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APPENDIX A Relative response to various combustible gases

1.0 INSTRUMENT OVERVIEW

1.1 FEATURES

Utilizes Catalytic Gas Sensor (Pellistor Pair)

Hi Alarm, Low Alarm, and Sensor Fault SPDT 5A latched relays with reset pushbutton

Relays are field selectable as Normally On or Normally Off.

Microprocessor based instrument

Pushbutton calibration and Alarm setting

Delayed control of relays after power on and calibration to reduce nuisance alarms

Advanced Diagnostics

0 - 99 %LEL range on 2 digit LED display

Calibration/Alarm parameters stored in non volatile memory

Rack mountable modules

1.2 DESCRIPTION

The ISA 7X is an intelligent Combustible Gas Detector with a measurement range of 0 to 99 % of the lower explosive limit (%LEL) of combustible gases which is designed to the CSA No. 152 specification.

Advanced microprocessor technology provides an easy to follow pushbutton approach to calibration and Alarm settings. Two relays for independently settable Hi and Lo alarms are available with 5A SPDT contacts. In addition a Sensor Fault relay (5A SPDT) is also provided. All three relays are latched and can only be reset via the Relay Reset pushbutton on the front panel (as per CSA No. 152). The relays may be set to Normally On or Normally Off.

Calibration is a 2 point procedure. The sensor is gassed with 2 different concentrations of a test gas in turn and the instrument automatically calculates the appropriate calibration factors which are saved in permanent memory. To minimize nuisance alarms after calibration and powerup, alarms are disabled for a period of time to allow the sensor signal to stabilize.

2.0 SPECIFICATIONS

2.1 SENSOR SPECIFICATIONS

OPERATION		Continuous diffusion mode Catalytic Pellistor Pair
PERFORMANCE		
	Accuracy	+/-2% LEL Methane
	Repeatability	+/-2% LEL Methane
	Response time	2sec to 25% LEL in 50%
	Linearity	Linear 100% LEL
	Sensitivity	0.5mV/%LEL minimum.
POWER		0.75W @ 2VDC
MECHANICAL		Stainless Steel Housing for sensor with sintered stainless steel flame arrestor.
INHIBITORS		Volatile substances containing halogens
POISONS		Silicon oils and greases Gasoline additives Phosphate esters

2.2 ISA-7RM COMBUSTIBLE GAS DETECTOR SPECIFICATIONS

ALARM RELAYS		5A SPDT Latched with onboard common reset switch.
	Hi Alarm	Settable between 5 to 60% LEL (As per CSA 152 spec)
	Lo Alarm	Settable between 5 to 60% LEL (")
	Sensor Fault	Checks sensor wiring integrity.
INTERFACE		2 digit 0.36" LED display. LED panel for Alarm relays, calibration and Error status. Pushbuttons / selector switches for Calibration and Alarm setpoints.
POWER REQUIREMENTS		+5V @ 1A , + / -12V @ 50mA (per ISA-7RM module)
MECHANICAL		
	Rack mount module	2.00" Wx 5.25"H x 7.00"D. Mates with single row 0.156" spaced, 22 position edge connector on ISA-7MB rack.
ENVIRONMENTAL		
	Operating Temp.	-5 to +70 Deg. C
	Humidity	0 -100% RH

3.0 INSTALLATION

NOTE: If any damage to the instrument is found, please notify an Enmet Canada representative as soon as possible prior to installation.

3.1 SENSOR INSTALLATION

The location of the sensor should be determined based on the type of gas that is being monitored. For monitoring of heavier than air gases, the sensor should be mounted 18 to 24 inches above the floor. Conversely for lighter than air gases, the sensor location should be near the ceiling.

Regardless of the type of gas, the sensor should not be positioned beside gas ovens, heaters, or directly exposed to intense heat or steam. For a representative reading of the %LEL levels of gases in an enclosed space, the sensor should not be located close to windows, vents, or doors where the %LEL readings may be lower.

The sensitivity of the sensors may be temporarily impaired by operation in the presence of substances which are called inhibitors. These are usually volatile substances containing halogens. The sensors may recover after a short period of operation in clean air. Some substances can permanently affect the sensor response and are called poisons. Common inhibitors and poisons are listed in the Sensor specifications.

