QEL DEDESCO LTD

CEA-3000 Combustion/Emissions Analyser Operating Manual

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1 Introduction

The Model CEA-3000 Combustion/Emissions Analyser is a portable instrument designed to simplify and speed up the task of making combustion and emissions measurements on a furnace or boiler. The Combustion/Emissions Analyser has been carefully assembled and tested and will provide many years of trouble-free service when used in accordance with the instructions provided in this manual.

Oxygen measurement calibration is updated each time the instrument is used. The net-temperature circuitry has been accurately calibrated at the factory and can be expected to maintain its calibration for two years. Calibration of the remaining electrochemical sensors is recommended at six-month intervals or more frequently for maximum accuracy. The operator should not attempt to make internal adjustments or calibration changes. A calibration service is available from QEL Dedesco Ltd.

The Model CEA-3000 Combustion/Emissions Analyser can be equipped with optional gas sensors such as nitric oxide (NO) for NOX measurements. A compact infrared printer is available as an option to provide a hard copy of all measurements.

The firmware of the analyser can be upgraded. It is a good idea to check with the factory on a yearly basis for software upgrades due to continued product development and refinement. If a software upgrade is combined with factory calibration, it can be provided free of charge. Our service staff will upgrade any units returned to the factory for service automatically if new software is available.

1.1 Contact Information

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Additional information is available on our company web site, as well as new product information and updates to this manual when available.

2 Instrument Familiarization

To become familiar with the analyser, it is recommended that the complete operating instructions be read prior to first use. Figure 1 details the various components of the analyser and sample probe and will be referenced throughout the text.

