

**INSTRUCTION MANUAL
GASTECH PERSONAL FOUR-WAY ALARM
MODEL GX-86
FOR SIMULTANEOUS DETECTION OF COMBUSTIBLES, OXYGEN,
HYDROGEN SULFIDE AND CARBON MONOXIDE**

SCOPE OF APPLICATION

This instrument is designed and intended for personnel safety in entering or occupying potentially hazardous confined spaces that may contain Class I Division 1 Group C and D gases (which include all normal hydrocarbons and combustible gases except hydrogen and acetylene). The instrument is certified to be intrinsically safe against initiation of explosion when used in such environments.

Use of the instrument in Group A or B (acetylene and hydrogen) environments requires special consideration. Likewise, use of the instrument in oxygen-enriched atmospheres is beyond the normal scope of its intended application.

DO NOT ATTEMPT TO USE IN OXYGEN-ACETYLENE MIXTURES AS FOUND IN OXY-ACETYLENE WELDING AND CUTTING EQUIPMENT.

WARNING

THE MODEL GX-86 IS DESIGNED TO DETECT THE HAZARDS OF COMBUSTIBLE GAS, OXYGEN DEFICIENCY, HYDROGEN SULFIDE (H₂S), AND CARBON MONOXIDE (CO) TOXIC GAS EXPOSURE ONLY. THESE CONDITIONS CAN BE LIFE-THREATENING. BE SURE TO READ AND UNDERSTAND THE INFORMATION IN THE FOLLOWING PAGES OF THIS INSTRUCTION MANUAL.

These instructions apply to:

Model GX-86 for Combustible Gas, Oxygen, H₂S and CO.

Stock No. 72-7515

Serial No. _____

Standard alarm settings are shown on pages 7 and 12. Other alarm settings are available and may be specified at the time instrument is ordered. Alarm settings for this instrument are:

STANDARD SETTINGS OR

LEL	_____ and _____ %
O ₂	_____ and _____ %
H ₂ S	_____ and _____ ppm
CO	_____ and _____ ppm

INTRODUCTION TO GASTECH MODEL GX-86

This new microprocessor-controlled Model GX-86 is a gas detection instrument of extraordinary capabilities in a compact and convenient size for personal monitoring. The dot-matrix display gives a great deal of information, most of which is self-explanatory. However, the tabulation of the various combinations of display readings with audible and visual alarms, given on page 12, should give a quick reference for interpretation of normal and abnormal conditions.

The indications listed are additive. That is, if abnormal conditions exist at more than one sensor, the combination of indications listed will be displayed.

The Model GX-86 has low energy electrical circuits so is intrinsically safe and may be operated without danger of ignition in any Class I Division 1 Group C or D hazardous atmosphere.

Consult following instruction manual pages for more complete information.

Watch the display each time you turn the GX-86 on to be sure it goes into normal operation. Then verify detection and alarm functions by breathing out over the open end of detector housing to see that oxygen deficiency indication and alarm action occur. Recheck periodically during the working day.

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I. GENERAL DESCRIPTION

The Model GX-86 Personal Four-Way Gas Alarm is a portable, automatic microprocessor controlled instrument. It detects for combustibles, oxygen deficiency, hydrogen sulfide (H_2S) and carbon monoxide (CO). As a personal instrument it may be carried by means of a belt loop or a shoulder strap, leaving the hands free for normal work. It is fully automatic, self-adjusting and when preset levels of oxygen deficiency or presence of combustible, CO or H_2S gas are detected, it will give characteristic warnings. It can detect and indicate combustible concentrations up to the lower explosive limit, H_2S concentrations up to 100 ppm or CO concentrations up to 300 ppm, and it also analyzes for oxygen over a range of 0 to 40%.

This instrument also contains a special microprocessor program which will present at any time the average of the hydrogen sulfide (H_2S) or carbon monoxide (CO) exposure accumulated since the time the instrument was last turned on. After the ON switch is pressed and the preliminary cycle is complete, the program will collect and store the exposure to H_2S /CO. Each time an exposure occurs, it is added to all previous exposures. When the display command is given, the program will divide the stored accumulation by the elapsed time, and the display will show the time-weighted average in PPM H_2S /CO, as well as the elapsed time.

If for any reason the oxygen concentration should exceed 22%, an alarm is given to warn of potential fire hazard.

Detection is by a diffusion head mounted on the bottom of the instrument, which alternatively may be used on an optional extension cable. The head is attached to the instrument by means of a 12-pin connector. Mounted within the diffusion head are four separate and distinct plug-in detectors. The combustibles detector uses a catalytic element and a reference element as half of a Wheatstone bridge circuit; the H_2S , CO and oxygen detectors use an electrochemical cell. Instrument has sufficient battery capacity to operate for 10 hours and it includes warning statement features to notify the user of any malfunction.

Reliability and ease of adjustment are combined in the GX-86.

- * The instrument is turned on at the touch of a switch pad. However, it cannot be turned off accidentally, as a sustained pressure on the OFF pad for 5 seconds is required to turn it off.
- * Adjustments for zero combustibles, CO and H_2S are automatic but only when the appropriate combination of buttons is pressed. This precludes unintentional incorrect adjustment in a contaminated background.

II. DETAILED DESCRIPTION

A. Housing

The Model GX-86 is housed in a rigid plastic case which is durable and shock-resistant. The detectors are protected by a snap-on slotted metal enclosure on the bottom end. Opposite the diffusion head at the top is the control panel and display, canted slightly for ease of operation and visibility while in its carrying case.

Instrument is carried in a leather case which has openings to expose the control panel, the detectors, the buzzer grill and the remote buzzer and earphone jacks. The case includes a leather strap loop for carrying on a belt and the instrument includes metal rings for attaching a shoulder strap.

