Users Manual

for

LiquiMaster™ Type 421

USERS MANUAL

FOR

***LiquiMaster* type 421**

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LiquiMaster type 421

This *LiquiMaster* dosage system provides you with an easy way of obtaining accurate doses, or accurate flow rates, as well as dilution, pipetting, multidispensing or multisampling due to its easy programming, calibration and tube change. It also controls the *LiquiMaster* mini robot for 8-channel operation
If you read this manual carefully you will be able to utilize the *LiquiMaster* to its full capacity in a few minutes.

Before switching power on you must ensure that the liquid being transferred by the pump can not inadvertently cause damage to the surroundings, and that the type of tubing used is compatible with the liquid in question.

Setting up.

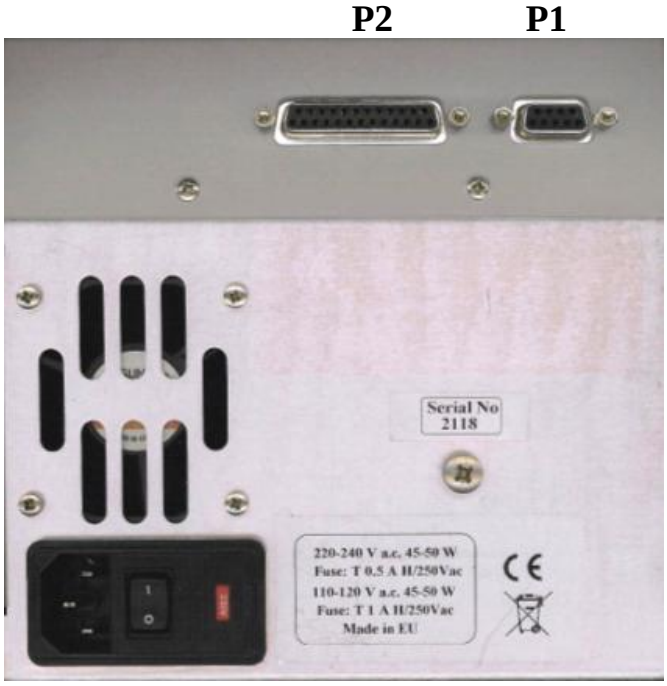


Fig 1. LiquiMaster type 421 seen from the back.

Do not switch on until all cables have been connected.

1. Connect the power cable to the power socket on the back of the *LiquiMaster* and connect the other end to the mains supply.
2. The “Start” and “Stop” functions of the pump may be controlled from an LM- pipette or a footswitch. Both have a cable with a 9-pin plug, which should be connected to P-1 on the back of the *LiquiMaster*.
Read more about the use of the LM-pipette and footswitch on page 27.
3. Connecting a printer.
Connect the appropriate end of the printer cable to the printer. Then connect the other end to P2 on the back of the *LiquiMaster*. **Do not turn on printer or *LiquiMaster* till all cables are connected.**
Read more about print-outs on page 25.

Inserting the tubing.

The insertion of a new piece of tube is very easily done.
1. To insert a new piece of tubing, first switch on the *LiquiMaster.*
2. Then press "Prime" for a short moment. This will ensure that the pump rollers will take a position with one roller pointing up. Starting in this position will provide maximum accuracy of doses delivered.
3. Turn power off, and open the pumphead as shown in fig 2A.
Power should always be turned off before opening the pumphead, to avoid risk of injuring operators fingers.

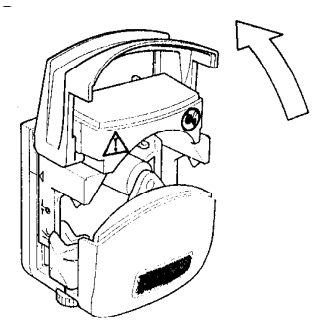


Fig 2A

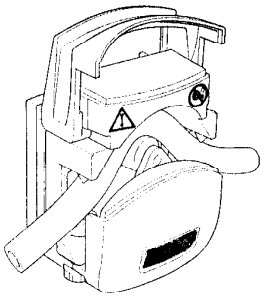


Fig 2B

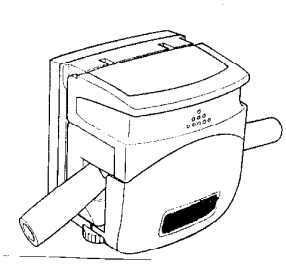
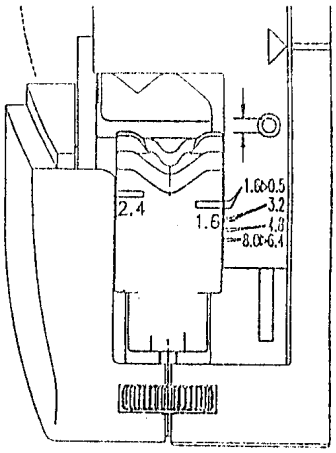


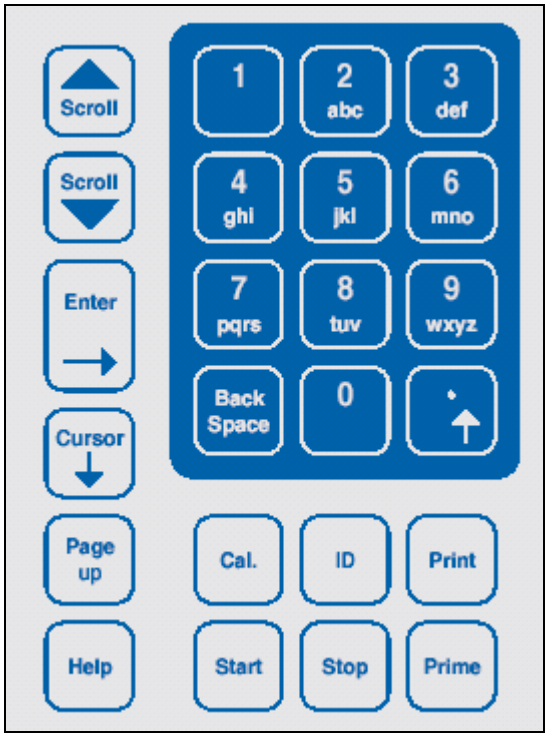
Fig 2C

4. With the lid fully open adjust the finger screws on both sides of the pumphead so that the V-shaped tube holder is placed with the 1.6 mm groove opposite to the size of the tubing you want to apply. See drawing below. This setting is not very critical. It serves to hold the tubing in place in the pumphead when the rotor is rotating**. Make sure not to squeeze the tubing unnecessarily.**



5. Place the tube over the roller, as shown in fig 2B, and centre it on the roller so that it comes out over the V-shaped tube holder on each side of the pump.
6. Close the pump as shown in fig 2C.
7. Turn Power on and press "Prime" to see that the tube is not being pulled into the pump by the action of the rollers, and tighten slightly if necessary. The *LiquiMaster* is now ready for programming.

How to use your *LiquiMaster*.



In all windows you can use the Cursor↓ button to move the cursor to the next field, where something can be inserted or changed. Pressing the Cursor↓ button briefly will make the cursor move forward, but if you press the Cursor↓ button for more than half a second the cursor will move backwards as long as you keep the button depressed.
The Enter button is used to confirm what you have inserted in the field where the cursor is. The Enter button also brings the cursor forwards to the next field, where you may make changes, or just confirm with Enter that the value which is already there will remain the same.
Scroll-up - Scroll-down buttons are used to change such things as Number of pumpheads, Tube size, as well as Unit of measurement etc.

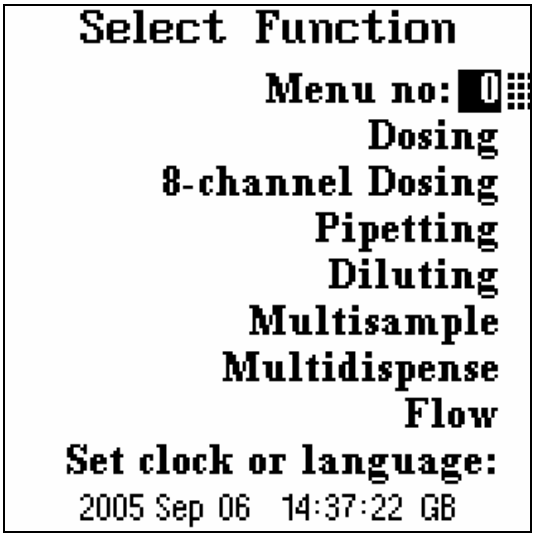
A little sign like this at the end of the line indicates when to use the Scroll buttons.

