


## behr S3 automatic steam distillation apparatus




341107

Operating Manual

**behr**  
Labor-Technik

Please read this operating manual carefully before starting use of your new behr S3 steam distillation apparatus! The manual introduces you to the use of the apparatus with clear and simple guidance. For reasons of safety in use of the system, please follow all safety warnings carefully. These are designated in the text by a warning symbol .

 Additional information, which is useful and important for an understanding of the manner of operation of the apparatus, is denoted by a stripe in the margin.

We wish you success in the use of the  
behr  
S3 Steam Distillation Apparatus

## Safety Warnings



***Danger of electric shock! Make sure that no liquids get into the apparatus housing or come in contact with the electrical wires and connections. There are no components inside the appliance which you need to operate. Repairs to electrical equipment must be carried out only by suitably qualified and authorized personnel. Unplug the mains plug before opening the appliance.***



***Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.***



***Risk of burns and injuries! When working with corrosive substances, follow the safety guidance in the pertinent Safety Data Sheets.***



***Caution: reaction vessels get hot and can cause burns! During the distillation and for a short time thereafter, do not touch any parts of the distillation system behind the Plexiglas door!***



***Do not operate the S3 steam distillation apparatus in damp or explosive atmospheres!  
The maximum allowable humidity is 80%  
The maximum allowable room temperature is 30 °C***

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## Scope of Delivery

Immediately on receipt, check the contents of the delivery for absence of damage and completeness.

A claim for damage in transport, which is evident on the outside of the packing, must be immediately submitted to the carrier (postal, rail or road haulage carrier) – see the shipping label on the package.

If components are damaged, but no damage to the external packing was evident (concealed transport damage), contact the behr customer service immediately (also in the event of other complaints). The address is:

### behr Labor-Technik GmbH

Spangerstraße 8

D-40599 Düsseldorf

Téléphone : (+49 211) 7 48 47 17

Télécopie : (+49 211) 7 48 47 48

E-Mail: info@behr-labor.com

Please check the contents against the following list.

## Parts List

behr S3 distillation apparatus, completely assembled

Hose set:

- 1 Water inlet hose, 10/17, with 1/2" and 3/4" standard fittings, 2 m

Hoses marked with numbers:

- 2, 6:** 2 x PVC tubing, 4/7, 2 m
- 3, 4:** 2 x PVC tubing, 8/12, 2 m
- 5:** Verprene tubing, 8/12, 2 m

(The cooling-water inlet hose, the cooling-water outlet hose **4** and the steam-generator feed hose **6** come in a separate hose package)

- 2 PVC tube, 6 x 1, 420 mm
- 1 PVC tube, 10 x 1, 420 mm
- 1 PP tube 10 x 2, 400 mm
- 1 Electrical (mains) cable
- 1 Crucible tongs
- 1 spare for steam hoses
- 1 spare Viton stopper
- 1 screwdriver 3 mm
- 1 screwdriver 2.5 mm

## Use of the behr S3 in Chemical Analyses

The behr S3 is an effective automatic distillation apparatus for use in various applications. Principally, it finds application in the steam distillation of Kjeldahl ammonia solutions. In this application, the automatic addition of NaOH and H<sub>2</sub>O, as well as the automatic draining of spent sample waste, provide for a high degree of safety and convenience in use.

**If you want to use the device for other kinds of analyses, please ask the behr customer service if it is fit for use with the chemicals needed for this purpose.**

Be certain to carefully implement the following guidance for the sake of safety in operation and the greatest possible working life of the behr S3:

- **Operate the apparatus always in accordance with the instructions and warnings in this operating manual!**  
**Modification or changes to the apparatus are unauthorized and lead to termination of the guarantee. Modifications may result in serious operational safety hazards and /or reduced reliability of the S3.**
- **Do not expose the steam distillation unit to corrosive vapors, such as acids, bases or organic solvents!**

## Operating Conditions

**Operate the behr S3 steam distillation apparatus under normal laboratory conditions.**

**The S3 steam distillation apparatus may be connected to a cold water tap having a standard 1/2" pipe thread.**

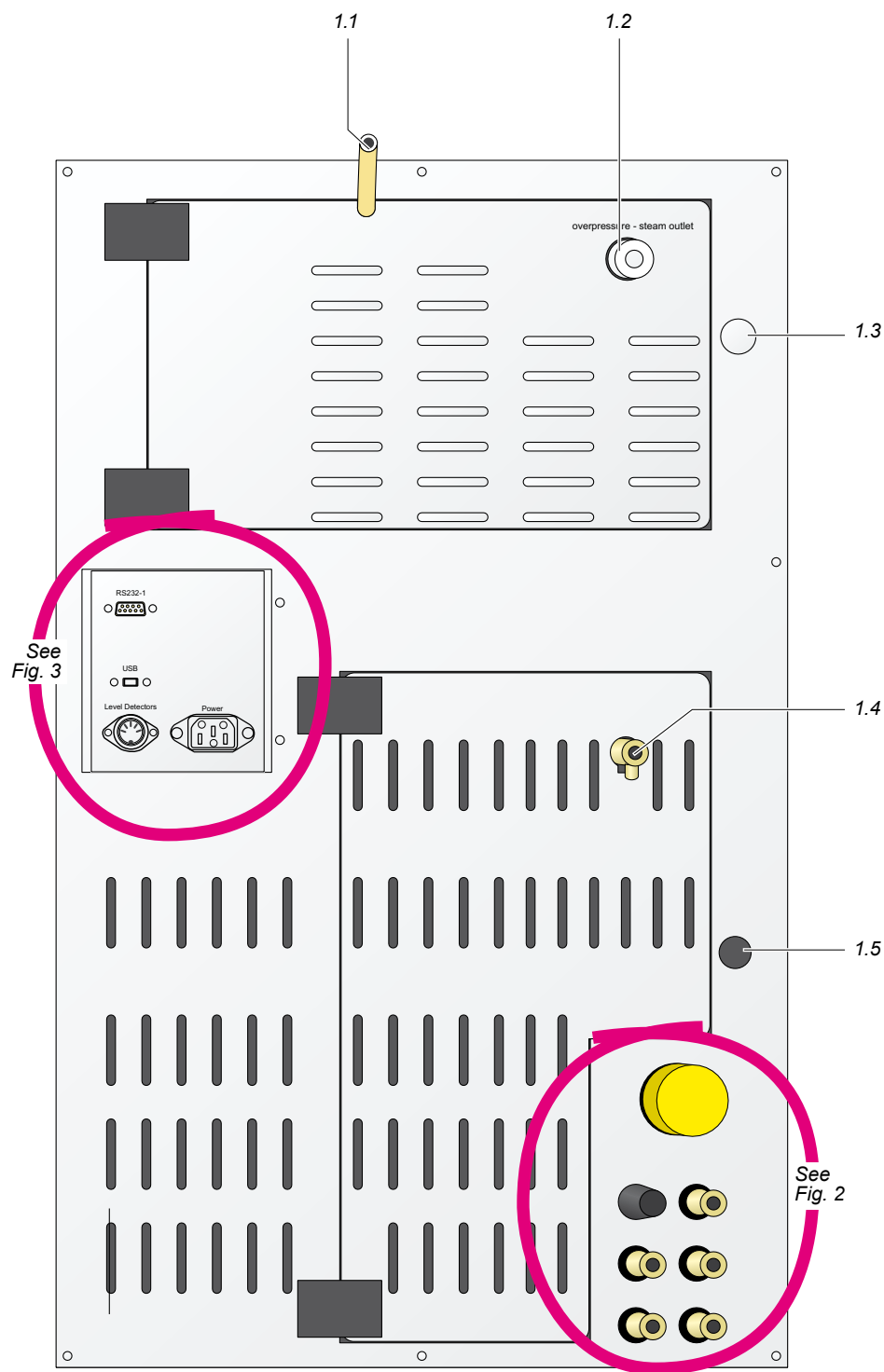


Figure. 1: behr S3 – rear view

# Rear view of the behr S3

Fig. 1: Overview of the rear side

1.1	Air vent
1.2	Overpressure steam release
1.3	Steam generator overflow outlet
1.4	Steam generator drain
1.5	Excessive temperature circuit breaker

Fig. 2: Tubing connections

--	Cooling water inlet connection with filter sieve; $\frac{3}{4}$ " connection for 10/17 PVC hose
1	Not used
2	sample dilution water; Connection nipple for 4/7 PVC tubing
3	NaOH. Connection nipple for 8/12 PVC-tubing
4	Cooling water outlet, 8/12 PVC tubing
5	sample waste disposal;-Connection nipple for 8/12 Verprene tubing
6	H <sub>2</sub> O for steam generation; Connection nipple for 4/7 PVC-tubing

Fig. 3: Electrical connections

3.1	Socket for electrical (Mains) power cable
3.2	Socket for level monitoring
3.3	Reserved for future use
3.4	RS 232 port for titrator
3.5	RS 232 port for software updates
3.6	25-pin port for titrator
3.7	Printer port

