



**BASCOM-TURNER
INSTRUMENTS**

GAS-SENTRY® DETECTORS

OPERATION MANUAL

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

Part Number OM-1008

LIMITED WARRANTY

Bascom-Turner Instruments warrants Gas-Sentry 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, Groups A, B, C and D atmospheres.

This product has not been tested for intrinsic safety in oxygen enriched atmospheres.

Change batteries and service detectors only in non-hazardous locations.

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SPECIFICATIONS ^(1,2)

Gases Detected	Natural Gas (Methane) Carbon Monoxide (CO) Oxygen (O ₂)
Sensors	Catalytic Combustion (CH ₄) Thermal Conductivity (CH ₄) Electrochemical (CO) Electrochemical (O ₂)
Ranges	
% GAS	0 to 100% by volume of methane in steps of 0.05% up to 4.0% and 1% from 4 to 100%.
% LEL	0 to 100% LEL of methane in steps of 1%.
TRACK GAS	0 to 80% LEL of methane in steps of 0.2% LEL (0 to 4% methane in steps of 0.01% GAS)
PPM CO ³	0 to 5000 ppm of carbon monoxide in steps of 5 ppm or 1 ppm ³ .
% O ₂	0 to 40% by volume in steps of 0.1%
Calibrated Accuracy² (5° to 45°C)	±2% LEL for % LEL scale ±2% GAS for % GAS scale ±5% of reading ±10 ppm for PPM CO scale (±10% from 1000 ppm to 5000 ppm) ±5% of reading for % oxygen

Warm-Up Time	30 seconds, typical
Operating Temperature (with fresh batteries)	-30°C to 50°C (-20°F to 120°F)
Maximum Temperature of Sampled Gas	325°C (620°F)
Storage Temperature	-40°C to 60°C (-40°F to 140°F)
Continuous Operating Time per Battery Set	12 hours typical (25°C)
Humidity	0 to 98% RH (non-condensing)
Power Supply	Four AA Alkaline (1.5V Type AM-3)
Dimensions	Height 7.25" (18.4 cm) Width 3.62" (9.2 cm) Depth 1.70" (4.5 cm)
Weight	20 ounces (570 g)

(1) Not all instruments detect all gases. For a list of detectors see page 2.

(2) Specifications are applicable to properly calibrated instruments, see page 3.

(3) Models CGC-301 and CGC-311 are available with 1 or 5 ppm CO resolution. Model CO-150 has a 1 ppm resolution.

PART 1. OPERATION

FEATURES

The Gas-Sentry® portable methane, CO, and combined methane/carbon monoxide and methane/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:

- **Measurements Over the Full Range of Gas**

The instruments detect methane over the full range of methane concentrations.

- **TRACK GAS Scale**

A sensitive scale with quick response makes it easy to find gas leaks.

- **Automatic Zero**

Automatic zero adjustment without knobs to turn or buttons to press.

- **Automatic Calibration**

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

- **Automatic Sampling**

An intrinsically safe pump automatically samples ambient air or flue gas. No need to "purge" on changing operating mode or scale.

- **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 alarms on each scale that can be individually set.

Visual alarms for background monitoring of CO or O₂.

- **Easy-to-Use**

One selector switch sets the mode and scale. No complicated or confusing displays.

- **Easy-to-Read, Bright Display**

A bright, efficient LED display is easy to read both indoors and outdoors.

- **A Dust and Water-Block Filter**

A special Teflon® filter keeps water out even if the probe is fully immersed in water and also filters dust.

- **A Tough, Light-Weight Package**

Housed in high impact ABS, the instruments weigh only twenty ounces.

- **Carryall**

Leatherette carryall with shoulder strap provides hands-free portability for instrument and probes.

1. THE GAS-SENTRY DETECTORS

This manual describes the operation, maintenance, and calibration of the family of Gas-Sentry detectors for natural gas and carbon monoxide:

- Model CGI -201 - Detects natural gas and displays it as % LEL or % GAS
- Model CGI -211 - Detects natural gas and displays it as % GAS
- Model CGC-301 - Detects natural gas and carbon monoxide and displays % LEL or % GAS and PPM CO (parts per million of CO)
- Model CGC-311 - Detects natural gas and carbon monoxide and displays % GAS and PPM CO (parts per million of CO)
- Model CGO-321 - Detects natural gas and oxygen and displays % LEL or % GAS and % Oxygen.
- Model CO -150 - Detects carbon monoxide and displays PPM CO (parts per million of CO)

All models which detect natural gas may be used to:

- test ambient air for natural gas
- bar hole
- locate and track gas leaks in pipes and other conduits

All models which detect carbon monoxide (CO) may be used to:

- test for CO in ambient air
- test for CO in flue gas and gases given off by appliances

Depending on the model, the following operating modes can be selected:

- TRACK GAS - Displays the concentration of natural gas in % LEL (Models CGI-201, CGC-301, and CGO-321) or % GAS (Models CGI-211 and CGC-311) and operates a beeper for tracking the source of a leak
- % GAS - Displays natural gas as % GAS by volume
- % LEL - Displays natural gas as % LEL (Models CGI-201, CGC-301, and CGO-321)
- PPM CO - Displays carbon monoxide as PPM (parts per million by volume)
- % OXYGEN - Displays oxygen as percent by volume
- AUTO ZERO - Automatically zeros all scales while sampling clean air

A unit alerts the user audibly (with an alarm) when the concentration exceeds preset limits. Alarm limits can be reset by the user (see Part 2, Section 3). Factory set limits are:

- % GAS = 1% equivalent to % LEL = 20%
- PPM CO = 200 ppm
- % OXYGEN = 19.5% for low and 23.0% for high

In the "TRACK GAS" mode, the frequency of a beeper depends on the natural gas concentration. The beeper speeds up with rising concentration and is on continuously at 0.1-0.15% GAS (2-3% LEL) above ambient.

2. OPERATION

A. Overview of Essential Operating Practice

Gas-Sentry detectors are easy to use. Once the appropriate scale is selected, operation is automatic. However, a few general rules must be followed to insure reliability and accuracy.

Pump. Gas-Sentry 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 first turned on.

Pump Test: Connect the probe you plan to use and select the % GAS or the CO scale. When the display shows a number, normally zero, block the probe tip with your finger until the display shows "*bloc*".

If "*bloc*" does not appear, there may be a leak along the probe. Tighten all connections and repeat the test. If a block condition is still not observed, remove the hose and block directly the inlet to the instrument. If "*bloc*" still does not appear, replace the pump or return the instrument to the factory for repair.

WARNING: The instrument should never be used when "*bloc*" fails to appear upon blocking the inlet.

Filters. 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 Gas-Sentry detector without a filter on the hose. Operation without filters will void the limited warranty on the sensors.

From time to time, examine the dust and water-block filter on the hose. If loose dirt has accumulated, shake it out. Do **not** poke at the filter with a tool or any other implement which may puncture it. If the filter is substantially discolored by dirt, replace it.

Zero Check. All sensors drift to some extent over time. Sensor drift is corrected by using the AUTO ZERO position (see Section 3, Instrument Checks). Zeroing takes about 30 seconds and is normally required no more frequently than once a day. 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 will be introduced in all subsequent measurements.

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

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 verify that the gas sensor(s) are in operating condition. To verify and adjust, if necessary, their sensitivity they must be calibrated (see Section 1 in Part 2).

A detector can be automatically calibrated in approximately one minute using Bascom-Turner's calibration gas (50% LEL 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.

Accuracy. A properly operating and calibrated detector will respond to gas and CO 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 much wider area.

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

B. Operational Description

To conserve the batteries, the selector switch should be in the "OFF" position when the instrument is not in use.

To Detect Gas with the % GAS Scale. Connect an appropriate probe to the dust and water-block filter attached to the coiled hose and turn selector switch to position marked "% GAS". The display shows "GAS" for about 10 seconds.

- After warm-up, the display shows the concentration of gas in air in percent by volume (% GAS). If the air is clean (contains no gas), the display should read zero. If it does not, switch to position marked "AUTO ZERO". After automatic adjustment of zero is complete (display shows "End"), return the switch to the "% GAS" position. The % GAS scale spans the whole range of gas in steps of 0.05% from zero to 4.0% and in steps of 1% from 4 to 100%.

Bar Holing. The CGI-201, CGI-211, CGC-301, CGC-311 and CGO-321 detectors 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 be several percent. Therefore an alarm for gas is likely, but it has no relevance to the ambient atmosphere above ground. Under these conditions, the alarm for the % GAS scale may be turned OFF (see Part 2. Calibration and Alarm Selection).

