BASCOM-TURNER

INSTRUMENTS

GAS-EXPLORER™ DETECTORS

OPERATION MANUAL

NATURAL GAS, CARBON MONOXIDE, OXYGEN, HYDROGEN SULFIDE

Part Number OM-0517

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

Intrinsically safe Class I, Div 1, Groups C & D, T4

For use in Groups C and D atmospheres (Methane, Propane)

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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SPECIFICATIONS

Gases Detected	Natural Gas (Methane)
	Carbon Monoxide (CO) [Optional]
	Hydrogen Sulfide [Optional]
	Oxygen (O_2) [Optional]
Sensors	Dual Catalytic Combustion (CH_4)
	Thermal Conductivity (CH_4)
	Electrochemical (CO, H_2S O_2)

Ranges

GAS	0 to 10,000 ppm CH_4 by volume
	0 to 100% CH_4 by volume
PPM CO	0 to 2000 ppm carbon monoxide
% O_2	0 to 40% by volume
PPM H_2S	0 to 100ppm by volume

Data Storage And Reports	24 calibrations
	Exposure and Bar-Hole Measurements, Calibration History, Sensor Sensitivity, Operational Periods by User and Unit ID, Office Reports

Calibrated Accuracy CH4: (5°C to 30°C)	2% of reading ± 20ppm
	±0.1% to 5 vol %
	±2.0% from 5% to 100 vol %
CO:	±5% of reading ±10 ppm
H_2S:	±5% of reading ± 1ppm
O2:	±0.2% vol %

Resolution		
GAS		20 ppm from 0 to 10,000 ppm
		0.05 vol % from 0 to 5 vol %
		1.0 vol % from 5 to 100 vol %
CO		1 ppm
H_2S		1ppm
O_2		0.1 vol %
Warm-Up Time		60 seconds
Response Time:	**CH4:**	0.7 seconds (Track)
		2.0 seconds (Monitor)
	H_2S/CO:	45 seconds
	O2:	60 seconds
Operating Temperature		-20°C to 40°C (0°F to 105°F)
Storage Temperature		-40°C to 60°C (-40°F to 140°F)
Humidity		0 to 95% RH (non-condensing)
Power Supply		Two C-size Alkaline or Two C-size Rechargeable NiMH
Continuous Operating Time per Battery Set		10 hours typical (25°C)
Weight		24 oz. (680 g)

FEATURES

The Gas-Explorer™ 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:

- **Absolute Compliance** (Optional)
  The instrument automatically calls for and requires calibration at the end of a pre-determined interval.

- **Automatic Data Storage and Reports**
  Automatic storage of time and mode-stamped readings. Automatic storage of the last 24 calibrations. Automatic generation of reports.

- **Automatic Calibration**
  Calibration is performed automatically using Bascom-Turner's calibration gas.

- **One-Gas Calibration** (Optional)
  Calibration of the thermal conductivity sensor (vs methane) is automatically carried out with the One-Gas routine. Alternatively, the sensor can be calibrated with System Gas.

- **Measurements Over the Full Range of Gas**
  The instruments detect methane over the full range of methane concentrations up to 100% GAS. Peak and current readings are displayed simultaneously.

- **Track Gas**
  A sensitive, calibrated scale with 20ppm resolution and quick response makes it easy to find gas leaks.

- **Bar Holing**
  Peak and sustained bar-hole readings are automatically displayed after gas is pumped for a precise, fixed time.

- **Purge**
  Measures the concentration of natural gas with resolution of 0.1% by volume as sensed by the thermal conductivity sensor.

- **Automatic Sampling**
  An intrinsically safe pump automatically samples ambient air, flue gas, or 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 O_2.

- **Easy-to-Use**
  Simple operation without complicated or confusing displays. A short "help" manual is stored onboard.

1.   THE GAS-EXPLORER DETECTORS

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

Model EGI -201 -   Detects natural gas and displays it as PPM, % LEL or % GAS

Model EGI -211 -   Detects natural gas and displays it as PPM and % GAS

Model EGC-301 -   Detects natural gas and carbon monoxide and displays it as
and -311   PPM and % LEL (301) or % GAS (311) and PPM CO (parts per million of CO)

Model EGO-321 -   Detects natural gas and oxygen and displays gas as PPM, % LEL or % GAS and % Oxygen.