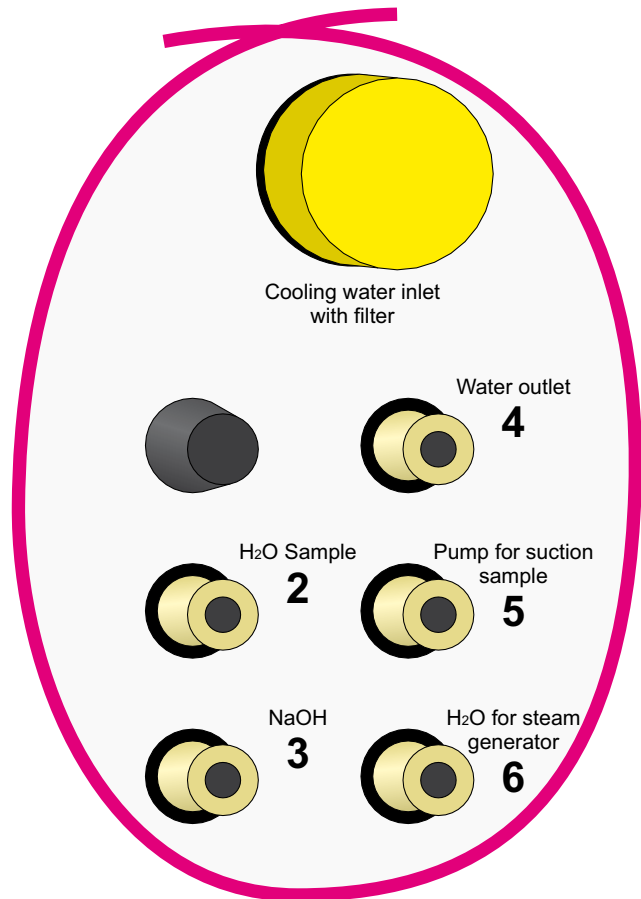


Figure 2: Hose connectors

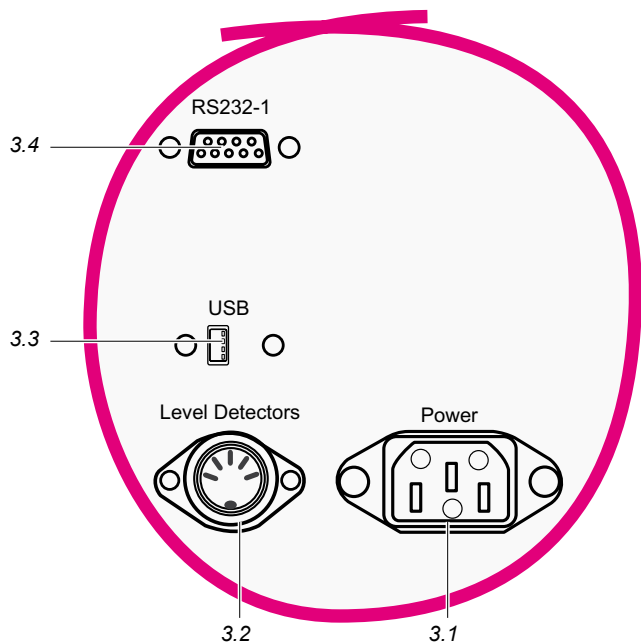


Figure 3: Electrical connectors

## Installing the behr S3

- ❑ In installing the S3, be certain to adhere to all building codes pertaining to plumbing and to waste water disposal regulations.
- ❑ In selecting the location for installation, keep in mind that the hoses and tubing provided have a length of 2 meters.

Place the behr S3 steam distillation apparatus on a sturdy horizontal flat laboratory bench top, with access to both water tap and drain and sufficient space for the reagent containers below the bench top.

Select a cold water tap to which you can permanently attach the hose for the cooling water supply.

- ❑ **Faucets providing a mixture of hot and/or cold water should not be used.**
- ❑ **The water pressure must be at least 0.5 bar for the proper functioning of the water pressure safety monitor.**

The steam distillation unit is completely assembled by the manufacturer. Please unpack it carefully.

## Emplacing the steam distillation apparatus

Place the apparatus on the bench top.

Unpack the accessory parts.

First, put the reagent containers in place:

- Container for distilled water
- Container for sodium hydroxide (NaOH)
- Container for sample waste

The optimal location for these containers is directly beneath the laboratory bench top.

- ❑ **In no case should the reagent containers be placed at a level higher than the steam distillation apparatus.**

## Connecting the hoses and tubing

- ❑ **Pay careful attention to the labels of the hose and tube connections found on the back of the S3.**

Insert the ends of the two 6 x 1 PVC tubes into the two 4/7 PVC tubing segments numbered ② and ⑥.

Connect the free ends of the PVC tubing segments to the following connection nipples on the rear of the S3:

***H<sub>2</sub>O for steam generator*** (⑥),  
***H<sub>2</sub>O sample*** (②).

Insert the PVC tubes into the container for distilled water.

Insert the end of the 10 x 1 PVC tube numbered ③ into an 8/12 PVC tubing segment. Insert the 10x1 PVC tube into the container for NaOH, and connect the free end of the PVC tubing segment to the connection nipple labelled ***NaOH*** (③) on the rear of the S3.

- ❑ **Make certain that the tubes are securely inserted in the PVC tubing segments.**

Using the pressure-resistant fabric-reinforced hose, connect the cold water tap ½" pipe thread to the ¾" fitting labelled ***cooling water inlet with filter*** on the rear of the S3.



Finally, connect the two discharge tubing segments:

Insert an end of the Verprene hose **5** into the PP tube.

Connect the Verprene tubing segment **5** to the connection nipple labelled **pump for suction sample (5)** and insert the PP tube into the container for sample waste discharge.

Connect the 8/12 PVC tube segment to the connection nipple labelled **water outlet (4)** and lead the other end to a drain.

**Make sure the hoses are laid out without kinks. Otherwise the suction pumps cannot deliver correctly. Analysis errors may occur as a result, or distillation may be aborted due to lack of water in the steam generator. Also make sure the waste water from the discharge tubes can discharge freely. This is most important for the distillate discharge hose. If there are bends (siphons) in the hose, discharging liquid might suck contents from the distillation vessel, thus causing analytical errors.**

#### In case you are using the container set KAS 30:

- ▶ Connect the individual sensor cables from the various reagent containers to the central junction box. Then connect the cable from the central junction box to the socket labelled **LEVEL DETECTORS** on the rear of the S3.

### Connecting to the electrical power line

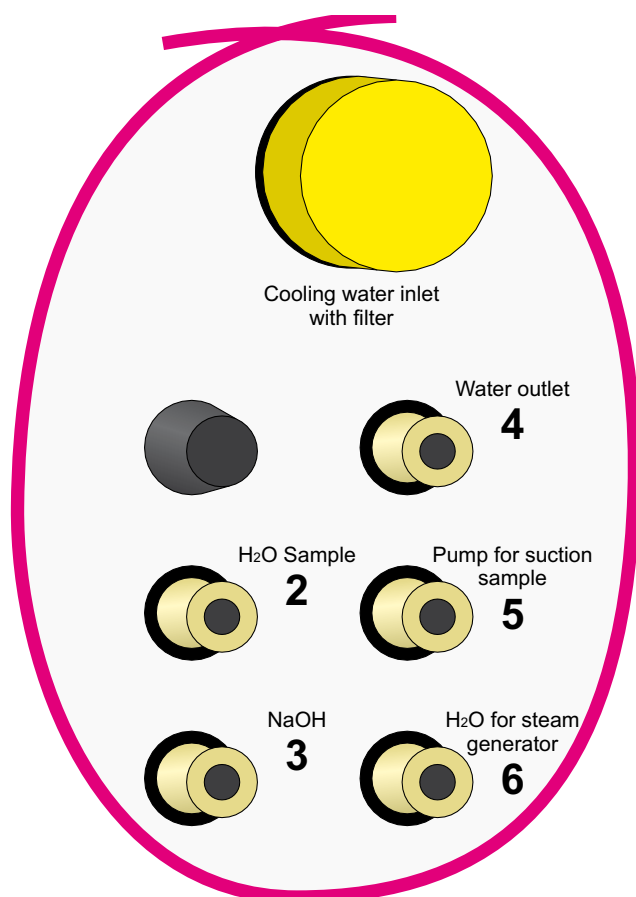
First, insure that the voltage specification stated on the model identification sticker of your S3 corresponds to the electrical line voltage.

Insure that the electrical power **MAIN SWITCH** on the front of the S3 is set to "0".

Connect the electrical power cable to the socket on the rear of the S3 identified as **MAINS**.

Connect the mains plugs of the S3 and of the titrator to a grounded electrical power socket.

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## Filling the Steam Generator



**If you fill the steam generator with pure distilled/demineralised water the level sensor cannot work. The steam generator would overflow. Add a little NaCl to the first water filling, as described here.**

The level sensor is a conductivity sensor; it cannot work if the water has not a conductivity of about 100  $\mu\text{S/cm}$ . This is achieved by addition of NaCl. During distillation, the salt will remain in the steam generator; it won't affect distillation. Only after long use, the salt may wear out. Then the steam generator must be refilled, adding a little NaCl to the first filling again.

- ▶ In a 1-liter beaker, dissolve about 40 mg of NaCl in some distilled water, and fill up to 1 liter with distilled water.
- ▶ Put the suction lance of the water-supply hose into the beaker.
- ▶ Switch the steam distiller on.

The device will fill the steam generator from the beaker. It needs about 0.7 liters. The pump will not draw this amount in one step, but will stop at 0.2 liters and display an error message.

**If the pump has drawn considerably less than 0.7 liters and now displays an error message:**

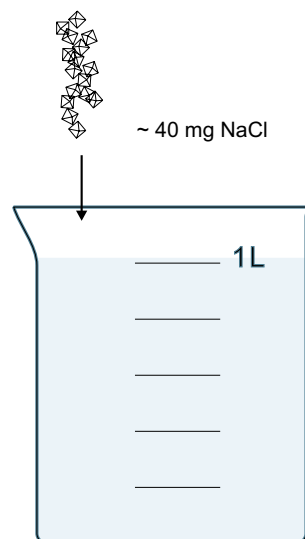
- ▶ Switch the device off and, after a few seconds, on again.
- ▶ Repeat these steps until the pump will not deliver any more and no error message is displayed.

