User's Guide...

Mercury Analyser

Hg-254 NE

Hg-Detection according to EN 1483

Mercury in

Drinking water	Ground water	Surface water	Waste water
Sewage sludge	soil	ores	Suspensions
food	Chemicals	air	gases

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Version Number

Edition	Month / Year	Valid for Software Version
1.0	June 2002	1.42

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Part No: V70-3-03-22e

Edition 1.0

Release 06.2002

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1. CUSTOMER SERVICE

We at Seefelder want to provide you with the very best customer service possible. If you have any questions, problems or comments about the instrument, we would like to hear from you. In addition, it is recommended that all maintenance and repair work on the instrument should only be done by Seefelder customer service or appropriately trained personnel. You can reach us at:

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2. SAFETY INSTRUCTIONS

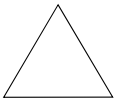
Throughout this User's Guide we will try to indicate explicitly hazardous situations that could potentially result in personal injury or damage to the instrument.

Please read this User's Guide carefully before installing and using the instrument. In particular, please pay attention to paragraphs that refer to possible hazardous situations.

Warnings and messages are presented as follows:

Indicates that non-compliance with the instructions can lead to potential personal injury.

Warning



Indicates that the instructions must be followed explicitly to avoid damage to the instrument.

Attention

Voltage

Danger of potential injury

Warning

- Always run the instrument with a ground connection (grounding).
- Do not remove or open the internal ground connection under any circumstances.
- If the instrument is switched on, the electrical connections are charged. Therefore, do not attempt to touch internal components when the instrument is switched on. Internal components should only be touched or removed when the monitor has been switched off.

The following general guidance should be followed during operation of the instrument:

- Do not touch the interior components of the instrument when it is switched on.
- Never operate the instrument if the cover or any other parts the instruments are removed.

- Only Seefelder customer service or appropriately trained personnel should perform maintenance and repair work.
- If you observe that the instrument has insufficient grounding or that the grounding connection is damaged, please take the instrument out of operation and prevent unauthorised use of the instrument.

Some situations leading to insufficient instrument grounding include:

- Instrument has visible physical damage.
- Instrument was stored for a long time under unfavourable conditions (e.g. high humidity environments).
- Instrument was handled improperly during transportation and shipping.

Explosive gases in the operating environment

The instrument should never be operated in an explosive environment.

Warning

Some other environments that can lead to operating problems and should be avoided include:

- Outdoor environments where the instrument is not appropriately protected from nature's elements (sun, rain and snow).
- Excessively humid environments.

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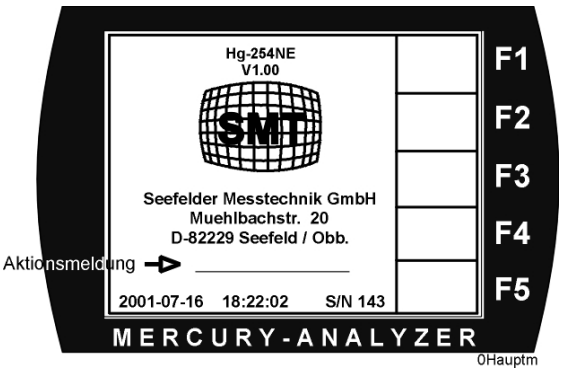
short form instruction Hg-254 NE

Set-up and Measuring

After switching on mains on the backpanel of the instrument it will be initialised automatically.



You will see these information on the display, step by step:

Waiting for lamp

Stabilising

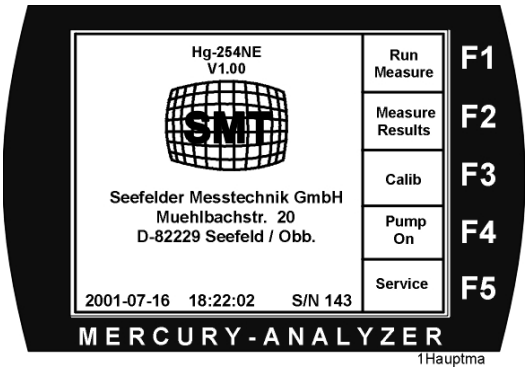
Zero adjust

Attention: This procedure might take up to 20 minutes depending on temperature.

During running this procedure the hose pump at the front panel will be switched on and off automatically. After the final zero adjust the Hg-254 NE is ready for operation.

We recommend, to switch on the instrument one hour before the measurements should begin. Specially in the low trace levels the instrument should be at its final operating temperature to avoid any thermal drift effects.

Measuring



F1 **Run Measure**

F2 **Measure Results**

F3 **Calib**

F4 **Pump On**

F5 **Service**

F2 Zero Adjust Before each batch of samples it will be useful to run a manual initiated „Zero-Adjust“. Press the key **F2** to run this procedure.

F3 Calib Chose one of the stored calibration curves ***C1 – C4***.

F1 Run Measure Press **F1** and run a measurement. Follow the instructions on the display.

2 INTRODUCTION

The Hg Monitor 3000 is a compact fixed wavelength UV photometer for measuring mercury concentrations in air. It can be used in the laboratory, for process control, for workplace exposure studies and for mobile field applications. The instrument has been designed so that it can operate with minimal start-up preparation. Using the built-in flow pump, air passes through an optical cuvette in the instrument and real-time values are displayed continuously. The instrument is factory calibrated and does not require a user-calibration process. Within the measuring range, two threshold alarm limits can be selected. When concentrations exceed those threshold values, an external alarm can be triggered via output signals. The instrument can be attached to an external recording device (e.g. strip-chart recorder.) It is also possible to connect the analyser to a personal computer and values can be displayed either numerically or graphically. Analogue output consists of 0 to 10 volts or 4 to 20 mA. The analogue output is proportional to the measured values. By pressing the **F2 Stop** selection, measurements are temporarily paused, however, the pump still continues pulling air through the analyser.

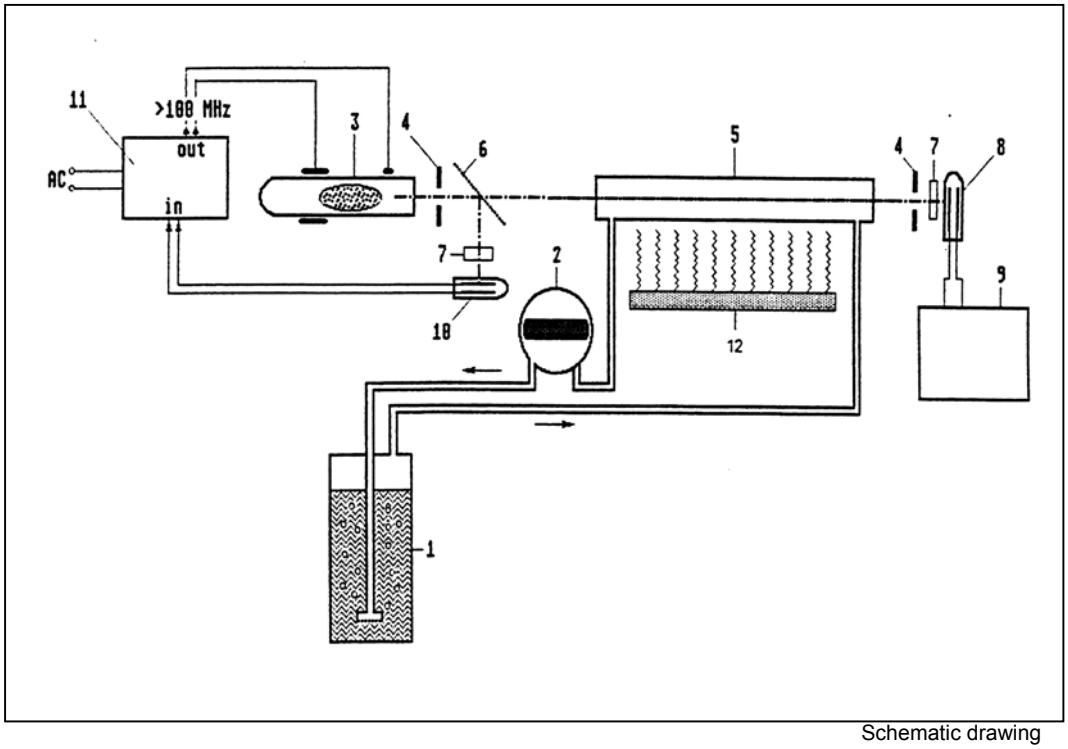
2.1 Measuring Principle

The Hg Monitor 3000 operates on the principle of Atomic Absorption Spectroscopy (AAS). This technique is one of the most reliable and sensitive methods for measuring mercury. Besides noble gases (e.g. Argon, Krypton etc), Mercury is one of the few elements that is monatomic at ambient temperatures. This attribute allows mercury to be measured using AAS. Sample air passes continuously through the optical cuvette where absorption (attenuation) of the light produced by a UV lamp (253.7 nm Hg line) is measured.

