



F-950 Controller Software and Calibration Instructions

Pre-Calibration Preparation

The following is a list of the **total** standard gases needed to calibrate **ALL** sensors available in the F-950. Refer to the following graphs to verify which gases/solids are required to calibrate individual sensors in your instrument and the calibration schedule to verify the frequency of calibration.

- Ethylene calibration gas for C₂H₄ ppm sensor (20 ppm recommended)
- Ethylene verification gas for C₂H₄ ppm sensor (10 ppm recommended)
- CO₂ calibration gas for CO₂ PCT sensor (16% recommended)
- CO₂ verification gas for CO₂ PCT sensor (5% recommended)
- O₂ calibration gas (21% recommended)*Can use ambient air
- 100% Nitrogen (N₂) gas for CO₂ PCT sensor and O₂ sensor
- Potassium Permanganate (KMnO₄) granules
- Hi-Res Flow Meter Capable of Measuring 150 mL/min and lower
- Fixed Volume Needle Probe (Included with 950 when shipped)
- Tubing with low outgassing properties (Viton)

*The above listed gases are a recommended value and can be replaced with similar concentrations as long as the gas used is of a standard, consistent value.

Calibration Schedule for F-950:

Calibration	C ₂ H ₄ ppm sensor	CO ₂ PCT sensor	O ₂ sensor
Set Zero	Daily	6 months	6 Months
Set Span	6 months	6 months	6 Months

Standard Gas Needed for Each Sensor:

	20 ppm (C ₂ H ₄) gas	10 ppm (C ₂ H ₄) gas	16% (CO ₂) gas	5% (CO ₂) gas	21% (O ₂) gas **	100% (N ₂) gas	Flow Meter (≤150 mL/min)	Low outgas Tubing (Viton)	Potassium Permanganate (KMnO ₄)
C ₂ H ₄ ppm sensor	✓	✓					✓	✓	✓
CO ₂ PCT sensor			✓	✓		✓	✓	✓	
O ₂ sensor					✓	✓	✓	✓	

** Can use ambient air instead of purchasing 21% (O₂) gas

Controller Software

*not required for calibrations involving Potassium Permanganate (KMnO₄):

1. If you have not already done so, download the package setup software from <http://www.felixinstruments.com/support/f-950-support/software> and install it on your computer. This package includes the latest firmware updates for the 950, as well as the controller software needed for real time monitoring and calibration of the 950.
2. Connect the 950 to computer via a USB cable.
3. Turn on the 950.
4. On the 950, from the main menu, go to Setup > Mode and change the “USB” setting to “Controller”, and the “Measure” setting to “Continuous”. Return to the main menu by pressing the left arrow
5. Open the controller software.
6. In the top left of the window, select the 950 unit listed.
7. Click the “Calibration” tab and select the “950” sub-tab.

Ethylene (C₂H₄) PPM Sensor Calibration

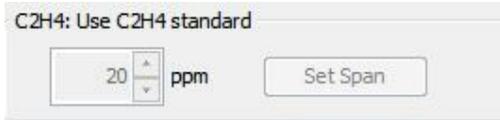
Setting the Zeroes (Offset) with Potassium Permanganate (KPMnO₄) *daily

1. Place fresh potassium permanganate (KMnO₄) in the external conditioning tube
2. Connect the conditioning tube to the intake and outake of the F-950 utilizing Viton tubing (see photo)
3. Power on the F-950 and when 'Measure' is selected, right arrow key and allow to run for 3 minutes to stabilize
4. Navigate back to the main menu and select Setup > Set Zero, press the right arrow key to initiate.
5. When the instrument has set zero, a beep sounds and the word 'OK' appears.



Ethylene (C₂H₄) Sensor Set Span *6 months

1. Connect the high resolution flowmeter, Ethylene calibration gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of ethylene is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950, begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the C₂H₄ concentration graph.
4. Set the flowrate on the C₂H₄ gas tank so that the flow meter reads roughly 70 mL/min. If the 950 gives a "Flow Blocked" error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.
6. In the controller software, in the C₂H₄ field, set the concentration to the value of the calibration gas being used. Then hit the "Set Span" button.

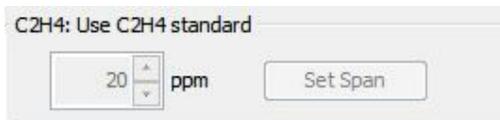


7. The concentration on the 950 should now read the same as the calibration gas within $5\% \pm .5$ ppm.

Ethylene (C₂H₄) Sensor Verification *After Setting the Span

Perform this process immediately after calibrating (set span) the ethylene sensor on the 950

1. Connect the high resolution flowmeter, Ethylene verification gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of ethylene is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950, begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the C₂H₄ concentration graph.
4. Set the flowrate on the C₂H₄ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a "Flow Blocked" error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.