B. Combustible Gas Detector

The combustible gas sensitive detector is a replaceable plug-in assembly which is installed within a cylindrical metal shell with a perforated cap. Detector is retained in diffusion head by means of a bayonet-style base.

The active detector element is of the platinum catalyst type, and an electrically identical but non-catalytic reference element mounted in the same environment serves to stabilize the measurement and compensate for effects of non-combustible gases, temperature variations, etc. Elements are protected by a stainless steel sintered metal flame arrestor, which permits access of surrounding atmosphere but prevents outward propagation of flame should an explosive atmosphere be sampled. Flame arrestor also acts as a diffuser to isolate elements from flow fluctuations.

Detector assembly connects electrically to diffusion head by means of four pins at the base of the detector.

C. Carbon Monoxide and Hydrogen Sulfide Detectors

The CO and H₂S detectors are also bayonet type and are externally identical except for the label. The label will indicate the gas to which the detector is sensitive. The detectors are assembled into a cylindrical plastic case with a contact point at one end and a perforated disc at the other end to allow the surrounding atmosphere to diffuse into the active face. The CO detector has a slip-on charcoal filter covering the perforated disc, held in place with a rubber retainer, to eliminate interference from H₂S.

Gas detection occurs in an electrochemical cell consisting of two precious metal electrodes in an acid electrolyte, covered by a permeable fluorocarbon membrane. Gas in the atmosphere surrounding the perforated face of the detector diffuses through the membrane at a rate proportional to its partial pressure. The gas enters into an electrochemical reaction which produces a current directly proportional to its concentration, and this current in turn is amplified in the instrument circuitry to produce a reading in ppm and trigger alarms at preset points. To keep a stabilized sensitivity, these cells have a regulated bias voltage applied whether or not the instrument is energized.

This detector is connected electrically by means of bayonet retaining pins.

D. Oxygen Detector

The oxygen detector is a plug-in cell assembly in a metal enclosure with pins to retain the detector in a bayonet-type socket. The shell forms one electrical contact, and an insulated button at the bottom end makes the other contact. A perforated metal guard at top end allows the surrounding atmosphere to diffuse in and reach the active part of the cell.

Oxygen detection occurs in an electrochemical cell consisting of a gold and a lead electrode in an alkaline electrolyte, covered by a fluorocarbon membrane. Oxygen in the atmosphere surrounding the detector diffuses through the membrane at a rate proportional to the partial pressure of oxygen.

This oxygen enters into an electrochemical reaction which produces a current directly proportional to the oxygen concentration, and this current in turn develops a voltage across a temperature-compensating thermistor/resistor network. The voltage is applied to the detector terminals, and hence to the instrument circuitry where it produces a reading in percent oxygen, and triggers alarms at preset points.

E. Display

Indications of the instrument are shown on a dot matrix liquid crystal display on top face of instrument. Display reads combustible gas, oxygen, H_2S and CO concentrations simultaneously.

As the instrument steps through its automatic turn-on sequence, the display indicates the steps being taken and the results. At the end of the sequence a double tone sounds.

At a particular command the display will show the results of the H_2S and CO accumulation since the last turn-on.

A photodiode light sensor located at the upper left of the display controls the illumination of the display. As the available light lessens, LEDs that illuminate the display will turn on.

F. Controls and Indicators

The control panel contains the display, four alarm lights and five switches. Use of the touch-type switches allows the panel to be flat and thus without protruding light lenses or switch handles which could be inadvertently activated or damaged.

1. POWER ON/OFF switch positions have momentary pushbutton action. Pressing the ON position applies power to the instrument, sounds a single tone and starts it through its automatic preparatory sequence. When the sequence is complete, a double tone sounds and the display shows 00% LEL combustibles, 20.9% oxygen, 00 ppm H_2S and 000 ppm CO. The instrument is ready for use and no further preparatory action is required.

Instrument is provided with a time delay OFF switch. To turn instrument off, it is necessary to maintain pressure on the OFF pad for about 5 seconds continuously. This is an added safety feature to assure that the instrument is not turned off inadvertently.

2. BATT/AIR switch has a momentary action. Pressing the BATT/AIR position momentarily, then releasing, causes a single tone to sound and then the battery voltage to be displayed. The display will hold for five seconds, then return to the normal display functions.

BATT/AIR switch has a second function, of initiating automatic zero adjustment when pressed in conjunction with the PEAK/AIR switch. To initiate the AUTO ZERO/ SPAN mode, press the BATT/AIR switch for 3 seconds. Then, while still holding the BATT/AIR switch, press PEAK/AIR switch and the automatic zero and span adjustment will proceed.

NOTE

On the BATT/AIR and the PEAK/AIR switches, "AIR" is printed in red to help the user select these switches for the AUTO ZERO/SPAN function.

3. DOSE switch has a momentary action. Each time an H₂S or CO exposure occurs it is added to all previous exposures and when the DOSE command is given, the program will divide the stored accumulation by the elapsed time. When the DOSE switch is pressed until a tone is heard, it causes the accumulation program to display the elapsed time and the average H₂S and CO ppm since turn-on.
4. PEAK/AIR switch has a momentary type action. Pressing the PEAK/AIR position will cause a single tone and the highest gas concentration reading (lowest in the case of oxygen) to be displayed and retained for 5 seconds. The highest exposure encountered since the instrument was turned on will be recalled and displayed. At this time the letter P will show at the left of the display to show that the instrument is in the HOLD mode.

NOTE

BATT voltage and DOSE accumulation readings cannot be made while the instrument is in the PEAK mode. Allow the PEAK function to finish before taking either of these readings.

The PEAK/AIR switch has a second function of initiating the AUTO ZERO/SPAN adjustment, in conjunction with the BATT/AIR switch. See 2. above.