2.2 Analyser Design

The Hg Monitor 3000 consists of a radiation source (UV lamp at 253.7 nm), the absorption cell/cuvette, the photodetector with an amplifier and the computer. A diaphragm pump pulls air directly through the cuvette. The UV radiation is absorbed by mercury atoms in the sample gas stream resulting in a signal modification, which corresponds to the concentration of mercury within the sample stream.

2.1 Schematic sketch of the photometer



Schematic drawing

1 - Reaction bottle with bubbler
2 - hose pump
3 - UV-source 253,7 nm
4 - orifice
5 - cuvette
6 - beam splitter
7 - interference filter
8 - photo detector
9 - display / recorder
10 - reference detector
11 - Amplifier, HF-circuit
12 - heating for cuvette (option)

3 TECHNICAL DESCRIPTION

3.1 UV Lamp

An electrodeless low-pressure mercury lamp is used to obtain long-term stability. This UV source was developed exclusively for our mercury analysers. The extremely long life span of the lamp is achieved because the lamp does not possess any inner electrodes (which are common in hollow cathode lamps.) To maintain constant output, a high-frequency field is maintained around the lamp. The main spectrometric line produced by the analyser is 253.7 nm and it is extremely narrow. In order to eliminate lamp drift, the lamp temperature is controlled thermostatically.

3.2 UV Detector

A unique UV sensitised photodiode is used for measuring UV radiation. The photodiode together with the preamplifier form the UV detector. Using a narrow-band interference filter eliminates stray radiation.

3.3 Optical Cuvette

The optical cuvette is constructed from SUPRASIL and has an optical path length of 230 mm. The pump is configured behind the cuvette and ensures an even flow rate within the cuvette. Within the cuvette, mercury atoms absorb the UV radiation resulting in an attenuated signal that is dependent upon the mercury concentration.

3.4 Measurement Value Display

The current measurement value can be read directly from the front display. The last measured value is written on the front screen and displayed graphically. It is possible to configure the instrument to display values for time intervals ranging from 0.5 hour to 16 hours. The current value can also be displayed simultaneously on a chart recorder. Calibration of the analyser is not required. Zero adjustment takes place automatically at preselected time intervals. If the Zero interval is set to 0, no automatic zero point adjustment is done.

3.5 Measurement Value Outputs

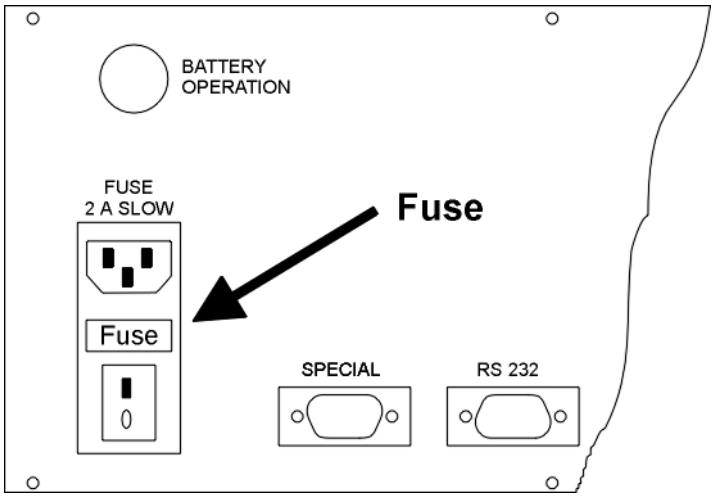
The sockets and built-in connections on the back panel have the following specifications:

ANALOG OUTPUT	4 - 20 mA or 0 - 10 V, see identification plate (optional), BNC socket, centre: + pluses / outside: - minus
PRINTER	Standard Centronics
RS232: 9 – pin SUB-D	Pin No. 2 RxD1, pin No. 3 TxD1, pin No. 5 GND, remaining pins: unoccupied Data communication: 9600 Baud, 8 data bit, 1 stop bit, no log, no parity
COMMUNICATION PROTOCOL	Data communication: 9600 Baud, 8 data bit, 1 stop bit, no log, no parities

STATUS: 9 – pin SUB-D	Reed-relay, 50 V, 400 mA -actively: Contact closed Exceedance of alarm level 1: Pin No. 1.2 Exceedance of alarm level 2: Pin No. 3.4
SPECIAL: 9 - pin SUB-D	9 pin SUB D connector for internal service
I/O: 50 – pin SUB-D	Not used currently
POWER: FUSE 2A / SLOW	100 – 240 V AC

3.6 Electrical Fuse Protection

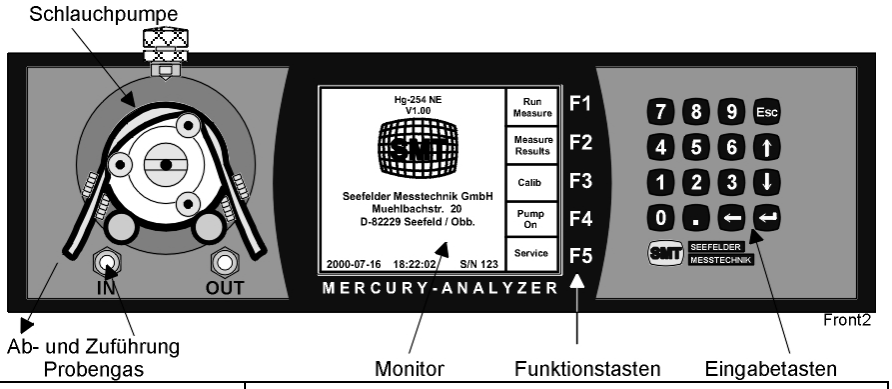
On the back panel of the instrument you will find a fuse between the power switch and the electrical connection socket. Please refer to the analyser identification plate for details. Normally for 230v a T 2 A fuse is used. Please disconnect mains before exchanging the fuse.



3. The Analyser 254 NE

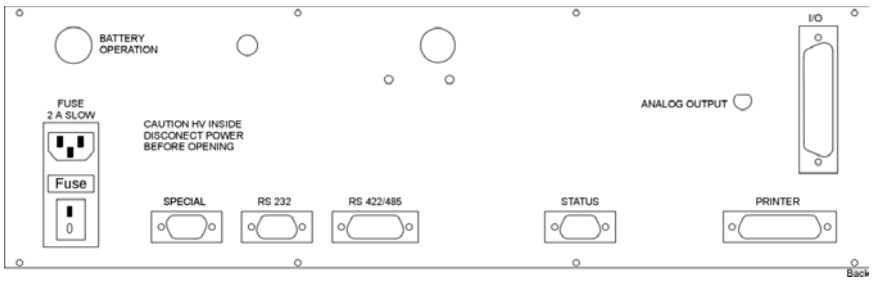
3.1 Operating elements and display

3.1.1 Front panel



Touch the	**soft keys F1 to F5**	on the keypad. You have access to the different menus shown on the display.
The	**ENTER-key**	confirms flashing displays.
Use the	**ESC-key**	to leave the active window.
with	**Backspace "◀ "**	It is possible to move the cursor in order to change numbers and settings.
Use the	**Arrows "▲ ▼"**	to navigate in the menu.

3.1.2 Back panel



The Hg-254 NE can be operated by mains supply only. The 12 VDC connector at the back panel, named "BATTERY OPERATION" is **not** activated for instruments of the type Hg-254 NE. Furthermore there are connectors named "ANALOG OUTPUT" (4... 20 mA or. 0...10 VDC) and "PRINTER". The port "SPECIAL" can be used for digital data acquisition. All the other connectors are for service and maintenance purpose only.

