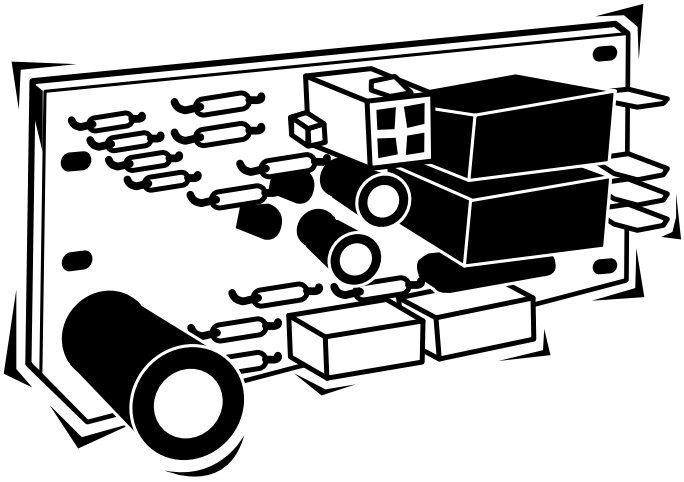
TECHNICAL SERVICE GUIDE

Adaptive Defrost



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CAUTION

To avoid personal injury, disconnect power before servicing this product. If electrical power is required for diagnosis or test purposes, disconnect the power immediately after performing the necessary checks.

RECONNECT ALL GROUNDING DEVICES

If grounding wires, screws, straps, clips, nuts, or washers used to complete a path to ground are removed for service, they must be returned to their original position and properly fastened.

GE Consumer Home Services Training
Technician Service Guide
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The intent of this service guide is to introduce the appliance technician to the theory and operation of adaptive defrost.

Adaptive defrost is a feature on the electronic refrigerators starting in the 2001 model year.

ADAPTIVE DEFROST

Adaptive defrost can be described as a defrost system which adapts to a refrigerator's surrounding environment and household usage.

Unlike conventional defrost systems which use electromechanical timers with a fixed defrost cycle time (10 hour, 12 hour, etc.), the adaptive defrost system utilizes an intelligent, electronic control to decide when defrost is necessary. In order to make this decision the control monitors important refrigerator operations:

· Length of time the refrigerator doors were open since the last defrost.
· Length of time the compressor has run since the last defrost.
· Amount of time the defrost heaters were on in the last defrost.

Just prior to defrost heater operation, the refrigerator will enter a **Prechill** mode.

Note: *Some models* have a special mode called "Defrost Hold-Off". This mode prevents the refrigerator from exiting the prechill mode until the control has sensed two hours without any doors being opened. This period of door inactivity allows the refrigerator to enter defrost during periods of low usage. However, there is a maximum defrost hold-off of 16 hours. This puts the refrigerator into defrost after 16 hours even though there hasn't been two hours without the doors being opened.

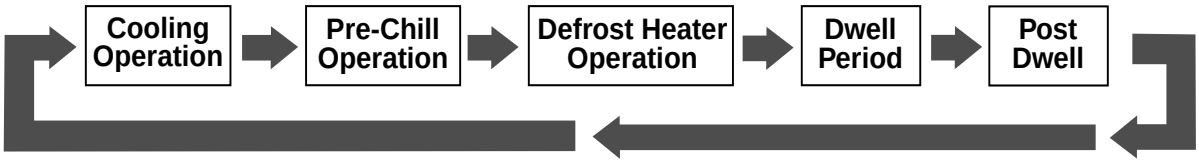
In the prechill mode, the electronic control bypasses the freezer thermistor input and forces the compressor to run constantly for approximately 1 to 2½ hours (depending on the model) in preparation for defrost heater operation.

During defrost, the electronic control monitors defrost heater operation (heater ON time). Once heater operation is terminated, or times out (maximum of 45 minutes), the electronic control will allow a **Dwell Time** before initiating the next cooling cycle. Dwell time is the elapsed time from heater termination until cooling operation is resumed and will discussed later in this guide. After the dwell time, the control will begin a **Post Dwell** period. In post dwell, the compressor and condenser fan will operate, but the interior fan(s) will be off. This mode will allow the evaporator coil to cool down before the fans circulate air.

