

**MODEL 5000**  
**S E N T R Y**  
**GAS MONITORING SYSTEM**

**Version 6**

**Calibration and Maintenance**



**APPLICABILITY & EFFECTIVITY**

**Effective for all Sentry systems manufactured after September 1, 1995.**

**Instruction Manual Part Number T12001-A1**

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## 5. CALIBRATION

### 5.1 SENTRY CALIBRATION - AN OVERVIEW

Calibration is a simple three step process:

1. Initiate calibration via the controller keyboard.
2. Apply zero gas (if required) and then span gas to the sensors.
3. Close the calibration via the controller keyboard.

Calibration parameters are configured via the **CHANGE CALIB** activity and are saved by Sentry for future calibrations.

During calibration Sentry "peak holds" the sensor signal output for zero and span gas and then uses those values to construct a curve for continuous reference during normal gas monitoring.

There are two alternative calibration methods, Global Calibration and Local Calibration.

#### 5.1.1 GLOBAL CALIBRATION

When Global Calibration is selected, the Sentry controller collects zero and span value data from all sensor modules eligible for calibration based on a global keyboard command. It is not necessary to calibrate all the sensors, those which do not receive span gas will be rejected automatically.

The operator presses the **ENTER** key to initiate, and complete, collection of the zero value and then the span value. Calibration gas may be delivered to the sensor module in a variety of methods dependent upon the accessibility of the sensor.

The benefits of Global Calibration are:

- Magnetic calibration head not required.
- All "zero's" can be set at one time.

Global Calibration is particularly useful when:

- The sensor is in a position which is difficult to access, because a calibration gas delivery tube can be installed to a more accessible location.
- The magnetic head is not available or the magnetic switch in one of the sensors is not functioning.

#### 5.1.2 LOCAL CALIBRATION

When Global Calibration is turned off, the Sentry controller collects zero and span value data from each sensor module eligible for calibration based on a local command at the module.

Calibration gas is delivered through a magnetic fitting which causes a switch in the sensor to command the controller to remember the module output. The procedure calls for the magnetic cap to be applied twice (zero first, span second) except that the magnet is applied only once for oxygen modules.

The benefits of Local Calibration are:

- Individual modules can be calibrated while others remain on line.
- Time savings when sensors must be exposed to zero air due to the environment.

Local Calibration is particularly useful when:

- Plant operating procedures demand that some modules remain on line while others are being calibrated.

### 5.2 CALIBRATION INITIALIZATION

#### 5.2.1 MODULES

Before any module can be calibrated it must be initialized via the **CHANGE MODULE** activity. Initialization includes turning the module on, setting the alarm levels and setting the factor(s). This activity is described in step by step form in Section 4.3 steps 6 through 18. If a module is not initialized, an error prompt **INITIALIZE MODULES FIRST** will display when calibration is attempted.

**NOTE**

*The following calibration instructions are applicable to controllers with version 6.xx firmware. For earlier version firmware (example 4.2) refer to the Instruction Manual furnished with that controller. To determine the firmware version installed in any Sentry controller, press **TEST**, **ENTER** and observe the firmware version number on the lower LCD screen.*

**NOTE**

*If any sensors are not previously calibrated use Diagnostic Code 0020 or 0021 to force calibration prior to performing the normal calibration procedure. See Section 8.3.5.*

**5.2.2 CALIBRATION PARAMETERS**

Use the **CHANGE CALIB** menu to configure calibration parameters as follows: Calibration parameters remain in Sentry memory until changed by the operator, they do not require initiation at every calibration

