

# **INSTRUCTION MANUAL**

## **Model NP-204 PORTABLE METHANE GAS DETECTOR**

The accompanying instrument is sold and serviced in the USA by RKI Instruments, Inc. Please contact RKI Instruments for any follow up service needs, including questions, warranty issues, repairs, and spare parts and sensors. Thank you for selecting this fine instrument for your use. With proper care and maintenance, it will provide you with many.

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## INTRODUCTION

The Model NP-204 is a proven gas detection instrument, in use internationally for detection of natural gas levels over the full range of concentrations. The NP-204 is compact, easy to use, and offers the following features:

- Battery operated, the NP-204 can use either alkaline or Ni-Cad cells. Batteries are easily field replaceable.
- The NP-204 detects natural gas over two ranges : 0-5% volume (or optionally 0-100% LEL), and 0-100% volume.
- Gas levels displayed on an easy to read analog meter.
- Two sensor types are utilized: Platinum catalytic combustion sensors for low levels, and thermal conductivity sensors for high level detection.
- Sample drawing by use of an aspirator bulb provides quick, positive sampling. A probe and hose allow sampling from hard to reach locations.
- Ease of operation. Controls easily accessible for user operation and adjustment.
- Vinyl carrying case with shoulder strap provided.
- Extremely rugged construction assures that the instrument will provide years of troublefree operation.

### WARNING

**The NP-204 is designed to detect combustible gas levels which could be life threatening. Users must follow the instructions and warnings in this manual to assure proper and safe operation of the instrument. Read and understand instruction manual before use.**

## DESCRIPTION

The RKI Model NP-204 is a rugged battery operated portable instrument for detection of combustible gas (methane) levels over a wide range. The two ranges, 0-5% by volume and 0-100% by volume, are displayed on a built in analog meter. The NP-204 utilizes a rubber aspirator bulb for drawing of a test sample through a hose and probe. Typical uses are to test for gas levels in wells or pipelines at landfills, natural gas handling plants, or other natural gas delivery systems.

The NP-204 is rugged and compact, and is supplied with a padded vinyl carrying case with shoulder strap for easy transporting. The NP-204 is easy to adjust and maintain, with user-replaceable batteries and sensors.

## COMPONENTS AND CONTROLS

### Case

The NP-204 has a cast aluminum housing that is durable and shock-resistant. The sensors are housed inside the instrument in a sample chamber. The "lift to turn" protected controls are located on the top face of the unit, along with the analog meter readout. The carrying case has openings for connection of the sample inlet tube and aspirator type sample bulb, and the top flap of the case folds back during use to provide access to the controls and meter. The case includes shoulder strap loops and a strap.

### Sensors

The sensors are mounted inside the instrument to a flow chamber that sample flow passes through when the aspirator bulb is squeezed.

Combustible Gas Sensor (0-5% range, or 0-100% LEL range).

The combustible gas (LEL) sensor consists of a filament set and wires. The filaments are inserted and attached to the internal flow chamber. The flow chamber brings the sample gas to the filaments when the aspirator bulb is squeezed. The chamber contains a flame arrestor to prevent ignition of sampled flammable gases or vapors from exiting the instrument to the surrounding atmosphere or to the sample line.

#### *Combustible Gas Sensor - Principle of Operation*

The LEL sensor is a platinum-coated resistive element, with a sealed, electrically identical reference element, to compensate for temperature variations and other environmental factors. The active elements are housed in a sintered stainless steel flame arrestor that permits the atmosphere to diffuse inward, but prevents flame from passing outward when an explosive atmosphere is encountered. The two elements form half of a balanced Wheatstone Bridge. When voltage is applied to the elements, combustible gas in the atmosphere catalyzes on the platinum coating, raising the temperature and changing the resistance of the element, causing an imbalance in the Wheatstone Bridge. The imbalance is measured by the circuitry of the NP-204 and converted to a measurement of gas concentration.

## 100% Volume Gas Sensor

The Volume Percent Gas sensor also consists of a filament set and wires. The filaments are similar to the LEL sensors in that they are inserted and attached to the internal, flame arrestor protected flow chamber. The flow chamber brings the sample gas to the filaments when the aspirator bulb is squeezed.