3.2 Hg-254 NE Mercury Analysing System

The complete system consists of:

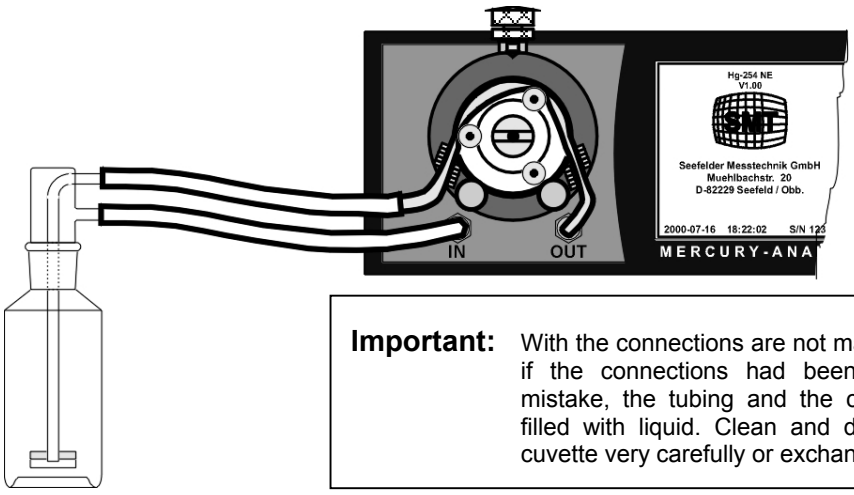
- the **Mercury-Analyser Hg-254 NE**,
- the **Reaction bottle** with **Bubbler** (according to EN 1483)
- a complete set of **tubing** to connect pump and reaction bottle
- **Mains** and **Analogue cable**

The volume of the reaction bottle including the volume of the tube connections is a systematic constant number during measuring. The tube should be as short as possible, since MEMORY effects can particularly affect measurements within the trace range. To the basic equipment a reaction bottle with cross section (according to DIN 12039) and bubbler is provided. For the measurements the liquid and/or the gas volumes in the equipment cycle must remain unchanged. Mercury that is stripped out is in an equilibrium with the pumped gas and the liquid in the bottle.

The equilibrium depends on the total volume of the measuring system. Therefore it is important to mark the filling level on each used bottle (e.g. 200 ml). Depending upon sample quantity, different bottles (e.g. 1l, 250 ml, 100 ml, 50 ml) can be used. The samples may be so highly filled in however that in no case that liquid or foam will be pumped into the tubing and the analyser.

3.3 Connecting the Bubbler and Reaction Bottle

The pump rotates against clockwise direction. Please use the two Tygon® tubing to connect the pump to the bubbler.



Important: With the connections are not made correct, or if the connections had been changed by mistake, the tubing and the cuvette will be filled with liquid. Clean and dry tubing and cuvette very carefully or exchange tubing.

ATTENTION:
Please take care that the lower connection of the bubbler (free inlet for gas) is connected to the inlet fitting **" IN "** of the Hg-254 NE. The upper connection of the bubbler (connected to the glass tube of the bubbler) must be connected to the pump hose (left side end). The right side end of the pump hose (Silicon) is already directly connected to the outlet fitting **" OUT "** of the analyser.

3.4 Pump hose exchange

In order to have optimum flow a silicone tube of the size of 8.4 x 11.2 mm of 21 cm length should be used. After loosening of the adjusting screw for the contact pressure of the hose saddle this part can be removed. First attach the new hose on the right Fitting named "Out" and then over the driving pulleys. Take care that no break between the hose pump and the entrance connecting piece occurs. Also changing the short silicone hose approx.. 2 cm with new plastic tubing angle is recommended. Attach the two clamps again after exchange to fix the angle again.

3.5 Installation

The analyser should be put on the handle and/or on the foldable feet at the bottom cover. This gives a certain distance to the laboratory table and to liquids that might be on this table. Also the tubing can hang free and without kinks. To place the bubbler during the free rinsing procedure a beaker (600-1000ml) can be used. Better however a clamping attachment of the bubbler at a stand is in sufficient height. The reaction bottle can be fast placed underneath with a further clamping jaw. This allows easy handling. This set-up makes measurement easy, as only the washing bottles have to moved for each measurement.

Direct sun exposure and strong variations in temperature should be avoided. Also the instrument should not be installed too close to a wall to maintain free ventilation behind the instrument.

If the measurement should show up on paper, a simple chart recorder can be attached. Please use the BNC to banana plug adapter cable in this case (standard accessory). A commercially available printer, for example HP 900 series, can be attached at the printer port as well.

3.6 Set-up

Make sure before the start-up of the equipment that the front attached hose pump can run freely, if the instrument is switched on. In case this is not the case, loosen or remove the hose saddle. Take care that the pressure on the tubing is correct, adjust with the screw above the saddle.

By putting the power supply plug into the mains socket and switching on the power switch on the rear side of housing the instrument can be started. First the equipment waits until the internal mercury lamp ignites and the lamp unit reaches its operating temperature . After this stabilising procedure an automatic zero point alignment is done and the photometer goes into the “stand by” mode.

These information are indicated successively on the TFT screen:

Waiting for Lamp!..... This procedure can last depending upon initial temperature up to 20 minutes. Note: During the 1 operation hour the system can drift. If in the first hour is to be measured, should now and then a manual zero point alignment is made.

The following listed information will be shown on the display sequentially.

WAITING FOR LAMP!	Waiting till the lamp ignites.
STABILIZING!	Waiting till operating temperature is reached.
ZERO ADJUST!	Automatic zero adjust.

These procedure can take up to 20 minutes

Attention:	During the first hour of operation a thermal drift still can occur. If measurement is required during this time, a frequent manual zero adjust should be performed. In case the measurements start after one hour, also an initial zero adjust should be made.

4. Working with the Mercury analyser Hg-254 NE

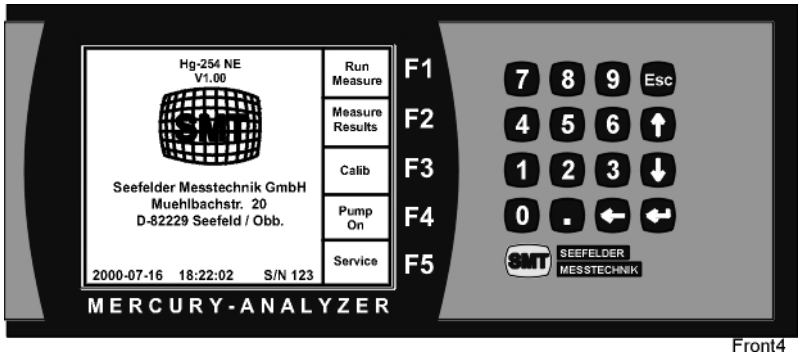
4.1 Sample preparation

The sample preparation and/or the sample digestion depends very strongly on the sample material which can be analysed. For the levels of mercury in water and waste water that are regulated by authorities the standard method, f.e. the EN 1483 should be used, even other methods are possible on the instrument, too. For additional information about the preparation of other sample materials there are appropriate regulations and methods available in the chemical literature as well as in the internet.

4.2 Operating the Mercury analyser Hg-254 NE

The Hg-254 NE contains a microcontroller with up to date features. All procedures necessary for the operation can be started from the keypad and the F1 to F5 keys. All single steps of the measuring program are shown on the TFT display. The program is structured according to the standard method, all single steps can be edited and/or changed. If the programs requires input from the user (f.e. the washing bottle volume), the cursor flashes at the right positions. All inputs in this case must be confirmed by pressing the key “SAVE”.

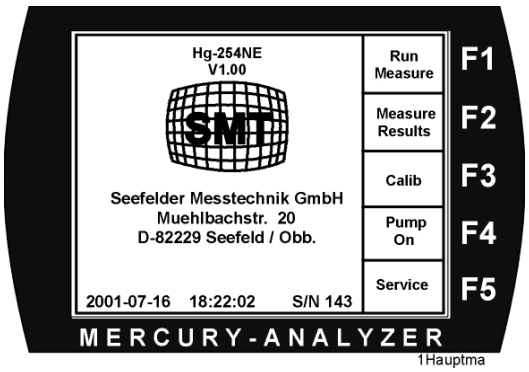
Choosing a program-step on the display, just press the referred function key F1 – F5.



Front4

4.3 Manual zero adjust

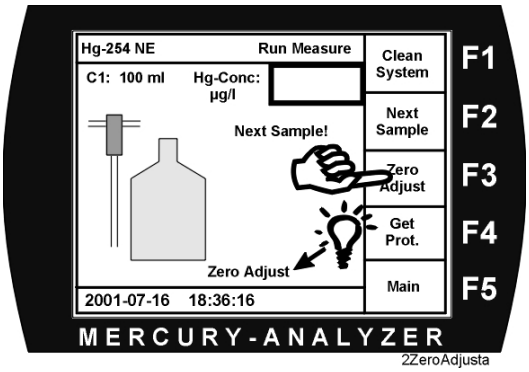
Although when switching on an automatic zero point alignment is done, after an interval of approx.. 15 minutes a manual zero point alignment should be made. In addition, the bubbler should be put on a clean surface or fixed somewhere. From the main menu you call



F1 Run Measure
F2 Measure Results
F3 Calib
F4 Pump On
F5 Service

the program step **F1 "RUN MEASURE"**.

