Heliprobe® Analyzer

(HPU-011)

Used for detection of

Gastro duodenal

Helicobacter pylori

infection

Technical Manual

1. INTRODUCTION

Helicobacter pylori is a gram-negative spirally shaped bacterium that exclusively exists in the mucosa of the stomach, particularly in the antrum. *Helicobacter pylorus causes* gastritis which in turn can lead to ulcers and eventually cancer. This relationship between *Hp* and gastritis and ulcers was first discovered by Barry Marshall in 1983.

Hp-infection can be confirmed with different methods and tests such as gastroscopy, Urea Breath Tests (UBT), stool-antigen and serology. UBT is recommended by European *Helicobacter pylori* experts as the first choice and the most reliable non-invasive test for diagnosing an active infection as well as for follow-up of eradication of infection.

1.1 Theory of test method

Helicobacter pylori produce an enzyme, urease, which catalyzes the hydrolysis of urea to ammonium and carbon dioxide. *Helicobacter pylori* require the alkaline ammonium in order to establish an optimal local mucosal environment within the acidic milieu of the stomach. The produced carbon dioxide (CO_2) is diffused into the blood vessels and is further transported as bicarbonate to the lungs where it is exhaled as CO_2 with the exhaled air. This is used in the Urea Breath Test method (UBT).

When performing the UBT, the patient is given an oral dose of ^{14}C labeled urea. If *Helicobacter pylori* are present in the stomach, hydrolysis takes place, and the produced CO_2 will contain the labeled ^{14}C. In the absence of hydrolysis, all of the administered urea will pass through the stomach intact to be absorbed further down in the gastrointestinal tract, and excreted in the urine.

Bacteria other than *Helicobacter pylori* that produce urease are rarely found in the gastric flora. The presence or absence of a *Helicobacter pylori* infection can thus be determined by detecting if labeled CO_2 is present in exhaled air shortly after intake of labeled urea.

1.2 The Heliprobe® System

The Heliprobe® System works with the ^{14}C isotope as a label. It is a completely "dry" method built around two key components:

1. BreathCard™; which is a single use disposable breath-collecting unit, used to collect the exhaled air
2. Heliprobe® Analyzer; which is the instrument used to measure the activity in the breathcards. E.g the activity that existed in the collected exhaled air.

The test procedure is simple; 10 minutes after the patient has swallowed ^{14}C-labeled urea, the patient exhales into BreathCard™ until it is fully saturated.

This will be indicated by built-in indicator, which changes color from orange to yellow. BreathCard™ is inserted into the analysis unit and a single button press starts the analysis. The result is presented 250 seconds later as "infected", "not infected", or "borderline".

- Not infected (Heliprobe 0)
  Counts below or equal to 25 cpm (counts per minute)

- Infected (Heliprobe 2)
  Counts above or equal to 50 cpm

- Borderline Heliprobe 1)
  Counts between 25 and 50 cpm

The advantages with the Heliprobe® urea breath test system compared to other systems are speed and simplicity. The tests can be performed directly at site, without the aid of external facilities or expertise. The result will be accessible 15-20 minutes after the patient has swallowed the urea.

The clinical accuracy of the Heliprobe® System has been validated in clinical studies with various sources of urea against a urea breath test based on trapping 1 mmol of $^{14}CO_2$ in Hyamine solution and ß-scintillation analysis (conventional UBT).

The ^{14}C-Urea doze is very low (1 µCi), this corresponds to a body exposure of 0, 0006 mSi (which is less than an ordinary x-ray).

2. THE HELIPROBE® ANALYZER

The Heliprobe® Analyzer contains two shielded Geiger-Müller counters mounted face-to-face. An opening in the shield allows insertion of BreathCard™ between the two counters. When BreathCard™ is fully inserted its two pads are perfectly lined up with the two counters. Correct position of BreathCard™ is verified with an optical sensor. The analysis sequence can only be initiated if the card is properly inserted.

Microprocessor controlled electronics in the analyzer steer the measurement cycle. The system keeps continuous track of and compensates for variations in background radiation that are not blocked by the shielding around the Geiger-Müller counters. It also compares the result with programmed cut-off levels for determination of test results, calculates and presents the result on its LCD display.

A serial thermal printer can be connected to the Heliprobe® Analyzer and allows the user to print the result.

3. PRINCIPLE OF OPERATION

3.1 Detection of radioactivity

The absorbed ^{14}C in the two pads mounted in BreathCard™ emits low energy ß-radiation. The activity level is very low and has a very short range; 0.25 mm in plastic, and 24 cm in air.

