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## **OWNERS MANUAL**

### **PULSE OXIMETER AND CARBON MONOXIDE DETECTOR MODEL AERO-455 Rev. B**

### LOG OF REVISIONS

REV NO.	PAGE NO.	DATE	DESCRIPTION	APPROVED
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## **FORWARD**

This document provides information intended for use by persons who, pursuant to current requirements, are qualified to install this equipment. Because equipment and system installations vary depending on a particular aircraft, this document is intended only as a guideline. If further information is required, contact:

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## DESCRIPTION

### 1.0 GENERAL

This section gives a physical and functional description of the CO Guardian Pulse Oximeter and CO Detector unit (AERO-455) as installed in a typical reciprocating engine type aircraft. See physical description below.

### 2.0 PHYSICAL DESCRIPTION (AERO-455)

Panel mounted Pulse Oximeter and CO Detector part numbers are listed in Table 1.

<b>PART NUMBER</b>	<b>Description</b>	<b>SERVICE LIFE</b>	<b>RS232 Output for MFD (CO, Pressure, Cabin Temp)</b>	<b>POWER Volts</b>	<b>Cabin Pressure warning Light at (10K)</b>
455-101	Panel mount Detector	5 years	Yes	14/28	Yes

Table 1 - Part Numbers

The Detector must be returned to CO Guardian at the end of Service Life for replacement and calibration of the CO sensor to maintain airworthiness of the unit.

NOTE: The main reason for replacement of the sensor is the degradation of the sensor and dirt accumulation over the years. The replacement will be turned within five business days. See [www.coguardian.com](http://www.coguardian.com) for exact procedures.

**3.0 LEADING PARTICULARS**

Table 2 Pulse Oximeter and CO Detector leading particulars and specs.

**LEADING PARTICULARS/SPECS**

<b>PARAMETER</b>	<b>SPECIFICATION</b>
<b>PHYSICAL</b>	
Dimensions (approximate)	2.95” long. X 2.50”W in x 2.50” H
Weight (actual)	8.0 oz.
<b>ENVIRONMENTAL</b>	
Cooling	Passive
<b>Temperature and Altitude</b>	
Temperature	
Non-operating high temperature	+85 °C
Non-operating low temperature	-55 °C
Operating high temperature	+70 °C
Operating low temperature	-20 °C
Temperature Variation	
Altitude Compensation with built in	
Pressure sensor	25,000’
Humidity	
	95%
<b>POWER REQUIREMENTS</b>	
Power – 14/28 VDC Models	Nominal 9.0 vdc to 30.3vdc
Dissipation (maximum)	<1 watt

**Table 2 Leading Particulars**

#### 4.0 SCOPE

The Model 455 Pulse Oximeter and Carbon Monoxide Detector is designed to detect, measure, and provide a visual alert to the crew of Reciprocating Engine type aircraft before the cockpit level of carbon monoxide (CO) reaches a critical level, and enables the occupants of the aircraft to monitor their physiological condition using a pulse oximeter installed in the cockpit's instrument panel measuring SPO2 (oxygen saturation percentage in blood) and hearth rate.

The installation consists of a single pulse oximeter and carbon monoxide detector instrument operating on aircraft DC power (14v or 28v). The aircraft supplied power and aircraft wiring is protected by a 2 ampere, resettable, trip free, type circuit breaker. The pulse oximeter and Carbon Monoxide Detector recommended location is in aircraft instrument panel where it can be reached by both pilot and copilot at all times.

The Pulse Oximeter and CO Detector installation consists of the AERO-455 unit mounted on the cockpit instrument panel.

The carbon monoxide alarm level is calibrated to provide a visual alert on the aircraft's MFD within 5 minutes or less whenever the carbon monoxide level reaches 50 parts per million (PPM) by volume or greater. The warning time is shortened at higher levels of CO concentrations and becomes approximately instant should the carbon monoxide level reach 400 parts per million by volume (PPM) or greater.