5. Alarm lights COMB, OXY, CO and H₂S are red LED's and blink with the alarm tone when their respective preset alarm points are reached. They will remain in this condition until the alarm state passes.

G. Buzzer/Earphone

A solid-state electronic buzzer is mounted inside at the front of instrument. The buzzer gives a pulsed tone on detection of gas, and a continuous tone in case of malfunction, higher level of gas, or low battery voltage. A socket located in the lower left rear corner is provided for an extension buzzer. For example, a remote buzzer may be used to warn personnel in a manhole and personnel on top simultaneously, to prepare for possible evacuation. Also an added buzzer located on the lapel may be used in areas of high noise level.

As an alternate to the lapel buzzer, an earphone may be used. Earphone socket is provided at the lower right rear corner with an attenuated buzzer output to prevent any hearing damage. Any transistor radio monaural earphone with a 2.5mm phone plug may be used.

See Parts List, Section VII, for a listing of available repeater buzzers and earphones.

H. Batteries

The Model GX-86 is powered by two C-size alkaline dry cells which will run the instrument for approximately ten hours. Rechargeable nickel-cadmium C-size cells may be used but must be removed to be recharged. They will run the instrument for approximately 7 hours. Access to the batteries is through a removable sliding door on the front of the instrument.

As an available option, a built-in charger adapter can be provided, which allows nickel-cadmium batteries to be charged in place. This conversion must be carried out at the factory.

I. Circuit Boards

All circuit components are arranged on two printed circuit boards. The main analyzer board lies along the back of the instrument and contains the connectors for the detachable diffusion head, control circuits and adjustment potentiometers which are accessible when the battery cover is removed.

The display board is canted parallel to the face and contains the light sensor, display, control switches, alarm lights and display control circuits.

All board interconnections are by plug-in connectors for convenient maintenance.

III. PLACING IN OPERATION

A. Preparation

Very little preparation is required for this instrument. It should be kept and used in its vinyl carrying case. It may be used with the detector plugged directly into its socket at bottom or used remotely with the diffusion head extension cable. The cable is attached as follows:

WARNING

EACH TIME AN EXTENDER CABLE IS ATTACHED OR REMOVED, READJUSTMENT STEPS B.1 AND B.2 MUST BE PERFORMED BEFORE THE INSTRUMENT IS PUT INTO USE. FAILURE TO DO SO WILL RESULT IN ERRONEOUS READINGS AND POSSIBLE HAZARD TO PERSONNEL.

1. Temporarily release catches of outer vinyl case to gain access to detector cover.
2. Slide the slotted cover downward and away from the instrument, releasing it by pressing on the spring retainer.
3. Move aside the two spring clips which hold the detector assembly in place.
4. Attach the mating end of the cable to the instrument and lock the spring clips in place.
5. Attach the detector assembly to the opposite end of the cable, lock the spring clips in place and slide the slotted cover over the detector assembly, being sure it snaps into place.
6. To minimize shock damage, slip the protective rubber boot over the detector assembly.
7. To remove the influence of interfering gases, the activated carbon filter disc must be in place over the CO detector. To apply the disc to the detector, place it over the end of the cell and maintain it in position by the flanged synthetic rubber sleeve which seals it onto the end of the detector.

The CO filter is an absorber disc containing activated carbon, which will remove H₂S and most hydrocarbons, thus eliminating many possible sources of interference with the CO measurement. (See paragraph L below for interference information.)

B. Operation (See also Table of Indications on page 12)

This instrument is fully automatic and requires only that it be turned on, and that normal indications are confirmed.

1. Press the ON switch. A single tone will sound and the display will indicate a series of statements in the following sequence:

- a. BATT. CK (MIN 2.3V), the minimum battery voltage which will operate the instrument.
 - b. BATT. (X.X V), actual battery voltage. (Example 2.9V.)
 - c. SELF DIAGNOSIS, microprocessor controlled analysis of readiness of instrument, indicating that preparation for adjustment is occurring.
 - d. STAND BY, a built-in pause to give microprocessor time to reset circuits.
 - e. 00, 20.9, 00, 000; a double tone will sound indicating the sequence is complete. (These readings may deviate slightly from the ideal values shown).
2. If above readings deviate substantially from ideal, the zero settings and the oxygen span setting may need adjustment. To adjust:
 - a. Take instrument to a known fresh air location.
 - b. Press BATT/AIR switch for 3 seconds.
 - c. Then, also press PEAK/AIR switch. Instrument will self-adjust to the ideal readings shown above and retain these settings until again readjusted, even after the instrument has been turned on or off repeatedly.
 3. The instrument is now ready for use. To reassure that operation is normal, breathe out over detector end of instrument. Oxygen reading should drop down to perhaps 18 and audible and visual alarms should activate.

A quick check of combustibles response can also be made with a controlled source of vapor, such as from a bottle of isopropyl (rubbing) alcohol.

C. Detection

The display will continuously indicate the gas, oxygen, H₂S and CO concentrations.

If the gas reading (LEL) rises above the first alarm setting, normally 10%, the buzzer will sound in a series of pulses with the COMB alarm light. If the reading continues to rise and goes above 50%, the alarm tone and light will become steady. Similarly, if the oxygen reading falls below its normal 19.5%, the buzzer will sound and the OXY alarm light will come on in a series of alternating pulses. In addition, when the oxygen content rises above 22%, the buzzer will sound a continuous warning (See E.4 below). If the H₂S concentration exceeds 10 ppm, or if the CO concentration exceeds 35 ppm, the buzzer will sound a series of long pulses in synchronism, with the H₂S or CO light. If reading rises to 30 ppm H₂S or 100 ppm CO, both light and tone will become steady.

