



**BASCOM-TURNER  
INSTRUMENTS**

**GAS-ROVER™ DETECTORS**

**OPERATION MANUAL**

**NATURAL GAS, CARBON MONOXIDE  
AND OXYGEN DETECTORS**

**Part Number OM-0108**



## LIMITED WARRANTY

**Bascom-Turner Instruments warrants Gas-Rover Detectors to be free from defects in materials and workmanship for one year following the date of shipment. This limited warranty applies to the original purchaser of the Detector and is not transferable except by Bascom-Turner's authorized Distributors.**

**The instruments described in this manual are produced with standard commercial parts, any of which may fail under some circumstances. Although the probability of such failure is low, it is not zero. Accordingly, all personnel using such instruments must be trained to recognize instrument malfunctions and to have such instruments repaired promptly. Bascom-Turner offers no warranty that failures will not occur – only that when they occur, they will be promptly cured with the following procedure:**

**During the limited warranty period, we will repair or replace, at our option, any defective products or parts at no additional charge. A return merchandise authorization (RMA) number must be obtained prior to returning a detector to Bascom-Turner. A detector returned to Bascom-Turner with probe and water-block filter, shipping prepaid, will be repaired, calibrated and returned second day air. Warranty repairs do not include pump cleaning, filter replacement and calibration. All replaced parts and products become the property of Bascom-Turner Instruments.**

**This limited warranty does NOT extend to any Detectors which have been damaged as a result of accident, abuse, modification, misuse such as failure to follow the operating instructions provided by Bascom-Turner Instruments, or other contingencies beyond our control. No other warranty is expressed or implied. Bascom-Turner is not liable for consequential damages.**

## CAUTION

**Personnel who operate, calibrate, or repair this instrument must first read and fully understand this manual in its entirety.**

**For use in Class I, Division 1, Group D atmospheres (Propane and Methane).**

**These products have not been tested for intrinsic safety in oxygen enriched atmospheres.**

**Change batteries, service, and use the USB interface only in areas known to have non-hazardous atmospheres.**



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## ACCESSORIES AND SPARE PARTS

## FEATURES

The Gas-Rover™ portable methane, and combined methane, carbon monoxide and oxygen detectors are intrinsically safe, microprocessor based instruments designed to test ambient air and flue gas over a wide temperature range.

These detectors have many features for easy and reliable operation:

- **PPM Measurement of Natural Gas with Catalytic Combustion Sensors**  
A calibrated ppm range up to 40,000 ppm of natural gas.
- **Measurements Over the Full Range of Gas**  
The instruments detect methane over the full range of methane up to 100% GAS. Peak and current readings are displayed simultaneously.
- **Survey and Truck Survey**  
Two operating modes with quick response and high sensitivity make it easy to find gas leaks during walking or truck surveys.
- **Bar Holing**  
Peak and sustained bar-hole readings are automatically displayed after gas is pumped for a precise, fixed time.
- **Automatic Data Storage**  
Automatic storage of time and mode-stamped data readings. Automatic storage the last 24 calibrations. Automatic generation of reports.
- **Automatic Calibration**  
Calibration is performed automatically using Bascom-Turner's calibration gas.
- **Automatic Sampling**  
An intrinsically safe, built-in pump automatically samples ambient air, flue gas, and bar hole gas.
- **Automatic Self-Tests**  
Automatic checks of battery, sensors, and pump. Tests for blockage and for tight connection of probe to instrument.
- **Audible and Visual Alarms**  
Audible and visual alarms individually set. Continuous monitoring of natural gas, and (optionally) CO and oxygen.
- **Easy-to-Read, Back-Lit, Bright Display**  
A bright, large LCD display is easy to read both indoors and outdoors.
- **Easy-to-Use**  
Simple, intuitive operation without complicated or confusing displays. A brief operating manual is stored onboard.
- **A Tough Package and a Light Weight**  
Housed in a high impact case, the instruments weigh only 24 ounces.

## SPECIFICATIONS

<b>Gases Detected</b>	Natural Gas (Methane) Carbon Monoxide (CO) [Optional] Oxygen (O <sub>2</sub> ) [Optional]
<b>Sensors</b>	Dual Catalytic Combustion (CH <sub>4</sub> ) Thermal Conductivity (CH <sub>4</sub> ) Electrochemical (CO, O <sub>2</sub> )
<b>Ranges</b>	
<b>GAS</b>	0 to 40,000 ppm CH <sub>4</sub> by volume 0 to 100% CH <sub>4</sub> by volume
<b>PPM CO</b>	0 to 2000 ppm carbon monoxide
<b>% O<sub>2</sub></b>	0 to 40% by volume
<b>Data Storage And Reports</b>	24 Calibrations 2 to 3 months readings (typical) Exposure and Bar-Hole Measurements, Calibration History, Sensor Sensitivity, Operational Periods by User and Unit ID, Office Reports
<b>Accuracy (10° to 35°C)</b>	<b>CH<sub>4</sub>:</b> 2% of reading ±20 ppm ±0.1% to 5%; ±2.0% to 100 vol % <b>CO:</b> ±5% of reading ±10 ppm <b>O<sub>2</sub>:</b> ±0.2% vol %

<b>Resolution</b>	
<b>GAS</b>	1 ppm from 0 to 40,000 ppm 0.05 vol % from 0 to 5 vol % 1.0 vol % from 5 to 100 vol %
<b>CO</b>	1 ppm
<b>O<sub>2</sub></b>	0.1 vol %
<b>Warm-Up Time</b>	60 seconds
<b>Response Time:</b>	<b>CH<sub>4</sub>:</b> 0.6 seconds (Survey) 1 second (Monitor)
	<b>CO:</b> 45 seconds
	<b>O<sub>2</sub>:</b> 60 seconds
<b>Operating Temp.</b>	-20°C to 40°C (0°F to 105°F)
<b>Storage Temperature</b>	-40°C to 60°C (-40°F to 140°F)
<b>Humidity</b>	0 to 95% RH
<b>Power Supply</b>	Two C-size Alkaline or Two C-size Rechargeable NiMH
<b>Continuous Operating Time per Battery Set</b>	10 hours typical (25°C)
<b>Weight</b>	24 oz. (680 g)



## PART I. OPERATION

### 1. THE GAS-ROVER DETECTORS

This manual describes the operation of the family of Gas-Rover detectors for natural gas, carbon monoxide and oxygen:

- Model VGI-201 - Detects natural gas and displays it as PPM, %LEL and % GAS
- Model VGI- 211 - Detects natural gas and displays it as PPM and % GAS
- Model VGC-301 - Detects natural gas and carbon monoxide and displays as PPM, % LEL and % GAS, and PPM CO
- Model VGC-311 - Detects natural gas and carbon monoxide and displays PPM and % GAS and PPM CO
- Model VGO-321 - Detects natural gas and oxygen and displays PPM, % LEL and % GAS, and % Oxygen
- Model VGO-322 - Detects natural gas and oxygen and displays PPM and %GAS and %Oxygen
- Model VGA-411 - Detects natural gas, CO, and oxygen and displays PPM, % LEL and % GAS, PPM CO and % Oxygen
- Model VGA-412 - Detects natural gas, CO, and oxygen and displays PPM and % GAS, PPM CO and % Oxygen

All models display gas in ppm in the Survey and Truck Survey modes.

All models may be used to test ambient air and bar holes for natural gas and locate gas leaking from pipes and other conduits. All models which detect carbon monoxide (CO) may be used to test for CO in ambient air, flue gas, and gases given off by appliances.

A detector alerts the user acoustically and visually, by "flashing" the symbol(s), for detected gas(es), whose concentration exceeds preset limits. Visual alarms are displayed in-between readings. For example, the display will flash "*CO*", approximately every two seconds, in-between normal Monitor mode displays. If the concentration of natural gas also rises above its alarm limit, the display will flash "*GAS*", then a normal Monitor mode display, then "*CO*", and so on. Simultaneously, the sound alarm will be on.

Visual alarm symbols are "*GAS*" for natural gas, "*CO*" for carbon monoxide. "*Low Oxygen*" for low oxygen, and "*High Oxygen*" for high oxygen.

**Factory set alarm limits are 1.0% methane, 35 ppm CO, and 19.5% for low and 23.0% for high oxygen.**

No alarms are given in the Bar Hole, Survey, and Truck Survey modes. However, in the Survey and Truck Survey modes the acoustic element (buzzer) will sound if gas is detected above a user selected value (see Part 2, Section 1).