When BreathCard™ is inserted into the slot in the Heliprobe® Analyzer the correct position is confirmed by a sensor. By pressing the start key, a 250 second analysis cycle is initiated. During this cycle the two Geiger-Müller counters mounted in the Heliprobe® Analyzer will detect and sum up all type of radioactive activity (α, ß, and γ) reaching the sensors. Due to the short range of ß-radiation, the activity from the upper pad will only be detected by the upper Geiger-Müller counter and similarly with the lower.
The final diagnosis is based on adding the activity from both Geiger-Müller counters, but in the analysis procedure, the separation helps to increase the precision in the measurement as described below.

3.2 Compensation for background activity

Since the Geiger-Müller counters cannot discriminate between different types of radiation, the number of counts will represent the total radioactivity picked up from the pads in BreathCard™ together with any background activity that penetrated the shield. To account for this source of error, the background activity is accounted for in the measurement procedure.

Since the radioactivity from the pads can only reach one of the two counters, all activity registered by both sensors simultaneously, must originate from background activity, and thus all these activities are disregarded in the counting process.

3.2.1 Calculation of background activity

In-between measurements, the background radiation is continuously measured and stored in memory. A moving average calculation assures that the stored background value adapts if fluctuations occur. The average is calculated from the measured activity during the last 1 000 or 2 000 seconds (programmable option). In more exact terms, it is based on twenty or forty (depending on programmed value) 50-second periods. Every 50-seconds a new period is added, the last period discarded, and a new average calculated.

Please note:
This process, which assures very accurate background estimation, requires that the Heliprobe® Analyzer always is connected to power.

3.2.2 Protection Card

The background measurement should be performed during identical conditions as when the diagnostic measurement is performed and BreathCard™ is inserted into the Heliprobe® Analyzer. Therefore, a Protection Card should be positioned in the analyzer during all time in-between diagnostic measurements.

3.2.3 First start-up

The first time the Heliprobe® Analyzer is used, the background from testing in factory is present in its memory. This background value is set via the set-up procedure and must be performed at installation. The set-up procedure is also used to set programmable parameters. By waiting 2000 seconds before first diagnostic analysis, the instrument will be updated with the actual background value.

3.2.4 Loss of power or moving the Heliprobe® Analyzer

A correct background value is essential for accurate diagnosis and the Heliprobe® Analyzer should thus always be connected to power and have a Protection Card inserted in the BreathCard™ slot. At temporary loss of power (less than a few minutes) the latest calculated background value is retained in memory to assure a proper functioning when the power is turned back on.

However, if the power has been disconnected for more than a few minutes, or the Protection Card has not been inserted during the last few minutes, or the unit has been moved to a new location, this background value may not reflect current background radiation status (fluctuations are quite common).

If this situation has occurred, it is recommended that the Heliprobe® Analyzer be connected to power sufficiently long before performing a diagnostic procedure. It takes 17 minutes to perform this recalculation if a 20 period background length is used, and 34 minutes if a 40 period background length is used.

3.2.5 Background alarm

The Heliprobe® Analyzer has an alarm function that alerts the user if the measured average background value exceeds a certain programmable level. The background can increase abruptly if the Heliprobe® Analyzer becomes contaminated.

3.3 Presentation of results

When the 250 seconds measurement cycle is completed, the BreathCard™ activity is used to determine if the patient is infected. The BreathCard™ activity is defined as the total number of counts detected by both Geiger-Müller counters during the measurement minus the background average. The units of the result are thus counts per 250 seconds. The terminology used in this manual is cpm (counts per measurement). The cpm value is compared with cut-off levels that are programmed in the memory of the Heliprobe® Analyzer.

The cut-off levels have a low level and a high level:

- a cpm value that is below or equal to the lower level is defined as a negative result (Heliprobe 0).
- a cpm value above or equal to the higher level is defined as a positive result (Heliprobe 2)
- a cpm value between the lower and the higher level is defined as a borderline result (Heliprobe 1)

A negative or positive infection is presented immediately on the LCD, while a borderline result triggers a second 250 seconds measurement cycle to improve the measurement accuracy. If the average of the first and second measurement results in a negative or positive infection the measurement procedure is completed and the result is shown on the LCD, but if the second measurement also falls in the borderline range (Heliprobe 1), a third 250 seconds measurement cycle is initiated. On completion of the third measurement cycle, the average of all three cycles is calculated and the result is presented on the LCD.

The Heliprobe® Analyzer is shipped with the upper (50) and lower (25) cut-off levels pre-programmed to optimal values as determined by clinical validation studies, but the values for each measurement cycle can be independently changed to user preferred values.

The result is presented as cpm, and the cut-off levels are defined based on this unit. There is however, an option for the user to set a linear calibration factor for each Geiger-Müller counter individually in order to convert the registered counts to, for instance, disintegrations per minute. This does, however, require that a sample with known activity be used to determine the correct conversion factor. In this context, it is important to note that this value will not resemble the value obtained with traditional liquid sampling in hyamine because the amount of sampled CO_2 differs between the two methods. Calibration factors are set to 1.0 for both GM-counters at factory.