D. Battery Status

Actual battery voltage is displayed automatically at turn-on, and may be compared with minimum voltage to estimate probable battery life remaining. A new set of batteries reads close to 3.0 volts, and the minimum operating voltage is 2.2 volts.

When voltage reaches 2.2, the letter "B" flashes intermittently at the left end of the display, accompanied by a pulsing audible tone. When voltage reads 2.1 then the system goes to low battery condition with buzzer sounding continuously and the display showing "LOW BATT".

When the BATT/AIR button is pressed momentarily and released, a single tone is heard and the display will indicate the battery voltage for 5 seconds. This test may be made at any time after instrument has been put into operation.

If the battery voltage is below 2.2V prior to turn on, the instrument will not start.

E. Safety Self-check

It is unlikely that during proper operation any malfunctions would occur. However, a continuous "trouble" tone is provided to warn the user of the following display indications:

1. The display shows FAIL (HC, O₂, HS or CO), if any of the detector circuits should fail "open" prior to turn-on.
2. Display shows ELEMENT TROUBLE, should either or both of the combustibles elements open up after turn-on.
3. Display shows 00 OVER 00 000, should the oxygen detector circuit fail open after turn-on.
4. Display shows a normal oxygen reading with the alarm tone sounding when reading drifts upwards to 22% or greater. This safety feature is added to warn the user of increased fire hazard, because of excess oxygen, or to indicate oxygen cell failure in the high-output mode.
5. Display shows LOW BATT when the useful life of the batteries has been exhausted. Replace with two C-size disposable alkaline dry cells, or recharge if rechargeable cells have been used.
6. Display shows FAIL H₂S or FAIL CO, should the H₂S or CO cell fail or be removed after first turn-on.

NOTE

Instruments shipped prior to November 1987, did not contain the program that immediately displayed this malfunction. They were programmed to alert the user after the next periodic "SELF DIAGNOSIS" step, done automatically every 13 minutes.

F. Emergency Operation

The Model GX-86 is capable of temporary operation on the remaining detectors, even if one or more sensor should fail. If any one or more is disconnected at the time of turn-on, then the instrument will give seven audible pulses, readjust for the remaining sensors and give an "XX" display at the position of the defective sensor or sensors. Normal operation can be continued for the remaining active sections, for 13 minutes, after which the instrument goes through a "SELF DIAGNOSIS" step and then goes into the malfunction condition. It must be turned off, and then turned on to restart for another 13 minute period.

If a malfunction occurs during operation, the defective channel goes into malfunction alarm and the instrument must be turned off, then turned back on. Then operation can be resumed for another 13 minutes, without benefit of the defective sensor, and with XX displayed as its indication.

G. Peak Hold

The peak hold feature is put into effect by pressing the PEAK/AIR switch pad. Hold it down for at least a second, and listen for a single audible pulse which confirms that the microprocessor has accepted the instruction. A letter "P" will appear at the far left of the display.

While in this mode, the display will show for 5 seconds the reading which represents the maximum deviation from normal that has been experienced during the entire operating period since first turned on; that is, the highest reading for the combustibles, H₂S and CO ranges, and the lowest for oxygen. This extreme reading will be "remembered" by the instrument until a higher reading occurs or until the instrument is turned OFF. This relieves the operator of the need to watch the display constantly for a maximum reading.

H. Filament Poisoning

Certain substances have the property of desensitizing the catalytic surface of the platinum filament. These substances are termed "catalyst poisons" and can result in reduced sensitivity or in failure to give a reading on samples containing combustible gas. The most commonly encountered catalyst poisons are the silicone vapors and samples containing such vapors, even in small proportions, should be avoided.

Occasional calibration checks on known gas samples are desirable, especially if the possibility of exposure to silicones exists.

I. Rich Mixtures

When sampling rich mixtures the following instrument action may be expected:

1. Mixtures up to 100% LEL -Reading on scale
2. Mixtures between LEL and UEL (Upper Explosive Limit) -Reading full scale or over

3. Mixtures above UEL

-As sampling continues, reading goes to full scale, then comes back down scale. Very rich mixtures will give close to a zero reading.

J. Oxygen Deficient Mixtures

Samples which do not have a sufficient proportion of oxygen may tend to read low, as there is not enough oxygen to react with all combustible gas present in the sample. As a general rule, samples containing 10% oxygen or more have enough to give a full reading on any combustible gas up to the LEL.

K. Oxygen Enriched Mixtures

Samples having more than normal proportion of oxygen will give a normal reading. However, they should be avoided because the flame arrestor used is not dense enough to arrest flames from combustible gas in oxygen, which can be more intense than those in air.

DO NOT ATTEMPT TO USE THE MODEL GX-86 ON SAMPLES OF COMBUSTIBLE GAS IN OXYGEN, FOR EXAMPLE, OXY-ACETYLENE MIXTURES.