The Numeric Keyboard is used to key in digits in the various fields.

A little sign like this at the end of the line indicates when to use the keyboard.

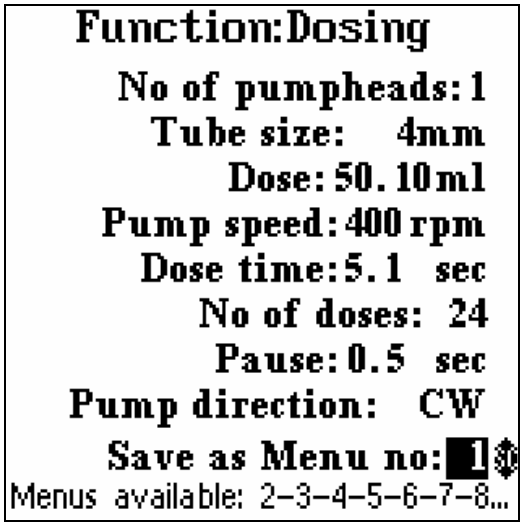
The Page-up button is used to bring you back to a previous window.

If you press the Help button, you will get a window with an explanation about what to do when the cursor is in the position where you pressed the Help button.



In the Select Function window you use the Cursor ↓ button to go to the function you want to perform next, then press Enter and in the next window you insert data for the operation.

The lines at the bottom of the Select Function window are used to set clock and language. When the cursor is in the Set clock or language line press Enter.
The cursor now goes to year month, date and clock which you fill in using the keyboard, Scroll buttons and Enter.
At the end of the line you may change between English, German or French language using the Scroll buttons and Enter.



Setting up for dosing.

You may use your *LiquiMaster* with one or two pumpheads.Two pumpheads give lower pulsation and higher speed, assuming that you use a Y-connector before and after the pump. The dosing time will be reduced to half of what it is with one pumphead and retain the accuracy of the small tubing.
With the cursor in the first line use the Scroll buttons to choose one or two pumpheads. Then press Enter to confirm your setting, and now the cursor goes to Tube size:

Choise of tube size is a balance between speed and accuracy. On page 30 you will find a table, explaining which tube size to use for a given volume and accuracy.
Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm.
If you have chosen two pumpheads the maximum tube size is 2mm.

With the cursor now in Dose, you use the Keyboard to key in the volume you want, and press Enter to confirm.
Then use the Scroll buttons to choose ml or µl or even liters. Confirm with Enter.

If you have requested a volume which is either too small or too large to be delivered by the tube size you have chosen, the *LiquiMaster* will give a **bip** and change the volume setting to show you the smallest or largest volume that can be pumped with your choice of tubing.
To go back and change volume or tube size, hold the Cursor button depressed for more than half a second, and the cursor will move backwards to the volume fields and the tube size field.
You may now choose to change tube size or volume to get inside the capacity of the tubing. When you have corrected these values press Enter and go to Pump speed.

You can choose speeds from 1 to 500 rpm. Use the Keyboard and insert desired speed and press Enter.

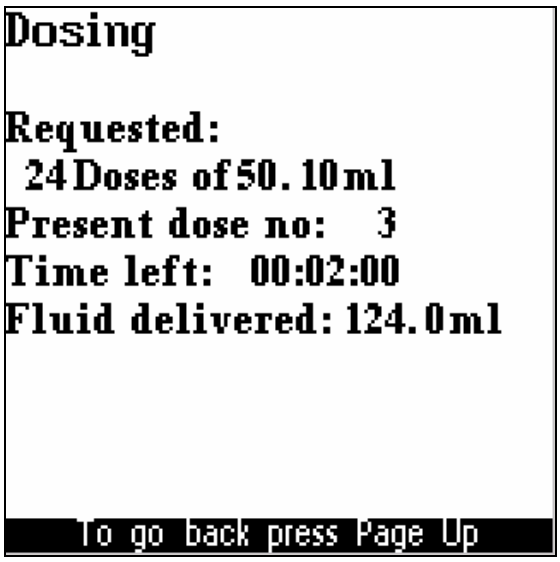
In the next line you can now read Dose time, telling you how long it takes to dispense the volume you have requested, with the tube size and pump speed you have chosen.

The cursor has now moved to No of doses: and again you use the keyboard to key in how many you want and press Enter.

In Pause you insert the pause between fillings using the Keyboard, and choose between seconds and minutes using the Scroll buttons. Press Enter to confirm each setting.

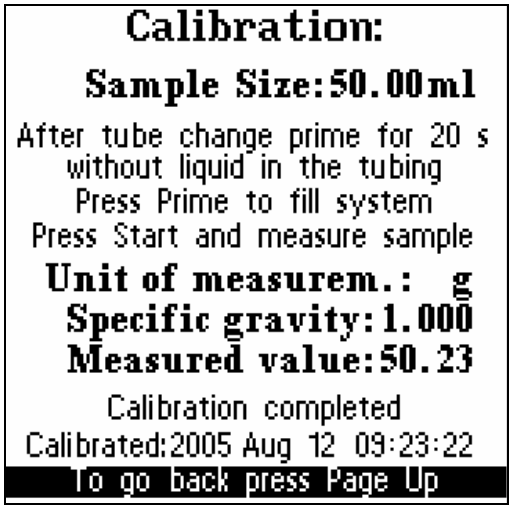
In Pump direction you use the Scroll buttons to choose between clockwise or counterclockwise and press Enter.

You have now completed a set-up for dispensing, rapidly and accurately.
Press Start to begin the sequence, or press the Cal. button for a quick calibration.



Process window.

When you have requested f. ex 24 doses in the set-up window and pressed Start, the window shown above will turn up in the display.
This is a follow up window, which tells you how far into your process you are now.
It serves to let you stop dispensing, if something requires a stop before you have come to the end of the process you have started.
If you press the Stop button once, you obtain a pause in the process. If for example you press stop in the pause between dose number 5 and 6 you may take a pause (for inst. to answer the telephone) and when you press Start again the process will continue with dose no 6 and you can complete your process.
If you want to stop the process completely after a certain amount of doses, without completing the series of doses you have started, you have to press Stop twice, and the pump will then start a new process with dose no 1, on Start.
If you press Stop in the middle of delivering a dose, this dose will not be completed when you press Start again, so try to stop in one of the pauses between doses.
To go back and change something in the set-up window just press Page up.



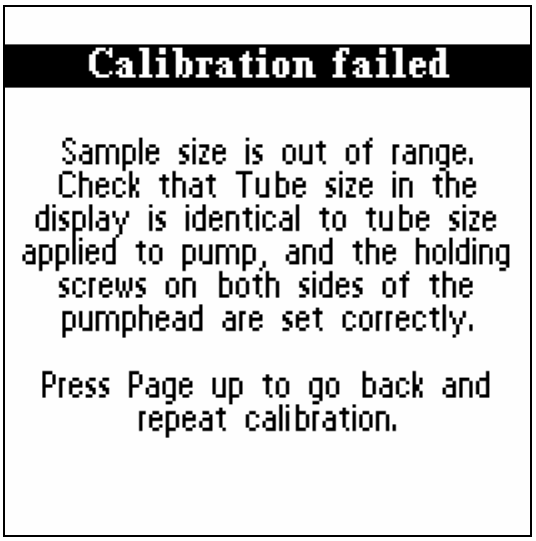
Calibrating a Dosing set-up

When you have completed a dosing set-up you may press the Cal button in order to get the calibration window shown above.

The cursor will be in the Sample size field. Here you may key in the volume of the sample you want for calibration.
You may choose any volume that will give you a good reading on your measuring cylinder or balance. Often you would choose a volume 2 to 10 times higher than the dose size you have asked for. Higher values give better accuracy, but also take more time.
Press Enter to confirm your choice.
Now use the Scroll buttons to choose between µl and ml, and press Enter.

The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied. After that you use the prime button to fill the system. And then you press Start to obtain your sample and measure it.

The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance use the Scroll buttons to choose grams or mg.
When you have chosen grams or mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the keyboard and press Enter.
The cursor will now be in the Measured value line.
Use keyboard to key in your measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.
If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.



Setting up for 8-channel Dosing.