**If the pump does not stop delivering at all**, causing the steam generator to flow over, the level sensor is defective or has been connected incorrectly.

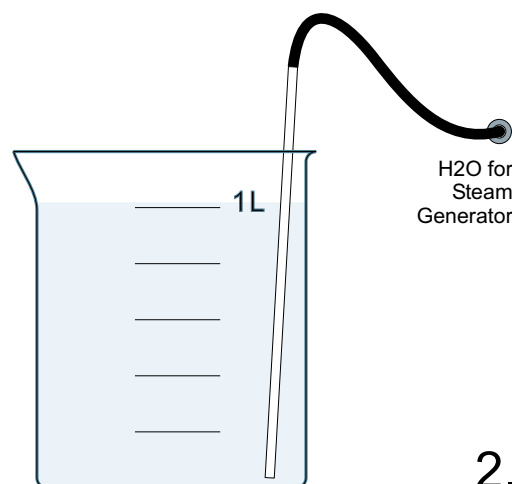
As soon as the steam generator is full, the pump will stop delivering and the steam generator will start heating.

Leave the suction lance in the beaker still; this way you can check if the device is working properly.

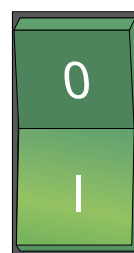
- ▶ Fill the beaker with distilled water.
- ▶ Insert a sample vessel into the device and place a reception vessel on the shelf.
- ▶ Perform some distillations and make sure the device is working properly.



1.



2.



3.

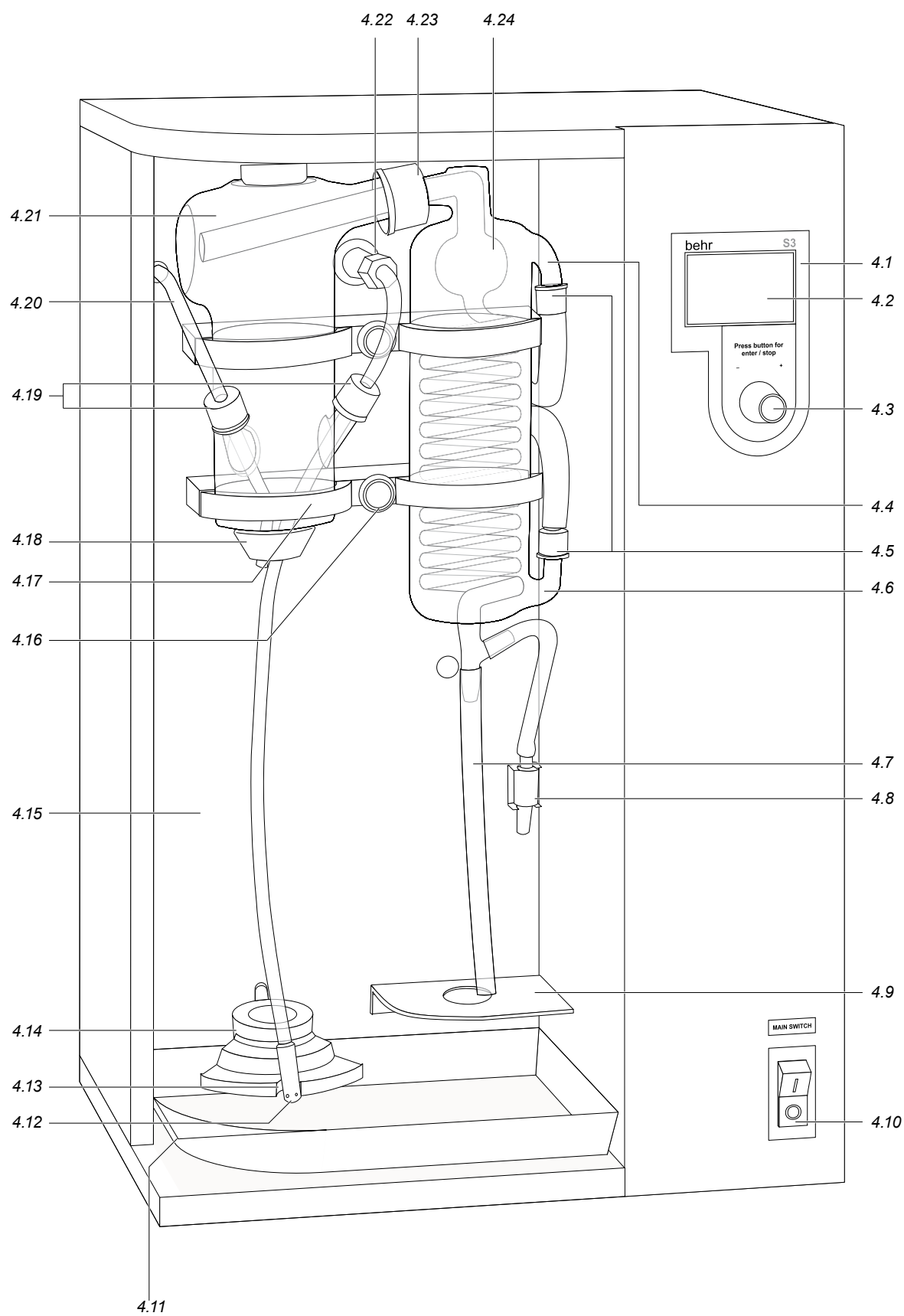


Figure 4: behr S3 – Front view

# Front view of the behr S3

Figure 4: Diagram legend

4.1	Operating control unit: Chemical-resistant plastic foil
4.2	Liquid crystal display (LCD)
4.3	Control knob
4.4	Cooling water outlet
4.5	Screw-on connectors GL 14
4.6	Cooling water inlet
4.7	Distillate delivery tube, silicone 8/12
4.8	Air release valve
4.9	Shelf for distillate receiver flask
4.10	Electrical power switch
4.11	Drip tray
4.12	PTFE steam delivery tube
4.13	Notch for positioning the steam delivery tube between distillations
4.14	Quick release fastener for holding the sample vessels during distillation
4.15	Plexiglass protective door (not shown)
4.16	Fastening screws for glassware mounting
4.17	Glassware mounting
4.18	Viton stopper for sealing vessel mouth
4.19	GL 18 screw-on connectors with silicone gaskets
4.20	PTFE delivery tube for NaOH
4.21	Distillation head, glass
4.22	Polypropylene steam/water inlet junction with polypropylene nut
4.23	GL 32 screw-on connector with silicone gasket
4.24	Condenser

# Turning the steam distillation apparatus on

## Preparations



**Acids and bases can cause burns and other injuries!**  
**In working with acids and bases, observe the safety precautions prescribed for these substances in the Material Safety Data Sheets!**

Fill the reagent containers with the appropriate chemicals.

Verify by checking the tubing connections which reagents are to be filled into which containers. Then fill the containers accordingly:

- Distilled or deionized water (e.g. from a behropur® water deionizer)
- NaOH, 32%
- H<sub>3</sub>BO<sub>3</sub>, 2 - 4%

If it has not yet been done, empty the waste-water container, disposing of the contents in accordance to regulations.

## Provide the cooling water supply

Open the water tap.

## Switching the S3 on

Turn the power on by switching the **MAIN SWITCH** on the front of the S3 to the position „I“.

The electrical power switch of the S3 fulfills two functions. It serves to turn the apparatus on and off and also has an electrical circuit-breaker built in.

This circuit breaker operates on a similar principal to those used in homes. If too much current is drawn, it shuts off.

The operation of this circuit breaker requires that a spring within it be cocked. For this reason, a somewhat greater pressure is required on the switch to turn it on than is required in a similar switch without circuit breaker.

After turning the apparatus on, the display on the front will briefly show an initialization notification. Immediately thereafter, the pump begins filling the steam generator and you see the following notification on the display:

### steam generator filling

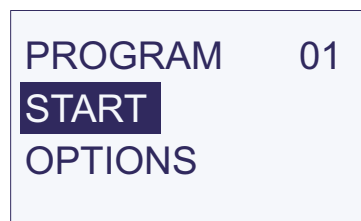
An hourglass symbolizes the ongoing process.

Next, the following notification appears:

### steam generator heating

Again, the hour glass is seen on the display.

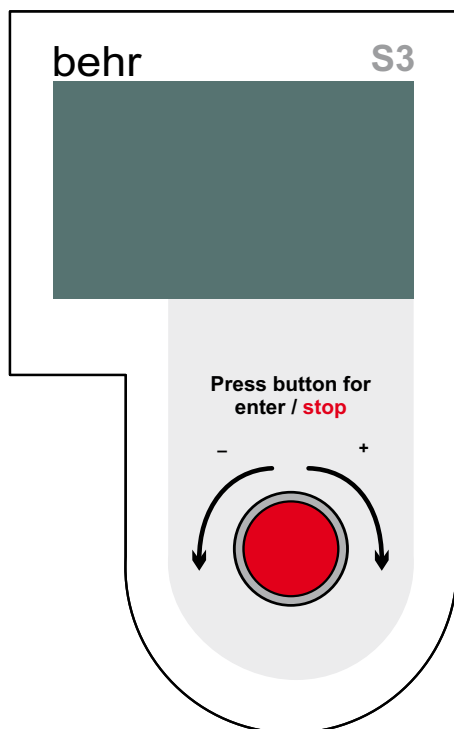
These two procedures can take a bit of time, especially when the apparatus is switched on for the first time. These procedures have been completed when the display switches to the „Start“ mode



The S3 steam distillation apparatus is now ready for operation.

# Distilling with the behr S3

## The operating control unit



## Programming the S3

After filling and heating of the steam generator you will see the following display:



This is the **main menu**. From here you come to all other menus and displays.