<p>WARNING: If the alarm for the % GAS scale is OFF, NO AUDIBLE ALARM will be given on this scale under all conditions.</p>
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Bar holing may be done with optional probes available from Bascom-Turner. These include a clear plastic probe, a fiberglass probe, and a steel probe with an electrically insulated handle (see Section 8). Optional accessories, include a bar-hole filter and a water-stopper. The water-stopper may be used to minimize interruptions from accidental aspiration of ground water (see Section 9).

To Detect Gas with the % LEL Scale. Connect an appropriate probe to the dust and water-block filter attached to the hose and turn selector switch to position marked "% LEL". The display shows "*LEL*" for about 10 seconds.

- After warm-up, the concentration of gas in air is displayed as percent of the lower flammable limit (LEL). If the air is clean (contains no gas), the display should read zero. If it does not, switch to position marked "AUTO ZERO". After automatic adjustment of the zero is complete (display shows "*End*"), return the switch to the % LEL position.
- The % LEL scale ranges from 0 to 100 % in steps of 1%. Some detector models overrange, in steps of 20%, to 2000% (pure gas). Detectors which dock and can be cleaned with boost gas do not overrange. The following table shows equivalent readings in % LEL and % GAS (percent volume):

EQUIVALENT READINGS IN % LEL AND % GAS		
% LEL		% GAS
0.6	equivalent to	0.03
1		0.05
2		0.1
10		0.5
20		1.0
100		5.0

To Detect Gas and Track its Source with the TRACK GAS Scale. Connect an appropriate probe to the dust and water-block filter attached to the hose and turn selector switch to position marked "TRACK GAS". The display shows "*SniF*" (sniff) for about 10 seconds.

- After warm-up, the display shows the concentration of gas in air in % LEL with the CGI-201, CGC-301, and CGO-321 and % GAS with the CGI-211 and CGC-311. If the air is clean (contains no gas), the display should read zero. If it does not, switch to position marked "AUTO ZERO". After automatic adjustment of zero is complete (display shows "*End*"), return switch to the "TRACK GAS" position.
- Advance probe along pipe or other conduit suspected of having a gas leak. The beeper will speed up with rising concentration, and will beep continuously at 0.1-0.15% GAS (2-3% LEL) above ambient. By listening to the beeper or by reading the display, the source of gas can be located.

Notes: It is recommended that initial measurements be made on the % LEL or % GAS scales and the TRACK GAS scale then be used to locate the source of a leak.

The ambient gas concentration used to establish the lowest beep frequency is automatically measured and the beeper is reset, every time the "TRACK GAS" mode is selected.

Use a gooseneck probe to shorten the response time when tracking gas. Since methane is lighter than air, track a conduit from above, where possible.

To Detect Carbon Monoxide (Models CGC-301, CGC-311 and CO-150)

Carbon Monoxide in Ambient Air

- Connect an appropriate probe to the dust and water-block filter and turn selector switch to position marked "PPM CO". The display shows "CO" for about 10 seconds.
- 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, switch to "AUTO ZERO". After automatic adjustment of the zero is complete (display shows "End"), return the switch to the "PPM CO" position.

Carbon Monoxide in Flue Gas

- Connect the flue gas probe, with an attached flue gas filter, to the dust and water-block filter on the hose and turn selector switch to position marked "PPM CO". The display shows "CO" for about 10 seconds.
- 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>WARNING: 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 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). Sampling flue gas without a filter or with a spent filter may damage the CO sensor and will void the limited warranty for this sensor.</p>

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>CAUTION: Do not touch the flue probe immediately after a measurement. Wait until it cools. Running the instrument in air helps cool the probe.</p>

Background Check for CO (Models CGC-301 and CGC-311). When the % LEL or % GAS scales are in use, the instrument carries out automatic "background" readings of CO. If the CO reading exceeds the alarm limit (200 ppm set at the factory or the value selected by the user), the alarm will sound and the display will alternate between readings of % LEL (or % GAS) and CO, that is, the display will flash "CO".

A background check of CO is carried out as long as the gas (methane) is below its flammable limit (100% LEL or 5.0% GAS). Above this limit, CO background checks are not made. The table below summarizes the automatic CO checks carried out by the instrument.

Automatic Background CO Checks			
Scale	Readings on Scale in Use	Background CO Check	Alarm
% LEL	0 to 99	Yes	Audible/Flash "CO"
	≥100	No	No CO alarm
% GAS	0 to 5.0	Yes	Audible/Flash "CO"
	>5.0	No	No CO alarm

WARNING: If the alarm for CO is disabled, background checks are not made. The alarm will **not** sound and the display will **not** flash "CO" at any concentration of CO.

WARNING: Background checks on methane are **not** made when the CO scale is in use.

Note: It is recommended that initial measurements be done using either the % LEL or % GAS scale, even if the main interest is in detecting CO. Once it is established that methane is below its alarm limit, the instrument can be switched to the CO scale.

Background Checks for Model CGO-321. When the % LEL or % GAS scales are in use, background readings for oxygen are made and if the oxygen level is outside its limits, the alarm sounds and the display flashes "O2". Background checks for CH₄ are made when the % Oxygen scale is in use. No alarm is given if the alarm for oxygen is OFF.

WARNING: No background checks are made when the TRACK GAS scale is in use.

C. Catalyst Poisons

The three way filter (Part No. WF-405) protects the sensors from some air contaminants which may poison the catalysts. The three way filter is used in place of the dust and water-block filter. When using a three way filter, replace it approximately every three months.

WARNING: Both the methane sensor and the CO sensor 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.

3. INSTRUMENT CHECKS

Automatic Battery Check

If the estimated battery life is less than about 1 hour, the display flashes "Lo" (low) between readings. The batteries should be changed at a convenient time. If the battery life is over, the display stays on "Lo". The batteries must then be changed to make the instrument operational.

Automatic Pump Check

If the intake is blocked, the display shows "bloc" (block) and the detector beeps until the problem is cleared. This check is carried out whether or not a probe is being used.

If the intake is blocked during AUTO ZERO (see below), or during the warm-up phase before gas concentrations are displayed, the display shows "bloc" but the detector does not beep. In AUTO ZERO, the instrument beeps when zeroing is complete and "End" appears on the display.

Check for Tight Connections

To check for tight connections, block the probe inlet to observe "bloc" on the display within a few seconds. If "bloc" fails to appear, there is a leak (see Part 1, Section 7, "Troubleshooting").

CAUTION: The instrument should not be operated if it fails to display "bloc" when the air intake is blocked.

Automatic Zero

To adjust the zero automatically, advance the selector switch to "AUTO ZERO". Zero adjustment, which takes 25 to 35 seconds, is typically required only once a day.

Display	Automatic Operation
GAS	The zero of the thermal conductivity sensor is adjusted.
LEL or SniF	The zero of the combustion sensor is adjusted.
CO	The zero of the CO sensor is adjusted.
O ₂	The % Oxygen scale is adjusted to ambient O ₂ levels.
End	The instrument beeps briefly denoting that it has been zeroed and is ready for use.

After "End" is displayed, return the switch to the selected scale. If automatic adjustment of zero cannot be carried out, for example, because the methane concentration is too high, the display shows "nogo" (no go) and does not advance to "End" (see Troubleshooting Section).

WARNING: Zero adjustment must be carried out with clean air. If the air is not clean, a systematic error will be introduced in subsequent measurements. The instrument will auto zero in concentrations of methane below 0.2% (3% LEL) and concentrations of CO below 20 ppm. If higher concentrations of methane or CO are detected, the instrument will not change its zero, and the display will show "nogo" (no go).
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Automatic Sensor Check

If a gas sensor fails (opens up), or if the O₂ sensor is bad, the display shows "FAIL" (see Troubleshooting Section).

4. INTERFERENCE FROM OTHER GASES OR LIQUIDS

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 CGC-301 and CGC-311 methane and carbon monoxide detectors use the sensors listed above plus a third sensor which is the only sensor in the Model CO-150:

- iii) A three-electrode, electrochemical cell.

Model CGO-321 methane and oxygen detector uses 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:

- i) Substances which can be combusted on the catalytic combustion filament. Examples are ethane, propane, ethylene, propylene, octane, and the like.
- ii) 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 in Models CGC-301, CGC-311, and CO-150 include:

- iii) 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.

Interference in CO Measurements

If the ambient concentration of oxidizable substances is relatively high, it is likely that CO measurements will be affected. Many of these substances are removed by the flue gas filter attached to the telescoping metal probe. 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: DO NOT attach the flue gas filter to the standard probe. It is designed to be used only with the CO probe (flue probe).