With the function key F3 you select "ZERO ADJUST".



F1 Clean System
F2 Next Sample
F3 Zero Adjust
F4 Get. Prot.
F5 Main

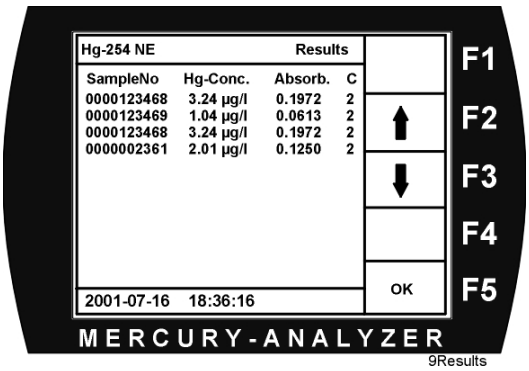
The hose pump starts automatically. On the display the flashing message appears "ZERO ADJUST." After approximately 20 seconds the hose pump stops automatically and zero adjustment is finished.

This procedure should be occasionally repeated during the measurements

4.4 How to call stored results

The microcontroller of the instrument automatically stores the measured results of the past 50 measured samples. After each measurement the overview can be called.

Call the results by pressing the function key **F2 Measured Results**. This key is available from the main menu. Then the following menu appears.



F1
F2 ▲
F3 ▼
F4
F5 OK

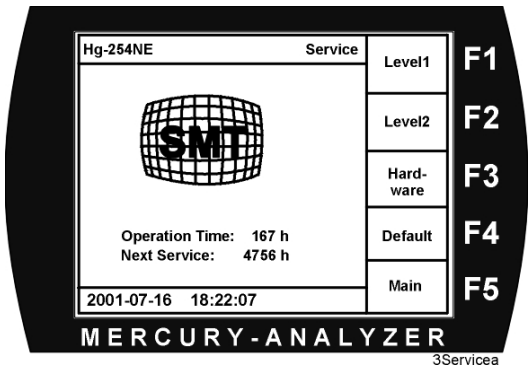
With the arrow keys you can navigate to the different measured value windows.

Leave this option by pressing **F5 OK**.

5. System Settings

5.1 Setting of Date and Time

Date and time can be set by these commands:

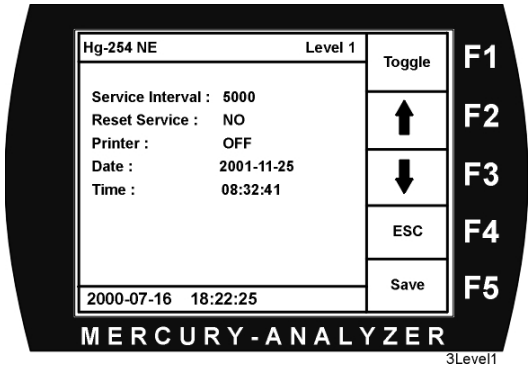


3Servicea

F1 Level 1
F2 Level 2
F3 Hardware
F4 Default
F5 Main

Navigate from the **main menu** to **service menu**.

Then go to **Level1**.



3Level1

F1 Toggle
F2 ▲
F3 ▼
F4 ESC
F5 Save

Select the line „Date“ or „Time“ by pressing the arrow keys. Edit as required.

Do not forget to press the **F5 Save** key before leaving this level with ESC.

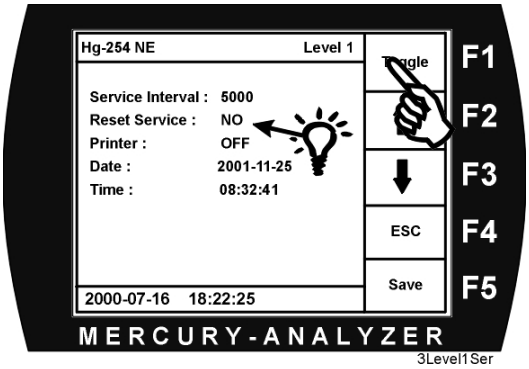
5.2 Service- / Maintenance-Interval

The Hg-254 NE includes a counter for the hours of operation. This allows to monitor the intervals for maintenance. After expiration of the maintenance interval the external tubing and the pump hose should be exchanged. If necessary also the cuvette should be cleaned.

Setting and Resetting of the Service- / Maintenance-Interval.

To set the service-interval please move from the **main menu** to the **service menu** and then **to Level 1**.

You will see this screen:



F1 Toggle
F2 ▲
F3 ▼
F4 ESC
F5 Save

In the line “Service Interval“ the present setting for service interval is displayed. This number can be changed any time. After this interval has passed, the instrument will show the status “Service“ (yellow) on the main menu.

After making sure that all necessary service had been made the status service should be reset. For this reset please go to the line “Reset Service“, then go to key **F1 Toggle** and change from NO to “YES“.

Save this reset by pressing the key **F5 Save**.

The service interval is now resetted, the counter starts again from beginning.

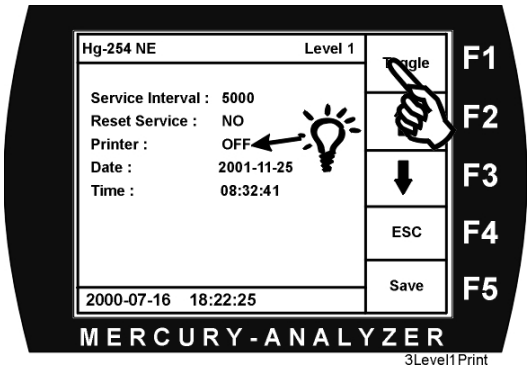
5.3 Output of data

Beside the analogue output of the results (0 .. 10 V or 4 ... 20 mA) the Hg-254 NE also provides digital data output through the RS 232 serial port and print protocols through the printer port.

5.3.1 Printer

If a printer is connected to the instrument, the data output must be activated in Service Level 1.

To set the printer move from the **main menu** to the **service menu** and then **to Level 1**.



3Level1Print

F1 **Toggle**
F2 ▲
F3 ▼
F4 **ESC**
F5 **Save**

Choose the line “Printer“ and press the key **F1 Toggle** to “ON“. The printer port is now activated.

Save your setting by pressing **F5 Save**.

5.3.2 Printer protocol

As soon as you will start measuring real samples, the results will be saved. You might print them from the **Run Measure** menu with the function key **F4 Get Prot.** The printout will take some seconds while the hose pump is still moving and the instrument is in “Cleaning” status. Of course the command form feed (FF) is installed, it is formatted to the US-letter format and German DIN-A4. On the next page you see an example of a printout.

Hg-Analysator: Hg-254 NE; S/N 165; SWVer.: V1.30
Seefelder Messtechnik; Date 21.01.2002
Cal. Parameters: 2002-01-15 09:55; Reactor Size: 100 ml; Curve: C1
Regressionsfunktion: y = 0.06051 * x + 0.0030
Corr. Coefficent: 0.99914 USER: _____

Cal. Point 1 : 00.00 µg/l 0.0001 Abs.
Cal. Point 1 : 01.00 µg/l 0.0673 Abs.
Cal. Point 1 : 03.00 µg/l 0.1783 Abs.
Cal. Point 1 : 05.00 µg/l 0.3160 Abs.
Cal. Point 1 : 07.00 µg/l 0.4206 Abs.

Measurements:

No.	Hg-Conc. Dil. Corrected	Dilution	Hg-Conc. µg/l	Abs.	Time	Date
0000001234	2.54	1	2.54	0.1567	10:04:19	23.01.2002
1234567890	13.61	10	1.35	0.0847	10:16:35	23.01.2002

This protocol contains all necessary data of the measurement that are required by authorities for documentation purposes.

5.3.3 RS 232 Serial interface

Also the serial interface RS 232 can be used to acquire data.

A dataset does not consist of a fixed number of single data, as measurements do take longer or shorter time according to the matrix of the sample. Beside Date and Time you can see the calibration curves and on-line the absorption (extinction) data of the measurement. The last number is the calculated content of mercury in microgram per litre. All single data are separated by semicolon to make the further processing in Excel or other spreadsheet software easy.

