### Description

The model SOX2 standalone combustion check meter measures %O₂ and temperature of flue gases and can calculate the %CO₂ and the % Excess Air. The SOX2 is designed to give you essential information about the combustion process being analyzed. The SOX2 comes with clips for mounting the thermocouple to the end of the pump snoot, a water trap and filter with replacement filters to keep the sensor clean and free of moisture and a hand pump for manual aspiration of the sensor.

Since %CO₂ is calculated based on a known fuel, the %CO₂ reading is only meaningful when testing combustion products of the selected fuel.

#### How to Use

1. Thoroughly inspect combustion equipment for problems.
2. Determine where the flue is and if the equipment is condensing or non-condensing.
3. Turn on unit and allow one minute for warm up before use.
4. Determine what kind of fuel the equipment uses.
5. Calibrate temperature if needed (see Field Calibration).
6. Clip the thermocouple to the snoot of the SOX2 pump using the included clips making sure to bend the bead tip (see photo) for optimum accuracy.
7. Connect the water filter, pump and probe to the SOX2.
8. Ensure that the water trap is securely fastened and that the filter is clean and properly installed.
9. Purge the sensor and pump of any left-over contaminants from the previous measurements. Pump uncontaminated air into the SOX2 for one minute before inserting in the flue.
10. Look at the manufacturer’s specifications to determine the required EA%(Excess Air %), CO₂% or O₂% in the flue are required.
11. Select the desired parameter to display between EA%, CO₂% or O₂% using the EA/CO₂/O₂ button. If in CO₂% mode, the correct fuel type must be selected by using the FUEL button.
12. Once the system has stabilized and the SOX2 has been purged, insert the snoot into the flue gas.

In order to ensure accurate testing, wait until the system is stabilized before taking flue gas readings. This means that the temperatures throughout the system have stabilized, and there is a steady flow of fuel and air in the equipment.

Combustion samples should be taken before dilution air enters the system, through components like draft hoods and barometric dampers. Testing within 18” of the breech is the typical location for most oil-fired equipment.

13. Read temperature of the flue gas, EA% (Excess Air %), CO₂% or O₂% directly on the display by selecting the appropriate test using the EA/CO₂/O₂ button. Make sure you keep pumping and that the parameter you are reading is stable.
14. Take a large cup of ice water.
15. Read temperature from lower display.
16. Make sure the appropriate degree scale is selected.
17. Plug in a k-type thermocouple and then turn the Temp-Cal pot while measuring a known temperature. Ice water is very close to 32°F and is readily available.

#### Field Calibration

**Temperature:** To calibrate the temperature sensor, turn the Temp-Cal pot while measuring a known temperature. Ice water is very close to 32°F and is readily available.

1. Stabilize a large cup of ice water.
2. Read temperature from lower display.
3. Make sure the appropriate degree scale is selected.
4. Plug in a k-type thermocouple and then immerse entire metal tip into the ice water.
5. For optimum accuracy at ambient pressure, adjust the calibration pot to read 32°F or 0°C, depending on the scale selected.

#### Button Functions

- **Backlight Button:** Toggles backlight.
- **H/MAX/MIN Button:** Cycles through the Hold, Max, and Min functions displaying the current, maximum or minimum value respectively.
- **FUEL Button:** Toggles between Natural Gas, Oil #2 and Propane for the %CO₂ calculation.
- **ON/OFF Button:** Turns the meter on and off.
- **EA/CO₂/O₂ Button:** Cycles between Excess Air %, CO₂% and O₂% using the FUEL button.

#### Temperature Display:

- **Upper display for Excess Air%, CO₂% and O₂%.**
- **Lower display always displays the temperature from the thermocouple.**

#### Display Types:

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper display</strong></td>
<td>Displays whether the meter is holding the current, max or min measurement. A blank field indicates the measurements are in real time. Select the desired mode with the H/MAX/MIN button.</td>
</tr>
<tr>
<td><strong>Lower display</strong></td>
<td>Displays which fuel is being used for the %CO₂ calculation. Choose between Natural Gas, Oil #2 and Propane using the FUEL button.</td>
</tr>
</tbody>
</table>

#### Battery Check Function:

The SOX2 allows the user to check the battery charge at any time during use, simply by holding down the EA/CO₂/O₂ button for one second.

