Calibration of LI-7500 Sensor for the CO2flx and ECOR Systems

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Revision Date 05/04/2007 (D. R. Cook)

Introduction

This document gives instructions for calibrating the LI-COR LI-7500 open path CO_2 and H_20 vapor sensor (also called IRGA in this document) that is used for eddy covariance flux measurements in the 60 m tower, 4 m, and ECOR eddy correlation systems. CO_2 calibration gas, zero air gas, and a LI-COR LI-610 dew point generator are used to perform the calibrations.

Frequency of Calibration

The calibration should be performed once every 6 months, usually during Spring and Fall.

Frequency of Chemical Bottle Changes

The chemical scrubber bottles should be changed annually.

LI-7500 Manual as Reference

Calibration of the LI-7500 is described in the attached material from the LI-7500 manual. Use the manual as a reference to instructions given below.

CO_2 Calibration Gas

Zero air and CO_2 span gas are provided in marked cylinders. The zero air should be filtered using the zero air filter provided.

LI-610 Dew Point Generator

The LI-610 dew point generator is described in attached material from the LI-610 manual. Before using the LI-610, check condenser and radiator water levels and top off with distilled or DI H_2O.

Data locations and programs for work at ARM-SGP

Filemaker Pro	**Network Places**
Data on Ops	**Data on Ops**
New holding	**New Holding**
hcf pm	**hcf pm**
Licor cal.	licor._cal

A note about units: When performing calibrations, please pay careful attention to the units that are requested in the report.

CO_2 concentrations are always reported in umol/mol = ppm.

H_2O concentrations are reported in mmol/m^3 as well as dewpoint temperature (C).

1. Determine what procedures to perform

1.1 Inspect the calibration record for the IRGA (based on IRGA serial number) and determine if the last time that the internal chemicals were changed is significantly more than 6 months. If in doubt, please consult with the instrument mentor.

1.2. If chemical change not required, then go to step 3. and perform calibration.

1.3. If a chemical change is required, perform steps 1.4-1.6.

1.4. Perform calibration as per Steps 3-11.

1.5. Change chemicals as per Step 2, waiting overnight for new chemicals to scrub IRGA housing.

1.6. Repeat calibration in Steps 3-12.

2. Change Chemicals Annually (if required)

2.1. Remove existing chemical bottles from the IRGA using the procedure outlined in the user manual. Dispose of old chemical bottles in accordance with SGP waste management procedures.

2.2. Inspect O-rings on bottle covers (see manual) for signs of decay or cracking, clean any dirt that is present, and apply thin layer of vacuum grease to O-rings. If O-rings are cracked, stop procedure and report to mentor.

2.3. Flush both internal spaces of the IRGA with a gentle flow (~ 2 LPM or such that air is just sensible with the tongue) of zero air for 30 seconds each.

2.4. Install new chemical bottles supplied by LICOR.

2.5. Leave the IRGA running overnight to allow effective scrubbing of internal spaces.

3. Start Calibration

3.1 Bring sensor into calibration facility and allow time for the LI-7500 to reach room temperature (typically 1 hr).

3.2 Record sensor serial number, date, and technician name.

3.3 Record pressure of calibration gases (note before each calibration, check that there is adequate pressure in cylinders (p > 500 PSI) to perform the calibration). Note; if pressure at completion of calibration is less than 600 PSI, please contact mlfischer@lbl.gov or scbiraud@lbl.gov and request delivery of new cylinders.

4. Power Up LI-610 Water Vapor Generator

4.1 Check water levels in radiator (top plug) and condenser (back level tube). Adjust accordingly.

4.2 Set dewpoint to 15 C (~5 C cooler than room air temperature).

4.3 Set flow rate to 15 on output 1 (output 2 should be off).

5. Open LI-7500 (IRGA) electronics box; inside box:

5.1 Connect Computer Serial Cable from PC to LI-7500 com port (second green connector from left).

5.2 Unplug internal thermistor (far right hand connector) being careful to not damage thermistor and connect thermistor cable from Calibration Hood.

5.3 Connect power to IRGA.

5.4 Clean IRGA window. Do not scratch them with paper towels!

5.5 Connect pressure monitor line from Calibration Hood to pressure sensor (marked tube in box).

6. Run LI-7500 Communication Software

6.1 Connect to IRGA. Numbers should appear on program window indicating that connection is active.

6.2 Select "diagnostics" menu screen and record AGC level on data sheet. AGC value should be in range of 50-70%.

7. Mount Calibration Hood on LI-7500 Sensor Head

7.1 Re-check AGC level with diagnostics screen in software. If AGC level changes more than 2 units (%) then readjust mounting to better center Calibration Hood on sensor head.

7.2 Record pressure and temperature from diagnostics screen.

8. Record Initial Offsets and Span Slopes

8.1 Select the "Calibration" menu and then the "Manual" tab screen.

8.2 Record CO_2 zero, CO_2 span, H_2O zero, and H_2O span as "Initial Values" of "CO_2 Offset", "CO_2 Span Slope", "H_2O Offset", and "H_2O Span Slope", respectively.

9. Zero Sensor(s) for CO_2 and H_2O

9.1 Flow zero gas into Calibration Hood. Note flow rate with tongue until it is clearly flowing (pressure ~ 99-100 kPa).

9.2 Select the "CO_2" tab screen of software.

9.3 Note CO_2 concentration drop. Flow zero until CO_2 concentration (umol/mol) stops dropping and reaches steady state (typically 3-5 min).