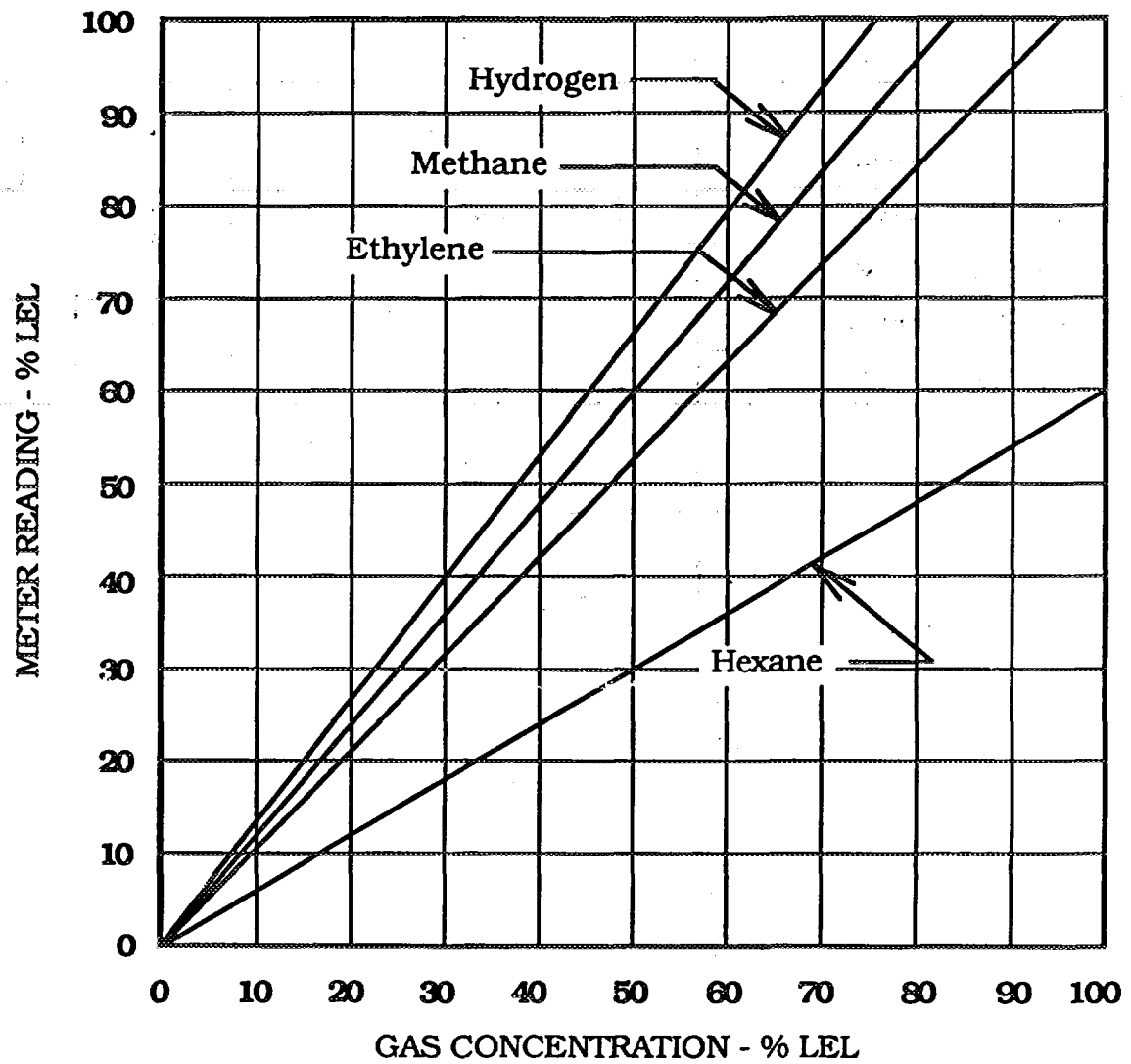
L. Interfering Gases

The CO detector responds to other gases, even with its absorber filter disc in place. The CO detector with filter will cause an instrument reading of 70 ppm CO when exposed to 250 ppm of acetylene (C_2H_2) and 100 ppm CO when exposed to 300 ppm hydrogen (H_2).

M. Relative Combustible Response

Because of the inherent characteristics in the sensors, this instrument responds to gases other than the ones to which it is calibrated. The combustibles sensor will respond in some degree to most all combustible hydrocarbon gases.

Model GX-86 instruments are normally calibrated on methane gas. The curves in the graph on the following page show the typical response of the instrument to selected other gases when calibrated on methane. Note that a 50% LEL methane concentration produces a meter reading of 60% LEL. This is done intentionally as a safety factor to partially accommodate heavier hydrocarbon vapors such as hexane (representative of gasoline, crude oil and petroleum based products). These hydrocarbons produce lower responses than methane, for a given percent LEL, because of the difference in diffusion rates.



**RELATIVE RESPONSE TO METHANE CALIBRATION FOR
MODEL GX-86 FOUR-WAY PERSONAL ALARM**

TABLE OF INDICATIONS - MODEL GX-86

CONDITION	DISPLAY	Buzzer and alarm lights not operating unless otherwise specified									
		LEL	LT	OXY	LT	H ₂ S	LT	CO	LT	BUZZER	
OFF	(Blank)										
ON (1)	6 seconds										
(2)	6 seconds										
(3)	11 seconds										
(4)	3 seconds										
(5)	continuous										
COMB. GAS 10-49	BATT. CK (MIN 2.3V)										
(2)	BATT. (2.8V)										
(3)	SELF DIAGNOSIS										
(4)	STAND BY										
(5)	00 21.0 00 000										
COMB. GAS 50-99	10+ 21.0 00 000										
(2)	50+ 21.0 00 000										
COMB. GAS 100+	OV 21.0 00 000										
OXY 0-19.5	00 19.5- 00 000										
OXY 22-40	00 22.0+ 00 000										
OXY 41+	00 OVER 00 000										
H ₂ S 10-29	00 21.0 10+ 000										
H ₂ S 30-99	00 21.0 30+ 000										
H ₂ S 100+	00 21.0 MAX000										
CO 35-99	00 21.0 00 35+										
CO 100-300	00 21.0 00 100+										
CO 300+	00 21.0 00 MAX										
LEL DETECTOR FAIL (Before turn-on)	FAIL HC *										
(After turn-on)	ELEMENT TROUBLE										
OXY DETECTOR FAIL (Before turn-on)	FAIL O ₂ *										
(After turn-on)	OVER										
H ₂ S DETECTOR FAIL (Before turn-on)	FAIL HS *										
(After turn-on)	FAIL HS **										
CO DETECTOR FAIL (Before turn-on)	FAIL CO *										
(After turn-on)	FAIL CO **										
LOW BATTERY (2.1V-2.3V)	B 00 21.0 00 000 (B Flashing)										
DEAD BATTERY (BELOW 2.1V)	LOW BATT.										