You may use your *LiquiMaster* with one or two pumpheads. Two pumpheads give lower pulsation and higher speed assuming that you use a Y-connector before and after the pump. The dosing time will be reduced to half of what it is with one pumphead, and retain the accuracy of the small tubing.
With the cursor in the first line use the Scroll buttons to choose one or two pumpheads. Then press Enter to confirm your setting, and now the cursor goes to Tube size:
Choice of tubing is limited to 1 – 2 and 4 mm inner diameter. To get an accuracy of 2 % use 1 mm tubing for doses up to 200µl pr well and 2 mm tubing from 200µl to 2 ml. Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm.
Pump speed may now be keyed in, using the Keyboard.
You can choose speeds from 1 to 500 rpm, but for 8-channel applications it is advisable to choose a high speed, f.ex. 500 rpm.
This will prevent drops from forming at the end of the thin filling needles, which could lead to inaccuracies with very small doses pr well. Press Enter to confirm your choice.
With the cursor now in Dose pr well you may use the Keyboard to key in the volume you want, and press Enter to confirm.
Then use the Scroll buttons to choose µl or ml. Confirm with Enter.
If you have requested a volume which is too small to be delivered by the tube size you have chosen, the *LiquiMaster* will give a **bip** and change the volume setting to show you the smallest volume that can be pumped with your choice of tubing.
To go back and change volume or tube size, hold the cursor button depressed for more than half a second, and the cursor will move backwards to the volume fields and the tube size field.
You may now choose to change tube size or volume to get inside the capacity of the tubing. When you have corrected these values press Enter and go to Distributor.
Here you may use the Scroll buttons to choose between Minirobot and Pipettor.
If you have a ***LiquiMaster*** **minirobot** connected you choose Minirobot and press Enter, and you are now in the Array line. Here you may choose 8 wells pr row for a 96-well plate, or 16/2 wells pr row, filling half of the 16 wells pr row in a 384 well plate. Having filled half of the wells you turn the plate around and fill the other half. Having made your choice press Enter and move to the next field.
Here you use the Keyboard to key in the number of rows you want to fill and press Enter. You have now completed your set-up.
If you work with an **8-channel LM- pipettor** you should choose Pipettor when the cursor is in the Distributor line. Use the Scroll buttons, and press Enter to confirm your choice.
The cursor now goes to the second field of the Array line. Use the Keyboard to key in the number of rows you want to fill and press Enter.
In the Pause line you key in the pause you need to move the pipettor from row to row. Range is from 0,1 sec and upwards.
Then press Enter. Now choose sec or min, and press Enter.
You have now completed your set-up.
Press Start to begin the sequence, or press the Cal. button for a quick calibration.

Process window.

When you have requested for instance 16/2 X 20 rows, and pressed Start on the robot, the window shown above will turn up in the display.
This is a follow up window, which serves to tell you where in the process you are now.
It also tells you to rotate the plate, in order to fill the other half of the same 20 rows. If you press Stop, for some emergency reason, during the filling of either first or second half of the 20 rows, the process will stop completely, and start from the beginning next time you press Start.
When you have filled the first half of the 20 rows a new follow up window will appear, saying:

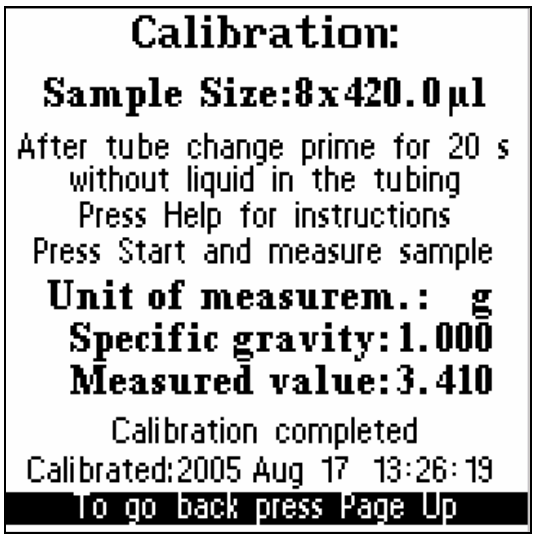
READY TO FILL THE OTHER HALF OF 20 ROWS.
ROTATE PLATE AND PRESS START.

The robot will now fill other half of the same rows it filled in the first run.
The follow up window now says:

NOW FILLING LAST HALF OF 20 ROWS.

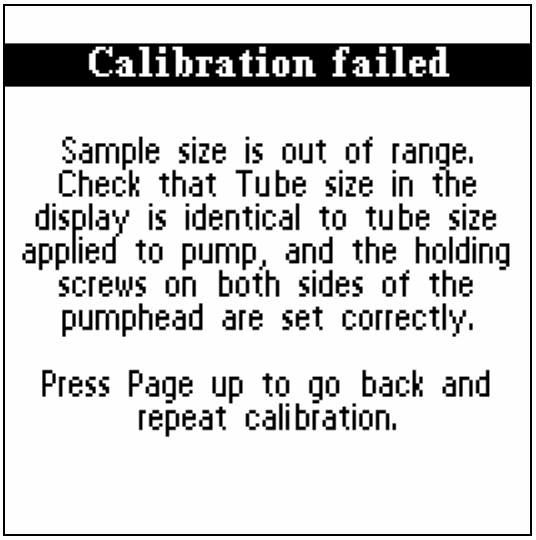
When this is completed a new window says:

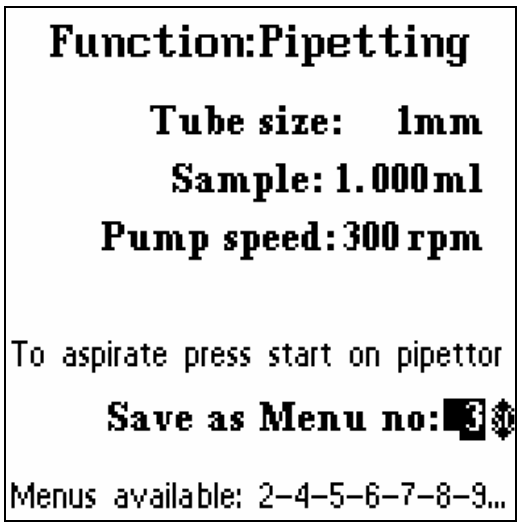
READY TO FILL FIRST HALF OF 20 ROWS. APPLY A NEW PLATE.



Calibrating an 8-channel Dosing set-up.

When you have completed a set-up for 8-channel operation you may press the Cal button in order to get the calibration window shown above.
The cursor will be in the Sample size field.
You will notice that it says 8 times a given volume pr well.
This means that the pump will supply a volume of liquid for calibration, corresponding to the total volume of a row of wells, i.e. 8 wells.
You may choose any volume pr well which will give you a good reading on your measurement cylinder or balance. Often you would choose a volume 2 to 5 times the dose you have requested for each volume.
Higher values give better accuracy, but also take more time.
Press Enter to confirm your choice.
Now use the Scroll buttons to choose between µl and ml, and press Enter.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied.
After priming press the help button in order to get the following advice:
Remove the distributor from the robot.
Hold it against a sterile napkin or similar, with the needles pointing upwards and press Prime on the pump, until the tubing and the distributor is filled with liquid.
Holding it upwards, turning it a bit from side to side, will remove air bubbles from the distributor, so that the liquid will be evenly distributed.
Put the distributor back on the arm of the robot.
To go back press Page up.
Now press Start to get your sample and measure it.
The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance use the Scroll buttons to choose grams or mg and press Enter.
When you use grams and mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the keyboard and press Enter.
The cursor will now be in the Measured value line.
Use keyboard to key in you measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.
If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.





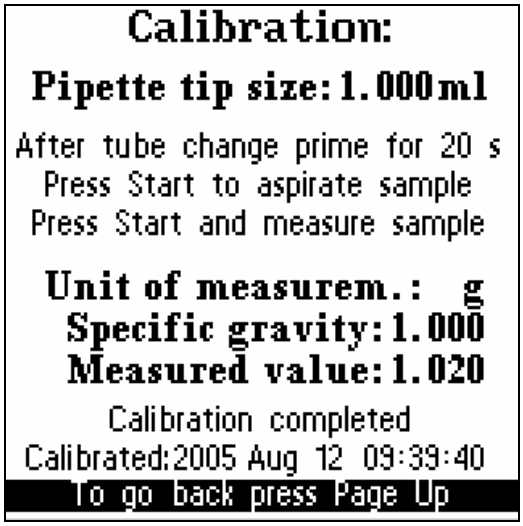
Setting up for pipetting.