## 2. ESSENTIAL OPERATING PRACTICE

Gas-Rover detectors are easy to use. A detector is turned on by pressing the left button; its operation is controlled by three buttons whose function is shown on the display. The middle button generally toggles "Mute" on and off. Once a display is selected, operation is automatic. However, a few general rules must be followed to insure reliability.

**Pump.** Gas-Rover detectors have a built-in pump and depend on this pump for their operation. If the pump is not functioning normally, the instrument will not function properly. It is therefore essential to check the pump each time the instrument is turned on.

**Pump Test:** Connect the probe you plan to use and turn the instrument on. After the display shows "Block Intake", block the probe at its intake to show "Pump OK".

If "Pump OK" does not appear, tighten all connections and repeat the test. If a block is still not observed, remove the probe and block directly the inlet. If "Pump OK" still does not appear, return the instrument for repair.

A pump test can be carried out as above at any time during normal operation of the instrument. **If there is any indication that the pump is not operating normally, the instrument should not be used until repaired.**

**Filters.** Dust and water-block filters protect the sensors and the pump from dust and accidental intake of liquid water. Just as a car would not be operated without air and fuel filters, do not operate a detector without a filter on the probe. **Operation without this filter will eventually degrade the sensors and the pump. It also voids the limited warranty.**

It is essential that the filter be replaced monthly or sooner if it turns brown. Operation without a filter will degrade the natural gas sensor and will void the warranty. Filters are available from Bascom-Turner in packages of five, Part No. WF-505.

**Zero Check.** All sensors drift to some extent over time. Sensor drift is corrected by zeroing if the drift is within 0.1% vol. GAS (and 10ppm CO if the unit is equipped with a CO sensor). If the drift is outside these limits, "NO GO" is displayed and the user is asked to autozero the unit in "clean" outdoor air. The unit will re-zero unless the zero has drifted over 0.5% vol. GAS, in which case the instrument must be checked by a trained professional (the sensor may need replacement). Zero adjustment must be done in clean air, for example, outdoor, otherwise a systematic error may be introduced in subsequent measurements.

<b>WARNING: On a call, turn the instrument on outdoors, not indoors.</b>
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**Test and Calibration.** Gas-Rover detectors must be calibrated periodically with gas of known composition. The sensors depend on catalysts which lose activity during use. The necessary frequency of calibration depends on actual use and on the concentration of catalyst poisons in the sampled gas. This concentration is, of course, not generally known.

A detector can be tested with "bump" gas. Such tests merely verify that the gas sensor(s) are in operating condition. To verify and adjust, if necessary, their sensitivity they must be calibrated.

A detector can be automatically calibrated in approximately one minute using Bascom-Turner's calibration gas (2.5% CH<sub>4</sub> and 100 ppm CO in air). Given the ease and speed of

automatic calibration, it pays to calibrate as frequently as possible, and certainly, at least monthly.

**Accuracy.** A properly operating and calibrated detector will respond with the specified accuracy. If combustible gases other than the gas used for calibration are likely or suspected, the instrument **cannot** be relied upon to give a proper indication of their concentration and hence of how close to their combustible limits they may be. For example, the detector responds quite differently to gasoline, to methane, and to propane. Accordingly, readings of % LEL (or its equivalent in percent gas) refer only to the calibration gas and can be relied upon only in this respect in assessing an atmosphere sampled by the detector. Furthermore, concentrations displayed by the detector refer to a local sample at the tip of the instrument probe. Low gas concentrations at one spot do not necessarily mean that the gas concentration is low throughout a wider area.

**WARNING: All gases detected by a particular instrument are monitored continuously only in the Monitor mode.**

**WARNING: Each detector responds to the gases for which it was designed. Other toxic or dangerous gases may not be detected.**

**WARNING: Only methane is detected and measured in the Survey Mode.**

**Safety.** These instruments measure the concentration of natural gas in air and give, more generally, an indication of the presence of other combustible gases. When used by trained personnel, they constitute one element for assessing the safety, or lack thereof, of a particular atmosphere. **However, they must not be relied upon by themselves for judging safety; all other significant factors must be taken into account.** As noted previously, the measured concentration refers only to the immediate vicinity of the probe – concentrations in a wider area may be significantly different. A trained technician should consider possible interferences, physical or chemical, and be aware that calibrated values are only valid in air. If other gases, including inert gases such as carbon dioxide are present, the measurements may not be reliable. Finally, although there are built-in safeguards, a specific instrument may malfunction. It is therefore imperative that other indicators, including, for example, odorant levels, must be taken into account.

**WARNING: Catalytic combustion sensors do not respond in inert or reducing atmospheres. Also, they should not be used for detecting combustible dusts or mists.**

### 3. OPERATIONAL DESCRIPTION

To conserve the batteries, the instrument should be turned OFF when not in use.

The instrument is controlled by three push button switches whose function changes with each particular display (see Appendix 1). The function of each push button is shown on the display in each case. In general, the middle button silences the beeper (“mutes” the instrument).

**Startup Sequence.** To turn the instrument on, press the left switch. A series of screens is automatically displayed preparatory to entering the first operational mode, viz. “Survey”. Along the way, a number of specialized screens can be used to access specialized functions.

The first screen shows the Model Number and the second displays gases detected by the instrument and provides access to the USB interface (see Part 3). The next screen shows the date and time and the state-of-charge of the batteries. To edit the date or time, press the right “Edit” button. The first digit of the hour will begin flashing and can be changed from 0 to 1 or 1 to 0 by pressing the right “Update” button. Pressing the “Next” button advances the flashing digit which can then be edited (or not) by pressing the right (or left) button, and so on. The same screen provides access to a short manual by pressing the left “Help” button.

Following the Edit/Help screen, the pump is tested (“Block Pump” screen). If no block is detected in 40 seconds, “Check Probe” is displayed, followed by “Remove Probe and Block Intake” and finally “Repair Pump” followed by an automatic turning off of power.

The next display suggests a “Calibrate by [a date thirty days from the date of the last calibration]” and an opportunity to calibrate (see Part 2, Calibration). If calibration is not chosen, the instrument proceeds to enter the operational mode of “Survey” (see below).

The period of thirty days between calibrations is only a suggestion. The instrument should be calibrated as often as possible, ideally every day. In any case, if poisoning of the natural gas sensor or some other problem is suspected, the instrument should be promptly checked by calibration with CAL Gas (see Part 2, Calibration).

**Backlight.** Pressing any button backlights the display for 20 seconds. To backlight any display, press the middle button twice (this sequence leaves the instrument in its original state – mute or not mute). The only exception to this procedure is during bar holing (middle button initiates sampling). Pressing the middle “Go” button automatically backlights the display long enough (60 seconds) to read the results.

**Turning the Instrument Off.** The instrument can be turned off from a number (but not all) displays. Such places are obvious when a particular button is marked “Off.” In all such cases the screen accessed by pressing “Off” requires a second operation (“Yes”) to actually turn the instrument off. This sequence guards against accidental turning off.

When a direct “Off” button is not available, you may follow the procedures suggested below:

1. At the USB access display, press the left “USB” button and then after the new screen, the right “Off” button.
2. During warm-up of the Survey mode, press the left “BH” button, then “Go”, and then “Stop” (as soon as it appears) and then “Off.”

**Operational Modes.** The instrument operates in four distinct modes: “Survey”, “Truck Survey”, “Bar Hole” and “Monitor”. A mode may be entered from another by pressing the appropriate button either during warm-up or regular operation. For example, the Bar Hole Mode can be selected when the instrument is first turned on by pressing the left “BH” button during the warm-up period for the Survey Mode.

**Survey:** Connect an appropriate probe and power the unit. Following the preliminary displays (see above), “*Survey PPM*” is shown for about 20 seconds. At the end of the warm-up period (bar reaches the right border of display), “*Operation Check*” is available. To use it, present a source of at least 50ppm methane in air to the probe intake. The Rover will automatically carry out the operation check and, if satisfactory, will display “*Operation Check OK*”. If the check is not satisfactory, a “*Please Calibrate*” message will appear. Calibration can be carried out as described in Part 2.

**WARNING:** The calibration check is NOT equivalent to regular calibration and cannot be used as a substitute for calibration.