* This reading is transitory, will change to XX and allow 13 minutes of operation on remaining sensors before going to malfunction mode.

** See III.E.6., Safety Self-Check

IV. ADJUSTMENT AND CALIBRATION

NOTE

To maintain safe and accurate measurements, the GX-86 must be calibrated periodically. It is recommended that a regular schedule of calibration (once a month, for example) be maintained to keep the GX-86 in proper working condition.

Since this instrument is microprocessor controlled, many of the adjustments, such as the alarm thresholds, are automatic or are factory set. There are only four internal adjustments to be made.

The four internal adjustments are the COMB SPAN, the O₂ ZERO, the H₂S SPAN and the CO SPAN. A fifth adjustment, COMB 1.5V is factory set and need not be changed. These are on the main analyzer circuit board next to the battery holder and are available when the battery cover is removed. Carry out the following steps to make these adjustments:

NOTE

1. *Any intermittent audible alarms sounded during this adjustment time may be ignored.*
2. *Instrument responds slowly to adjustment changes. Make a small adjustment and wait 15 seconds for the effect to show. Clockwise rotation tends to increase reading.*

A. LEL Span

1. Turn instrument on and allow it to warm up and stabilize, preferably for 5 minutes.
2. Open battery compartment by sliding cover outward. Locate COMB SPAN potentiometer on circuit board. (Left hand control of the four accessible ones, as viewed from exposed end of battery compartment.)
3. Expose combustibles detector to a known calibrating gas sample. If sample is under pressure (e.g., the GasTech Calibration Kit) the mixture should be allowed to flow directly over the combustibles detector (the one on the far left).

CAUTION

The combustibles measurement is flow sensitive. Always use a low flow rate, barely audible when escaping from the calibration cylinder. If a flowmeter is available, set to 0.8 SCFH (0.4 l/m).

4. Watch combustible display carefully. If reading does not correspond to desired value, adjust it by turning SPAN potentiometer.
5. Recheck zero, and repeat above steps until correct reading is obtained.

6. If reading cannot be set high enough, replace combustibles detector. (See Section V. MAINTENANCE, paragraph F. Detector Removal/Replacement.)

B. Oxygen Zero

1. While battery compartment is still open, identify O₂ ZERO potentiometer (the one next in line to the COMB SPAN).
2. Expose oxygen detector to a known oxygen-free sample such as nitrogen, argon or helium.
3. Watch display carefully. If reading does not go exactly to zero, adjust it by turning ZERO potentiometer.
4. If zero adjustment cannot be made, have oxygen cell reactivated.
- *5. If instrument cannot bring reading to 20.9% O₂ during the first cycle after turn-on, replace cell or have it reactivated.

C. H₂S/CO SPAN

Adjustments to H₂S and CO circuits are similar and are presented here together.

1. With the case open identify the H₂S or CO SPAN potentiometer (right hand pair).
2. Expose H₂S or CO detector to a known calibrating gas sample as in A.3. above.

NOTE

The CO filter disc can be left in place for this adjustment if the 81-1112 calibration cup is used.

3. Watch H₂S or CO display carefully. If reading does not correspond to desired value, adjust it by turning H₂S/CO SPAN potentiometer.
- *4. If reading cannot be set high enough, replace detector.

* See Section V. MAINTENANCE, paragraph F. Detector Removal/Replacement.

V. MAINTENANCE

A. Batteries

1. Check battery voltage periodically by pressing BATT/AIR button. Replace before voltage reaches minimum allowable as shown during initial cycle. (See Section III.B.)
2. To replace cells, remove battery compartment cover by sliding off to the side. Cells are held by springs and may be forced out with the fingers. Verify that the battery compartment is clean. Snap in new alkaline C-size cells or recharged Ni-Cd cells, noting polarity, and replace compartment cover.

NOTE

Ordinary carbon-zinc cells can be used, but will give very short life, approximately 3 to 4 hours. Their use is not recommended because if left in the instrument while in a discharged state, leakage can cause severe damage.

When replacing batteries, be sure that contact surfaces are clean. Any failure to make contact, even momentarily, will result in turning the instrument off.

3. The batteries are constantly supplying a small current to maintain the toxic gas cells in a state of readiness, even when the instrument is turned off. Thus a certain rate of self-discharge is normal. In the usual application of the GX-86, with operation at least once every two weeks, this self-discharge will not be noticed. However, if the instrument is left idle for several weeks at a time, it will probably be necessary to replace batteries before use.

B. Combustibles Detector

1. Detector assembly may require replacement if:
 - a. Instrument cannot be calibrated on a known gas within range of the LEL SPAN potentiometer.
 - b. LEL display will not read 00% when initial cycle is completed.
2. A complete replacement plug-in detector may be ordered from the factory. An exchange allowance is made on returned detectors.

C. Oxygen Detector

1. Oxygen detector assembly may require repair if:
 - a. Zero reading cannot be obtained on an oxygen-free gas within range of the OXYGEN ZERO potentiometer.
 - b. Oxygen display will not read 21.0% when initial cycle is completed.
 - c. Oxygen reading tends to drift with change in instrument position.

D. H₂S or CO Detector

1. H₂S or CO detector may require replacement if:
 - a. Instrument cannot be calibrated on known gas sample, using the respective SPAN potentiometer.
 - b. Display will not read "00" for H₂S or "000" for CO when initial cycle is completed.

NOTE

Do not expect H₂S or CO cell to give correct readings immediately after a new cell has been plugged into instrument or dead batteries have been replaced. Wait an hour before attempting to use it, and up to 12 hours for final stabilization.