The option **START** is pre-programmed as a default setting.

### Operating control unit

Your behr S3 steam distillation apparatus is programmed and operated easily with a single knob.

The principle remains in all cases the same:

Turning the knob enables you to choose an option. The currently addressable option is recognized by being highlighted with green text on a black background.

The knob may be turned in both directions. In doing this, you will pass all possible options in the display shown and will always again find the desired option on continued turning. Try this for yourself.

The desired option is implemented by pressing on the knob.

The complete procedure of choosing by turning and implementing by pressing will henceforth simply be called "selecting".

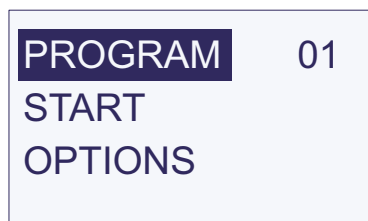
The following pages will show you how to program and operate your steam distillation apparatus.

## Modifying a distillation program

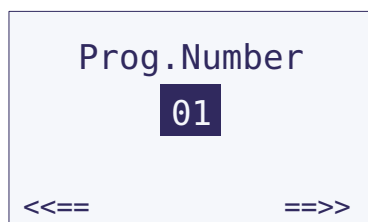
With the S3, you can define 10 different distillation programs. This allows you to define the appropriate conditions and the appropriate quantities of reagents for different analyses and different sample concentration ranges.

Program no. 00 is a test program to check the steam delivery rate of the device.

When defining a program, make a note of its purpose and the settings you made.



Turn the operating control knob clockwise or counterclockwise until the menu item **Program** is highlighted. Then press the knob once. You will now see the following display:



You can now select which of the 10 programs of the S3 you wish to enter or modify. Simply turn the operating control knob until **Prog.Number** appears in green on a black background. If you now press the knob once, you will be able to dial to another number. Turning the knob clockwise advances the display to the higher numbers, while turning counterclockwise brings you to the lower numbers. At both ends of the number range, continued turning of the knob will bring you to the other end of the range, specifically

- turning clockwise beyond 10 will bring you back to 00
- turning counterclockwise from 00 will bring you to 10.

By pressing on the operating control knob you will then enter the programming options of the selected program number.

If you are working with the S3 for the first time, then leave the program number selection on 01.

**Pump delivery rates depend on the position of the chemical vessels (desk or floor) and the length of hose lines.**

By turning the operating control knob and pressing, select the option **==>>**.

You will now see the following menu displayed:

Prog.Number	01
Dil. H2O	3.0
NaOH	3.0
Dist.Time	060
<<== back ==>>	

Read the menu items as follows:

<b>Prog.Number 01</b>	You can modify the settings of program no. 01
<b>DIL.H<sub>2</sub>O</b>	Delivery time for dilution water in seconds. Possible entry values range from 0.0 sec to 99.9 sec. The factory default setting is 3.0 sec.  Delivery of the pump approx. 16 ml/sec. 80 ml/5 sec 965 ml/min
<b>NaOH</b>	Delivery time for sodium hydroxide in seconds. Possible entry values range from 0.0 sec to 99.9 sec. The factory default setting is 3.0 sec.  Delivery of the pump approx. 10 ml/sec. 51 ml/5 sec 610 ml/min
<b>Dist.Time</b>	Distillation time in seconds. Possible entry values range from 0 sec to 999 sec. The factory default setting is 300 sec.
<b>&lt;&lt;==</b>	back
<b>==&gt;&gt;</b>	further

If you wish to change an entry, simply turn the operating control knob to highlight the value of interest and press the knob to access the entry value. Then dial the desired value by turning the operating control knob and enter it in memory storage by pressing the knob again.

Once all entry values have been entered according to your wishes, select **==>>** and press the operating control knob to bring up the following program menu.

Prog.Number	01
Reac.time	010
Power	80%
DrainSample	010
<<==	back

Explanation:

<b>Prog.Number 01</b>	You can modify the settings of program no. 01
<b>REAC.TIME</b>	Delay time in seconds between the end of NaOH addition and the start of distillation. Possible entry values range from 0 sec to 999 sec. The factory default setting is 0 sec. For the distillation in the Kjeldahl nitrogen determination, do not change the preset default of 000.
<b>POWER</b>	Steam generator power. Possible entry values range from 30% to 100%. The factory preset default value is 80%. You can change the electrical power for steam generation and thereby the intensity of steam generation.  The steam generator is switched on and off on by a pressure sensor. The on/off set points of the pressure sensor cannot be adjusted by the user. It is only possible for the user to adjust the steam generation power.
<b>DRAINSAMPLE</b>	Run-time in seconds for the pump draining the sample waste after distillation. Possible entry values range from 0 sec to 999 sec. The factory default setting is 30 sec.
<<==	back
==>>	further

If you wish to change any of the values, select the desired parameter by turning the operating control knob. Press on the control knob to access the numerical entry value. Then dial the desired value by turning the operating control knob and enter it in memory storage by pressing the knob again.

You have now completed program no. 01.

Select **<<==**. By repeatedly pressing **<<==** you will return to the main menu.

## Distilling



**Danger of electric shock! Make sure that no liquids get into the cable connections or the inside of the equipment.**



**Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.**



**Risk of burns and injuries! When working with acids and bases, follow the safety guidance in the pertinent Safety Data Sheets.**



**Caution: reaction vessels get hot and can cause burns! During the distillation and for a short time thereafter, do not touch any parts of the distillation system behind the Plexiglas door!**



**Do not operate the S3 steam distillation apparatus in damp or explosive atmospheres! The maximum allowable humidity is 80%. The maximum allowable room temperature is 40 °C.**



**The steam induction tube may still have NaOH on it from a previous distillation. If carried over to the distillation vessel, it will cause false analysis results. When handling the steam induction tube, do not spatter the adhering liquid. Keep the receiver flask shelf clean, and avoid touching the shelf with the distillate delivery tube.**

## (Re)filling the reagent lines

Before you use your S3 for the first time or after longer periods of disuse, the delivery pumps and tubing should be filled with the respective reagent, replacing any air or distilled water in the lines. By this you make sure all reagents will be delivered in the correct amounts.

- **Inspect the reagent containers and the tubing connections.**
- **Open the water tap.**

## Inserting the glassware

Insert the distillate delivery tube into an empty Erlenmeyer flask, which should be set on the flask shelf.

Guide the PTFE steam delivery tube into the mouth of an empty sample vessel. Seat the mouth of the vessel properly against the Viton stopper above and secure the vessel in place from below by seating it in the recess of the quick-release fastener. Check for firm and complete seal of the vessel mouth against the Viton stopper.

## Switching the steam distillation apparatus on

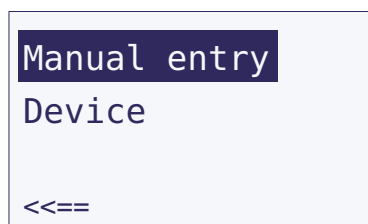
Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

In the main menu, select **Options**.

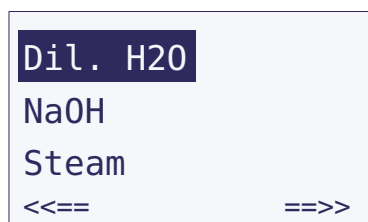


## Performing the (re)filling

The following menu appears:



Select **MANUAL ENTRY**. The display will then appear as follows:



Select **DIL.H<sub>2</sub>O** and hold the operating control knob depressed until water flows into the sample vessel.

Select **NaOH** and hold the operating control knob depressed until sodium hydroxide flows into the sample vessel.

Now select **==>>** to proceed to the next menu.

Select **DrainSample** and hold the operating control knob depressed until the liquid in the sample vessel has been drained.

Press the quick-release fastener down and remove the sample vessel.

Push the PTFE steam delivery tube into its retaining notch.

By repeatedly pressing **<<==** you will return to the main menu.

## Test run

Especially reliable and reproducible results will be obtained if you perform a „warm-up“ distillation without sample before starting your daily analyses.

In the course of this first „warm-up“ distillation, the steam will come in contact with cold glass components, leading to a higher degree of condensate formation. This could lead to excessive dilution of an actual sample and to an excessive volume of liquid in the sample vessel.

The introduction of steam at a temperature of approx. 106°C results in noises, which can be loud. These noises are no cause for concern. With utilization of our high-quality behrotest® sample digestion vessels, models SR 3i, KJ 500 or KJ 750, the risk of glass breakage is minimal.

Open the water tap.

### Inserting the glass vessel



**Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.**



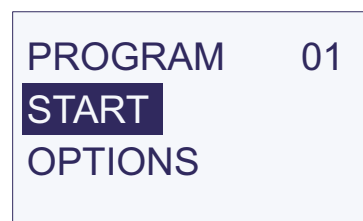
**Risk of burns and injuries! When working with acids and bases, follow the safety guidance in the pertinent Safety Data Sheets.**

Insert the distillate delivery tube into an empty Erlenmeyer flask placed on the shelf beneath the condenser.

### Switching the steam distillation apparatus on

Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

Following the initialization, the main menu appears:



The menu selection **Start** is highlighted.

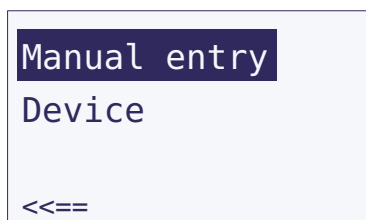
## Starting the test run



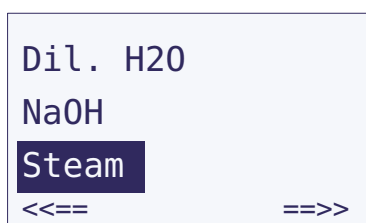
**Caution! Sample vessel is hot! During the distillation and for a short time thereafter, do not touch any parts of the distillation system behind the plexiglass door.**

Select **Options** in the main menu.