The Operation Check is offered when the instrument is first turned on. It is not offered when the Survey mode is re-entered subsequent to bar-holing or monitoring. The time window for carrying out the calibration check is 30 seconds; the test can be bypassed by pressing the “Override” button in the initial screen or subsequently in the “*Please Calibrate*” screen.

After the instrument enters the Survey mode, it shows the concentration of gas in air in parts per million by volume (ppm). The beeper will sound if the ambient concentration of gas rises above a user selected value (see Part 2, Section 1). The factory set value is 10ppm. If it is desirable to silence the beeper during a leak survey, the middle switch mutes the instrument (“*Mute*” appears on the display). If the gas concentration is over 40,000 ppm (4% gas by volume), the unit automatically enters the Monitor mode (see below).

Under some circumstances, it may be necessary to re-zero the survey mode. If a “fresh” zero is required, for example, if the zero has drifted with the result that the instrument shows a reading when sampling clean air, press the right switch after raising the probe away from the ground, then press the right “Zero” button. The reading will be reset to zero within a few seconds.

**The  Symbol.** The symbol depicted here is used in the “Survey” modes to indicate sensitivity at any particular instant. In general, sensitivity is an inverse function of background noise – the lower the noise, the greater the sensitivity. The noise is primarily thermal and is caused by natural convection.

Under most circumstances, all three vertical bars should be present. If the background noise increases, one or more bars will be missing and in extreme circumstances, the whole symbol may disappear. If the noise level rises so that more than two vertical bars are deleted, the instrument should be allowed to return to its normal state by holding it steady for about two to three seconds.

**CAUTION:** If two or more bars are consistently absent, replace the natural gas sensor or return the instrument for repair.

**Survey by Truck:** If a survey is to be conducted by truck, turn the instrument on as above and carry out a calibration check. Connect the instrument, using an appropriate filter, to the sampling system of the truck (see Appendix 2) and select the Truck mode.

The Truck mode is faster and more sensitive than the Survey mode and as such, it may require occasional re-zeroing. To re-zero, press the right key and then choose “Zero” by pressing the right key again.

**Survey to Truck Survey and Truck Survey to Survey:** Once either Survey or Truck Survey modes have been entered, the transition from one to the other is relatively rapid (20 seconds). Either can be selected from the other by using the right button in each screen and selecting Survey or Truck, as the case may be, in the screen that follows. It should be noted that if another mode is selected in between, that is, either Bar Hole or Monitor, a warm-up period is necessary when re-entering the Survey or Truck Survey modes.

**Bar Holing:** The detector measures gas levels in sampling holes used for locating underground natural gas resulting from seepage or leaks in a conduit. Gas concentrations in a bar hole near a significant leak will exceed several percent. Therefore an alarm for gas is likely, but since it is not relevant to the ambient atmosphere above ground, it is automatically suppressed. During bar-holing, the alarms for all gases are automatically turned OFF.

To bar hole, select an appropriate probe (see Part 1, Section 7) and set the front panel to Bar Hole (BH). The instrument automatically clears any residual gas and checks for clean air. The pump is then turned off and the instrument is ready for bar holing. After inserting the probe into the bar hole, press the “Go” button. The pump is turned on and the instrument samples gas for a fixed time (**factory set time is 15 seconds**). Readings during sampling are shown on the display. At the end of the fixed time for sampling, the instrument turns off the pump, and displays the peak and sustained readings. Both values are in % GAS.

If in the course of bar holing, water is encountered, press the left “Stop” button to stop the pump. Use of a water-stopper (see Figure 2 in Section 8) will prevent water from entering the instrument.

**WARNING: If a check is to be made for trace amounts of gas, for example around the foundation of a structure, the Survey or the Monitor – not the Bar Hole - mode should be selected.**

**Monitor:** The detector shows the concentration of natural gas (methane) in air in steps of 0.05% GAS (1% LEL) up to 5% GAS (100% LEL) and then in steps of 1% GAS up to 100% GAS. The concentrations of CO and O<sub>2</sub> are also shown if the unit is equipped with the corresponding sensors (see below). To mute the alarm, press the middle button (mute is displayed). Pressing any button backlights the display for 20 seconds. To backlight while in the Monitor mode, press the middle (mute) button twice.

The peak reading for GAS is retained and displayed along with the current readings until the unit is turned off, another mode of operation (e.g. Survey) is chosen, or a new zero is obtained.

## To Detect Carbon Monoxide

### Carbon Monoxide in Ambient Air

Connect an appropriate probe with a water-block filter and select the Monitor mode. After warm-up, the display shows the concentration of CO in parts per million (ppm). If the air is clean (contains no carbon monoxide), the display should read zero. If it does not, use the right “Zero/Off” button to obtain a new zero in clean air.

### Carbon Monoxide in Flue Gas

Connect the flue gas probe, with an attached flue gas filter, to the water-block filter on the hose and select the Monitor mode. After warm-up, insert the probe into the flue and read the concentration of CO in parts per million. A flue gas check of CO should take one minute or less. For every minute of flue gas sampling allow the detector a minute of room air sampling to dry the filters.

<p><b>CAUTION:</b> The filter provided with the flue probe <b>must</b> be used to avoid interference by nitrogen oxides in combusted gas. A filter is good for about three months of ordinary use. It should be replaced or refilled when about 90% of its purple material has changed color to brown, or when it gets clogged or flooded (see "Accessories and Spare Parts", Flue Gas Filter, Part No. FF-005 and Purple Beads and Spare Retaining Disks, Part No. PR-050).</p>
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**Note:** The standard flue gas probe and filter are suitable for spot checks lasting a minute or two. For measurements of CO in flue gas over longer periods use an Extended Duty Flue Gas Probe and Filter (Part No. FP-012).

<p><b>WARNING:</b> <b>Do not touch the flue probe immediately after a measurement. Wait until it cools. Running the instrument in air helps cool the probe.</b></p>
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### “Air-Free” CO Flue Measurements.

The VGA-411/412 detectors can display measurements of CO on an “air-free” basis if this feature is selected (see Part 2). Where this selection is made, the measured CO concentration is referred to air-free flue gas according to:

$$\text{"Air - Free"PPM CO} = \frac{20.9}{(20.9 - \text{measured } \% O_2)} (\text{measured ppmCO})$$

The instrument displays CO concentrations on an air free basis, using the above relation, up to 16% Oxygen. Beyond this, CO concentrations are displayed without conversion, i.e. the “air-free” formula is **not** used.

“Air-free” CO readings shown on the display are labeled AFCO, i.e. air-free CO.

#### 4. INSTRUMENT CHECKS

##### **Automatic Sensor Check**

If a gas sensor fails (opens up), the display shows "*Replace Methane Sensor*".

##### **Automatic Pump Check**

If the intake is blocked, the display shows "*Flow Blocked*" and the detector beeps until the problem is cleared. This check is carried out whether or not a probe is being used. During the power on sequence, if a blocked flow is not detected within 40 seconds (from manually blocking the intake to the pump), the detector displays "*No Block Check Probe*" then "*Remove Probe and Block Intake*", and finally "*Repair Pump*".

##### **Check for Tight Connections**

To check for tight connections, block the probe inlet to observe "*Flow Blocked*" on the display. If "*Flow Blocked*" fails to appear, there may be a leak.

**WARNING:** The instrument will not operate when first turned on if it fails to block when the air intake is blocked. Subsequently, however, connections can only be checked by blocking the probe inlet and observing "*Flow Blocked*" on the display. If "*Flow Blocked*" fails to appear, the probe and/or inlet must be checked for leaks.

##### **Automatic Zero**

The zero is adjusted automatically when Zero is chosen from an appropriate display.

**CAUTION:** Zero adjustment **must** be carried out in clean air, otherwise a systematic error will be introduced in subsequent measurements. The instrument will auto zero in concentrations of methane below 0.10% GAS and concentrations of CO below 10 ppm.

## 5. INTERFERENCE FROM OTHER GASES, LIQUIDS, OR RFI

The methane detectors use two sensors:

- i) A catalytic combustion filament calibrated with methane. It is used up to about the lower flammable limit (5.0% by volume) of methane.
- ii) A thermal conductivity sensor calibrated with methane. It is used from the lower flammable limit (5.0 vol %) to 100 vol % of methane.

Models VGC-301 and VGC-311 (methane and carbon monoxide detectors) use the sensors listed above and:

- iii) A three-electrode, electrochemical cell for carbon monoxide.

Models VGO-321 and VGO-322 (methane and oxygen detectors) use the methane sensors listed above and:

- iv) A two-electrode, electrochemical cell for oxygen.