5. CHANGE OF BATTERIES

Gas-Sentry detectors are powered by four (4) alkaline (non-rechargeable) AA batteries (1.5V, Type AM-3). 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 display flashes "Lo" (low) between readings. If the batteries get very low, the display stays on "Lo", and 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. Remove spent batteries
 - a) Snap open the bottom part of the carryall and partially withdraw the instrument.
 - b) Slide out the battery cover by depressing latch with thumb while pressing down on cover with fingers.
 - c) Discard four alkaline AA cells.
2. Insert four, fresh AA alkaline batteries.

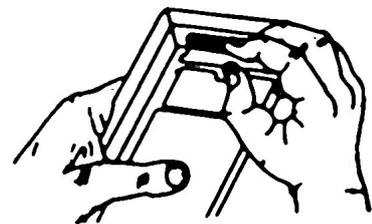


Fig. 1.

Note battery polarity and insert each battery with the correct polarity as shown on rear of instrument. Replace battery cover and lock into place.

If the instrument does not operate after battery replacement, there is a high probability that one or more cells have 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. Do not mix used and new batteries. When operating in cold weather (below -10°C) use a fresh set of batteries, if possible.

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

WARNING: Use only alkaline batteries (AA) in a Gas-Sentry. Use of any other type of battery is a misuse of the Gas-Sentry.

6. RADIO FREQUENCY INTERFERENCE

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

7. TROUBLESHOOTING

Problem	Probable Cause	Action
1. Display is blank and pump does not operate.	<ul style="list-style-type: none"> Batteries are too low or spent. 	<ul style="list-style-type: none"> Replace batteries (see Part 1, Section 5 ("Change of Batteries")).
2. Batteries are replaced but display is blank and pump does not run.	<ul style="list-style-type: none"> One or more batteries were inserted with the wrong polarity. One or more batteries are too low. 	<ul style="list-style-type: none"> Re-insert batteries with proper polarity. Replace batteries with a new set.
3. The Display shows "bloc".	<ul style="list-style-type: none"> The intake to the instrument is blocked. There is water in the probe. 	<ul style="list-style-type: none"> Check probe tip and water-block filter, drain probe, and dry probe and filter by shaking. Detach probe from water-block filter, drain probe, and dry probe and filter by shaking.
4. The display does not show "bloc" when the probe tip is blocked.	<ul style="list-style-type: none"> There is a leak between the probe tip and the pump. 	<ul style="list-style-type: none"> Tighten connections of probe. Check hose and probe for cracks. Disconnect hose and block intake. If "bloc" does not appear, clean pump. Repeat zero in clean air.
5. The display shows "nogo" prior to "End" when on AUTO ZERO scale.	<ul style="list-style-type: none"> Ambient concentration of methane or CO is too high Detector will not purge on %GAS or %LEL scale. 	<ul style="list-style-type: none"> Check pump by blocking probe's tip. If "bloc" appears repeat zero in clean air following coarse "zero" procedure described below.
6. The display shows "FAIL".	<ul style="list-style-type: none"> A gas sensor, or the O₂ sensor has failed. 	<ul style="list-style-type: none"> Replace sensor.
7. The display shows "noid".	<ul style="list-style-type: none"> The instrument has misread the E-Prom. 	<ul style="list-style-type: none"> Return instrument for repair.

Coarse Zero: Place switch 3 of the calibration switch (CS in Fig. 5) in the up position. Then turn the front panel selector switch to the "AUTO ZERO" position. After "End" is displayed, return switch 3 to the down position and resume operation.

WARNING: Do not open a sensor under any conditions. Sensors must be replaced only by personnel trained in instrument service.

WARNING: Do not operate an instrument which fails to show "bloc" when the intake is blocked. Replace the pump or return the instrument for repair. See the inside of the front cover (limited warranty) on how to return an instrument.

8. PROBES

Standard Probe

The standard probe (Part No. SP-307), a rigid tube, connects to the dust and water-block filter. If extra length is desired, an extension (7") 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 filter cartridge directly to the sample hose - always use a dust and water-block filter.

CAUTION: 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.

Gooseneck Probe

The optional gooseneck probe (Part No. GP-014) is 14" long and attaches directly to the inlet port of the detector. The short length and low internal volume of this probe optimize the response time on the TRACK GAS scale. To increase sensitivity in windy conditions, use a rubber gas collecting tip (Part No. RT-107) on the end of the probe.

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/Ceiling 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 bar hole/ceiling probes have a single inlet on the end and come 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 dust and water-block or bar hole filter on the coiled hose. A more convenient hose for bar hole measurements, five feet of straight tubing, is available as Part No. SH-060. A convenient way to release water from a bar hole probe is with a water-stopper (Part No. WS-001) described in Section 9.

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

9. ROUTINE MAINTENANCE

Dust and Water-Block Filter

A filter, housed in a knurled nut, removes particles of dust and dirt, and blocks water. The white disk in the filter should be inspected periodically for accumulated dirt which may slow air sampling. A filter can be cleaned by removing the probe and tapping the filter cartridge on a hard surface to remove dry dust and dirt. Do not insert objects into the water-block filter while attempting to clean it as they may puncture the filter. Typically, the filter needs to be replaced twice a year. Replacement water-block filters are available as Part No. WF-305 (package of 5 filters).

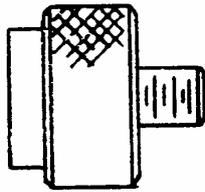


Fig. 2. Dust and water-block filter.

Inlet Dust Filter

Removal of the intake connector (used to attach the sampling hose) of the detector exposes a filter cup pressfit onto the intake. These filters are not a substitute for three-way or 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 (Part No. IF-105 for threaded hose and Part No. IF-205, for quick connect hose).

Water-block Filter for Gooseneck Probe

A Teflon® filter housed in a knurled nut, removes particles of dust and dirt and blocks water. See the dust and water-block filter description in this section for details on cleaning. Replacement filters are available as Part No. WF-205 (package of 5 filters).

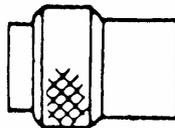


Fig. 3. Water-block filter for gooseneck probe.

CAUTION: Do not use a Gas-Sentry without a dust and water-block filter . Do not use a water-block filter with a puncture.
--

Water-stopper

The water-stopper (Fig. 4) 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. The part number of the water-stopper is WS-001.

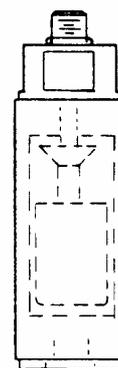


Figure 4. Water-stopper

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. Replacement flue gas filters are available as Part No. FF-005 (package of 5 filters).

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. The heavy hydrocarbon filter can also remove some alcohols and unsaturated hydrocarbons which can interfere with CO readings. 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. Heavy hydrocarbon filters are available as Part No. HF-005 (package of 5 filters).

Activated carbon for refilling approximately 50 cartridges is available as Part No. HR-050. 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.

Bar Hole Filter

This filter is designed to be used between the hose and a bar hole probe and blocks water and dust while removing contaminants found in bar holes that may affect the catalysts. 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 water or on a fixed schedule of about six months.

PART 2. CALIBRATION AND ALARM LEVEL SELECTION

INTRODUCTION

Instruments are calibrated at the factory before shipment. The sensors need to be re-calibrated over time as they age and their response changes. All instruments can be calibrated manually with the procedures described in Section 2 of Part 2 or with the automatic calibration feature A-CAL™ as described below.

1. AUTOMATIC CALIBRATION WITH A-CAL™

The A-CAL firmware calibrates instruments automatically using calibration gas available from Bascom-Turner.

Calibration Gas. The gas required for automatic calibration of the catalytic combustion and CO sensors is Bascom-Turner's methane & CO calibration gas containing 2.5 ±0.05% methane and 100 ppm ±2 ppm CO in air. It is provided in disposable aluminum tanks containing either 105 or 620 liters of gas, sufficient for many automatic calibrations.

The thermal conductivity sensor can be calibrated with either pure methane or system gas provided by the user.

Calibration Gas Dispenser. The calibration gas must be delivered at or near atmospheric pressure to ensure accurate calibration. Bascom-Turner recommends using the Calibration Gas Dispenser (Part No. CGD-001) which regulates and displays the delivery pressure, approximately 6-7 inches of water.

A-CAL Operation. In carrying out automatic calibration with the A-CAL firmware, **always calibrate the catalytic combustion and CO sensors first**, that is, use the Bascom-Turner methane & CO calibration gas first. If the thermal conductivity sensor is to be re-calibrated as well (see below), this sequence of calibration gases ensures that no errors are introduced from residual gas in the detector.