Model EGO-322 -   Detects natural gas and oxygen and displays PPM or %GAS and %Oxygen.

Model EGA-411 -   Detects natural gas, CO, and oxygen and displays PPM, or %
and -412   LEL (411) or % GAS (412), PPM CO and % Oxygen

Model EGA-611 -   Detects natural gas, CO, H_2S and oxygen and displays PPM
and -612   or % GAS, PPM CO, PPM H_2S, and % Oxygen.

All models display gas in PPM in the Track Gas mode.

All models may be used to test ambient air and bar hole to locate natural 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 the 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, HS for H_2S, *"Low Oxygen"* for low oxygen, and *"High Oxygen"* for high oxygen.

Factory set alarm limits are 1.0% methane, 35 ppm CO, 9ppm H_2S, and 19.5% for low and 23.0% for high oxygen.

No alarms are given in the Bar Hole mode.

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

OPTIONS

All units may have (optionally) Blue Tooth (Option BT) and/or GPS (Option GPS). The former may be used for transmitting stored calibrations, while the latter assigns coordinates to all measurements (gas readings) obtained by an instrument. GPS coordinates are automatically stored together with corresponding readings of all sensors on-board.

2.   ESSENTIAL OPERATING PRACTICE

Gas-Explorer detectors are easy to use. A detector is turned on by pressing the left button; its operation is controlled by three *"Soft"* buttons whose function is shown on the display. The middle button toggles *"Mute"* on and off in the Track Gas mode (see later). Double-clicking the middle button turns the backlight continuously ON, or OFF depending on its previous state. Once the appropriate display is selected, operation is automatic. However, a few general rules must be followed to insure reliability.

Pump. Gas-Explorer 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 tip with your finger to show *"Pump OK"*.

If *"Pump OK"* does not appear, tighten all connections and repeat the test. If a block condition is still not observed, remove the probe and block directly the inlet to the instrument. 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. If there is any indication that the pump is not operating normally, return the instrument for repair.

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 natural gas sensor and the pump. It also voids the limited warranty.** Filters are available from Bascom-Turner in packages of five, Part No. WF-505 for all models except WF-705 for EGA-611/612.

Zero Check. All sensors drift to some extent over time. Sensor drift is automatically 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 this limit, "*NO GO*" is displayed and the user is asked to autozero the unit in "clean" outdoor air. The user can override this limit and re-zero the instrument unless the zero has drifted over 1.0% vol. GAS, in which case the instrument should be checked by a trained professional (the sensor may need replacement). It is important that the zero adjustment be done in clean air, for example, outdoors. If the sampled gas is not clean, a systematic error may be introduced in subsequent measurements.

> **WARNING:**   **On a call, turn the instrument on outdoors, not indoors.**

Test and Calibration.   Gas-Explorer detectors must be checked and calibrated periodically with gas of known composition. The catalytic combustion, carbon monoxide, and hydrogen sulfide sensors depend on catalysts which may loose activity or get poisoned during use. When this happens, there will be diminished response.

The necessary frequency of calibration depends on actual use and on the concentration of catalyst poisons in the sampled gas. This concentration is, or course, not generally known.

A detector can be tested with "bump" gas. Such tests 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_4 and 100 ppm CO in air). Given the ease and speed of automatic calibration, it pays to calibrate as frequently as possible, and certainly, no less than monthly.   2.

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

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 <u>not</u> be relied upon by themselves for judging safety; all other significant factors must be taken into account.** 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. They should not be used for detecting combustible dusts or mists.**

3.   OPERATIONAL DESCRIPTION

To conserve the batteries, turn the instrument OFF when not in use.

The instrument is controlled by three push button switches whose function changes with each particular display. A label for each key is shown on the display.

To turn the instrument on, press the left switch. A series of screens is automatically displayed preparatory to entering the first operational mode, viz. "Monitor" (see Section below). Along the way, a number of specialized screens can be used to access specialized functions.

