INSTRUCTION MANUAL
RKI INSTRUMENTS, INC.

MODELS: OX-94, CO-94, HS-94
PORTABLE SINGLE GAS MONITORS

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INTRODUCTION

The RKI Models OX-94, CO-94, and HS-94 (the 94 series) are compact portable gas detection instruments. They are designed to protect the worker from dangerous gas levels, and are also intended to be used as survey tools to determine gas levels in a workspace or other confined space. These instruments offer a full range of features, including:

- Continuous detection of one of three hazards.
  Oxygen Deficiency (OX-94)
  Carbon Monoxide levels (CO-94)
  Hydrogen Sulfide levels (HS-94)

- Large LCD readout with backlighting for dark areas and with easy to understand symbols for Battery Condition, Peak Hold, STEL, and TWA.

- Loud audible alarm, directed upward for easier hearing.

- Intrinsically Safe design for Class I, Division 1, Groups A,B,C, and D hazardous atmospheres.

- Microprocessor control for reliability, ease of use, and advanced capabilities.

- Small, lightweight design for user comfort.

WARNING

These instruments are designed to detect potentially life threatening gas levels. Users must follow the instructions and warnings of this manual to assure proper and safe operation of the instrument.

DESCRIPTION

The RKI Models OX-94, CO-94, and HS-94 are advanced portable instruments for detection of either Oxygen Deficiency levels, Carbon Monoxide levels, or Hydrogen Sulfide levels. Each instrument version is capable of detecting one type of gas. See Table 1 for the detection ranges. Gas detection features include audible alarm and blinking display for dangerous gas concentrations, time weighted averaging for exposure to toxic gases (CO or H2S), a Peak Hold function for toxic gases, and minimum hold function for Oxygen detection.

The 94 series instruments are very compact to easily fit in a shirt pocket or on a belt. It also comes equipped with a lanyard which can be used to hang the instrument from the users shoulder or to wear around ones neck. The 94 series also comes equipped with a vinyl carrying case for added protection and durability.

The 94 series is housed in a rugged water resistant plastic housing, and has a touch pad control panel with two pushbuttons from which all functions can be accessed.

These instruments are easy to adjust and maintain, with user replaceable batteries and diffusion sensors.

INSTRUMENT TYPE	**GAS DETECTED**	**RANGE**
OX-94	Oxygen	0-40% volume
CO-94	Carbon Monoxide	0-500 ppm
HS-94	Hydrogen Sulfide	0-199.0 ppm

COMPONENTS AND CONTROLS

CASE

The 94 Series has a rigid plastic case that is durable and shock resistant. The sensor is housed within the case, and faces upward. The display and touch pad control panel are located on the side of the unit. The carrying case covers the entire unit, except it has a hole for the sensor to protrude through and is also shaped so that it does not muffle the audible buzzer sound. The plastic case has a substantial spring loaded clip for easy, secure attachment to ones shirt pocket or belt.

SENSOR

The sensor is mounted within the plastic case on the top of the instrument. A water resistant disc covers the sensor area, and is held in place with a rubber cap. This cap and disc should be left in place for maximum water resistance. The sensor is inside the instrument and is removable if the instrument is opened. The sensor plugs into sockets on the PCB, for quick periodic replacement. The sensor principles of operation are as follows:

Oxygen Sensor

The oxygen sensor is an electrochemical cell, consisting of gold and lead electrodes in an alkaline electrolyte. A fluorocarbon membrane covers the cell, and allows atmosphere to diffuse into the electrolyte at a rate proportional to the partial pressure of oxygen. The oxygen reacts in the cell, producing a current proportional to the concentration of oxygen. The current develops a voltage across a temperature-compensating thermistor/resistor network. The voltage is measured by the circuitry of the GX-82 and converted to a measurement of gas concentration.

CO & H_2S Sensors

The CO and H_2S sensors are electrochemical cells, consisting of three precious metal electrodes in an acid electrolyte. A gas permeable membrane covers the cell, and allows gas in the atmosphere to diffuse into the electrolyte at a rate proportional to its partial pressure. The gas reacts in the cell, producing a current proportional to the concentration of gas. The current is amplified by the circuitry of the 94 series instrument and converted to a measurement of gas concentration.

CONTROL PANEL

The control panel is on the side of the instrument for easy access when the display is viewed. It contains the display and switches that control the many functions of the instrument. The switches are touch-pads, to reduce the possibility of accidental activation or damage.

- POWER / MODE Button

  The POWER / MODE switch controls power to the instrument, and is also used for selecting the mode of operation of the unit.