A-CAL Calibration with the Methane & CO Calibration Gas

1. Place the selector switch in "AUTO ZERO" and zero the instrument in clean air. The usual series of displays will appear on the detector display, depending on the model.
2. After "End" appears on the display and the instrument beeps, insert the standard probe partially into the outlet port of the gas dispenser. If a manual calibration apparatus (for example, Part No. PCA-001) is used, attach the detector's three-way filter to the threaded hose barb (TB-512) with the regulator's valve off and wait for "bloc".
3. After "bloc" appears on the detector display, push the probe completely into the dispenser port. The "bloc" display will be replaced by "go" and the instrument will proceed to calibrate the catalytic combustion and CO sensors.

If a manual apparatus is used, open the regulator's valve and observe "go" on the display.

4. Depending on the model, the detector display will show "LEL" or "GAS" while the catalytic combustion sensor is being re-calibrated and "CO" when the CO sensor is being re-calibrated.
5. After calibration is complete, the detector display will show "CAL" and the instrument will beep briefly. Remove the probe from the gas outlet. The instrument is ready for use.

Note: During calibration, the selector switch on the detector remains in the AUTO ZERO position. After calibration is complete and "CAL" is displayed, the selector switch must be placed at some other scale (or the OFF position) to return the detector to a normal operating mode.

<p>CAUTION: Automatic calibration presupposes and depends on using Bascom-Turner's calibration gas (Part No. MC-105 or MC-620). Do not use a different gas for automatic calibration of the catalytic combustion and CO sensors..</p>
--

A-CAL Calibration with Methane or System Gas

As noted previously, the thermal conductivity sensor is calibrated at the factory with methane. In contrast to the catalytic combustion sensor, routine re-calibration of this sensor is not necessary. The thermal conductivity sensor is checked operationally using air as the reference gas every time the AUTO ZERO routine is used. However, the thermal conductivity sensor should be re-calibrated from time to time, particularly if it has been re-calibrated by the user with system gas since the gas composition often varies seasonally and sometimes more frequently.

To calibrate the thermal conductivity sensor, proceed as follows:

1. Place the selector switch on "AUTO ZERO" and zero the instrument in clean air. The usual series of displays will appear on the detector display, depending on the model. Note that if the instrument had just been calibrated with the methane and CO calibration gas, the selector switch must be moved to some other scale (or to the OFF position) before the AUTO ZERO routine is repeated.

2. After "End" appears on the display and the instrument beeps, block the probe tip manually until "bloc" appears on the display. Now release the block. The display will show "go" and the instrument is ready for calibration.
3. Connect the probe to a source of pure methane or system gas. The gas pressure should not exceed 6" or 7" of water. The display will show "GAS" while the thermal conductivity sensor is being calibrated. When calibration is complete, "CAL" will appear on the display and the instrument will beep briefly.
4. Disconnect the probe from the gas and let the instrument run briefly in clean air to purge residual gas. Monitor the purging by placing the selector switch on the GAS scale. When the reading on this scale returns to zero, the instrument is ready for use.

Note that while the probe is being connected to a source of methane or system gas, "bloc" may appear briefly on the display, for example, if some time elapses between connection to the gas outlet and opening of a valve that allows calibration gas to flow. This will not interfere with proper calibration.

Error Codes during Automatic Calibration. The only special error code that may appear during automatic calibration is "nogo" (no go). This code, which denotes that automatic calibration cannot proceed, may appear in the following circumstances:

- i) More than 30 seconds elapse between the "go" display and the introduction of calibration gas. If this is the case, wait for an additional period up to 60 seconds, with gas flowing through the instrument. The "nogo" display will be replaced by "CAL" when the sensors are calibrated.
- ii) A sensor is outside the normal range for automatic calibration. If this is the case, the "nogo" display will alternate with a display indicative of the sensor which cannot be calibrated. Thus, "nogo" alternating with "LEL" indicates that the catalytic combustion sensor is outside the range for automatic calibration. Similarly, "nogo" alternating with "CO" indicates that the CO sensor is outside the range for automatic calibration and "nogo" alternating with "GAS" indicates that the thermal conductivity sensor is outside the range for automatic calibration. If this result is obtained, the detector must be calibrated manually (see Part 2, Section 2).
- iii) A sensor is not sufficiently stable for calibration to proceed normally or some malfunction causes the gas composition to vary with time. If this is the case, wait for an additional period of up to 60 seconds with gas flowing through the instrument. If response is stable, the detector will be calibrated and "CAL" will appear on the display. If the instability persists, the "nogo" display will persist. The instrument must then be tested manually and the cause of the malfunction corrected.

<p>CAUTION: Do not use a calibration gas other than Bascom-Turner's methane calibration gas (Part No. MC-105 or MC-620) and pure methane or system gas for automatic calibration. If some calibration gas other than those stipulated here is to be used, calibration should be carried out manually as described in Part 2, Section 2.</p>
--

2. MANUAL CALIBRATION

Manual calibration may be required when new sensors are installed (see Part 3, "Sensor Replacement") or when sensor sensitivity has changed substantially since the last calibration.

Required Gases and Tools

The recommended calibration gas for all detectors is Bascom-Turner Instrument's methane and CO calibration gas containing 2.5% $\pm 0.05\%$ methane and 100 ppm ± 2 ppm CO in air. A supply of pure methane or system gas is also needed for calibrating the % GAS scale. Calibration gases with other known concentrations of methane and/or CO can be used in manual calibration only. The concentration must be known to $\pm 0.05\%$ for methane and to ± 2 ppm for CO. The only required tool is a #2 jeweler's screwdriver.

Calibration gas must be delivered to the detector at or near atmospheric pressure to ensure accurate calibration. Bascom-Turner Instrument's offers a Manual Calibration Apparatus (Part No. PCA-001) which comes with 105 liters of methane and CO calibration gas (Part No. MC-105), a flow regulator (Part No. FR-001) and a length of tubing with a special connector (TB-512). Bascom-Turner Instruments also offers a Manual Calibration Apparatus (Part No. PCA-302) which comes with 620 liters of methane and CO calibration gas (Part No. MC-620), a flow regulator (Part No. FR-302), and a length of tubing with a special connector (TB-512).

Manual Calibration of Individual Sensors

Before calibration, always zero the instrument with "AUTO ZERO". After "End" appears, switch to the scale to be calibrated. Always calibrate the CO sensor first. Note that the display reads zero in clean air. Also, block the intake and note that "bloc" appears on the display.

Connect the intake to the calibration gas. If the display shows the correct concentration, there is no need to calibrate the scale. If it does not, use the manual calibration procedure as given in Table 1 which is common to all scales. A single calibration potentiometer is used to calibrate all sensors. The front panel selector switch selects the specific sensor to be calibrated:

Sensor Calibrated	Selector Switch Position	Calibration Gas
Electrochemical Cell	PPM CO	Bascom-Turner's MC-105 or MC-620
Catalytic Combustion	% LEL - Models 201, 301, 321 TRACK GAS - Models 211, 311	Bascom-Turner's MC-105 or MC-620
Thermal Conductivity	% GAS -All models	100% methane or system gas

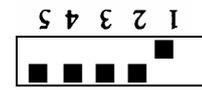
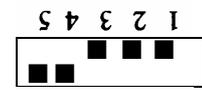
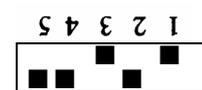
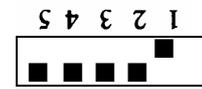
CAUTION: At the end of the procedure described in Table 1, make certain the calibration switch (CS in Figure 5) has been returned to its standard configuration. If it is not, the instrument will become inoperative as soon as the front panel selector switch is moved from its current position (see Section 4, "Troubleshooting During Calibration or Alarm Selection").

TABLE 1. MANUAL CALIBRATION PROCEDURE

After zeroing the instrument, set the front panel selector switch to the scale to be calibrated and proceed as follows:

Calibration Switch

1. Remove rubber plug (Fig. 6) to access the calibration switch and potentiometer (Fig. 5). The standard configuration (*) of the calibration switch is shown at right.
2. Move switch 3 up (towards front panel) and then connect the probe to the appropriate calibration gas. Turn the slotted metal shaft of potentiometer CP with a #2 jeweler's screwdriver until the correct concentration is shown on the display.
3. Move switch 2 up to set the configuration shown here. Display will show "SAVE" after the potentiometer position has been stored.
4. Return switches to their initial positions.
5. Wait until the correct concentration is again shown on the display. If the display reading is not correct, repeat Steps 2 through 4.
6. Replace rubber plug or go on to another scale with the front panel selector switch and repeat Steps 2 through 5 with the appropriate calibration gas.



(*) If the beeper for the TRACK GAS scale is disabled, the standard configuration is shown at right.