The first screen shows the Model Number and the serial number. The second screen displays gases detected by the particular instrument and provides access to the USB interface (see Part 3). The next screen shows the date and time. To edit the date or time, press the right "Edit" button. The first digit of the display will begin flashing and can be edited by pressing the right "Update" button. Pressing the left "Next" button advances the flashing digit to the next position which may be edited (or not) by pressing the right button, and so on. The same screen provides access to a short manual by pressing the "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 shows 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 required, the instrument proceeds to enter the operational mode "Monitor" (see below).

The period of thirty days between calibrations is a maximum. The instrument may 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 permanently, press the <u>middle</u> button twice (if in Track Gas mode, 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 in the Bar Hole Mode 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 of (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 Track Gas 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, "Monitor", "Track Gas", "Bar Hole" and "Purge".

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, H_2S (HS), and O_2 are also shown if the unit is equipped with the corresponding sensors (see below).

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

Models EGI-201, EGC-301, EGO-321, EGA-411, and EGA-611 display concentrations in increments of 1% LEL up to 100% LEL and then in increments of 1% vol. from 5% to 100% GAS. All other models display % vol. gas in increments of 0.05% up to 5% and then in increments of 1% to 100% GAS.

Track Gas: Connect an appropriate probe (see Section 7) and select "TRACK GAS". The display shows *"TRACK GAS"* for a few seconds. After warm-up, the display shows the concentration of gas in air in parts per million by volume (ppm). Advance a probe along the pipe or other conduit suspected of having a gas leak. The beeper will sound if the ambient concentration of gas rises above 20ppm. Since methane is lighter than air, track a conduit from above whenever possible. Sometimes it is desirable to silence the beeper during a leak survey. To silence the beeper, press the middle switch. *"Mute"* will appear on the display and the beeper will be silent. If the gas concentration goes over 10,000 ppm, (1% Gas) the unit automatically enters the Monitor Mode.

As in the Monitor Mode, the peak reading for Gas is retrained and displayed until another mode of operation is chosen, or a new zero is obtained, or the unit is turned off.

Bar Holing: The detector may be used to measure 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 atmospheres above ground it will not sound. During bar-holing, the alarms for all gases are automatically turned OFF.

To bar hole, select an appropriate probe (see Section 7) and set the front panel to Bar Hole (BH). The instrument will automatically clear any residual gas and check 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 "*GO*" (the middle switch). 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, 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. A water-stopper (Fig. 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 Monitor or Track Gas – not the Bar Hole – mode should be used.**

Purge: The purge mode measures the concentration of natural gas in nitrogen with a resolution of 0.1% by volume from 0.0% to 100.0% as sensed by the thermal conductivity sensor. Purging air-filled lines into service requires lowering the oxygen content to less than 9.7% (or natural gas concentration over 70%).   5.

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 button ("Zero/Off") to get 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 two. For every minute of flue gas sampling allow the detector a minute of room air sampling to dry the filters.

CAUTION: The filter provided with the flue probe **must** be used to avoid interference by nitrogen oxides present 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).

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).

WARNING: Do not touch the flue probe immediately after a measurement. Wait until it cools. Running the instrument in air helps cool the probe.

"Air-Free" CO Flue Measurements

The EGA-411/412 and 611/612 detectors can display measurements of CO on an "air-free" basis if this feature is selected (see Part 2). When this selection is made, the measured CO concentration is referred to air-free flue gas according to:

$$\text{"Air-Free" PPM CO} = \frac{20.9}{20.9 - \text{measured \% O}_2} (\text{measured ppm CO})$$

The instrument displays CO concentrations on an air-free basis using the above relation. The CO reading on the display is labeled by ppm AFCO, i.e. air-free CO. This calculation is used up to 16.0% Oxygen. Beyond this, measured CO concentrations are displayed without conversion, i.e., the "air-free" formula is **not** used.

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. 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 whenever "zero" is chosen in a display.

CAUTION: Zero adjustment **must** be carried out in clean air to avoid systematic errors.

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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 EGC-301 and EGC-311 use the sensors listed above and:

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

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

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

Models EGA-411/412 use all four sensors.

Models EGA-611/612 use the four sensors listed above and an electro chemical H_2S sensor.

Gases, or liquids with appreciable vapor pressure, which may interfere with the detection of methane include substances which combust 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. This filter should **not** be used in ambient air with EGA-611/612.

