

1) Introduction

The Duty Cycle Analyzer (DCA) is designed to monitor and record the cumulative operation time of a refrigeration system compressor, or of the room thermostat/solenoid circuit operation, over some time period. For the thermostat/solenoid circuit, this measurement is then used to calculate the "Duty Cycle" factor which is used in the Analysis Spreadsheet. For the compressor, the "Duty Cycle" is a direct indication of the health and efficiency of a refrigeration system.

The DCA contains circuitry to detect a small amount of AC voltage, and turns on an elapsed-time meter as long as the input voltage is present. A self-contained rechargeable battery provides enough power for over two weeks of operation.

The input sensitivity of the DCA is such that the voltage output of a Frigitek[®] Tee Sensor is sufficient to operate the elapsed-time meter. Alternatively, an accessory clamp-on sensor probe can be used to provide the input voltage. The clamp-on sensor may be applied to any current-carrying conductor which is energized when the compressor is running, or when the room is cooling.

2) Indicators and Switches

The front of the DCA has a elapsed-time meter which records operating time in 1/10 minute (6 second) increments. The meter cannot be reset, and its reading will only increase. When the reading reaches the maximum for the meter, it will cycle to 00000.0 and continue to increase.

There is a red LED on the front of the DCA. This LED indicates battery charge condition. When the battery charger is connected, the LED is on all the time. During normal operation, the LED monitors the battery voltage, and blinks when the battery needs re-charging. Note that there are still some 4 to 5 days of operation still left when the LED begins blinking.

On the side of the DCA is a push-button switch. This switch is used to momentarily turn on the DCA so that the meter may be read. The metal post next to the push-button switch prevents inadvertent operation of the switch if the DCA is placed on its side.

A toggle switch on the side sets the DCA sensitivity to HIGH or LOW. This switch is normally left in the LOW sensitivity position, unless the DCA is being used to monitor a low-current device, such as a relay or solenoid valve. Note that, in the HIGH position, electric fields from nearby high-voltage (480VAC) conductors can erroneously trigger the DCA into recording mode. Care must be taken to avoid this condition.

3) Connections

The DCA is designed to be connected to a Frigitek[®] Tee, or to be used with a clamp-on probe to sense current flow. A special cable is available for use with a Tee, which allows operation of both the DCA and a Frigitek at the same time. There is a round connector on the side of the DCA for this connection. The accessory clamp-on probe also is connected here.

On the side of the DCA is a black power connector. The accessory re-charger is connected here to re-charge the internal battery. It is recommended that the charger not be attached to the DCA while the DCA is monitoring a refrigeration system.

4) Operation

a) To compare refrigerator operation with the Frigitek in "before and after" modes:

(Note - a Frigitek[®] must be installed for this comparison test)

1) For the Thermostat/Solenoid circuit -

Using the special cable with the two-pin connectors on it, connect the Tee to the Frigitek[®] and the DCA. Use the attached hook to hang the DCA in a convenient location, out of the way.

2) For the compressor -

Typically, the clamp-on sensor will be used for this test. It must be clamped on to a single wire (not a wire pair) which is carrying current only when the compressor is running. This could be one of the compressor power wires, or one of the wires to the condenser fan. Secure the DCA in some location where vibration of the operating compressor will not dislodge it.

b) To check operation of a refrigeration system with no Frigitek installed:

1) For the Thermostat/Solenoid circuit -

Typically, the clamp-on sensor will be used for this test. It must be clamped on to a single wire (not a wire pair) which is carrying current only when the solenoid is open. This could be either one of the wires between the thermostat and the solenoid, anywhere the wires are accessible.

Use the attached hook to hang the DCA in a convenient location, out of the way.

2) For the compressor -

Typically, the clamp-on sensor will be used for this test. It must be clamped on to a single wire (not a wire pair) which is carrying current only when the compressor is running. This could be one of the compressor power wires, or one of the wires to the condenser fan. Secure the DCA in some location where vibration of the operating compressor will not dislodge it.

