INSTRUCTION MANUAL
MODEL GX-94

PORTABLE FOUR GAS MONITOR

RIKEN FINE
RIKEN KEIKI CO., LTD.
2-7-6 Azusawa Itabashi-ku Tokyo, 174, Jpan

Phone : Tokyo (03) 3966-1113
Fax : (03) 3558- 9110 GIII
Telex : 272 2638 RKNFNE
Cable : RIKENFINE TOKYO

Table of Contents

INTRODUCTION

The RKI Model GX-94 is an advanced gas detection instrument, in use internationally for personal protection in a wide variety of industries. The GX-94 is compact, convenient, and offers a full range of features, including:

- Simultaneous detection of combustible gas (% LEL,) oxygen deficiency (O_2), carbon monoxide (CO), and hydrogen sulfide (H_2S)
- Dot-matrix liquid crystal display (LCD) for complete, understandable information at a glance
- Distinctive audible alarms for dangerous conditions and malfunctions
- Intrinsic safety for Class I, Division I, Groups A, B, C, and D hazardous atmospheres
- Microprocessor control for reliability, ease of use, and advanced capabilities, including data logging and user-adjustable alarms
- Convenient size

WARNING

The GX-94 is designed to detect combustible gas, oxygen deficiency, hydrogen sulfide, and carbon monoxide, which can be lethal. Users must follow the instructions and warnings in this manual to assure proper and safe operation of the instrument.

DESCRIPTION

The RKI Model GX-94 is an advanced portable instrument for simultaneous detection of combustible gas (LEL), oxygen deficiency (O_2), carbon monoxide (CO), and hydrogen sulfide (H_2S). See Table 1 for detection ranges for these gases. Gas detection features include distinctive alarms for dangerous gas concentrations, time-weighted averaging and short term exposure limit for toxic gases, and logging of detection data.

The GX-94 is compact enough to be carried by belt clip, leaving the user's hands free. It has a rugged plastic housing, touch-pad control panel, and a back-lit dot matrix LCD.

The GX-94 is easy to adjust and maintain, with user-replaceable batteries and sensors. The microprocessor control enables the user to display a comprehensive listing of gas levels detected and other related data.

Table 1 -Range of Gases Detected

Gas Detected	Range
Combustible	0 - 100% LEL (lower explosive limit)
O_2	0 - 40%
H_2S	0 - 100 ppm (parts per million)
CO	0 - 300 ppm

COMPONENTS AND CONTROLS

Case

The GX-94 has a plastic case with a rubber guard for shock-resistance. The sensors are housed at the top rear of the instrument, under a detachable screen. The touch-pad control panel and dot matrix display are located on the front. The case includes shoulder strap loops and tethered covers for the battery compartment and interface port.

Control Panel

The control panel is at the front of the instrument for easy access when the GX-94 is carried. It contains the display, alarm light, and switches that control the many functions of the GX-94. The switches are touch-pads, to reduce the possibility of accidental activation or damage.

Switches

1. ON/OFF/INPUT

   The ON/OFF/INPUT switch controls power to the instrument. (Bias power for the electrochemical sensors is not affected by the power switch.) It also selects input modes to access user-changeable features.

2. AIR/▲

   The AIR/▲ switch activates the GX-94's demand zero function, which automatically adjusts the instrument in fresh-air conditions. It is also used to scroll through the display and settings modes.

3. DISPLAY/(ADJ)

   The DISPLAY/(ADJ) switch is used to activate the display modes, and to enter instructions into the GX-94's microprocessor.

4. (SHIFT)/▼

   The (SHIFT)/▼ switch is used to scroll through the display and settings modes, and to enter instructions into the GX-94's microprocessor.

5. Alarm Light
   A red light-emitting diode (LED) provides visual alarms for gas concentrations and malfunctions.

Battery Compartment

The GX-94 battery compartment is located on the back of the instrument. It has a tethered access panel for easy replacement of the batteries.

The GX-94 uses two "C" size cells; alkaline batteries will run the GX-94 for approximately 10 hours, rechargeable nickel-cadmium batteries will run for approximately 7 hours. (Rechargeable batteries must be removed from the GX-94 and charged separately.)