In case of a carbon monoxide alert, the pilot will receive a visual warning alert displayed on the aircraft's MFD. The visual alert will remain until the carbon monoxide level is reduced below the alert level. The indicator is automatically reset when the CO level drops below 50 PPM. There is a three-minute delay at startup to stabilize the sensor before the unit will accurately sense CO levels.

The 455 have a built in pressure compensation sensor to detect cabin altitude changes up to 25,000 to give a better accuracy in CO detection. This model also alarms if the cabin altitude goes above 10,000 feet. This model also has RS232 output for display data of CO Level on Garmin GNS480, G1000 and other manufacturers. See website [www.coguardian.com](http://www.coguardian.com) to see the latest manufacturers capable of showing data on Multi Function Displays.

## 5.0 SERVICE FACILITIES

The operator can service all other components of the installation at an FAA certified Repair Station or by A&P mechanic. CO Detectors must be returned to CO Guardian for repair, calibration or overhaul. The sensor life is 5 years from date of installation.

### NOTE

**The sensor requires special gases for testing. If any discrepancies are found with the unit during installation or during the operational service life, the unit must be returned to CO Guardian for repair or replacement. The CO Detector unit must be returned to the manufacturer for CO sensor replacement and re-calibration at the end of the service life applicable to the unit's part number.**

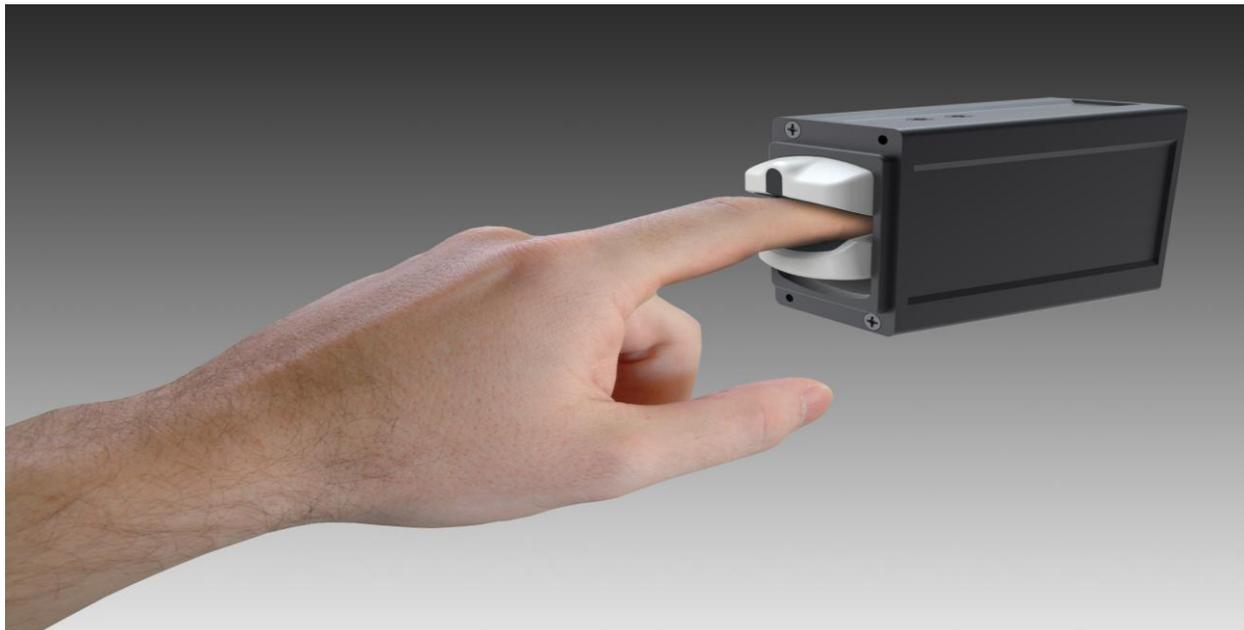
## 6.0 INSTALLATION 455

The following documents the installation criteria of the AERO-455 Pulse Oximeter and Carbon Monoxide detector.