- AIR Button

  The AIR switch is used for adjusting the unit in fresh air, and is also used in conjunction with the POWER / MODE switch for accessing various other functions which will be explained later in this manual.

BATTERY COMPARTMENT

The 94 series battery compartment is located on the rear of the instrument. The sliding access panel allows for easy replacement of the batteries. A large screw on the side of the unit holds the battery compartment cover in place. The screw can be removed with a screwdriver, fingernail, or coin.

The 94 series uses two “AAA” size cells standard alkaline batteries which will run the unit for approximately 100 hours.

CIRCUIT BOARDS

The GX-82 has two circuit boards; the main board, and the sensor/buzzer board. The main board contains the electronics and the display. The sensor/buzzer board contains only the sensor and buzzer, and connects to the main board with a ribbon cable.

OPERATION

1. Start Up

A. Press and hold the POWER switch for two seconds. The buzzer will sound a single tone, and the display will activate all of its digits and symbols.

B. After about 3 more seconds, the display will show a picture of a battery, and the current battery voltage. A fully charged battery set will display 3 small blocks in the battery symbol, and a low battery will display only one or two small blocks. A dead battery will display no small blocks within the battery symbol.For best results, replace the batteries when only one small block shows.

C. After another 3 seconds, the display will show the current gas concentration in the surrounding atmosphere, in either ppm (H2S or CO), or in % volume (Oxygen). The instrument will sound a double tone to indicate that it is now warmed up and ready for operation.

2. Verify Operation

To easily verify operation of the OX-94, breathe out over the diffusion sensor on the top of the instrument. The oxygen reading should drop to about 18%, the audible alarm for Oxygen deficiency should sound, and the display reading should blink. Press the POWER / MODE button to reset the alarm.

To verify operation of a toxic sensor on the HS-94 or CO-94, it is necessary to expose the detector to a concentration of the gas to be detected (H2S or CO). Test gas kits are available from RKI Instruments, Inc.

WARNING

If the Instrument does not respond to these verifications, take it to a known "fresh-air" environment, then follow the zero and calibration procedures in this manual. Repeat the Verify Operation procedure before using the Instrument in a potentially hazardous location.

3. Normal Operation

The 94 Series Instrument will continuously monitor the atmosphere, display the O_2, H_2S, or CO concentrations present, and sound alarm if a dangerous level is encountered.

A. Backlight

The instrument has a display backlight to enable reading in dark areas. The display backlight can be turned on by pressing the Mode button once, and it will automatically turn off after 20 seconds. The backlight also automatically comes on anytime any alarm condition occurs, except for low battery alarm.

B. Checking battery voltage

The battery voltage is displayed when the instrument is first turned on, as described in section 1. B. above. A single tone will sound and the battery voltage will show on the display. New alkaline batteries will register approximately 3.0V. The minimum voltage required for operation is 2.1V. As the batteries get used up, the small blocks within the larger battery outline on the display disappear as follows:

2.3 volts or higher	All three small blocks are present.
2.2 volts	Two small blocks are present, indicating 10 to 20 hours of battery life left.
2.1 volts	Only one small block present, indicating less than 10 hours of operation left. It is recommended that the batteries be changed when they reach this stage.
2.0 volts or lower	No small blocks are present. The large battery outline will blink off and on, and the instrument will sound a constant tone alarm indicating that the battery is dead. The battery voltage is now too low to properly operate the instrument and the batteries must be replaced before the instrument can be used.

Note

The 94 series automatically checks battery voltage during start-up; if the measurement is below 2.1V, the instrument will not operate. During normal operation, when the battery voltage drops to 2.0V, the battery sign will blink on the display, a continuous alarm tone will sound, and the display will show a blinking battery.

WARNING

The instrument does not monitor the atmosphere during a dead battery alarm. When the low battery indicator flashes on the display, take the instrument to a non-hazardous location to change the batteries. (See Maintenance-Batteries.)

C. Peak (Minimum) Hold Function.

Press the Mode switch twice to enter this mode. During use,the instrument automatically latches onto the maximum gas reading for the toxic gases (and onto the lowest reading for the Oxygen version). This reading is displayed on the readout, and can be reset once the actual gas condition has cleared by pressing the MODE switch once. The PEAK HOLD function will activate itself for any alarm condition, and can be reset once the gas condition is below the alarm level (or above the alarm level for the Oxygen version). To clear the peak (or minimum) readings, press the mode switch once after the gas condition has cleared.