Interface Port

The GX-94's built-in data logger records gas concentrations at programmed intervals. These measurements can be downloaded through the interface port to a PC-compatible computer for use in data analysis programs.

Buzzer

A solid-state electronic buzzer is mounted inside the back of the case, behind a felt screen. The buzzer sounds for gas alarms, malfunction, low battery voltage, and during use of the many display options on the GX-94.

Belt Clip and Strap Loops

The GX-94 can be worn on the belt using the case-mounted clip. An included shoulder strap can also be attached to the loops at the sides of the instrument case.

Sensors

The sensors are mounted on the of the instrument near the rear. A detachable metal screen protects the sensors, but allows atmosphere to diffuse inward.

Combustible Gas Sensor

The combustible gas (LEL) sensor is contained in a metal cylindrical shell, with a pin-mounted base for easy replacement. The flame arrestor on the top of the shell allows atmosphere to diffuse into the sensor.

The LEL sensor detects combustible gas and vapors in the atmosphere with a catalytic platinum element. The reaction of gas with oxygen on the catalyst causes a change in the resistance of the element, which is converted by the GX-94 into a reading of gas concentration.

The sensor responds to a wide range of gases; see Appendix A for the Relative Response Chart.

Oxygen Sensor

The oxygen (O_2) sensor is contained in a cylindrical shell, with a pin-mounted base for easy replacement. The opening at the top of the shell allows atmosphere to diffuse into the sensor.

The O_2 sensor is an electrochemical cell, which reacts to the oxygen in the atmosphere, producing a current proportional to the oxygen concentration. This current is converted by the GX-94 into an oxygen reading.

CO, and H_2S (Toxics) Sensors

The toxics sensors are physically identical, except for their external labels and openings. The toxics sensor is housed in a cylindrical plastic shell, with a pin-mounted base for easy replacement. The perforation at the top of the shell allows atmosphere to diffuse into the sensor. The CO sensor has a larger opening than the H_2S sensor. It also uses a charcoal filter disk that covers opening, to eliminate interference from H_2S. The filter is mounted between the sensor cap and the diffusion screen.

The toxics sensors are electrochemical cells, which react to gas in the atmosphere, producing a current proportional to the concentration of gas. The current is converted by the GX-94 into a measurement of gas concentration. To maintain sensitivity and stability, these sensors are exposed to a continuous bias current, even when the instrument power is off.

Circuit Boards

The GX-94 circuit boards analyze, record, control, store, and display the information collected. These circuit boards contain no user-serviceable components.

OPERATION

Preparation

Normally the GX-94 requires little preparation before use. To install the available sample drawing attachments, see the ACCESSORIES section.

Standard Start-up

1. Press the ON/OFF/INPUT switch once.

   a. This message shows the minimum usable and actual battery voltage (for example, 2.9V).

   ```
   BATTERY
   MIN. 2.3V
   BATTERY
   NOW X.XV
   ```

   b. This message shows to verify that the data logger circuits are set properly for accurate data collection according to time and conditions.

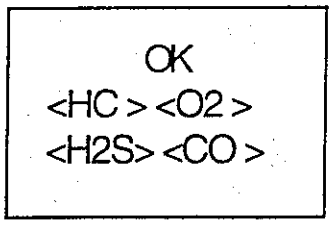
   ```
   MON D YY
    HR:MN
   TEMP. XX°C
        XX°F
   ```

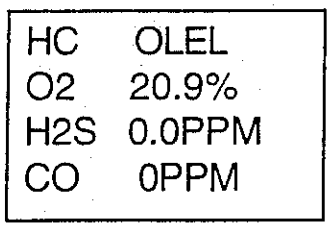
   c. These messages show while the GX-94 checks itself for proper operation. If a malfunction occurs, the display will alert the user. (The display shows "HC" [hydrocarbons] for the %LEL reading.)

   ```
   SELF
   DIAGNOSIS
   10 SECONDS
   TO GO
   ```

   ```
   STANDBY
   <HC> <O2>
   <H2S> <CO>
   ```

d. The normal operating display shows after the "OK" message, showing fresh-air concentrations for all gases. The GX-94 sounds a double tone to indicate the instrument is in normal operation.