Gases, or liquids with appreciable vapor pressure, which may interfere with the detection of methane include substances which can be combusted on the catalytic combustion filament (examples are ethane, propane, ethylene, propylene, octane, and the like) and substances which differ in thermal conductivity from air (examples are hydrogen, helium, carbon dioxide, other hydrocarbons).

Gases or vapors which may interfere with carbon monoxide detection include substances which can be electrochemically oxidized or reduced on the working electrode of the electrochemical sensor. Examples are hydrogen, hydrogen sulfide, oxides of nitrogen, alcohols, and unsaturated hydrocarbons.

Many of the substances that interfere with CO are removed by the flue gas filter (Part No. FF-005). This filter can be used for both flue gas measurements and for ambient air measurements of CO whenever the ambient concentration of other oxidizable substances is significant.

**WARNING:** The methane and CO sensors use catalytically active surfaces which may be poisoned by air contaminants. These sensors should not be exposed to atmospheres that contain silicones, halogens and halides, such as chlorides, and volatile compounds containing lead or antimony. If exposure to atmospheres that adversely affect the sensors is suspected, the detector should be recalibrated promptly.

### Radio Frequency Interference

The Gas-Rover detectors have an interior coating on their cases to suppress radio frequency interference (RFI).

## 6. CHANGE OF BATTERIES

Gas-Rover detectors may be powered by two (2) alkaline (**non-rechargeable**) C-size batteries (1.5V, Type AM-3) or by two rechargeable nickel metal hydride (NiMH) batteries sold by Bascom-Turner. The batteries are good for at least eight, and typically twelve, hours of continuous operation. When the batteries are drained to about one hour of remaining continuous use, the unit alarms and the display flashes "*Low Batteries*" between readings. If battery life is over, the unit displays "*Low Batteries*" and powers down; the batteries must be changed to make the instrument operational again.

**WARNING: The batteries must be changed in an atmosphere known to be non-hazardous.**

To change batteries:

1. Turn instrument OFF.
2. Remove spent batteries.
  - a) Unscrew the battery cap and slide out two C-cells.
  - b) Discard two alkaline C-cells or recharge the NiMH cells.
3. Insert two, fresh C-size alkaline batteries or two charged NiMH C-sized cells.
4. Replace the battery cap and give it one quarter turn (battery cap bar vertical).

Note that the batteries are inserted with the positive terminal first.

If the instrument does not operate after battery replacement, there is a high probability that a battery has been inserted with the wrong polarity. Re-insert the batteries taking extra care to insert each battery correctly.

**Note:** Always replace a set of batteries with a new set. When operating in cold weather (below -10°C) use a fresh set of batteries, if possible.

**WARNING: Do not attempt to charge the alkaline (non-rechargeable) batteries because they may leak or vent.**

**WARNING: Use only rechargeable batteries from Bascom-Turner.**

**WARNING: To reduce the risk of a battery venting, do not mix old batteries with new batteries, or mix batteries from different manufacturers.**

**WARNING: Do not attempt to service the instrument in a hazardous atmosphere.**

## 7. PROBES

### Surface Probes

A surface probe, 36 inches long, terminating in a rubber cone, is available for above ground service (Part No. SP-636).

### Gooseneck Probe

The gooseneck probe (Part No. GP-514) is a 14 inch long flexible probe which connects to the dust and water-block filter and a quick connect fitting.

### Flue Gas Probe

The flue gas probe (Part No. FP-110) is a telescoping metal probe screwed finger-tight into the flue gas filter. The other end of the filter attaches to the dust and water-block filter. This probe, together with its filter, may also be used for CO measurements in ambient air.

**CAUTION:** Never attach the flue gas filter cartridge directly to the sample hose - always use a dust and water-block filter.

**WARNING:** Hold the probe without touching metal while it is in the flue and immediately afterwards. Running the instrument in air after a measurement will help cool the probe quickly and dry the filters.

### Bar Hole Probes

There are five optional probes suitable for bar holing:

Bar Hole/Ceiling Probe (Part No. BP-034) 34" long, clear, one hole at end.

Bar Hole Probe (Part No. BP-134) 34" long, clear, side holes.

Bar Hole Probe (Part No. BP-136) 36" long, fiberglass, one hole at end.

Bar Hole Probe (Part No. BP-236) 36" long, fiberglass, side holes

Bar Hole Probe (Part No. BP-536) 36" long, steel, side holes.

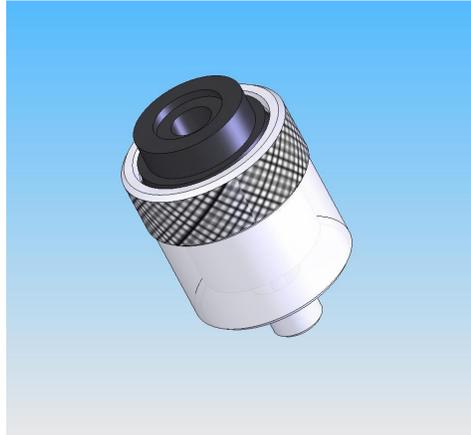
The stainless steel probe has an electrically insulated handle. Bar hole probes are designed to be attached to the water block filter on the hose. A convenient way to release water from a bar hole probe is with a water-stopper (Part No. WS-001) described in Section 8.

**WARNING:** Hold the steel bar hole probe only by the insulated handle to avoid electrical shock from buried power lines.

## 8. ROUTINE MAINTENANCE

### Dust and Water-block Filter

A filter, housed in a knurled nut, removes particles of dust and dirt and blocks water. Do not insert objects into the water block filter as they may puncture the filter. The filter needs to be replaced monthly or sooner if it turns brown. Replacement dust and water-block filters are available as Part No. WF-505 (package of 5 filters).



**Figure 1.** WF-505.

**CAUTION:** Do not use a Gas-Rover without a dust and water-block filter.

### Inlet Dust Filter

Removal of the intake connector of the instrument (used to attach the sampling system of choice) exposes a metal filter pressfit onto the intake. These filters are not a substitute for dust and water-block filters as they will not block water or remove very fine dust and dirt. If this filter gets blocked, it should be replaced.

### Water-stopper

The water-stopper (Figure 2) provides a quick way to continue bar holing if water is encountered in a bar-hole. The water-stopper is inserted between the dust and water-block filter and the bar hole probe. A float inside the water-stopper is connected to a plunger which blocks flow whenever the float is lifted by water. By depressing a release push-button, the water is released and the plunger returned to its normal position.



**Figure 2.** Water-stopper

### Dust-Stopper

The dust-stopper is a filter with a large surface area on which dust can collect without slowing the sampling rate of the Gas-Rover. The filter element is easily cleaned or replaced by removing the threaded cap and either blowing off the accumulated debris or pulling the filter off

and replacing it. Replacement dust filter cartridges are available as Part No. DF-105. The dust-stopper should be inserted between the dust and water-block filter and the probe or water-stopper.

### **Flue Gas Filter**

This filter is screwed, finger-tight, between the telescoping metal flue probe and the dust and water-block filter. It must be used for CO measurements in flue gas and may also be used for CO measurements in ambient air. The beads in the filter cartridge should be replaced when about 90% of the material has changed color from purple to brown or when it becomes blocked by soot or water. Filter beads for refilling approximately 50 cartridges are available as Part No. PR-050. Replacement flue gas filters are available as Part No. FF-005 (package of 5 filters).

To refill the filter cartridge, remove the threaded top and pour out the spent filter material. Retrieve the plastic retainer disk from the spent filter material. Fill the cartridge with fresh filter material up to the bottom of threads, place the plastic retainer disk flat on top, and screw the top finger tight. Check the seal by carrying out a block test with the detector.

