CO^2 Leak Test Procedure

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Procedure

- Straw Prep
- Leak Testing
- Straw Cleanup
- Data Analysis and saving to database

Straw Prep

- Take straw from packaging

Straw Prep

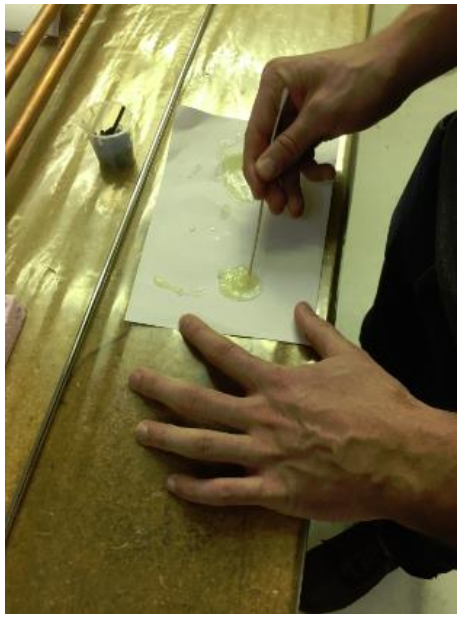
- Remove paper in straw.

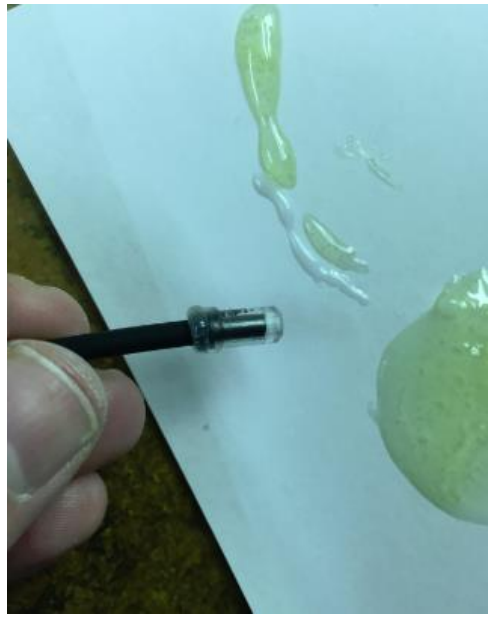
Twist both ends of paper to reduce inner radius of paper spiral so it does not drag across the inner lining of the straw. Carefully pull paper out.

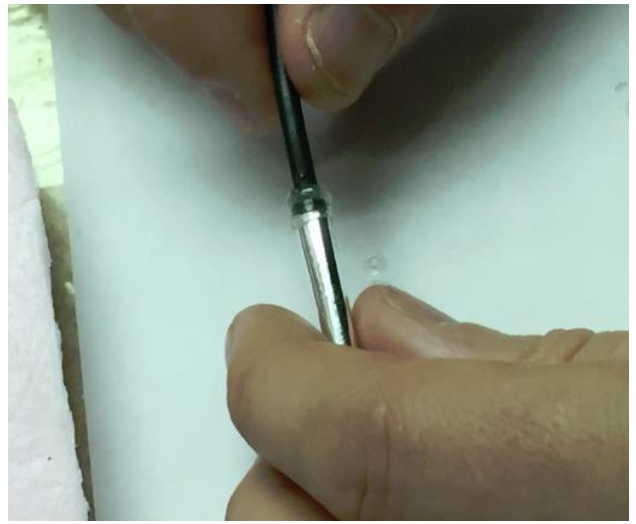
Straw Prep

- Use DP110 epoxy (10 min epoxy) to attach end pieces to straw.

Carefully mix the epoxy. Apply the epoxy to the endpiece. Install endpiece onto straw, twisting to ensure epoxy is evenly spread. When installing some epoxy should roll out onto the endpiece. Wait 20 minutes for epoxy to dry to handling strength.