2. Verify Operation

To easily verify correct operation of the GX-94, breathe out over the diffusion grill of the instrument until the oxygen reading drops below the low alarm level. The audible alarm for oxygen deficiency will sound, the ALARM LED will blink, and "O2" will flash on the display.

To verify detection of combustibles use a controlled source of flammable vapor, for example a bottle of isopropyl alcohol. The audible alarm will sound, the ALARM LED will blink, and "HC" will flash on the display.

Caution

Do not use gas from a cigarette lighter to test response to combustibles. Exposing the sensor to uncontrolled high concentrations of gas in this manner will reduce response and sensor life.

WARNING

If the GX-94 does not respond to these verifications, take it to a known "fresh-air" environment, then follow the demand zero procedure described in Adjustment and Calibration. Repeat the Verify Operation procedure before using the GX-94 in a potentially hazardous location.

Normal Operation

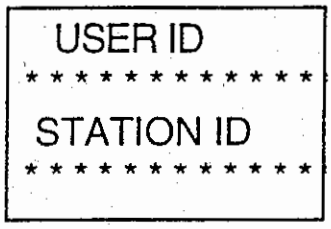
The GX-94 will continuously monitor the atmosphere, and display the LEL, O_2, and toxic gas concentrations present. If the GX-94 is taken into a low-light environment, the display backlight will automatically turn on. To use with sample-drawing attachments, insert the probe into the area to be monitored and wait a few seconds for response.

DISPLAY FUNCTIONS

While the GX-94 is in normal operation, press the DISPLAY/(ADJ.) switch to step through the measurement functions. The display will hold for 20 seconds before reverting to normal detection, or until DISPLAY/(ADJ.) is pressed to go to the next screen.

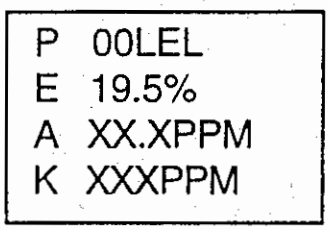
1. User and Station ID

   This function appears only when the user ID option is activated. Use this screen to verify user, location, or other programmed information.



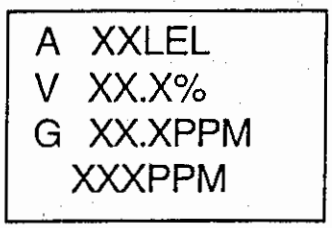
2. Peak

   The Peak function shows the highest (lowest for O_2) concentrations detected since the GX-94 was turned on. Peak readings stay in the instrument's memory until a higher level is detected, or the unit is turned off.



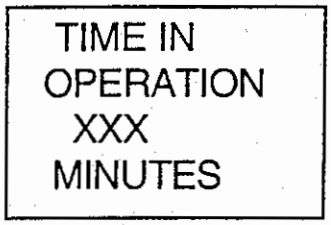
3. Average

The Average function shows the average gas concentrations detected since the last time the GX-94 was turned on.



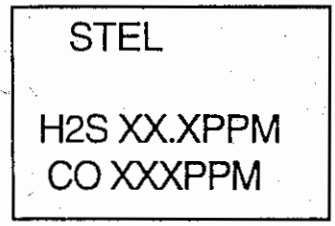
4. Elapsed Time

The Elapsed Time function shows the time in minutes since the memory was cleared (STEL/TWA CLEARED at Start-up or DATA LOGGER CLEARED). This allows the user to easily track total time over multiple monitoring sessions.



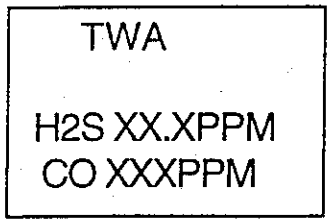
5. Short-Term Exposure Limit (STEL)

The STEL function shows the average reading for toxic gases during the last 15 minutes.



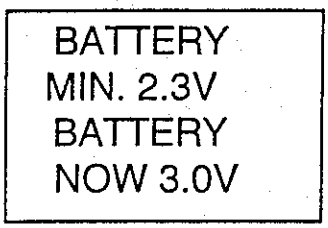
6. Time-Weighted Average (TWA)

The TWA function shows the average reading for toxic gases during the last 8 hours. If 8 hours has not elapsed since the last time the STEL/TWA was cleared, the average is still calculated over 8 hours, with the missing time assigned a 0 value for readings.