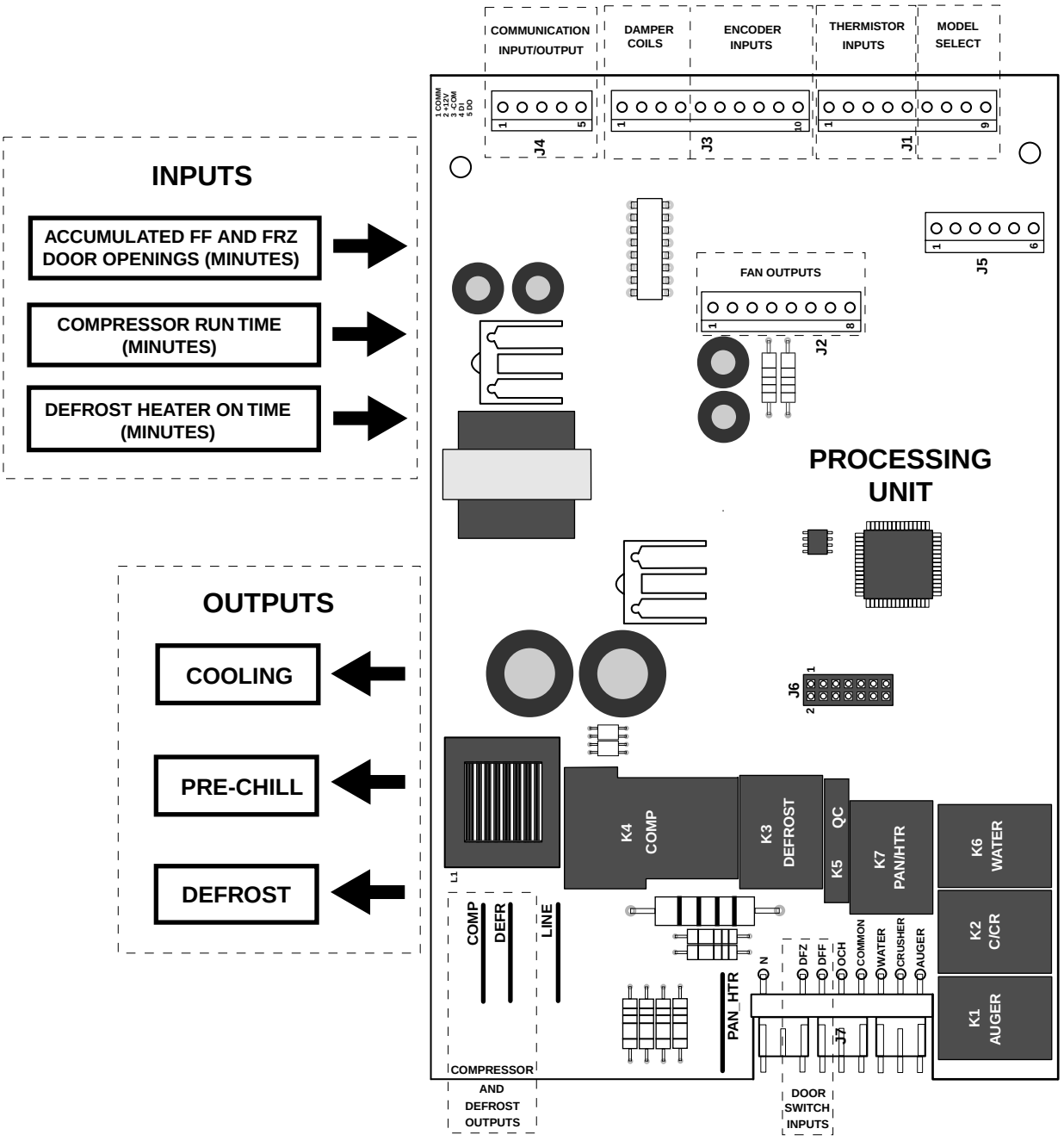
In summary, the refrigerator's electronic control board controls the amount of time between defrosts. This allows for efficiency by extending the time between defrosts. In other words, instead of a fixed defrost time (10 hour, 12 hour, etc.), the adaptive defrost system only defrosts when needed.

Now that you understand the basics of adaptive defrost, let's move onto the details.

ADAPTIVE DEFROST OPERATION



In actual operation, the electronic control receives inputs and provides output from many different locations on the board, but in order to simplify and illustrate it's operation, we'll divide the control into 3 different sections. The first section consists of the **Inputs** from various refrigerator operations (door openings, control settings, thermistor readings, etc.). The second section is the **Processing Unit,** where all of the decision making occurs (when to defrost, when to run the compressor, etc.). These decisions are based on the inputs the control has received. *The control retains this input information even after power failures.* The third section is what we'll refer to as the **Outputs**, where all of the work is performed (relays open and close to initiate and terminate various operations (defrost, cooling, etc.).



COOLING OPERATION (Normal adaptive)

During cooling operation, the electronic control monitors door opening times (fresh food and freezer doors) and compressor run times. These times are measured in seconds and are accumulated until they add up to 60 hours of total ***equivalent*** compressor run time. Once 60 hours (3600 minutes) of total equivalent compressor run time is reached, the refrigerator will enter the Prechill mode (prechill will be discussed in greater detail later in this guide).

Total equivalent compressor run time is calculated by multiplying the accumulated amount of time the doors were open since the last defrost cycle by a *multiplication factor*, then adding to that number the actual amount of time the compressor has been running since the last defrost.

The **multiplication factor**, which can range from a number value of 120 to 255 depending of the refrigerator model, is used to compute an equivalent compressor run time for each minute a refrigerator door is open. As an example, a refrigerator with a multiplication factor of 143 means 1 minute of door open time is equivalent to 143 minutes of compressor run time for that model. If both the fresh food and freezer doors are open at the *same time*, the multiplication factor is double. In the above example, if both doors are open at the same time for one (1) minute, the equivalent compressor run time for that one minute is 286 minutes.

As stated earlier, the control accumulates the total amount of time the doors are open and multiples that number by the multiplication factor for the particular model. It then adds the accumulated compressor run time since the last defrost. The result is the ***total equivalent*** compressor run time.

As we stated earlier, the adaptive defrost system is able to adapt to its surrounding environment (ambient temperatures effect compressor run times) and household usage (accumulated door opening times). The length of time between defrost cycles is decided by the electronic control. Heavy usage and warm ambient temperatures will require an early defrost, while low usage and a cool ambient will allow longer periods between defrost cycles.

(**Accumulated door open time (minutes)** X **Multiplication Factor**) + **Accumulated compressor run time (minutes)** = **Total equivalent compressor run time (minutes)**

NOTE: **Multiplication Factor =** 1 minute of door open time is equivalent to between 120 to 255 minutes of compressor run time (depending on model)

TOTAL EQUIVALENT COMPRESSOR RUN TIME EXERCISE

Using the example given below, calculate the total equivalent compressor run time. Use the space below to perform your calculations:

Example:
Since the last defrost occurred, the refrigerator usage has been as follows:

- The fresh food door has been opened 8 times. 6 times the door was opened for 30 seconds and 2 times for 1 minute each time.