### *100% Volume gas sensor - Principle of Operation*

The 100% Volume gas sensor is a Thermal Conductivity (TC) type of sensor. It consists of two electrically identical TC elements. The active element is placed in the sample chamber in the gas stream, and the reference element is placed outside of the gas stream. The two elements form half of a balanced Wheatstone Bridge. When voltage is applied to the elements, the elements heat up. "Thermal conductivity" is a measurement of the rate a gas can carry heat away from a hot object. High levels of natural gas (methane) in the sample stream carry heat away from the hot reference element in the gas stream faster than heat transfers from the reference element which is surrounded by air. This causes a difference in temperature between the active and reference elements, which causes a difference in the electrical resistance of the elements. This causes an imbalance in the Wheatstone Bridge circuit. The imbalance is measured by the circuitry of the NP-204 and converted to a measurement of the % Gas concentration.

## Control Panel

The control panel is at the top of the instrument for easy access when the NP-204 is carried. It contains the display, range lights, and switches that control the functions of the NP-204. The switches are "lift to turn" type knobs, to reduce the possibility of accidental turning.

### Switches

#### 1. RANGE SWITCH

The range switch has the following selections:

- |           |  |
|-----------|--|
| OFF       | This position turns the power off to the instrument.   |
| VOLT ADJ. | This position is used to set the proper voltage for the detector elements (used in conjunction with the "VOLT ADJ." potentiometer).  |
| L         | This position selects the LOW range (0-5% gas by volume or 0-100% LEL ranges). When the switch is in the "L" position the instrument will detect and display the low range only. |
| H         | This position selects the HIGH range (0-100% gas by volume range). When the  |

switch is in this position the instrument will detect and display the high range only.

2. ZERO ADJ.

This adjustment is used to Zero the reading for the LOW range. This is generally done before each use of the instrument. (The zero adjustment for the % gas range only rarely needs adjustment, so is not externally adjustable).

3. VOLT ADJ.

This adjustment is used to set the voltage for the detectors. When the "RANGE" switch is in the "Volt Adj." position, this knob can be turned to bring the meter reading to match the red "V" line, which sets the detector voltage to the proper level.

4. LIGHTS

L                    When this light is lit, it indicates that the instrument is turned on and that the LOW range sensor is energized.

H                    This light indicates that the HIGH range sensor is energized.

5. Meter Mechanical Zero

Located centered directly below the meter, this adjustment is used if necessary to adjust the meter Mechanical Zero while the power is turned off to the instrument.

## Battery Compartment

The NP-204 battery compartment is located on the bottom of the instrument. It has a removable panel for easy replacement of the batteries. The panel is held in place by one screw located on the bottom of the instrument.

The NP-204 uses two "D" size cells; alkaline batteries will run the NP-204 for approximately 5 hours, rechargeable nickel-cadmium batteries will run for approximately 4 hours. (Rechargeable batteries must be removed from the NP-204 and charged separately.)

## Circuit Boards

The NP-204 has one circuit board. The circuit board contains the screw connectors for the replaceable detectors, adjustment potentiometers for High range Zero and Span and for Low range span, and wiring to the external switches and adjustments. The circuit board is internally mounted directly to the back of the meter.

## OPERATION

### Preparation

Normally the NP-204 requires very little preparation before use. Before using the instrument, follow the steps listed below:

#### Start-up

1. Mechanical Zero

Before turning the instrument on, set it on a flat surface and verify that the meter reading is exactly on zero. If necessary, turn the Mechanical Zero adjustment to bring the reading to zero. The mechanical zero adjustment is located centered directly underneath the meter.

2. Battery Check

Turn the range switch to the VOLT ADJ. position. Lift and turn the VOLT ADJ. knob to bring the meter reading exactly to the red "Volt Check" line indicated on the meter by a red "V" and line near the top of the scale. Turning clockwise will increase the voltage reading.

If you are unable to adjust to the voltage up the red "volt Check" line, replace or recharge batteries before use. **Do not attempt to use the instrument if the voltage cannot be set high enough.**

3. Flow System

Attach the hose to the inlet fitting on the left hand side of the instrument, and the sample probe to the end of the hose. Assure that the hose and probe fittings are secure. Close off the inlet to probe with finger, and squeeze aspirator bulb. Bulb should remain collapsed while probe inlet is sealed off with finger. If not, re-check hose and probe fittings and re-tighten if necessary.

With probe inlet sampling from fresh air, squeeze aspirator bulb 5 times to flush out any remaining gas from the instrument and sample line.

4. Zero (Low range)

Turn range selector switch to "L". Lift and turn the ZERO ADJ. knob to bring the meter reading to exactly zero. If unable to adjust to zero, filaments may need to be replaced or sample system may not be fully flushed with fresh air.

