petroleum
2. natural gas
3. nuclear
4. hydro-electric
5. gasoline
6. diesel
7. solar photovoltaic (PV)
8. wind
9. biomass

For each of the generation sources, up to 100% may be entered, so long as the total for all ten does not exceed 100%. For example, if 51% is entered for coal, there would be 49% left for the remaining sources. The final total does not need to equal 100% since there are possibly more sources beyond the ten that are included (such as wood).

Below is an example for coal when it makes up 51% of the electricity generation mix:

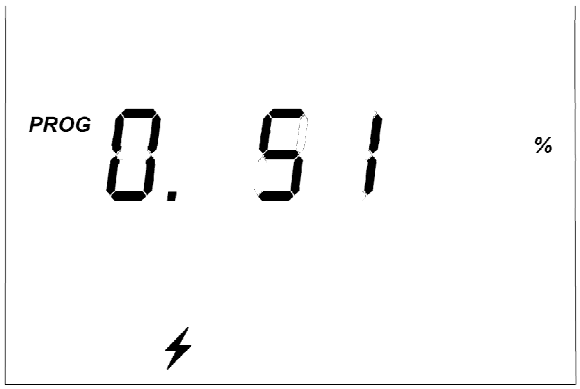

Figure 3.3.4

Pressing the enter button after entering a value for all ten sources will move on to configuring the amount of water required to generate electricity. Information on your generation mix can be obtained from your local government or via the EnerWorks Web site.

3.3.5 Water required for electricity generation

The production of electricity requires water. In order to calculate the amount of water saved by displacing electricity generation, an average value for the volume to generate one kWh of electricity needs to be defined. This value is used along with the amount of energy delivered (see section 2.1.1) to give the amount of water saved by displacing electricity generation (see section 2.1.4). Water required for electricity generation is the volume of water that is not used because of the amount of electricity that is offset by the EnerWorks Solar Water Heating Appliance.

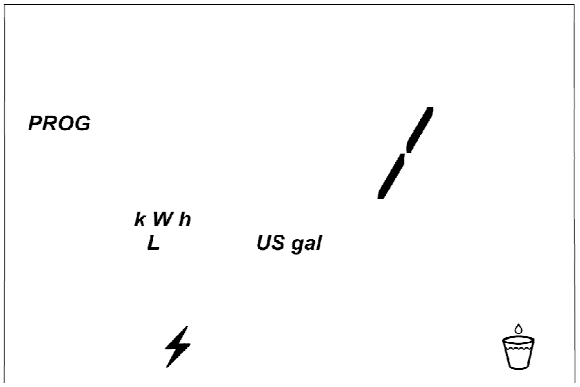

Figure 3.3.5a

There are two screens involved for this setup. The first one will ask for the preference of units (either litres or US gallons). Pressing the up or down button will switch between "L" and "US gal".

Pressing the enter button after selecting units will move on to the next screen that allows entering a value for how much water is needed to produce a kWh (3 US gal/kWh is the default). For a list of values for your area, visit the EnerWorks Web site.

Pressing the enter button after setting the value will return to the outputs menu.

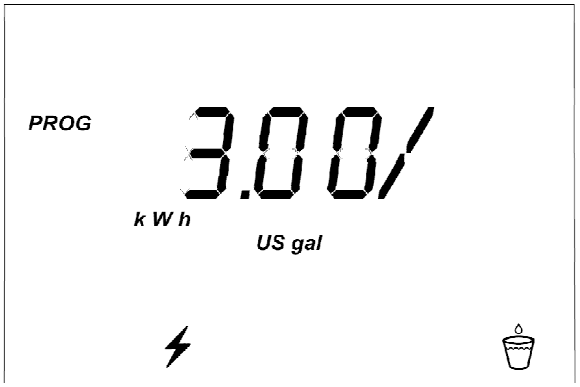

Figure 3.3.5b

4.0 Date/time menu (Thermal Energy Controller) PROG

Menu buttor

There is a third menu in which you can set the date and time, and reset the historic maximum and minimum values that are stored. To get to the date/time menu, press the menu button twice from the outputs menu. The PROG icon will light up to indicate that you are in a programming mode. Pressing the menu button again from any display will return to the outputs menu and will not reset the settings. Use the up and down buttons to toggle values, and the enter button to accept the value for the current item and move to the next item.