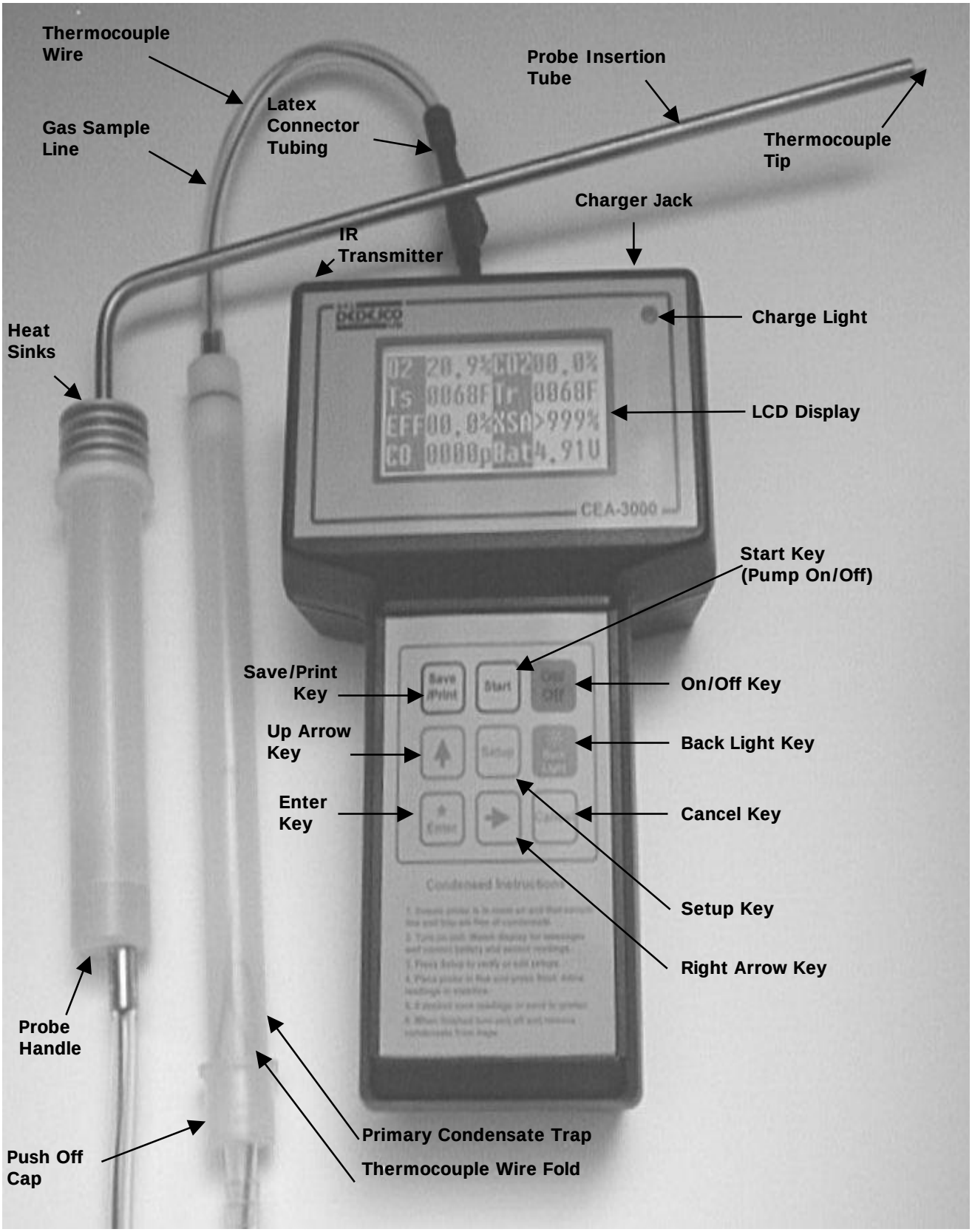
2.1 Summary Of Operation

The Model CEA-3000 Combustion/Emissions Analyser is a battery-powered instrument for combustion flue-gas monitoring and emission level testing.

The standard analyser is equipped with O_2 and CO (ppm) gas sensors. The measurements are taken by means of a sampling probe that is inserted into the flue. An integral pump draws a sample from the flue into the analyser for analysis. A thermocouple contained in the probe gives a measure of net stack temperature. Variables are selected for display by means of the keypad and selection of one of seven fuels ensures accurate determination of CO_2, Excess Air and Efficiency.

An optional printer is available to print out readings sent via the built-in Infrared (IR) transmitter. An optional RS-232C-compatible serial port permits data logging to an external device.

2.2 Analyser Features & Controls [Figure 1]



2.3 Instrument Power

This section covers all issues regarding the provision of power to the analyser as well as successful portable operation of the unit.

IMPORTANT NOTE: When storing the instrument for any longer than a week, either

1) Leave the instrument on constant charge (this will not damage the NiMH batteries)

or

2) Remove the NiMH batteries from the instrument during storage. Before using the instrument after storage, install batteries at least 24 hours prior to use (to allow biased sensors to stabilize). Then perform a complete charge cycle to the batteries using the charger supplied.

Failure to perform either of those actions could result in the batteries being drained to the point where they are damaged and cannot be re-charged.

2.3.1 Battery Specifications

The standard Combustion/Emissions Analyser operates on four rechargeable AA Nickel Metal Hydride (NiMH) cells. NiMH cells are recommended because of the instrument's total current demand. They will provide about 8 to 12 hours of use between charges depending upon options and are not subject to "memory effect". Units are typically shipped with the battery installed in a charged or partially charged condition.

Alkaline cells may be used for short-term emergencies, but must not be charged (i.e.: don't plug in the AC adapter at the same time you are using alkaline cells). Zinc Carbon cells (regular or heavy duty) is not recommended. In general, non-rechargeable cells will leak fluid or heat up when charged. Non-rechargeable cells do not accept the charge, and therefore there is no gain by attempting to charge them. Rechargeable alkaline cells use a different charging algorithm than implemented in the analyser and is therefore not recommended for charging inside the analyser. Please use a specially designed external charger.

The newer type Lithium AA cells may also be used for emergencies or for backup, but due to the nature of Lithium cells they can explode when charged. For safety reasons, remove lithium AA cells after use to avoid the risk of charging them by accident.

Nickel Cadmium rechargeable cells can be used for emergencies, and be recharged, but they deliver less than half the capacity of NiMH cells.

NiMH battery technology is improving at a rapid pace. We therefore recommend keeping an eye on the latest capacities available. NiMH cells of any capacity can be used, as long as they are NiMH technology. The capacity indication of the unit will remain accurate, independent of total capacity. The battery life specification for the unit is based on cells of 1500 mAh and will therefore increase if cells of higher capacity are used. Cells of up to 2200 mAh are available at the time of release of this document.

2.3.2 Low Battery Indication

Remaining battery charge is displayed on the main screen in percentage of total charge (indicated by Bat). The remaining battery charge indication is modeled on the discharge curve for NiMH cells and will therefore show a less accurate indication for other cells. When the remaining charge drops below 12%, the unit will switch off automatically after three short beeps. Some capacity needs to be kept in reserve to maintain the bias of the gas sensing cells.

2.3.3 Charger Adapter

A battery charger adapter is supplied with the analyser. The charger jack is located on the back of the analyser to the right. The analyser may be operated with the charger plugged in, but must not be operated on the charger with the battery removed.

Warning: Do not use non-rechargeable cells with the charger adapter plugged in.

Do not use an adapter other than that supplied with the instrument or damage may result. Contact the factory for a replacement charger if necessary.

2.3.4 Battery Charging

A new battery is shipped in a partially charged state and should be charged fully before use. With the charger plugged in and the meter turned off, the battery will fully charge in 14-16 hours. The charger should not be used until the cells have been allowed to warm up above 5°C (41°F). Damage to the cells could also occur if they are charged when hot (i.e.: unit was left on dashboard of vehicle in sunlight, which is not a good idea either).