WARNING: **The methane and CO sensors use catalysts 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-Explorer detectors have an interior coating on their cases to suppress radio frequency interference (RFI).

6. CHANGE OF BATTERIES

Gas-Explorer detectors may be powered by two (2) alkaline **(non-rechargeable)** C-size batteries (1.5V, Type AM-3) or by two rechargeable 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, and the batteries must be changed to make the instrument operational.

> **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.

3. Insert two, fresh C-size alkaline batteries.
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 alkaline (non-rechargeable) batteries because they may leak or vent.**
>
> **WARNING:** **Use only alkaline batteries or rechargeable batteries sold by Bascom-Turner in a Gas-Explorer.**
>
> **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

Metal Gooseneck Probe

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

Standard Probe

The standard probe (Part No. SP-306), a rigid tube, connects to the dust and water-block filter. If extra length is desired, an extension (7", SP-308) is screwed finger-tight onto the end of the probe. A rubber gas collector (Part No. RT-107) is useful for finding leaks under windy conditions.

CAUTION:	Do not use this probe for flue gas measurements. The plastic probe may become soft, deform, or decompose.

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 the 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 four 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-236) 36" long, fiberglass, side holes
Bar Hole Probe (Part No. BP-536) 36" long, steel, side holes.

The bar hole/ceiling probe has a single inlet on the end and comes with a rubber gas collector (Part No. RT-030) useful for finding leaks in overhead pipes. 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). Models EGA-611/612 use WF-705 filters only.
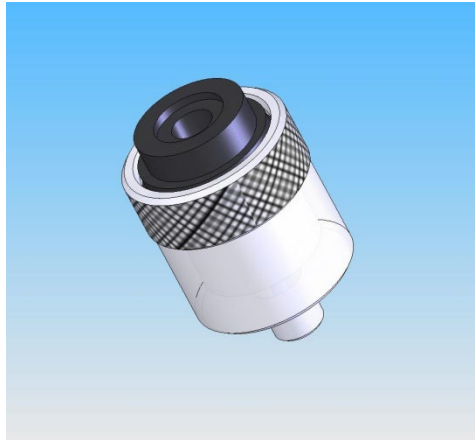
TheWF-505 Filter

CAUTION:	Do not use a Gas-Explorer without a three-way or dust and water-block filter. Do not use a three-way or dust and water-block filter with a puncture.

Inlet Dust Filter (IF-705)

Removal of the intake connector (used to attach the sampling hose) of the detector 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 may be cleaned with compressed air or replaced.

Water-stopper (WS-001)

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. Water is released and the plunger returned to its normal position by depressing a release push-button.

Water-stopper

Dust-Stopper (DS-001)

The dust-stopper is a filter with a large surface area on which dust can collect without slowing the sampling rate of the Gas-Explorer. The filter element is easily cleaned or replaced by removing the threaded cap and either blowing off the filter element or pulling it off and replacing. Replacement dust filter cartridges are available as Part No. DF-105. The dust-stopper should be used between the dust and water-block filter and the probe or water-stopper.

Flue Gas Filter

This filter is designed to be screwed finger-tight between the telescoping metal 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 threaded top and pour out spent filter material. Retrieve the plastic retainer disk from the spent filter material. Fill cartridge with fresh filter material to bottom of threads and place the plastic retainer disk flat on top of the filter material. Screw in top until finger tight and check seal with block tests.

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, is designed to 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 endcaps 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 endcaps. 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.

PART 2. SETUP, CALIBRATION AND ALARM LEVEL SELECTION

1.   SETUP PARAMETERS

To change setup parameters, power on the Gas-Explorer and while it displays "*Bascom-Turner Gas-Explorer*" press the right button once. A menu will be displayed with a pointer:

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

The "Yes" button selects the parameter while the "No" button advances the pointer.

Once a parameter is selected the current setting can be changed by the "Edit" button. If editing is selected, the screen flashes the parameter which can be incremented with the "Update" button. Press the "Next" button to either advance or to leave the Edit screen and display the edited parameter.