The cell requires conditioning by operation at a low voltage (bias voltage) which is supplied by the circuit continuously whether the instrument is on or off. Removal of the cell or disconnecting the battery for a few minutes, as when installing the extender cable or replacing batteries does not necessitate this restabilization time.

E. Detector Repair

If any of the plug-in detector assemblies requires repair, it should be sent to factory for rebuilding or reactivation. A replacement sensor can be ordered, on an exchange basis.

Cells for O₂, H₂S and CO are electrochemical devices which will gradually deteriorate, regardless of usage of the cell. They require periodic factory reactivation, consisting of replacement of the electrolyte or total rebuilding which is done at the factory at a flat rate on an exchange basis.

New or reactivated cells are guaranteed usable for one year, or other schedule to be stipulated by GasTech at the time of sale, and any CO or H₂S cell returned for reactivation within that time period will be inspected and tested for operability. If found to have failed prematurely, it will be reactivated at a pro-rated cost. Oxygen cells returned within the year they will be replaced at no charge. Cells are date-coded.

Cells and sensors which are sent to GasTech and are found to be functional will be returned for continued use at a nominal handling charge.

F. Detector Removal/Replacement

All detectors are of the bayonet base type and are easily removed and replaced. To change detector:

NOTE

These detectors are not interchangeable. Each detector must be placed in its own socket. Combustibles detector has four pins which must be properly aligned before it can be installed in its socket.

1. Slide the slotted diffusion head cover down and away from the instrument to expose detector.
2. Release spring clips and unplug detector head assembly.
3. To remove individual detectors, press inward on detector and rotate counter-clockwise to release bayonet pins. Pull detector from socket.
4. Install in reverse order, being sure the detector is locked in place.

WARNING

AFTER ANY DETECTOR OR CELL IS REPLACED, THE INSTRUMENT MUST BE RUN THROUGH ITS AUTO ZERO/SPAN CYCLE IN A CLEAN-AIR GAS-FREE ATMOSPHERE. (REFERENCE II.F.2. AND III.B.2.) REMEMBER THAT A CO OR H₂S DETECTOR REQUIRES A STABILIZATION PERIOD TO OPERATE ACCURATELY. (REFERENCE V.D.)

G. CO Filter

The CO filter is a disc, containing activated carbon, which should be replaced when the CO readings become suspect. Refer to paragraph III.A.7. for installation information.

VI. OPTIONAL ACCESSORIES

A. Extender Cable

Extender cables of various lengths are available, which permit dropping or placing the detector assembly at a point remote from the instrument, for example to check the atmosphere within a tank or a manhole prior to entry. The instrument end of the cable has contact pins which match the pin arrangement of the block and it clamps to lower end of the GX-86, in place of the detector block. At the far end of the cable is a socket which mates with the pins of the detector.

Cable lengths of 5 and 10 meters are available as standard; other special lengths up to 50' can be supplied. Remember that instrument must be readjusted before use, when any cable is added or removed. (See Sections III.A, B, and C.)

B. Sample-Drawing Accessory

The Model GX-86 is designed primarily as a diffusion-sampling instrument, and operation in the diffusion mode, with the detector head immersed in the space to be tested (extender cable), is recommended whenever practical. However, in some applications, such as testing through small openings in tanks or manhole covers, the sample-drawing mode is more advantageous.

For this application a sample-drawing accessory is available. It consists of a hose and probe for insertion into the space to be tested, an aspirator bulb to provide suction for drawing the sample, and a molded rigid plastic cup which covers the sensors when the instrument is left in its leather case. The bulb, hose and probe connect to a nipple at the bottom of the cup. To use:

1. Slide the plastic cup over the bottom of the instrument in its leather case, covering the exposed edges of the case.
2. Attach the bulb, hose and probe then turn instrument on allowing it to complete its turn-on cycle.
3. Sample drawing accessory is now ready for use. Verification of operation can be made by exhaling breath into the probe inlet while squeezing bulb. Oxygen reading should fall below 19.5% and oxygen alarm should come on. Be sure to purge accessory with fresh air before continuing further.
4. Squeeze bulb continuously while searching with probe tip.
5. Instrument will respond normally as the probe is slowly moved about. Locations where undesirable concentrations are reached should be noted and appropriate action should be taken.
6. After noting a location where an alarm state exists place probe tip in a gas free location and squeeze the bulb 20 to 30 times to clear the accessory. Continue searching as in 4. and 5., if needed.

WARNING

WITH THE SAMPLE-DRAWING ADAPTER IN PLACE AND NO SQUEEZE BULB ACTION, THE INSTRUMENT WILL NOT MONITOR FOR AMBIENT HAZARDS. IF ATMOSPHERE IS SUSPECT, REMOVE ADAPTER AND USE AS A DIFFUSION INSTRUMENT.

C. Confined Space Entry Kit

A complete kit including the Model GX-86, a 5 meter extender cable and a sample-drawing accessory, is available in a rugged waterproof padded carrying case. Components may be purchased as individual items or as a complete kit.

D. Lapel Buzzer

A repeater buzzer is offered, which provides a louder sound and may be placed closer to the ear for use in noisy environments. It plugs into the socket at lower edge of GX-86, and has a spring clip for convenient attachment to shirt pocket or lapel.

A two-ear repeater is available in conjunction with an earmuff-type hearing protector. This serves the function of ear protection and assures that alarms will be heard even in high-noise areas.

E. Earphones

A small single earphone is available, which plugs into the "Earphone" jack on bottom of instrument (opposite the "Buzzer" jack). This can be worn in one ear and produces an audible tone similar in sound to the internal buzzer. This will be effective in moderately noisy areas.