Step	Activity	Display
1	Select <b>CHANGE CALIB</b> menu	<b>PRESS ENTER TO &lt;CHANGE CALIB&gt;</b>
	Use <b>MODE</b> key to select <b>CHANGE CALIB</b>	
2	Select Gas Type	<b>USE ARROWS/ENTER GAS TYPE: COMB</b>
	Sentry displays the last gas type which was calibrated. Use the arrow keys to change the type. Press <b>ENTER</b> to continue to the next parameter	
3	Edit Full Scale	<b>USE ARROWS/ENTER FULL SCALE = 100</b>
	If the full scale value is set above 999, the display will default percent full scale (%FS). (Alarm values must be set using PPM, not %FS.) Press <b>ENTER</b> to continue to the next parameter.	
4	Edit Span Gas Concentration	<b>USE ARROWS/ENTER CALIB CONC = 050</b>
	Use arrow keys to set the span gas concentration to match the concentration of gas to which the sensors will be exposed. Press <b>ENTER</b> to continue to the next parameter	
5	Edit Calibration Frequency	<b>USE ARROW/ENTER CAL FREQ =30 DAYS</b>
	Use the arrow keys to set the number of days till the next calibration. Sentry will use this number to count down to the next calibration and display " <b>CALIBRATION OVERDUE</b> ". Press <b>ENTER</b> to continue to the next parameter.  The calibration overdue message is a notification only and does not cause the module to go out of service. The message can be suppressed by setting the calibration frequency to "00" days at the time of calibration	
6	Select Calibration Method	<b>USE ARROWS/ENTER GLOBAL CAL ON</b>
	Use the arrow keys to turn Global Calibration ON for Global Calibration or OFF for Local Calibration.	

**5.3 CALIBRATION PROCEDURE**

**5.3.1 CONTROLLER SET-UP**

Use the **CALIB** menu to initiate the calibration session at the controller.

Step	Activity	Display
1	Select <b>CALIBRATION</b> activity	<b>PRESS ENTER TO &lt;CHANGE CALIB&gt;</b>
	From normal operate mode, press <b>MODE</b> and <b>ENTER</b> to access the calibration activity.. (If a user code has been set in the system it must be input to access the <b>CALIB/CHANGE</b> activity. See Section 8.3.3).	
	Successive Displays.	<b>CALIB/CHANGE SELECTED</b>
	Successive Displays	<b>READ INSTRUCTION MANUAL FIRST</b>
	Select Gas Type	<b>ENTER TO CALIB COMB 50% LEL</b>
	If the gas type is not correct press the <b>ARROW</b> until the correct gas type and concentration is displayed. Use <b>CHANGE CALIB</b> menu selection to change span gas concentration. (See Section: 5.2 )	
3A	Initiate Calibration (Global)	<b>ENTER TO ZERO 1 2 3 4 5 6 7 8</b>
	If the display is similar to this example, the controller is configured for Global Calibration. Continue to Section 5.3.1.1.	
3B	Initiate Calibration (Local)	<b>APPLY 0 &amp; 50% LEL 1 2 3 4 5 6 7 8</b>
	If the display is similar to this example, the controller is configured for Local Calibration. Continue to Section 5.3.1.2.	

**NOTE**  
*In all calibration examples, the responses for combustible gas are used as an example. Other gases will provide appropriate similar displays.)*

5.3.1.1 GLOBAL CALIBRATION

Proceed with the following steps to perform Global Calibration.