- The freezer door was opened once for 2 minutes, and twice for 30 seconds each time.

- Since the last defrost, the compressor has run for an accumulated compressor run time of 25 hours (or 1500 minutes).

The refrigerator has a *multiplication factor* of 143.

What is the total equivalent compressor run time?

How to solve the example:

Start by calculating the total time all of the doors were open (in minutes).

- Fresh food door 6 X 30 seconds = 3 minutes
- Fresh food door 2 X 1 minute = 2 minutes
- Freezer door 2 X 30 seconds = 1 minute
- Freezer door 4 X 30 seconds = 2 minutes

Accumulated door opening time = **8** minutes

Next, multiply 8 minutes of accumulated door opening time by **143**.

Remember that 1 minute of door opening time is equivalent to 143 minutes of compressor run time for the refrigerator in the example.

8 minutes X 143 = **1144** minutes

Next, add the 1144 minutes you calculated above to the 1500 minutes of accumulated compressor run time.

1144 minutes + 1500 minutes = **2644** minutes

2644 minutes/60 = **44.07** hours

Total equivalent compressor run time is equal to 44.07 hours

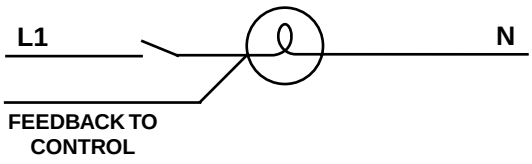
(Accumulated door open time (minutes) X **Multiplication Factor**) + Accumulated compressor run time (minutes) = **Total equivalent compressor run time (minutes)**

NOTE: **Multiplication Factor =** 1 minute of door open time is equivalent to between 120 to 255 minutes of compressor run time (depending on model)

COOLING OPERATION (Normal adaptive continued..)

As stated earlier, during cooling operation the electronic control monitors door opening times (fresh food and freezer doors) and compressor run times. The control monitors door opening times by looking for voltage (INPUT) present on the "DFF" or "DFZ" terminals of the board. When voltage is present at either (or both) of these terminals, the electronic control will begin counting until the voltage at these terminals is removed.

When the fresh food door is open, voltage is supplied to terminal "DFF" on the board as long as the door switch contact remains closed (door open). Also, the fresh food light bulb is not part of the INPUT circuit to the control. In other words, the fresh food door light could be burned-out (open) and the electronic control would still be able to monitor the voltage present at terminal "DFF". The same is also true for the freezer door light circuit.



To summarize, the door switches provide INPUT to the electronic control. These inputs are independent from the door lights. A failed light bulb (open), would have no bearing on adaptive defrost operation. However, a failed light switch (failed open, or failed closed) would affect adaptive defrost operation by either allowing constant input (defrost too early) or not supplying input at all (defrost too late) to the electronic control.

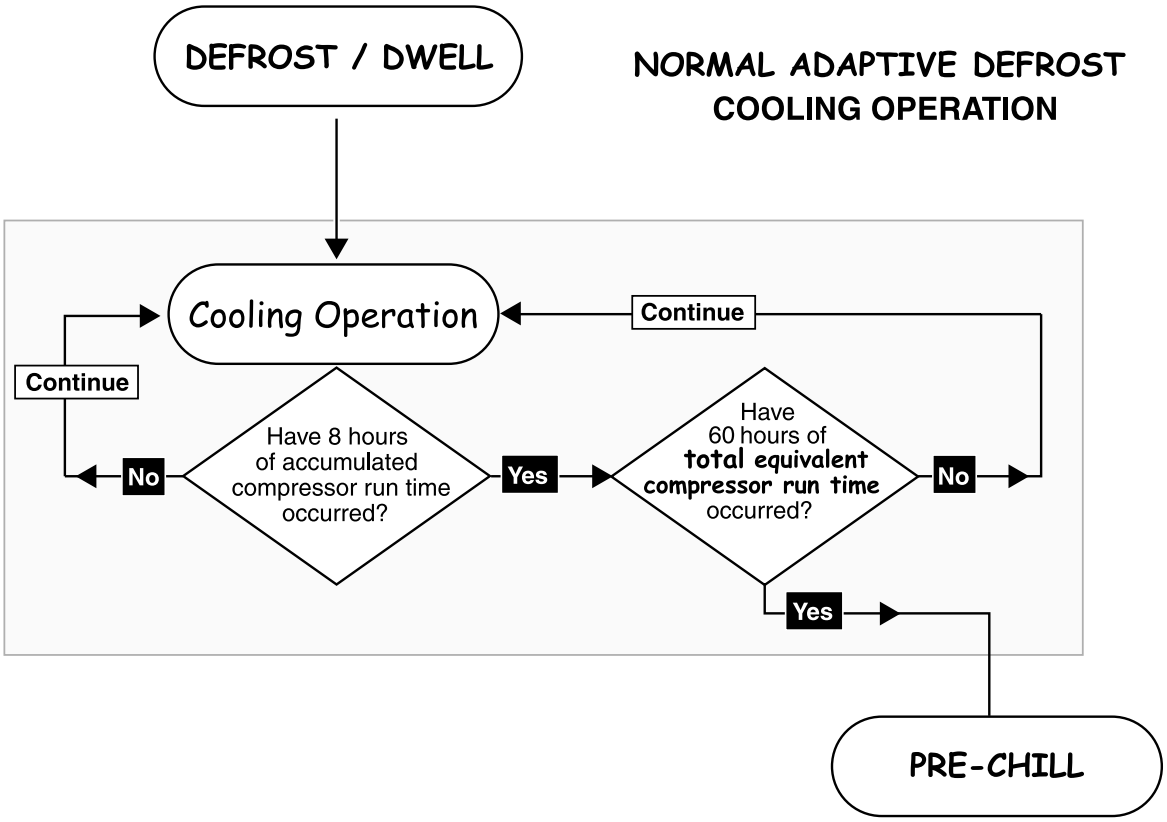
Let's assume for a moment that the compressor has run continuously for 25 minutes since the last defrost cycle occurred. Let's also assume that during this same period of time (25 minutes) the customer opened the fresh food door and forgot to close it. This refrigerator also uses a multiplication factor of 143. Based on what you have learned so far, let's calculate the equivalent compressor run time:

(25 mins. x 143) + 25 mins. = 3,600 mins. or 60 hrs.