- a. Choose a location in the instrument panel for the installation of the Pulse Oximeter and CO Detector. Choose a location with space available that also meets the following criteria. A typical installation is shown in Pictures 3 & 4. The unit can be installed on any side of the instrument panel (middle section of the instrument panel is recommended since the unit has to be reached by both pilot and co-pilot for usage).
- b. Insure that the area around the CO Detector panel location will permit unrestricted airflow through the unit.
- c. Install in a cockpit area not exposed to excessively dusty or dirty conditions.
- d. Insure that the air intake on the front of the CO Detector is not obstructed in any manner.
- e. Install the CO Detector in a location without high or disturbed airflow movement. The CO Detector will detect the presence of CO more effectively if the unit does not have air blowing over it.
- f. Insure that the CO Detector installation area meets the temperature and humidity ranges listed in the List of Particulars specifications. Temperature and humidity conditions outside the specification may affect the sensitivity of the detector.
- g. The AERO-455 unit can be installed anywhere around the instrument panel within pilots reach. Verify that there is no obstruction of airflow to the unit.



**Picture 1 AERO – 455 PULSE OXIMETER AND CO DETECTOR**



**Picture 2 "Life Guardian" Pulse Oximeter and CO detector**

## 6.1 RECOMMENDED INSTALLATION AREAS

- Typical installation areas are depicted below in Pictures 3 & 4.



**Pulse  
Oximeter  
and CO  
detector  
installed in  
the middle  
of the  
instrument  
panel**

**Picture 3 AERO-455 installed in a CESSNA 206**



**Picture 4 TYPICAL PILOT INSTALLATION SHOWN**

## 6.2 INSTALLATION INSTRUCTIONS (AERO-455)

- a. Install the Pulse Oximeter and CO Detector in accordance with Drawing # 455-001 Section B-B, Section E-E, and Section F-F.
- b. Install the CO Detector 2 amp circuit breaker in accordance with Drawing # 455-001 Flag Note 5. It is recommended that the circuit breaker be installed on the Essential or Avionics Buss that is not subject to emergency electrical load shedding. Placard or engrave the circuit breaker as **CO DETECT** in accordance with Flag Note 11.
- c. Wire the CO Detector installation in accordance with drawing # 455-001 page 3.

455	
PIN	FUNCTION
1	Power Wire
2	CO Alert Relay
3	Spare Ground
4	Remote Reset Test
5	Power Ground
6	500 Ohm Audio Tone
7	RS-232 out
8	RS-232 in
9	Cabin Pressure Relay

### CO DETECTOR CONNECTOR NINE PIN PINOUT

Observe the following items:

- The installation of wiring in accordance with Flag Note 10.
- Connect Pin 1 to +14 VDC or to +28 VDC power as applicable to the installation aircraft and the CO Detector voltage rating.
- Ground power return wire (Pin 5) to suitable aircraft structure ground near circuit breaker panel.

### **6.2.1 INSTALLATION CHECKS (455)**

- a. With the CO Detector disconnected from the aircraft harness, conduct a continuity check of the added aircraft wiring.
  - b. Turn ON the aircraft Battery Switch. Close the CO DETECT circuit breaker and measure aircraft voltage between pins 1 and 5 of the CO Detector connector. Pull the CO DETECT circuit breaker. Verify the voltage between pins 1 and 5 is OFF.
  - c. Close the CO DETECT KEEP ALIVE circuit breaker and measure aircraft voltage between pins 9 and 5 of the CO Detector connector. Turn aircraft Battery switch OFF. Measure aircraft voltage between pins 9 and 5 of the CO Detector connector. Pull the CO DETECT KEEP ALIVE circuit breaker. Verify the voltage between pins 9 and 5 is OFF.
  - d. Connect the CO Detector connector to the aircraft harness. Turn aircraft Battery Switch ON. Close CO DETECT circuit breaker.
  - e. Verify the unit can be shut off with the CO DETECT circuit breaker.
- a. Determine the moment arm for the installed CO Detector location and record in aircraft weight and balance manual. CO Detector weight is 8 oz.

