The CO$_2$ Sensor Calibration Kit

For use with all BAPI CO$_2$ Sensors

Instruction Manual
BAPI’s CO₂ Sensor Calibration Kit is designed to calibrate and verify the operation of all BAPI’s room and duct CO₂ sensors.

Items included in the Kit are:
- A CD containing test software and cable drivers
- A communications cable to connect a computer to the BAPI CO₂ sensor
- A funnel used as a gas shroud
- Tubing to connect the funnel to the test gases
- Rubber bands to secure the funnel to the BAPI CO₂ sensor
- Shunt jumpers to place the BAPI CO₂ sensor into the test mode

Options
- An optional carrying case that fits the BAPI test kit along with a customer supplied regulator and two gas canisters is available. Please request (BA/CO2-C) when ordering.

Equipment supplied by the customer:
- Test gases (Two 17 or 34 liter gas canisters (3” x 10 ¾”), CO₂ concentrations described below)
- 0.5 liter per minute test gas flow regulator
- Laptop computer running Windows 97 or later

Two CO₂ calibration gas concentrations are required to perform a complete calibration as explained in the calibration section of this document: the single point gas at a concentration of 400 to 800 ppm, and the span gas at a concentration of 1,000 to 1,200 ppm.

Test gases and flow regulators can be purchased online or through local HVAC distributors. A few online sources for the test gases are:
- http://www.gasdetectionsolutions.com
- http://www.mercury-instrumentsusa.com

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Best practice is to read all the steps in a section before performing them.

If you are running Windows 7 or greater, check your screen resolution for compatibility with BAPI’s CO₂ sensor software. To do this, right click on the Desktop -> then left click on “Personalize” -> then left click on the word “Display”. Verify that the “Smaller - 100%” radio button is selected. If it is selected, close that window. If it is not selected, click on it and restart the computer.
Section 1 - Loading Software continued...

Step 1.4
Confirm installation by clicking on “Next” on the “Confirm Installation” pop-up. If your computer displays a pop-up window warning you about the program modifying your computer, click “Yes” to allow the modification.

Step 1.5
A status bar on the “Installing” pop-up will display the installation progress. Depending on your computer, this may take up to five minutes. If your computer displays a pop-up window warning you about the program modifying your computer, click “Yes” to allow the modification.

Step 1.6
When installation is complete, click “Close” on the “Installation” pop-up to exit the installation program. Remove the CD from the CD drive.

Section 2 - Running the Software and Communicating with the CO₂ Sensor

Step 2.1
Plug the Communications Cable into a USB port on the test computer. (Use the same port for all subsequent tests.) Double click on the BAPI CO₂ icon (Fig 3) to start the program.

Step 2.2
The Calibration Software startup screen will appear. Configure the serial port by clicking on “Tools”, “Serial Port” and “Configure” (Fig 4). A “Serial Port Properties” dialog box will open (Fig 5). In this example, the Communications Cable is configured as COM4 but your computer may use a different serial port. After selecting the port, click “OK”. Then open the serial port by clicking on “Tools”, “Serial Port” and “Open” (Fig 6).

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Section 2 - Running the Software and Communicating with the CO₂ Sensor continued...

Step 2.3
Remove the CO₂ wall sensor from its backplate or open the cover of the BAPI-Box duct unit to expose the circuit board. Plug the Communications Cable onto the circuit board connector as shown in the ovals in Figures 7-11 below. Place a shunt jumper (included with the kit) onto the terminals to place the unit in CAL or PRG mode as shown in Figures 7-11 below.

Step 2.4
Click on the magnifying glass to search for the CO₂ sensor (Fig 12). When the software successfully identifies the sensor, information for that specific CO₂ sensor is automatically filled in (Fig 13). Each sensor has unique information, so your sensor will have different information from that shown in Fig 13. If your computer does not display the CO₂ sensor information, go to Step 2.5. If the CO₂ sensor information is displayed, go to Step 2.6.
Section 2 - Running the Software and Communicating with the CO₂ Sensor continued...

Step 2.5
(Skip if sensor information is displayed in Step 2.4)

If the computer cannot communicate with the CO₂ sensor, you will get an error message saying “No device found” (Fig 14). Try each of the solutions listed below, then click on the “Rescan” button. If the “Rescan” button is grayed out, you will have to close and reopen the software.