Current-limiting circuitry in the instrument allows the battery to be left on charge indefinitely. Two automatic charging modes are implemented:

- Fast Charge – Indicated by an amber charge indicator, which is in effect until the battery reaches 100% charge, or when the pump motor is on.
- Trickle Charge – Indicated by a green charge indicator, which is in effect when the battery is fully charged and the pump motor is off.

2.3.5 Operation During Battery Charging

The Model CEA-3000 will charge during operation with the charger plugged in. When the battery is low, the charger should be plugged in before continuing to operate the analyser. The battery will charge slower during such operation. The analyser must not be operated on the charger with the cells removed.

2.3.6 Battery Replacement

To replace the cells, remove the battery compartment lid from the underside of the meter. Remove all four cells and insert replacement cells in the holders with polarity as indicated on the battery compartment lid. The cells fit snugly and a small screwdriver may be required to lift the cells out of the compartment. Lift the cells from the side of the positive terminal. Please take care not to damage the enclosure. Replace the battery compartment lid when done.

Note: Replacement cells should be of the same type (NiMH Rechargeable) and condition (preferably new) to ensure uniform charge and discharge for best life and performance. It is advised to replace all four cells at the same time.

2.4 Sample Probes

A standard probe plus some additional special probes is available as described below.

2.4.1 Standard Probe

The Model CEA-3000 Combustion/Emissions Analyser is supplied with an 11-inch probe as standard equipment. The probe incorporates a thermocouple contained in the 11-inch probe insertion tube. Heat sinks located on the tube protect the probe handle by preventing contact with hot surfaces. The thermocouple wire passes continuously though the gas sampling line and terminates at the analyser in a thermocouple jack. The probe sample line connects the probe to the condensate trap and the condensate trap to the analyser at the sample port fitting by means of a short length of black latex connecting tube.

2.4.2 High-Temperature Probe [OPTION]

For unusually high stack temperatures, the probe materials can changed to Inconel or other suitable steels. Temperature limitations relate to both thermocouple and probe materials. Applications should be discussed with QEL Dedesco Ltd for optimum design.

2.4.3 Extended Probes [OPTION]

In cases where measurements are to be taken in larger stacks or where edge effects may disturb the readings of either temperature or sample gas, extended- length probes are available.

2.5 Condensate Trap And Filter

There is a condensate trap and damper filter provided on the Model CEA-3000 Combustion/Emissions Analyser. Regular condensate removal from the condensate trap is essential for trouble-free operation.

2.5.1 Condensate Trap

The condensate trap is located in the gas sampling line. It has sufficient capacity to provide approximately 20 minutes of continuous operation before the condensate must be emptied. For most effective operation, allow the metal tube end of the condensate trap to hang lower than the other end. This trap has a push off cap which allows it to be emptied easily while the instrument is in operation. Remove condensate by carefully pushing off the cap and dumping as required. Always take care to ensure that the cap is securely pushed back on to form an airtight seal, since room air leaked into the sampling line would cause erroneous gas readings.

The fold in the thermocouple wire is to prevent condensate from running along the wire and into the stainless tube. Make sure the fold is retained. Care has been taken in the design to prevent condensate from coming into contact with both the pump and the gas sensors since they can be easily damaged by water. Care must be taken by the user to ensure the condensate trap in the gas sampling line does not overfill.

2.5.2 Filter

Located in the sample line just before it attaches to the analyser is a glass wool filter designed to prevent particles from entering the pump. This filter should be examined frequently for buildup, but in general should only require replacement during the recommended yearly factory service. The filter may require drying out if too much condensate has passed through the condensate trap. This can be done by drawing dry room air through the filter for a period of time.

You can determine whether the oxygen cell is being affected by condensate by removing the probe from the flue and observing the oxygen reading. If the reading returns to 20.9% (the original calibration value) it is not being affected by condensate. If it settles to a value less than 20.9% it is being affected by condensate and removing the condensate from the trap and line. Drying out the glass wool filter will improve measurement accuracy.

The filter is field-replaceable; contact our factory for more information.

3 Operating Instructions

The CEA-3000 combustion analyser has two important modes of operation. The start-up mode is entered when the unit is powered up. This mode calibrates the Oxygen and Stack temperature measurements. The Measure Mode is followed by the start-up mode automatically. In Measure Mode, the unit will analyze the gas sample drawn from the flue.

3.1 Start-Up

Note: During start-up important parameters are captured. The accuracy of the unit is affected by the conditions under which the start-up cycle is performed. Please study the instructions below carefully to ensure accurate and reliable flue gas analysis.

3.1.1 Zeroing And Warm-Up

Caution: The probe can become extremely hot when inserted into the stack. When checking or handling the probe, keep it well away from yourself, clothing or any object that can be melted or damaged by high temperatures.