Step	Activity	Display
1	Begin ZERO value read.	ENTER TO ZERO 1 2 3 4 5 6 7 8
	Press ENTER to start the controller recording the zero signal value for all modules of the selected gas type.	
2	Complete ZERO value read.	APPLY ZERO GAS ENTER WHEN DONE
	<p>The upper display will cycle through all the applicable module numbers with "00" displayed as the level.</p> <ul style="list-style-type: none"> <li>• Example "1. 00", "2 00" etc.</li> <li>• If any module has not been previously calibrated the "00" will be replaced by a "--".</li> <li>• If any sensor is not known to be in clean air at this time, go to each such sensor which is to be calibrated and deliver clean air at 100 cc/min for three minutes using the apparatus in Section 5.3.2.</li> </ul> <p>Wait until the display cycles through all module numbers.</p> <p>Press ENTER to complete the zero read and the display will advance to the span prompt.</p>	
3	Begin SPAN value read	ENTER TO SPAN 1 2 3 4 5 6 7 8
	Press ENTER to begin the span process. The top display begins to cycle through all sensor module numbers which are configured for the selected calibration gas. Each module number will show a "period" immediately after the number and a numerical concentration display as in the following example. [1. 00] [2. 00].	
4	Apply SPAN gas.	APPLY 50% LEL ENTER WHEN DONE
	<p>Apply calibration gas to each sensor which is to be calibrated using the apparatus in Section 5.3.2. Use magnetic or non magnetic calibration gas delivery fitting.</p> <p>During the time calibration gas is being delivered the upper display on the controller will continue to cycle through all applicable module numbers. The module responding to gas will generally show an increasing reading on each pass.</p>	
5	Complete SPAN gas	CALIB COMPLETE PLEASE WAIT 3:00

Step	Activity	Display
	application - no errors	
	When all modules have received calibration gas press ENTER to indicate completion of the span process. If all modules have been successfully calibrated the controller will begin the three minute time delay before placing modules back on line	
6	Error Conditions - Low Sensitivity	LOW SENSITIVITY 1 2 3 4 5 6 7 8
	If any modules were missed, or if any sensors failed to respond correctly to the calibration gas the low sensitivity message will identify those sensor module numbers. If calibration of the module was attempted, note the number and plan corrective action as described in Section 7.	
7	Error conditions - Not Calibrated	NOT CALIBRATED 1 2 3 4 5 6 7 8
	Press ENTER again. If all modules have been successfully calibrated the controller will begin the three minute time delay before placing modules back on line. If any modules were displayed as LOW SENSITIVITY, they will be displayed again as NOT CALIBRATED. Press ENTER to acknowledge	
8	Return to Operate Mode	PRESS ENTER TO OPERATE MODE
	<p>When the time delay is complete the display will read PRESS ENTER TO OPERATE MODE Press ENTER and the procedure is complete. Repeat the process as necessary to recalibrate modules or to calibrate other gases.</p> <p>Remove all calibration apparatus from sensors.</p>	

**5.3.1.2 LOCAL CALIBRATION**

Proceed with the following steps to perform Local Calibration

Step	Activity	Display
1	Apply <b>ZERO</b> and <b>SPAN</b> gas to each sensor.	<b>APPLY 0 &amp; 50% LEL</b> 1 2 3 4 5 6 7 8
	<p>Apply zero and span calibration gas to each sensor for which calibration is required. (Sensors which are not exposed will be reported as "Not Calibrated" and will retain their prior calibration status).</p> <p>The calibration gas must be applied via the magnetic delivery head supplied with the Sentry system.</p> <ol style="list-style-type: none"> <li>Remove the rainshield (where applicable).</li> <li>Using the apparatus in Section XXX, thread the calibration head into the sensor assembly. At this time the controller top display will lock onto this module number.</li> </ol> <p>If the ambient environment is one which has been determined to be clean at the time of calibration, leave the magnetic head in place for 30 seconds and then remove. If the ambient environment is potentially contaminated, bleed clean air through the calibration head for two minutes at 100 cc/min and then remove the air and the calibration head.</p> <ol style="list-style-type: none"> <li>Wait thirty seconds after the magnet is removed. During this period the controller will stop displaying the module number and will show dashes "- -" on the upper display.</li> <li>Thread the calibration head into the sensor assembly a second time. The controller will again lock onto the number for that module but will add a period immediately following the number.</li> </ol> <p>Bleed calibration span gas through the magnetic head at 100 cc (or as required for permeation tube calibrator). The controller will display the concentration which would be determined based on the prior calibration of the module</p> <ol style="list-style-type: none"> <li>Remove the gas and the calibration head, replace the rainshield and repeat the process for the next module. As each sensor is correctly exposed to calibration gas the respective module number will disappear from the display making it possible, at any</li> </ol>	