Alarm Limits. Alarm levels which may be saved or edited are:

%LEL	Alarm Limit: 1 to 20%	Factory Setting: 20%
%GAS	Alarm Limit: 0.1 to 1%	Factory Setting: 1%
PPM CO	Alarm Limit: 1 to 200ppm	Factory Setting: 35ppm
PPM H_2S	Alarm Limit 1 to 10ppm	Factory Setting: 9ppm

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

Bar-Hole Time. The time can be set from 5 to 60 seconds, factory setting is 15 seconds.

Air-Free CO. Detectors with both CO and Oxygen sensors may be set to display CO on an "air-free" basis. This choice displays the concentration of CO in a gas free of Oxygen and is labeled as AFCO. If Oxygen exceeds 16%, CO is reported without correction.

2.   FURTHER SETUP PARAMETERS

Power on the Gas-Explorer and while the detector displays "*Bascom-Turner Gas-Explorer*", press the right and center buttons once. A menu of four choices will be displayed:

> Cal Due Time   ←
> Pump Current
> New Sensor
> Power Off

Cal-Due Time. This may be set from 1 to 30 days; factory setting is 30 days.

Pump Current. The "Up" key turns the pump on. The current is should be 50-65 ma. When the intake is blocked, it should increase to about 220 ma. The Pump Noise test follows when the "Exit" key is pressed.

The test must be run (with hose, probe, and filter connected) for about 3 minutes to get meaningful numbers. The noise should be 5.0 or less (pump "Off") and less than 12 with the pump "On"

New Sensor. This screen **must** be run after a new sensor is installed and before the sensor is first calibrated. When selected, the instrument reverts to a normal start up screen and proceeds through a mandatory 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-Explorer using calibration gas available from Bascom-Turner. The CAL gas required for automatic calibration is Bascom-Turner's methane and CO calibration gas containing $2.5 \pm 0.05\%$ methane and 100 ppm $\pm$ 2 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-Explorer. 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-Explorer.

A-CAL Calibration.   A-CAL calibration can be carried out either with a One-Gas routine or by using system gas as well as Bascom-Turner calibration gas. A One-Gas calibration requires only Bascom-Turner calibration gas (2.5% methane and 100 ppm CO in air) and automatically calibrates the thermal conductivity sensor with methane.

A-CAL Calibration with System Gas.   Power on the Gas-Explorer with the left "Power-On" button and while the unit displays "*Calibrate By .....*" press the right "CAL" button. After a successful autozero, choose the "A-CAL" button, connect 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 of the H_2S sensor. Proceed as above for pure methane, but use the H_2S calibration gas (10ppm H_2S in methane). The instrument will automatically calibrate the thermal conductivity sensor as well as the H_2S sensor.

One Gas Calibration with 2.5% Methane and 100 ppm CO. Power on the Gas-Explorer 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 µw/ppm and mw/1%. The first quantity (µw/ppm) refers to the Track Gas mode, the second (mw/1%) to the Monitor mode. If the sensitivity falls below 0.5 µw/ppm, or below 8 mw/1% GAS, the gas sensor should be changed. In both cases the display reads *"Please Change Methane Sensor"* and the instrument is Turned Off.

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-Explorer 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 and in a companion manual for DATA-LINK4Access.

DataLink4Access is an intuitive, easy to use data management system that allows users to download and organize readings, calibration and GPS data from Gas-Explorers. Each button's operation is clearly labeled, and users can navigate from one feature to the next by closing an operation window or selecting a previously opened tab. With DataLink4Access, users can view and archive readings, data and calibration records; assign a detector to a specific user; update a detector's date and time; and manage all active and retired units.