The following menu appears:



Select **MANUAL ENTRY**. The display will then appear as follows:



Select **Steam**. In this function the operating control knob acts as an on/off switch.

The introduction of steam is started by a short press of the operating control knob. Steam will continue to flow into the sample vessel until the operating control knob is pressed again.

Press the operating control knob briefly to start the steam delivery. Continue the introduction of steam until approximately 1 cm of condensate has accumulated in the titration vessel.

## Ending the test run

Press the operating control knob to end the distillation.

Now select **DRAINSAMPLE**. Hold the operating control knob depressed until there is no more water in the sample vessel.



**Caution! Sample vessel is hot! After distillation do not touch the sample vessel by hand. Use the crucible tongs or a suitable kind of protection.**

Depress the quick-release fastener remove the sample vessel.

Push the PTFE steam delivery tube into its retaining notch.

By repeatedly pressing **<==**, you will return to the main menu.

## Automatic Distillation with the behr S3



**Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.**



**Risk of burns and injuries! When working with acids and bases, follow the safety guidance in the pertinent Safety Data Sheets.**

Open the water tap.

## Inserting the sample vessel

Insert the steam delivery tube into the sample vessel containing the digested sample material. Press the quick release fastener down and insert the sample vessel.

Check for firm and complete seal of the vessel mouth against the Viton stopper.

Insert the steam delivery tube into an empty sample vessel. Press the quick release fastener down and insert the sample vessel. Check to insure that the sample vessel is firmly seated against the Viton stopper.

Fill the desired volume of boric acid (4 %) into an Erlenmeyer flask. Insert the distillate delivery tube into the Erlenmeyer flask. The distillate delivery tube must reach below the level of boric acid. If necessary, add more boric acid. Place the Erlenmeyer flask on the shelf beneath the condenser.

## Switching the steam distillation apparatus on

Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

Following the initialization, the main menu appears:



The menu selection **Start** is highlighted.

## Starting the automatic distillation



**Caution! Sample vessel is hot! During the distillation and for a short time thereafter, do not touch any parts of the distillation system behind the plexiglass door.**

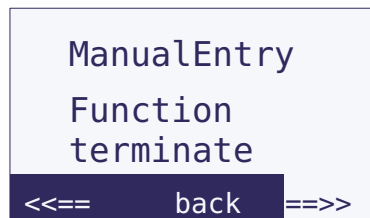
Press the operating control knob briefly to start the distillation.

The device will add the reagents, perform the distillation and afterwards empty the sample vessel. The display shows the status of the program execution and the remaining time.

## Interrupting or terminating the distillation program

You can interrupt or terminate the distillation program at any time during the course of program execution by pressing the operating control knob.

Distillation will be interrupted, and this menu will appear:



Now the device waits for your decision. You can abolish this distillation; but you can also try to correct some mistake and then go on distilling. In order to do the corrections, you can even access the **ManualEntry** menu, perform some manual entries and then return to this menu.

Select

**Manual Entry** in order to go to the **ManualEntry** menu, e. g. to deliver an additional amount of a reagent. When you have finished there, return to this menu by selecting <<== until you are back here.

**==>>** In order to permanently terminate the program. Your will be returned to the main menu.

**<<==** In order to continue the program.

## Ending the automatic distillation



**Caution! Sample vessel is hot!**  
After distillation do not touch the sample vessel by hand. Use the crucible tongs or a suitable kind of protection.

After completion of the distillation program, depress the quick-release fastener and remove the sample vessel.

Push the PTFE steam delivery tube into its retaining notch.

— **Sodium hydroxide and - to a lesser extent – boric acid attack the pumps and tubing. It is therefore advisable, following the last distillation every day to rinse the delivery lines (pumps and tubing).**

The procedures you should follow are described on page 21 in the section „Before shutting the S3 down.“ Do not forget to refill the reagent lines and pumps before using the apparatus again.

## Manual distillation with the behr S3



**Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.**



**Risk of burns and injuries! When working with acids and bases, follow the safety guidance in the pertinent Safety Data Sheets.**

If you desire, you may control the performance of the distillation by manual operation of the behr S3.

Open the water tap.

## Inserting the sample vessel

Insert the steam delivery tube into the sample vessel containing the digested sample material. Press the quick release fastener down and insert the sample vessel.

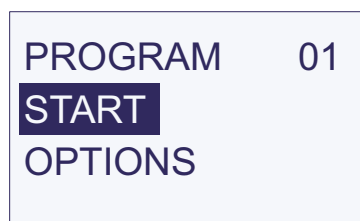
Check for firm and complete seal of the vessel mouth against the Viton stopper.

Fill the desired volume of boric acid (4 %) into an Erlenmeyer flask. Insert the distillate delivery tube into the Erlenmeyer flask. The distillate delivery tube must reach below the level of boric acid. If necessary, add more boric acid. Place the Erlenmeyer flask on the shelf beneath the condenser.

## Switching the steam distillation apparatus on

Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

Following the initialization, the main menu appears:

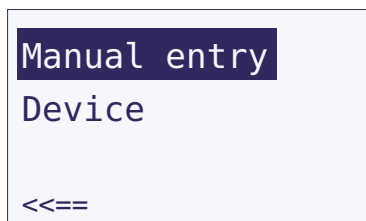


The menu selection **Start** is highlighted.

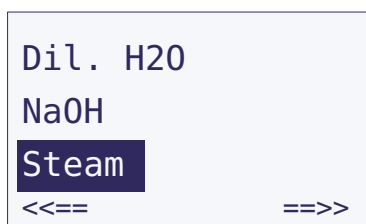
## Performing a manual distillation

In the main menu, select **Options**.

The following menu appears:



Select **MANUAL ENTRY**. The display will then appear as follows:



First, select **DIL.H<sub>2</sub>O**. Hold the operating control knob depressed until the desired volume of dilution water has been added.

Next, select **NaOH**. Hold the operating control knob depressed until the desired volume of NaOH has been added.

Select **Steam**. In this function the operating control knob acts as an on/off switch.

The introduction of steam is started by a short press of the operating control knob. Steam will continue to flow into the sample vessel until the operating control knob is pressed again.

Press the operating control knob briefly to start the distillation.

## Ending the manual distillation

Press the operating control knob to end the distillation.

Proceed **==>>** to the next menu.

Select **DrainSample**. Hold the operating control knob depressed until there is no more liquid in the sample vessel.

Take the Erlenmeyer out to do the distillation.



**Caution! Sample vessel is hot!**  
**After distillation do not touch the sample vessel by hand. Use the crucible tongs or a suitable kind of protection.**

Depress the quick-release fastener and remove the sample vessel.

Push the PTFE steam delivery tube into its retaining notch.

By repeatedly pressing **<<==** you will return to the main menu.

## Before shutting the S3 down

If you have finished work with the S3 for the day, please take a few precautions to make sure that the apparatus will not be damaged during this interval of disuse.

- **Sodium hydroxide attacks the pumps and tubing.** With ambient air, sodium hydroxide will form deposits of soda ( $\text{Na}_2\text{CO}_3$ ) which can clog the pump and tubings. After the last distillation of the day, always rinse the delivery lines (pumps and tubing) and close the storage bottles.

## Rinsing the tubes

Fill a container with distilled water and place it near the steam distillation unit.

- **The container must not be situated at a level higher than the pumps.**

Remove the PVC reagent feed tubes from the NaOH and  $\text{H}_3\text{BO}_3$  containers and insert them into the container of distilled water, which you have placed nearby.

Open the water tap.

## Inserting the sample vessel

Insert the steam delivery tube into an empty sample vessel. Press the quick release fastener down and insert the sample vessel.

Check to insure that the sample vessel is firmly seated against the Viton stopper.

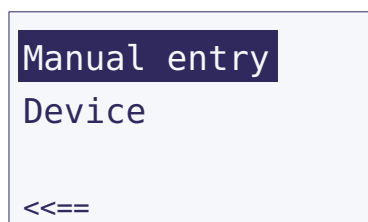
## Switching the steam distillation apparatus on

Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

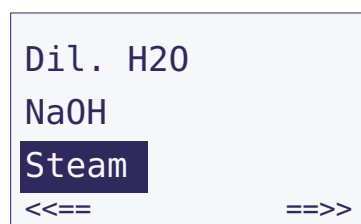
In the main menu, select **Options**.

## Rinsing

The following display appears:



Select **MANUAL ENTRY**. The display will then appear as follows:



Select **NaOH** and hold the operating control knob depressed until the sample vessel has been filled up to about three quarters.

Remove the PVC reagent tube for NaOH out of the container of distilled water. Hold the operating control knob depressed until no more water flows into the sample vessel.

Empty the sample vessel and insert it again. The NaOH pump and delivery lines have now been rinsed and emptied.

Select **DrainSample** and hold the operating control knob depressed until the liquid in the sample vessel has been drained and only air is being pumped.

Close the storage bottles.

Press the quick-release fastener downwards and remove the sample vessel.

Push the steam delivery tube into its retaining notch.

By repeatedly pressing <<== you will return to the main menu.

- ☐ **Do not forget to refill the reagent lines (page 16) before again performing distillations.**

# Maintenance

## Checking the steam delivery rate

If steam delivery lines, valves or distributors get clogged the device cannot deliver the necessary amount of steam into the sample vessel. This can cause low analysis results. For checking the steam delivery rate, there is a test program 00. Its settings are:

Heating power 80%; Distillation time 300 seconds; deliveries for dilution water, sodium hydroxide and boric acid are set to zero. Time for "Drain Titr" is set to zero as well, so you can measure or weigh the distillate that has developed.