First you have to decide which tube size you are going to use for your application.
Choice of tube size is a balance between speed and accuracy. On page 30 you will find a table, explaining which tube size to use for a given volume and accuracy.
Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm.
With the cursor now in Sample you use the Keyboard to key in the volume you want, and press Enter to confirm.
Then use the Scroll buttons to choose ml or µl. Confirm with Enter.

If you have requested a volume which is too small to be delivered by the tube size you have chosen, the *Fill-Master* will give a **bip** and change the sample value to show you the smallest volume that can be pumped with your choice of tubing.
To go back and change volume or tube size, hold the cursor button depressed for more than half a second, and the cursor will move backwards to the sample field and the tube size field.
You may now choose to change tube size or volume to get inside the capacity of the tubing. When you have corrected these values press Enter and go to Pump speed.

You can choose speeds from 1 to 500 rpm. For pipetting, speeds in the range of 300 to 500 rpm will often be suitable.

Use the Keyboard and insert desired speed and press Enter.
You have now completed your set-up for pipetting, and you may press Start on the pipettor for the first aspiration, or you may press the Cal button for a quick calibration.

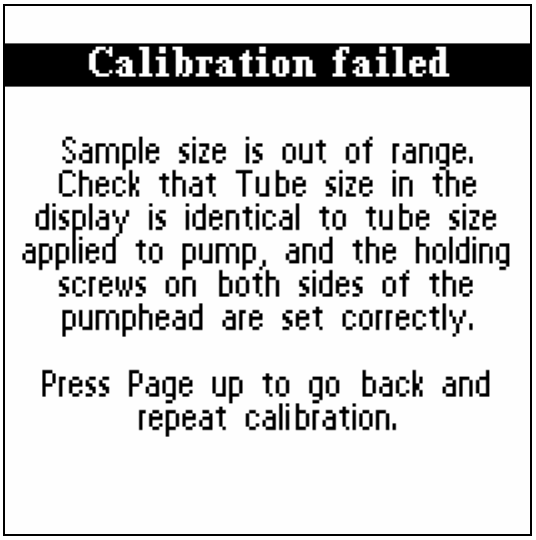


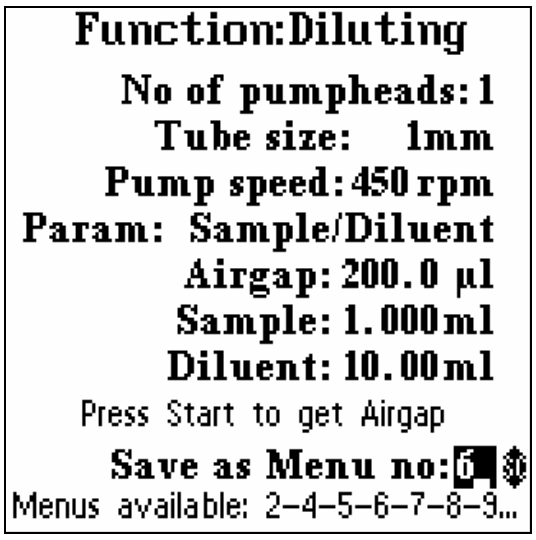
Calibrating a pipetting set up.

When you have completed a pipetting set-up you may press the Cal button in order to get the calibration window shown above.
To obtain the best possible accuracy in calibration you should use the largest possible sample volume when calibrating.
For pipetting this will be the maximum volume of your pipette tip.
Thus start filling in the Pipette tip size.
Use the Keyboard to fill in the volume, press Enter, and use the Scroll buttons to choose between ml and µl, and press Enter.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied.
After priming you press Start on the pipettor as requested, to aspirate the calibration sample.
To deliver the sample for measurement press Start on the pipettor again, as requested in the next line.

The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance, use the Scroll buttons to choose grams or mg.
When you use grams and mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the Keyboard and press Enter.
The cursor will now be in the Measured value line.
Use keyboard to key in your measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.

If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.





Setting up for diluting.

The *LiquiMaster* can make dilutions fast and simple when following the easy set-up procedure.
The tubing should be applied to the pump in such a way that the left hand end of the tubing, as seen from the front, goes to the supply of diluent, while the right hand end of the tubing goes to the filling needle, tip or handle used for aspirating the sample and delivering the total dispense volume.
You may use your *LiquiMaster* with one or two pumpheads. Two pumpheads give lower pulsation and higher speed, assuming that you use a Y-connector before and after the pump. The dosing time will be reduced to half of what it is with one pumphead and retain the accuracy of the small tubing.

With the cursor in the first line use the Scroll buttons to choose one or two pumpheads.
If you have chosen two pumpheads the maximum tube size is 2mm.
Then press Enter to confirm your setting, and now the cursor goes to Tube size:

Choise of tube size is a balance between speed and accuracy. On page 30 you will find a table, explaining which tube size to use for a given volume and accuracy.
Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm and go to Pump speed.

You can choose speeds from 1 to 500 rpm.

Use the Keyboard and insert desired speed and press Enter.
In the next line you may choose the dilution process you prefer.

There are three ways of making dilutions:

1. Inserting values for Sample and Diluent.

2. Inserting value for Sample only, and inserting a dilution factor. The pump then calculates the amount of diluent.

3. Inserting the Dispense volume, and a dilution factor. The pump then calculates the sample size.

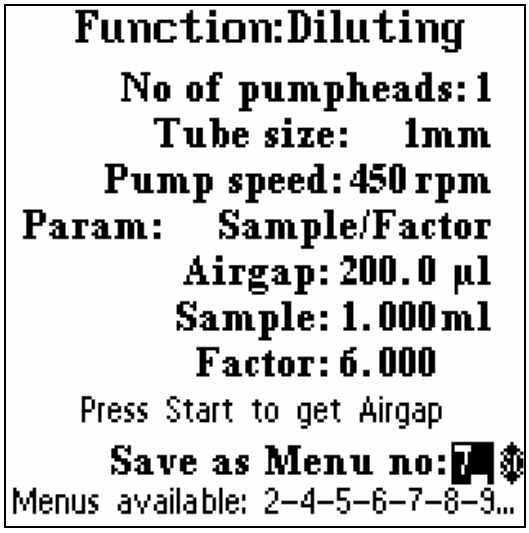
You may use the scroll button to choose one of the following:

1. SAMPLE / DILUENT
   or
2. SAMPLE / FACTOR
   or
3. DISP.VOL / FACTOR

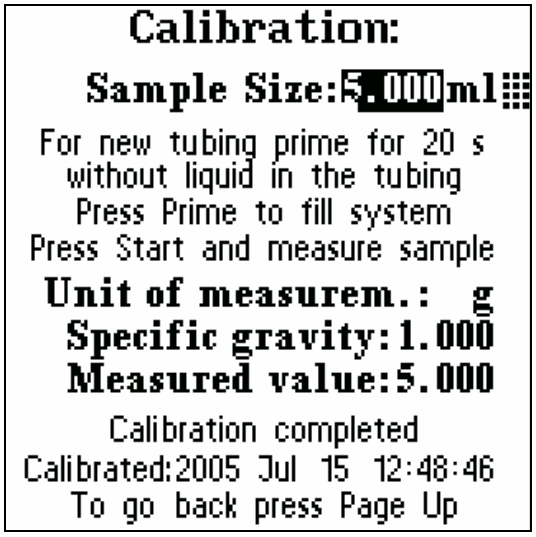
Press Enter to confirm your choice.

If you choose **Sample/Diluent** the window will be as the one above, and the cursor will be blinking in the Airgap field.
If you want an airgap between sample and diluent use the Keyboard to key in a size of airgap that suits your pipette tip size.
Press Enter and use the scroll button to choose µl or ml. Press Enter
If you do not need an airgap between sample and diluent you key in 0000 in the airgap line. This will save you one operation in the diluting process.
Now use the Keyboard to key in the sample size, press Enter and use the Scroll buttons to choose µl or ml and press Enter.
In the next line you insert the size of the diluent in the same way and press Enter.
You have now completed a dilution set-up.