Conditions to meet for proper start-up:

- **Inlet of probe must be in room (clean) air (to get proper Oxygen calibration).**
- **Tip of probe must be cool, preferably at room temperature (to get proper net stack temperature calibration).**
- **Analyser unit temperature must be equalized with room ambient (influences net stack temperature value).**

With the probe out of the stack, turn the instrument on by pressing the On / Off key. The LCD display will show a start up screen with model and software revision number. The pump is started at power-up and cannot be turned off during this phase. The unit can be turned off during this phase by pressing and holding the On/Off key until a beep is heard.

After a few seconds, the unit will show a number of start-up values and adjust the zero for net stack temperature, as well as oxygen and gas sensors.

The start-up values can be ignored and are shown for monitoring purposes by the factory technical and service staff. The numbers should follow more or less the same pattern for each start-up. If you notice a number suddenly being different by a large amount during a start-up, it could indicate a fault in the unit. Before contacting the factory, please make sure the start-up conditions are met and the battery is fully charged. The numbers will vary slightly by ambient temperature and air quality in the room.

The start-up sequence takes 30 seconds and is automatically followed by the measurement display screen, at which point it is possible to switch off the pump. The unit proceeds automatically to the Measure Mode.

The items below are accessible from Measure Mode.

3.1.2 Fuel Selection

Press Setup to see a screen labeled "Fuel:", which allows you to select a fuel type. If you wish to go on to the next setup (Temperature Units) without changing the fuel type simply press *Enter.

If you wish to change the fuel type press either Arrow key to scroll up or down between the fuel choices and press the *Enter key to select the displayed choice.

If you wish to exit the setup without saving the fuel type changes, press Cancel .

3.1.3 Temperature Units Selection

After pressing the Setup key to show the Fuel selected as above, press *Enter to show the next setup window labeled "Units:", which selects between temperature units in degrees Fahrenheit (ºF) or degrees Celsius (ºC). If you wish to go on to the next setup (Main Display Selection) without changing the unit type simply press *Enter.

If you wish to change the units press either Arrow key to toggle between the choices and press the *Enter key to select the displayed choice.

If you wish to exit the setup without saving the temperature unit change, press Cancel .

3.1.4 Main Display Selection

After pressing *Enter for the temperature units as described in the paragraph above you will next see a screen labeled "Main Display:", which allows you to select the main display type: either a full text display ("Graph=No") or a text and graph display ("Graph=Yes").

If you wish to leave setup without changing the main display type, simply press *Enter or Cancel.

If you wish to change the main display type press either Arrow key to scroll up or down between the display type choices and press the *Enter key to select the displayed choice.

3.2 Measurement Mode

With setup complete, the analyser is now zeroed, calibrated and ready for use with values of interest on the main display. See this section for detail on the main display values being shown.

The measured values described below are updated while the pump motor is running. If the pump motor is stopped, most measured and calculated values are frozen. This is handy to capture a set of measurements that need to be printed on the optional IR printer.

While the pump motor is not running, only the room temperature and remaining battery charge indications will be updated. Restart the sample pump to continue updating the readings. Give the measured values ample time to stabilize as described below.

3.2.1 Oxygen (O_2 %)

After zeroing the analyser and calibrating the oxygen measurement to 20.9% on room air, insert the probe in the flue. The measured oxygen will be displayed in the upper portion of the display. The analyser will begin to react to the oxygen concentration in the flue gas in approximately five seconds and reach a stable value in 25 to 45 seconds with typical oxygen concentrations. Time taken to stabilize will be greatest with lowest oxygen concentration.

Should you wish to recheck the O_2 calibration and sensor zeros during operation this can be done by disconnecting the gas sampling line from the condensate trap - where this is more convenient than removing the probe from the flue. Allow the analyser to draw in clean room air for two minutes to ensure all flue gas is purged out.

3.2.2 Carbon Monoxide (CO ppm)

The CO sensor responds to Carbon Monoxide. CO is displayed continuously in the main display in parts per million (ppm). Insert the probe in the flue and wait approximately 60-90 seconds for the reading to stabilize.

The CO sensor is calibrated with 450 ppm CO for maximum accuracy. 450 ppm CO is considered a critical level. Note that a reading of 450 ppm is equivalent to 0.045%.

Recheck for a 0 ppm reading of CO if some time has passed since initial zeroing and re-zero if necessary. The CO measurement can be re-zeroed by disconnecting the gas sampling line from the condensate trap and waiting 2 minutes to purge the gas from the meter. If the CO reading is no longer zero it can be reset by turning the unit off then on again to re-zero.

The electrochemical CO sensor should be calibrated at intervals of about six months or more frequently for critical measurements. This may be verified in the field using a suitable analyzed reference gas or by returning the analyser to the factory for calibration. Refer to the Service and Calibration section below.