GPS enabled Gas-Explorer users can use DataLink4Access to preview a single survey or set of bar holes in Google Earth, use the search by address function to view recent or historical data for a specific location, or export data for overlay on ArcGIS, MapeFrame or other GIS asset maps.
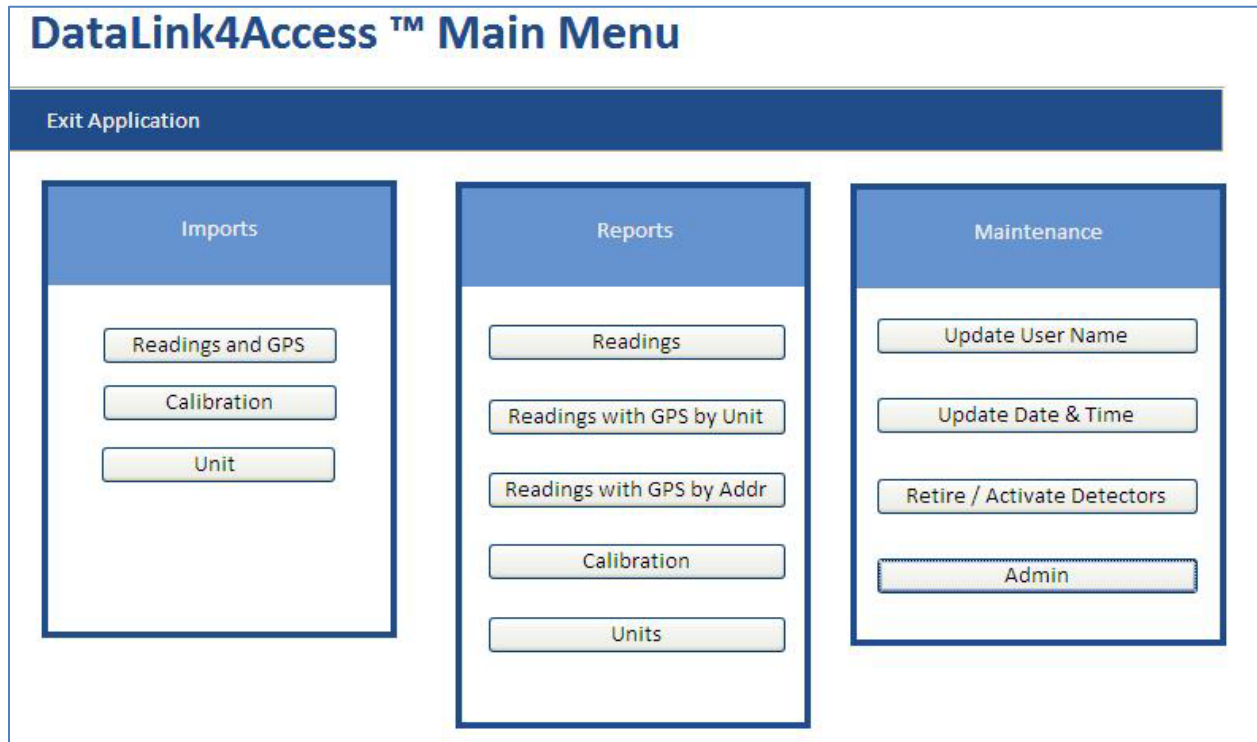
1.   **DOWNLOADS**

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_2	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, 411, and 611. 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_2 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   16.

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.

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: 18.

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.   ADMINISTRATION

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.

PART 4. MAINTENANCE

1. SENSOR AND PUMP INSTALLATION

To install a new sensor or pump follow these steps:

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, CO, and combined CO/H$_2$S 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.

CAUTION: 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.

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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 sensor, perform the New Filament procedure (described under Part 2, Setup and Calibration) and then calibrate the instrument.
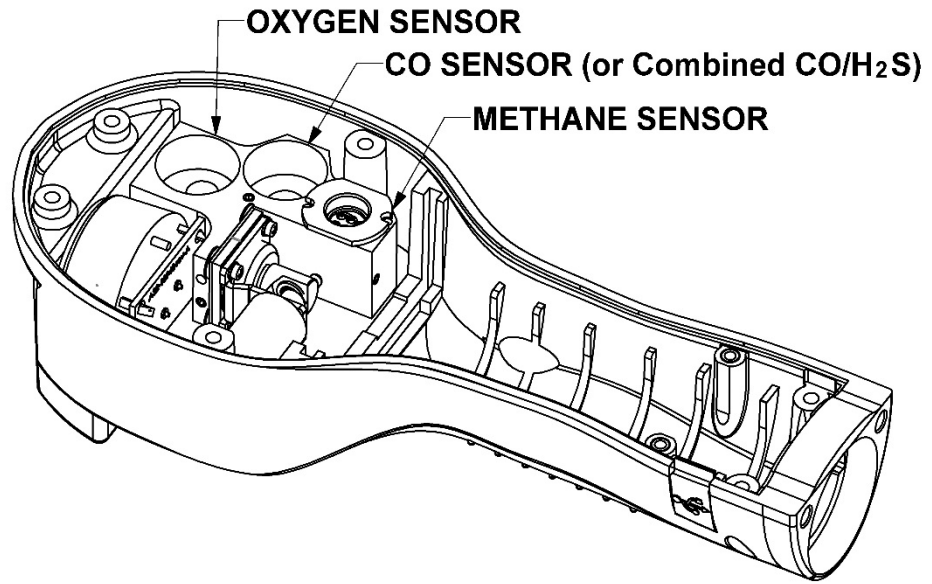

