



### **Operation of the AES System (Automatic Energy Selector).**

The control system on the AES selects the most suitable energy source. The selection will be made with highest priority to 120 volt, second priority to 12 volt from the alternator (if tag line is connected) and lowest priority to gas operation. There are only two customer controls to operate the system; the thermostat and the on-off switch. When the switch is turned on, a green indicator light glows to show that the system is operating. This indicator light will flash red on the gas mode, if the propane supply is depleted.

The AES has a built in safety device that delays gas ignition and start up 20-60 minutes from 12 volt operation. This enables the customer to stop and refuel the vehicle without touching the refrigerator. If the delay is not desired after stopping, the system may be re-set by switching the refrigerator off and then back on.

### **Safety Device**

The AES system also has a built-in safety device that will shut down operation, if one of the following parts break down: A. the printed circuit board, B. the igniter or, C. there is no control voltage to the relay. This feature ensures that propane will not leak uncontrolled due to a part failure.

## **PART EXPLANATION AND TROUBLESHOOTING DIAGNOSIS**

### **Printed Circuit Board**

The printed circuit board is the heart of the AES. From this point, all the energy sources are controlled, including the gas start-up delay from 12 volt operation. The 120 volt operation is not affected by the 12 volt delay feature. Anytime the system receives 120 volts, the refrigerator will switch over to the electric mode. It should be noted, however, if the 120 volt supply is disconnected within the 20-60 minute delay cycle, a gas start-up will not occur until the end of delay period. As before, if a delay is not desired, the refrigerator may be re-set by making an off-on procedure. A normal gas start-up will then occur.

The circuit board on the AES also has the ability to monitor the control voltage. If the incoming voltage to the refrigerator drops below  $9.5 \pm 1$  volts, the AES will switch to gas operation and the refrigerator will be unaffected by the thermostat. Until the low voltage situation is corrected, the system will remain on gas continuously and will not switch to 120 or 12 volt. As a warning device, the green indicator light will shut off during the voltage drop. When the incoming voltage returns to 12 volts, the green indicator lamp will switch back on and the refrigerator will again switch to the most suitable energy source. It must be remembered that the AES requires 12 volts at all times to operate on 120 volts, 12 volt or gas.

When a problem with the refrigerator system is being diagnosed and it is suspected that the circuit board is at fault, most likely the failure will be visible on the board itself. If the AES fails to operate and it is noted that there is a shorted wire between diodes or a shorted or burned section of the connecting foil on the circuit board, it is probable that it is defective. Be sure the troubleshooting steps outlined below are followed **BEFORE** changing the board.

### **Heaters**

The 120 and 12 volt heaters that are included in the AES refrigerator are the same as on earlier models. For ease of replacement they contain a quick connect contact plug. These plugs are polarized and will fit only one way. When checking the electric element, you should notice a 42 ohm's reading with the 1303 AES. With this model on 12 V operation, the refrigerator will draw 22.9 amps.

### **Solenoid Valve**

The AES uses a solenoid valve for opening and closing the gas supply line instead of the usual manually operated safety valve. When the refrigerator is ready to light on gas, the circuit board will send 12 volts to the solenoid valve to open it. After the flame is lit the current from the thermocouple will keep the solenoid valve open. The 12 volt signal current from the circuit board will drop off in 30-40 seconds after the flame is lit. To check the valve for operation, disconnect the braided cable from the solenoid valve. Connect a jumper wire from the 12 volt positive terminal on the refrigerator to the lower lug on the solenoid valve. When this is done, an audible clicking noise should be heard. This indicates that the valve is operational. The solenoid valve should be replaced if it does not click open. If the valve opens, the D.C. voltage from the igniter must be checked. To open the solenoid valve, there must be 80V between the yellow wire on the igniter (marked L) and ground. If the voltage is less than 80V, the igniter should be replaced. It should be noted that the resistance cannot be checked across the terminals on the solenoid valve without damaging the circuit board.

### **Thermostat**

The thermostat used in the AES system is a normal electric thermostat without an off position. It operates on low voltage from the printed circuit board. If the thermostat is broken and has lost its charge, the refrigerator will not operate on gas, 120 or on 12 volt. If it is believed that the thermostat is broken, by-pass the thermostat by removing the two wires connected to it. Then place the two leads from the thermostat together and try for operation. The Thermostat should be replaced, if the refrigerator now functions properly when the leads are connected.