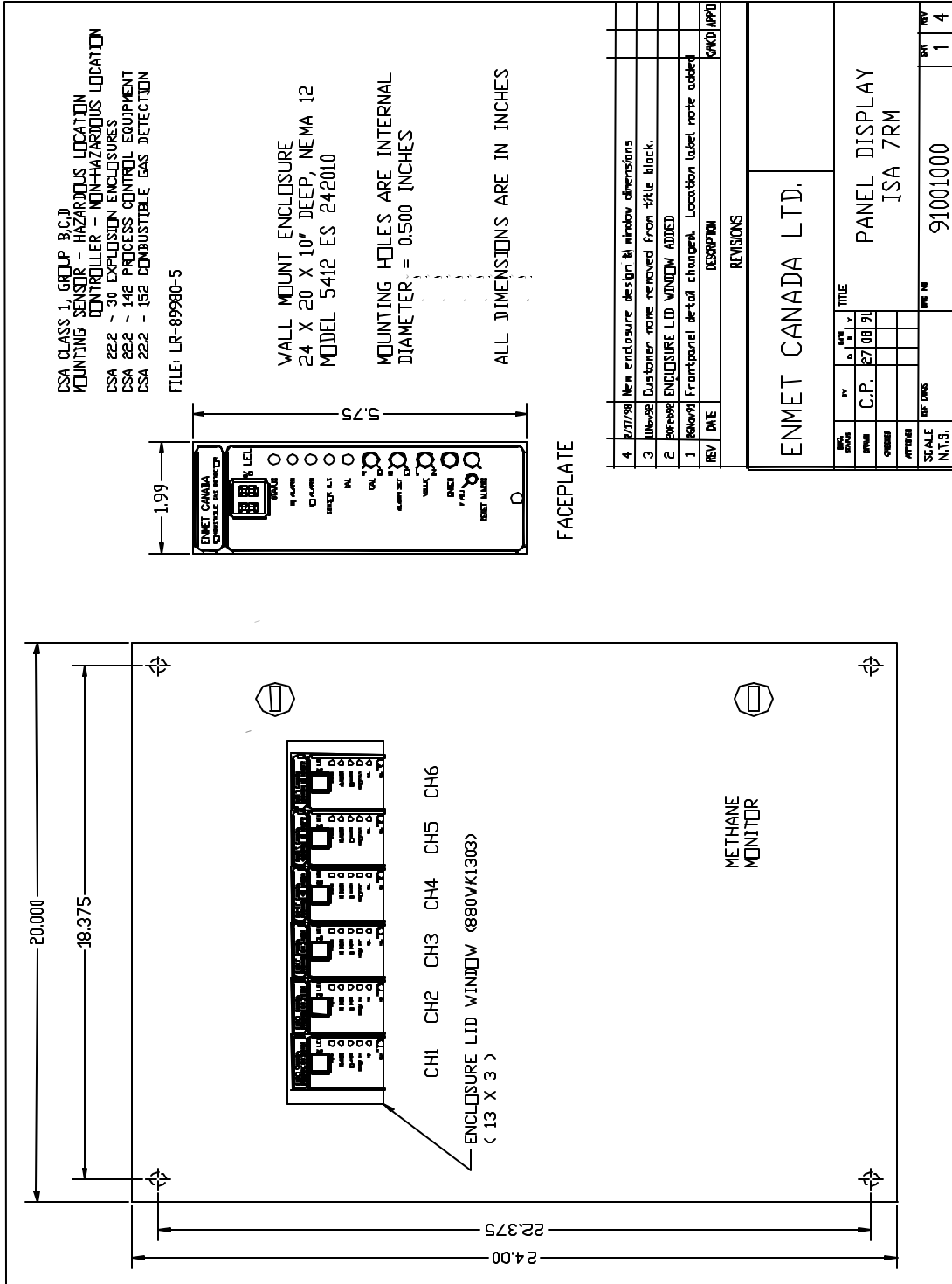
NOTE: If the sensor is exposed to inhibitors or poisons, the unit should be recalibrated. On calibration, the sensor performance (sensitivity and offset) are checked and an error is indicated (status indicator shows red) if they are out of allowed tolerance.

