

Technical Bulletin #61

To: Coulometrics Support Personnel
From: Engineering Dept.
Date: 11-17-05
Subject: Electronic Evaluation of a CM5014S Sulfur Coulometer

Procedure for checking the Electronics of CM5014S Sulfur Coulometer

The following is a procedure to evaluate the electronics of a CM5014S Sulfur Coulometer in the field. It requires the unit to be plugged in and turned on with no cell in the instrument. The Coulometer should be on for at least 30 minutes prior to testing to allow the electronics to stabilize.

1. Perform the Electronic Calibration Check:

There are two methods that can be used to perform the electronic check. One makes use of a digital multimeter (DMM) and one uses the normalized reading technique. The use of a calibrated DMM with the ability to read current of 200 ma to a resolution of at least .1 is the preferred method.

For Both Methods

Set the CM5014S coulometer as follows:

Select RUN DIAGNOSTICS from the main screen.

Press '2' to Select Print Settings option to print the existing settings. Keep this for reference and to make sure the instrument is set back to these settings after the test

Press '1' to select the Change settings option.

Press '1' to select Sulfur

Press 'n' to select units only

Press enter to select the default value on the on the % Difference screen.

Press enter to select the default value of 1.00 on the on the Factor screen.

Press 02 and Enter to select 2 as number of readings.

Press enter on the Interval screen to select he default of 1 min.

Press '2' to select fixed number of readings on this screen.

Press '1' to select Manual sampling method.

Press '1' on the next screen to select CAL TEST PRINT OUT

Press 'n' to select NO to the write to disk option.

Press '4' to exit diagnostics

2. If using a DMM:

- (a) Insert the DMM set up for milliamp current measurement in the CELL Black- and Red + connections. The meter will be in series with the instrument in place of the cell electrodes. Caution the Coulometer power supply develops 180 VDC. Be sure the cell switch is in the off position when connecting and disconnecting the meter.
- (b) Turn the meter on and set it to measure DC milliamps.
- (c) Turn the Cell switch to the **ON** position.
- (d) Select RUN ANALYSIS and press enter.
- (e) Press F2
- (f) Press enter to select the default value of 01 as the number of samples.

- (g) Press enter on the next screen. The Coulometer will start the analysis.
- (h) Record the cell current displayed on the meter as DMM current below.
- (i) The analysis will run for 1 minute and finish. Remove the printout. The printout will display 5 sets of numbers. They are as follows left to right:

Reading number, time in minutes, reading in ug, detector current in ua, cell current in ma

- (j) Record the time (in minutes) of the second reading in the table below.
- (k) Record the value (in ug) of the second reading as the reported reading in the table below.

TABLE FOR CALIBRATION CHECK USING A DMM (Digital Multimeter)

Mode	DMM Current	Time	Reported Reading	Calculated reading	Error
Sulfur (s)	_____	_____	_____	_____	_____
Sulfur Dioxide (SO2)	_____	_____	_____	_____	_____
Sulfur Trioxide (SO3)	_____	_____	_____	_____	_____
Hydrogen Sulfide (H2S)	_____	_____	_____	_____	_____

- (l) Determine the theoretical reading as follows by using the following formula:

$$\frac{\text{Current (in amps)} * \text{time (seconds)} * \text{Multiplier}}{96489}$$

Where Multiplier is as follows: S = 16.03, SO2 = 32.0294, SO3 = 40.0291, H2S = 17.0379

- (m) If desired, repeat the test for SO2, SO3 and H2S using the new values and multipliers. It will be necessary to go into run diagnostics and change the units each time.
- (n) When finished, use the printout obtained in step 2 to go back into the diagnostics and reset the coulometer to the original analytical settings.

Example calculation using a DMM:
The DMM reported 200.01 ma of current

The printout showed for reading #2

2 1.011 2012.44 0.0 199.695

The time reported is 1.011 minutes

The ug reported by the instrument is 2012.44 (running in S mode)

Using the formula:

$$\frac{\text{Current (in amps)} * \text{time (seconds)} * \text{Multiplier}}{96489}$$

$$\frac{.20001 * (1.011 * 60) * 16.03}{96489} = 2015.63 \text{ ugs}$$

The instrument reported 2012.44. The calculated value is 2015.63
 The difference indicates the instrument is low 3.19 ugs

Some error may be a result of the resolution and calibration of the bench meter.
 A bench meter capable of reading 5 & ½ places is used for calibration of an instrument at UIC.

3. If testing without a DMM using the Normalized reading method:

- (a) Turn the Cell switch to the **TEST** position.
- (b) Select **RUN ANALYSIS** and press enter.
- (c) Press **F2**
- (d) Press enter to select the default value of 01 as the number of samples.
- (e) Press enter on the next screen. The Coulometer will start the analysis.
- (f) The analysis will run for 1 minute and finish. Remove the printout. The printout will display 5 sets of numbers. They are as follows left to right:

Reading number, time in minutes, reading in ug, detector current in ua, cell current in ma

- (g) Record the time (in minutes) of the second reading in the table below.
- (h) Record the value (in ug) of the second reading as the reported reading in the table.

TABLE FOR CALIBRATION CHECK NORMALIZED METHOD (No DMM)
 (Assumes actual current of 200.00 ma)

Mode	Theory	Actual Time	Actual Reading	Normalized Reading	Error (+/-)
Sulfur (C)	1993.60	_____	_____	_____	_____
Sulfur dioxide (SO2)	3983.38	_____	_____	_____	_____
Sulfur Trioxide (SO3)	4978.28	_____	_____	_____	_____
Hydrogen Sulfide (H2S)	2118.94	_____	_____	_____	_____

- (i) Normalize the reading by dividing the actual reading by the actual time in minutes.
- (j) The test can be repeated for the other modes by going back to RUN Diagnostics and Changing to 2 for SO2, 3 for SO3 etc.

Example of calculation using Normalized approach (No DMM)

Instrument reported:

The printout showed for reading #2

2	1.011	2012.44	0.0	199.695
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To normalize the value, simply divide the reading by the actual time in minutes from the coulometer printout. In this case the actual reading $2012.44/1.011 =$ normalized reading of 1990.54

The theoretical value was 1993.60. The error is -3.06 ugs. The normalized approach assumes the cell current to be the factory-calibrated value of 200.00 ma. It is possible that some drift could have occurred in the maximum cell current. If this value is not exactly 200.00 then the coulometer could still be in analytical calibration but the normalized value would indicate some error. This is why this approach is not as desirable as the use of a good DMM. The normalized approach is however, a useful tool to evaluate the instrument if a calibrated DMM is not available.