F. Nickel-Cadmium Batteries

For frequent use, rechargeable batteries offer economy over disposable cells, and fit into the battery holder in the same way that the disposable ones do. A plug-in charger capable of overnight recharging of two size D nickel-cadmium cells is offered as an accessory. It operates from any 115 volt AC receptacle.

To order, specify nickel-cadmium batteries and charger separately. (See Section VII. PARTS LIST.)

G. Calibration Kit

The calibration kit contains three cylinders including one for H₂S. The H₂S cylinder is a special type designed to maintain the marked concentration of H₂S for at least 6 months. It has its own regulator which releases the H₂S mixture (about 25 ppm) at a controlled rate. The other cylinders are standard steel disposable type with a dispensing valve. One cylinder contains 2.5% methane (about 55% LEL) for calibrating the combustibles sensor. The other cylinder contains 200 ppm CO in nitrogen, and can be used to calibrate the CO section or check oxygen zero.

All cylinders and valves are packed in a padded carrying case. Individual cylinders can be replaced. (See Section VII. PARTS LIST.)

VII. PARTS LIST

<u>Stock No.</u>	<u>Description</u>
13-0190	Carrying strap, replacement
20-0302	Vinyl case, instrument
20-0606	Carrying case, padded, instrument and accessories
21-1081	Battery cover
21-1082	Detector cover
33-7101	CO filter
33-7104	Flanged synthetic rubber adapter, CO filter
47-1631	Detector Extension Cable, 5m.
47-1635	Detector Extension Cable, 10m.
49-1211	Battery: Size C, alkaline (2 required)
49-1503	Battery, Size C, nickel-cadmium (optional, 2 required)
49-2006	Charger, external, for Ni-Cad batteries, 115V AC
52-2031	Buzzer, repeater, lapel type
52-2052	Alarm repeater, ear-muff type
52-7515	Alarm repeater, single ear
61-0220E	Combustibles Detector, exchange
61-0220	Combustibles Detector, replacement
61-0255	Detector Block, Plug-In
65-1051	Oxygen cell, replacement
65-1051E	Oxygen cell, exchange
65-2003	Carbon monoxide cell, replacement
65-2003E	Carbon monoxide cell, exchange
65-2033	Hydrogen Sulfide cell, replacement
65-2033E	Hydrogen Sulfide cell, exchange
71-0046	Instruction Manual, Model GX-86 H ₂ S/CO
81-0012	Calibration cylinder, 2.5% methane
81-0069	Calibration cylinder, 200 ppm CO in N ₂
81-0151	Calibration cylinder, 25 ppm H ₂ S
81-0312C	Calibration Kit, H ₂ S plus 2.5% methane plus 200 PPM CO
81-1112	Calibration cup
81-1159	Sample-drawing adapter kit

SERVICE POLICY

GasTech Inc. maintains an instrument service facility at the factory. Some GasTech distributors also have repair facilities; however, GasTech assumes no liability for service performed by other than GasTech personnel. Should your instrument require non-warranty repair, you may contact the distributor from which it was purchased, or you may contact GasTech directly.

If GasTech is to do the repair work for you, you may send the instrument, prepaid to GasTech Inc. 8445 Central Avenue, Newark, CA 94560, Attn: Service Department. Always include your address, purchase order number, shipping and billing information and a description of the defect as you perceive it. If you wish to set a limit to the authorized repair cost, state a "not to exceed" figure. If you must have a price quotation before you can authorize the repair cost, so state, but understand that this involves extra cost and extra handling delay. GasTech's policy is to perform all needed repairs to restore the instrument to full operating condition, including reactivation of all out-of-warranty electrochemical cells.

To expedite the repairs operation, it is preferable to call in advance to GasTech Instrument Service, (415) 794-7015, obtain a Return Authorization Number (RA#), describe the nature of the problem and provide a purchase order number.

If this is the first time you are dealing directly with the factory, you will be asked to provide credit references or prepay, or authorize COD shipment.

Pack the instrument and all its accessories (preferably in its original packing). Enclose your Purchase Order, shipping and billing information, RA#, and any special instructions.

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STANDARD WARRANTY

GAS DETECTION INSTRUMENTS

We warrant gas alarm equipment manufactured and sold by us to be free from defects in materials, workmanship and performance for a period of one year from date of shipment from Gas Tech Inc. Any parts found defective within that period will be repaired or replaced, at our option, free of charge, f.o.b. factory. This warranty does not apply to those items which by their nature are subject to deterioration or consumption in normal service, and which must be cleaned, repaired or replaced on a routine basis. Such items may include:

- a) Lamp bulbs and fuses
- b) Pump diaphragms and valves
- c) Absorbent cartridges
- d) Filter elements
- e) Batteries
- f) Most catalytic and electrochemical sensors are covered by a separate warranty of 12 or 24 months.

Warranty is voided by abuse including rough handling, mechanical damage, and alteration or repair procedures not in accordance with instruction manual. This warranty indicates the full extent of our liability, and we are not responsible for removal or replacement costs, local repair costs, transportation costs, or contingent expenses incurred without our prior approval.

Gas Tech Inc.'s obligation under this warranty shall be limited to repairing or replacing, and returning any product which Gas Tech Inc. Material Review Board examination shall disclose to its satisfaction to have been defective. To receive warranty consideration, all products must be returned to Gas Tech Inc. at its manufacturing facilities with transportation charges prepaid.

This warranty is expressly in lieu of any and all other warranties and representations, expressed or implied, and all other obligations or liabilities on the part of Gas Tech Inc. including but not limited to, the warranty of fitness for a particular purpose. In no event shall Gas Tech Inc. be liable for direct, incidental or consequential loss or damage of any kind connected with the use of its products or failure of its product to function or operate properly.

This warranty covers instruments and parts sold (to users) only by authorized distributors, dealers and representatives as appointed by Gas Tech Inc.

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