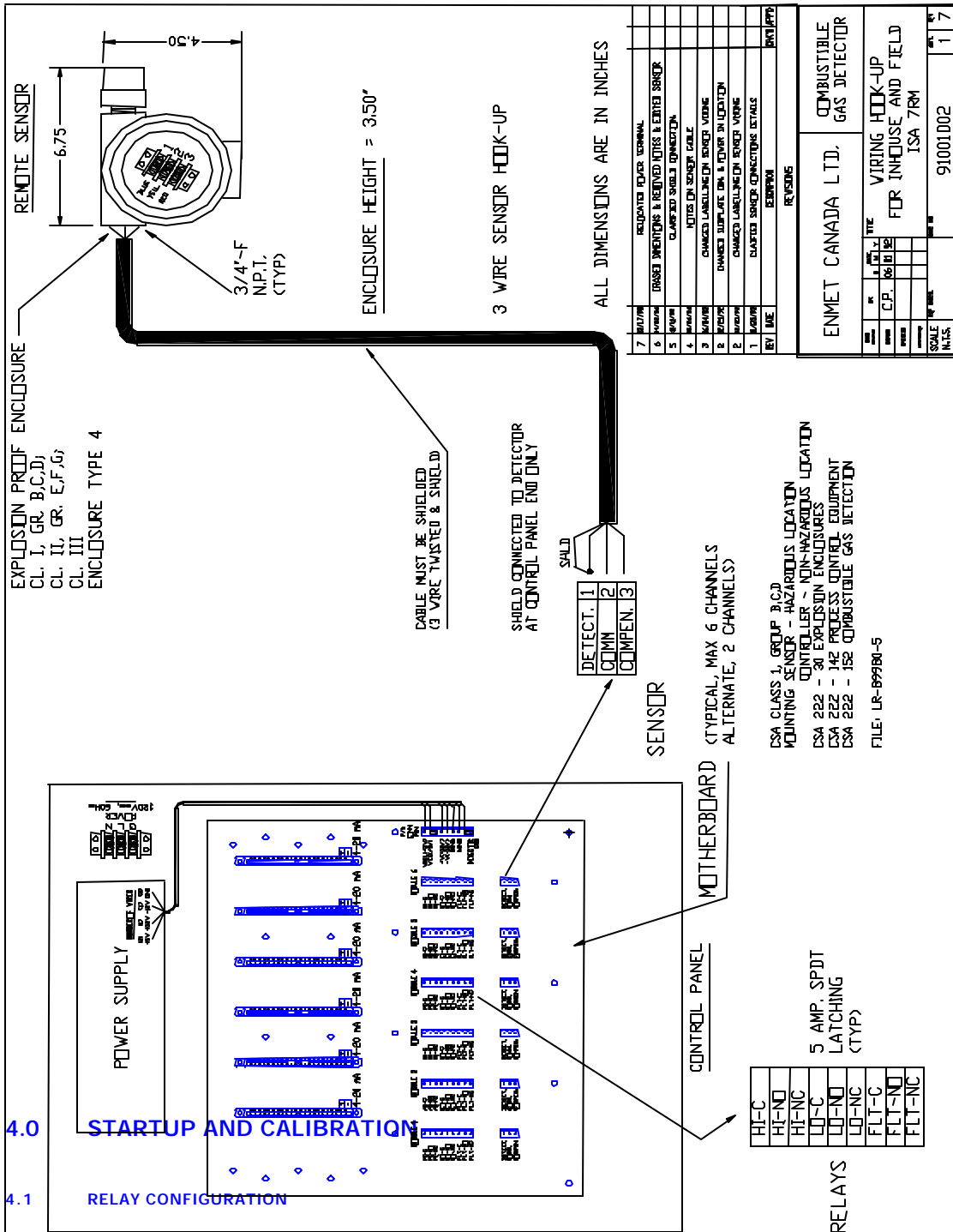
Please consult your Enmet Canada representative if the application area contains sensor inhibitor or poison fumes.

3.2 ISA-7RM INSTALLATION

A typical system consists of a ISA-7MB rack which can accommodate up to six ISA-7RM plug in modules. The ISA-7MB may be ordered in a variety of enclosures. Connections to and from the ISA-7RM plug-in modules are made via connectors mounted on the ISA-7MB rack.