Possible Solutions
• Make sure that the jumper is properly positioned on the sensor under test.
• Make sure that the test cable is securely plugged into the computer and that the cable is properly connected to the sensor under test.
• Try another USB port on your computer.
• Try a different serial port from the Tools/Serial Port/Configure menu.

Step 2.6
(Sensor information must be displayed in Step 2.4)

Click on the “Charts” tab and the “Start” button to begin trending the CO₂ sensor’s reading over time (Fig 15). Be careful not to breathe on the sensor under test as this could affect the readings.

A small window in the upper left part of the screen (green circle on Fig 15) shows the current CO₂ ppm reading. During the rest of this test, this is the only place where the current CO₂ reading is shown.

The display on the front of the CO₂ sensor is locked during this test and will not display the CO₂ concentration correctly.

To export the trend data, use the “File” menu to create and export a CSV text file which is easily read by spreadsheet programs.

Fig 14: Communications Error Message

Fig 15: CO₂ Sensor Trend
Section 3 - Connecting the Test Gases

Step 3.1
Make sure that the rubber bands are tied together. For these pictures, rubber bands of different colors were used for clarity.

Step 3.2
Remove the tubing from the funnel. Place the funnel over the gold colored CO\textsubscript{2} sensor. Hook one of the rubber bands over the funnel's spout (Fig 17).

Step 3.3
Pull the rubber bands around the enclosure (Fig 18).

Step 3.4
Loop the rubber band over the funnel's spout (Fig 19).

Step 3.5
Thread the tubing into the funnel's spout about 1 inch (2.5 cm). Figures 20 and 21 show the proper positioning of the funnel and test cable on the BAPI-Stat 3 and BAPI-Stat 4 room sensors. Figure 22 shows proper positioning for the BAPI-Box duct sensor.

Step 3.6
Screw the regulator onto the canister of test gas until it is snug. Attach the tubing to the output port of the regulator. Figure 23 shows a complete setup.

Fig 16: Tubing, funnel and rubber bands.
Fig 17: Place the funnel spout over the gold-colored CO\textsubscript{2} sensor and hook the rubber band over the spout.
Fig 18: Pull the rubber band around the enclosure.
Fig 19: Hook the rubber band over the spout.
Fig 20: BAPI-Stat 3 room sensor.
Fig 21: BAPI-Stat 4 room sensor.
Fig 22: BAPI-Box duct sensor.
Fig 23: Test setup complete.
Section 4 - Sensor Performance Tests

Sensor performance tests should only be conducted after the CO₂ sensor has been installed and continuously powered for a minimum of 21 days. There are two different performance tests described below: Single Point Check and Span Check. The Single Point Check tests the sensor’s offset or accuracy at a single concentration, while the Span Check tests the sensor’s slope or accuracy at two different concentrations. It is the responsibility of the test engineer, test technician or commissioning agent to determine which tests are required.

Before starting the test, make sure the calibration program is running as described in Section 2 and that the funnel is connected to the sensor as described in Section 3.

SINGLE POINT CHECK

Step 4.1
Connect a CO₂ test gas cylinder with a concentration of 400 to 800 ppm to the regulator. Open the regulator valve fully. The regulator will limit the flow to 0.5 liters per minute. If the cylinder was in a very hot or cold environment, it is recommended to allow 1 hour for the cylinder to reach room temperature.

Step 4.2
Place the software into the charting mode as described in Step 2.6 to view the CO₂ measurement. Be careful not to breathe on the sensor under test. It may take several minutes for the CO₂ reading to stabilize on the chart.

Step 4.3
When the reading has been stable for a minimum of 30 seconds, compare the sensor’s CO₂ measurement to the concentration of test gas cylinder. If the measurement and the test gas concentration differ by more than ±30 ppm or 3% for single channel units (-ACD05 or -ACD10 in the part number) or by ±75 ppm for dual channel units (-DCD05 or DCD10 in the part number), BAPI recommends that you perform a Single Point Calibration as described in Section 5. If a Span Check is required, complete the Span Check described below before performing the Single Point Calibration.

Step 4.4
If the Single Point Check is the only testing that is required and no calibration is necessary, go to Section 6 which describes the steps for ending the testing session.