In this example you can see during a 25 minute period of time (since the last defrost occurred), the cooling operation has already reached 60 hours of equivalent compressor run time. What you would expect to happen next is for the control board to initiate the prechill mode. However, 25 minutes of compressor run time is hardly sufficient time to provide proper cooling. In addition, 25 minutes is much too short a time between the last defrost and the next prechill cycle.

To avoid this situation, a minimum of eight (8) hours accumulated compressor run time must occur before the control will allow the refrigerator to enter the prechill mode. As you can see from the flow chart on the following page, once 8 hours of accumulated compressor run time has occurred, the electronic control will check for total equivalent compressor run time (accumulated compressor run time + equivalent compressor run time) to see if 60 hours has been reached. If 60 hours has occurred, the control will terminate the cooling operation and initiate the Prechill mode. If not, the control board will continue to operate in the cooling mode until 60 hours of total equivalent compressor run time has been reached.

Again note some models have the special mode called “Defrost Hold-Off”. This mode prevents the refrigerator from exiting the prechill mode until the control has sensed two hours without any doors being opened. This period of door inactivity allows the refrigerator to enter defrost during periods of low usage. However, there is a maximum defrost hold-off of 16 hours. This puts the refrigerator into defrost after 16 hours even though there hasn’t been two hours without the doors being opened.



NOTES

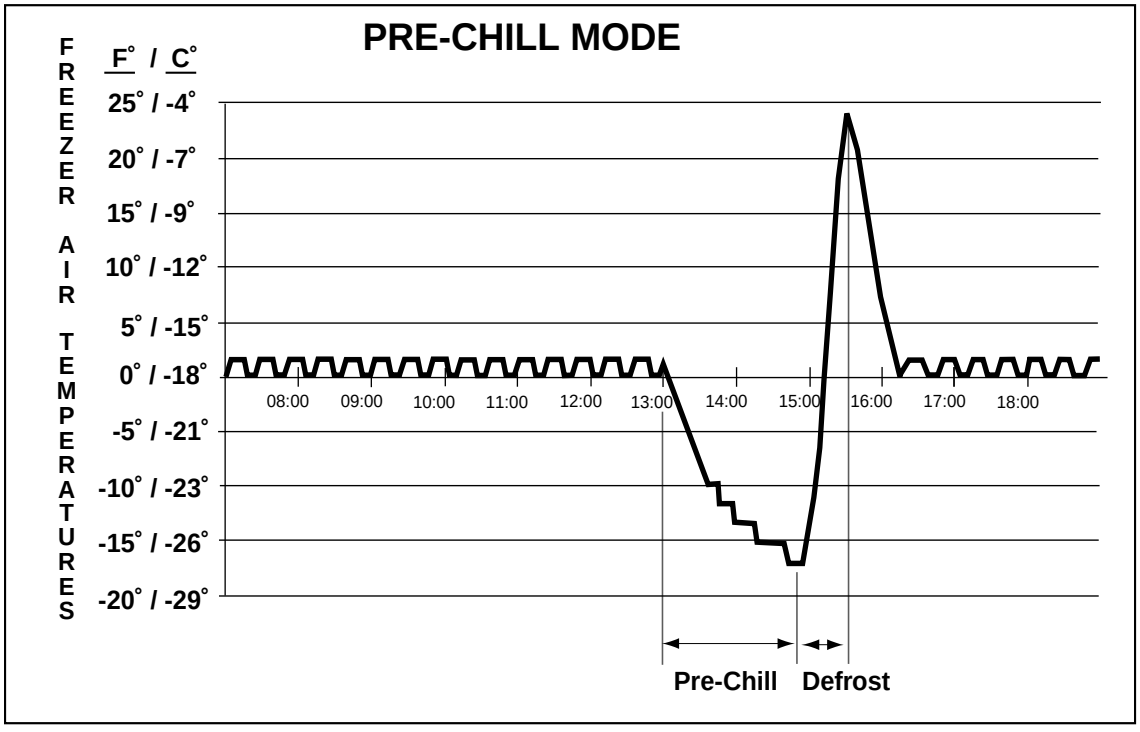
PRECHILL

When the electronic control board determines a minimum eight (8) hours accumulated compressor run time has occurred and 60 hours of total equivalent compressor run time has been reached, the control will force the refrigerator into a continuous cool mode (**Prechill**). It is important to note in order for the refrigerator to enter the prechill mode, the compressor must be running. In other words, if the unit has met the above criteria (a minimum of 8 hours accumulated compressor run time and 60 hours total equivalent compressor run time) and the temperature is satisfied (compressor not running), the unit will NOT enter the prechill mode until the electronic control calls for the compressor to run again. The unit will then immediately enter the prechill mode.