3.2.3 Carbon Dioxide (CO2 %)

If Graph mode has not been selected, Carbon Dioxide will be displayed in the upper right part of the display as %CO2. CO_2 is a calculated value derived from the oxygen measurement and fuel data for

each type of fuel. The correct fuel type must be selected and the probe must be in the flue to ensure that correct values of CO_2 are displayed. For the measurement to be correct, the sample must not be diluted by leakage air.

3.2.4 Stack Temperature Ts (°F or °C)

The stack temperature will be displayed in the upper left of the display in degrees Fahrenheit or Celsius as selected in the Setup mode. Allow adequate time for the stack temperature to reach equilibrium before recording the data. The time required to reach equilibrium will vary with different furnaces and boilers.

3.2.5 Efficiency (EFF %)

With the probe in the flue and the appropriate fuel selected, the analyser will calculate and display the furnace efficiency in the lower left of the display window in percent. The instrument will use the current readings of stack temperature, room temperature, percent oxygen and fuel constants to calculate and display the percent efficiency of the furnace or boiler. This calculation will be automatically updated as the Oxygen % or stack temperature change.

The analyser will automatically adjust the efficiency calculation program when the flue gas temperature is below the condensate point to provide correct efficiency measurements on high efficiency condensing furnaces.

3.2.6 Excess Air (XSA %)

With the probe in the flue and the appropriate fuel selected, the analyser will display the calculated excess air in the lower right of the display window in percent. Excess Air is a calculated value derived from the oxygen measurement and fuel constants.

3.2.7 Nitric Oxide (NOX ppm) [OPTION]

The Model CEA-3000 Combustion/Emissions Analyser can be equipped with an NO (NOX) sensor as an option.

Note: To achieve fast warm up and stability, the NOX cell is continuously biased by the battery power supply in the meter. For accurate measurements, it is essential that this bias be maintained. A fully charged set of cells will provide power for biasing for about 30 days. Hence, the battery must be charged overnight (12-16 hours minimum) at least once every month even when the unit is not in use. The charger may be plugged in for longer periods with no risk of overcharging the battery.

The electrochemical NO sensor should be calibrated at intervals of 6 months. The NOX calibration may be verified in the field using a suitable analyzed reference gas or by returning the analyser to QEL Dedesco Ltd for calibration. For critical measurements, calibration should be verified with analyzed gas at the time of testing. Please refer to the Service And Calibration section below.

3.3 Non-standard Operation Procedures

Each time the analyser is turned on; the warm-up procedure (checking of the oxygen calibration for 20.9% and gas zeroing) must be done to ensure accurate measurement of gases and correct calculation of CO_2, Excess Air and Efficiency.

Zeroing must be done with the analyser sampling room air to ensure proper zero values are recorded. All combustion measurements are taken with the probe in the flue after suitable warm-up and zeroing procedures.

Note: All flue gas must be purged out of the meter before zeroing or re-calibrating to ensure that the oxygen calibration and the gas sensor zeros are based on room air and not on flue gas. Two minutes of running time with the probe in room air is

usually long enough to thoroughly purge the meter, followed by turning the unit off and on again to re-zero if zero values have drifted.

3.3.1 Re-zeroing And Purging

If the analyser undergoes a wide temperature change while in use, its accuracy can be improved by re-establishing the zero values.

The procedure for doing this is to purge the analyser by removing the probe from the flue or disconnecting the gas sampling line from the condensate trap or enclosure fitting.

Press Start if required to turn the pump on and allow the analyser to purge for two or three minutes on room air.

Turn the unit off and then on again with the On / Off key to perform automatic zero adjustment of the oxygen, gas sensors and net stack temperature measurements.

The purging is necessary to ensure that the gas sensors are zeroed on room air free of flue gases. Check if the probe tip has cooled down appropriately.

3.3.2 Purging A Dry Analyser

If the analyser has been out of service long enough for all condensate droplets to have dried completely from inside the gas sampling line, then allow a sample of flue gas to be drawn into the analyser followed by re-zeroing and purging on room air (see above). The moisture added to the line will make a small improvement in the accuracy of the calibration.

3.4 Low Temperature Performance Of Analyser

The analyser contains temperature compensation circuitry and will provide accurate measurement in ambient temperatures from 0°C to 49°C (32°F to 120°F).

Calibration at the factory is done at room temperature and the unit will perform most accurately when used between 18°C and 25°C (or 64°F and 77°F).

The user should avoid storing the analyser below freezing temperatures (such as in the truck overnight), since this can cause damage to the electrochemical cells. The remainder of the instrument can withstand storage at temperatures down to -40°C (-40°F) without damage.

If the instrument is cold and condensate form on it when first put into operation, it may perform unreliably for a few minutes until the condensate evaporates. Restart the analyser as soon as the condensate has evaporated to ensure correct zeroing and calibration.