The approximate percentage of battery charge will be displayed on the main display for two seconds before returning to its prior reading.

#### Standalone Combustion Check Model: SOX2

- **Description:**
  - The model SOX2 standalone combustion check meter measures %O₂ and temperature of flue gases and can calculate the %CO₂ and the % Excess Air. The SOX2 is designed to give you essential information about the combustion process being analyzed. The SOX2 comes with clips for mounting the thermocouple to the end of the pump snoot, a water trap and filter with replacement filters to keep the sensor clean and free of moisture and a hand pump for manual aspiration of the sensor.
  - Since %CO₂ is calculated based on a known fuel, the %CO₂ reading is only meaningful when testing combustion products of the selected fuel.

- **How to Use:**
  - 1. Thoroughly inspect combustion equipment for problems.
  - 2. Determine where the flue is and if the equipment is condensing or non-condensing.
  - 3. Turn on unit and allow one minute for warm up before use.
  - 4. Determine what kind of fuel the equipment uses.
  - 5. Calibrate temperature if needed (see Field Calibration).
  - 6. Clip the thermocouple to the snoot of the SOX2 pump using the included clips making sure to bend the bead tip (see photo) for optimum accuracy.
  - 7. Connect the water filter, pump and probe to the SOX2.
  - 8. Ensure that the water trap is securely fastened and that the filter is clean and properly installed.
  - 9. Purge the sensor and pump of any left-over contaminants from the previous measurements. Pump uncontaminated air into the SOX2 for one minute before inserting in the flue.
  - 10. Look at the manufacturer’s specifications to determine the required EA%(Excess Air %), CO₂% or O₂% in the flue are required.
  - 11. Select the desired parameter to display between EA%, CO₂% or O₂% using the EA/CO₂/O₂ button. If in CO₂% mode, the correct fuel type must be selected by using the FUEL button.
  - 12. Once the system has stabilized and the SOX2 has been purged, insert the snoot into the flue gas.

In order to ensure accurate testing, wait until the system is stabilized before taking flue gas readings. This means that the temperatures throughout the system have stabilized, and there is a steady flow of fuel and air in the equipment.

Combustion samples should be taken before dilution air enters the system, through components like draft hoods and barometric dampers. Testing within 18” of the breech is the typical location for most oil-fired equipment.

13. Read temperature of the flue gas, EA% (Excess Air %), CO₂% or O₂% directly on the display by selecting the appropriate test using the EA/CO₂/O₂ button. Make sure you keep pumping and that the parameter you are reading is stable.

Press the HOLD button to lock in the readings. Press the EA/CO₂/O₂ button to scroll between the different measurements.

14. Make adjustments to bring the equipment to within manufacturer’s specifications. See the chart in this manual for an example of a typical manufacturer’s recommended measurements.

15. Retest

#### WARNING

Plug any hole that may have been created in the flue with heat resistant silicone or comparable plug.

#### Battery check function:

The SOX2 allows the user to check the battery charge at any time during use, simply by holding down the EA/CO₂/O₂ button for one second.

The approximate percentage of battery charge will be displayed on the main display for two seconds before returning to its prior reading.
COMBUSTION BASICS

Combustion is the rapid oxidation of fuel. Oxygen from air (20.9% oxygen & 79.1% nitrogen) is used to burn fuel which produces heat. The appliances installed and serviced by technicians rely on clean efficient flames to provide the energy needed to heat homes, water, etc. Combustion testing is necessary to maximize the efficiency of the combustion systems and to minimize the harmful emissions produced such as carbon monoxide and carbon dioxide (greenhouse gas emissions). Proper tuning of the combustion process by combustion testing reduces the production of harmful carbon monoxide and decreases the amount of fuel burned due to increase in efficiency.

Combustion efficiency can typically be increased by creating a more balanced air to fuel ratio. The ratio of air to fuel determines how much CO₂ is produced and how efficient the flame is.

Tuning the O₂, CO₂ excess air, stack temperature and temperature rise to match the appliance manufacturer’s specifications will increase the efficiency and help to maximize the performance and life expectancy of the equipment.