If you choose **Sample/Factor** you make the set-up in the same way as described above, except for the last line which will now be showing Factor instead of Diluent.
You insert the desired dilution factor by means of the Keyboard, and press Enter .
You have now completed the set-up.



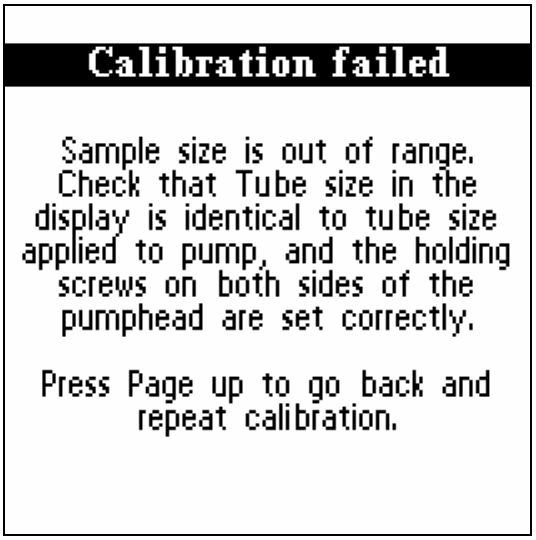
If you choose **Disp.vol./Factor** you make the set-up in the same way as described above, except for the line showing Disp.vol.
Here you use the Keyboard to insert the desired dispense volume, and press Enter.
Use the Scroll buttons to choose between µl and ml, and press Enter.
Now you insert factor by means of the keyboard, press Enter and you have completed the set-up.

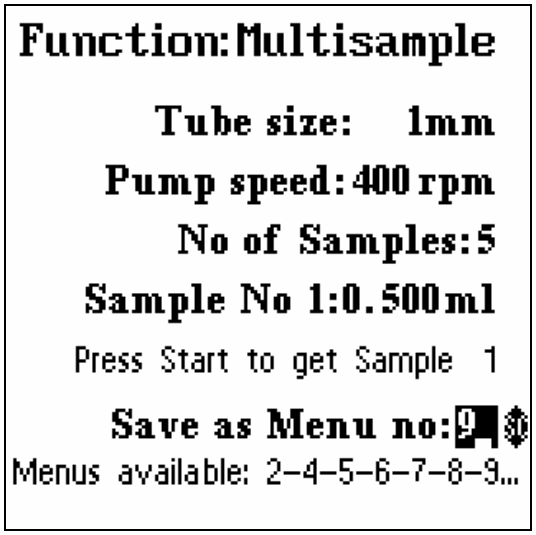


Calibrating a diluting set-up.

When you have completed a diluting set-up you may press the Cal.button in order to get the calibration window shown above.
The cursor will be in the Sample size field. Here you may key in the volume of the sample you want for calibration.
You may choose any volume that will give you a good reading on your measuring cylinder or balance. Often you would choose a volume 2 to 10 times higher than the sample size you have asked for. Higher values give better accuracy, but also take more time.
Use the keyboard to fill in the sample size. Press Enter to confirm your choice.
Now use the Scroll buttons to choose between µl and ml and press Enter.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied. After that you use the Prime button to fill the system.
If you use a pipettor it is important that you hold it with the tip pointing upwards while priming, so that you get all air bubbles out of the tip.
Then you press Start and the pump will now deliver a volume of diluent, similar in size to the sample size you have keyed in above. Now measure this amount, either by volume or by weight.
The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance use the Scroll buttons to choose grams or mg and press Enter.
When you use grams and mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the keyboard and press Enter.
The cursor will now be in the Measured value line.
Use Keyboard to key in your measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.

If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.





Setting up for Multisampling.

This function is used to collect a number of samples of individual size into a pipette tip large enough to contain all the samples.
In the first line you may insert the tube size in question.
Choice of tube size is a balance between speed and accuracy. On page 29 you will find a table, explaining which tube size to use for a given volume and accuracy.
Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm
The cursor now moves to Pump speed.
You can choose speeds from 1 to 500 rpm.
Use the Keyboard and insert desired speed and press Enter.
The next line asks you how many samples you want to aspirate before dispensing.
Choose a pipette tip that is big enough to hold all the samples you want to aspirate.
Use the Keyboard to key in the number of samples to be aspirated before dispensing.
Press Enter.
In the following line you may key in the volumes of the individual samples in the following way: When the cursor blinks in Sample no 1, press Enter and the cursor moves forward to the next field.

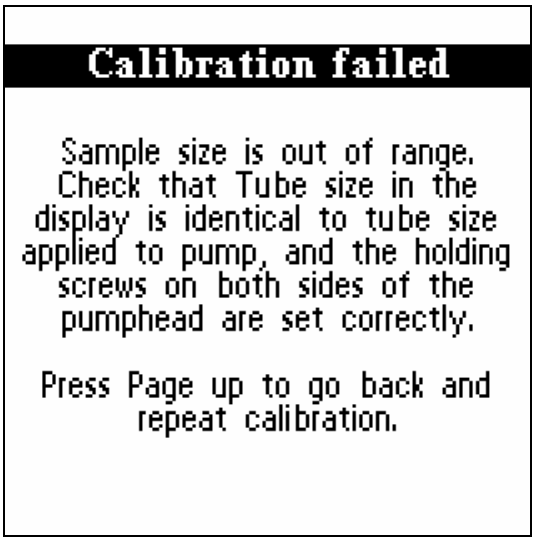
Here you use the keyboard to key in the size of the first sample. Press Enter.
Now use the Scroll buttons to choose between µl and ml and press Enter.

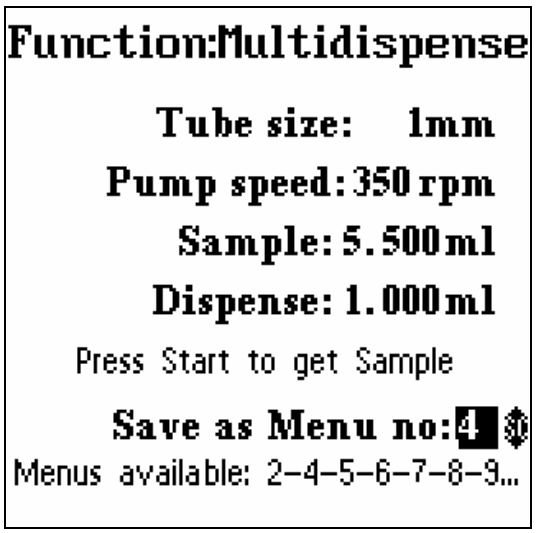
The cursor now moves to the number field again. Press Enter and insert the volume of sample no 2 and press Enter
Use Scroll buttons to choose µl or ml.
Press Enter and use the same procedure for sample no 3 – 4 – etc.
When you have completed all settings the pump is ready to aspirate the first sample when you press Start.
You press Start for aspirating each individual sample.
When all the required samples have been aspirated the pump will give a **bip** and dispense the total volume next time you press Start.
After dispensing the pump is ready to aspirate a new series of samples.

Calibrating a Multisampling set-up.

When you have completed a set-up for multisampling you may press the Cal button in order to get the calibration window shown above.
The cursor will be in the Sample size field. Here you may key in the volume of the sample you want for calibration.
To get best possible accuracy you should choose a sample size that will fill you pipette tip.
Use the keyboard to fill in the sample size.
Press Enter to confirm your choice.
Now use the Scroll buttons to choose between µl and ml, and press Enter.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied.
After priming you press Start on the pipettor as requested, to aspirate the calibration sample.
To deliver the sample for measurement press Start on the pipettor again, as requested in the next line.
The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance use the Scroll buttons to choose grams or mg and press Enter.
When you choose grams or mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the Keyboard and press Enter.
The cursor will now be in the Measured value line.
Use Keyboard to key in your measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.

If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.





Setting up for multidispense.

In this function you may aspirate a certain volume into a pipette tip, and then dispense this volume in smaller portions.
For example, you may aspirate 5 ml and dispense 10 times 0,5 ml.
In the first line you may insert the Tube size in question.
Choice of tube size is a balance between speed and accuracy. On page 30 you will find a table, explaining which tube size to use for a given volume and accuracy.
Now use Scroll buttons to insert the size of tubing you have applied to the pumphead and press Enter to confirm
The cursor now moves to Pump speed.
You can choose speeds from 1 to 500 rpm.
Use the Keyboard and insert desired speed and press Enter.
The next line is asking you how large a sample you want to aspirate.
Use the Keyboard to insert the desired volume, and press Enter to confirm.
The cursor now moves to the line where you set the volume of each dispensing.
Use Keyboard to insert desired volume, and press Enter.