7. Battery Voltage

The Battery Voltage function shows the minimum operating voltage and present battery voltage.

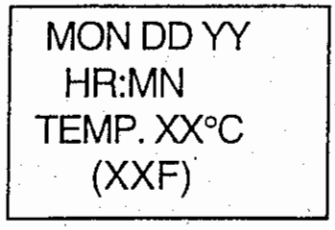


Note

The GX-94 automatically checks battery voltage during start-up; if the measurement is below 2.3V, the GX-94 will not operate.

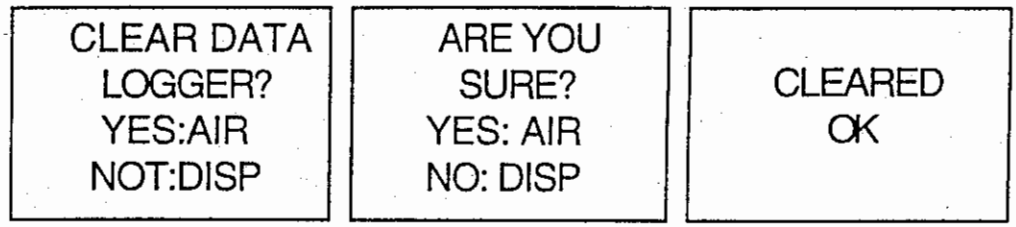
8. Time/Date/Temperature

This function shows the current time, date, and ambient temperature, for example:



9. Clear Data Logger

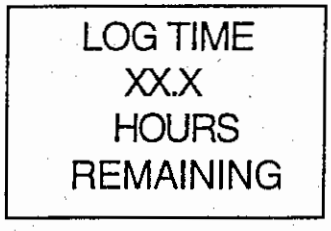
The Clear Data Logger function allows the user to reset the data logger storage to accept a new set of data. This function shows three displays. Press AIR/▲ to continue through this function, or DISPLAY/(ADJ.) to skip to the next function.



The Remaining Log Time has now been reset, and the collected data has been erased.

10. Remaining Log Time (Data Logger option only)

    The Remaining Log Time function shows the time left on the data collection program. The duration depends upon the frequency of sampling. Press DISPLAY/(ADJ.) once more to return to the normal operating display.



ALARMS

Alarm Indications

1. Combustibles (%LEL)

   If the combustible gas detected exceeds the low alarm setting (20% LEL for most applications), a pulsed tone will sound, the ALARM LED will blink, and the display will flash "HC."

   If the combustible gas detected rises above the high alarm setting (50% LEL for most applications), the alarm tone and LED will be continuous.

2. Oxygen

   If the oxygen content of the air drops below the low alarm setting (usually 19.5%), a pulsed tone will sound, the alarm LED will blink, and the display will flash "O2."

   If the oxygen content of the air rises above the high alarm setting (usually 22.5%), the alarm tone and LED will be continuous.

3. H_2S

   If the H_2S detected exceeds the alarm setting (usually 10 ppm), a pulsed tone will sound, the ALARM LED will blink, and the display will flash "H2S."

4. CO

   If the CO detected the alarm setting (usually 25 ppm), a pulsed tone will sound, the ALARM LED will blink, and the display will flash "CO."

5. STEL (Toxics only)

   If the average toxic gas level detected over the last 15 minutes exceeds the STEL, an alarm will sound and the message "STL" will show on the display in the field for that gas.

6. TWA (Toxics only)

   If the average toxic gas level detected over the last 8 hours exceeds the TWA, an alarm will sound and the message "TWA" will show on the display in the field for that gas.

7. CLG (CO only)

   If CO detected exceeds the ceiling level (usually 200 ppm), the alarm tone and LED will be continuous, and the display will alternate between "CLG" and "CO" in the field for that gas.

8. If the maximum reading is exceeded for any channel, the alarm tone and LED will be continuous. The display will show "MAX" in the field for that gas.