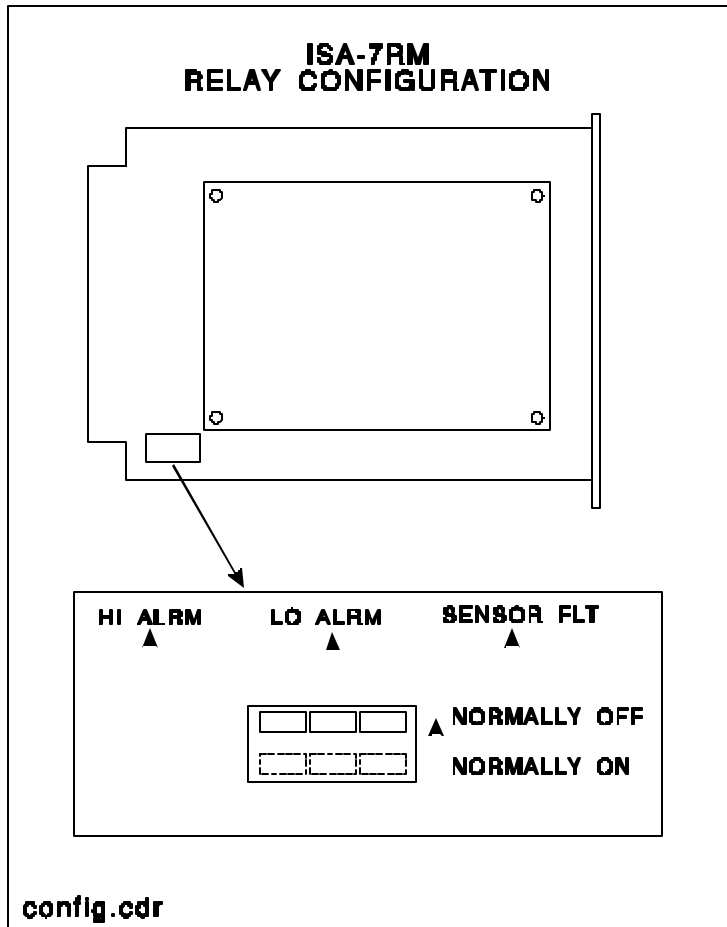
- 1- Install the ISA-7MB enclosure
- 2- Install the sensor in the desired location (1 per ISA-7RM module). See Sensor Installation for details.
- 3- Do not connect sensors or alarm relay contacts at this time.





The High Alarm, Low Alarm and Sensor Fault relays on the ISA-7RM modules may be individually configured for Normally On or Normally Off. The configuration of the relays is done via a switch mounted on each ISA-7RM module.

CONFIGURATION	IN ALARM	NOT IN ALARM
Normally On	Relay de-energized Indicator On	Relay energized Indicator Off
Normally Off	Relay energized Indicator On	Relay de-energized Indicator Off



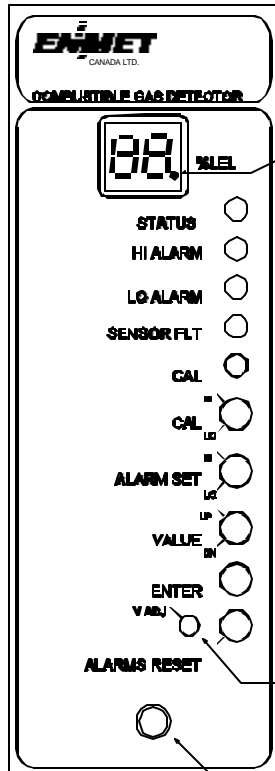
4.2 INITIAL STARTUP

Refer to the ISA-7RM Wiring Hookup drawing for this section.

- 1- Make sure power is off to the ISA-7MB rack enclosure. Install the ISA-7RM plug-in module in to the ISA-7MB rack.

Always ensure that power is Off before plugging in or removing ISA-7RM modules from the rack.

- 2- Apply 115VAC to the power connector on the ISA-7MB rack.
- 3- Connect a voltmeter (set to read DC volts) between the Detector and Compensator terminals of the corresponding ISA-7RM module connector on the rack.
- 4- Using a fine screwdriver, adjust the **V adj** miniature screw dial located at the bottom of the module front panel to 2.000VDC.
- 5- Connect the sensor wires to the terminals of the corresponding ISA-7RM module as shown in figure X.
- 6- Measure the voltage **AT THE SENSOR** and re-adjust the voltage to 2.000V if necessary.
- 7- Wait at least 5 minutes to allow the sensor to stabilize and re-adjust the voltage to 2.000V if necessary.