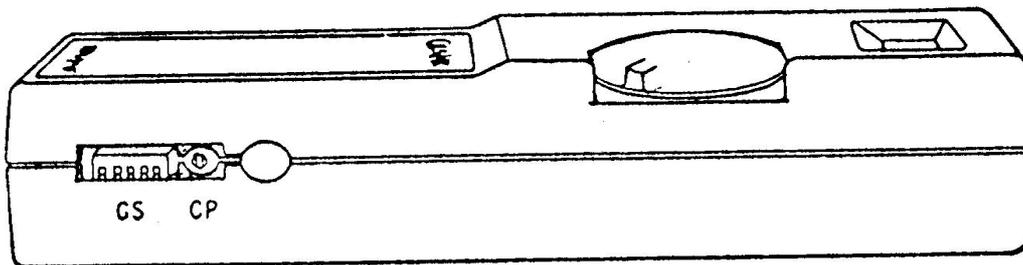


Fig. 5. Calibration Switch (CS) and Calibration Potentiometer (CP).

Note: Do not remove rubber plug to right of CP during calibration.

3. ALARM LEVEL SELECTION

The instrument has a built-in alarm which is activated at preset levels. Factory set alarm levels are 1% for GAS, 20% for % LEL and 200 ppm for PPM CO. Alarm levels can be reset or disabled by using the calibration switch and potentiometer as described in Table 2. The TRACK GAS scale has both an alarm level and a beeper. The beeper can be disabled by moving switch 1 of the calibration switch down.

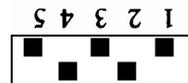
If the calibration switch is not returned to a standard configuration after alarms are set, the instrument will become inoperative when the front panel selector switch is moved from its current position (see Section 4, "Troubleshooting During Calibration or Alarm Selection").

TABLE 2. ALARM LEVEL SELECTION
(All models except CGO-321)

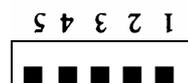
With the front panel selector switch set at the scale (TRACK GAS, % GAS, % LEL or PPM CO) whose alarm level is to be set or disabled, proceed as follows:

1. Remove rubber plug (Fig. 6) to access the calibration switch and potentiometer (Fig. 5). The standard configuration of the calibration switch is shown at right.
2. Move switch 5 up (towards front panel). Display shows current alarm level or "OFF" if the alarm is disabled.
3. Move switch 3 up and turn the slotted metal shaft of potentiometer CP with a #2 jeweler's screwdriver to display the new alarm level; if the new level is more than 3.0 for % GAS, 60 for % LEL, or more than 210 for PPM CO, "OFF" is displayed and the alarm is disabled (clockwise decreases alarm level).
4. Move switch 2 up to set the configuration shown here. Display will show "SAVE" after the new alarm level is stored.
5. Return switches to their initial positions.
6. Replace rubber plug or go on to another scale with the front panel switch and repeat Steps 2 through 5.

Calibration Switch



Note: To disable the beeper for the TRACK GAS scale, set the calibration switch to the configuration shown at right.



**TABLE 3. ALARM LEVEL SELECTION
(Model CGO-321)**

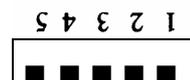
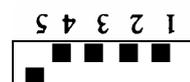
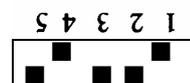
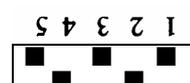
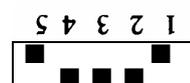
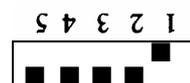
With the front panel selector switch set at the scale (TRACK GAS, % LEL or % OXYGEN), whose alarm level is to be set or disabled, proceed as follows:

Calibration Switch

1. Remove rubber plug (Fig. 6) to access the calibration switch and potentiometer (Fig. 5). The standard configuration of the calibration switch is
2. Move switch 5 up (towards front panel). Display shows current alarm level or "OFF" if the alarm is disabled. ("HOFF" is displayed on % OXYGEN scale).
3. Move switch 3 up and turn the slotted metal shaft of potentiometer CP with a #2 jeweler's screwdriver (clockwise decreases alarm level) to display the new alarm level; if the new level is more than 3 for % GAS or 60 for % LEL, "OFF" is displayed, if more than 25 ("H25.0") for % OXYGEN, "HOFF" is displayed.
4. Move switch 2 up to set the configuration shown here. Display will show "SAVE" after the new alarm level is stored.
5. Before changing scales, return switches to their initial positions.
6. To display the low oxygen alarm level, move switch 4 up.
7. To adjust the low oxygen alarm, move switch 3 up and turn slotted metal shaft of potentiometer CP with a #2 jeweler's screwdriver (clockwise decreases alarm level) to display the new alarm level; if the new alarm level is less than 10% ("L10.0"), "LOFF" is displayed and the alarm is disabled.
8. Move switch 2 up to set the configuration shown here. Display will show "SAVE" after the new alarm level is stored.
9. Before changing scales, return switches to their initial positions.
10. Replace rubber plug or go on to another scale with the front panel switch and repeat Steps 2 through 5.

NOTE

11. To disable the beeper for the TRACK GAS scale, set the calibration switch to the configuration shown here.



4. TROUBLESHOOTING DURING CALIBRATION OR ALARM SELECTION

Problem	Probable Cause	Action
1. "LEL" then "nogo" or "SniF" then "nogo" during AUTO ZERO.	<ul style="list-style-type: none"> • Concentration of methane over 3% LEL or 0.2% GAS • Instrument will not purge below 3% LEL or 0.2% GAS • Zero of sensor has drifted. 	<ul style="list-style-type: none"> • Repeat zero in clean air. • Check pump by blocking probe's tip. If "bloc" appears, repeat zero in clean air following "coarse zero procedure" (p.11). • Use coarse zero procedure (p.11)
2. "GAS" then "nogo" during AUTO ZERO.	<ul style="list-style-type: none"> • Zero of sensor has drifted too far. 	<ul style="list-style-type: none"> • Use coarse zero procedure (p.11)
3. "CO" then "nogo" during AUTO ZERO.	<ul style="list-style-type: none"> • Concentration of CO is over 20 ppm. • PPM CO scale will not purge to below 20. • The CO sensor failed. 	<ul style="list-style-type: none"> • Check PPM CO scale. If higher than 20, leave instrument on in clean air to purge. • Check pump by blocking probe's tip. If "bloc" appears, repeat zero in clean air following "coarse zero procedure" (p.11). • Replace CO sensor
4. Unsteady readings during manual calibration of catalytic combustion sensor.	<ul style="list-style-type: none"> • A Model CGI-211 or CGC-311 instrument is incorrectly set at % GAS. • A leak in the gas train. • The catalytic combustion sensor has failed. 	<ul style="list-style-type: none"> • Repeat with the scale set at TRACK GAS. • Check for "bloc" and tighten connections. • Replace methane sensor.
5. The display shows "• •" (two dots) after calibration or alarm setting.	<ul style="list-style-type: none"> • The calibration switch is in a non-standard configuration. 	<ul style="list-style-type: none"> • Repeat procedure correctly and set calibration switch to a standard configuration.
6. The display shows "EP" (instead of "SAVE") at Step 3 in Table 1 or Step 4 in Table 2.	<ul style="list-style-type: none"> • Electronic failure of the E-Prom. 	<ul style="list-style-type: none"> • Return instrument for repair.
7. The display shows "8" or "8888".	<ul style="list-style-type: none"> • Electronic failure. 	<ul style="list-style-type: none"> • Return instrument for repair.

<p>WARNING: Do not open a sensor under any conditions. Sensors must be replaced only by personnel trained in instrument service.</p>

PART 3. SENSOR REPLACEMENT

1. METHANE SENSOR REPLACEMENT (all models except CO-150)

If after coarse zeroing (Part 1, Section 7) "nogo" is displayed in the AUTO ZERO position immediately after "GAS" or "LEL" is shown on the display, and if the gas being sampled is clean air, or if "FAIL" is displayed during instrument operation, the methane sensor must be replaced. Also, if it is not possible to adjust the reading to the correct gas concentration during manual calibration, the methane sensor must be replaced.

The Bascom-Turner methane sensor is housed in a sintered metal flame arrestor and is connected to the board by a short length of cable terminating in a 6-pin connector. A hold-down plate, used to secure the methane sensor to a manifold, is captive on the cable. The tools required for replacement and calibration are a Phillips #1 and a jeweler's #2 screwdriver. The ambient temperature should be known to a degree Centigrade or Fahrenheit.