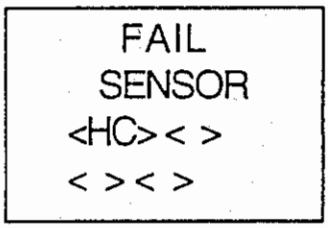
Resetting Alarms

The GX-94 can be set for latching or self-resetting logic. Latching alarms will not reset until the gas concentration falls the alarm point. When the condition is corrected, press SHIFT/▼ to reset the alarm. Self-resetting alarms will automatically shut off when the concentration falls below the alarm point.

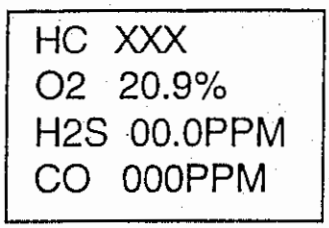
Malfunction Alarm and Emergency Operation

The GX-94 continuously monitors itself for proper operation. If a malfunction occurs, a single steady "trouble" tone will sound, and one of the following messages will show on the display:

1. If any sensor fails during operation, the display will show the failed sensor in parentheses (in this example, combustibles sensor):

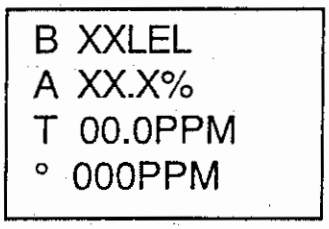


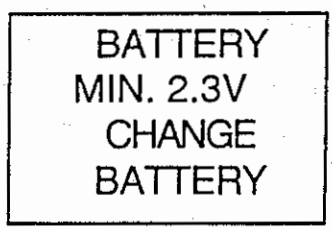
To continue using the GX-94, turn it off, then follow the appropriate start-up sequence. The display will indicate the failed sensor as "XX or XXX":



Low Battery Alarm

When the battery charge drops near the lower limit, the display will show the first screen below. When the charge drops to the limit, the second screen will show, and the GX-94 cannot be used to monitor gas concentrations:





CALIBRATION AND MAINTENANCE

The GX-94's microprocessor circuits require only a few user adjustments—combustibles span, oxygen zero, H_2S span, and CO span. The remaining adjustments are made using the Demand Zero function.

Note

Calibrate the GX-94 when a gas reading drifts below zero, when a sensor has been replaced, and periodically to assure proper sensor response. The frequency of calibration depends on the amount of use and type of use the instrument receives, but a typical frequency would be once per month.

Calibration Supplies and Equipment

To calibrate the GX-94, you will need the following supplies and equipment:

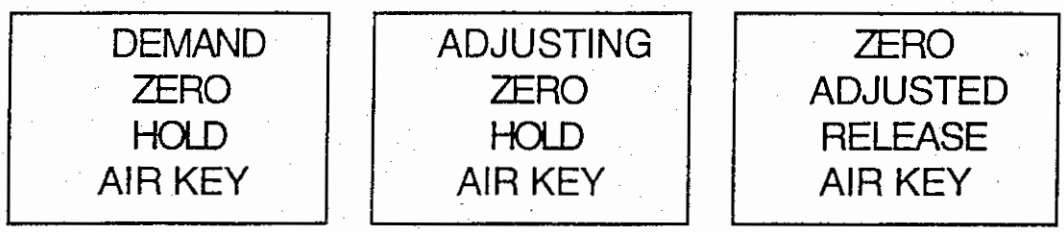
- Known calibrating samples of combustible and the appropriate toxic gases. The samples should have concentrations in approximately the middle of the range of detection.
- An oxygen-free source, such as pure nitrogen or CO in a nitrogen balance (non necessary if using an RKI 4 gas mix cylinder)
- A flowmeter with a range of 0 - 1.0 SCFH (not necessary if using a regulator instead of a valve)
- A control valve or pressure regulator, non-absorbent tubing, and Calibration adapter plate

For convenient one-source AUTO Calibration, the RKI Four Gas Cylinder can be used to adjust all sensors at the same time. Instructions for the Four Gas Cylinder and Auto Calibration are given below, followed by the optional procedure using individual cylinders for each gas.

Preparation

1. Take the GX-94 to a non-hazardous location with fresh-air conditions.
2. Turn on the instrument and allow 1 minute to warm up.
3. Demand Zero

   Press and hold the AIR/▲ switch on the control panel until a tone sounds. Follow the instructions on the display:



   The instrument will automatically set the LEL and toxics circuits to zero and the O_2 circuit to 20.9%.