The sample amount should always be larger than the total amount of dispenses required.

If for example you want five dispenses each of 1 ml you should key in a sample of 5.1 ml. The pump will automatically keep control of how much liquid is left in the pipette tip before dispensing.

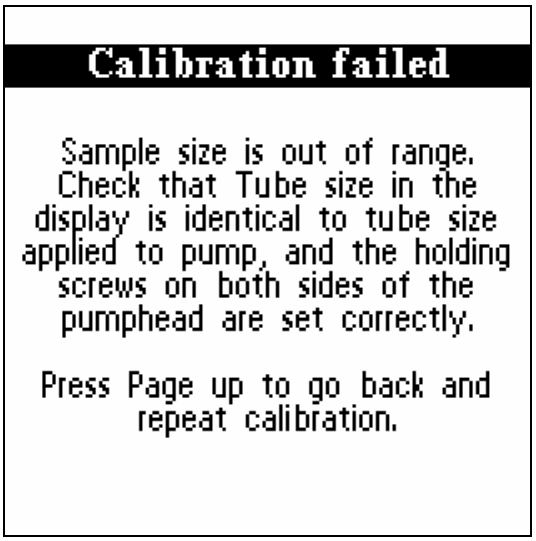
This means, that if there is not enough liquid left to dispense the last amount required, the pump will give a double **Beep**, to warn you that you don't have enough liquid left, and a window will appear saying: TO PURGE PRESS PRIME.
Now press Prime, or if you are using a pipettor, press the start switch on the pipettor to start purging, and press it again to stop purging. You are now ready for a new sample.

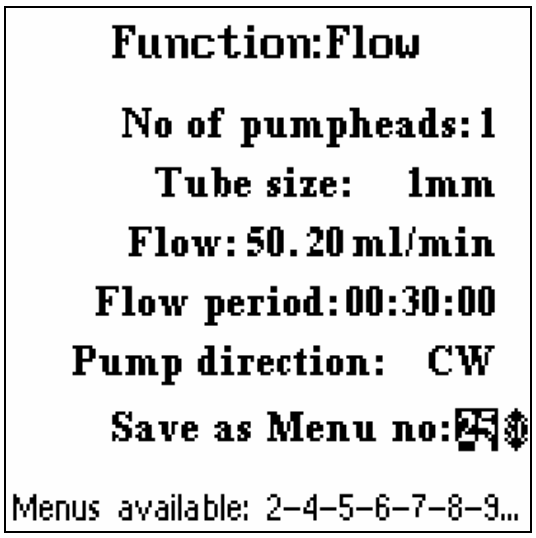
Calibrating a Multidispensing set-up.

When you have completed a set-up for multidispensing you may press the Cal button in order to get the calibration window shown above.
The cursor will be in the Sample size field.
Here you may key in the volume of the sample you want for calibration.
To get best possible accuracy you should choose a sample size that will fill you pipette tip.
Use the Keyboard to fill in the sample size.
Press Enter to confirm your choice.
Now use the Scroll buttons to choose between µl and ml, and press Enter.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied.
After priming you press Start on the pipettor as requested, to aspirate the calibration sample.
To deliver the sample for measurement press Start on the pipettor again, as requested in the next line.

The cursor is now in the field Unit of measurement.
If you used a measuring cylinder use the Scroll buttons to go to µl or ml, and press Enter.
If you used a balance use the Scroll buttons to choose grams or mg and press Enter.
When you choose grams or mg you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the Keyboard and press Enter.
The cursor will now be in the Measured value line.
Use Keyboard to key in your measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.

If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.





Setting up for calibrated flow.

In this window you set up a menu to provide a calibrated flow of liquid from one container to another.
You may use your *LiquiMaster* with one or two pumpheads.Two pumpheads give lower pulsation and higher speed, assuming that you use a Y-connector before and after the pump. The transfer time will be reduced to half of what it is with one pumphead and retain the accuracy of the small tubing.

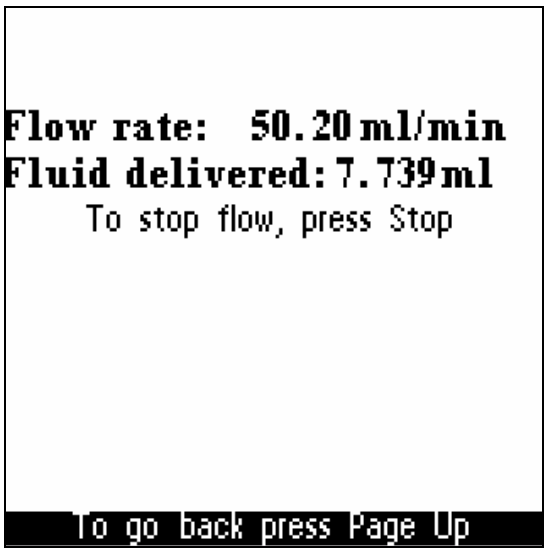
With the cursor in the first line use the Scroll buttons to choose one or two pumpheads.
If you have chosen two pumpheads the maximum tube size is 2mm.
Then press Enter to confirm your setting, and now the cursor goes to Tube size:
You may use tubing with inner diameters of 0,3 - 0,5 - 1 - 2 and 4 mm.
The highest flow rate you can obtain for these diameters are as follows:

0,3 mm	3,6ml/min
0,5 mm	15ml/min
1 mm	63ml/min
2 mm	228ml/min
4 mm	795ml/min

These values are at maximum pump speed.
With the cursor in Tube size use the Scroll buttons to insert the size of tubing you have chosen to apply to the pumphead, and press Enter to confirm.
The cursor is now in the Flow field.
Use the keyboard to key in the amount of liquid you want to transfer pr minute.
Press Enter to confirm and use the Scroll buttons to choose between µl and ml.
Press Enter and the cursor moves to the Flow period field.
You may use the Scroll buttons to alter between a continuous flow, which you start and stop using the Start and Stop buttons, or you may choose Flow period, where you can insert how many hours, minutes and seconds you want to pump, and the pump will stop automatically after the time you set has passed.
Use the Keyboard to key in first the hours, and press Enter, then minutes and press Enter and finally seconds and Enter.
The pump will now operate the amount of time you have set, after pressing Start, and then stop automatically.
Finally you choose between clockwise and counter-clockwise by means of the Scroll buttons and press Enter.
You have now completed a set-up for calibrated flow.
Press the Cal button to get an exact calibration of your set-up.

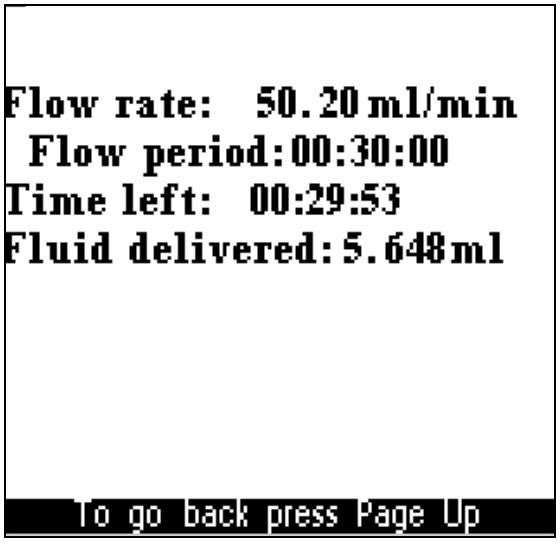
Process window

When you have pressed Start the display will change to a window allowing you to see how far the process has come.
This window looks as follows in continuous mode:



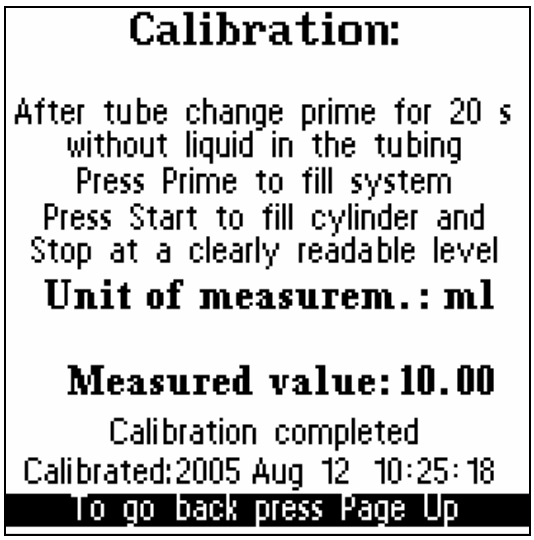
It allows you to follow how much fluid has been delivered at any time.
You may then press Stop when you have had the required amount of liquid.