- ▶ If it has not yet been done, switch the S3 on. While the steam generator is heating up, continue preparations:
- ▶ Open the cooling water tap.
- ▶ Empty the erlenmeyer titration vessel and weigh it.
- ▶ Insert the steam delivery tube into an empty sample vessel. Press the quick release fastener down and insert the sample vessel.
- ▶ Check to insure that the sample vessel is firmly seated against the Viton stopper.
- ▶ Close the protective door.



**Caution! Sample vessel and distillation head will become hot and may cause burns!**

**During the test program keep the protective door closed.**

**After distillation, do not touch the sample vessel with bare hands. Use crucible tongs or other suitable finger protection.**

- ▶ In the main menu, select **Program**.
- ▶ Select **Program No. 00**.
- ▶ Go <<== to the main menu, and select **Start**.

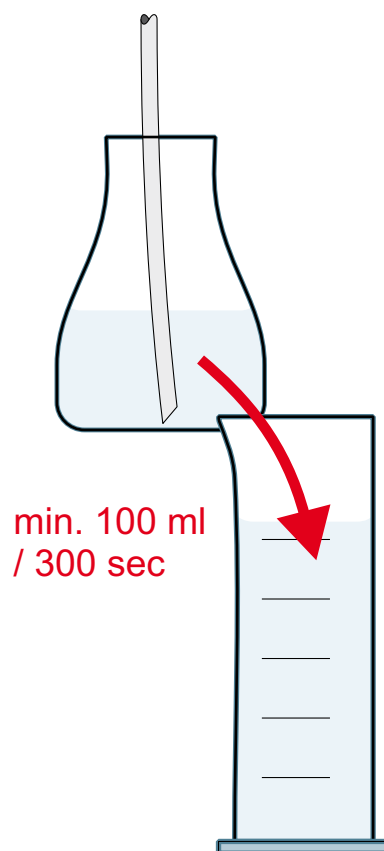
Hot steam is delivered into the sample vessel and into the distillation head.

When the program is through, take the titration vessel out and weigh it or measure the distillate with a graduated cylinder.

**If less than 100 ml of distillate have been formed, steam delivery lines or distributors are probably clogged. Ask the behr customer service.**

When the test is done, depress the quick-release fastener and remove the sample vessel.

Push the steam delivery tube into its retaining notch.





## Cleaning the NaOH Lines

During use of the distiller, soda ( $\text{Na}_2\text{CO}_3$ ) can form from the sodium hydroxid and form deposits in hoses, non-return valve and pump. We recommend, therefore, to rinse the NaOH lines with diluted hydrochloric acid every 3 months to dissolve any such deposits.

- ▶ Rinse the lines with water as described before. Stay in the **Manual entry** menu.
- ▶ Pour 100 ml diluted hydrochloric acid (about 5%) into a suitable vessel and insert the NaOH suction lance.
- ▶ Select **NaOH** and keep the control knob pressed until the hydrochloric acid has just been sucked in.
- ▶ Let the acid work for some minutes.
- ▶ Pour distilled water into the vessel and rinse the lines with it. To rinse thoroughly, use at least 300 ml water; empty the sample vessel when it is full, re-insert it and continue rinsing.

## Cleaning the Distillation Head

During distillation, splashes of the digestion mixtures can deposit in the distillation head. Although the test program 00 will at the same time rinse the distillation head, you will need to take the glassware out of the device in order to clean it thoroughly at regular intervals.

If need be, you can change tubings, non-return valves and other wear parts on this occasion. A Maintenance Set is available which includes the tubings and other wear parts that are most exposed to wear and tear. It comes with a detailed instruction manual that is currently available in English or German.



**Caution: the tubing may still hold remainders of chemicals (especially, caustic soda). Liquid leaking out might burn you or damage the device.**

**Rinse the tubing with distilled water before changing it.**



**Glass can break and cause injury! In working with glass components, observe all appropriate safety precautions.**

- ▶ Lay out a towel or some other soft cloth beside the device.
- ▶ Take the sample vessel and the titration vessel out of the device.
- ▶ Pull the end cap off the steam delivery tube.
- ▶ Undo the screw connection ① that connects the steam delivery tube to the distribution head.
- ▶ Undo the two screw connections ② that introduce the delivery tubes into the glassware distillation head.
- ▶ Pull the delivery tubes out of the distillation head. The right one (the steam delivery tube) is loose now; lay it aside. Leave the left tube (the NaOH delivery tube ③) hanging behind the glassware.



- ▶ Screw the cooling-water connectors ④ off the condenser.
  - ▶ Screw off the lower of the two mounting brackets ⑤ which support the glassware.
  - ▶ Secure the glassware with one hand against toppling, and screw off the other mounting bracket ⑥.
- Remember there is still water in the condenser; it might drip out when dismantling the glassware.
- ▶ Grasp the distillation head with the left hand and the condenser with the right, and pull the glassware out of the device.
  - ▶ Lay the glassware on the cloth beside the device.
  - ▶ Undo the screwcap ⑦ that fixes the condenser inlet tube to the distillation head.

Now you can clean the distillation head and the condenser separately. To assemble the glassware again, just reverse the steps described here.

The Viton stopper for connecting the sample vessel and the steam tubing inside the device are the parts that are most subject to wear and tear. Therefore a spare stopper and a piece of spare hose come with this device.

A Maintenance Set including several other spare parts is available. Ask your behrr customer service.

## Changing the Viton Stopper

If the Viton stopper gets fissured or otherwise faulty, it must be replaced. Do not perform distillations with a leaky stopper; it will cause false (low) analysis results!

- ▶ Pull the defective stopper off the distillation head. If need be, cut it with a sharp knife.
- ▶ Push the new stopper on the nozzle.



## Checking the Inside of the Device

In the rear side of the device you will find two maintenance doors. In order to check the inside of the device you just open these doors; you need not pull off the hoses nor dismantle the back panel.



**Caution: some parts inside the device will get hot and can burn you. Wait for the device to cool down before opening it.**



**Danger of electric shock! Make sure that no liquids get into the apparatus housing or come in contact with the electrical wires and connections. Unplug the mains plug before opening the appliance.**

The two maintenance doors are shut up with two knurled screws each; for opening them you just turn the knurled screws loose. The knurled screws are fastened to the doors so you cannot lose them.

Regularly check if any hoses or connections have become leaky.

Read in the following chapter how to change the steam tubings. A maintenance set containing some more hoses and non-return valves that are frequently needed is available; it comes with a user's manual in German and English.



Upper maintenance door



# Changing the Steam Tubing



**Caution:** some parts inside the device will get hot and can burn you. Wait for the device to cool down before opening it.



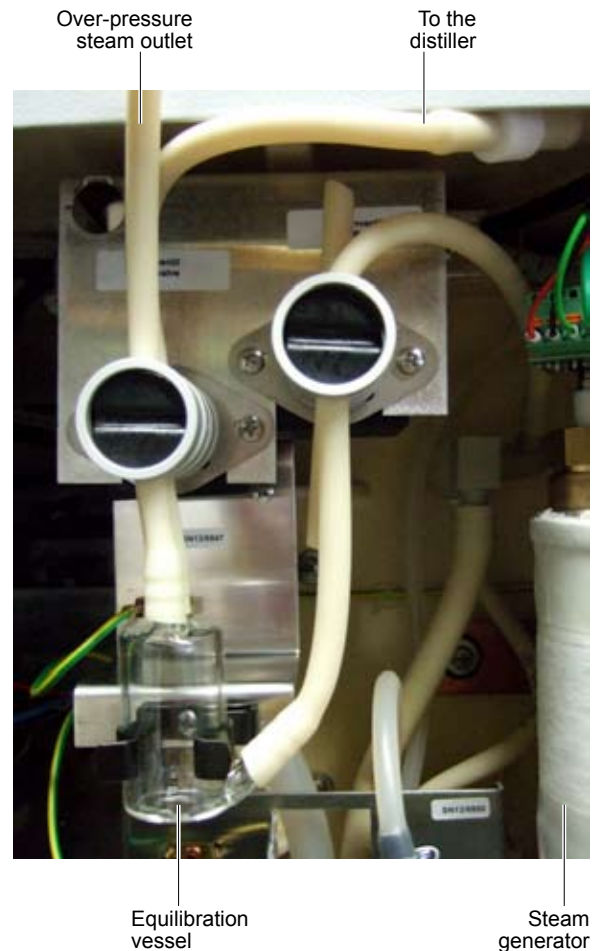
**Danger of electric shock!** Make sure that no liquids get into the apparatus housing or come in contact with the electrical wires and connections. Unplug the mains plug before opening the appliance.

If the distiller's steam delivery rate gets poorer (less than 100 ml distillate in 5 minutes at 80% heating power) it might be because the steam tubing is worn out.

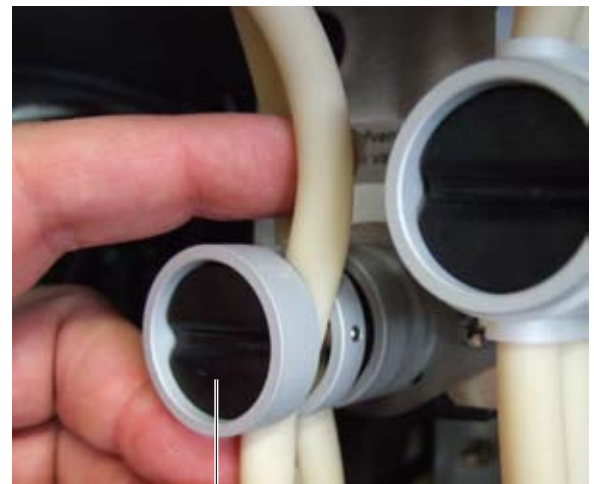
Introduction of steam into the sample vessel is controlled by squeeze valves that pinch the steam hose and release it again. Eventually the steam hose may lose its elasticity; then it must be replaced.