5) Field Test Form

The field test form is used to record the DCA test data. Typically, a Frigitek[®] before/after comparison test will be conducted for a two week period, with the Frigitek turned on for one week, and off for one week. A week-long period is the minimum recommended test period, so as to monitor the system under all normal operation conditions. The Form is keyed to this type of test, and has blanks in which to enter the start and stop dates and times, and the meter readings.

6) Interpreting readings

The difference between the stop and start meter readings provides the total operation time of the compressor, or the active cooling time of the room, during the monitoring period. It is also necessary to accurately determine the number of hours in the monitoring period in order to calculate the duty cycle. If the start and stop times are the same, one week apart, then the monitoring period is 168 hours. If they are not the same time, then you may add or subtract the appropriate number of hours (and tenths) to determine the actual monitoring time period.

Divide the DCA recorded operation hours by the monitoring period hours, and multiply the result by 100 to determine the duty cycle. This gives the percentage of time the compressor is operating, or the percentage of time the room is being cooled (the "Duty Cycle").

Typically, well-designed and correctly operating refrigeration systems have a room duty cycle somewhere in the range of 30% to 50%. If the room duty cycle is dramatically higher than 50%, there is usually some problem with the system, such as evaporator coil blockage or low refrigerant. The problem should be brought to the attention of the customer, because the Frigitek[®] will not be able to deliver its best saving while the problem exists. In some instances however, the refrigeration system is under-sized for the cooled volume and load, causing the high duty cycle. Note that the Frigitek[®] cannot provide its normal good savings with an under-sized refrigeration system running at a high duty cycle.

A duty cycle substantially lower than 40% indicates that the refrigeration system may be over-sized for the cooled volume and load. In these systems, the Frigitek[®] will provide better than normal savings, since the refrigeration system is operating mainly to remove the evaporator fan motor heat from the box.

7) Re-charging

The DCA needs to be re-charged whenever the red LED on its front is blinking. The DCA will be able to continue operation for two to three days after the light begins blinking, but, as time passes, the LED will

become dimmer, and eventually stop blinking. The DCA will cease to function a day or so before the light stops blinking.

When the charger is connected, the LED will light, indicating the battery is being charged. Leave the charger connected for at least 24 hours, to fully recharge the battery. Leaving the charger connected for longer than 24 hours will not over-charge or damage the battery. Do not use a charger other than the one supplied.

8) Accessories

Available for use with the DCA are the following:

- a) Tee connector "Y" cable – used to connect the DCA and a Frigitek[®] to a Tee Sensor.
- b) Clamp-on Sensor Probe – used to monitor a compressor, or a room where no Tee is installed.

A battery charger module is supplied with the unit.

9) Specifications

Size – 2.25" x 3.25" x 5.25".

Weight – 29 Oz (1.8 Lbs).

Power – Internal, 12V, 6AH, Gel-type, re-chargeable, non-spillable battery.

Input Sensitivity – Lo - .25V; Hi – 25 mV for elapsed-time meter operation.

Operation Time – Approximately 2.5 weeks.

Charger Module – 18 VDC, .02A.

Frigitek DCA Field Test Form

Energy Control Equipment, Inc.

Name: _____ Date: _____

Address: _____ City: _____

Room Name: _____ Contact: _____ Phone: _____

Refrigerator/Freezer - Box Dimensions: _____ W x _____ L x _____ H Cu Ft: _____

Temperature Set: _____ °F. Compressor Hp: _____ Size fan motors: _____

Amps/fan: _____ # of Coils: _____ # of Fans: _____ Volts: _____ Total Amps: _____

Frigitek Serial #: _____ Frigitek Serial #: _____ DCA Serial #: _____

Test #1 – Frigitek **OFF**

Start:

Date: _____ Time: _____ DCA* Reading: _____

Stop: Seven days later. Total Hours: _____ Diff: _____

Date: _____ Time: _____ DCA* Reading: _____ %

Test #2 – Frigitek **ON**

Start:

Date: _____ Time: _____ DCA* Reading: _____

Stop: Seven days later. Total Hours: _____ Diff: _____

Date: _____ Time: _____ DCA* Reading: _____ %

*DCA – Duty Cycle Analyzer

Comments: _____

Person Reading Instrument