4 INSTALLATION

The package should contain the following items:

- Heliprobe® Analyzer (1 pc)
- Power supply (1 pc)
- Protection Card

4.1 Action upon delivery

Verify that all items have been delivered and are not damaged. Any damage should be reported to the local sales representative. Save all containers and packaging material, they will be required if it is necessary to return the equipment.

4.2 Preparation prior to installation

The Heliprobe® Analyzer should be placed on any stable horizontal surface, but not close to a gamma camera or other radioactive or magnetic sources.

4.3 Bringing into operation

At installation, the set-up procedure must be performed in order to obtain and store the baseline background value. This procedure also allows the user to change any of the programmable parameters from default values (shipped settings). However, during normal circumstances, the default values do not need to be changed and should be kept unchanged.

The set-up procedure is described in paragraph ***5.1.1***. On completion, the Heliprobe® Analyzer is ready for its first diagnostic procedure. A thermal printer (model MCP9800) can be connected to the Heliprobe® Analyzer for printing of the result. The set-up procedure for this is described in paragraph ***5.1.2***.

If the Heliprobe® Analyzer has been moved to a new location, or the power has been discontinued, or the Protection Card has not been inserted for several minutes, the stored background value may be inaccurate. To make the Heliprobe® Analyzer ready for diagnostic usage one of the two options described below should be followed.

<u>Option 1</u>

- Connect power
- Make sure that a Protection Card is inserted and wait for 34 minutes (if shipped settings/default values are unchanged). The background average value is then updated to match the present background radiation level. The procedure is finalized when the diode longest to the right either gives a steady or blinking green light. The instrument is now ready to use.

Option 2
Perform the set-up procedure as described in paragraph ***5.1.1***.

Please note:
All programmable parameters will return to default values when the memory is cleared.

5 OPERATING PROCEDURES

5.1 Set-up procedures

5.1.1 Instrument installation

The set-up procedure is outlined below:

1. Connect the power supply (9V, 4W) to the wall outlet.

2. To enter the set-up menu, press and hold the start key (green button on the front panel) while connecting the power supply to the lower backside of the Heliprobe® Analyzer.

3. Press the ***Confirm*** key when the set-up menu appears on the LCD.

4. When the question (*Choose menu, clear start?)* appears press the ***Confirm*** key. Confirm by pressing the ***Confirm*** key a second time.
   The message clearing EEPROM will now appear on the LCD

5. Go through the menu by pressing the ***Confirm*** key repeatedly until the message (*Chose menu: Set clock?*) appears on the LCD.

6. Press the ***Confirm*** key to enter the menu.
   Set the correct date and time:
   - press the ***Printer Active*** key (furthest to the left) to decrease a value
   - press the ***Menu*** key to increase a value
   - press the ***Confirm*** key to continue to the next figure.

7. Continue through the set-up menu by pressing the ***Confirm*** key repeatedly.

8. When the question (*Set-up completed, exit?)* appears, insert the Protection Card in the slit of the Heliprobe® Analyzer and press the ***Confirm*** key the final time.

9. A 1 000 seconds first background measurement cycle will now start automatically. The diode longest to the left will emit a steady red light during the complete cycle.

   The procedure is finalized when the diode longest to the right either gives a steady or blinking green light. The instrument is now ready to use.

5.1.2 Printer installation

A thermal printer can be connected to the Heliprobe® Analyzer for printing of the result.

1. Connect the 9-pole RS-232 connector on the cable to the serial port of the printer.

2. Connect the telephone plug on the cable to the RS-232 port to the lower backside of the Heliprobe® Analyzer.

3. Connect the power supply to a wall outlet and the printer.

4. Turn on the printer.

The printer is now ready for usage.

5.2 Controls, indicators, and alarms

5.2.1 Control of function of GM-tubes

A control of the function of the GM-tubes starts automatically when the power is connected to the Heliprobe® Analyzer. For this control to be approved the GM-tubes must emit at least one pulse during a ten seconds control window. The LCD will display *Testing GM tube* during the measurement and *GM tube OK* on approval. If the GM-tubes fail this control the red diode longest to the right, will show a steady light and the LCD display will have an error message saying: *GM-tube error*. The Heliprobe® Analyzer is then locked in this position and can not perform any measurements. If this happens, please contact your local sales representative.

5.2.2 Control of too high Background emission

A control of the background emission is activated all the time when the Heliprobe® Analyzer is connected to power, except at the time for a measurement. The cut-off values for the background could, if needed, be changed in the set-up menu (see section 11). At the time for delivery the setting of the background is 250 and does not usually need to be changed. If the background emission level exceeds the programmed cut-off level, the red diode will show a steady light and an error message will be seen; "*too high BGR"*. The Heliprobe® Analyzer is then locked in this position and can not perform any measurements. If this happens, please contact your local sales representative.