- ▶ Switch the device off and pull the mains plug.
- ▶ Wait for the device to cool down.
- ▶ Open the upper maintenance door.

Inside the device you will notice four intransparent hose lines that go through two squeeze valves. One of them is just a short piece of hose that only serves to absorb the force of the squeeze valve.



First push the front-side hose out of the valve...



... then press the black button down and push the rear-side hose out

The squeeze valves act by squeezing one hose and releasing the other one. In home position, the frontside hose is free. If the black button is pressed the frontside hose is squeezed and the rear-side one becomes free.

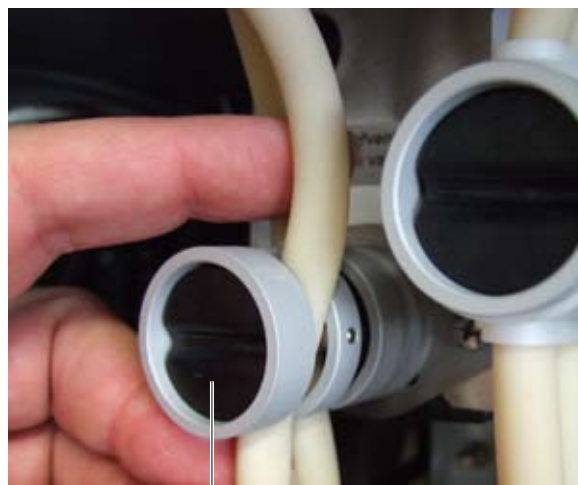
To dismantle the tubings,

- ▶ pull the frontside hose sideways out of the valve,
- ▶ then press the black button and
- ▶ pull the rearside hose sideways out of the valve.
- ▶ Carefully pull the steam equilibration vessel out of the bracket to the front, and lay it aside along with the tubing.
- ▶ Pull the Novoprene hose that leads from the steam equilibration vessel off the connector piece under the roof of the housing.
- ▶ Cut the new tubings in the same lengths as the old ones and connect them.
- ▶ On the old steam release tube there is a curved piece of PTFE hose. It serves to convey the steam coming out of the steam release tube to the outside. Take the PTFE tube off and put it on the new steam release tube.
- ▶ Connect the Novoprene hose that will lead to the connecting piece under the roof of the housing to the rearside nozzle on top of the steam equilibration vessel, put the steam release tube on the frontside nozzle and the hose leading to the distributor block to the nozzle near the bottom on the right.
- ▶ Gently push the steam equilibration vessel into the bracket from the front. Pull it downwards far enough to make a sufficient distance to the squeeze valves.

If too little space is left between the upper nozzles of the steam equilibration vessel and the squeeze valves, the valve cannot shut the tubes properly. When doing a distillation, steam will escape through the pressure outlet rather than get into the sample vessel. Push the equilibration vessel downwards far enough to leave a distance of about 3 - 4 cm from the nozzles to the squeeze valve.

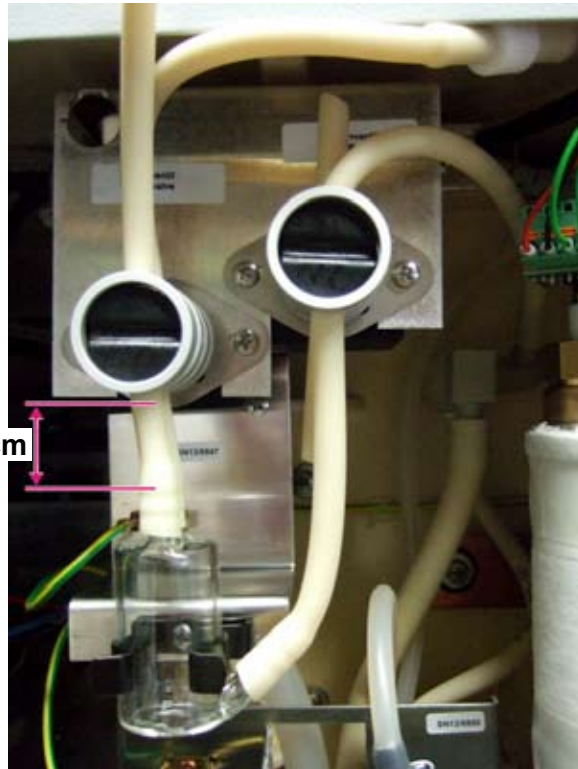
- ▶ Push the hose that is connected to the frontside nozzle of the equilibration vessel into the frontside slot of the left squeeze valve from the right.
- ▶ Pressing the button of the squeeze valve, push the hose connected to the rearside nozzle of the equilibration vessel into the rearside slot.
- ▶ Connect the other end of this hose connection to the non-return valve.
- ▶ Push the hose that is connected to the bottom nozzle of the steam equilibration vessel into the frontside slot of the right squeeze valve from the right.
- ▶ Connect the other end of this hose to the steam input nozzle of the distributor head.
- ▶ Pressing the button of the squeeze valve, push a short piece of Novoprene hose into the rearside slot.
- ▶ Fix the rear panel again, leading the PTFE outlet tube through the boring.

First push the front-side hose out of the valve...



... then press the black button down and push the rear-side hose out

3-4 cm



341107

## Emptying the Steam Generator

The steam generator filling must be renewed

- if you suspect the water might be contaminated
- or if, after very long time of use, the salt in the steam generator filling has been exhausted so the level sensor does no more work properly.

To empty the steam generator, you need

- a vessel (beaker, measuring cup, ...) of 1 liter
  - the Allen-head screwdriver that came with the device
  - a suitable piece of hose. It should be heat-resistant (e. g. Novoprene).
- ▶ Place the empty vessel under the drain valve.
- ▶ Connect a suitable piece of hose to the nozzle of the drain valve and run it into the vessel.



**Caution: the water in the steam generator is hot! Be sure the hose goes into the vessel. Do not touch the valve or the hose with bare hands.**

- ▶ Open the drain valve, using the Allen screwdriver.

The valve cone of the drain valve is a headless screw that will unblock the outlet when screwed out. You will have to do several turns until the valve cone will visibly stick out of its seat. But avoid screwing the cone out completely, or the water will spurt out of the boring too!

- ▶ Let the water flow out into the vessel.
- ▶ Close the drain valve again.

Check the quality of the outflowing water. If the water is foaming or otherwise visibly contaminated, the kettle should be rinsed with distilled water several times. To do this, fill the kettle with distilled water as described on the next page, and empty it again as described above.

An insufficient water quality might sometimes arise from the deionized-water supply itself. While ion exchangers remove inorganic, ionic components very efficiently, brand-new exchange resins can sometimes give off organic substances which will then cause foam problems. In this case it will help to install an active-charcoal filter downstream the ion exchange cartridge. Ask behr for such a filter.

For refilling the steam generator, proceed as described on page 10.



## Adapting the behr S3 to your personal requirements

Your steam distillation apparatus can be adapted to a significant degree to accommodate your personal requirements and those of your work environment.

To do this, first select **Options** in the main menu and then select **Device** in the sub-menu.

You will find several options.

### Choosing the language

**Language** This enables you to choose the language of the display.

These languages are available:

**D** = German

**GB** = English

**F** = French and

one additional language, which you may have possibly specified in purchasing your behr S3.

### Configuring the level sensor

**Canister** Switches the level sensor for the reagent and waste canister set on or off.

The factory default setting is **Off**. Switch the setting to **On**, if you are using the behr KAS 30 canister set. If you are not using the canister set, then do not change the factory default setting.

### Setting the time

**Time** Set the time of day using the operating control knob.

Once all settings in this menu have been made in accordance with your requirements, you can proceed to the next menu using **==>>**.

## Cooling Water Source Setting

**Cool water** The factory default setting is **Off**. Do not change this setting if you have connected the distillation apparatus to a cold water tap. Cold water will only be drawn from the tap during actual distillation operation.

Select **On**, if you are using a circulating water cooler. The cooler will circulate cold water. The cooling water will circulate continuously as long as the steam distillation apparatus remains switched on.

☐ Follow the instructions in the operating manual provided with your circulating water cooler.

Select **==>>** to proceed to the next menu, or **<<==** to return to the previous menu.

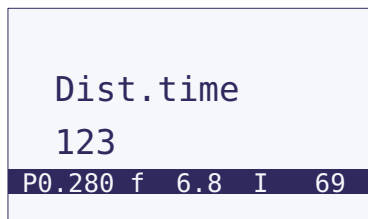
### Setting the Date

On the third page of the Device Menu you can set the current date. Select and modify the **Year**, **Month** and **Day** entries separately.

Select **<<==** to return to the previous menus.

## What to do if ...

### How to Display Current Operating Data



While you are running a distillation, you can have a status bar displayed that will show you some operating data:

- on the left: the steam generator pressure in bar
- in the midst: the signal frequency of the level sensor, in kHz (low frequency = high level)
- on the right: the heating current, in arbitrary units.

In order to display the status bar, just turn the operating control knob, no matter if left or right.

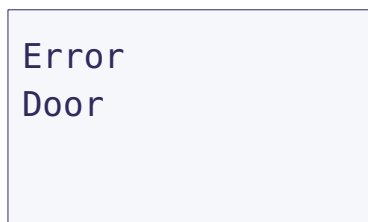
If you turn the operating control knob once more, the status bar will vanish again.