Note: The capacity of the NiMH cells drop at lower temperatures.

4 LCD Display Utilities

Some additional features applicable to the LCD display are explained in the section.

4.1 Backlight

Use the Back Light Key to toggle the LCD backlight. The backlight will drain the battery quicker due to the extra current drain.

The Analyser always starts up with the LCD backlight off, irrespective of the backlight state when the unit was switched off.

Switch the backlight off to conserve power when the remaining battery charge is limited.

4.2 Contrast Adjustment

While in Measure Mode, the LCD display contrast can be adjusted by pressing and holding the Up Arrow Key. The contrast is adjusted incrementally at every beep and will cycle from light to dark. When the contrast setting reaches its darkest level, it will roll over to the lightest level.

The contrast setting cannot be adjusted during the auto zero phase. When the battery and charger is removed, the LCD contrast setting will return to the default setting.

The LCD contrast adjustment does not influence the life of the battery.

5 Expansion Port [OPTION]

Data transmission is available via an optional expansion port located at the back of the instrument. This port also supports additional external sensors and input/output expansion for future needs.

6 Infrared Printer [OPTION]

The Model CEA-3000 Combustion/Emissions Analyser has an infrared transmitter located at the back of the analyser for wireless communication with an optional compact Infrared Thermal Printer.

6.1 Printer Operation

Note: Please refer to the Operation Manual supplied with the printer for additional information concerning the printer itself.

6.1.1 Printer Precautions

Please take note of the points below concerning the printer:

- **Allow the printer to warm to room temperature during cold weather.**
- **Do not operate printer without paper.**
- **Damage to the print head will result if paper is pulled out at the back of the printer.**

6.1.2 Printer Activation

Place the printer 6 inches to 3 feet from the back of the CEA-3000 with its infrared window facing toward the back of the CEA-3000, ensuring there are no obstructions for the infrared beam.

- **Turn the printer on.**
- **Press Save/Print key on CEA-3000.**
- **The printer will print a header for date, time and all current sensor and calculated values.**
- **Avoid moving either the CEA-3000 or the printer while printing to ensure continuous communication.**

6.1.3 Paper Feed

Press the PAPER FEED pushbutton D on printer to advance paper. Ensure printer is not printing during a paper feed operation.

6.1.4 Printer Self-Test

Printer operation can be verified at any time as follows:

- **Ensure printer has paper.**
- **Turn printer on while holding down paper feed pushbutton D, then release paper feed pushbutton.**
- **Printer will print out a test pattern and stop automatically when test program is complete.**

6.1.5 Printer Specifications

Item	Specification
Manufacturer	Hewlett Packard
Print Type	Thermal Dot Matrix

Power Supply	4 X AA Cells or Optional Power Adaptor
Battery Life	Approximately 6000 print lines
Power Down	Automatic after 10 minutes
Print Speed	One 24 character line/sec
Paper	HP82175 paper. Prints black, 2.25" x 80 ft roll, 57mm x 25m
Size	7.3 x 3.6 x 2.4 in, 19 x 9 x 6 cm

For best battery life, turn printer off when not in use, set contrast to lowest reasonable level, use optional AC adapter.

6.1.6 Printer Troubleshooting

Symptom	Possible Cause	Remedy
Printer power LED not on	Print power switch not on. Battery dead. Printer auto shutdown.	Turn printer switch on. Replace battery. Turn printer off then on again.
No Printout	CEA-3000 not turned on. Paper not feeding properly. Infrared beam obstructed.	Turn on CEA-3000. Ensure paper feed is clear. Remove obstructions between unit and printer.
Printout Faint	Contrast not set properly. Battery weak.	Adjust printer contrast switch. Replace battery.
Characters missing or replaced by rectangular blocks.	Marginal IR signal path. Analyser moved too much. Printer battery low.	Re-orient Analyser and Printer for unobstructed and straight path between IR transmitter and printer IR sensor. Do not move the Analyser while printing. Do printer self test to see battery condition.

6.2 Printer Paper

Refer to the printer user manual for additional information.

6.2.1 Paper Roll Replacement

To replace paper:

a) Advance remaining paper out the top of the printer.
b) Open paper holder door and discard old roll.
c) Unroll several inches of paper from new roll and trim the end straight.
d) Place roll in paper door holder with paper feeding from bottom of roll.
e) While pushing paper into printer slot hold down paper feed pushbutton until paper emerges.
f) Place paper in compartment and close door.

Caution:

- **Do not operate printer without paper.**
- **Do not pull on paper to feed through, use paper feed button.**
- **Do not pull paper back through printer.**
- **Do not run paper to end of roll if paper is attached to inner core.**

7 Service And Calibration

Great care was taken in the design of the CEA-3000 analyser to make it rugged and able to cope with the conditions it will be used in.