6. The 950 should read the same value as the verification gas within $5\% \pm .5$ ppm. If it does not, repeat the "Ethylene Sensor Calibration" section above.

Carbon Dioxide (CO₂) PCT Sensor Calibration

Setting the Zeroes (Offset) with Nitrogen Gas (N₂) *6 months

Perform the set zero before the set span process. *User also has the ability to zero the sensor utilizing Soda Lime on closed loop and connecting to the controller software the same way.

1. Connect the high resolution flow meter, N₂ gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of N₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.

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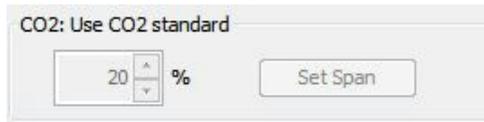
2. On the 950, begin continuous measure mode.
3. Set the flowrate on the N₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag of N₂ is being used, skip this step.
4. Let the 950 read the gas for five minutes
5. In the controller software, select CO₂ in the “Zero sensors” field, then click the “Set Zero” button
6. The 950 should now read 0 for the CO₂ sensor



Carbon Dioxide (CO₂) PCT Sensor Set Span *6 months

Perform the set zero before the set span process.

1. Connect the high resolution flow meter, CO₂ calibration gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of CO₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950 begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the CO₂ concentration graph.
4. Set the flowrate on the CO₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.
6. In the controller software, in the CO₂ field, set the concentration to the value of the calibration gas being used. Then hit the “Set Span” button.



7. The concentration on the 950 should now read the same as the calibration gas within 5%.

Carbon Dioxide (CO₂) PCT Sensor Verification *After Set Span

Perform this process immediately after calibrating the carbon dioxide sensor on the 950

1. Connect the high resolution flow meter, CO₂ verification gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of CO₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950 begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the CO₂ concentration graph.
4. Set the flowrate on the CO₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.
6. The 950 should read the same value as the verification gas within 5%. If it does not, repeat the “Carbon Dioxide Sensor Calibration” section above.

Oxygen (O₂) Sensor Calibration

Setting the Zeroes (Offset) with Nitrogen Gas (N₂) *6 months

1. Connect the high resolution flow meter, N₂ gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of N₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950, begin continuous measure mode.
3. Set the flowrate on the N₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag of N₂ is being used, skip this step.
4. Let the 950 read the gas for five minutes
5. In the controller software, select O₂ in the “Zero sensors” field, then click the “Set Zero” button
6. The 950 should now read 0 for the O₂ sensor



Oxygen (O₂) Sensor Set Span *6 months

1. Connect the high resolution flow meter, O₂ calibration gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of O₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.

2. On the 950 begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the O₂ concentration graph.
4. Set the flowrate on the O₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.
6. In the controller software, in the O2 field, set the concentration to the value of the calibration gas being used. Then hit the “Set Span” button.
7. The concentration on the 950 should now read the same as the calibration gas \pm 5%.



Oxygen (O₂) Sensor Verification *After Set Span

Perform this process immediately after calibrating the oxygen sensor on the 950

1. Connect the high resolution flow meter, O₂ verification gas, and 950 intake ports together using a T-junction of tubing. If a sample bag of O₂ is being used, make a connection from the 950 intake port to the bag using the huber needle.
2. On the 950 begin measure mode.
3. Scroll through the graphs on the 950 (use the up and down arrow keys) so that it is displaying the O₂ concentration graph.
4. Set the flowrate on the O₂ gas tank so that the flow meter reads roughly 90 mL/min. If the 950 gives a “Flow Blocked” error, then increase the flow on the meter by 10 mL/min and begin measure mode on the 950 again. If the error persists, contact tech support. If a sample bag is being used, skip this step.
5. Let the 950 read the gas for three minutes.
6. The 950 should read the same value as the verification gas \pm 5%. If it does not, repeat the “Oxygen Sensor Calibration” section above.

Continuous Mode Verification *After Set Span

The following procedure is to check whether the sensors were calibrated to read within spec of the actual gas value.

It is highly recommended that this step be performed after one full day has passed since the calibration was performed. If this step is not performed, accuracy of the calibration cannot be verified.

Repeat the verification sections from above for each gas and record the results here after three minutes (at least) of measure time. If any of the values are out of specification, check your procedure and recalibrate the sensor again.

Gas	950 Results	± 5% of standard gas
Air (Air is ~20.9% O₂)		<input type="checkbox"/> Yes <input type="checkbox"/> No
CO₂ Verification Gas		<input type="checkbox"/> Yes <input type="checkbox"/> No
O₂ Verification Gas		<input type="checkbox"/> Yes <input type="checkbox"/> No

Gas	950 Results	5% ± .5 PPM of standard gas
C₂H₄ PPM Verification Gas		<input type="checkbox"/> Yes <input type="checkbox"/> No

For information on sourcing known gases required for calibration, please refer to the following website to inquire about your region:

<https://www.airliquide.com/group/where-we-operate>