Date, Time, Cal.Curve.Nr.; Abs.; Abs.; Abs.; Abs.;..... Abs.; Hg-Conc;

One dataset as example:

15-02-02;10:43:07;C1;0.0202;0044.9;.....2.74{Return}

You see date, time, curve C1, absorption and the final reading of 2,74 µg/l.

5.3.4 Analogue output (OPTION)

According to the option, pre-set by the manufacturer according to the requirement of the customer, the Hg-254 NE gives an output of 4 .. 20 mA or 0 ... 10 V.

On the back panel of the instrument you will see a BNC-connector, where the signal can be acquired. In any case, voltage or current, the range is set according to European Standard Method EN 1483 to a maximum of 0 .... 10 µg/l.

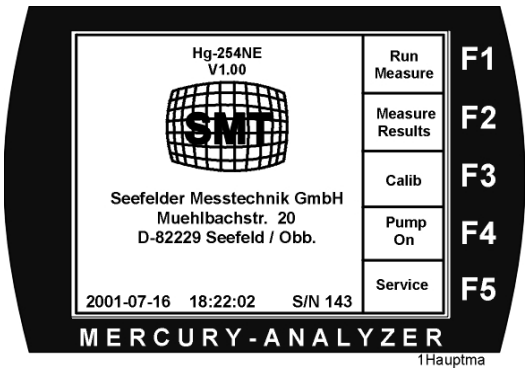
6. Calibrating and Measuring

6.1 Calibrating the instrument

In order to measure mercury concentrations in liquid samples with the Hg-254 NE, first calibration curves must be acquired. All analytical procedures are identical as for the measurement itself with the only exception, that instead of samples a known standard must be used.
The Hg-254 NE stores up to 4 calibration curves (**C1 to C4**), which can be recalled later for the measurement in different sample matrices. Each calibration curve may contain up to seven single calibration points.

6.1.1 Recalling stored calibration curves

Already stored curves should be recalled to run a measurement:

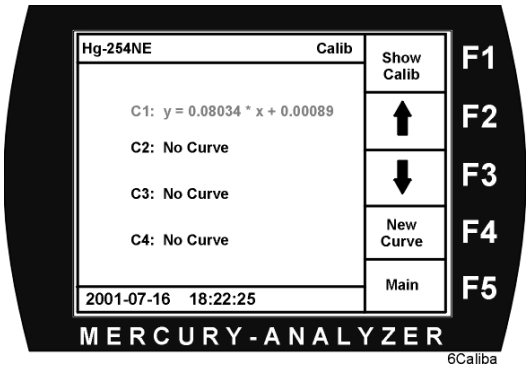


1Hauptma

F1 Run Measure
F2 Measure Results
F3 Calib
F4 Pump On
F5 Service

At first select the key **F3 Calib** from the main menu.

The active curve shows a different colour than the other curves.



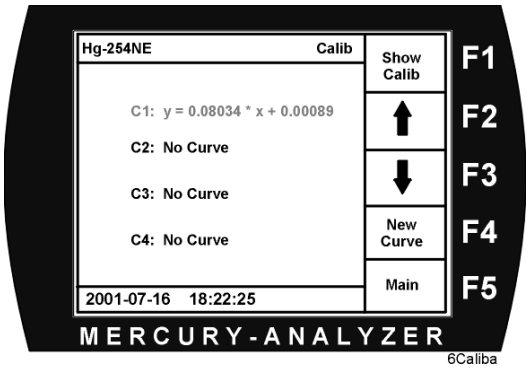
6Caliba

F1 Show Calib
F2 ▲
F3 ▼
F4 New Curve
F5 Main

The newest created calibration curve shows different colour than the other four curves. If any of the other curves should be activated, you have to navigate with the arrow keys to the curve you want to use. Curves not yet stored are marked with “no curve”.

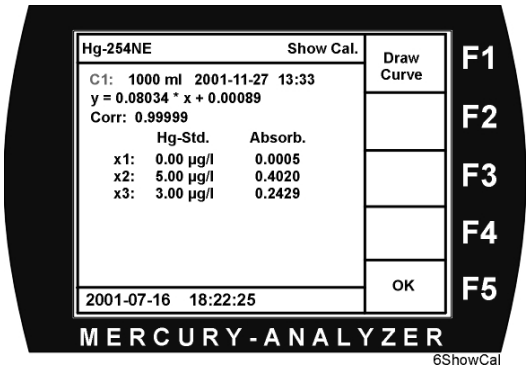
You can leave this menu only by pressing the function key **F5 Main**.

6.1.2 Display of the stored calibration data



F1	**Show Calib**
F2	**▲**
F3	**▼**
F4	**New Curve**
F5	**Main**

Starting from the main menu press the key **F3 Calib.** You will enter the *Calib-Menu*. By pressing **F1 Show Calib** you can have a look on the data of the selected calibration curve.

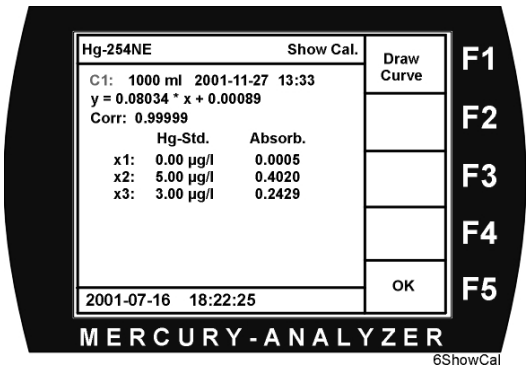


F1	**Draw Curve**
F2	
F3	
F4	
F5	**OK**

Besides the number of the curve you will see the volume of the standard solution as well as date and time when the calibration curve had been acquired.

Directly below you see the calculated correlation data. These are taken from the signal pairs X1 to X7.

Furthermore you also can have a look on the curve displayed as graph. To do so press **F1 Draw Curve**. With **F5 OK** you can leave this menu.



F1	**Draw Curve**
F2	
F3	
F4	
F5	**OK**

6.1.3 Acquiring and storing of new calibration curves

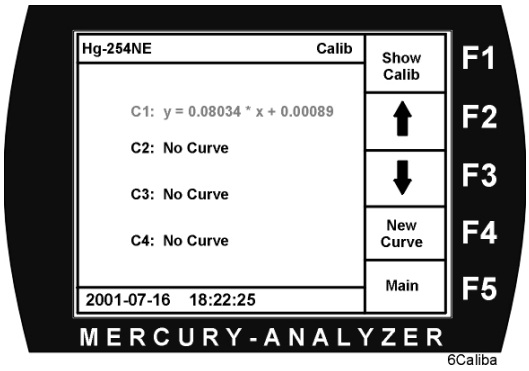
To acquire a new calibration curve, first a mercury standard solution should be provided. The usual way is to use a standard solution of 1 g Hg/l, which is available at all major laboratory suppliers. Starting from this solution, a standard of 1 mg/l must be diluted.

Use 1 ml of the commercial available standard, dilute with some aqua dest, add some ml HNO_3 conc. And fill up to 1 l with H_2O. This new made standard now has a concentration of 1 mg/l Hg.

This laboratory standard now is the base for a lot of lower level standards for calibration curves.

Use a precise pipette to add a certain volume, f.e. 1 ml, of the laboratory standard into the reaction bottle and fill up with aqua dest to a known volume. Ad reduction solution, insert the bubbler into the reaction bottle and start calibration. Each single step for the calibration will be shown on the display interactive. The procedures requires the manual input of the concentration in the measured solution.

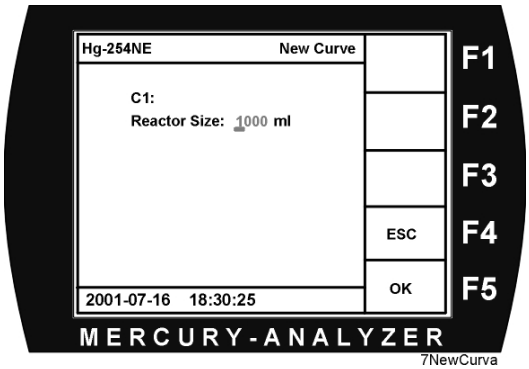
Starting from the calib-Menu and the selection „New Curve“ C1, C2, C3 or C4 the calibration procedure will be started with **F4 New Curve**.