4. Screw the adapter plate to the threaded hole in the metal diffusion screen that protects the sensors.
5. Assemble the calibration cylinder, valve or regulator, flowmeter (only necessary if using a valve instead of a regulator) and adapter plate.

Enter Calibration Mode

Press and hold the (SHIFT)/[?] switch, then press the DISPLAY/(ADJ.) switch. The display will show:

```
1. AUTO CAL

2. SET SPAN
    <HC>
```

Press the AIR/▲ and (SHIFT)/▼ switches to scroll up and down through the calibration menu. The flashing number indicates the active selection. Press ON/OFF/INPUT to start calibration for that selection.

Calibration With the RKI Four Gas Cylinder

A special cylinder of gases is available from RKI Instruments that contains the following mixture:

50% LEL methane (CH_4)

12% O_2

25 ppm H_2S

50 ppm CO

The RKI Four Gas Cylinder is ideal for verifying or calibrating all four gas detection ranges using the "Auto Calibration" feature. The ranges can be set all at once, automatically.

1. Once in the calibration mode, with the number next to the AUTO CAL blinking, press the ON/OFF/INPUT button to start the auto cal sequence.
2. Display now will read

AUTO CAL.
YES : AIR NO : DISP.

Press the AIR button to accept the auto cal mode. If auto cal mode is not desired, then press DISPLAY button to return to normal screen.

3. Setting calibration values

   The calibration values display shows the settings in the instrument memory for Auto Calibration. These values must agree with the gas concentrations written on the 4-gas cylinder. If they do, press input button now to proceed to the calibration step. If they do not, change them now. To change, pressthe SHIFT and DISPLAY/ADJ. buttons. Then use the UP arrow (AIR key) and DOWN arrow (SHIFT key) to adjust the display reading to match with the gas cylinder concentration for LEL (normally 50% LEL) When finished, press ON/OFF/INPUT to accept this value. Then repeat this procedure Oxygen, H2S and CO, pressing the INPUT button when finished.

4. Prepare the Four Gas Cylinder, connections, and the GX-94 as described in Preparation.

5. Open the cylinder regulator to allow gas to flow into the sensors.

6. Allow adequate time for full response (1 - 2 minutes, or until the readings stabilize).

7. Once stabilized, press the ON/OFF/ENTER button to adjust the calibration. The GX-94 then automatically adjust the calibration of all gas ranges to match the cylinder values.

8. **If any sensor is unable to calibrate to the proper value, the display will indicate FAIL for that sensor. Replace the defective sensor and then recalibrate.**

Calibration Procedure Using Individual Gas Cylinders

Note

Allow adequate time for the GX-94 to respond to changes in adjustment. Adjust the controls in small increments, then wait approximately 3 seconds for a change in reading. Ignore alarms during the calibration procedure.

Enter Calibration Mode

Press and hold the (SHIFT)/▼ switch, then press the DISPLAY/(ADJ.) switch. The display will show:

```
2. SET SPAN
  <HC>
3. SET ZERO
  <O2>
```

Press the AIR/▲ and (SHIFT)/▼ switches to scroll up and down through the calibration menu. The flashing number indicates the active selection. Press ON/OFF/INPUT to start calibration for that selection.

Combustibles Span

1. Select SET SPAN <HC>. The display will show:

```
HC CAL
0 LEL
APPLY GAS/
ADJ/INPUT
```

2. With a combustible gas calibration cylinder attached, place the adapter cup over the combustibles sensor. Adjust the flow rate to

0.8 SCFH (0.4 *l/m*). Allow time for the reading to stabilize. The display should show the LEL concentration marked on the calibration cylinder.

Note

The combustible gas sensor is a general hydrocarbon sensor that responds to most flammable vapors and gases; the response will vary depending upon the substance. For best results, calibrate the instrument to the gas or vapor intended to be detected. See Appendix A for Relative Response Curves for common gases and vapors.

3. If the reading does not correspond to the sample, press the AIR/▲ switch to increase the reading, or the (SHIFT)/▼ switch to decrease the reading. A series of tones will sound when each switch is pressed.