### **7.0 GENERAL FEATURES OF THE AERO-455**

- CO detector from 10 – 999 PPM
- Heart Rate
- SPO2 Blood Oxygen Level
- Cabin Temperature
- Cabin Pressure
- Reminder to check SPO2 periodically based on cabin altitude
- Tone generator for headsets
- Relay to CO and Cabin pressure
- Inside temperature

## 8.0 SELF TEST SEQUENCE AT STARTUP

When the airplane master battery switch is selected ON, the 455 Detector goes through a self-test routine. The self-test checks for functionality of critical components such as the CO sensor, temperature sensor, pressure sensor, pulse oximeter, and integrity of the system and remote display will remain off if everything working properly. The RS232 MFD will show no CO on the CO Detector page.

## 9.0 SELF TEST SEQUENCE AT STARTUP WITH INSTALLATION OF AERO-455 WITH AERO-55

If the Aero-455 is installed to display on the Aero-55 Display, the following test sequence should be shown at startup:

The screen will show the CO Guardian software version along with two beeps, as shown on pictures 5 & 6, at the same time the amber light will flash twice, and then a third beep along with the red light flashing twice as well. After this the display will show the standby screen "CO LEVEL NORMAL", as seen on Picture 7.



Picture 5



Picture 6



Picture 7

### 10.0 FUNCIONALITY TEST

The AERO-455 is designed to display on the aircraft's MFD. The display page on the MFD depends on the MFD manufacturer. Please see pictures 8, 9 (for the SPO2 and Hearth rate data only), and 10 (for CO Level indication) for an example.



Picture 8 As seen on the Grand Rapids



Picture 9 As seen on the Advanced Flight Systems



Picture 10 As seen on the MVP-50

When both the AERO-455 (Picture 8) and the AERO-55 display are installed, place a finger in the AERO-455 (as shown on picture 2 above) and hold it for about 10 seconds, readings of the SPO2 (blood lever saturation percentage) and HR (hearth rate) will be displayed on the AERO-55 as shown on Picture 9.



Picture 11



Picture 12

And for the CO Level display please look at Picture 13.



Picture 13 Aero 55 Displaying Carbon Monoxide level in parts per million (PPM).

## 11.0 CO LEVEL ALARM ACTIVATION

CO level alarm activated after: in PPM (Parts per million)

### PPM

10 - 50	Display only No alarm
50 - 70	04 minutes Alarm mode
70 - 100	03 minutes Alarm mode
200	02 minutes Alarm mode
300	01 minutes Alarm mode
>400	15 seconds Alarm mode

## 12.0 EFFECT OF CO AND HYPOXIA IN HUMAN BODY

NOTE: Concentration of CO in air Inhalation time and toxic developed

50 parts per million (PPM) Safety level as specified by the FAA

200 PPM Slight headache within 2-3 hours

400 PPM Frontal headache within 1-2 hours

800 PPM Dizziness, nausea, convulsions within 45 minutes

The symptoms of Hypoxia can range from headaches, fatigue, shortness of breath, a feeling of euphoria and nausea. Also, it can change levels of consciousness, can provoke seizures, coma, priapism, and death can occur. Please refer to the following link for more detailed information

<http://www.flightstat.nonin.com/documents/Hypoxia,%20Oxygen%20and%20Pulse%20Oximetry.pdf> ).

### 13.0 ALARM INDICATOR

Relevant alert messages will display on multi-function display like (G1000, GNS480, EI-50 and others).

**The RS-232 Data Buss** option is currently available on numerous MFD units. The RS-232 data buss output will couple CO Detector status information to electronic display systems with RS-232 input capability.

See Multi-Function display manufacturers Installation Manual for interface guidance. The CO ALERT can be reset through the RS-232 interface provided the Multi-Function system contains the reset capability.