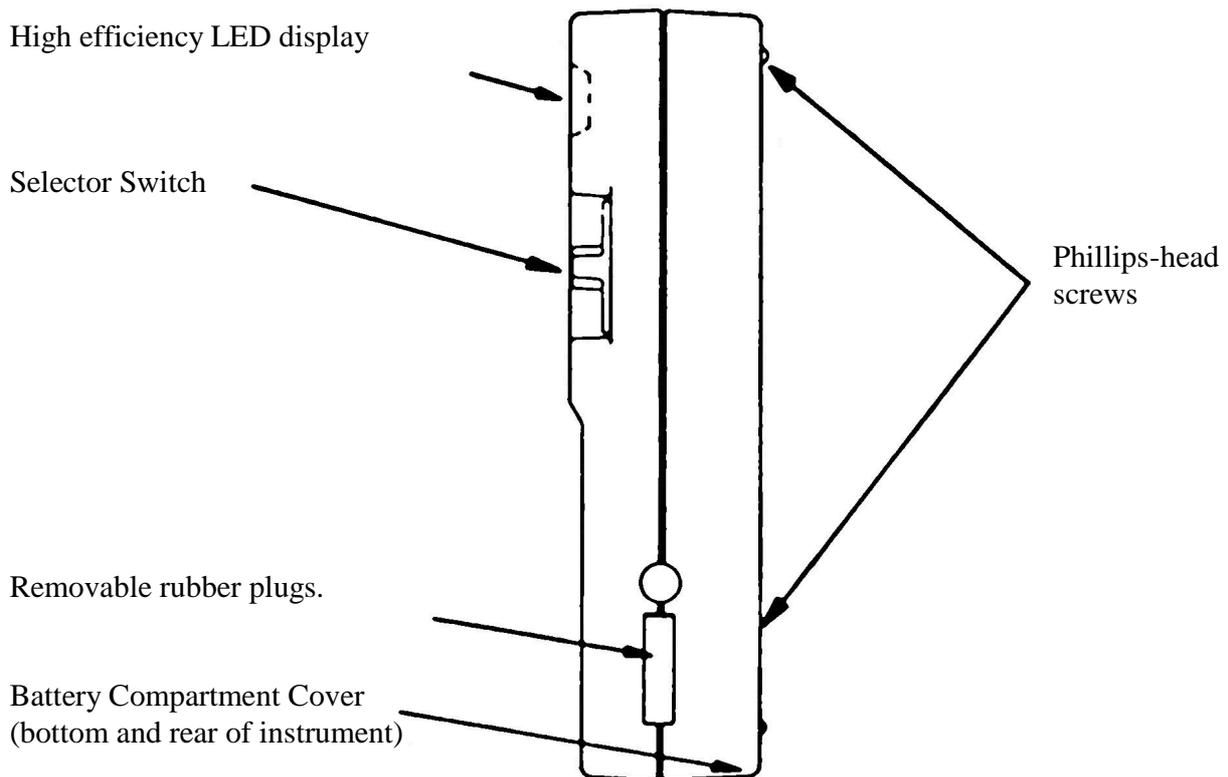


Fig. 6. Side View of Instrument.

A. Replacement of the Methane Sensor

The following stepwise procedure will result in an efficient and trouble-free installation:

1. Place the selector switch to OFF and remove the battery compartment cover, the four AA batteries, the two rubber plugs on the side of the case, and the two Phillips-head screws from the back of the case (see Fig. 6).
2. With the instrument facing up, lift the top cover off exposing the main circuit board. Unscrew the cable clamp nearest the 6-pin connector on the board, disconnect the cable from the 6-pin connector, and remove the clamp from the cable.
3. Remove four screws from the aluminum block manifold freeing the sensor hold-down plate and lift the methane sensor out of its well. Verify that an O-ring remains positioned on the shelf at the top of the well.
4. Install the new sensor assembly and press down until it sits in the well with its cable aligned directly toward the 6-pin connector on the main circuit board. Align the four holes in the new sensor hold-down plate with the corresponding holes in the manifold, and insert and tighten the four screws.
5. Reconnect the 6-pin filament connector to the main circuit board with the label on the connector facing upward. Put the cable clamp around the new cable and secure the clamp to the manifold with a screw.

Note: If the 6-pin filament connector is inverted, the display will show “*FAIL*” when the instrument is turned on.

6. Replace the top cover on the instrument and move it gently until the post of the selector switch falls into the slotted switch on the main circuit board. Replace the batteries and battery compartment cover while holding the two halves of the instrument case firmly together; then place the instrument on a work bench with the display facing up. Do not, as yet, replace the two screws holding the top to the bottom half of the case.

B. Adjustment and Calibration of the Methane Sensor

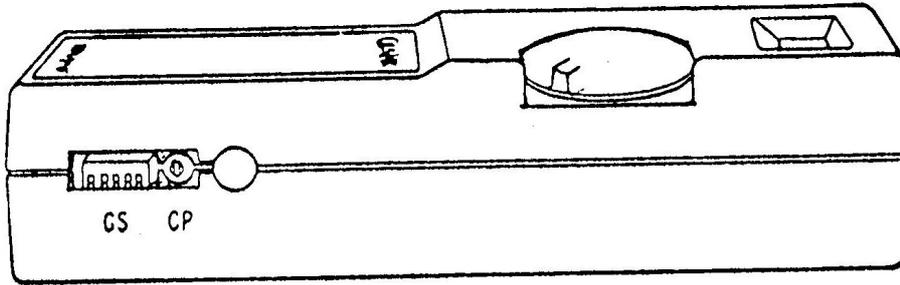


Fig. 7.

Note: The standard configuration of the calibration switch (CS) is

If the beeper for the TRACK GAS scale is disabled, the standard configuration is

1. Move switch 5 up (towards front panel).
2. Turn the front panel selector switch from OFF to AUTO ZERO. Display will show "dE9" (degrees C) followed by a numeric display.
3. Move switch 3 up.
4. Adjust the calibration potentiometer (CP) with #2 jeweler's screwdriver until the instrument's display agrees with the ambient temperature in degrees centigrade to within $\pm 1^{\circ}\text{C}$. If a thermometer graduated in degrees F is used, convert the thermometer reading to $^{\circ}\text{C}$ where $^{\circ}\text{C} = 0.555 (\text{degrees F} - 32)$.

Note: Turning the calibration potentiometer **clockwise** always increases temperature. Continue clockwise until the correct temperature is displayed.

5. Move switch 2 up to set the configuration shown here. Display will show "SAVE" after the temperature setting has been stored.
6. Return all switches to the original standard configuration and return the front panel selector switch from AUTO ZERO to OFF.

Calibration Switch

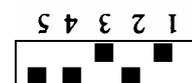


7. Move switch positions 3 and 4 up and turn the front panel selector switch from OFF to AUTO ZERO. Display will show "FIL" (FILAMENT) followed by the temperature of the combustion filament in degrees centigrade.



8. Lift the top cover off the instrument without changing the selector switch position from AUTO ZERO. Use the jeweler's screwdriver and the potentiometer located on the top of the main circuit board (above the calibration potentiometer) to adjust the temperature shown on the display to 640°C.

9. Replace the top cover on the instrument and move the top gently until the post of the selector switch falls into place in the slotted switch on the main circuit board. Move switch position 4 down and wait for AUTO ZERO routine to display "End".



10. The new sensor must be calibrated either with the A-CAL firmware or manually:

- a) Return switch 3 to standard configuration.
- b) Automatic calibration of the catalytic combustion sensor with A-CAL is described in Part 2, Section 1. Begin at the point where the probe tip is blocked by partial insertion in the outlet of the gas dispenser. After calibration of the catalytic sensor is complete ("CAL" appears on the display), place the front panel selector switch in any other position until the instrument purges, and then return it to the "AUTO ZERO" position. After "End" appears on the display, calibrate the thermal conductivity sensor as described in Part 2, Section 1.

Note: In some instances automatic calibration of a new sensor may not be possible ("*nogo*" display) because the uncalibrated sensor cannot recognize the calibration gas. If this proves to be the case, calibrate the sensor manually.

- c) Alternatively, calibrate manually the catalytic combustion and thermal conductivity sensors as described in Part 2, Section 2.

After automatic or manual calibration has been carried out, place the front panel switch in the OFF position and replace the two Phillips-head screws in the back of the case. Make sure that the calibration switches are in their original positions and replace the two rubber plugs.

2. CO SENSOR REPLACEMENT (Models CO-150, CGC-301 and 311)

The Bascom-Turner CO sensor consists of an electrochemical CO cell with a small circuit board and a battery. The CO cell should not be opened since it contains a sulfuric acid electrolyte, which is corrosive. The old CO cell (including the circuit board and the battery) should be returned to Bascom-Turner for proper disposal. Please use the container furnished with the replacement cell for the return.

The tools required for replacement and calibration are a Phillips #1 and a jeweler's #2 screwdriver.