Enter buttor

Note that the status of the system will not be displayed while in programming mode.

Up button

Down butto

4.1 Setting up the system time/date AM PM 1 31 365

4.1.1 System time AM PM

The first screen for setting the time asks whether the time format should be in 12-hour format or 24-hour format. Pressing the up or down button will switch between the two selections:

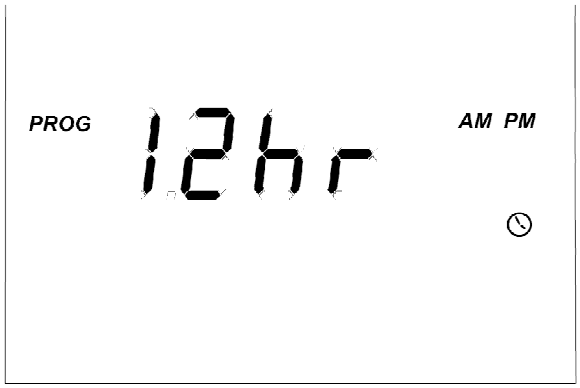

Figure 4.1.1

Press the enter button to accept the time format. The time can then be set up by using the up and down buttons to scroll through the hour. Press enter to accept the hour, and then use up and down to set the minutes. Press enter to accept. The screen will move next to setting the date.

4.1.2 System date

The first element to set for the date is the year. Use the up and down buttons to scroll through and set the current year. Press enter to accept. Repeat the process for month and then day.

Figure 4.1.2a

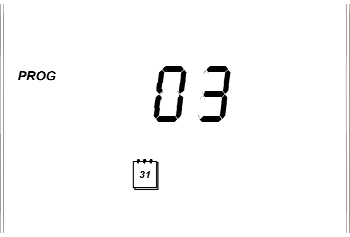

Figure 4.1.2b

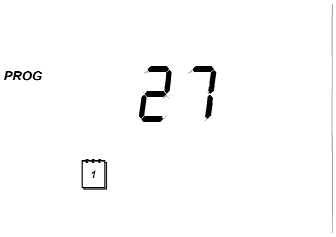

Figure 4.1.2c

After the day is set and the enter button is pressed, the screen will return to the outputs menu.

4.2 Reset maximum/minimum values

This menu item allows you to reset the maximum/minimum values of the various temperature readings to 0. The screen below is what will be displayed:

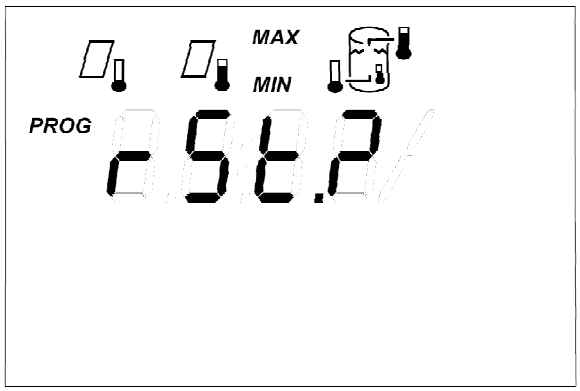

Figure 4.2

Hold the **up** and **down** buttons **simultaneously** for **three seconds** to activate the reset. Press the enter button to view the software version of the Thermal Energy Controller.

MAX

4.3 Reset energy values

MIN

This menu item allows you to reset the energy values that have been collected by the appliance, including dollar savings, carbon dioxide offset, and water used. The screen below is what will be displayed:

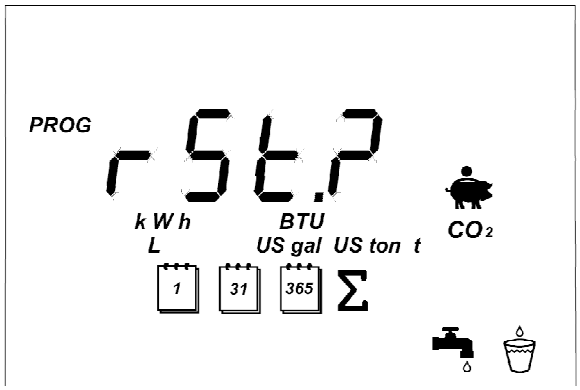

Figure 4.3

Hold the **up** and **down** buttons **simultaneously** for **three seconds** to activate the reset. Press the enter button to view the software version of the Thermal Energy Controller.