5. Verify Response (Low Range)

To verify detection of combustibles use a controlled source of flammable vapor, for example a bottle of isopropyl alcohol. For accurate testing of calibration, use a known calibrating gas source, such as 50% LEL methane. (See calibration section of this manual for calibrating instructions).

After verifying response, squeeze the aspirator bulb 5 times again to flush fresh air through the system.

**Caution**

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

**WARNING**

**If the NP-204 does not respond to these verifications, take it to a known “fresh-air” environment, Sample the fresh air and Re-Zero the unit. Repeat the “Verify Response” procedure before using the NP-204 in a potentially hazardous location. Do not attempt to use the instrument unless the response is verified.**

6. Zero (High range)

Turn the range selector switch to the “H” (High) position. Allow a few seconds for instrument to warm up, and verify the reading is exactly on zero. If it is not on Zero, adjust the reading to zero using the internal adjustment before using the instrument. Refer to the “Internal Adjustments” section of this manual for instructions on how to adjust the High range zero.

7. After the above steps are successfully completed, the instrument is ready to take to the job site and use. It may be turned off until needed. When using, refer to the Normal Operation section of this manual below.

**Normal Operation**

The NP-204 can now be used to check atmospheres for gas levels. Before each sample is taken, the user should follow the following steps:

1. Turn unit on to Volt Adj., and adjust voltage to the red Volt Check line on the meter, using the Volt Adjust knob.
2. Turn Range switch to “L” position, and adjust the Zero to be exactly zero using the



Zero Adj. knob.

3. Generally, when testing an unknown space or sample, it is recommended to have the range selector switch in the H position. This helps to extend the life of the Low range sensor by not stressing it with exposures to very high concentrations.
4. Attach hose and probe and check for leaks by holding finger over probe inlet while squeezing aspirator bulb. Bulb should remain collapsed if there are no leaks in the system.
5. Insert probe into the space or atmosphere to be tested, and squeeze aspirator bulb 4 to 5 times. Watch meter and observe the maximum reading.

If reading is very low, and range selector switch is on the "H" position, remove probe from test space and place in fresh air, squeeze bulb 5 times, then repeat steps 2 and 5 above.

6. When test is completed, remove probe from the test space and place in fresh air. Squeeze bulb 5 times to flush any test vapors out of the system, and turn instrument off.

### **WARNING**

**If repeated tests are to be taken, it is necessary to periodically verify the battery voltage is properly set (to the red Voltage Check line). If the voltage is not set properly, the instrument may not provide correct readings.**

### **Alarms**

The NP-204 contains no audible or visual alarms.

### **CALIBRATION AND MAINTENANCE**

The NP-204 requires only a few user adjustments. These are the zero and span for the low range and high range sensors. The Low range span should be checked periodically ( preferably every use for critical applications). The high range span needs to be checked only when the sensor is replaced.

The sensors need to be replaced if the span cannot be set to read the proper value, or if they cannot be set to read Zero with the appropriate zero adjustment.

## Calibration Supplies and Equipment

To adjust the NP-204, you will need the following supplies and equipment, some of which is available in an RKI Calibration Kit:

- Known calibrating sample of 2.5% Volume (50% LEL) natural gas (methane) in air.
- A flowmeter with a range of 0 - 1.0 lpm (0-2.0 SCFH).
- A control valve for the cylinder, and a tubing length to connect the gas to the NP-204.
- A source of 100% natural gas or methane.

All the above items except the 100% natural gas source are available from RKI in a test kit. The 100% natural gas source can be obtained by bleeding off a sample from a gas company, as piped to homes for stoves or furnaces.

## Calibration Procedure

### Combustibles Span (Low range span)

1. Take the NP-204 to a non-hazardous environment before calibrating.
2. Loosen the two large screws on the top of the instrument, and separate the top half of the case from the bottom case. Locate the potentiometer on the PCB marked "SPAN (L)"
3. Turn the instrument on to "VOLT ADJ.," and adjust the voltage to the red Volt Check line near the top of the meter. Turn the Range switch to "L", allow two minutes warm-up, and then Zero the reading using the external zero adjustment.
4. Connect the hose and probe onto the instrument, and connect the span gas tubing to the probe tube.
5. Open the valve connected to the 50% LEL Methane span gas cylinder, and, verifying flow with flowmeter, flow about 0.5 lpm through instrument.
6. Adjust the SPAN (L) potentiometer if necessary to match the meter reading to the span gas concentration. Turning the potentiometer clockwise increases the reading.