4. When the reading is correct, press the ON/OFF/INPUT switch. The display will automatically return to the selection menu.

5. Turn off the combustible gas sample and disconnect the cylinder.

Oxygen Zero

1. From the calibration menu, select SET O2 ZERO. The display will show:

O2 ZERO 20.9% APPLY GAS/ ADJ/INPUT

2. Connect a 100% N_2 or other oxygen-free cylinder to the control valve.
3. Open the control valve and set the flow to 1.0 SCFH.
4. The reading should fall to near zero. Adjust to 00.0 using the AIR/▲ and (SHIFT)/▼ switches.
5. Press ON/OFF/INPUT to lock the reading and complete the oxygen zero sequence.
6. Turn off the zero oxygen cylinder and disconnect it from the valve.

H_2S and CO Span

1. Select SET SPAN <H2S> or SET SPAN <CO >.
2. Connect the appropriate calibration cylinder to the regulator.
3. Repeat the adjustment procedure as described in Combustibles Span.

Note

The GX-94 will display up to 99 ppm H_2S, but the limit of linear response is 60 ppm, well above acceptable exposure levels. Do not rely upon the GX-94 for readings exceeding these limits.

The GX-94 will display up to 499 ppm CO, but the limit of linear response is 150 ppm, well above acceptable exposure levels. Do not rely upon the GX-94 for readings exceeding these limits.

MAINTENANCE

Batteries

1. Check the battery voltage periodically by pressing the DISPLAY switch to reach the Battery Voltage function. Replace the batteries before the voltage drops to the operational limit (see Operation-Alarms).

WARNING

TAKE THE GX-94 TO A NON-HAZARDOUS LOCATION BEFORE REPLACING THE BATTERIES.

2. To replace the batteries, unscrew the battery compartment cover. Remove the batteries and verify that the battery compartment and electrical contacts are clean. Insert fresh batteries (alkaline or fully-charged NiCd) according to the polarity (+/-) markings and replace the cover.

3. Bias Current Discharge

   The batteries continuously supply a small current to maintain the

toxics sensors, even when the instrument is off (see Sensor Maintenance). This current drain is minimal, but will result in a normal discharge of the batteries over a period of several weeks.

Note

If the batteries are fully discharged before replacement, allow 1/2 hour for the toxics circuits to show a normal response.

Sensor Maintenance

Electrochemical sensors (O_2, H_2S, CO) gradually deteriorate, regardless of use, and require periodic replacement. Combustibles sensor life is generally related to usage, but certain environmental factors may affect duration.

The GX-94 sensors are easy to replace, but only the combustibles sensor contains user-serviceable components. If a sensor requires replacement, call RKI or your local distributor. All sensors are warranted usable for one year from the date of shipment. Sensors that fail within the warranty period will be replaced at no charge.

Combustibles Sensor

Replace the combustibles sensor or filaments when:

1. The combustibles circuit cannot be calibrated correctly.
2. The HC (%LEL) display does not show 00 immediately after the start-up sequence, and it cannot be set to zero by the Demand Zero command.

O_2 Sensor

Replace the O_2 sensor when:

1. The O_2 circuit cannot be set to 00.0% on an oxygen-free sample.
2. The OXY (O_2) display does not show 20.9% immediately after the start-up sequence and after the Demand Zero command.
3. The O_2 reading tends to drift with instrument orientation.

Toxics Sensors

Replace the sensor when:

1. The detection circuit cannot be calibrated correctly.
2. The display does not show 00 immediately after the start-up sequence and cannot be set to zero by the Demand Zero command.

Note

Allow up to 1/2 hour after the toxics sensors have been replaced to show a normal response, then calibrate.

CO Filter

CO sensors are equipped with an activated carbon filter disk that removes H_2S and most hydrocarbons to limit interference with the CO measurement.