4.4 Software version

This menu item allows you to view the software version. An example is shown below:

Figure 4.4

Press the enter or menu button to return to the outputs menu.

5.0 Programming mode (Thermal Energy Monitor)

PROG

Up button

Your installer will automatically program the communication address on the Thermal Energy Monitor. This is the address shared with Thermal Energy Controller so that data can be exchanged.

Down button

The only reason that this address would need to be changed for the Thermal Energy Monitor that was included with your appliance is if the Thermal Energy Controller had its address changed by the installer.

You may also have multiple Thermal Energy Monitors in your home for displaying information about one Energy Pack. In this case, they must all share the same address to display your information correctly.

To change the communication address, press and hold the **up** and **down** buttons **simultaneously** for **five seconds**. The screen will change to the one seen below, with your communication address (this one says 3A8D with a lowercase "d"):

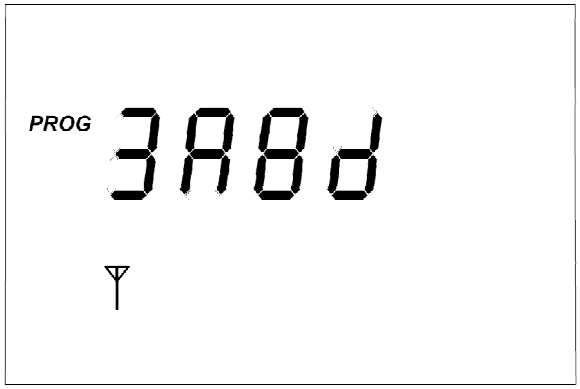

Figure 5.0

Use the **up** button to **change** the value and the **down** button to **accept** the value. The characters are changed from left to right. After entering the final character, let the Thermal Energy Monitor sit for a minute before it will resume normal operation.

6.0 Icon reference

1.  - No solar energy available/minimum collector temperature. When the ΔT is not high enough to collect solar energy, the cloud and the collector will show. The collector and the thermometer are shown in conjunction to indicate the historical minimum collector temperature in the outputs menu along with the MIN segment (icon #3).

2.  - Solar energy available/(maximum) collector temperature. When the ΔT is high enough for the system to collect solar energy, the sun and the collector will show. In the outputs menu, the collector and the thermometer are shown together for the current collector temperature and, with the MAX segment (icon #3), to show the historical maximum collector temperature.

3. 

- Maximum/ΔT/Minimum. MAX/MIN is used when displaying maximum/minimum values for, typically, temperature. ΔT is for displaying the temperature differential between the collector and the storage.

4.  - Tank status. The thermometer on the left represents the incoming temperature of the mains water. The interior thermometer represents the temperature of the storage. The thermometer on the right represents the outgoing temperature of the heated water. The arrow inside the tank blinks when there is a draw on the tank.

5.  - Pump status. Heat-transfer fluid-lines are represented by horizontal/vertical lines running between collector and tank. The four lines blink clockwise when the pump is running, i.e. from the bottom of the tank to the collector, then from the collector to the top of the tank. The four lines don't show when the pump isn't running.

6. *PROG* - Programming mode. Indicates that the Thermal Energy Controller is in programming mode.

7. AUTO / MAN - Pump setting. AUTO means automatic mode, as in the pump will run based on the logic of temperature differential control (ΔT, max/min temperatures, etc.). MAN means that the pump is in manual mode, either turned on manually (runs for 15 minutes before defaulting back to automatic mode) or turned off manually and stays off until manually turned back on.

8.  - Seven-segment digits plus decimals, colon, and slash. The four digits are used to display input/output values along with the decimals. The colon is only used for displaying the time. The slash is used when setting the fuel price and the amount of water needed to generate electricity.

9. AM PM - AM/PM. Used for displaying the 12-hour clock.

10. °F °C - Temperature units. Metric and imperial units for displaying temperature.

11. % - Percentage. Used for setting generation mix of electricity.

12. ✓ ✗ - Checkmark and x-mark. These symbols are used in various ways together, typically meaning on/off, enable/disable, and so forth.

13. 1 2 - Service status. The hammer-and-wrench icon will appear with the 1 segment annually to indicate that annual maintenance is required, and the 2 segment appears triennially to indicate replacement of the heat-transfer fluid is needed. The hammer and wrench will blink in conjunction with an error message to indicate a problem in the system (usually just a sensor that has yet to be hooked up).