Overfreezing will occur in the refrigerator, if the thermostat capillary tube is in the wrong position in its holder. For the model 1303 AES, the capillary tube distance should be 3 1/2" from the tip of the sensing tube to the bottom of its holder.

## **Igniter**

The igniter operates off of 12 volt current. On gas operation the igniter senses the resistance between the electrode and burner. When there is no flame at the burner, the resistance is high and the igniter begins sparking to light the refrigerator. As soon as the flame is lit, the resistance between the electrode and burner drops and the igniter stops sparking. The resistance is monitored by the circuit board and for any reason the flame goes out, the circuit board signals the igniter to begin sparking until the burner is lit. This insures that the flame will always be lit when desired.

If the igniter does not spark, first make sure that it is receiving 12 volts. If the igniter is receiving 12 volts and does not spark, it must be checked for operation. Remove the wire from the electrode and igniter and place 12 volts at that lug. If no internal clicking sound is heard, the igniter is broken. It is important to remove the high current wire from the electrode and the igniter when you are checking the igniter for operation. The high current wire and the electrode can be connected to ground causing the circuit board to think that the flame is lit, resulting in no spark on gas operation. Moisture or dirt on the electrode itself will also affect the igniter. When diagnosing an igniter problem double check it to make sure the igniter is dry and clean.

## **Indication Lamp**

The indication lamp consists of two diodes; one green and one red. When the gas supply to the refrigerator is adequate to operate the system, the green light shows. If the system runs out of propane fuel, this green indicator light flashes red to warn you that the gas supply is depleted. If the battery voltage drops below  $9.5 \pm$  volts, the indicator light will shut off to warn you of the low battery condition. At this time, the flame will be continuously lit until the battery returns to 12 volts. It also must be remembered, that all electrical connections in the AES are polarized, including the indicator light. This light will show constant red and flashing green if it is inserted upside down.

## **Main Switch**

The switch operates on 12 volts from the circuit board. In normal operation, the switch should travel only to the **ON** and **OFF** positions. A switch that travels more than this has been installed incorrectly or the installation nut that holds the switch in place has worked loose. If the switch is the suspected point of failure, check the connecting ribbon cable for visible cuts or shorts. The switch can be checked for resistance between terminals 1 and 2, 4 and 5, and 6 and 7. Remember to disconnect the switch from the circuit board when checking for continuity.

## Electrode

The electrode serves two basic functions on the AES refrigerator. It is used as a contact point to transmit the spark from the igniter to the burner. The electrode also acts to measure the resistance between it and the burner and sends this information to the printed circuit board. When the resistance is high, the igniter starts sparking and when it is low the igniter stops sparking. Because of this, the electrode position is extremely important. If the electrode is too close to the burner (below 1 mm) the resistance is low and the system will think the burner is lit. In this situation, no spark will occur. On the other hand, if the gap from the electrode to the burner is too large (more than 6 mm) the resistance will be too high and the igniter will continue to spark even though the flame is lit. With this situation, the flashing red indicator light will come on in approximately 3 minutes.

In closing, there are two more external parts that can cause problems with your AES refrigerator. First, if your propane supply to your refrigerator is depleted, no cooling on gas will take place and the red indicator light will flash. When it is noticed that the indicator light is flashing red, always check your fuel supply first. The second external part that may be causing the problem with the control system, is the 12 volt battery. If a weak or dead battery is used to operate the refrigerator, the AES controls will not function properly. No cooling or bad cooling on gas, electric and 12 volt will occur, if the battery is discharged or shorted. If the battery drops below  $9.5 \pm$  volts, the refrigerator will only be operational on gas. It also has been noted that the AES will sometimes over-freeze with a weak battery in line. No indicator or interior light and no control functions indicate a dead battery. Remember, without a constant 12 volt source to the refrigerator, the system will not work on 120 or 12 volt or on gas.

I hope this answers some of your questions on the AES refrigerator. If you run into any problems that are not addressed here, please contact your nearest Dometic location for further information.

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