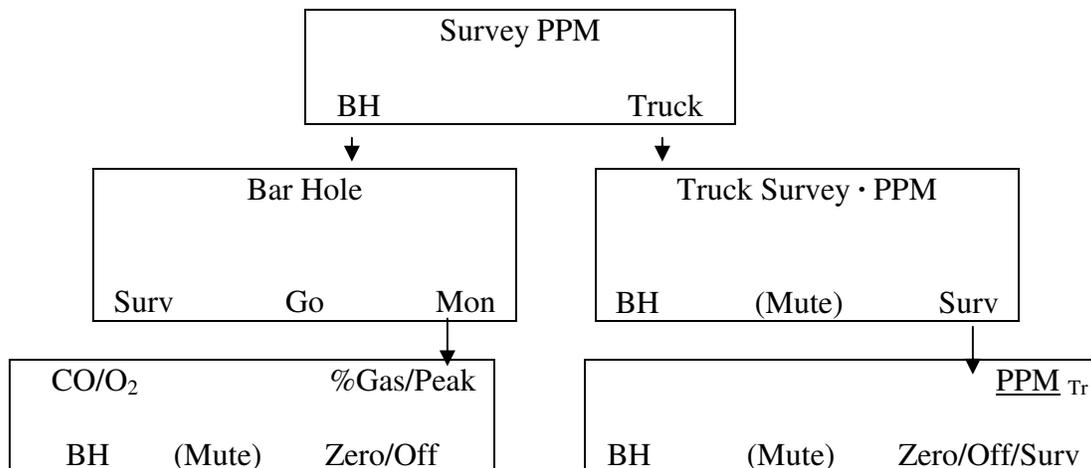
**CAUTION:** Do not remove or puncture the white filter in the bottom of the filter cartridge. If this filter becomes damaged, discard the filter cartridge.

### **Heavy Hydrocarbon Filter**

A heavy hydrocarbon filter, filled with activated carbon, can be used with the standard probe or the bar hole probe on a one-time-only basis. Activated carbon adsorbs gasoline and other heavy hydrocarbons (for example, propane or butane) which interfere with methane detection. In order to keep the filter material from adsorbing hydrocarbons prior to use, the filter is fitted with plastic end caps which must be removed just before use. The filter should be either discarded after use or refilled with activated carbon and recapped with the plastic end caps. This filter is designed to be screwed finger-tight between the probe and the dust and water-block filter. Activated carbon for refilling approximately 50 cartridges is available as Part No. HR-050. The refill procedure is the same as described for the flue gas filter. Heavy hydrocarbon filters are available as Part No. HF-005 (package of 5 filters).

The heavy hydrocarbon filter can also remove some alcohols and unsaturated hydrocarbons which can interfere with CO readings. The filter should be discarded or refilled after each use.

**APPENDIX 1**  
**MAIN SEQUENCES FOR OPERATION MODES**



**APPENDIX 2**

**THE GAS-ROVER™ IN MOBILE SURVEYS**

The Gas-Rover™ can easily be installed in a company’s vehicle if the sampling system meets Bascom-Turner’s specifications. Vehicles that are currently using a Heath Detecto-Pak III or IV for mobile surveys need minimal modification. Vehicles using older equipment or equipment from other manufacturers, such as Dafrol or Southern Cross, need a more extensive modification. For new vehicles, Bascom-Turner has available a mobile survey kit (Part No. MP-001) which can be installed in about 4 hours.

**MODIFICATIONS OF EXISTING SAMPLING SYSTEMS**

The two chain and funnel assemblies that run from the front bumper should be about four feet apart and centered. Adjust the funnel height to one inch above ground. Connect a flow meter capable of displaying flows from 0 to 5 LPM (Dwyer RMA-26 or equivalent) to the tubing that connects the pump to the instrument. Turn the adjustment knob on the outlet side of the pump to read 3 LPM. Remove the flowmeter and connect the Rover to the outlet of the pump using the special connector supplied by Bascom-Turner (Part No. MA-024). When using the Rover in a mobile fashion, the unit must be set in the *Truck* mode.

**MODIFICATIONS FOR OLDER SYSTEMS**

Problems with older systems may be inadequate secondary pump volume and multiple funnel assemblies. The funnel assemblies should be reworked to only two funnels set one inch above ground. The secondary pump must be replaced with a larger pump supplied by Bascom-Turner (Part No. HP-001).

**WARNING:** In all instances, it is important that the sampling systems be leak tight. Even slight leaks can compromise the accuracy and response time of a mobile sampling system.

## PART 2. SETUP AND CALIBRATION

### 1. SETUP

**Setup Time and Date.** To change the time and/or date of a Gas-Rover, power the unit with the left “Power-On” button and when the unit displays the time and date, press the right “Edit” button once. The first digit of the hour will begin to flash. The right “Update” button will increment the flashing digit and the left “Next” button will advance it. When Next is pressed at the last flashing digit, the Edit screen is restored and the power-on sequence resumes with the edited time and date.

To review or change other setup parameters, power on the Gas-Rover with the left “Power-On” button and while the unit displays “*Bascom-Turner Gas-Rover*” press the right button once. A menu of three parameters will be displayed with a pointer to the right of the first parameter:

```
Alarm Limits      ←
Bar Hole Time
Air Free CO
Power Off
```

The left “Yes” button selects the parameter indicated by the pointer while the right “No” button advances the pointer to the next parameter.

Once a parameter is selected the current setting can be saved unchanged by pressing the left “Save” button or can be changed by pressing the right “Edit” button. If editing is selected, the Edit screen flashes the parameter or portion of the parameter which can be toggled or incremented with the right “Update” button. When a (flashing) parameter is OK, press the left “Next” button to either advance to the next digit or to leave the Edit screen and display the edited parameter.

**Alarm Limits.** Alarm level displays which allow limits to be saved or edited are:

%LEL	Alarm Limit: 1 to 20%	Factory Setting: 20%
%GAS	Alarm Limit: 0.1 to 1%	Factory Setting: 1%
SURVEY PPM	Alarm Limit: 5 to 500 ppm	Factory Setting: 10ppm
PPM CO	Alarm Limit: 1 to 200ppm	Factory Setting: 35ppm

The low and high percent oxygen alarm limits (19.5% and 23%) can not be changed.

**Bar-Hole Time.** The bar-hole time is the time, in seconds, during which gas is sampled from a bar-hole. The peak and the average of the last three readings are stored and displayed. The bar-hole time can be set from 5 to 60 seconds. The factory setting is 15 seconds.

**Air-Free CO.** Gas-Rover detectors with both CO and Oxygen sensors may be setup to display CO on an “air-free” basis. This choice may be appropriate when sampling flue Gas which may contain varying amounts of “excess” air. When this feature is enabled, the instrument automatically calculates the concentration of CO in ppm in a gas free of Oxygen and displays it in the Monitor mode labeled as AFCO. Whenever the amount of Oxygen in the sampled gas exceeds 16%, CO is automatically reported without the excess air correction, i.e. as measured, on the assumption that the medium is in fact air and not flue gas. This feature is set at the factory at OFF, i.e. disabled.

## 2. FURTHER SETUP PARAMETERS

Power on the Gas-Rover with the left “Power On” button and while the detector displays “*Bascom-Turner Gas-Rover*”, press the right button once and the center button once. A menu of four choices will be displayed:

Cal Due Time	←
Pump Current	
New Filament	
Power Off	

The left “Yes” button selects the option indicated by the pointer and the right “No” button advances the pointer to the next line.

**Cal-Due Time.** The Gas-Rover should be calibrated regularly and this parameter specifies the desired calibration period in days. When the detector is turned on, the Gas-Rover notifies the operator when calibration is due. If the calibration period has expired, the Gas-Rover reminds the operator that calibration is overdue by waiting at the Calibration Due screen. The “Override” button allows the operator to continue and use the instrument. The factory setting for the calibration period is 31 days; this parameter may be set from 1 to 31 days.

**Pump Current.** The test starts with the pump off, indicated by 0, and a current that should be a small number, less than 5, possibly negative. The left “Up” key turns the pump on. The nominal current is 60 ma, range 55-70 ma. When the detector intake is blocked, the pump current should increase significantly, nominally to 220 ma. Typically, the pump current rises by about 15 ma when a hose and probe are attached.

The Pump Noise test follows when the “Exit” key is pressed. Pump Noise is meaningful only under load, i.e. when hose, probe, and filters are connected to the detector’s intake nozzle. The detector should not be handled or moved when the pump noise test is running.

Pump Noise (Typical)	
Off	On
1.2	7.4

The pump is cycled through Off and On, in round robin fashion, while the overall sensor noise is measured. The flow should be smooth in order to have consistent readings in the PPM range. If the pump is pulsing, the resolution of the PPM readings will be reduced. This may occur if particulate material gets caught in the pump. Because of thermal drift, this test must be run for about 3 minutes before meaningful noise numbers are displayed.