6Caliba

F1	F1	**Show Calib**
F2	F2	▲
F3	F3	▼
F4	F4	**New Curve**
F5	F5	**Main**

The menu „*New Curve“* now is on display.

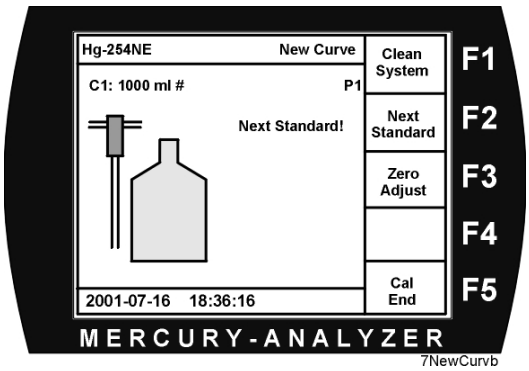


7NewCurva

F1	F1	
F2	F2	
F3	F3	
F4	F4	**ESC**
F5	F5	**OK**

On display is now the number of the selected curve. The program requires now the input of the sample volume during calibration.

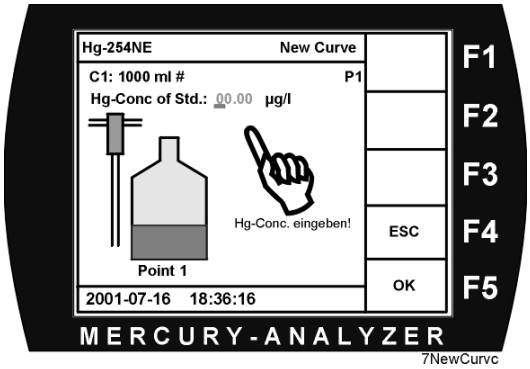
Pressing **F5 OK** leads to the next step of the procedure.



F1	F1	**Clean System**
F2	F2	**Next Standard**
F3	F3	**Zero Adjust**
F4	F4	
F5	F5	**Cal End**

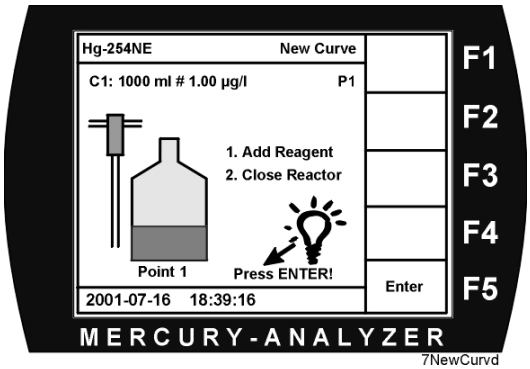
You may run one additional zero adjust, if required. To do so, just press the key **F3 Zero Adjust**.

With the key **F2 Next Standard** you can start acquiring the single calibration points for the calibration curve selected.



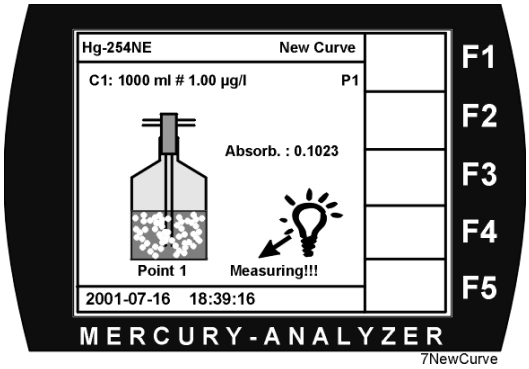
F1	F1	
F2	F2	
F3	F3	
F4	F4	**ESC**
F5	F5	**OK**

Enter the mercury concentrations of the standard to be measured, concentration in µg/l and not in ppm. Confirm with **F5 OK**. If you don't want to confirm, press **F4 ESC**



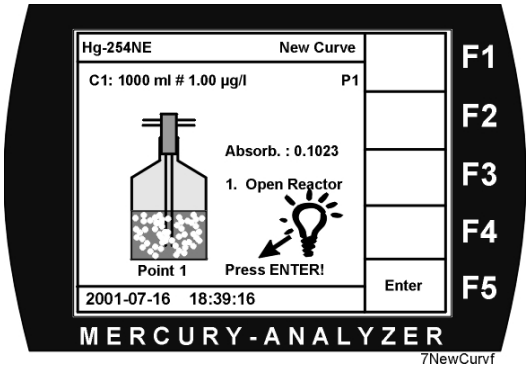
F1	F1	
F2	F2	
F3	F3	
F4	F4	
F5	F5	**Enter**

Now you should bring the reagent, usually $SnCl_2$, ,into the reaction bottle. Close the bottle with the bubbler. Press **F5 Enter** to start the measurement.



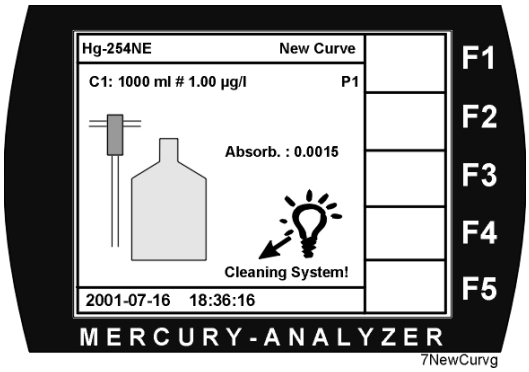
F1
F2
F3
F4
F5

You will see the absorption signal rising during mercury is stripped out of the standard solution. These data are displayed on the screen. As soon as there is an equilibrium in the system, you will see this menu.



F1
F2
F3
F4
F5 **Enter**

The system asks you to open the remove the bubbler from the reaction bottle and confirm this with pressing **F5 Enter**.



F1
F2
F3
F4
F5

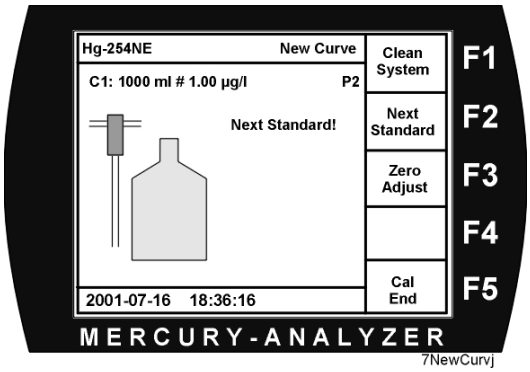
Now the systems starts to clean itself. Ambient air is used to clean the inside and outside tubing as well as the cuvette. During this cleaning procedure the absorption is still measured. After 3 minutes the absorption should fall short of a minimum level.

Now two cases can apply.

1. The absorption reaches a value ***below the maximum level***.

The program now asks to press **F2 Next Standard** to proceed in the calibration process or to finish the calibration with **F5 Cal End.** In the second case, the calibration is a two point calibration (zero and point 1).

It is recommended to run now a **F1 Clean System** procedure.

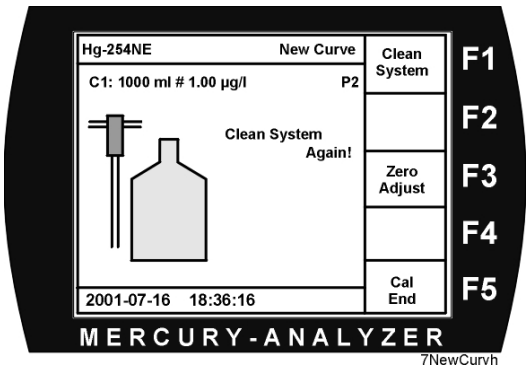


7NewCurvj

F1 Clean System
F2 Next Standard
F3 Zero Adjust
F4
F5 Cal End

2. The absorption does not reach a value ***below the maximum level***

You may run once more the *Clean System* with **F1 Clean System** or finish the acquisition with **F5 Cal End**. It makes sense to run several Clean System to get all

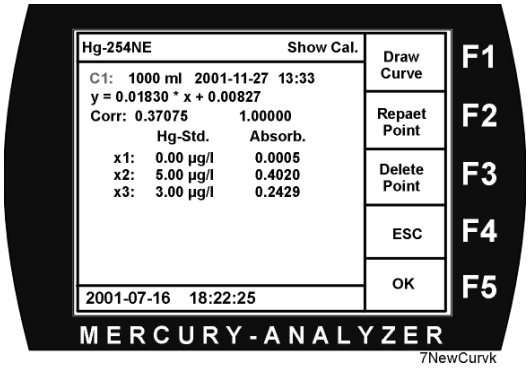


7NewCurvh

F1 Clean System
F2
F3 Zero Adjust
F4
F5 Cal End

contamination out of the system. Only after frequent *Clean System* without positive result a new *Zero Adjust* should be performed.