D. Toxic Gas (H_2S and CO) Exposure.

Press the MODE switch three times to display the **TWA** value (time weighted average dose for the last 8 hours of operation of the instrument).

Press the MODE switch four times to display the **STEL** value (time weighted average dose for the last 20 minutes of operation of the instrument).

The instrument will return to normal operation itself after 20 seconds of displaying these modes. To bypass the 20 second delay, press the MODE switch to return to normal operation immediately.

4. Auto Zero/Span

To automatically adjust the zero point for H_2S or CO, (or the span to 20.9% for oxygen), take the instrument to a known fresh-air environment. With instrument in normal operation, press and hold the AIR button. The unit will beep three times, and then give a double beep indicating that it has adjusted to the surrounding atmosphere.

5. Alarms

Gas Level Alarms

The 94 Series instruments have standard alarm points as listed below:

OX-94	**19.5% decreasing, 23.5% increasing**
CO-94	**25 ppm increasing, 25 ppm TWA, 400 PPM STEL**
HS-94	**10 ppm increasing, 10 ppm TWA, 15 ppm STEL**

When an alarm point is exceeded, the instrument sounds a pulsed tone, and the display reading will blink. In the case of TWA or STEL alarms, the display will also indicate which alarm level has been exceeded. The instrument reading will automatically latch onto the highest reading (or lowest reading for low oxygen levels). To reset, press the MODE switch once. If the gas concentration has dropped to below the alarm point, the alarm will silence, and the unit will give the current reading. If the unit has not dropped to below the alarm point when the MODE switch is pressed, then the audible alarm will still sound and the unit will latch onto the new reading present at the time the MODE switch was pressed.

Safety Self-Check

The 94 Series instruments continuously monitor themselves for proper operation. If a malfunction occurs, a steady “trouble” tone will sound. There are two modes of malfunction that will sound a steady

“TROUBLE” alarm. These are:

LOW BATTERY — This alarm will sound if the batteries are too low to operate the instrument. Replace the batteries before further use.

SENSOR FAIL	This alarm will sound if the sensor is missing or has an internal open connection. This type of alarm is indicated by the steady audible tone, and with a large "X" appearing on the display upper left. To resolve, verify that there is a sensor in the instrument, or, replace the sensor if necessary.

CALIBRATION AND MAINTENANCE

The 94 series microprocessor circuit allow the instrument to be calibrated and zeroed completely with the external buttons. There are no internal user adjustments.

Note

Adjust the instrument Zero (or oxygen span at 20.9 %) if a gas reading drifts off zero (or 20.9 %) or when a sensor has been replaced. All calibration and Zero adjustments should be done in a known clean air environment.

Calibration Supplies and Equipment

To adjust the 94 series monitors, you will need the appropriate calibration gases and supplies.These are readily available from RKI in an RKI Calibration Kit. The kits contain calibration gas, valve, test cup, tubing, and any other accessories necessary. Although other concentrations could be used, the recommended calibration gas concentrations are as follows:

HS-94	25 ppm H2S in nitrogen or in air.
CO-94	50 ppm CO in nitrogen or in air.
OX-94	100 % nitrogen.

Entering Calibration Mode:

To access calibration mode on the 94 series instruments, the unit must be initially turned on a special way. Turn the instrument OFF and turn back on as follows:

1. Press and hold the AIR button.

2. While continuing to hold the AIR Button, press also the MODE button until instrument beeps.
3. After the beep, release the MODE button but continue to hold the AIR button for a few seconds until the display completes warmup and reads the gas concentration. Just to the left of the gas reading there will be a small arrow pointing downward. This indicates that the instrument is ready to set the zero reading.

Zeroing the instrument:

4. Apply the zero gas. For the H2S or CO units, the Zero gas can be the surrounding ambient air if it is known to be gas free. For the Oxygen version, expose the sensor to a known oxygen free sample such as 100% nitrogen. Flow the gas onto the sensor using a test cup covering the sensor area on the top of the unit, and allow sufficient time for the reading to stabilize, typically 30 to 60 seconds. If you wish to skip the zero adjustment, press the MODE switch and continue to step 7.
5. Once full reading is reached, press the AIR button for about 5 seconds. The unit will beep 3 times initially, and then two more times to indicate that it has completed the adjustment.