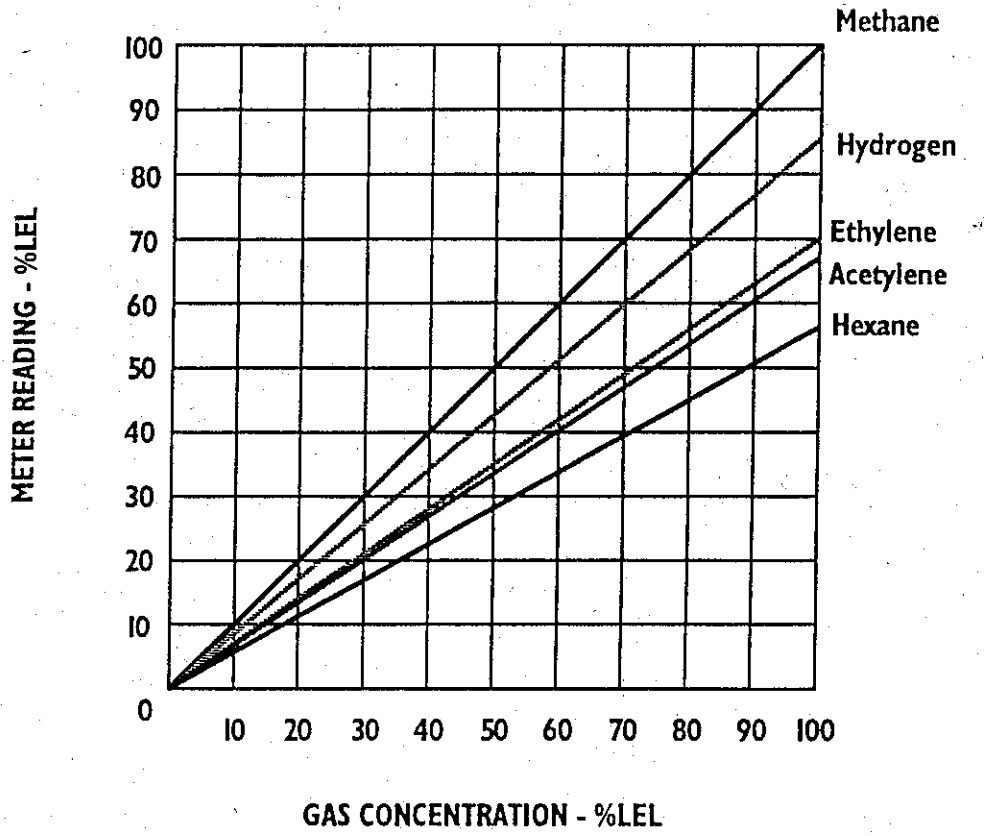
To install the filter remove the diffusion screen and old filter. Place the new filter in the filter slot. Replace the filter when CO readings become suspect (e.g., CO circuit calibrates properly, but shows response in a known CO-free environment), or when replacing sensor, whichever comes first.

Sensor Replacement

1. Take the GX-94 to a non-hazardous location and turn the power off.
2. Remove the four (4) Phillips screws from the bottom of the instrument. (Two in the belt clip and two next to the label.)
3. Pull the instrument case apart where the rubber cushion covers the seam. This opens the entire case.
4. To replace individual sensors, gently unplug from the circuit board by pulling straight up.

5. Carefully insert a new sensor. Be sure to sure to place the sensor in the correct position; sensors are not interchangeable between positions.
6. Reinstall the cover, belt clip, and screws.
7. Turn on the instrument and verify the display is normal.
8. Calibrate the detection circuit to work correctly with the new sensor (see Calibration).

APPENDIX A - RKI MODEL GX-94 RELATIVE RESPONSE CHART



SETTINGS MODE

This printing of the instruction manual is preliminary and does not include a detailed description of the Settings mode. A brief description follows.

A variety of operating parameters may be adjusted by entering the Settings mode, including the alarm points, lunch break mode, alarm latching, and the buzzer tone. To enter the Settings mode, with the instrument power off press the AIR/▲ and SHIFT/▼ keys simultaneously and while holding them down press the ON/OFF/INPUT key. You may now scroll through the Settings menu by using the AIR/▲ and SHIFT/▼ keys. The number of the current item in the menu will flash. To choose an item for adjustment, press the ON/OFF/INPUT key. To exit the Settings mode and begin normal operation, scroll through to item 14, START, and press ON/OFF/INPUT. The startup sequence will begin. If further information is needed, please contact the factory.