Decimal Point: ON when relays are disabled after powerup and calibration to minimize nuisance alarms

STATUS INDICATOR: GREEN = OK, RED = ERROR

On for alarm condition (i.e.) % LEL above alarm point
Actual relay condition depends on FAILSAFE Switch settings

FAULT CONDITION: ON if any of the three sensor wires are disconnected
Actual relay condition depends on FAILSAFE switch settings

CALIBRATION IN PROGRESS / ALARM SETTING CONFIRMATION
ON during calibration procedure. Flashes during calibration sample.
ON to acknowledge alarm setting entries

CALIBRATION SET switch. Used with the VALUE and ENTER switches to set the 2 point calibration values.

ALARM SET switch. Used with the VALUE and ENTER switches

VALUE Switch. Used to change the value of a calibration point or alarm setting

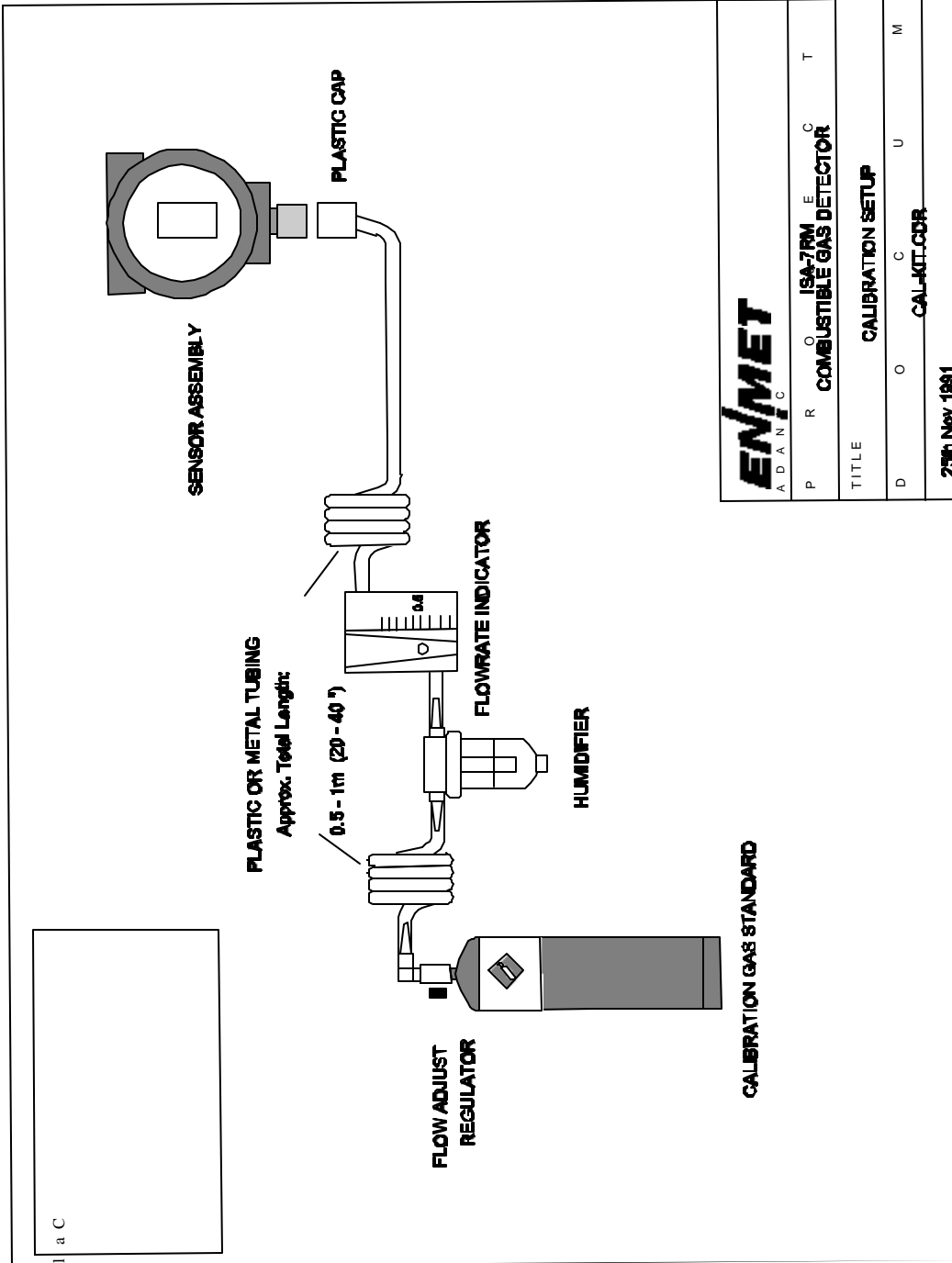
ENTER switch. Sets the selected parameter equal to the value displayed.