5.3 Preparation

If the Heliprobe® Analyzer has been connected to power with a Protection Card inserted for the preceding half hour, it is ready to use. No calibration checks, etc is needed to be performed prior to starting the diagnostic procedure. If it was recently moved to another location, the power has been disconnected, or the background card has not been inserted for the last few minutes, please consult paragraph 3.2.4 before proceeding.

A stable or blinking green light from the diode longest to the right indicates that the instrument is ready for use.

5.4 Analysis procedure

The analysis procedure, which is described below, is a one key procedure that results with the diagnostic result showing up on the LCD 250 to 750 seconds after initiation.

1. Remove the Protection Card and insert used BreathCard™ into the mouthpiece facing out on the instrument. The LCD will show *ready to measure, standard program*

2. Press the ***Start/Stop*** key to initiate the analysis procedure.

3. The LCD will change its message to say: *measuring* and indicate remaining measuring time in seconds. The diode longest to the right will blink with a yellow light.

4. When the measurement is completed, the Heliprobe® Analyzer will emit two beeps, the diode longest to the right will emit a steady yellow light, and the result will automatically be illuminated on the LCD.

5.5 Presentation of Results

The result is presented as a grading: *Heliprobe 0*, *Heliprobe 1*, or *Heliprobe 2*. The grading is based on the total BreathCard™ Activity per measurement (total number of counts detected by both Geiger-Müller counters minus the stored background average) and the cut-off values as specified below:

Grading	Disease status	Cut-Off values
Heliprobe 0	NOT infected	$d \leq 25$ cpm
Heliprobe 1	Borderline	$25 \text{ cpm} < d < 50$ cpm
Heliprobe 2	Infected	$d \geq 50$ cpm

d = BreathCard™ Activity per measurement (cpm)

To see the d value (the quantitative assessment), remove the card and press **OK** until the following message appears on the LCD:

EXAMPLE

d:230 t:250
d1:120 d2:110

d1 = BreathCard™ Activity from upper pad (cpm) – most recent average background value for Geiger-Müller counter 1 (cpm)

d2 = BreathCard™ Activity from lower pad (cpm) – most recent average background value for Geiger-Müller counter 2 (cpm)

d = (*d1* + *d2*) = total BreathCard™ Activity per measurement (cpm)

t = measuring time

Pressing the **OK** once further will show the stored background value for each counter:

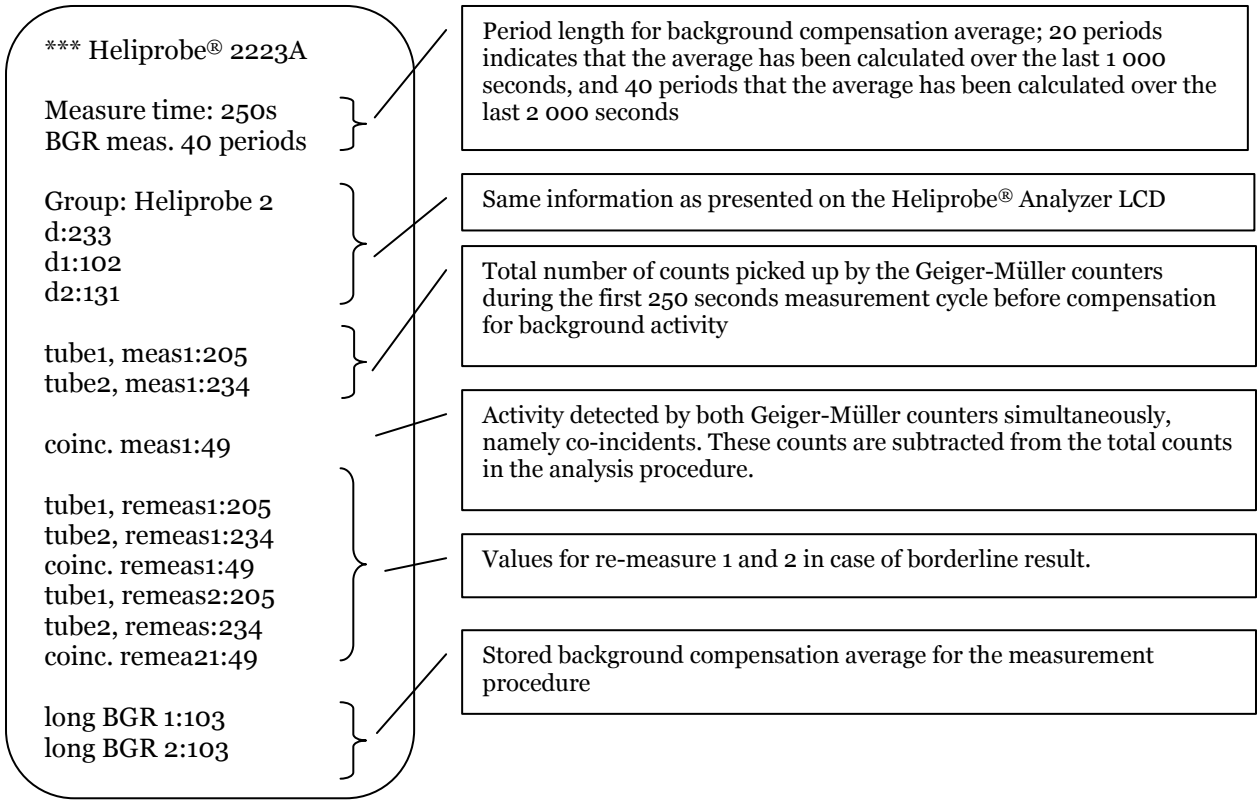
EXAMPLE

long BGR 1:99
long BGR 2:99

long BGR 1 = Most recent average background value for Geiger-Müller counter 1

long BGR 2 = Most recent average background value for Geiger-Müller counter 2

The result may be printed by pressing the ***Printer Activate*** key (furthest to the left), provided that a printer has been connected to the Heliprobe®. The printout contains the following information:



A given result is automatically illuminated on the LCD for 20 seconds. The result can be re-called to the LCD by pressing the ***Confirm*** key repeatedly, or printed by pressing the ***Printer Activate*** key marked at any time until the next diagnostic procedure has been initiated, or the power to the Heliprobe® Analyzer has been disconnected.

Please note:
The cut-off points may be changed by the user if so wished.

If the sample is removed during the analysis procedure, the Heliprobe® Analyzer will emit a beep, the LCD show sample removed!, and the analysis procedure is interrupted.

If the result falls into the Infected or NOT infected zone, the analysis is completed following the first 250 seconds measurement. In the rare event of a borderline grading a second 250 seconds measuring cycle starts automatically. If the average of the first and second measurement falls in the positive or negative grading, the average result is presented. If the average grading still falls in the borderline zone, a third and last analysis cycle is performed, thereafter the average result based on the three measurements is presented.

Consequently, if no re-measuring occurred, the d value is based on total number of counts detected during the measuring cycle. If one re-measuring episode occurred the d value is based on the average of the two performed cycles, and if two re-measuring episode occurred, d value is based on the average of the three performed cycles.

5.6 Shut-down procedure

On completion of the diagnostic procedure, the Protection Card should be inserted and the Heliprobe® Analyzer left connected to power.

5.7 Internal quality control

The Heliprobe® Analyzer contains two Geiger-Müller-counters that measures the ^{14}C bound to the BreathCard™. The Heliprobe® Analyzer is working if the LCD shows results. NO Calibration is needed. If the user still wants to check performance, positive BreathCard™ can be used as a reference.