In Flow period it looks as follows:



Here you can see how much time is left, and how much fluid has been delivered
If you press Stop before the requested period is finished, you can continue till the end of the set period, by pressing Start once more.

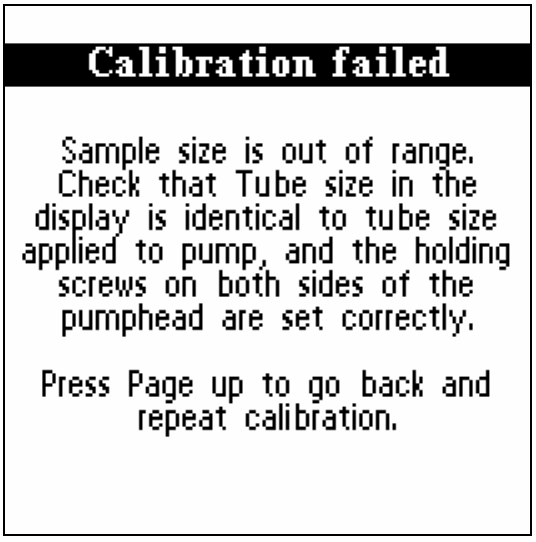
If you want to stop the process press Stop twice.



Calibrating a Flow set-up.

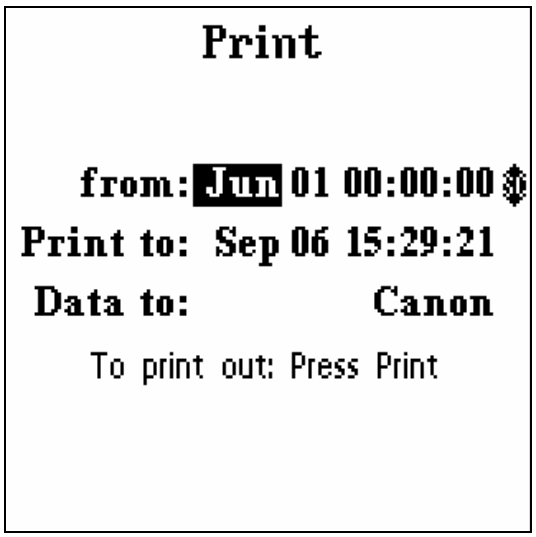
When you have completed a set-up for a certain flow rate you may press the Cal button in order to get the calibration window shown above.
The cursor is now in a line which encourages you to prime for 20 seconds, in order to take the basic stiffness out of the tubing applied.
Then the cursor goes to the line where it says Press prime to fill system.
Here you press Prime again to fill the tubing and filling needle.
In the next line the cursor tells you to press Start to fill your measuring cylinder to a clearly readable level and press Stop.
The pump has measured the amount of liquid filled into your measuring cylinder, and is now waiting for your correction.
The cursor is now in the field Unit of measurement.
If you have an accurate measuring cylinder you may choose to measure in millilitres. Use Scroll buttons to choose between µl, ml and l.
Confirm your choice by pressing Enter
If you prefer to weigh you sample you may use the Scroll buttons to choose mg or grams.
If you used a balance use the Scroll buttons to choose grams or mg and press Enter.
Then you need to inform the pump about the specific gravity of the liquid in question, so that it can convert weight to volume.
Thus you key in the specific gravity on the Keyboard and press Enter.
The cursor will now be in the Measured value line.
Use Keyboard to key in you measurement result and press Enter.
A new line will now appear, saying:
To implement press Enter.
After doing that a line will tell you that calibration is completed and give you the date and time in a line below.

If you did not succeed the following window will appear, giving you instructions about how to repeat the calibration.



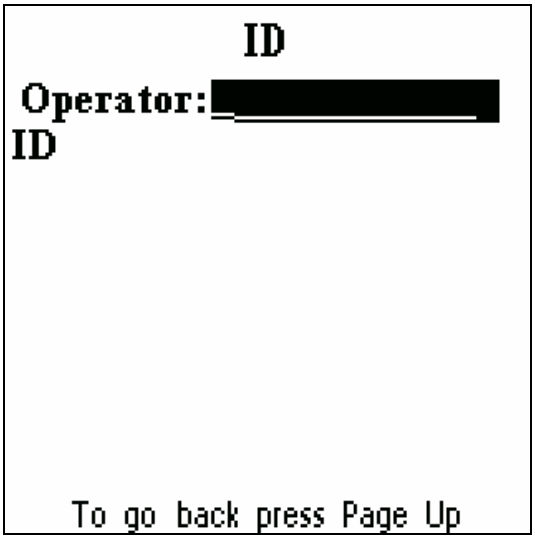
Print out and ID functions.

As an option the *LiquiMaster* type 421 may be equipped with a memory, or log, which will remember all set-ups as well as keyed-in ID-information, and you may print out this information at any time you need it.
Ask your distributor how to obtain this option.
All operations data are automatically stored, and you may go back in time and obtain a print-out of a certain time period within the last few days of working with the *LiquiMaster*
The memory contains up to 16 A-4 pages of information.
The information is not erased when you turn off the *LiquiMaster*, but is stored until the memory is full, and then it erases the oldest data as you fill in new data, leaving at all times about 16 pages of data stored.
This means that there is no age limit to the data stored, it only erases when you fill in more new data.
You don't have to print out all data in memory, in that you can go back in time and ask for print-out of a time period.



When you press the Print button the above window will appear.
Using Scroll buttons and Keyboard, and Enter to confirm each setting., you can now choose the period, for which you want to have a print-out.
The pump will suggest the date and time of the last print-out as starting time. This you may change using Scroll buttons and Keyboard.

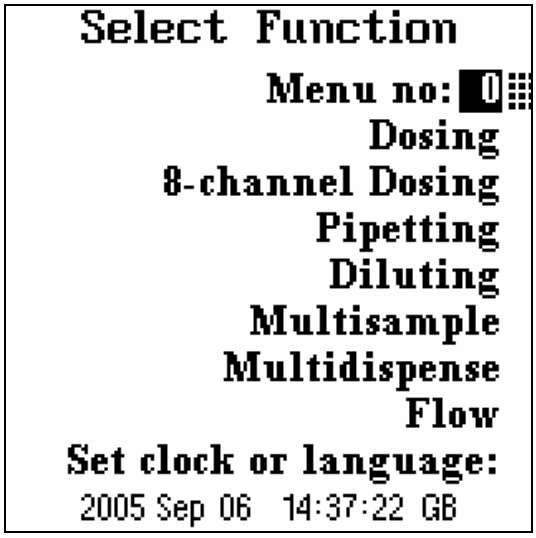
You may use a printer with a centronics, parallel output. This could be of the Canon, Brother, OKI, Epson or similar printers.
Here you use the Canon setting in the above window.
If you have a printer of the HP family, use the Scroll buttons to change to HP+ setting.
In addition to the operations data keyed into the *LiquiMaster* you may also store other ID information when you have purchased this option.
This can be done by pressing the ID button on the *LiquiMaster*.
Then you will obtain a window as shown below.
When the cursor is in the first line you may key in the operator name, using the keyboard. Then press Enter, and now you can key in eight lines of additional information, such as batch number, liquid identification, type of diluent etc. using keyboard and Enter. This information is now stored together with the parameters in the set-up window.



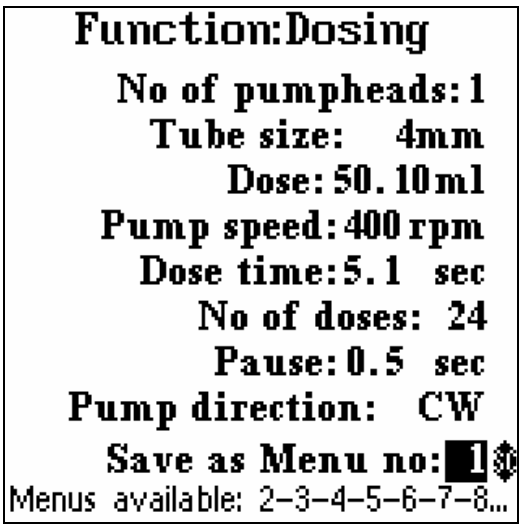
If you also have the menu memory option installed, and want to have this information stored together with a certain menu number which it belongs to, you press Page up, to go to the set up window.
Now use Cursor↓ till you get to: Save as menu no: Then key in the number under which to store it. If you use the number already there press Enter, and Enter again when it says: overwrite menu no:
Now you have stored set-up and ID info together, and all of it will be printed out when you press Print after the operation.