Step	Activity	Display
	time, to read which modules have not been exposed to calibration gas.	
2	Gas application complete - no errors	<b>CALIB COMPLETE</b> <b>PLEASE WAIT 3:00</b>
	<p>When all modules have received calibration gas press <b>ENTER</b> to indicate completion of the span process. (Required only if module numbers remain on the display)</p> <p>Press <b>ENTER</b> again. (Required only if error messages appear.) If all modules have been successfully calibrated the controller will begin the three minute time delay before placing sensor modules back on line.</p>	
3	Error Conditions - Low Sensitivity	<b>LOW SENSITIVITY</b> 1 2 3 4 5 6 7 8
	<p>If any sensors failed to respond correctly to the calibration gas the low sensitivity message will identify those sensor module numbers. Note the number and plan corrective action as described in Section 7.</p>	
4	Error Conditions - Not Calibrated	<b>NOT CALIBRATED</b> 1 2 3 4 5 6 7 8
	<p>Press <b>ENTER</b> again. Modules which were not attempted, and any modules which were displayed as "LOW SENSITIVITY", will be displayed as "NOT CALIBRATED". Press <b>ENTER</b> to acknowledge Press <b>ENTER</b> to acknowledge</p>	
5	Return to Operate Mode	<b>PRESS ENTER TO OPERATE MODE</b>
	<p>When the time delay is complete the display will read <b>PRESS ENTER TO OPERATE MODE</b> Press <b>ENTER</b> and the procedure is complete. Repeat the process as necessary to recalibrate modules or to calibrate other gases.</p> <p>Remove all calibration apparatus from sensors.</p>	

5.3.2 CALIBRATION GAS DELIVERY METHODS

Calibration gas is can be delivered to the sensors via the following delivery devices:

Model 5358-00: Calibration Adapter - used with portable calibrators. - See Figure 5-1

Model 5360-00: Calibration Gas Delivery fitting - permanently installed fitting which allows tubing to be run to a convenient delivery location

5.3.3 SENSOR EXPOSURE TO GAS

Calibration gas must be delivered to the sensor using the flow rate and duration listed in Table 5-1

Model	Gas	Flow	Period
5100-01	H <sub>2</sub> S	300 cc/min	3 minutes
5100-02	Combustible	100 cc/min	3 minutes
5100-03	O <sub>2</sub>	200 cc/min	3 minutes
5100-04	CO	150 cc/min	3 minutes
5100-05	H <sub>2</sub> S	300 cc/min	3 minutes
5100-06	CL <sub>2</sub>	300 cc/min	3 minutes
5100-07	H <sub>2</sub>	300 cc/min	3 minutes
5100-10	SO <sub>2</sub>	300 cc/min	3 minutes
5100-12	NO <sub>2</sub>	300 cc/min	3 minutes
5100-13	CO	300 cc/min	3 minutes
5100-16	CO	300 cc/min	3 minutes
5100-19	NO	300 cc/min	3 minutes
5100-21	HCL	1,000 cc/min	10 minutes
5100-22	HCN	300 cc/min	3 minutes
5100-25	NH <sub>3</sub>	300 cc/min	3 minutes
5100-26	HF	300 cc/min	3 minutes
5100-27	ETO	1,000 cc/min	3 minutes