6. SPECIFICATIONS

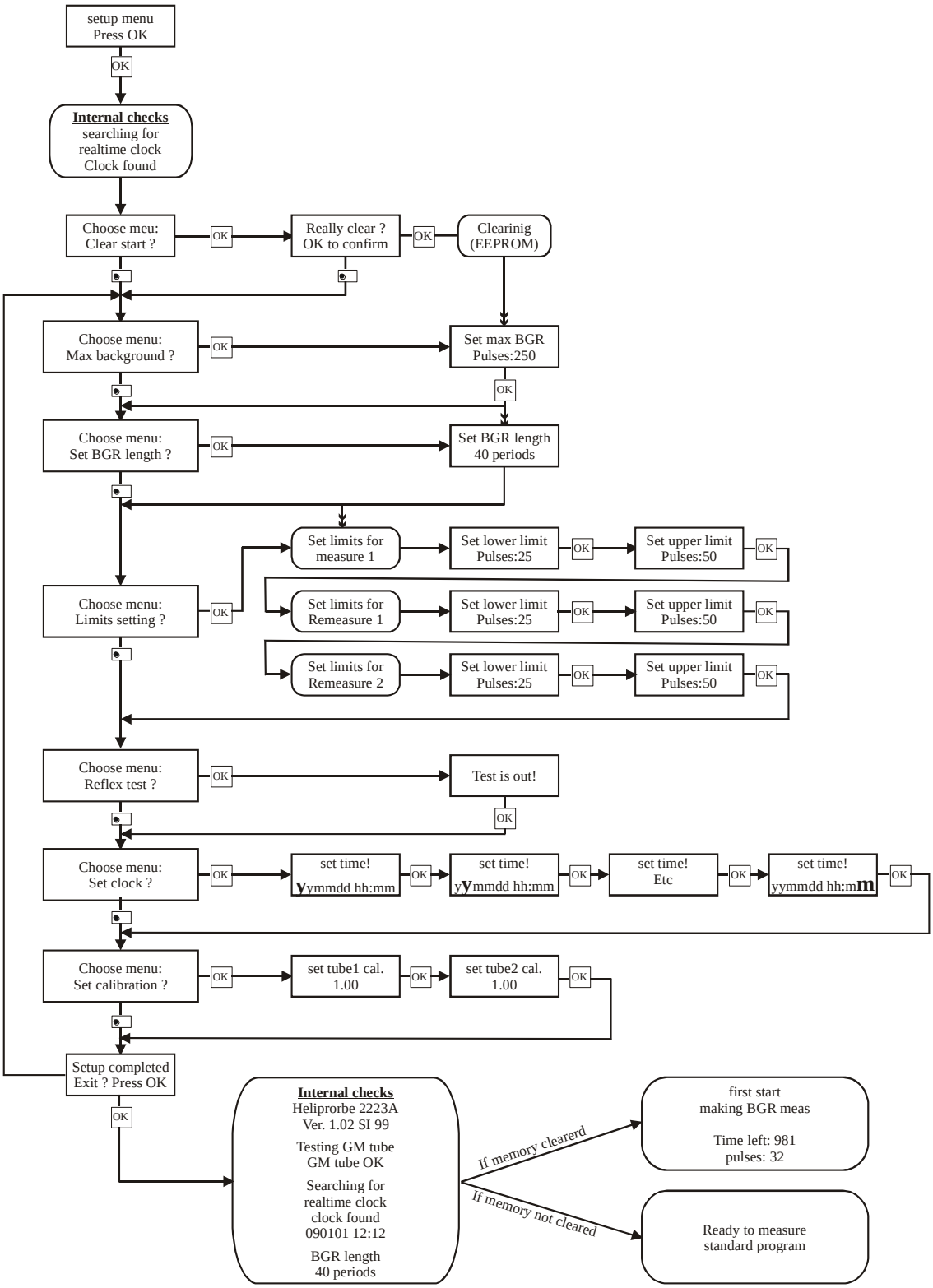
6.1 Technical specifications of Heliprobe® Analyzer

Detector:	GM-tubes and window 50 mm in diameter mounted face to face. Internal High voltage, 520 V Lifetime 10E8 pulses: results in approximately 30 years longevity (high usage and high background)
Display:	LCD, 16 positions x 2 rows, background illumination
Acoustic indication:	Beeper
Operating voltage:	9 V DC (stabilized), External power supply
Power consumption:	4 W
Measuring sensitivity:	Activity of 25 Bq (^{14}C) enclosed in the same condition as the BreathCard™, gives 1 pulse per second.
Temperature range:	0° - 50°C
Humidity:	Max 95 % RH
Dimensions:	150 x 130 x 140 (width x height x depth)
Weight:	4.2 kg
Serial output:	RS 232 Protocol Baud rate 9 600 No parity 8 data bits 1 stop bit
Emission:	Fulfill CE-regulations
Immunity:	Fulfill CE-regulations

6.2 Technical specifications of Power supply

Input:	230/130 V AC
Output:	9 V DC
Power:	20 W

6.3 Chart diagram



Loop-to-loop diagram describing how individual menus and options in the set-up program are organized.

6.4 Symbols

Print key

Start/Stop key

Menu key

OK Confirm key

7. PRECAUTIONS

Do not insert sharp objects into the card slot of the Heliprobe® Analyzer. Leave the Heliprobe® Analyzer turned on all the times and have calibration card inserted in-between measurements.

8. DISPOSAL INSTRUCTIONS

The Heliprobe® Analyzer contains electronic printed circuit assemblies. It should be disposed of in accordance with any applicable national or institutional policies relating to obsolete electronic equipment.

9. MAINTENANCE

The Heliprobe® Analyzer has no user-serviceable parts. If any component malfunctions, call your local sales representative. Any service should be carried out by authorized personnel.

The Heliprobe® Analyzer may be cleaned outside using mild cleaning agents. DO NOT immerse in liquid or expose to running water since there is high voltage in the Heliprobe® Analyzer. AVOID INSERTION OF ANY SHARP OBJECT INTO THE SLIT, AS THIS MAY DAMAGE THE INSTRUMENT.

10. WARRENTY INFORMATION

The warranty period for the Heliprobe® Analyzer is usually one year from the date of shipment to the original purchaser. Any component of the system developing defects during this time period will be replaced or repaired without charge, if the failure is the result of defective material or workmanship.

If any component of the Heliprobe® Analyzer fails or appears to malfunction, please contact your local sales representative for a return authorization.