Menu memory.

Your *LiquiMaster* will remember the last set-up you have used in all seven functions. However, if you are using several set-ups, for instance for making a number of different dosing operations, you may purchase an extra memory to remember all your different set-ups. See your *LiquiMaster* distributor about how to obtain this option.
The extra memory contains 26 slots, each containing a complete set-up.
You give each set-up you want to keep a number, and next time you want to use this set-up you go to the Select Function window and key in the number you have given this set-up when the cursor is in the Menu no: field, and you are ready to start operating, without having to key in all the parameters for this set-up.
You can choose any function you want and store it under a number of your choice, between 0 and 25.



Thus if you use certain operations on certain weekdays, you give each set-up a number, and you just key in the same number next week, when you need to repeat this operation.



The number you want to give a certain set-up should be keyed in when the cursor is in the line: Save as Menu no: after you have inserted all the parameters required for this operation.
If you use a number you have used before, but now made changes in the set-up, it will ask the question: Overwrite menu no:.
If you want to store the new set-up under the same number, you press Enter when it asks you Overwrite menu no.
The changes you have just made will now be stored under the number used before.

Start and Stop using an FM-pipette or a Footswitch.

The Start switch of the LM-pipette, or a footswitch, may be used to start and stop the pump, substituting the Start and Stop switches on the keypad.

The LM-pipette, or footswitch, should be connected to the back of the pump, as described on page 4. Then switch on the *LiquiMaster*, choose function, key in desired values and calibrate, as described in the relevant chapters of this manual.

Any work program will now start on the first touch of the microswitch of the LM-pipette, or on pressing the footswitch.
The *LiquiMaster* is pre-programmed to perform the various functions described on the preceding pages, and every touch of the switch will start either a work cycle, or the next logical subcycle.

Exceptions:
If a Start button is depressed in the middle of a dosage or flow program, it will stop the pump immediately, and the program will go into Pause mode. Clock and counters will stop.
This corresponds to pressing the Stop button on the keypad once.
When you press a start button again the program will continue.. Dose and flow counters will continue from where they left, till the program is finished.
If you press the switch in the middle of dispensing a dose, this dose will not be completed. When pressing again the next dose in line will be dispensed.
To stop a program completely, press the Stop button on the keypad twice. This will reset the clock and counters and you can now start again from the beginning of the program.
In Diluting, Pipetting, Multidispense and Multisample the microswitch or footswitch is used to start each individual subcycle.

For an emergency stop in these programs press the Stop button on the keypad.

The pump stops immediately, and the display shows this information:

FUNCTION INCOMPLETE –
PURGE – RESTART

This means that you have to press Prime in order to empty the pipette, and then start on a new work cycle.
The Stop button is always functioning, for emergencies.

Remote Control.

The 9 - pin socket, P 1, on the back of the unit may also be used for other remote control purposes.

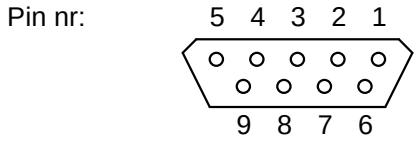


Fig.3. Remote control socket seen from outside.

1. Any operation can now be started or stopped in the following way:

a. Connect a closed switch between pin 5 and pin 9.
To start, open the switch momentarily, i.e. for at least 30 msec., and leave it closed during operation. The exact starting time is when the switch is opened.
To stop an operation, open the switch momentarily, i.e. for at least 30 msec. The exact time of stopping is when the switch is opened.
Or:
b. Connect an open switch between pin 4 and pin 9.
To start, close the switch momentarily, i.e. for at least 100 msec., and leave it open during operation. The exact starting time is when the switch is closed.
To stop an operation, close the switch momentarily, i.e. for at least 100 msec. The exact time of stopping is when the switch is closed.

In a Dose or Flow program the apparatus goes to "Pause" and will continue the program next time the button is depressed. If stopped in the middle of a dose, this dose will not be completed, but on depressing the button again the program will continue.
If Stop is activated while the pump is running in the Diluting, Pipetting, Multidispense or Multisample programs a warning window will appear, with the following text:
FUNCTION INCOMPLETE – PURGE - RESTART. You may now use the remote control switch to start priming on the first touch, and stop it again on the second touch.
Note: The "Stop" button on the keypad is always active, e.g. for emergency stopping.

2. The Start-Stop function may also be remotely controlled through an optocoupler, in order to keep the *LiquiMaster* system electrically isolated from other systems.

To activate Start-Stop through the optocoupler apply +24 Volts to pin 2 through a switch, and the negative pole to pin 3, as shown in fig 4B.
The switch will start and stop an operation in the following way:
To start, open the switch for at least 30 msec, and leave it closed while running.
The exact starting time is when the switch is opened.
To stop an operation, open the switch for at least 30 msec.
The exact stopping time is when the switch is opened.

In a Dose or Flow program the apparatus goes to "Pause" and will continue the program next time the button is depressed. If stopped in the middle of a dose, this dose will not be completed, but on depressing the button again the program will continue.
If Stop is activated while the pump is running in the Diluting, Pipetting, Multidispense or Multisample programs a warning window will appear, with the following text:
FUNCTION INCOMPLETE – PURGE - RESTART. You may now use the remote control switch to start priming on the first touch, and stop it again on the second touch.

3. A "Ready" signal may be obtained, also through an optocoupler, every time the pump stops.

To obtain a ready signal, apply +24 Volts DC to pin 1 as shown in fig 4C.
A positive signal will then be present at pin 6 whenever the pump is not running
Pin 6 should not be loaded with less than 5 kΩ, (i.e. max. 5mA current drain).

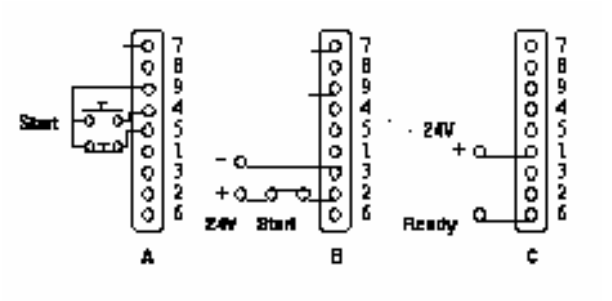


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Fig. 4. Remote control socket, pin connections.

Caution: Pin 7 and 8 should always be left open.

Specification.

Dosage range:	4 µl - 1000 ml
No of doses:	1 - 999
Flow range:	12 µl/min - 800 ml/min
Pipetting range:	60 µl - 10 ml
Reproducibility:	Better than 1 % for quantities over 60 µl
Supply voltage:	230 V AC or 115 V AC

Dimensions:

Width:	170 mm
Height:	165 mm
Depth:	215 mm
Weight:	3.2 kg

Repeatability and accuracy for various tube sizes.
Repeatability and accuracy depends on the number of pump rotations. For a given volume many rotations using a small tubing give higher accuracy than a few rotations using a larger tubing.

Tube size	Minimum dose	Repeatability:1% Accuracy: 1,6%		Repeatability:0,5% Accuracy: 0,8%		Repeatability:0,3% Accuracy: 0,4%	
		min. vol.	min.time	min. vol.	min.time	min. vol.	min.time
0,3 mm	4 µl	60µl	1,9 sec	120µl	3,5 sec	600µl	17,5 sec
0,5 mm	13 µl	200µl	1,1 sec	400µl	2,2 sec	2ml	8,3 sec
1,0 mm	42 µl	800 µl	1,1 sec	1,6ml	2,2 sec	8ml	8,3 sec
2,0 mm	152 µl	3 ml	1,1 sec	6,0ml	2,2 sec	30 ml	8,3 sec
4,0 mm	530 µl	10,6 ml	1,1 sec	21,2ml	2,2 sec	106ml	8,3 sec