**Table 5-1  
Calibration Gas Flow Rates**

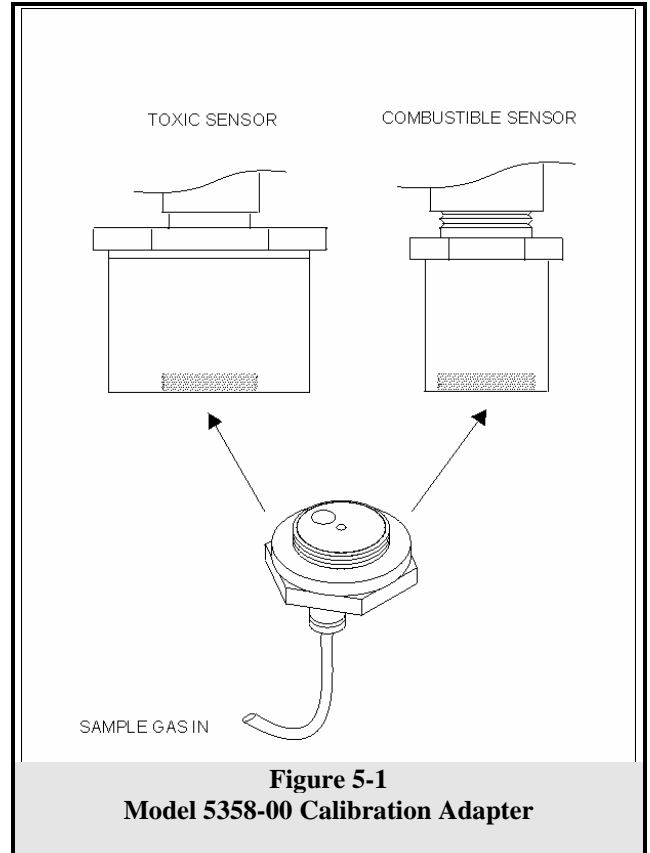
5.3.3.1 HYDROGEN SULFIDE

Hydrogen Sulfide gas must be supplied from a permeation tube device or from Sierra Monitor Model 9200 series calibrator.

5.3.3.2 COMBUSTIBLE

For compliance with factory Mutual (FMRC) Approval, the Sierra Monitor Model 1200-26 is the only Approved calibration gas delivery device. Apply 50% LEL methane in air or the calibration concentration of the gas to be monitored at 100 cc/min using Model 5358-00 or 5358-01 Calibration Adapter and Model 5360-00 Gas Delivery Fitting. For calibration with a standard gas and cross reference to a secondary gas, see Appendix D.

*NOTE*  
Cross reference factors are not FMRC approved.



**Figure 5-1  
Model 5358-00 Calibration Adapter**

5.3.3.3 OXYGEN

The calibration procedure is different for Oxygen because zero gas is not required and the sensor will be exposed only to span gas. This is a single point calibration.

- **Either:** Deliver calibration gas (clean air - 20.9% Oxygen) through the magnetic head at 100 cc/min for one minute and then remove the air and the calibration head.
- **Or:** If the local air is known to be clean leave the magnetic head in place for one minute and then remove.

5.3.3.4 TOXIC GAS

Toxic Gas for may be delivered from Sierra Monitor Model 9200 series calibrator or from appropriate permeation devices.

## 6. MAINTENANCE

### 6.1 MAINTENANCE REQUIREMENTS

The following are the manufacturer's recommendations for periodic maintenance of the Sentry system:

- 1 **CALIBRATION:** All sensors should be calibrated at a minimum of every 90 days.

<p style="text-align: center;"><i>NOTE</i></p> <p><i>FMRC approved combustible gas sensors are required to be calibrated every 90 days.</i></p>
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- 2 **BATTERY REPLACEMENT:** The lithium battery for memory retention should be replaced every two years. (See Service)
- 3 **DUST AND DIRT CONTROL:** When calibration is performed the controller and the modules should be checked visually to determine if dust or dirt build up needs to be removed. This cleaning should be done with dry instruments such as compressed air, cloth wipes or whisk broom.
- 4 **WIRING OR CABLE CONDITIONS:** Any wiring or cables which are not conduited should be checked once a year for damage to insulation or corrosion of splice or terminal points.
- 5 **LUBRICATION:** Lubricate metal to metal parts (module lid) periodically.
- 6 **INSPECTION:** Inspect modules, periodically, for moisture or water accumulation.