The noise shown in the “Off” column is independent of the pump. When new, the methane sensor noise should be less than 5.0. As the sensor ages, the noise may increase somewhat, but should remain less than 8.0. The noise with the pump on should be less than 12.0. The noise numbers change as the test runs and typical numbers should be used for interpretation; an occasional high number is not significant and may be ignored.

**New Filament.** This screen must be run after a new methane or CO sensor is installed and before the sensor is first calibrated. To start the new filament process, press the left “Run” button. After a “*Please Ensure Clean Air*” screen appears, the instrument reverts to a normal start up screen and proceeds through the various screens to a mandatory two gas calibration screen.

### 3. CALIBRATION

Calibration must be carried out on a new sensor the next time the instrument is turned on; with an already installed sensor, the calibration should be carried out at specified intervals. The A-CAL firmware calibrates the Gas-Rover using calibration gas available from Bascom-Turner containing  $2.5 \pm 0.05\%$  methane and  $100 \text{ ppm} \pm 2 \text{ ppm CO}$  in air. Calibration gas is provided in a disposable tank containing either 105 liters of gas (Part No. MC-105) or 620 liters (part No. MC-620). The thermal conductivity sensor can be calibrated with pure methane or natural gas. The oxygen sensor is calibrated with ambient air during power-up.

The calibration gas must be delivered at or near atmospheric pressure to ensure accurate calibration. For the 105 liter gas tanks Bascom-Turner recommends using a constant flow regulator (Part No. FR-001) set to the sampling rate of the Gas-Rover. For the 620 liter gas tanks Bascom-Turner recommends using an on-demand regulator (Part No. FR-401), which automatically adjusts its flow to the pumping rate of the Gas-Rover.

**A-CAL Operation.** For complete calibration, calibrate the thermal conductivity sensor with methane or natural gas first, and then calibrate the CO and catalytic combustion sensors with 2.5% methane and 100 ppm CO in air. For a partial calibration, calibrate the CO and catalytic combustion sensors with 2.5% methane and 100 ppm CO in air.

**A-CAL Calibration with Pure Methane or System Gas.** Power on the Gas-Rover with the left “Power-On” button and while the unit displays “*Calibrate By .....*” press the “CAL” button. After autozero, choose “A-CAL”, connect pure methane or natural gas and press the left “Yes” button. The screen displays “*Calibrating*” for about a minute and then changes to “*Calibration OK*” with a display of readings taken while sampling calibration gas or “*Does Not Calibrate*” if calibration was unsuccessful. Three tries are allowed before the screen displays “Please Service” for 15 seconds and then the instrument turns OFF.

**Calibration with 2.5% Methane and 100 ppm CO.** Power on the Gas-Rover with the left “Power-On” button and while the unit displays “*Calibrate By .....*” press the right “CAL” button once. After a successful autozero, choose A-CAL. With the unit’s screen displaying “*Connect Calibration Gas*”, connect the 2.5% methane and 100 ppm CO in air calibration gas and press the left “Yes” button. The screen displays “*Calibrating*” for about a minute and then changes to “*Calibration OK*” with a display of % GAS (and ppm CO readings if it has a CO sensor) or “*Does Not Calibrate*”, if calibration was unsuccessful. Pressing the left “Re-Try” button returns to the Calibration screen. If three tries at calibration are unsuccessful, the screen displays “*Please Service*” for 15 seconds and then the instrument turns OFF.

Following calibration, the left button leads again to calibration, the right button exits to the Monitor mode. In both cases, an intermediate screen displays the sensitivity in  $\mu\text{w/ppm}$  and  $\text{mw}/1\%$ . The first quantity ( $\mu\text{w/ppm}$ ) refers to the Survey mode, the second ( $\text{mw}/1\%$ ) to the Monitor mode. If the sensitivity of the Survey mode falls below  $0.5 \mu\text{w/ppm}$ , the natural gas sensor should be changed. Similarly if the sensitivity in the Monitor mode falls below  $8 \text{ mw}/1\%$  GAS, the gas sensor should be changed. In both cases the display reads “*Please Change Methane Sensor*” and the instrument is placed in Off condition until a new sensor is installed.

**CAUTION:** Automatic calibration presupposes and depends on using Bascom-Turner’s calibration gas (Part No. MC-105 or MC-620). Do not use a gas of a different composition for automatic calibration.

### PART 3. THE USB INTERFACE

The USB interface is used for docking calibration and for connecting a Gas-Rover to a computer for data transfer and for setting operating parameters. The cable required for the connection is a six foot long, 4-pin, mini BM plug to standard AM plug and is available from Bascom-Turner (Part No. UC-001).

Docking calibration is described in a separate manual and by prompts on the dock. Data transfer is described below.

**DATA-LINK™.** DATA-LINK™ is a software package available from Bascom-Turner (Part No. DL-001) for downloading and archiving data, viewing and optionally printing reports of data logged by Gas-Rovers, and for maintaining the detectors by uploading setup parameters. DATA-LINK™ can be installed on PC's with Windows 2000 or XP Pro operating systems and equipped with a USB port.



**Figure 3.** Main Menu, the initial DATA-LINK™ screen

## 1. DOWNLOADS

The main menu allows selection of four different downloads from the detector to the PC: readings, calibrations, locations (if available), and user, unit and setup data. Also three types of reports can be selected: Readings and Exposure (TWA and STEL), Calibration, and User, Unit and Office. Four types of maintenance can be performed: resetting date and time, adding, editing and deleting locations, users, units, offices and pins, and uploading unit setup parameters. There is an on-line help menu accessible by clicking on “Help” in the upper left corner of the window. Archived data can be backed-up and restored from back-up with the two buttons below the copyright notice.

**Readings.** Readings are time and date-stamped gas concentration measurements (e.g. %LEL, %GAS, %Oxygen, and ppm CO) recorded by the detector along with identifying information such as the detector's serial number, user's name, the operational mode used to acquire the readings, and the state of the pump when the readings were taken. When the memory is filled, the oldest data is automatically overwritten by the new data.

The following gas concentration readings are recorded with a full suite of sensors:

Percent LEL	0 – 100%	Percent O <sub>2</sub>	0 – 40% vol.
Percent GAS	0 – 100% vol.	PPM CO	0 – 2000 ppm

Note: % LEL readings are only recorded in detector models ending in 201, 301, 321 and 411.  
Standard: 100% LEL = 5% GAS; Optional: 100% LEL = 4% GAS.

The data also includes alarm flags set under the following conditions:

Start of any alarm condition	Start of a low/high O <sub>2</sub> alarm
Start of LEL alarm	Start of a high CO alarm

**Readings and Alarm Summary.** To save time, a Readings Summary data file can be downloaded resulting in the display of a Sorted Readings Table, which helps to identify when the unit was powered on and the operational mode changed. Using the data on alarm flags in the Readings Summary file, a Sorted Alarm Events table can be displayed to identify the time and date of alarm events without downloading the entire readings data file.

**Calibration Data.** Data from the last 24 calibrations are stored in the gas detector. The following data are stored for each calibration:

1. Key data that makes each calibration unique:

- Unit Serial Number
- Date Calibrated
- Hour and Minute Calibrated
- Calibration Sequence

2. Before calibration readings on calibration gas
3. After calibration readings on calibration gas
4. Sensor sensitivities
5. Operational information:

- Pump working OK (Y/N)
- Days since last calibration
- Calibration check OK (Y/N)
- Minutes operated since last calibration
- Number of times the unit was powered on since last calibration
- Methane sensor cleaned during calibration (Y/N)

**User Data.** The user data is stored in the detector as a single record and includes:

- User Name
- Day Limit Between Calibrations
- Personal Identification Number (PIN)

PIN entry can be optionally required for calibrating a detector at a docking station. The PIN can be a number entered on a keypad or an alphanumeric entered on a keyboard.

**Unit Data.** The unit data is partially stored in the detector and completely stored in one or more PCs. Some unit data is required and some is optional.

**Required Unit Data.** Unit ID Number is an integer assigned to the unit when it is entered into the unit database for the first time. Unit Serial Number is the multi-digit hyphenated number on the case of the unit and permanently stored in the unit's memory (i.e. XXXX-XXXXXX). Unit Model Number is the alpha-hyphen-numeric which appears on the label of the unit (i.e. VGC-301). Date Originally Invoiced is the date of Bascom-Turner Instrument's invoice when the unit was originally shipped. It serves as the start of all warranty periods and mean times between failure periods.