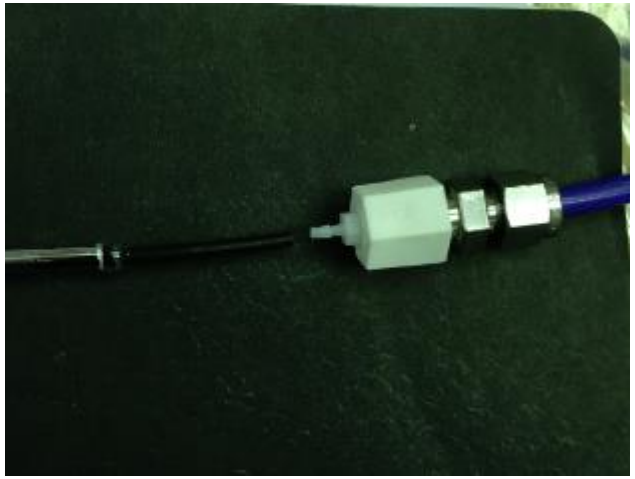


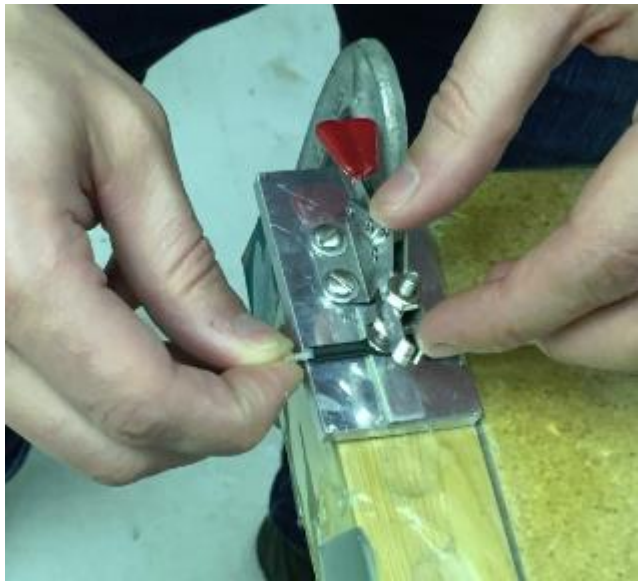




Straw Prep

- Flush straw with 50% CO^2 50% Argon mix
- Clamp far end and attach stopper
- Pressurize straw to 15 psi over ambient air pressure.
- Clamp injection end, remove gas feed, stopper end



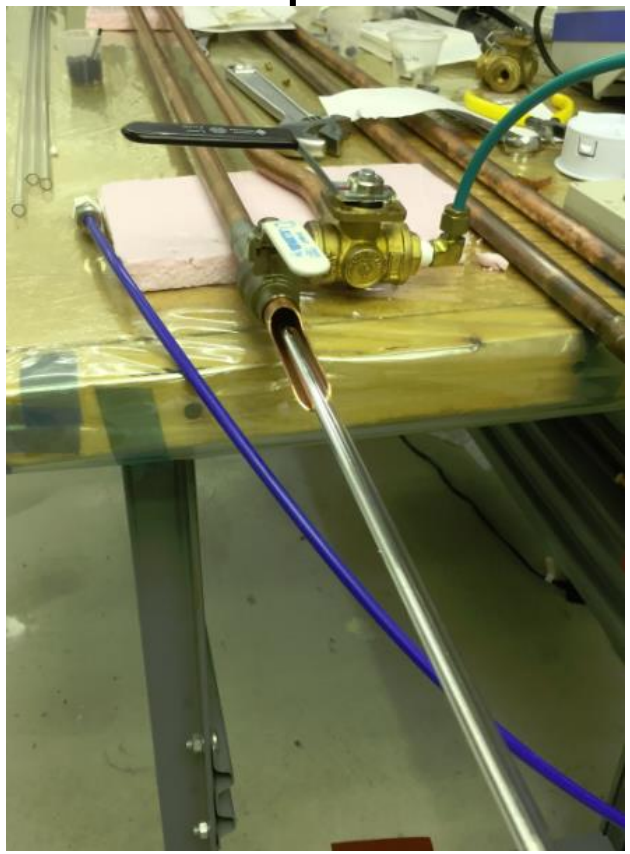


Straw Prep

- Label Straw (marker on straw is easy when pressurized)
- Label plastic containment tube (Barcode labeler and scanner)
- Put straw into containment tube