This will work during a distillation only. While you are in a menu, turning the operating control knob serves for changing from a menu item to another or for modifying an entry.

### Error messages

The following error messages inform you that you must take some corrective action in order to continue operation of the steam distillation apparatus:

#### Protection door open



You have attempted to execute a distillation program or to generate steam by means of a **MANUAL ENTRY**, but the protective door is open; or you have opened the protective door during a distillation.

Close the protective door, and press the control knob. Distillation will continue.

#### Sample Vessel Not Inserted

Error  
Sample vessel

You have attempted to execute a distillation program or to generate steam by means of a **MANUAL ENTRY**, without having first inserted a sample vessel into the apparatus.

Using the **MAIN SWITCH**, turn the steam distillation apparatus off.

Insert the steam delivery tube into an empty sample vessel. Press the quick release fastener down and insert the sample vessel.

Close the protective door and turn the apparatus on using the **MAIN SWITCH**.

#### Insufficient Cooling-Water Pressure

Error  
Cooling water

The cooling water tap is closed or not opened sufficiently.

Using the **MAIN SWITCH**, turn the steam distillation apparatus off.

Open the cooling water tap.

Turn the apparatus on again using the **MAIN SWITCH**.



## Reagent Level Sensors

Error  
Container

You have attempted to perform an automatic distillation and the automatic level sensors do not find sufficient reagent in one or more containers.

This error message can be generated in response to several situations.

Using the **MAIN SWITCH** (3.15), turn the steam distillation apparatus off.

### In the event that you are not using the behr KAS30 canister set:

Turn the apparatus on again using the **MAIN SWITCH**.

First select **Options** in the main menu and then select **Device** in the sub-menu.

Select **CONTAINERS** and change the setting to **OFF**.

Select <<== to return to the main menu.

### In the event that you are using the behr KAS30 canister set:

First, verify that all four plugs of the cables from the level sensors are properly inserted into the sockets on the central junction box.

Next, insure that the plug on the cable of the central junction box is securely inserted into the socket labeled **LEVEL DETECTORS** on the rear of the S3.

Check the levels of reagents in the canisters.

If the level of liquid in the canister for sample waste is too high, then dispose of the waste liquid properly.

If the fill-level of liquid in the reagent or distilled water canisters is too low then refill the canisters, as needed.

Turn the apparatus on again using the **MAIN SWITCH**.

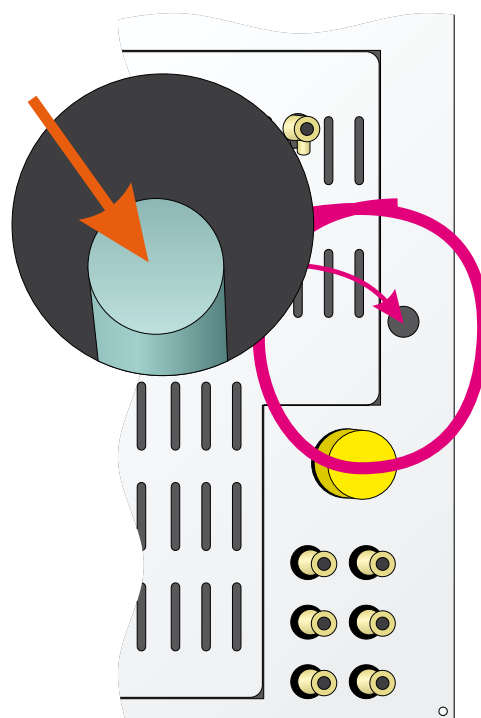
## Heating Does Not Work

Error  
Heating  
On  
Error No. 010

The heating is on but there is no current through the heating elements.

Switch the device off with the **MAIN SWITCH**.

Check if the excessive-temperature circuit breaker on the rear of the device has tripped. If so:



► Wait a while for the apparatus to cool down. Then push the protrusion of the excessive temperature circuit breaker back in, using a pointed object.

► Switch the device on again with the **MAIN SWITCH**.

If the error message reappears after a short time, then it was not possible to turn the heating on. Presumably, the triac is defective.

— Turn the apparatus immediately off and contact the behr customer service!

## Heating Cannot be Switched Off

Error  
Heating  
Off  
Error No. 011

The heating was operating continuously. Presumably, the triac is defective.

- ▶ Turn the apparatus immediately off and contact the behr customer service!

## Excessive pressure in the steam generator

Error  
Steam generator  
Pressure  
Error No. 020

There is excessive pressure in the steam generator.

- ▶ Turn the apparatus off immediately and contact the behr customer service!

## Level sensor error

Error  
Steam generator  
Sensor  
Error No. 021

The fill level sensor of the steam generator is giving a false signal.

- ▶ Turn the apparatus off immediately and contact the behr customer service!

## Lack of water in the steam generator

Error  
Steam generator  
H2O On  
Error No. 022

The water feed pump could not fill the steam generator within 30 seconds. This error may occur in several situations:

- After completely refilling the steam generator.

If you had to empty and refill the steam generator: when the message appears, just switch the device off and on again. Repeat this one or two more times; then the steam generator is full and the device can be operated again.

- If the feed-water container is empty or the feed hose is kinked or clogged or incorrectly connected.

Switch the device off. Refill the feed-water container and check the hose connections; then switch the device on again.

**If the error cannot be remedied this way**, the pump or the valves or tubings within the device will be defective.

- ▶ Turn the apparatus off immediately and contact the behr customer service!

## Spare Parts

Description	Art. No.
Round-bottom digestion vessel SR3i, 250 ml	B 0021 7959
Round-bottom digestion vessel KJ 500, 500 ml	B 0021 8195
Round-bottom digestion vessel KJ 750, 750 ml	B 0021 8218
Viton stopper	B 0022 6085
Novoprene hose for steam tubing	B 0022 5032
Maintenance Set	B 0060 6938

## Technical Specifications

Mains voltage	230 V~, 50 Hz
Max Power	1700 W
Cooling water usage, approx.	approx. 3 ... 6 l/min
Distillation time per sample, approx.	approx. 5 min
Reagent containers	Any size. - behrotest® canister set recommended
Data port	Software updates: RS-232
Display	LCD
Programs	10 (+ 1 test program)
Dimensions: (W x H x D in mm)	420 x 710 x 350
Weight	24 kg

## Support

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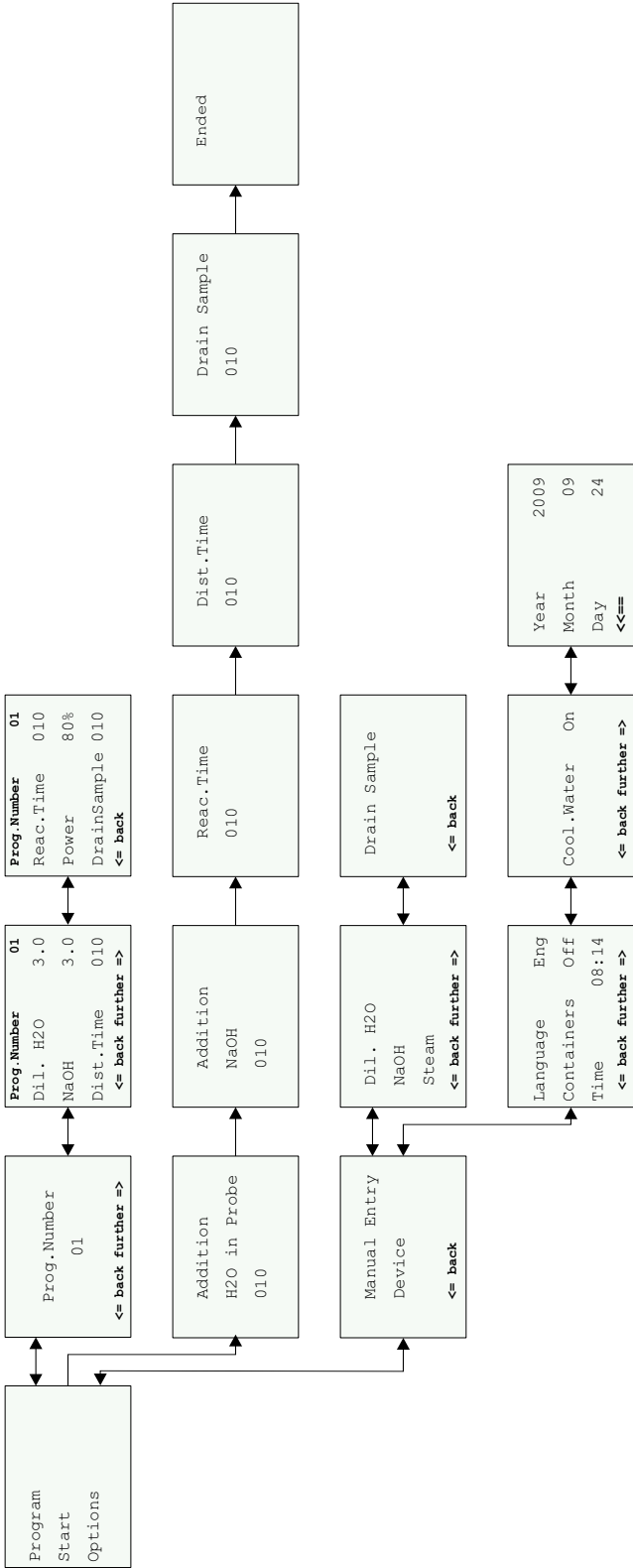


# Overview: Menus and displays of the behr S3

## Screens on Power On:



## Menus



## Error messages