**Optional Unit Data.** "Assigned to Office" is the name or number of the location where the detector will be stationed. User's name is the name or number of the person using the detector, or when the unit is retired and the reason why it is retired (i.e. Lost). Last assigned date and time is changed each time a new user's name is entered.

**Setup Data.** There is a factory installed setup file in every detector which contains operational parameters such as alarm levels for each gas detected, features enabled (Y/N), e.g. air-free CO, and settings such as Bar Hole time.

**Downloading Data.** Before downloading any data the operator is asked to verify that the unit is connected to the PC by USB. If the unit is not connected or becomes disconnected, the download program times-out and you must try again. Data is not erased in the unit after downloading so it can be downloaded multiple times. Only one copy of the data is archived in the PC no matter how many times it is downloaded from the unit to the PC.

**Downloading Readings Data.** It can take 5 minutes to download all the readings data from a unit to a PC. In order to save time a data summary can be downloaded, sorted, and only the desired readings can then be downloaded. The Readings and Alarm Events tables can be sorted by unit serial number, date, time, and the operational mode the unit was in when the readings were acquired in order to select the desired readings.

Downloading all readings in a time period bounded by two dates can also be done by first entering the date range and then selecting "Download Readings by Date Range".

## **2. REPORTS**

Reports are selected from the "Readings and Exposure Reports" submenu. This submenu has two tables listing units by unit ID with each table providing different information about the units. The tables of stored alarms and readings which can be scrolled independently of each other by first left-clicking with the mouse to highlight a field, then scrolling with either the up and down arrow keys or the Page Up and Page Down keys. The tables can be searched jointly by unit ID, serial number, operational mode and date to limit the unit information displayed in the tables. Complete data can be redisplayed in both tables by selecting any of the four searches and pressing the enter key without entering any search criteria. After viewing reports on the computer's screen they can be optionally printed.

**Readings Reports.** There are two readings history reports: one is tabular and the other is a screen consisting of concentration versus time plots. In order to view or print these reports the unit ID of the detector which acquired the data must be entered along with a date and time range. Once the report is displayed there is a print button for obtaining a hardcopy.

**Exposure Reports.** There are two exposure history reports: one is tabular and the other is a screen consisting of two STEL and two TWA versus time plots. In order to view or print these reports, the unit ID of the detector which acquired the data must be entered along with a date and time range. Once the report is displayed there is a print button for obtaining a hardcopy.

**Bar-Hole Report.** The bar-hole report is viewed or printed by entering the unit ID of the detector along with a date and time range. A print button is used to obtain a hardcopy.

**Calibration Reports.** Calibration Reports are selected from the "Calibration Reports" submenu. This submenu has two tables listing units by unit ID with each table providing different information about the units. The tables can be scrolled independently of each other by left-clicking with the mouse highlighting a field, then scrolling with either the up and down arrow keys or the Page Up and Page Down keys. The tables can be searched jointly by unit ID, serial number, assigned office and user to limit the unit information displayed in the tables. The complete data can be redisplayed in both tables by selecting any of the four searches and pressing the enter key without entering any search criteria.

There are two types of calibration reports, one type is a summary of data acquired during calibration limited to a specific unit and the second type is a general report of all units.

**Sensor Sensitivity History by Unit ID** is a report of the date and time of each calibration and the sensitivity of each sensor with the last calibration data listed first. This report can be used to forecast sensor performance and replace sensors before they reach the lower sensitivity limit.

**Calibration History by Unit ID** is a report of the date and time of each calibration with before and after calibration readings of each sensor. Since the pump must work in order to calibrate a detector, this is checked first and is indicated in the "Pump OK" column in the report.

**Operation Check Report by Unit ID** is a report of the methane operation check which can be optionally displayed and printed from Calibration History by Unit ID.

**Last Calibration Data by Unit ID** is a complete report of the last recorded calibration. The right hand column summarizes the date, time, pump, and sensor checks.

**Units Overdue for Calibration** is a report of all units not calibrated within their calibration period.

**Average Cal. and Operational Periods** first asks for "Prior Monthly Period Selection" with a default value of 1 month. If the averages over the last month are to be reported then select "OK", otherwise enter the desired number of months over which to average and then select "OK". The report lists units by unit ID number and has five averages for each unit:

Time/Use is total minutes unit was on divided by number of times it was turned on.

Use/Day is total minutes unit was on divided by number of days in use.

Uses/Day is number of times unit was turned on divided by number of days in use.

CAL. Period is the number of days in use divided by the number of times unit was automatically calibrated (either docked or non-docked).

**User, Unit, and Office Reports.** User, unit and office reports are selected from the "User, Unit, and Office Reports" submenu. This submenu has two tables listing units by unit ID with each table providing different information about the units. The tables can be scrolled independently of each other by first left-clicking with the mouse highlighting a field, then scrolling with either the up and down arrow keys or the Page Up and Page Down keys. The tables can be searched jointly by unit ID, serial number, assigned office and user to limit the unit information displayed in the tables. The full data can be redisplayed in both tables by selecting any of the four searches and pressing the enter key without entering any search criteria.

**Active Unit Report** is a listing of all detectors in the UNITLOG database indicated as non-retired. The report is entitled "Active Unit Data". Fields, which are columns in the tabular report, include:

Unit ID	Invoice Date
Serial No.	Assigned to Office
Model No.	Assigned to User

**Retired Unit Report** is a listing of all detectors in the UNITLOG database indicated as retired. The report is entitled "Retired Unit Data". Fields which are columns in the tabular report are identical to the Active Unit Report.

**Unit Assignment History by Unit ID** is a list of each time when a unit's assigned user is changed. Whenever the Unit Edit button is used to change a unit's assignment, there is a date and time stamped record created which provides an assignment audit trail of who began using the unit. The Unit Assignment History by Unit ID report summarizes this audit trail with a chronological list of users and the date and time when they were assigned the unit.

**Unit Assignment History by User** is a list of each time when a user is assigned a new unit. The Unit Assignment History by User report summarizes the assignment audit trail with a chronological list of units used by a user and the data and time when they were assigned the unit.

**Office Report** is a list of offices which have assigned units. The office name, office supervisor and their email address or FAX number are listed in the report.

### 3. MAINTENANCE

**Uploading Location.** From the main menu of DATA-LINK™ under Maintenance, click on the "Location" button. On the Maintain Location Data screen select a record with the desired location using the select buttons along the bottom of the table. Or add a record, if none exists for the location you are uploading. With just the desired record selected, click on the "Upload One Selected Location Record" button.

**Uploading Username.** From the main menu of DATA-LINK™ under Maintenance, click on the "User, Unit, Office & Pin" button. On the Maintain User, Unit, Office & Pin screen, select a record with the username you wish to upload using the select buttons along the bottom of the table. Or add a record, if none exists for the unit you are setting up, or edit an existing record for the unit with the username you would like to upload. With just the desired record selected, click on the "Upload One Selected User Record" button.

Readings & Exposure Reports

Return to Main Menu

Readings Reports By Unit ID, Date, & Time

- Readings History by Date & Time
- Readings Plotted by Elapsed Time
- Bar Hole Readings by Date & Time

Unit ID	Start Date MM/DD/YY	Start Time hh:mm:ss PM	End Date MM/DD/YY	End Time hh:mm:ss AM

For plotting use time periods of 1-2 minutes, 1-2 hours, or 5-20 hours.