If the AERO-455 is installed to display on the AERO-55 please refer to picture 14 to see how the AERO-55 will show the Amber light when the level concentration of CO in the cabin reaches above 50 PPM for more than 3 minutes. At the moment the amber alarm goes off, you will hear three short beeps every second. Use the "RST" button to shutoff the AUDIO alarm only. The amber light will go away until the CO concentration in the cabin disperses. Please look at paragraph 11 and



Picture 14 Amber alert light ON

### 14.0 CARBON MONOXIDE LEVEL INDICATION

Aero-455 can detect Carbon Monoxide from as low as 05 PPM. Aero-455 will trigger an alarm for CO long before the pilot/passengers can be affected by exposure to CO.

The effect of CO level on the human body is linked to the duration of exposure to CO. Our units are designed to set off CO alarms in progressively shorter durations as the concentration of CO increases. The intention is to prevent a false alarm when the CO level poses no danger, but at the same time ensure full protection when the level starts becoming dangerous.

**NOTE: Aero-455 IS design to comply with FAR 23.831(a) and SAE Standard AS 412A.**

## 15.0 HOW THE AERO-455 PROTECTS YOU AGAINST CO POISONING AND HYPOXIA

The CO display page on the MFD shows the CO level in PPM (Parts per million). The Aero-455 can display CO from 10 PPM to 999 PPM. (For any level above 999 PPM, the display will register only 999). The alarm will sound within 5 minutes if the CO level stays above 75 +/- 5 PPM. If the CO level rises above 400 PPM, the alarm will trigger instantly. (However, if the level reaches 400 PPM or above inside the cabin, it will still take a few seconds for the CO to reach the sensor inside the unit. Therefore it may take a few additional seconds for the unit to set off the CO alarm).

The Pulse Oximeter on the AERO-455 is another way to monitor the pilot's real health in altitudes where the Oxygen might decrease rapidly without being notice by him/her. The AERO-455 send reminders to the pilot every 30 minutes depending on the altitude.

## 16.0 TECHNICAL SPECIFICATIONS

- Power supply: 12 - 30 V DC
- Power consumption: 2 W
- Current drawn: 300 milli-amps
- Fuse: Use GMI type, fast acting fuse 2A 250V
- Temperature range: -20C to +65C
- Humidity range: 10-90% RH (Non condensing)
- Sensor calibration: Each unit calibrated at 75 PPM
- Weight of the unit is approximately 8 oz.

## 17.0 MAINTENANCE INSTRUCTIONS

The carbon monoxide detector and associated equipment consist of certain parts, which do not require periodic scheduled servicing or periodic scheduled preventive maintenance. At every power up the system will go through a self-diagnostic check.

**WARNING: If all Models show a flashing remote Amber light every 4 seconds, return the unit to CO Guardian for repair or replacement. See MFG Manual if Remote light is displayed on the MFD.**

**Field repair or service is allowable on all of the installed system components except for the CO Detector Indicator itself. The CO Detector must be returned to CO Guardian, LLC for all service.**

The aircraft wiring harness, circuit breaker shall be included maintenance instructions for general visual inspections for system integrity, installation security, corrosion and chaffing.

## 18.0 CARBON MONOXIDE DETECTOR SCHEDULED MAINTENANCE

Scheduled Maintenance Program tasks to be added to the aircraft operator's appropriate airplane maintenance program are as follows:

MAINTENANCE TASK	INTERVAL
a. Recommended Periodic Scheduled Servicing Tasks:	None Required.
b. Recommended Periodic Scheduled Preventative Maintenance test/checks to determine system condition and/or latent failures: <b>Note:</b> Be sure the vent on the faceplate is free of obstructions. Any failures of the system are evident to the pilot through a flashing remote Amber light approximately every 4 seconds.	Each time the unit is turned ON.
c. Recommended Periodic Inspections:	None Required.
d. Recommended Periodic Structural Inspections	None Required.
e. Required CO Sensor replacement and calibration.	At end of Service Life (Reference Par. 2.0)

### NOTE

The unit must be returned to the manufacturer for sensor replacement and recalibration at the end of the unit service life.

**NO FIELD SERVICE OR OVERHAUL OF MODELS IS AUTHORIZED.**

## 19.0 WEIGHT AND BALANCE / EQUIPMENT LIST

The Aero 455's Pulse Oximeter and CO Detector installation weighs 0.5 lbs. Reference the aircraft weight and balance manual for moment arm.