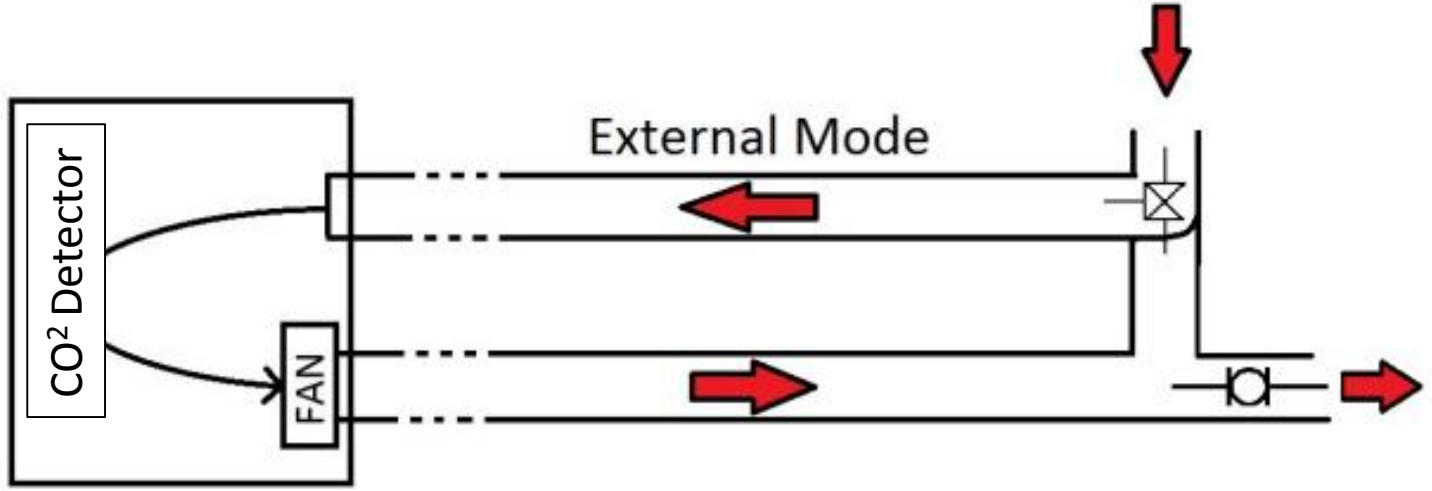
Leak Testing

- With the straw still inside the plastic tube, and both ends of the plastic tube open, the straw is placed in the leak chamber.