If after the measuring of maximum 7 concentration standards will be ended automatically or by pressing the key **F5 Cal End,** you will see this menu:



7NewCurvk

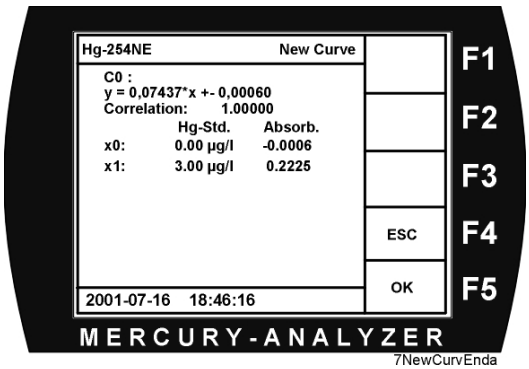
F1 Draw Curve
F2 Repeat Point
F3 Delete Point
F4 ESC
F5 OK

All measured standards are now listed including absorption data. The software calculates from all absorption and concentration data the calibration curve including the statistical reliability results. There is a – coloured – second correlation coefficient also on display. This is the correlation you could reach, if you would delete the worst – coloured – calibration point with the key **F3 Delete Point** .

You also have the choice to repeat the statistically worst point with **F2 Repeat Point.** In this case you have to dilute the required standard solution again according to the previous measurement.

Please take care that there is always a worst point, if you use 3 – 7 pairs of readings. Please choose a sufficient correlation coefficient and accept a well correlating curve by pressing the key **F5 OK.**

Now you have one curve stored in the memory, which you can recall any time you need it. You will see this screen:



7NewCurvEnda

F1
F2
F3
F4 ESC
F5 OK

Confirm with F5 OK.

6.2 Measuring samples

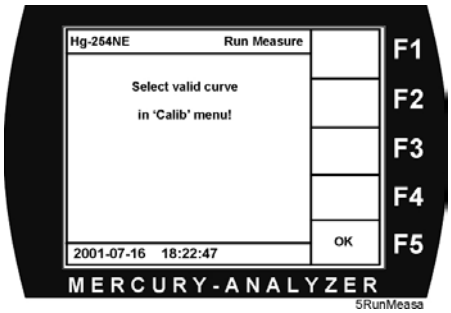
With the mercury analyser Hg-254 NE mercury from liquid, aqueous samples can be determined. The maximum concentration, in which the element in the solution should be present, are according to DIN EN 1483 10µg/l. A concentration above this level till approx.. 18 µg/l can be measured however, if a calibration curve for it had been acquired. With a volume of the reaction bottle (also steep neck bottle called) of 200 ml a limit of determination is reached at 10 ng/l. We recommend a reaction bottle with approx. 150 ml total volume and a sample volume of 100 ml.

6.2.1 Measuring with the Hg-254 NE

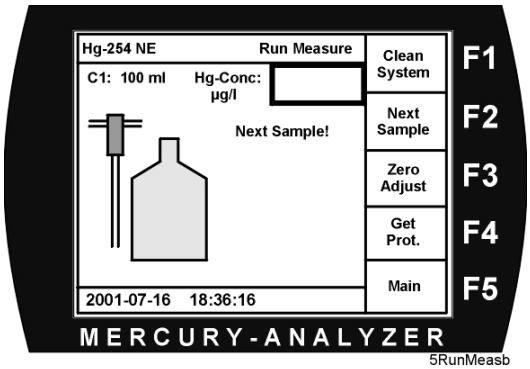
Coming from the main menu call F1 Run Measure.

Take care:

If you did not store a calibration curve, you will get the message: *Select valid curve in Calib menu.*



In the upper left corner you will see the previous selected calibration curve *C1 o C4*. For the best precise results the curve should be selected which is closest to the expected results. You may select this curve from the main menu by pressing the key **F3 Calib**.



F1 Clean System

F2 Next Sample

F3 Zero Adjust

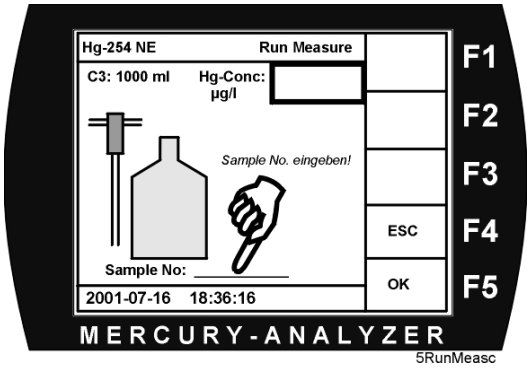
F4 Get Prot.

F5 Main

If required you may run an additional procedure **Clean System,** if required. Pressing **F2 Next Sample** leads you to the next input, sample number.

Using **F5 Main** you come back to the main menu.

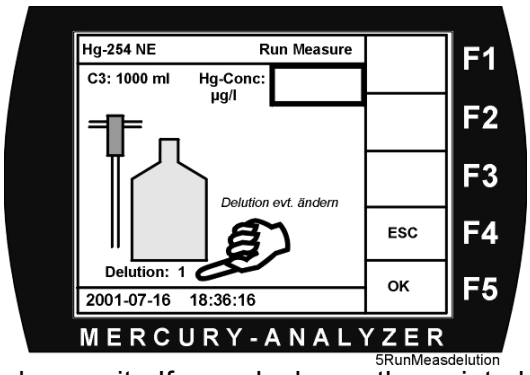
The system proposes a sample number which follows the previous one. You can confirm or overwrite. Go ahead with **F5 OK**.



5RunMeasc

F1
F2
F3
F4 **ESC**
F5 **OK**

Now you will see this menu. You will asked for a dilution factor. You may confirm or

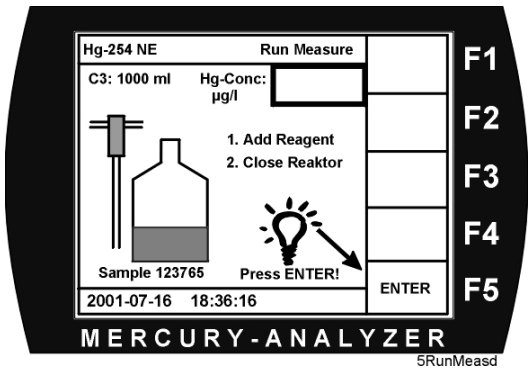


5RunMeasdelution

F1
F2
F3
F4 **ESC**
F5 **OK**

change it. If you look on the printed protocol, you will see the results already corrected with the dilution factor. On the TFT-display you only see the result which had been measured from the sample..

After confirming with **F5 OK** you will see the menu with flashing **Press ENTER!**

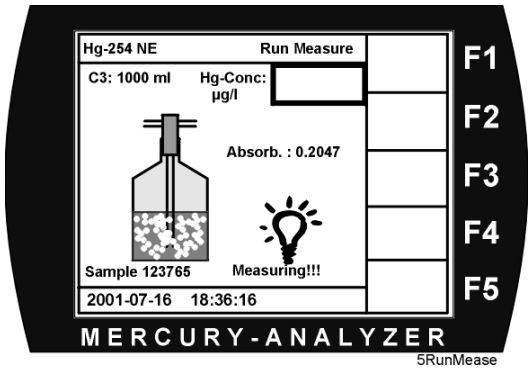


5RunMeasd

F1
F2
F3
F4
F5 **ENTER**

Fill in your sample, add reagent and close the bottle with the bubbler. Then press **F5 Enter** to confirm and start the measurement.