Prechill will last approximately 1 to 2½ hours, depending on the refrigerator model. Prechill time starts from the time the compressor last started. For example, if the prechill mode was 2 hours long and the compressor had been running for 15 minutes prior to 60 hours of total equivalent compressor run time being reached, the electronic defrost control would subtract 15 minutes from the 2 hours (1 hour & 45 minutes).

During prechill, the compressor, evaporator fan and condenser fan will run for the entire cycle. To accomplish this, the electronic defrost control ignores input from the freezer thermistor.

The prechill mode lowers the freezer temperature in preparation for defrost by approximately 15-20˚F. During defrost, heater operation will cause freezer temperatures to rise slightly. By lowering the freezer temperatures prior to defrost (prechill), the compressor "run-time" will be reduced once the cooling mode has resumed. In other words, it will take less time for the freezer to reach it's temperature setting.

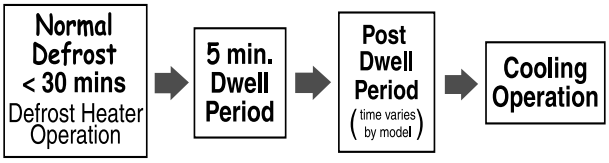


DEFROST OPERATION

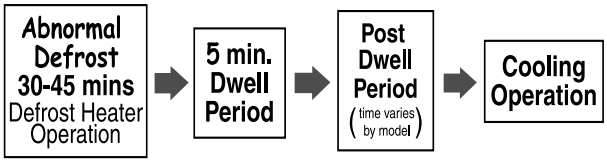
After two hours of prechill have completed, the electronic control turns off the compressor, condenser fan and evaporator fan. Next, the control energizes the defrost relay to complete the defrost heater circuit.

During defrost heater operation, the electronic control monitors heater ON time (total time defrost heaters are on). The control uses this information to determine how much frost has accumulated on the evaporator coils. Depending on the amount of frost, there are two possible defrost operations that can occur:

Normal Defrost Operation - defrost heater operation is terminated by the evaporator thermistor in less than 30 minutes of heater operation. Once the defrost heater is off, there is a fixed 5 minute dwell time, followed by a post dwell period before cooling operation is resumed and normal adaptive defrost.



Abnormal Defrost Operation - defrost heater operation is terminated by the evaporator thermistor within 30 to 45 minutes of heater operation. Once the defrost heater is off, there is a fixed 5 minute dwell time, followed by a post dwell period before cooling operation is resumed and non-adaptive defrost.



DWELL PERIOD

After defrost heater operation has been terminated by the electronic control, a five minute **Dwell Period** occurs. The dwell period is the elapsed time from heater termination until cooling operation begins. During dwell, the compressor, condenser fan and evaporator fan remain off. The remaining frost melting from the evaporator will continue to drip and drain so that prior to cooling operation, the evaporator will be totally clear of any moisture.

POST DWELL

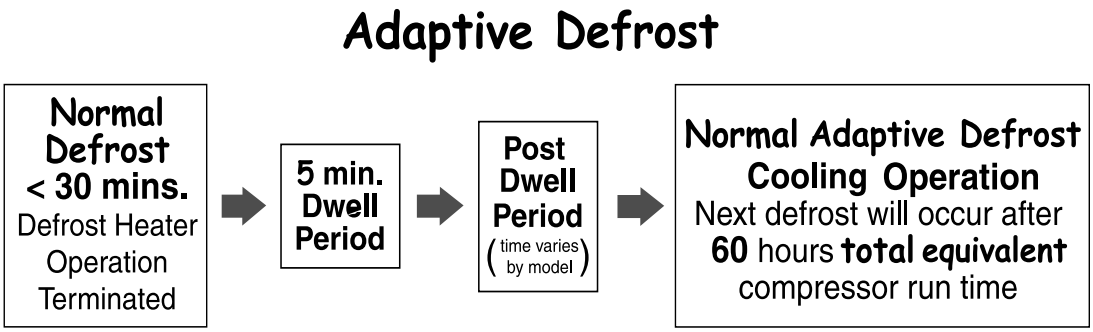
The post dwell period is designed to cool the evaporator before circulating air within the refrigerator. This prevents any residual heat on the evaporator from defrost from being distributed in the freezer.

During this period, the compressor and condenser fan are on, but all interior fan(s) are off and the damper (if applicable) is closed.

The amount of time before the fan(s) come on and damper opens can vary by model and is programmed into the control. Depending on the model, the electronic control can start the fan(s) once a certain evaporator temperature is reached or a certain length of time has elapsed. This setting is stored in the control's EEPROM and can vary from starting the fans immediately upon entering cooling to waiting for a certain evaporator temperature then starting the fans at slow speed and gradually increasing to high speed. Refer to the specific service guide or mini-manual for each model.

COOLING OPERATION (Normal Adaptive Defrost)

At the end of a normal defrost cycle, the electronic control will return the refrigerator to a normal cooling operation. The control will again monitor accumulated door open time and actual accumulated compressor run time. Once 60 hours of total equivalent compressor run time is reached, the next defrost cycle will occur.