OXYGEN SENSOR

CO SENSOR (or Combined CO/H₂S)

METHANE SENSOR

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

ACCESSORIES AND SPARE PARTS

Description		Part Number	

1. Probes and Hoses

Gooseneck Probe with Quick Connect and Filter (14 inch long)	**GP**	**-**	**514**
Surface Probe (with Quick Connect and Cone)	**SP**	**-**	**636**
Ceiling/Bar Hole Probe & Rubber Tip (34 inch long, clear)...	**BP**	**-**	**034**
Clear Bar Hole Probe (34 inch long, clear, side holes)	**BP**	**-**	**134**
Fiberglass Bar Hole Probe (36 inch long, no side holes)	**BP**	**-**	**136**
Two-Piece Bar Hole Probe (24 inch long when put together)…………………………...	**BP**	**-**	**224**
Fiberglass Bar Hole Probe (36 inch long, side holes)	**BP**	**-**	**236**
Metal Bar Hole Probe (36 inch long, side holes)	**BP**	**-**	**536**
Standard Flue Gas Probe & Filter (10 inch long)...	**FP**	**-**	**110**
Heavy Duty Flue Gas Probe & Filter	**FP**	**-**	**112**
Straight Hose with Quick Connect Fitting (42 in. long)...	**QH**	**-**	**042**
Straight Hose with Quick Connect Fitting (5 ft. long)	**SQ**	**-**	**060**

2. Filters

Dust & Water-block Filter (5/pkg)..	**WF**	**-**	**505**
Dust and Water-block Filter for Models EGA-611/612 (5/pkg)	**WF**	**-**	**705**
Water-stopper (with push-button release)	**WS**	**-**	**001**
Dust Stopper (with replaceable filter)	**DS**	**-**	**001**
Replacement Dust Filters (5/pkg)	**DF**	**-**	**105**
Flue Gas Filter (5/pkg)...	**FF**	**-**	**005**
Extended Duty Flue Gas Filter (5/pkg)	**FF**	**-**	**105**
Heavy Hydrocarbon Filter (5/pkg)..	**HF**	**-**	**005**
Inlet Filter & Quick Connect Air Intake (5/pkg)...	**IF**	**-**	**705**

3. Sensors

Methane Sensor (in flame arrestor)..	**MS**	**-**	**511**
CO Sensor..	**CO**	**-**	**302**
Oxygen Sensor (J Series)	**OS**	**-**	**501**
Oxygen Sensor (K Series) ………………………………………………………………...	**OS**	**-**	**502**
Combination CO/H2S Sensor…………………………………………………………………	**CS**	**-**	**601**

4. Replacement Parts, and Manual

Pump Motor	**PM**	**-**	**501**
Pump Head, Diaphragm/Plunger Assembly (5 sets/pkg)	**PD**	**-**	**505**
Intake Manifold with Pump	**RM**	**-**	**501**
Battery Compartment Cap	**BC**	**-**	**501**
Operating Manual	**OM**	**-**	**0215**

5. Instrument Case

Instrument Case w/Ethafoam Insert	**IC**	**-**	**501**

6. Accessories for Calibration & Maintenance

Manual Calibration Apparatus (with MC-620 & FR-401)..	**PCA**	**-**	**302**
Methane & CO Calibration Gas (2.5% methane & 100 ppm CO, 620 liters)................	**MC**	**-**	**620**
On-demand Regulator for MC-620	**FR**	**-**	**401**
Rechargeable C-Sized Batteries (NiMH, 4/pkg)...	**NM**	**-**	**524**
Rapid Charger for 2 to 4 C-Sized Batteries...	**RC**	**-**	**502**

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.

Bascom-Turner Instruments