A properly tuned natural gas appliance will have between 6-9 O₂% in the flue while an oil appliance will have 3-7 O₂%.

Adjustments to the combustion process ensures that the highest combustion efficiency is safely achieved, thereby reducing the overall amount of fuel used in producing the energy needed. It is still necessary to test and adjust the appliance to the manufacturers’ specification for airflow in the duct system, temperature rise across the heat exchanger and anything else that may need testing. Testing and balancing appliances to meet manufacturers’ specifications helps to ensure maximum system efficiency and equipment longevity.

Combustion testing does not take into account start up losses, standby losses, cabinet/boiler body losses, or distribution losses in ducts or piping.


Specifications:
Sensor Type: Highly accurate Oxygen Sensor.
Operating environment: 32°F to 122°F at <75%RH.
Storage temperature: -4°F to 140°F at <80%RH with battery removed from meter.
Battery life: 75 hours (continuous) typical.
Low battery indication: Battery: 9V.
Auto off: After 15 minutes.
Accuracy: Stated accuracies are at 73°F ±10°F, 75% R.H.
Dimensions: 7.9”(H) x 2.6”(W) x 1.4”(D).
Weight: approx. 14 oz including battery.

Included Accessories:
AOXP2- Hand pump with water trap
RAOX9- 3 C-clips, 4 filters, 1 O-ring, 1 calibration screwdriver
ATBF1- Hi Temp k-type thermocouple
9V battery (installed)
ANC1 Case
Operators Manual
Display: 4 digit liquid crystal display (LCD) with maximum reading 9999.

Specifications (continued)
Temperature
Range: -58°F to 1000°F (-50°C to 538°C)
Resolution: 0.1°F/0.1°C
System accuracy*: ±(0.6%, +3°F), after field calibration.
Thermocouple Accuracy: ±(24°F) on -50°F to 545°F
+/- 0.75%, 545°F to 1000°F.
Thermocouple range: -50°F to 900°F (continuous operation range) and up to 1000°F (maximum single exposure use).
*System accuracy overrides thermocouple accuracy after field calibration is performed.
Oxygen
Working range (percent): 0 to 25%
Accuracy: 0 to 25% ±0.3%O₂ (@72°F (22.2°C) 20.9%O₂ ambient).
Oxygen Sensor operational temperature range: -4°F to 122°F.
Warm up time: Under 2 minutes minimum or current reading.

TYPICAL RECOMMENDED FLUE GAS MEASUREMENTS

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Oxygen (O₂)</th>
<th>Stack Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric Fan Assisted or LPG</td>
<td>6-9%</td>
<td>625-500°F</td>
</tr>
<tr>
<td>Condensing Natural Gas or LPG</td>
<td>6-9%</td>
<td>90-140°F</td>
</tr>
<tr>
<td>Natural LPG Gas Power Burners</td>
<td>6-9%</td>
<td>275-500°F</td>
</tr>
<tr>
<td>Fuel Oil Flame Retention Power Burners</td>
<td>6-9%</td>
<td>275-500°F</td>
</tr>
<tr>
<td>Fuel Oil Non-Flame Retention Power Burners</td>
<td>6-9%</td>
<td>400-600°F</td>
</tr>
<tr>
<td>Condensing Oil</td>
<td>6-9%</td>
<td>90-140°F</td>
</tr>
</tbody>
</table>

Water Trap with Filter
Over time, the filter within the water trap will get dirty and eventually block airflow. Periodically, check the filter for excess contaminants.
1. Compress and twist cap to open the case.
2. Replace O-ring if it looks cracked or torn.
3. Replace filter if it looks dirty or clogged. Make sure you orient the filter as shown with the knob of the case going into the bottom of the filter.
4. Twist cap back on to seal trap.

Warranty and Service
The product is warranted to the original purchaser against defects in material or workmanship for a period of one (1) year from the date of purchase. During the warranty period, Fieldpiece Instruments will, at its option, replace or repair the defective unit. Any implied warranty of merchantability and fitness for purpose are limited to the above. Fieldpiece shall not be liable for incidental or consequential damages.

Return any defective SOX2 to Fieldpiece for warranty service along with proof of purchase. Contact Fieldpiece for out of warranty repair charges.

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