11. SPECIAL FUNCTIONS

The Heliprobe® Analyzer has an option allowing the user to customize several settings steering the function of the unit. All of these options are available in the set-up menu, which is accessed in the following way:

To enter the set-up:
Press and hold the green key while connecting the Heliprobe® Analyzer to power. Once in the set-up menu the keys are used as follows:

OK Enter sub-menu, confirm selection and go to next menu item

Move to next menu selection, increase parameter value when in sub-menu

Decrease parameter value

The parameters that can be customized are divided in different groups, or menus in the set-up procedure:

11.1 List of programmable parameters

All programmable parameters available to the user are shown in **Table 1** together with each parameter's shipped setting, its minimum and maximum value, and step length on the values between them.

Menu	Parameter	Shipped setting	Min	Max	Step length
Max background	Max background	250	10	2 000	10
Background length	Background period	40	20	40	20
Limit settings	Lower limit measure 1	25	5	5 000	5
	Upper limit measure 1	50	5	5 000	5
	Lower limit re-measure 1	25	5	5 000	5
	Upper limit re-measure 1	50	5	5 000	5
	Lower limit re-measure 2	25	5	5 000	5
	Upper limit re-measure 2	50	5	5 000	5
Clock	YY:MM:DD / HH:MM	NA	NA	NA	NA
Calibration	Geiger-Müller counter 1	1.00	0.00	1.99	0.01
	Geiger-Müller counter 2	1.00	0.00	1.99	0.01

Table 1: Programmable parameters, shipped settings, maximum and minimum values, and step length on the values between them.

11.2 Clear stored background value

This option allows the user to clear the stored average background value. If this option is chosen a new average background value will automatically be set in a 1 000 second's long measuring procedure at exit from the set-up menu.

This option must be used the first time the Heliprobe® Analyzer is installed in order to obtain a baseline background value. It can also be used if there is a suspicion that the stored average background value is inaccurate; e.g. if the Heliprobe® Analyzer has been moved to a new location, it has been turned off for a long period of time, or the protection card has not be inserted for a long period of time.
Please note: *This option also causes all user defined parameters to return to shipped settings.*

11.3 Max background

This menu allows the user to set an alarm level for the stored average background value. If the background value exceeds the programmed parameter value, max background, an alarm will sound (with long beep followed by red light at left LED). The instrument interrupts the measuring of BreathCard™ and the message "Too long BGR" will be displayed at LED. The alarm can indicate either that the background radiation has increased abruptly or that the Heliprobe® Analyzer has become contaminated. No measuring of BreathCard™ can be performed.
The instrument will start to measure again if the BGR returns to values below programmed parameters.

11.4 Background length

This menu allows the user to set number of time-periods used for calculation of the background average. One period length is 50 seconds giving an average based on the last 1 000 seconds if 20 periods are chosen, and an average based on the last 2 000 seconds if 40 periods are chosen.

11.5 Limit settings (cut-off values)

This menu allows the user to independently set the lower and upper cut-off values for measure 1, re-measure 1, and re-measure 2.

11.6 Reflex test

This option allows the user to test if the BreathCard™ position sensor is working properly. While in the menu the display should show "test is in!" if a BreathCard™ is inserted, and change to "test is out !" when BreathCard™ is removed or when the Protection Card is inserted.

Please note:
The position sensor is not activated by the Protection Card.

11.7 Clock

This menu allows the user to set the date and time

The structure of the menus is organized in a loop-to-loop program, described in paragraph ***6.3***.

12. TROUBLE SHOOTING

a. ***What should I do if BreathCard™ is wet after the patient has been breathing into it?*** Let the card dry for 30-60 minutes in open air before it is placed in Heliprobe® Analyzer for measuring and analysis.

b. ***Why can I get negative values and what are the consequences?*** It has to do with the background activity. We are constantly exposed to the environments radioactivity , so called background radiation. This radiation is differently depending on where you are and varies constantly. Heliprobe® Analyzer is designed to automatically calculate this activity and compensate for it during the measuring of the breathcards. Sometimes this compensation "miss" the real background activity with a few counts up or down. If you have a negative patient (BreathCard™ with 0 counts) and a background compensation is slightly higher than the real background, you will end up with a negative value [measured BreathCard™ activity (d value) = real BreathCard™ activity + real background - compensated background]. This is not a problem, and there is nothing wrong with the Heliprobe® Analyzer giving a minus "d" value. The patients with these values are clearly negative. The correct result is Heliprobe 0.

c. ***Why can a re-measurements on the same BreathCard™ differ slightly in cpm value?*** Due to variations in background radiation. See reasoning above in question b.

d. ***Why do re-measuring of low range results (negative patients) vary more than re-measuring of high range results (positive patients)?*** The same absolute variation due to "small misses" in background compensation occurs for both positive and negative patients. Due to the high BreathCard™ activity from a positive patient the relative difference is low and is not critical. For negative patients with a cpm value close to zero the relative difference can be quite considerable. An automatic security measure to avoid errors (due to background variation) has therefore been incorporated in the Heliprobe® Analyzer.