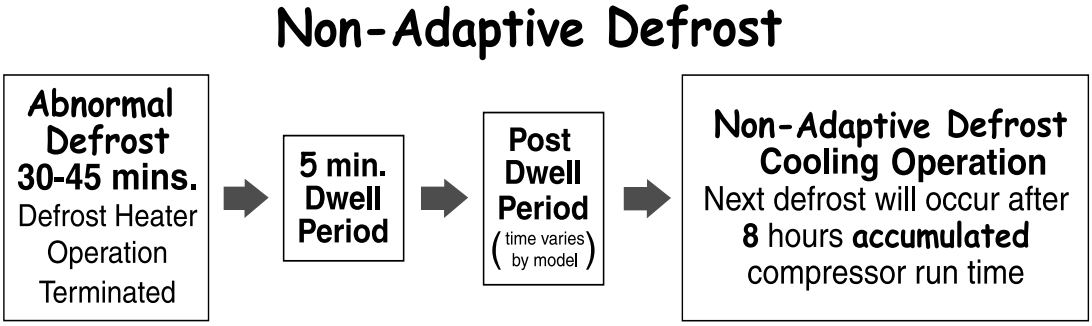


COOLING OPERATION (Abnormal Adaptive Defrost)

At the end of an abnormal defrost, the electronic control will return the refrigerator to cooling operation. However, due to the abnormal amount of heater ON time that occurred during the defrost cycle, the control will initiate the next defrost operation after a fixed 8 hours of accumulated compressor run time (non-adaptive defrost operation). The intent of this cycle is to attempt to clear any ice that may be remaining on the evaporator.

During this ***Non-Adaptive Defrost*** period, only the compressor run time will be monitored. The door open times will have no bearing on when the next defrost cycle will occur. The refrigerator will operate just like a conventional defrost system with an electromechanical, fixed 8 hour timer, *except* for the addition of a prechill mode.

If the next defrost is a **normal defrost** (heaters off in less than 30 minutes), the electronic control will allow the refrigerator to return to normal adaptive defrost operation. The next defrost will occur after 60 hours of total equivalent compressor run time. However, if the next defrost is abnormal, the refrigerator will once again revert to a fixed 8 hour accumulated compressor run time and then enter the defrost cycle (non-adaptive defrost operation).



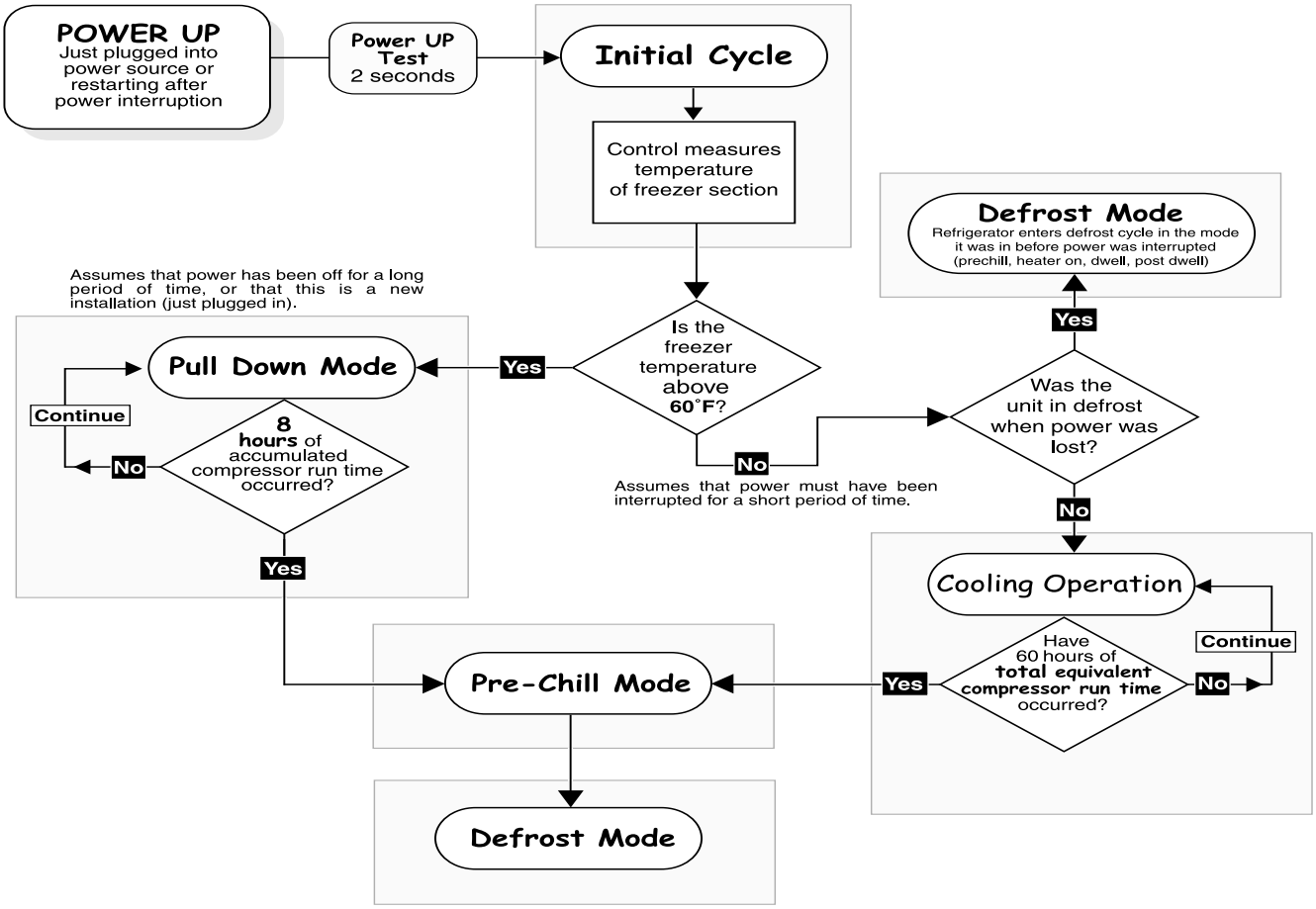
INITIAL CYCLE

When the refrigerator is first connected to power and turned on, the electronic control must determine whether this is a new installation, requiring a long cooling operation period, or a momentary power interruption. It makes this decision based on the temperature of the freezer section.