To maintain the accuracy and reliability of the analyser a service and calibration is strongly suggested every six months. The analyser will be exposed to harsh conditions during use and therefore frequent maintenance will keep it in a reliable operating condition.

When the unit is serviced, it will be inspected for worn components and extreme amounts of dirt collected in the piping. All worn components will be replaced or repaired to original factory specification.

Information is provided in this section as a guide to recognize situations where the unit needs to be serviced or calibrated. Please contact our factory for more detailed information.

7.1 Sensor/Cell Expected Life

O_2 Cell: 10-12 months
CO & NO Sensor: 2 years

7.2 Calibration Verification

Calibration verification can be done by the customer with the availability of calibration gas and equipment. Some items should rather be performed at the factory where the correct equipment is available.

7.2.1 Oxygen Sensor Calibration

No calibration is provided other than that performed during the zeroing procedure. Calibration may be verified using a suitable analyzed reference gas. When the output from the O_2 cell is too low, the analyser will display a message to replace the sensor.

The analyser accepts that room air contains 20.9% Oxygen and calibrates the signal from the sensor to 20.9% during the start-up cycle. It is therefore important to let the analyser draw in fresh air during the start-up cycle.

7.2.2 CO & NO Sensor Calibration Check

Gas sensors may have their calibration verified in the field using a suitable analyzed reference gas in the range normally expected during operation.

Note: Care must be taken to allow the analyser to draw the analyzed gas in by means of its integral pump at its normal flow rate. This can be accomplished by either using a demand-type regulator or by careful adjustment of the flow rate to the analyser. A flow meter tee'd into the gas supply line to the analyser can be used to indicate a very slight outward flow in the tee'd line, ensuring adequate but not excessive flow rate to the pump. Sensor calibrations are influenced to a high degree by changes in flow rate.

Purge the analyser for four minutes or longer if it has recently been used for testing. Re-zero the analyser on room air. Set up the gas supply system as recommended above. Begin gas flow to the analyser noting the response rate of the sensor in question. Allow the reading to stabilize to its final value. Although the initial response appears rapid, it may require several minutes for the reading to stabilize fully. The gas supply may then be removed to allow the sensor to return to zero.

If the displayed gas concentration during the calibration verification differs significantly from the analyzed gas concentration and the method of supplying gas to the analyser is as described above, we recommend returning the analyser for complete inspection and calibration.

7.3 Sensor/Cell Replacement

The O_2, CO and NO cells need to be replaced by a qualified technician familiar with electronic instrumentation, as well as gas calibration procedures. The correct replacement cell needs to be used to ensure reliable and accurate operation of the unit.

7.3.1 Oxygen Cell

The oxygen cell has an average operating life of 10-12 months. An Oxygen cell ends it's useable measurement life with little warning. When the meter can no longer be calibrated to 20.9%, or a warning message appears in the Cal Check window after turning the unit on, the oxygen cell should be replaced.

It is recommended that the analyser be returned for cell replacement service on a regular basis to provide uninterrupted operation.

7.3.2 CO & NO, Electrochemical Sensor

The life expectancy of the 3-wire electrochemical cells is approximately 2 years. When a cell needs replacement, the CO or NO display will not respond to changing gas concentrations.

A good rule of thumb is to become familiar with the typical CO or NO readings expected during a session. When the readings seem low, it is reasonable to suspect that the CO or NO sensor is nearing end of life. An electrochemical cell stops responding to gas when it needs replacement.

When servicing a furnace or boiler the operator expects the presence of a certain CO or NO reading. If an unexpected low reading is obtained, a failing sensor can be expected. It is a good idea to become familiar with typical readings obtained with different types of fuels and makes of furnaces and boilers while the instrument is new or freshly calibrated and serviced.

The analyser must be returned to QEL-Dedesco to have a new cell installed and calibration with analyzed gas performed.

8 Analyser Specifications

Item	Specification
Model	CEA-3000 The Model/Serial Number plate is located on the underside of the analyser.
Power	4 x 1500 mAh (or greater) AA rechargeable NiMH cells. 117 Volt AC charger adaptor with charger plug-in and charge limiting circuitry built into the analyser.
Analyser Dimensions	5.5"W x 8.6"H x 2.9"D
Carrying case Dimensions	18.4"L x 14.3"W x 6.3"H
Analyser Weight	Approximately 2.2 lb. including standard probe
Total Kit Weight	Approximately 8.8 lb
Ambient Operating Temperature	32 - 120 ^{o}F (0 - 50 ^{o}C)
Analyser Construction	Rugged ABS instrument case with durable Lexan face panel.
Carrying Case Construction	Durable foam padded & keyed equipment case
Software Revision	Revision 1.6B (or later).