A. Replacement of the CO Cell

The following stepwise procedure will result in an efficient and trouble-free installation:

1. Make sure the selector switch is in the OFF position, then remove the battery compartment cover and the four AA batteries. Remove also the two rubber plugs on the side of the case (see Fig. 6). Remove the two screws from the back of the case and lift the top cover exposing the main circuit board. Unscrew the plastic cable clamp near the 6-pin connector and leave it on the cable.
2. Disconnect the 6-pin connector noting that the printing on this connector is visible when oriented correctly.
3. Lift and tilt the main circuit board by raising the side of the board with the 6-pin filament connector to expose the 2-pin connectors on the underside of the main circuit board. The connector nearest the end of the board where the display is mounted leads to the CO sensor. The 2-pin connector further from the display connects the pump motor to the main board. In some units two single pin connectors connect the alarm to the main board and in other cases a 2-pin connector is used.

Disconnect all the connectors on the underside of the main circuit board and remove the board. Since the connectors may appear to be the same, take note when disconnecting to prevent swapping when reconnecting (see Fig. 8).

4. Remove the four screws which hold the CO sensor to the manifold and remove the CO sensor, with its attached circuit board, from the manifold. Verify that an O-ring is in position in the manifold's well and the well is clean. Remove the plastic (mylar) gasket from the old CO cell and place it on the bottom of the new CO sensor. Place the new CO sensor into the manifold and tighten the four screws to hold the sensor firmly against the O-ring.

Note: Do not press down in the center of the corrosive warning label on the CO sensor as this may damage the electrical connection to the sensor.

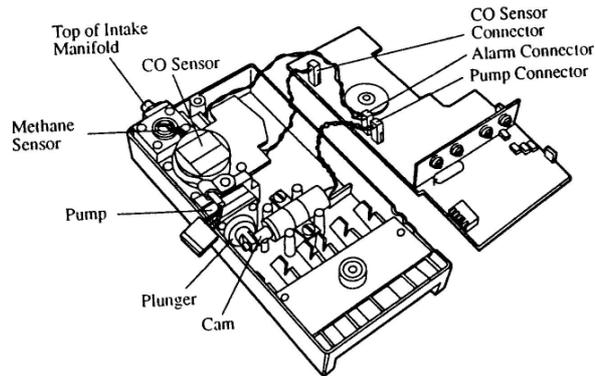


Fig. 8. Intake manifold assembly inside a detector.

5. Put the main circuit board along the side of the case and reconnect all connectors on the bottom of the board (see Fig. 8). Flip the main circuit board over and into place in the case verifying that the connector leads are not crimped or strained. Reconnect the cable to the 6-pin connector on top of the board and secure the cable clamp to the manifold with the screw. The connectors are all keyed to ensure correct orientation, but if incorrectly oriented they can still be forced into their receptacles. Exercise care when reconnecting to prevent swapping.
6. Position the top cover on the instrument, move the top gently until the selector switch post falls into place in the slotted switch on the board, replace the two Phillips-head screws in the back of the case, and replace the batteries and the battery compartment cover.

B. Adjustment and Calibration of the CO Cell

The CO scale's zero must be reset with the following procedure before manually calibrating the new CO sensor.

Coarse Zero Procedure

- a. Place switch 3 of the calibration switch (CS in Fig. 7) in the up position.
- b. Turn the front panel selector switch to "AUTO ZERO" and wait for "End".
- c. Return switch 3 of the calibration switch to the standard configuration.
- d. Calibrate either automatically or manually.

Automatic Calibration

Calibrate the CO sensor as described in Part 2, Section 1. Begin at the point where the probe tip is blocked by partial insertion in the gas dispenser outlet and continue until "CAL" appears on the display. Automatic calibration of a new sensor may not be possible ("*nogo*" display) in some instances because the uncalibrated sensor cannot recognize the calibration gas. If this proves to be the case, calibrate manually.

3. OXYGEN SENSOR REPLACEMENT (Model CGO-321)

If "FAIL" is displayed in the AUTO ZERO position with calibration switch position 3 up, immediately after "O2" is shown on the display, and if the gas being sampled is clean air, the oxygen sensor must be replaced. The oxygen sensor consists of an electrochemical oxygen cell which should not be opened since it contains potassium hydroxide, a corrosive liquid. The old oxygen cell should be returned to Bascom-Turner for proper disposal. Please use the container furnished with the replacement cell for the return.

The tools require for replacement and calibration are a Phillips #1 and a jeweler's #2 screwdriver.

A. Replacement of the Oxygen Cell

The following stepwise procedure will result in the most time-efficient and trouble-free installation:

1. Make sure the selector switch is in the OFF position, then remove the battery compartment cover and the four AA batteries. Remove the two rubber plugs on the side of the case (see Fig. 6). Remove the two Phillips screws from the back of the case and lift the top cover exposing the main circuit board. Unscrew the plastic cable clamp near the 6-pin connector and leave it on the cable.
2. Disconnect the 6-pin connector noting that the printing on this connector is visible when oriented correctly.
3. Lift and tilt the main circuit board by raising the side opposite the 6-pin filament connector to expose the 2-pin connectors on the underside of the main circuit board. The connector nearest the end of the board where the display is mounted leads to the oxygen sensor. The 2-pin connector further from the display connects the pump motor to the main board.

Disconnect all the connectors on the underside of the main circuit board then remove the board.

4. Remove the four screws which hold the oxygen sensor to the manifold and remove the oxygen sensor from the manifold. Verify that an orange gasket is in position in the manifold's well and the well is clean.
5. Place the new oxygen sensor into the manifold and tighten the four screws to hold the sensor firmly against the gasket.
6. Put the main circuit board back into place and reconnect all connectors below the board. Reconnect the cable to the 6-pin connector on top of the board and secure the cable clamp to the manifold with the screw.

7. Position the top cover on the instrument, move the top gently until the selector switch post falls into place in the slotted switch on the board, replace the two Phillips-head screws in the back of the case, and replace the batteries and the battery compartment cover.

B. Calibration of the Oxygen Cell

Calibrate the new oxygen sensor by placing switch 3 up (towards the front panel) and setting the front panel selector switch to AUTO ZERO. After AUTO ZERO is complete ("*End*" appears in the display), place switch 3 down and replace the rubber plugs on the side of the instrument.

To check that the oxygen cell has been replaced correctly and is functioning properly, place the selector switch at "% Oxygen" to read $20.9 \pm 0.1\%$ in ambient air. Use 100% methane or system gas to check that the reading for % Oxygen is $0.0 \pm 0.2\%$.

APPENDIX I

SET UP AND PURGE OF THE CALIBRATION GAS DISPENSER

Calibration Gas. The gas required for automatic calibration of the catalytic combustion and CO sensors is Bascom-Turner's methane and CO calibration gas (Part No. MC-105 or MC-620) containing $2.5 \pm 0.05\%$ methane and $100 \text{ ppm} \pm 2 \text{ ppm}$ CO in air. It is provided in a disposable aluminum tank (either containing 105 or 620 liters of gas) sufficient for many calibrations.

The thermal conductivity sensor can be calibrated with either pure methane or "pure" system gas provided by the user.

Calibration Gas Dispenser. The calibration gas must be delivered at or near atmospheric pressure to ensure accurate calibration. Bascom-Turner recommends using the Calibration Gas Dispenser (Part No. CGD-001) which regulates and displays the delivery pressure, approximately 5 to 10 inches of water, with a front panel pressure gauge.

Calibration Apparatus. The components of the automatic calibration apparatus shown assembled in Figure 9, can include:

Description	Part Number
Calibration gas dispenser	CGD-001
Methane and CO calibration gas (105L)	MC-105
Methane and CO calibration gas (620L)	MC-620
Flow regulator for 105L tanks	FR-001
Flow regulator for 620L tanks	FR-302

SAFETY PRECAUTIONS: For your safety please read these instructions carefully. To operate the flow regulator on a compressed gas cylinder, it is required that you be trained in its proper use or be under competent supervision.

1. Wear safety glasses when installing a gas regulator on a gas cylinder.
2. Never heat or expose a gas cylinder to temperatures above 125°F.
3. Be certain that the gas stream is shut off at the regulator when not in use.
4. Vent all calibration gas to outside air.

INSTALLING CALIBRATION GAS TANK

1. Inspect cylinder's and regulator's Standard Compressed Gas Association (CGA) connections for damage, dirt, dust, oil, or grease. Do not use if either is damaged. Remove all traces of foreign materials with a clean, lint-free cloth.

2. Be sure both the regulator and cylinder have compatible CGA fittings. Do not attempt to use an adapter to connect incompatible CGA fittings.
3. Attach the regulator to the cylinder and, when using the FR-302, tighten the CGA connection nut or, when using the FR-001, turn the tank clockwise while holding the regulator.
4. Verify that the regulator's valve is closed.
5. Secure gas cylinder to a wall, bench or stand so it will not tip over or fall.
6. Observe the inlet supply pressure gauge, which will verify cylinder pressure.