SPAN CHECK

Step 4.5
Connect a CO₂ test gas cylinder with a concentration of 1,000 to 1,200 ppm to the regulator. Open the regulator valve fully. The regulator will limit the flow to 0.5 liters per minute. If the cylinder was in a very hot or cold environment, it is recommended to allow 1 hour for the cylinder to reach room temperature.

Step 4.6
Place the software into the charting mode as described in Step 2.6 to view the CO₂ measurement. Be careful not to breathe on the sensor under test. It may take several minutes for the CO₂ reading to stabilize on the chart.

Step 4.7
When the reading has been stable for a minimum of 30 seconds, compare the sensor’s CO₂ measurement to the CO₂ concentration of test gas cylinder. If the measurement and the test gas concentration differ by more than ±30 ppm or 3% for single channel units (-ACD05 or -ACD10 in the part number) or by ±75 ppm for dual channel units (-DCD05 or DCD10 in the part number), BAPI recommends that you perform a Span Calibration as described in Section 5.

Step 4.8
If a calibration is not required, go to Section 6 which describes the steps for ending the testing session.

Section 5 - Sensor Calibration

Sensor calibration should only be conducted after the CO₂ sensor has been installed and continuously powered for a minimum of 21 days. BAPI recommends conducting the performance tests of section 4 to determine if calibration is necessary. There are two calibrations that may be performed: Single Point Calibration and Span Calibration. The Single Point Calibration sets the sensor’s offset at a single concentration, while the Span Calibration sets the sensor’s slope or calibration at two different concentrations. It is the responsibility of the test engineer, test technician or commissioning agent to determine which calibrations are required.

Before starting the test, make sure the calibration program is running as described in Section 2 and that the funnel is connected to the sensor as described in Section 3.

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**Section 5 - Sensor Calibration continued....**

### SINGLE POINT CALIBRATION

**Step 5.1**
Connect a CO₂ test gas cylinder with a concentration of 400 to 800 ppm to the regulator. Open the regulator valve fully. The regulator will limit the flow to 0.5 liters per minute.

**Step 5.2**
Place the software in “Charting” mode as described in Step 2.6 to view the CO₂ measurement (Fig 15). Be careful not to breathe on the sensor under test. It may take 1 to 10 minutes for the CO₂ reading to stabilize.

**Step 5.3**
When the reading has stabilized for at least 30 seconds, click on the “Stop” button in the lower left corner (Fig 15) and then the “Settings” Tab. This brings up the “Sensor Calibration Screen” (Fig 24).

**Step 5.4**
Enter the CO₂ concentration from the cylinder into the ppm window under “Single Point Calibration” (Fig 24). Press the “Start” button. A pop-up window will open showing the calibration progress (Fig 25). When the pop-up closes, the Single Point Calibration is complete.

**Step 5.5**
If a Span Calibration is not required, go to Section 6 which describes the steps for ending the testing session.

### SPAN CALIBRATION

**Step 5.6**
Connect a CO₂ test gas cylinder with a concentration of 1,000 to 1,200 ppm to the regulator. Open the regulator valve fully. The regulator will limit the flow to 0.5 liters per minute.

**Step 5.7**
Place the software into the “Charting” mode as described in Step 2.6 to view the CO₂ measurement (Fig 15). Be careful not to breathe on the sensor under test. It may take 1 to 10 minutes for the CO₂ reading to stabilize.

**Step 5.8**
When the reading has stabilized for at least 30 seconds, click on the “Stop” button in the lower left corner (Fig 15) and then the “Settings” Tab. This brings up the “Sensor Calibration Screen” (Fig 24).

**Step 5.9**
Enter the CO₂ concentration from the cylinder into the ppm window under “Span Calibration”. Press the “Start” button. A pop-up window will open showing the calibration progress (Fig 25). When the pop-up closes, the Span Calibration is complete.

**Step 5.10**
If no further testing or calibration is required, go to Section 6 which describes the steps for ending the testing session.

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**Section 6 - Ending the Test Session**

Perform these steps in when you are ready to end the testing session.

**Step 6.1**
Shut down the program.

**Step 6.2**
Close the regulator valve on the test gas.

**Step 6.3**
Remove the funnel, communications cable and jumper from the sensor.

**Step 6.4**
Close the cover for duct units or reattach the wall sensor to its base plate.

Specifications subject to change without notice.