Exposure Reports By Unit ID, Date, & Time

- STEL & TWA History by Date & Time
- STELs & TWAs Plotted by Elapsed Time

Start Times & Dates of Stored Alarms

Unit ID	Mode	Date	Start Time	LEL	-O <sub>2</sub>	+O <sub>2</sub>	CO	H <sub>2</sub> S	STEL TWA
4	T	7/13/2006	7:35:09 AM	Y					
5	M	7/13/2006	3:18:31 PM	Y					
5	M	7/13/2006	3:18:32 PM	Y					
5	M	7/13/2006	3:18:33 PM	Y					
5	M	7/13/2006	3:18:35 PM	Y					

ID  Mode  Date Search

Modes: B = Bar-Hole, F = Flue Gas, M = Monitor, T = Truck/Survey

Date Range of Stored Readings

Unit ID	Serial No.	First Date	Last Date
3	0411-054590	2/2/2005	8/29/2006
4	0628-300002	7/12/2006	7/13/2006
5	0628-300004	7/13/2006	7/14/2006
6	0630-300003	9/1/2006	9/5/2006
7	0628-300013	2/2/2005	8/28/2006

ID  Serial No. Search

## Readings and Exposure Report

Bar-Hole Readings by Date & Time for Unit: 13

Return to Sub-Menu

Print Report

Date	Time	Seq	Peak %GAS	Sustained %GAS	User	Location
12/19/2007	11:40:46 AM	2	.0	.0	Joe Jones	Norwood MA/111 Downey St
12/19/2007	11:41:23 AM	2	35.1	23.5	Joe Jones	Norwood MA/111 Downey St
12/19/2007	11:42:00 AM	2	22.2	14.2	Joe Jones	Norwood MA/111 Downey St
12/19/2007	11:42:42 AM	2	56.7	34.7	Joe Jones	Norwood MA/111 Downey St
12/19/2007	11:43:18 AM	2	16.3	2.4	Joe Jones	Norwood MA/111 Downey St

Bar Holing reports showing peak and sustained readings

## PART 4. MAINTENANCE

### 1. SENSOR AND PUMP INSTALLATION

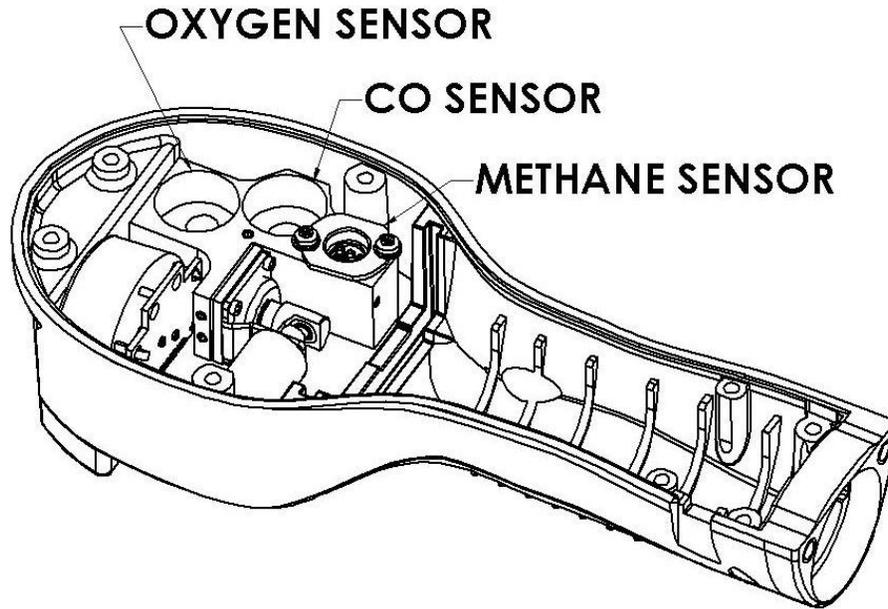
To install a new sensor or pump follow these steps while referring to figure 4:

1. Power OFF the instrument, remove the batteries, and with a box wrench unscrew the inlet port and filter assembly.
2. Remove the six recessed Phillips screws from the back of the instrument case and lift the top cover off the case. Do **not** remove the two large Phillips screws flush with the back of the case, unless installing a new pump.
3. Place the instrument on a flat surface and remove the two Phillips screws located near the end of the handle. Carefully lift the circuit board out of the case.
4. If the **methane sensor** is to be replaced, remove the two Phillips screws holding the old sensor and unplug the 8 pin connector on the end of the sensor cable. Replace the old sensor with the new and connect and secure as before.
5. The **oxygen and CO sensors** are replaced by unplugging the old sensor from the circuit board, recovering the black gasket on the end of the sensor and replacing it in the sensor well, and inserting the new sensor into the sockets on the circuit board.
6. The **pump** is replaced by removing the two large Phillips screws flush with the back of the case (see Step 2 above), removing the manifold from the bottom of the case, and unscrewing the four screws which secure the pump gasket, pump plate, diaphragm, and piston to the manifold. Usually replacing the pump plate is sufficient to restore operation. Reverse the process for reinstallation.
7. The **pump motor** can be replaced by following the procedure in Step 6 and then removing the four Phillips screws which secure the pump motor to the mounting bracket. Reverse the process with the new motor.
8. Verify that the manifold, methane sensor, pump, and pump motor are securely mounted to the bottom of the case and the sensors appropriate to the instrument are plugged into the circuit board.
9. Align the cables to avoid the pump and guide the battery board into the two grooves on the left and right side of the handle. Lower the main circuit board until it rests on all the bosses.

<p><b>CAUTION:</b> Crossed wires trapped between the main circuit board and the intake manifold will prevent the board from seating properly and may lead to intermittent contact of sensors with their sockets on the circuit board.</p>
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10. Secure the two Phillips screws on the right and left side of the circuit board toward the end of the handle.
11. Replace the top cover of the case and secure it with the six Phillips screws.
12. Replace the inlet port and filter assembly with a box wrench and replace the batteries.

**CAUTION:** After replacing a methane or a CO sensor, perform the New Filament procedure (described under Part 2, Setup and Calibration) and then completely calibrate the instrument (both with 2.5% and 100% gas).



**Figure 4.** Gas-Rover with top of case and main circuit board removed.

## ACCESSORIES AND SPARE PARTS

Description	Part Number
<b>1. Probes and Hoses</b>	
Gooseneck Probe with Quick Connect and Filter (14 inch long) .....	<b>GP - 514</b>
Surface Probe (with Quick Connect and Cone) .....	<b>SP - 636</b>
Ceiling/Bar Hole Probe & Rubber Tip (34 inch long, clear) .....	<b>BP - 034</b>
Clear Bar Hole Probe (34 inch long, clear, side holes) .....	<b>BP - 134</b>
Fiberglass Bar Hole Probe (36 inch long, no side holes) .....	<b>BP - 136</b>
Fiberglass Bar Hole Probe (36 inch long, side holes) .....	<b>BP - 236</b>
Metal Bar Hole Probe (36 inch long, side holes) .....	<b>BP - 536</b>
Standard Flue Gas Probe & Filter (10 inch long) .....	<b>FP - 110</b>
Heavy Duty Flue Gas Probe & Filter .....	<b>FP - 112</b>
Straight Hose with Quick Connect Fitting (5 ft. long) .....	<b>SQ - 060</b>
<b>2. Filters</b>	
Dust & Water-block Filter (5/pkg) .....	<b>WF - 505</b>
Water-stopper (with push-button release) .....	<b>WS - 001</b>
Dust Stopper (with replaceable filter) .....	<b>DS - 001</b>
Replacement Dust Filters (5/pkg) .....	<b>DF - 105</b>
Flue Gas Filter (5/pkg) .....	<b>FF - 005</b>
Extended Duty Flue Gas Filter (5/pkg) .....	<b>FF - 105</b>
Heavy Hydrocarbon Filter (5/pkg) .....	<b>HF - 005</b>
Inlet Filter & Quick Connect Air Intake (5/pkg) .....	<b>IF - 705</b>
<b>3. Sensors</b>	
Methane Sensor (in flame arrestor) .....	<b>MS - 601</b>
CO Sensor .....	<b>CO - 301</b>
Oxygen Sensor .....	<b>OS - 501</b>
<b>4. Replacement Parts, and Manual</b>	
Pump Motor .....	<b>PM - 501</b>
Pump Head, Diaphragm/Plunger Assembly (5 sets/pkg) .....	<b>PD - 505</b>
Intake Manifold with Pump .....	<b>RM - 501</b>
Battery Compartment Cap .....	<b>BC - 501</b>
Operating Manual .....	<b>OM - 0108</b>
<b>5. Instrument Case</b>	
Instrument Case w/Ethafoam Insert .....	<b>IC - 501</b>
<b>6. Accessories for Calibration &amp; Maintenance</b>	
Manual Calibration Apparatus (with MC-620 & FR-401) .....	<b>PCA - 302</b>
Methane & CO Calibration Gas (2.5% methane & 100 ppm CO, 620 liters) .....	<b>MC - 620</b>
On-demand Regulator for MC-620 .....	<b>FR - 401</b>
Rechargeable C-Sized Batteries (NiMH, 4/pkg) .....	<b>NM - 504</b>
Rapid Charger for 2 to 4 C-Sized Batteries .....	<b>RC - 504</b>

### Prices and Terms

Prices and specifications are subject to change without notice. Prices are U.S. dollars. Orders are subject to acceptance and are FOB Norwood, Massachusetts. Payment terms are Net 30 days. Minimum order is \$50.