## **20.0 LIMITATIONS**

The AERO-455 Pulse Oximeter and CO Detector may not replace any existing instrument or indicator required by the type design or operating limits.

## **21.0 PERFORMANCE**

No Change

## **22.0 EMERGENCY PROCEDURES**

- Shut off the heater, air conditioning or any other opening to the engine compartment.
- Open a fresh air source immediately.
- Don't smoke.
- Use 100% oxygen, if possible.
- Land as soon as conditions permit.
- Be sure the source of the contamination is corrected before further flight.

**NOTE: The alert message will stay on until the CO level goes below 50 parts per million (PPM) by volume of carbon monoxide concentration. SEE MFD manual if the "ALERT" display is integrated with the Manufacturers MFD.**

**DO not recycle the unit through the circuit breaker. A three-minute delay is required for the CO sensor to stabilize after each power-up in the 455 unit.**

## **23.0 UNIT FAILURE INDICATION:**

A failure of the CO Sensor, Temperature Sensor, or the Micro-controller will result in the following failure indications:

- **NOTE: SEE MFG manual if the fault data is integrated with the MFG MFD for fault analysis.**

In case of a failure indication, attempt to clear the failure condition by resetting the CO Detector. Should the failure condition continue, remove the CO Detector power by pulling the CO Detector circuit breaker.

## 24.0 Warranty

WARRANTY COVERAGE: CO GUARDIAN LLC. WARRANTS TO THE ORIGINAL CONSUMER PURCHASER, THAT THIS DETECTOR WILL BE FREE OF DEFECTS IN MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE (1) YEAR FROM DATE OF PURCHASE. THE MANUFACTURER'S LIABILITY HEREUNDER IS LIMITED TO REPLACEMENT OF THE PRODUCT, REPAIR OF THE PRODUCT OR REPLACEMENT OF THE PRODUCT WITH A REPAIRED PRODUCT AT THE DISCRETION OF THE MANUFACTURER. THIS WARRANTY IS VOID IF THE PRODUCT HAS BEEN DAMAGED BY ACCIDENT, UNREASONABLE USE, NEGLIGENCE, TAMPERING OR OTHER CAUSES NOT ARISING FROM DEFECTS IN MATERIAL OR WORKMANSHIP. THIS WARRANTY EXTENDS TO THE ORIGINAL CONSUMER PURCHASER OF THE PRODUCT ONLY.

Warranty Disclaimers: Any implied warranties arising out of this sale, including but not limited to the implied warranties of description, merchantability and fitness for a particular purpose, are limited in duration to the above warranty period. In no event shall the Manufacturer be liable for loss of use of this product or for any indirect, special, incidental or consequential damages, or costs, or expenses incurred by the consumer or any other user of this product, whether due to a breach of contract, negligence, strict liability in tort or otherwise. The manufacturer shall have no liability for any personal injury, property damage or any special, incidental, contingent or consequential damage of any kind resulting from gas leakage, fire or explosion.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

Some states do not allow the exclusion or limitation of consequential or incidental damages, so the above limitations or exclusions may not apply to you.

Legal Remedies: This warranty gives you specific legal rights and you may also have other rights that vary from state to state.

Warranty Performance: During the above warranty period, your product will be replaced with a comparable product if the defective product is returned, postage prepaid, to CO Guardian, Customer Service Department, 1951 East Airport Drive, Tucson, AZ 85706, together with proof of purchase date. Please include a note describing the problem when you return the unit. The replacement product will be in warranty for the remainder of the original warranty period or for six months whichever is longer. Other than the cost of postage, no charge will be made for replacement of the defective product.

Important: Do not attempt to open unit. If unit is opened, warranty will be void.

Your Carbon Monoxide Alarm is not a substitute for property, disability, life or other insurance of any kind. Appropriate insurance coverage is your responsibility. Consult your insurance agent.

### NOTE

The warranty will be void if the unit is opened or tampered with