If the freezer section is warm (above 60˚F), the electronic control assumes this must be a new installation or a long power interruption. As a result, it will cause the refrigerator to enter a **Pull-Down Mode** (a pull-down mode in described on the next page)**.** Also, if the control senses a warm freezer and a pull-down is required, all data recorded in memory, (thermistor readings, door openings, etc.) are cleared and the counters are reset to zero.

If on the other hand, the electronic control senses a cool freezer section, the control assumes the refrigerator must have experienced a temporary power outage and continues operating with the inputs stored in memory.

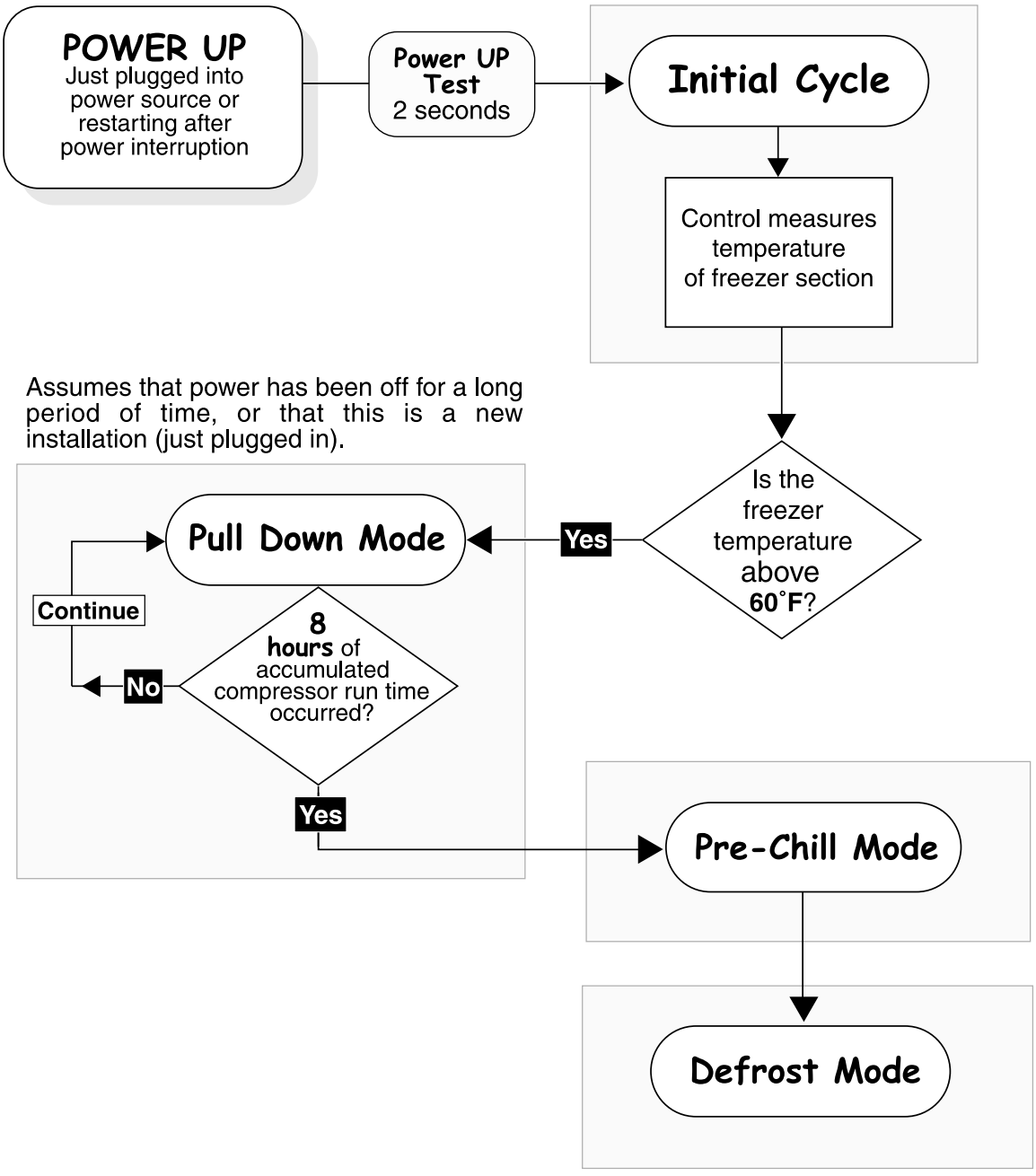
NOTE: There is one exception to this operation. If the freezer section is above 60˚F when power is restored and the defrost heater was ON when power was interrupted, the control will complete a dwell and post dwell period before entering the pull down mode.