14. M k W - Power units; mega kilo Watt. These units are used for instantaneous power.

15. M k W h - Energy units (metric); mega kilo Watt hour. Used to display energy readings – chiefly the solar energy delivered by the system to the household – and to input fuel prices.

16. M k W /m² - Solar radiation unit (metric); mega kilo Watt per square metre. If your appliance has a pyronameter (solar sensor) installed, these units are used to report solar radiation.

17. M M BTU - Energy units (imperial); thousand thousand British thermal units. Used to display energy readings – chiefly the solar energy delivered by the system to the household – and to input fuel prices.

18. $MMBTU/(h \cdot ft^2)$ - Solar radiation unit (imperial); thousand thousand British thermal units per hour square foot. If your appliance has a pyronameter (solar sensor) installed, these units are used to report solar radiation.

19. GJ - Gigajoule. This is a metric unit of measurement for natural gas.

20. m^3 - Cubic metre. This is a metric unit of measurement for natural gas.

21. L - Litre. This metric unit of measurement is used for propane, oil, and water.

22. $1000\ ft^3$ - Thousand cubic feet. This is a US customary unit of measurement for natural gas.

23. $US\ gal$ - US gallon. This US customary unit of measurement is used for propane, oil, and water.

24. $US\ ton$ - US ton (short ton = 2000 lbs). The US customary unit used to report carbon-dioxide reduction.

25. t - Tonne (metric tonne = 1000 kg). The metric unit used to report carbon-dioxide reduction.

26.  - Currency symbol. To internationalize the Thermal Energy Controller and the Thermal Energy Monitor, this symbol represents the monetary unit. The default configuration of the Thermal Energy Controller/Thermal Energy Monitor is dollars, but they can be easily used with any currency.

27. CO_2 - Carbon dioxide. This icon appears when displaying the offset of carbon dioxide, in conjunction with the measurement units (tonnes or US tons).

28.  - Load shifting. If your appliance is configured for load shifting, the sun will turn on when load shifting is in effect. The clock will appear when the schedule is being used. The antenna will turn on when the utility is controlling the load shifting remotely.

29.  - External communication. If your appliance has the capability of external communications, this icon will show up to indicate a connection.

30.  - Communication between the Thermal Energy Controller and the Thermal Energy Monitor. This icon will display on the Thermal Energy Monitor when there is communication between the Thermal Energy Controller and the Thermal Energy Monitor. If communication is fading or non-existent, this icon will blink on the Thermal Energy Monitor.

31.  - Low-battery warning. If the batteries in the Monitor are getting low and need to be replaced, this icon will appear.

32. 

- Timespans and calendar. "1" = day, "31" = month, "365" = year, "∑" = cumulative. The three calendar pages are used for daily, monthly, and yearly data outputs as well as representing the day, month, and year of a date. The cumulative icon is for outputs gathered from commissioning date.

33.  - Secondary application. If your appliance is also being used to heat your pool or your home, these icons will show when viewing the inlet and outlet temperatures. The low thermometer represents the cold-inlet temperature and the high thermometer is for the hot-outlet temperature.

34.  - Fuel types. The four auxiliary heating sources are, respectively, electricity, natural gas, heating oil, and propane. These symbols are used for setting energy prices and for displaying energy equivalency to the solar offset.

35.  - Water used. This icon shows up along with L or US gal to show how much water has been delivered through the EnerWorks solar water-heating appliance.

36.  - Water saved. This icon shows up along with L or US gal to show how much water has been saved by offsetting electricity (only). It's also used for setting the amount of water needed to generate one unit of electricity.

7.0 Error codes

When an error occurs, the Thermal Energy Controller and the Thermal Energy Monitor will remind every minute that there is a problem in the system, jumping to the reading that has its sensor disconnected. The service icon will also be illuminated.

Err0 - collector thermistor short circuit
Err1 - storage thermistor short circuit
Err2 - mains temperature-sensor short circuit
Err3 - hot-outlet thermistor short circuit
Err4 - mains flow-sensor short circuit
Err6 - secondary cold-inlet temperature-sensor short circuit
Err7 - secondary hot-outlet thermistor short circuit
Err8 - secondary flow-sensor short circuit
Err9 - pyronameter open/short circuit