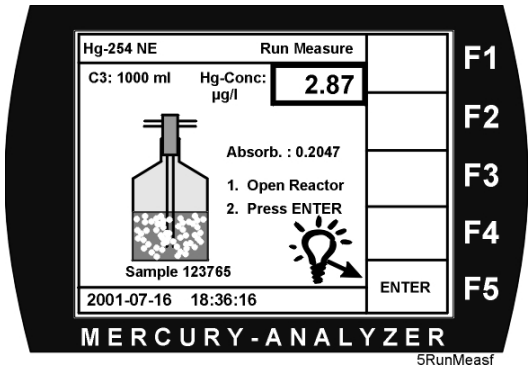
The peristaltic pump (hose pump) transports air into the liquid. Mercury is stripped out from the sample into the air and transported through the quartz cuvette. During the



5RunMease

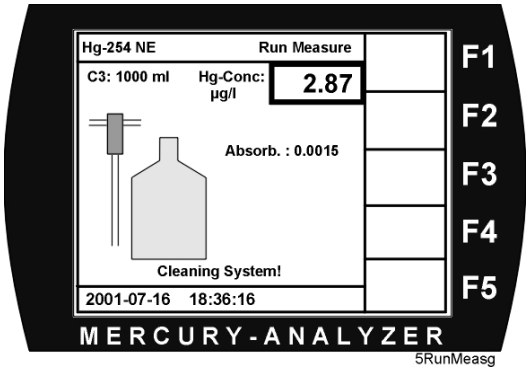
measurement you will see the Extinction (Absorbance) on the display. At the end also the calculated concentration. At the end of the measurement you will hear a beep and see the concentration in the upper right corner of the display.

After reaching a maximum of signal, the measurement will be finished automatically. You now will be asked to open the reactor and to confirm with **F5 Enter**.



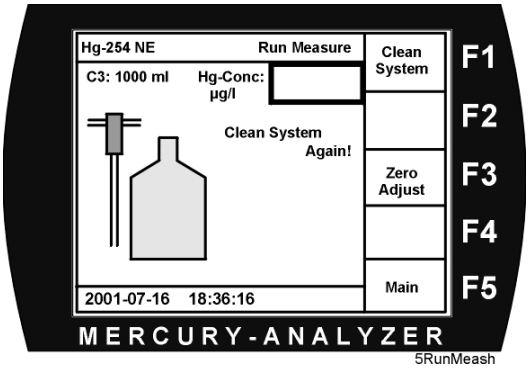
5RunMeasf

The tubing and the cuvette will be cleaned now, see also previous comments to „Cleaning System“. After Cleaning System is finished successfully, the next sample can be measured.



5RunMeasg

If the zero point is not reached after longer time, the menu appears "Clean system Again". Now one has to select the possibility either this option or a new zero adjust. It is important, specially at high concentrations, to work with “clean System again” in



5RunMeash

F1 Clean System

F2

F3 Zero Adjust

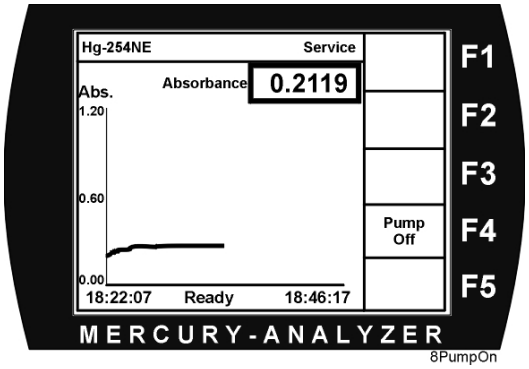
F4

F5 Main

order to keep contamination low.. Alternatively you may "clean" also the system by using the menu option **F4 pump on** from the main menu selects. Only in the case that the reading does not fall below the limit after several cycles, it is recommended a new zero point measurement. In case of persisting contamination, i.e. high absorption, the cuvette should be cleaned and the tubing exchanged.

7. Measuring Absorbance

If the correct extinction (absorption, absorbance) should be measured, the pump should be started and stopped from the main menu with **F4 Pump On**. This also might clean contaminated cuvettes.



8PumpOn

Beside the numeric announcement also a graphic announcement of the last measured values is displayed.

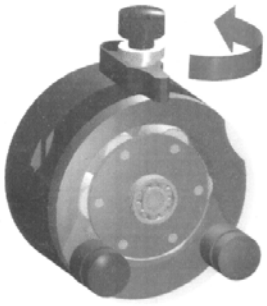
This is a tool to see how much the reaction bottle, the tubing and the cuvette are contaminated and how decontamination improves.

This way of operating the system also allows measurement in air, f.e. working area contamination. The only disadvantage is, that there is no reading in µg per cubic meter available. The better instrument for such purposes is the Hg-Monitor 3000 from Seefelder, which is based on the same photometer, but with different software.

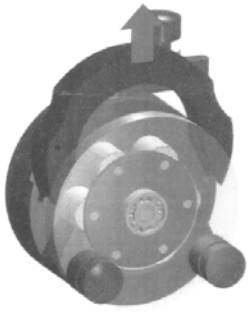
8. Maintenance

Maintenance the maintenance work with the Hg-254 NE is limited essentially to change of the tubing connection. The external tube connection should be more often changed as the interior tubing, particularly since the material of the pump hose is silicone. This material is not favorable straight regarding Hg-Absorbtion, but the best compromise between lifetime and mercury absorbing effects. Depending on the application also the interior tubing should be changed once a year. The material of the interior tubing is Tygon. It is the most favorable of all tube materials regarding Hg absorption.

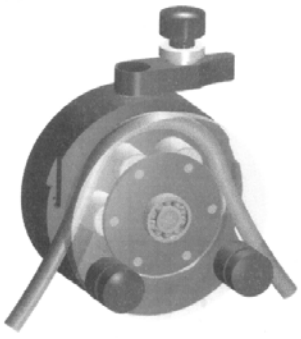
8.1 Exchange of the pump hose



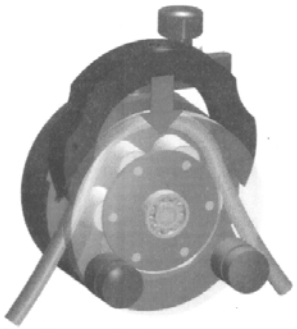
1. Schwenkhebel öffnen



2. Schlauchkassette entnehmen



3. passenden Schlauch einlegen



4. Schlauch straffziehen und Schlauchkassette einsetzen

5. Schwenkhebel bis zum Rastpunkt schließen.

Bei der ersten Inbetriebnahme der Pumpe muß nach dem Schlaucheinlegen die Einstellung des korrekten Anpreßdruckes überprüft werden und ggf. mit der Andruckschraube korrigiert werden

8.2 Cleaning of the optical cell (cuvette)

If a certain degree of contamination of the optical cell is exceeded, the cuvette must be cleaned.

How to clean the cuvette

After removing the frame cover the cuvette can be recognised easily.

1. Turn the cuvette in the cuvette retaining springs, until both inlet and outlet point to top.
2. Remove both springs at one side and remove the cuvette
3. Remove the tubing from the cuvette. Do not pull, better push the tubing.
4. Clean cuvette with H20, HCl, HNO3, depending of the type and grade of contamination. **Do NOT use HF**! Clean cuvette from all acids, rinse with aqua dest, methanol and let it dry.
5. Do not touch the windows of the cuvette with your fingers. Best procedure is to touch the cuvette only with optical paper or gloves.
6. Cuvette re-installation in reverse order. After the installation of the cuvette press it carefully into the metal bed.

9. Technical Data Hg-254 NE

instrument:	Desktop photometer with handle, 19“ version option
measuring method:	UV-photometer with reference beam and regulated lightsource
cuvette:	Quartz, optical length 230 mm
lightsource:	High frequency powered, electrodeless mercury low pressure lamp, output regulated, temperature stabilised
ranges:	0 ... 10 µg/l (15 µg/l) or. 0 ... 10 ppb (15 ppb) lowest range 0 ... 1 µg/l or 0 ... 1 ppb
sensitivity:	0,01 µg/l or. 0,001 µg absolute
required time:	0,5 to 2 minutes per sample
sample volume:	0,05 - 1 litre
software:	interactive operation according to EN 1483 (former DIN 38406)
keypad:	waterproof membrane keypad with 5 softkeys
display:	TFT-colour-graphic display, illuminated
output:	analogue: 0 - 10 V or (upon demand) 4...20 mA, printer port, RS 232 for PC (terminal program required), acoustic signal after each measurement
pump:	built in hose pump, ca. 1,1 l/min
fuse:	T 2 A
Operating temperature:	5 – 40°C, for best precision the instrument, the reagents and the sample should be at stable temperature
power supply:	100 – 240 V AC, 50 – 60 Hz, 40 VA, wide range
portable option:	12 VDC, battery pack for 4 hours of independent operation (Option)
dimensions:	19“-desktop, 450 mm (width, 490 with handle) x 133 mm (height) x 290 mm (depth)
weight:	~. 9,5 kg
included accessories:	Hg-254 NE Analyser, extraction bottle 100 ml or 250 ml, bubbler, tubing, power cord, analogue output connector, operators manual