Measurement Item	Range	Resolution
Oxygen	0 - 25 %	0.1 %
Carbon Monoxide	0 - 2000 ppm	1 ppm
Net Stack Temp	0 - 999 ^{o}F (-18 - 538^{o}C)	1 ^{o}F (1^{o}C)
Carbon Dioxide	0 - 15.5 %	0.1 %
Efficiency	0 - 100 %	0.1 %
Excess Air	0 - 999 %	1 %
Nitric Oxide [OPTION]	0 - 1000 ppm	1 ppm
Efficiency	Model CEA-3000 calculates furnace efficiency for each of seven possible fuels used in furnaces or boilers and displays the calculated reading. The efficiency calculation compensates automatically for condensing high efficiency furnaces.	

9 Warranty

This instrument is warranted against defects in material and workmanship for a period of one year after date of purchase by the original purchaser. QEL Dedesco Ltd. agrees to repair or replace any assembly or component (except the oxygen cell which is guaranteed for nine months) found to be defective, under normal use, during this period. QEL Dedesco Ltd.'s obligation under this warranty is limited solely to repairing any such instrument which in QEL Dedesco Ltd.'s sole opinion proves to be defective within the scope of the warranty when returned to the factory. Transportation to the factory is to be prepaid by the purchaser. Shipment should not be made without prior authorization by QEL Dedesco Ltd.

This warranty does not apply to any products repaired or altered by persons not authorized by QEL Dedesco Ltd., or not in accordance with instructions furnished by QEL Dedesco Ltd. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, the repairs will be billed at standard rates. QEL Dedesco Ltd.'s liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for QEL Dedesco Ltd any liability in connection with the sales of our products other than set forth herein.

When returning an instrument, ship prepaid to:

Canada:

QUATROSENSE ENVIRONMENTAL LTD.
5935 Ottawa Street, PO Box 749
Richmond, Ontario
K0A 2Z0
Tel: (613) 838-4005
Fax: (613) 838-4018
Email: QEL@QELsafety.com
Web: www.QELsafety.com

10 Quick-Start Guide

Zeroing

Ensure probe is in room air and that the sample line and trap are free of condensate.
Turn analyser on by pressing On / Off key.
Allow analyser to purge and warm up for 3 minutes.
Press Setup to verify or edit setup, especially that correct fuel has been selected.
Confirm that O_2 is reading 20.9% and CO is reading zero, if not, turn unit off and then on to re-adjust automatically.

Measurements

After room air calibration, insert probe in flue with the sample pump running.
Wait for readings to stabilize before recording (typically 30-40 seconds for O_2, 90 seconds for CO, temperature variable)
Readings will be displayed and updated for O_2, Stack Temperature, Efficiency,
To print a record, turn on IR printer, point IR transmitter at IR printer and press Save / Print key.

Shut Down

Remove probe from flue and allow to cool.
Turn unit off by pressing On / Off key.
Check that no condensate is in condensate trap.

11 Troubleshooting

Symptom	Possible Cause	Remedy
Blank display.	Battery discharged. Cells installed improperly.	Recharge battery. Check for proper polarity and good connection.
Battery doesn't charge.	Shorted battery. Electronic fault.	Replace shorted cell (or all). Return to factory.
Unbelievable readings (values seem to be incorrect).	Improper ZERO.	Re-zero using proper zero sequence. See Instructions.
Cannot calibrate Oxygen to 20.9%.	Oxygen cell at end of life.	Replace with new Oxygen cell
Oxygen reading high.	Air leak.	Check sample line for holes and ensure all connections are tight. Ensure Oxygen cell is installed correctly.
Oxygen reading low.	Condensation in dryer tube.	Drain condensate trap.
CO reading high.	Improper zero.	Re-zero using proper procedure.
CO reading doesn't return to zero.	Warm up period not adequate.	Re-zero using proper procedure. See Instructions.
No change in Temp reading.	Broken thermocouple wire.	Replace probe or return to factory for inspection.
Pump laboring.	Obstruction in sample system.	Change filters in dryer tube. Check for obstructions in piping or probe.
Unit beeps when off.	Electrical interference. Electronic fault.	Remove transmitters or cell phone. Return to factory for service.
Charge LED never goes to Green and remains at Amber.	Battery doesn't charge fully. Battery doesn't reach full voltage. Software outdated.	Check line voltage. Check AA cells, replace if necessary. Check software for revision 1.6B or later.
Analyser stops responding to keyboard.	Reset required. Software outdated.	Unplug charger, remove one AA cell to reset. Replace cell. Check software for revision 1.6B or later.
NOX reading doesn't return to zero.	Battery discharged fully before operation.	Make sure the unit is charged once every 30 days or less if NOX option is installed.
Analyser switches itself off.	Battery remaining charge below 12%.	Connect charger or change battery.
Battery life too short.	Battery at end of life. Battery capacity sensing out of calibration.	Replace all four cells with AA NiMH. Return to factory for calibration. Check software for revision 1.6B or later.