

## Appendix U. Field Investigation of Flow Rate Measurements

## Field Investigation of Flow Rate Measurements for Pesticide Monitoring Lompoc, California

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On November 16 and 17, 2000, Jeff Woodlee met with representatives of CAL/EPA, Department of Pesticide Regulation (DPR) in Lompoc, California. An audit of field flow measurement methods was conducted. Randy Segawa and Pam Wofford of DPR were investigating air concentrations of methyl isothiocyanate around the perimeter of the town as a result of a pesticide fumigation nearby. Five sites (map attached) were chosen for air sampling by evacuated cannisters and by sorbent tubes attached to air sampling pumps. The audit consisted of verifying flow rates measured by the investigative team for the air sampling pumps that were used with the sorbent tubes. Flow rates of the evacuated canisters were not taken. Ten sets of measurements were taken, five during the afternoon of November 16 and five on the morning of November 17. The summary of measurements are tabulated below.

DPR investigators were using a reported NIST tracable primary dry piston flow meter manufactured by BIOS International, model- DRY CAL/model: DCL-ml, to measure air pump flow rates through sorbent tube at the beginning and end of each sampling event. The auditor measured the same flow rates using a primary bubble flow meter manufactured by Gilian, model - Gilibrator that was calibrated to a high precision glass cylinder/ bubble meter optimized for 1000 ml/min flow rate, calibrated before and after the field event. DPR and auditor agreed to use the same single sorbent tube for all measurements, and to determine the flow rate as an average of three flow rate measurements. The table summary values are the averaged numbers.

**Flow Rate Measurements Afternoon 11/16**

Location	Gilibrator Flow Rate (mls/min)	Dry/CAL Flow Rate (mls/min)	Rotometer (liter/min)	% Deviation from Gilibrator
Animal Shelter	1045	1006	1.00	4%
School Roof	1078	1046	1.00	3%
Migeleto School	1089	1040	1.00	5%
APCD	1026	987	1.00	4%
Bus Station	1004	962	1.00	4%

Based on discussion with DPR and research into methods of flow rate measure, it appears that DPR is conducting flow rate measurements, with the intent of using the best technology available to achieve the most accurate and precise information. It also appears from discussion with the manufacturer that cold temperatures and high humidities will decrease the accuracy of the Dry/CAL system. The Dry/CAL is superior to general rotometer measurements.

The manufacturer's accuracy for the Dry/CAL is 3.5%. The manufacturer's accuracy for the Gilibrator is listed as better than 0.5%. The error measured relative to both methods accounts for the 4% average deviation measured on 11/16. The average deviation of around 7% measured on 11/17 is higher than would be expected from the manufacturer's reported accuracy. The measurements taken on 11/17 were early in the morning around 7:00 AM with a visible frost apparent at the sampling locations. It was very cold, with a chance of high humidity or condensation. In my opinion the error experienced on 11/17 is inherent in the Dry/CAL's dry piston technology which is susceptible to extreme cold and high humidity or condensation. However, it should be noted that even under these conditions the error is lower than the range expected from some rotometers. The manufacturer's reported operating range is 0-55 degrees C with relative humidity of 0-77%. It is likely that we were not outside the specified operating range, but near the lower temperature and upper humidity levels. It is clear that the technology of frictionless piston (the Dry/CAL) becomes less frictionless as the temperature decreases and the humidity increases, thereby accounting for the higher error on 11/17.

In my opinion and within the constraints of field operations, the Dry/CAL is a good choice and does provide accurate and reliable information when used within the constraints of the operating temperature and relative humidities listed by the manufacturer. Overall the accuracy measured for the field events were acceptable, when considering other technologies, such as rotometers, and with account for weather conditions. A comprehensive understanding of the limitations of the dry piston method will further enhance field operations. More accurate flow rates can be obtained using a bubble meter device. DPR has made good efforts to provide field reliable measurements for flow rate. The flow rate results are within limits expected for this event. It is recommended that DPR periodically calibrate the Dry/CAL meter in accordance with the manufacturer's instructions.

**Flow Rate Measurements Morning of 11/17**

<b>Location</b>	<b>Gilibrator Flow Rate (mls/min)</b>	<b>Dry/CAL Flow Rate (mls/min)</b>	<b>Rotometer (liters/min)</b>	<b>% Deviation from Gilibrator</b>
Animal Shelter	1034	936	1.00	9%
School Roof	1086	1011	1.05	7%
Migeleto School	1054	992	1.00	6%
APCD	1029	967	1.00	6%
Bus Station	985	920	0.95	7%