ALARMS RESET. Resets any of the latched alarm or sensor fault LED / relays (only if the alarm condition is no longer true).

Sensor Vref adjust for 2.000V

Captive Fastener

ENMET CANADA LTD.	
PROJECT	ISA-7RM COMBUSTIBLE GAS DETECTOR
TITLE	FRONT PANEL OVERVIEW
DOCUMENT No.	HW-LAB.CDR
25 Jan 1992	



ENMET
A D A N C

P R O D U C T
ISA-7RM COMBUSTIBLE GAS DETECTOR

TITLE
CALIBRATION SETUP

D O C U M E N T
CAL-KIT-CDR

25th Nov 1991

no i t a r b i l a c

4.3 CALIBRATION

NOTE:

If the sensor is ever exposed to inhibitors or poisons (see Sensor Installation Section 3.1), the unit should be recalibrated. On calibration, the sensor performance (sensitivity and offset) are checked and an error is indicated (status indicator shows red) if they are out of allowed tolerance.

Calibration requires the following:

Enmet Combustible Gas Detector Calibration Kit. This is available from your Enmet representative. It should contain the following:

- 1- 10% LEL Methane calibration gas
- 2- 20%LEL Methane calibration gas
- 3- regulator with humidifier bottle
- 4- hoses and sensor cap.

PROCEDURE

- 1- Half fill the humidifier bottle with tap water.
- 2- If the sensor is located in clean air (%LEL = 0) then one of the calibration points may be 0%LEL. In this case follow step 2a. If the ambient %LEL is not guaranteed to be 0%LEL then follow step 2b.
 - 2a Press and hold the CAL switch to the LO position. Depress the VALUE switch up or down to set the displayed calibration value to 00. Press the ENTER switch. The CAL indicator will blink on and off about 3 times and then remain on. The first calibration point has been entered. You now have 10 minutes to enter the 2nd. calibration point or the unit aborts calibration.
 - 2b Make sure the regulator knob set to OFF (fully clockwise). Attach the 10%LEL calibration gas cannister to the regulator. See the Calibration Kit Figure for details. Adjust the regulator knob slowly counterclockwise till the bubbles in the humidifier bottle rise just a little faster than you can count them. Wait till the reading on the display stabilizes.

Press and hold the CAL switch to the LO position. Depress the VALUE switch up or down to set the displayed calibration value to 10%LEL. Press the ENTER switch. The CAL indicator will blink on and off about 3 times and then remain on. The first calibration point has been entered. Turn off the gas by turning the regulator knob fully clockwise and detach the gas cannister.

- 3- Attach the 20% LEL calibration gas cannister to the regulator. Adjust the gas rate as in 2b. Wait till the reading on the display stabilizes.

Press and hold the CAL switch to the HI position. Depress the VALUE switch up or down to set the displayed calibration value to 20%LEL. Press the ENTER switch. The CAL indicator will blink on and on about 3 times and then remain off. The STATUS indicator should remain GREEN to indicate successful calibration. If the STATUS indicator goes to RED a calibration error has occurred check all sensor connections and retry. **If the error persists after the**

2nd calibration attempt, the sensor performance may be out of tolerance and should be changed.

Release the CAL switch from the HI position. The display should read 20%LEL. Shut off the gas and detach the 20%LEL cannister.

- 4- The display should now read 00%LEL in clean air and 10%LEL when exposed to the 10%LEL methane gas from the calibration kit cannister.

NOTES:

Calibration may be aborted any time (once started) by skipping step 3.

If the calibration procedure is aborted or is unsuccessful, **the original calibration is not affected.**

At start of calibration, the alarms are disabled to avoid nuisance alarms. This is indicated by the decimal point on the least significant display lighting up.