PURGING THE GAS DISPENSER: Purging air from the gas dispenser should be done each time a new tank of calibration gas is installed and prior to instrument calibration.

1. Open the regulator's valve and observe 5 to 10 inches of water column pressure on the gas dispenser's gauge.
2. Leaving the regulator's valve open insert the tip of the detector's extended standard probe as far as it will go into the outlet on the front panel of the gas dispenser.
3. Switch to the % GAS scale and wait several minutes. The % GAS reading will slowly climb to a maximum and stabilize.

CALIBRATING DETECTORS

1. Calibrate gas detectors following the procedure for A-CAL calibration (Part 2, Section 1).
2. When finished calibrating close the regulator's valve.



Figure 9. Automatic calibration apparatus delivering calibration gas to a Gas-Sentry®.

APPENDIX II

SETUP OF THE MANUAL CALIBRATION APPARATUS

These instructions should be followed when setting up and using the manual calibration apparatus.

The components of the manual calibration apparatus are shown assembled in Figure 10, they include:

Manual Calibration Apparatus

Description	Part Number	Part Number
	PCA-001	PCA-302
Methane and CO calibration gas	MC-105	MC-620
Flow regulator	FR-001	FR-302
Tubing and connector	TB-512	TB-512

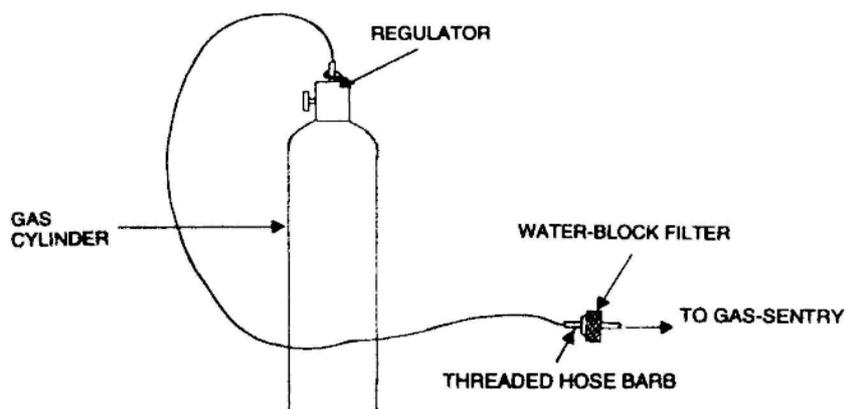


Fig. 10. Manual calibration apparatus

SAFETY PRECAUTIONS

For your safety please read these instructions carefully. To operate the flow regulator on a compressed gas cylinder, it is required that you be trained in its proper use or be under competent supervision.

1. Wear safety glasses.
2. Never heat or expose a gas cylinder to temperatures above 125°F.
3. Be certain that the gas stream is shut off at the regulator when not in use.
4. Vent all calibration gas directly to outside air.
5. Always use the flow regulator to prevent pump damage.

REGULATOR AND HOSE INSTALLATION

1. Secure gas cylinder to a wall, bench or stand so it will not tip over or fall.
2. Be sure both the regulator and cylinder have compatible CGA fittings. Do not attempt to use an adapter to connect incompatible CGA fittings.
3. Inspect cylinder's and regulator's Standard Compressed Gas Association (CGA) connections for damage, dirt, dust, oil, or grease. Do not use if either is damaged. Remove all traces of foreign materials with a clean, lint-free cloth.
4. Attach the regulator to the cylinder and, when using the FR-302, tighten the CGA connection nut counter-clockwise, or when using the FR-001, hold the regulator and turn the tank cylinder clockwise.
5. Verify that the regulator's valve is closed.
6. Observe the inlet supply pressure gauge, which will verify cylinder pressure.
7. Connect the 3/16" ID tubing fitted with a threaded hose barb (Part No. TB-512) to the hose barb on the regulator and secure with a cable clamp.

CALIBRATION

1. Use either the automatic or manual calibration procedure described in Part 2, "Calibration and Alarm Level Selection."
2. When finished close the regulator valve.

CAUTION: Always attach the detector's three-way filter to the threaded hose barb (TB-512) with the regulator off, wait for "*bloc*", then open regulator's valve. Blocking the flow with the regulator's valve open can result in a pressure surge when the flow is resumed which will damage the detector's pump.

ACCESSORIES AND SPARE PARTS

Description	Part Number
1. Probes and Hoses	
Standard Probe & Rubber Tip (two sections).....	SP - 307
Ceiling/Bar Hole Probe & Rubber Tip (34 inch long, clear).....	BP - 034
Clear Bar Hole Probe (34 inch long, side holes).....	BP - 134
Fiberglass Ceiling/Bar Hole Probe (no side holes).....	BP - 136
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
Extended Duty Flue Gas Probe & Filter.....	FP - 012
Long Adjustable Flue Gas Probe & Filter (15-23 inch long, telescoping).....	FP - 114
Gooseneck Probe (14 in. ### = 014 for threaded & 114 for quick connect).....	GP - ###
Coiled Hose (5 feet long when extended).....	CH - 060
Coiled Hose w/Quick Connect (5 feet long when extended).....	CQ - 060
Straight Hose (5 feet long).....	SH - 060
Straight Hose w/Quick Connect (5 feet long).....	SQ - 060
Rubber Gas Collecting Tips (for SP-307, 5/pkg).....	RT - 107
Rubber Gas Collecting Tips (for BP-034, and BP-336, 5/pkg).....	RT - 030
Surface Vacuum Probe (36 inch long).....	VP - 036
2. Filters	
Dust and Water-Block Filter (5/pkg).....	WF - 305
Three-way Filter (5/pkg).....	WF - 405
Water-block Filter for GP-014 & GP-114 (5/pkg).....	WF - 205
Water-stopper (with push-button release).....	WS - 001
Bar Hole Filter.....	BF - 001
Flue Gas Filter (5/pkg).....	FF - 005
Extended Duty Flue Gas Filter (5/pkg).....	FF - 105
Heavy Hydrocarbon Filter (5/pkg).....	HF - 005
Activated Carbon & Spare Retaining Disks for Refilling HF-005.....	HR - 050
Inlet Filter & Threaded Air Intake (5/pkg).....	IF - 105
Inlet Filter & Quick Connect Air Intake (5/pkg).....	IF - 205
3. Sensors	
Methane Sensor (in flame arrestor).....	MS - 001
Carbon Monoxide Sensor (with electronics).....	CO - 001
Oxygen Sensor.....	OS - 001
4. Replacement Parts and Manual	
Main Circuit Board (### = Model No.).....	CB - ###
Pump Motor.....	PM - 001
Pump Assembly with Installation Procedure.....	PA - 201
Pump Diaphragm/Plunger Assembly & Pump Head (5 sets/pkg).....	PD - 205
Intake Manifold with Pump and Alarm (### = Model No.).....	IM - ###
ABS Case (without BC-001, ### = Model No.).....	AC - ###
Battery Compartment Cover.....	BC - 001
Rubber Plugs (set of two).....	RP - 002
Operating Manual (CGC-301, CGI-201, CGC-311, CGI-211, CO-150 & CGO-321).....	OM - 1102
5. Carryall and Instrument Case	
Carryall with Shoulder Strap & Detachable Window.....	CC - 001
Instrument Case w/Ethafoam Insert.....	IC - 101
Detachable Window.....	DW - 001
Shoulder Strap.....	SS - 001
6. Accessories for Calibration & Maintenance	
Two in One Bump Gas (5/pkg).....	BG - 005
Calibration Gas Dispenser (without MC-105 & FR-001).....	CGD - 001
Manual Calibration Apparatus (with MC-105 & FR-001).....	PCA - 001
Manual Calibration Apparatus (with MC-620 & FR-302).....	PCA - 302
Boost Gas Apparatus (with BG-105 & FR-001).....	BGA - 001
Boost Gas (105 L).....	BG - 105
Methane & CO Calibration Gas (105 liters, 2.5% CH ₄ & 100 ppm CO).....	MC - 105
Methane & CO Calibration Gas (620 liters, 2.5% CH ₄ & 100 ppm CO).....	MC - 620
Flow Regulator for MC-105 or BG-105.....	FR - 001
Flow Regulator for MC-620.....	FR - 302
Threaded Hose Barb & Tubing.....	TB - 512
Pump Repair Kit (with 1 can of UJ-206).....	PK - 201
Ultrajet Compressed Gas (6x12 oz. cans/pkg).....	UJ - 206

Prices and Terms: Prices and specifications are subject to change without notice. Minimum order is \$50.



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