### 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. See Appendix A for Relative Response Curves for common gases and vapors, relative to a methane calibration.**

### Caution

The combustibles measurement (low range) is flow-sensitive. Use a flowmeter and set the flow rate to 0.8 SCFH (0.4 l/m).

7. Remove the span gas tubing from the probe, and place the probe in fresh air. Squeeze the bulb 5 times to expose the sensor to fresh air, and then verify that the combustibles reading returns to zero.
8. Repeat the exposure to the calibrating sample and verify that the combustibles reading reaches the correct level. Readjust and repeat from step 3 until no further adjustment is required.
9. If the combustibles reading cannot be set high enough to agree with the calibrating sample, replace the sensor.

### Maintenance

#### Batteries

1. Check the battery voltage periodically by turning the Range switch to the VOLT ADJ. position, and verifying that the voltage can be set to the red Volt check line. Replace the batteries if the voltage cannot be set to the Volt check line.

### WARNING

Take the NP-204 to a non-hazardous location before replacing the batteries.

2. The batteries are located in a compartment on the bottom of the case. To replace the batteries, loosen the screw on the bottom of the case, and remove the battery compartment cover. 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 (alkaline or fully-charged Ni-Cd) according to the polarity (+/-) markings on the battery holder diagram, and replace the cover.

### Sensor Maintenance

Combustibles sensor (Low range sensor) life is generally related to usage, but certain environmental factors may affect duration. Exposure to high concentrations (above 5% volume) will reduce the life of the low range sensor. The Thermal conductivity sensor (High range sensor, or TC sensor), is an extremely stable sensor that generally will last for several years. However, if liquid is drawn into the instrument, both sensors could be ruined.

If a sensor requires replacement, call RKI or your local distributor.

#### Low Range Sensor

Replace the low range sensor filaments when:

1. The low range cannot be calibrated correctly.
2. The low range cannot be set to zero after warmup using the external ZERO ADJ. knob.

### High Range sensor

Replace the high range sensor filaments when:

1. The High range cannot be calibrated correctly.
2. The high range cannot be set to zero after warmup using the internal ZERO (H) potentiometer.

### Sensor Replacement

1. Take the NP-204 to a non-hazardous location and turn the power off.
2. Remove the instrument from the carrying case.
3. Loosen the two large screws on the top face of the instrument, lift the top half of the case away from the bottom case, and lay the top case upside down on the workbench.
4. Locate the sensor/chamber block assembly. It is a rectangular shaped block in the case corner right next to the inlet fitting. The sensor filament sets are each held in place by a U shaped bracket and two screws. Filament sets have colored wires soldered to their rear posts, and these wires are connected to screw terminals on the circuit board.
5. To replace individual sensors, proceed as follows:

#### Low range sensor

- A. The low range sensor has wire colors of Black, Red, and White. Loosen (but do not remove) the screws on the circuit board holding these wires (terminals T1, T2, and T3) and remove the wires.
- B. Remove the two screws holding the U shaped bracket which secures the Low range sensor filaments into the sample chamber. Remove the bracket and pull the sensor filaments from the chamber.
- C. Install the replacement filaments into the chamber. Insure that the filaments with the black and white wires are installed into the hole closest to the corner of the instrument. Replace the U shaped bracket and tighten its two screws securely.
- D. Attach the three wires to the terminals on the circuit board, and tighten the screw terminals securely. Insure that the color coded wires go to the proper terminals, as indicated by the color wording printed on the circuit board.
- E. After sensor replacement, the instrument must be calibrated on a known gas sample. Refer to the calibration section of this manual for calibration instructions.

#### High range sensor

- A. The High range sensor has wire colors of Yellow, Blue, and Red. Loosen (but do not remove) the screws on the circuit board holding these wires (terminals T4, T5, and T6) and remove the wires.

- B. Remove the two screws holding the U shaped bracket which secures the TC sensor filaments into the sample chamber. Remove the bracket and pull the sensor filaments from the chamber.
- C. Install the replacement filaments into the chamber. Insure that the filaments with the black and white wires are installed into the hole closest to the corner of the instrument. Replace the U shaped bracket and tighten its two screws securely.
- D. Attach the three wires to the terminals on the circuit board, and tighten the screw terminals securely. Insure that the color coded wires go to the proper terminals, as indicated by the color wording printed on the circuit board.
- E. After sensor replacement, the instrument must be calibrated on a known gas sample. Refer to the calibration section of this manual for calibration instructions.

If sensor response is still too low, or is very slow, even after replacement of sensor filaments, it may be necessary to clean or replace the flame arrestor assembly.