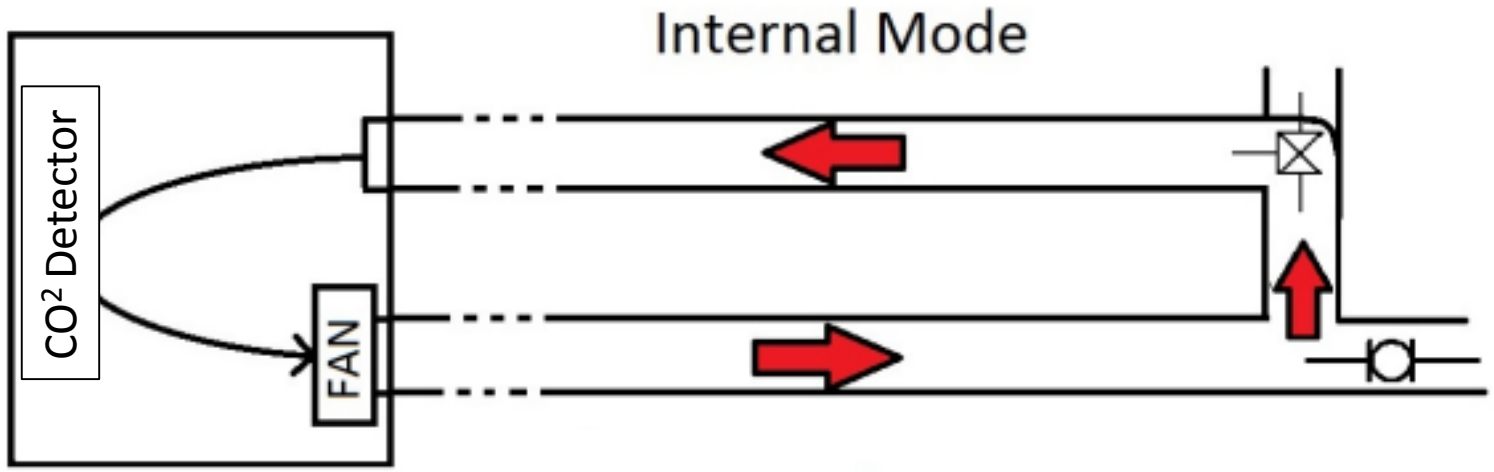
Leak Testing

- Put leak chamber in open external mode and flush with nitrogen for 1 minute. (We have been having some unexpected problems with the lack of CO2 and detectors, so the time might change in procedure)



Leak Testing

- Change leak testing to internal circulating mode.
- Run data collection for approximately an hour. (first ~15 minutes throw out data while CO^2 disperses)



Leak Testing

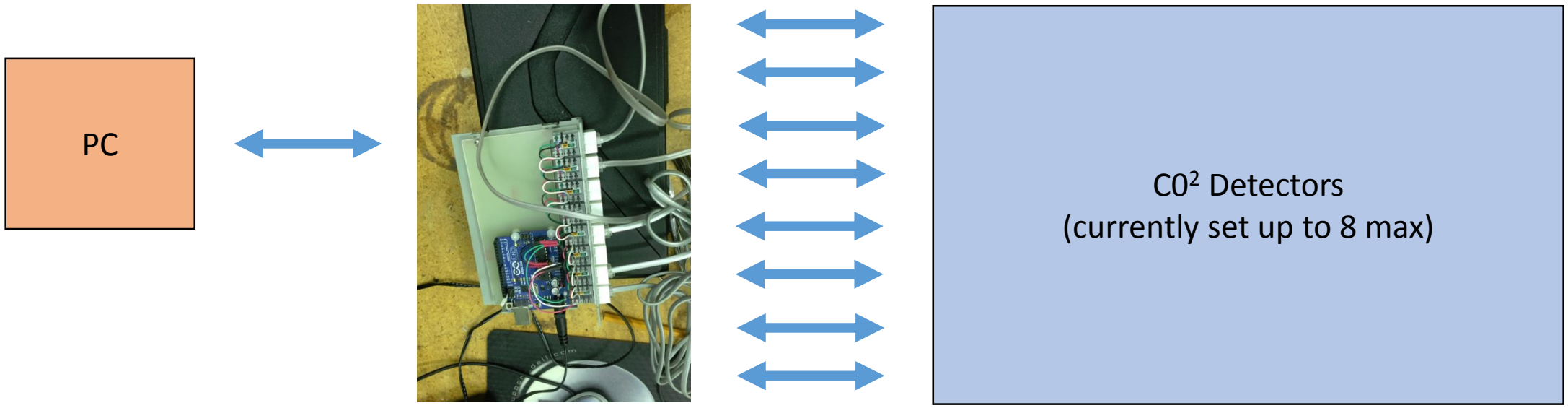
- Remove straw by tipping apparatus and pulling plastic tube out. (room for improvement here)

Leak Testing

- Remove stoppers from ends of the straws viton tubing. It is important not to leave the tubes inflated for longer than 24 hours else the $C0^2$ leaving faster than the air entering might cause the straw to collapse.
- Cap both ends of the plastic storage tube and put it into a location for safe keeping.

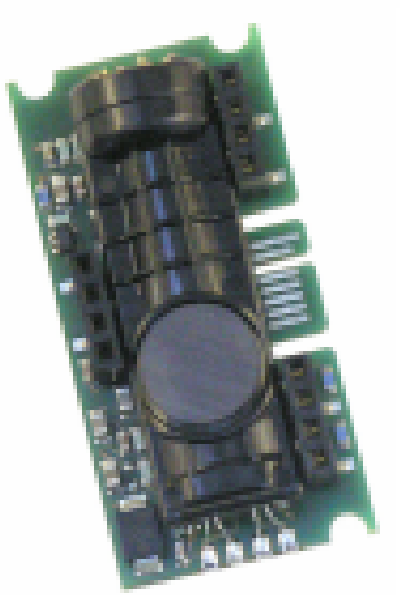
Analyzing data

The PC talks with the Arduino through a python script. The Arduino is recording information from the $C0^2$ Detectors. Raw data is saved into a txt file which can be analyzed with a fitting program (such as root).