9.4 Record Pre-zero CO_2 concentration (in range of 0 +/- 5 umol/mol) and pressure.

9.5 ZERO CO_2 channel using software controls.

9.6 Record post-zero CO_2 concentration (umol/mol).

9.7 Record the "Current Value" as "CO_2 Offset".

9.8 Select "H_2O" tab screen of "calibration" menu.

9.9 Note H_2O concentration (mmol/m^3) and check until H_2O concentration is dropping less than 10 mmol/m^3 in 5 minute.

9.10 Record Pre-zero H_2O concentration (mmol/m^3), dewpoint (C), and pressure.

9.11 ZERO H_2O channel using software controls.

9.12 Record Post-zero H_2O concentration (mmol/m^3) and dewpoint (C).

9.13 Record the "Current Value" as "H_2O Offset".

9.14 Record zero cylinder pressure, remove the zero tube connection to the calibration hood, shut the main cylinder valve, and remove the regulator from the cylinder.

10. Span Sensor(s) for CO_2

10.1 Connect span gas to calibration hood and flow at slow rate so that it is noticeable with tongue (Pressure ~ 99-100kPa).

10.2 Record cylinder number and concentration of CO_2 cal. cylinder.

10.3 In CO_2 cal. SPAN menu, enter CO_2 concentration (e.g. 375.7 umol/mol = ppm) marked on CO_2 cal. cylinder.

10.4 Wait until CO_2 concentration reading on screen stabilizes (typically 3-5 minutes).

10.5 Record Pre-span CO_2 concentration (ppm) and pressure.

10.6 SPAN sensor using software controls.

10.7 Record Post-span CO_2 concentration (ppm); this should closely match the value entered on the data sheet.

10.8 Record the "Current Value" as "CO_2 Span Slope".

10.9 Record CO_2 cylinder pressure, remove the zero tube connection to the calibration hood, shut the main cylinder valve, and remove the regulator from the cylinder.

11. Span Sensor(s) for H_2O

11.1 Connect LI-610 flow to calibration hood.

11.2 Record LI-610 dewpoint setting (e.g. 15.0 C).

11.3 In H_2O SPAN menu, enter LI-610 dewpoint temperature.

11.4 Wait until H_2O concentration reaches a steady value. This may take ~30 minutes or until the concentration changes by less than approximately 1 C/10 min (unless you are repeating the H_2O span steps).

11.5 Record Pre-span H_2O dewpoint temperature (C), concentration ($mmol/m^3$), and pressure.

11.6 SPAN H_2O sensor using software controls.

11.7 Record Post-span dewpoint temperature (C) and concentration ($mmol/m^3$); check that the dewpoint matches the reading entered from the LI-610, within 0.2 C.

11.8 If the dewpoint temperature does not match the LI-610 setpoint within 0.2 C, repeat steps 11.3 – 11.7 until it does (without recording the Pre-span values). One or two repeats of the steps are sometimes needed.

11.9 Record the "Current Value" as "H_2O Span Slope".

11.10 Remove LI-610 H_2O flow from the Cal. Hood and turn off the LI-610.

11.11 Remove Cal. Hood from IRGA sensor head.

12. Check Settings

12.1 Select “Output” settings tab of LI-7500 software.

For CO2flx systems (4m, Tower 25 and 60 m) use the following settings:

Delay = 11 = 302.369 ms

Bandwidth = 5 Hz

D/A #1

H_2O (mmol/m^3)

0V = 0.00

5V = 2000.0

D/A #2

CO_2 (mmol/m^3)

0V = 10.00

5V = 30.0

SDM does not matter

All “values to update” should be checked

If something is different make a note and, if possible, correct it.

For ECOR systems use following settings:

Delay = 9 = 289.11 ms

Bandwidth = 10 Hz

D/A #1

H_2O (mmol/m^3)

0V = 0.00

5V = 2000.0

D/A #2

CO_2 (mmol/m^3)

0V = 8.00

5V = 32.0

SDM does not matter

All “values to update” should be checked

If something is different make a note and, if possible, correct it.

12.2 Select “RS232” settings tab in LI-7500 software. The following boxes must be checked.

For CO2flx systems (4m, Tower 25 and 60 m) check the boxes:

Configure RS232 port of LI-7500 when disconnected from PC

Baud rate = 38400

Frequency = 10

Data boxes checked for output:

Temperature

Pressure

CO_2 (mmol/m3)

H_2O (mmol/m3)

Diagnostics

No options selected

End of Line set to Both (0D0A)

For ECOR systems check the boxes:

Configure RS232 port of LI-7500 when disconnected from PC

Baud rate = 9600

Frequency = 10

Data boxes checked for output:

- Temperature
- Pressure
- CO_2 (mmol/m3)
- H_2O (mmol/m3)
- Cooler Voltage
- Diag
- Ndx

No options selected

End of Line set to Both (0D0A)

12.3 Disconnect software connection to LI-7500.

13. Replace tubing and connectors

13.1 Remove Cal. Hood thermistor cable from far right connector.

13.2 Replace internal thermistor cable on far right connector.

13.3 Reconnect pressure tube to pressure sensor.

13.4 Remove external serial communications cable and reconnect internal serial communications cable to serial connector.

13.5 Close electronics box and return sensor to system.