4.4 ALARM CHECK

- 1- Press and hold the ALARM SET switch to the HI position. Depress the VALUE switch to change the displayed setting to 15%LEL. Press the ENTER switch to enter the value.
- 2- Press and hold the ALARM SET switch to the LO position. Depress the VALUE switch to change the display setting to 5%LEL. Press the ENTER switch to enter the value.
- 3- In clean air (0%LEL) the alarm indicators should be off and the relays should be in the normal position (as set by the configuration switch).
- 4- Gas the sensor with 10%LEL. The LO alarm indicator should light and the LO alarm relay should go to the alarm position (as set by the configuration switch).
- 5- Gas the sensor with 20%LEL. The HI alarm indicator should light and the HI alarm relay should go to the alarm position (as set by the configuration switch).
- 6- Allow the sensor to stabilize in clean air till the reading is 00%LEL. The alarms should still be on.
- 7- Press the ALARM RESET switch. The HI and LO alarm indicators should go off and the relays should go to the no alarm position (as set by the configuration switch).

4.5 SETTING ALARMS

- 1- Press and hold the ALARM SET switch to the HI position. Depress the VALUE switch to change the displayed setting to the desired HI alarm point. Press the ENTER switch to enter the value.
- 2- Press and hold the ALARM SET switch to the LO position. Set the LO alarm setpoint as above.

NOTE: The CSA No. 152 specification sets the upper limit of the HI alarm at 60%LEL.

4.6 SENSOR FAULT DETECTION

- 1- Disconnect each of the three sensor wires from the terminal in turn. In each case the following should happen:
 - 1- The display should go blank.
 - 2- The Hi, Lo, and Sensor Fault indicators should light.
 - 3- The relays should go to their alarm states as set via the configuration switch.
- 2- Upon reconnection of the removed wire, the display should resume showing the %LEL value. The relay indicators and relays should remain in the alarm state.

-
- 3- Press the Alarm Reset switch. The indicators should go off and the relays should go to their non alarm states (as set by the configuration switch).

5.0 PERIODIC CALIBRATION CHECK

This procedure should be performed periodically to ensure the correct calibration of the instrument.

To reduce nuisance alarms during calibration checking, press and hold the CAL switch to the HI position and press the ENTER switch. The decimal point on the least significant display should light indicating that the alarms have been disabled for 10 minutes.

Gas the sensor with 10%LEL methane: the display should read 10% LEL +/-2%.

Gas the sensor with 20%LEL methane: the display should read 20% LEL +/-2%.

APPENDIX A

RELATIVE RESPONSE TO COMBUSTIBLE GASES

6.0 RESPONSE TO DIFFERENT GASES

An attractive feature of the VQ elements is the most universal response to L.E.L. of Hydrocarbons. Almost all the detectable gases produce a similar bridge output at L.E.L. The following table lists theoretical factors by which the signal with a calibration gas should be multiplied to give the signal for other gases.

Example:

For an instrument calibrated with pentane

$K_{\text{pentane}} = 51.3$

n-decane	0.29	methyl ethyl ketone	0.38
		methyl propyl ketone	0.37
Olefins:			
ethylene	0.65	Aldehydes:	
propene	0.54	acetaldehyde	0.56
1-butene	0.47		
ois-butene-2	0.48	Organic Acids:	
trans-butene-2	0.53	acetic acid	0.29
isobutylene	0.51	acetic anhydride	0.51
1-pentene	0.43	n-butyric acid	0.41
Diolefins:			
1,3-butadiene	0.39		
1,4-hexadiene	0.66		
Esters:			
methyl formate	0.54		
methyl acetate	0.46		
methyl propionate	0.48		
ethyl formate	0.42		
ethyl acetate	0.39		
Sulphur Compounds:			
carbonyl sulphide	0.98		
carbon disulphide	0.14		
hydrogen sulphide	0.43		
dimethyl sulphide	0.43		
methyl mercaptan	0.62		
ethyl mercaptan	0.57		
Halides:			
methyl bromide	0.95		
methyl chloride	0.77		
methylene chloride	0.97		
ethyl bromide	1.06		
ethyl chloride	0.57		
vinyl chloride	0.55		
ethylene dichloride	0.67		
n-propyl chloride	0.55		
chlorobenzene	0.34		
Oxides:			

carbon monoxide	0.80
ethylene oxide	0.43
1,2-propylene oxide	0.39