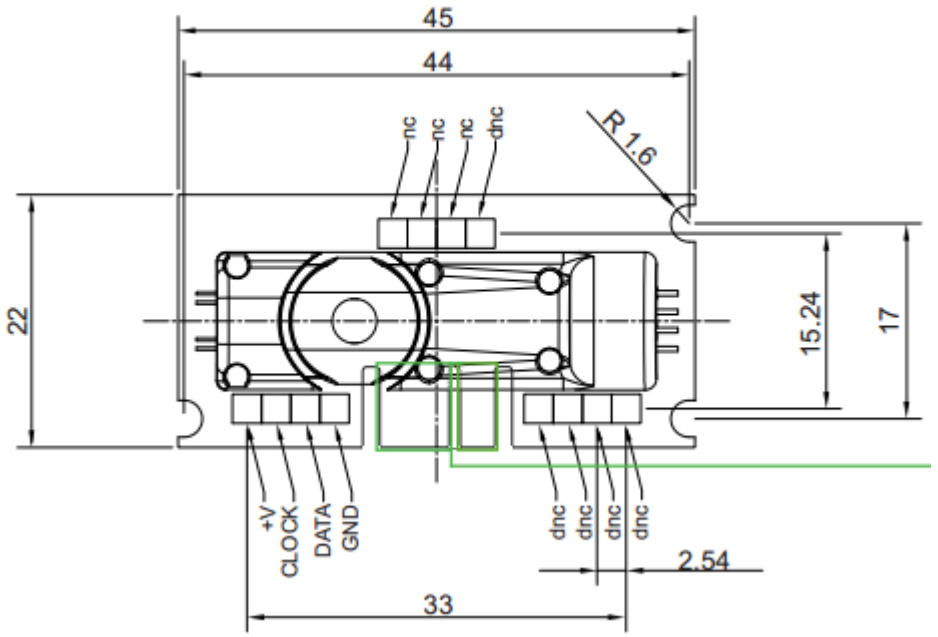


Analyzing data

The $C0^2$ Detectors : EE891



Connection Diagram / Dimensions (mm)



CO_2	
Measurement principle	Non-Dispersive Infrared Technology (NDIR)
Sensor	E+E Dual Source Infrared System
Working range	0...2000 / 5000 / 10000ppm
Accuracy at 25°C (77°F) and 1013mbar	0...2000ppm: < ± (50ppm +2% of measuring value)
	0...5000ppm: < ± (50ppm +3% of measuring value)
	0...10000ppm: < ± (100ppm +5% of measuring value)
Response time t_{90}	< 195s
Temperature dependence	typ. 2ppm CO_2/°C (0...50°C / 32...122°F)
Long term stability	typ. 20ppm / year
Measuring time interval [1]	adjustable from 15s up to 1h

Supply voltage	4.75 - 7.5V DC
Average power consumption [2]	3.7mA with 15s measurement interval
	58µA with 1h measurement interval
Peak current	max. 500mA for 0.05s

Analyzing data

Areas of improvement:

- Each detector has an Hardware address which is identified. However it only spits out data for each system connected(ex: 4 detectors writes to 4 columns). Sometimes it doesn't see a detector, messing up the column location for the higher numbered detectors.
- Detectors read -1 or nothing when they don't get enough voltage. This happens more often then we would like (5-10% one of the 5 detectors has a -1 or missing)
- Arduino buffers the results before writing once every half hour or so.
- Detectors have a floor that we seem to hit that they just read 0.0 until above that floor. This seems to be unique to each detector, but haven't seen readings less than 35 ppm.
- Arduino saves over txt file instead of appending it.(easy to change, this is here as a reminder).

Database system

- The goal is that all the leak test information will be stored onto the online database.
- Each straw will have a barcode and leak tests, resistance tests, cut length, straw position, etc… will be saved together.
- This is in the process of being worked out and organized.

This week at Fermilab

- We have completed the 5 test chambers here and are proceeding to test for background leaking.