It is the re-measuring function that occurs if a result falls in the borderline zone. A detected value below 25 cpm is clearly negative while a value between 25 and 50 may be due to a suppressed infection or a "miss" in background compensation. By re-measuring at this level, the likelihood of wrong background compensation decrease considerably.

e. ***What is a normal background reading, what is high, what is low?*** The value for the normal background is considered any value up to 100 counts. Values of 130-150 counts are considered being high. The value of the background does not affect the result.

f. ***What are the disturbances in the environment - variations in the background, interference with other machines, and high or low temperature, humidity in the air?*** Avoid placing the Heliprobe® Analyzer close to machines that generate high magnetic fields, like NMR, as high magnetic fields may impair the accuracy. Equipment like ordinary laboratory apparatus, computers and cellular phones do not affect the measurement. High temperatures (above 25°C) have a tendency to increase the background value with 1-2 counts and increased humidity usually has the contrary effect; the background will decrease 1-2 counts. These changes are insignificant.

g. ***What is a normal and not normal background fluctuation?***
Fluctuations in the background activity occurs naturally and this is the reason why the Heliprobe® Analyzer has a built-in automatic algorithm in order to compensate for this. Temporarily changes in the stored background value of 10-15% can be observed, but it should oscillate around your long term background average which should be stable over time. If the stored background value increases and stabilizes at a new level, it is an indication of either a changed environment (new equipment near by etc), or that the Heliprobe® Analyzer has been contaminated. A slight increase in background value is acceptable (independent of reason) but should be monitored. A higher increase will be picked up by the background alarm.

h. ***Why is there a long and short background compensation, when should I use the long respectively short compensation?***
The long background compensation is the standard setting and should be used during most circumstances. If you know that you have positioned the Heliprobe® Analyzer in an environment with rapid background fluctuations, you may consider switching to the short compensation.

i. ***What is the Protection Card and why do I need it?***
The Protection Card is simply a blank zero activity BreathCard™ with the corners removed (to avoid triggering the measure mode). The Protection Card should be inserted in the measurement slot of Heliprobe® Analyzer during all time when measure is not performed. The reason for this is that the background sampling should, as much as possible, be performed during identical geometrical conditions as during the measuring of the patients BreathCard™. If a Protection Card is not inserted in the instrument, the background calculation will still occur, but the stored value will differ from the background seen during the measuring of the patients BreathCard™. The presented d-values can therefore the incorrect and subsequently also the analyze value.

j. ***How long do I need to wait before I do the first measurement if the Heliprobe® Analyzer has been disconnected from power?***
If the Heliprobe® Analyzer has been disconnected from power for more than a few minutes, you should allow 40 minutes to pass from re-connecting power until performing any measuring of BreathCard™. The same applies if the Heliprobe® Analyzer has been moved to a new location, or has been standing without the Protection Card inserted in the instrument for more than a few minutes.

k. ***How long do I need to wait before I do the first measurement if I move the Heliprobe® Analyzer?*** See reasoning above in question j.

l. ***Is it possible to obtain the results in decrease per minute (dpm) instead of cpm?*** You need to obtain a sample with a known emission dpm (Bq) value. Insert this sample in the Heliprobe® Analyzer and adjust the calibration on tube1 and tube2 so that the cpm value matches the sample's value. Note, however, that result can not be compared to conventional liquid scintillation urea breath test results since the trapped amount of CO_2 differs between the two methods.

m. ***Is it possible to connect the Heliprobe® Analyzer to a computer?***
Presently it is not possible. There is, however, a thermal printer that you can connect with the Heliprobe® Analyzer in order to print the result and save in the pint-out in the patient file. Please contact your local sales representative for price and order number.

n. ***What should I do if the Heliprobe® Analyzer has been standing without a Protection Card?*** See answer on question i.

o. ***I had a power failure in my office, what should I do?*** You do not need to do anything except to wait for 40 minutes from the time the power was re-connected before performing the first measurement.

p. ***I do not like the borderline zone - can I get rid of it?*** If you do not like the idea with the borderline zone (Heliprobe I) you may re-program the Heliprobe® Analyzer to only show negative (Heliprobe 0) and positive (Heliprobe II) results by changing the lower and upper cut-off limits to the same value. See the loop-loop diagram for details. It is usually good to use a value close to 50 cpm as the new limit.

q. ***In case of positive result (>50 cpm), is it possible to correlate a specific disease status or bacterial load to the quantitative cpm value? For example, is there a cpm range for gastric ulcer, gastritis and stomach cancer?*** No studies have been done with the Heliprobe® System to look for such a correlation.

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