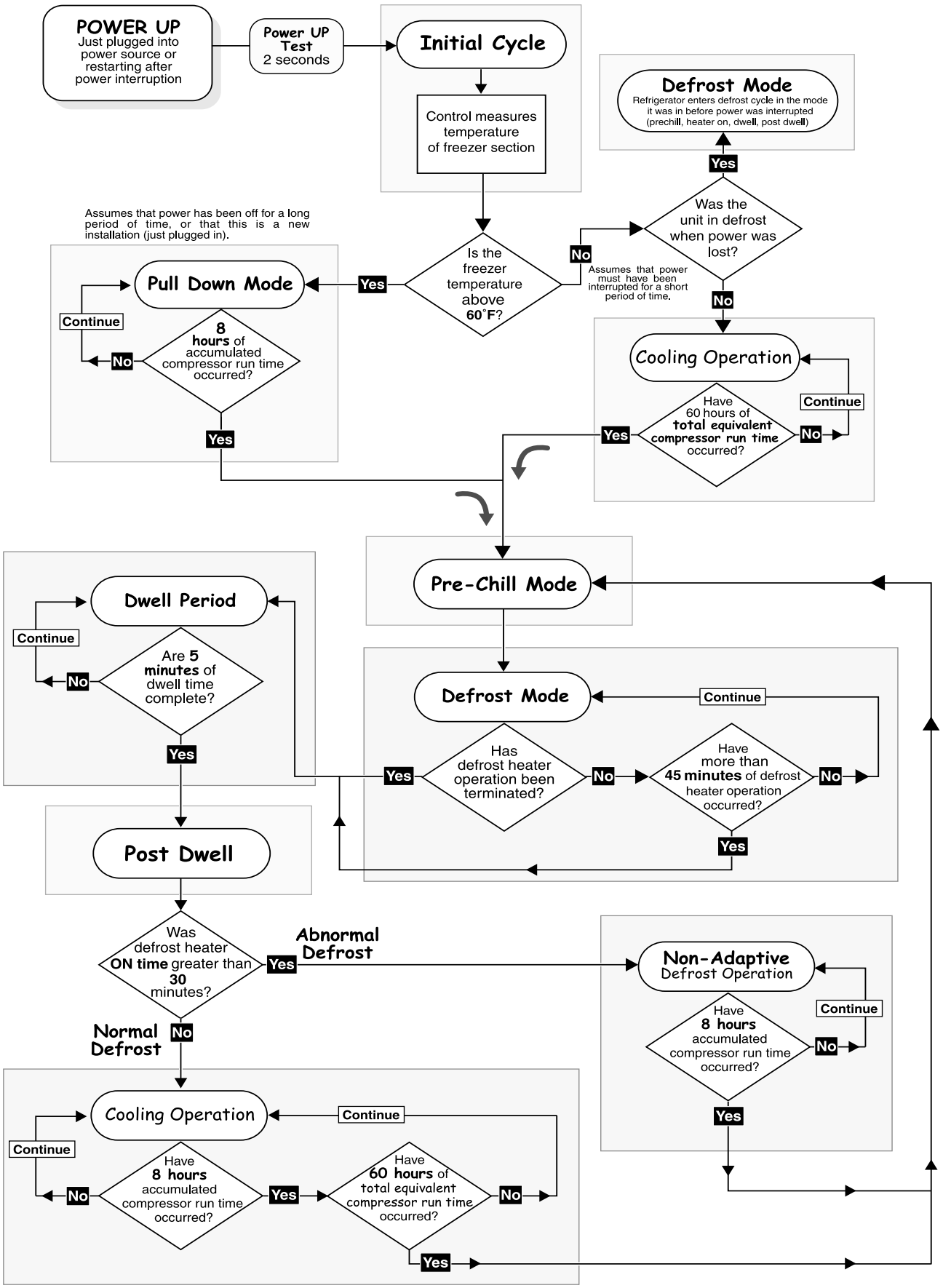
PULL DOWN

After a long power outage or initial start-up (when the control senses the freezer is above 60˚ F), the refrigerator will enter a **Pull-Down** mode. In this mode of operation, the control will run the cooling cycle until eight (8) hours of accumulated compressor run time has occurred, then enter prechill and begin a defrost cycle.

After the defrost cycle, dwell time and post dwell, normal cooling operation with adaptive defrost will begin and the control will begin monitoring door openings and compressor run time.



ADAPTIVE DEFROST FLOW CHART



KNOWLEDGE EXERCISE

1. The physical component which controls adaptive defrost operation is referred to as?
   a. defrost timer b. defrost thermistor c. electronic control d. defrost heater

2. In determining when to defrost, the control monitors:
   a. length of time the defrost heaters were off since the last defrost
   b. length of time the refrigerator doors were open since the last defrost
   c. length of time the compressor has been off since the last defrost
   d. all of the above

3. The electronic control determines an abnormal defrost has occurred if:
   a. the defrost heater is on for only 5 minutes
   b. a prechill mode occurred prior to defrost
   c. the defrost heater is on for over 30 minutes
   d. all of the above

4. If the fresh food light burns out, what will the effect be on adaptive defrost operation?
   a. no effect
   b. the unit will not defrost
   c. it will revert to a fixed 8 hour conventional defrost
   d. it will cause an abnormal defrost to occur

5. During "normal adaptive" cooling operation, the unit will enter the prechill mode after 60 hours of total equivalent compressor run time have occurred, but not until?
   a. 143 minutes of accumulated door opening time have occurred
   b. one of the refrigerator doors are opened
   c. 8 hours of accumulated compressor run time have occurred
   d. none of the above

6. During adaptive defrost, the multiplication factor used by the electronic control is?
   a. 60 hours
   b. 143
   c. based on the model
   d. 8

7. During which defrost operation will there be no dwell period?
   a. normal defrost b. abnormal defrost c. there is always a dwell period d. both a & b

8. What is the dwell period time when a normal defrost operation occurs?
   a. 5 minutes
   b. 10 minutes
   c. there is no dwell period during a normal defrost
   d. it varies by the length of defrost

9. When the refrigerator is first connected to power, what occurs?
   a. The unit will immediately enter the "prechill" mode
   b. The unit will immediately begin "normal adaptive" cooling operation
   c. The unit will determine freezer temperature
   d. The unit will enter a 5 minute dwell period

10. Just prior to the defrost cycle, the refrigerator begins the prechill mode except:
    a. when the control settings are lower than midpoint
    b. at the end of a pull down mode
    c. the refrigerator always will enter a prechill mode before defrost
    d. none of the above