Calibrating the instrument:

6. Press the MODE switch one time. The small arrow on the display to the left of the gas reading will change to pointing upward, indicating that the instrument is now in the “span set” mode.
7. For H2S or CO units, go to step 8. For Oxygen units, take the instrument to fresh air, press and hold the AIR button until the unit has beeped 5 times. The last 2 quick beeps indicate that the unit has completed the calibration adjustment. Now press the mode switch once to return to normal operation.
8. For H2S and CO units, after step 6 above, the display will read a value that the instrument believes is the concentration of the calibration gas that will be applied. If the value displayed matches the value of the calibration gas that you will apply, then go to step 9. If it does not match, then press the AIR button to scroll the reading to the correct value of your calibration gas. Note that the readout will only scroll up, but will return to Zero and start over after it reaches

30 or 60 (for H2S) or 150 (for CO). Once you have scrolled to the value of your calibration gas, go to step 9.

9. Press the MODE switch, and the instrument should read the gas levels in the surrounding air. Now apply the span gas to the instrument using an appropriate test cup to fit over the sensor area. Allow sufficient time for full response (30 to 60 seconds).
10. Press the AIR switch and hold for 5 beeps. The last 2 quick beeps indicate that the unit has adjusted the span to the level that it was set to believe was in the cylinder from step 8 above.
11. Turn off the gas supply, and press the mode switch once to return to normal operation. Calibration is complete.

Note

The 94 series instruments will display up to 199.0 ppm H_2S and 499 ppm CO, but the limit of linear response is 30 ppm for H_2S and 150 ppm for CO; well above acceptable exposure levels. Readings above these levels could be inaccurate and should only be referenced for trends.

Battery Replacement

To replace the batteries, loosen the screw on the side of the instrument with a screwdriver, fingernail, a coin or other appropriate device. Slide and remove the battery cover from the instrument. Remove the batteries and verify that the battery compartment and electrical contacts are clean. If necessary, use a soft wire brush to gently clean the compartment and contacts. Insert fresh batteries (2 "AAA" sized alkalines) according to the polarity (+/-) markings, and replace the cover.

Sensor Maintenance

Electrochemical sensors (O_2, H_2S, CO) gradually deteriorate, regardless of use, and require periodic replacement.

The 94 Series sensors are easy to replace. If a sensor requires replacement, call RKI or your local distributor to obtain a replacement sensor. 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.

- **O_2 Sensor**

  Replace the O_2 sensor when:

  1. The O_2 circuit cannot be set to 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 Auto Zero command (AIR adjust).
  3. The O_2 reading tends to drift with instrument position.

- **H_2S and CO Sensors**

  Replace the sensor when:

  1. The detection circuit cannot be calibrated correctly.
  2. The display does not show “0” immediately after the start-up sequence and cannot be set to zero by performing an Air adjust.

Sensor Replacement

1. Take the instrument to a non-hazardous location and turn the power off.
2. Remove the instrument from the carrying case.
3. Remove the screw from the top of the instrument and remove the blue plastic cover case section over the sensor area.
4. Unplug the sensor from the PCB sockets, and install the new sensor.
5. Re-install the blue plastic sensor cover, and screw it in place.
6. Turn on the instrument and verify the display is normal.
7. Calibrate the detection circuit to work correctly with the new sensor (see Calibration).

For issues not covered in this manual, or for any questions or problems, please contact RKI Instruments, Inc., at 800-RKI-5165.

PRODUCT WARRANTY

1/1/2002

RKI Instruments, Inc. warranties gas alarm equipment sold by us to be free from defects in materials, workmanship, and performance for a period of one year* from the date of shipment from RKI Instruments, Inc. Any parts found defective within that period will be repaired or replaced, at our option, free of charge. Parts must be returned to RKI Instruments, Inc. for repair or replacement. 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. Examples of such items are:

a) Pump diaphragms and valves
b) Fuses
c) Batteries
d) Filter elements

Warranty is voided by abuse including mechanical damage, alteration, rough handling, or repair procedures not in accordance with instruction manual. This warranty indicates the full extend 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.

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 RKI INSTRUMENTS, INC. INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL RKI INSTRUMENTS, INC. BE LIABLE FOR INDIRECT, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE OF ANY KIND CONNECTED WITH THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

This warranty covers instruments and parts sold to users only by authorized distributors, dealers and representatives as appointed by RKI Instruments, Inc.

We do not assume indemnification for any accident or damage caused by the operation of this gas monitor and our warranty is limited to the replacement of parts or our complete goods. Warranty covers parts and labor performed at RKI Instruments, Inc. only, and does not cover field labor or shipment of parts back to RKI.

* The Models GX-2001 and GasWatch 2 carry a two year warranty. The two year warranty applies to the instrument including original sensors. Replacement parts and sensors have a standard one year warranty.