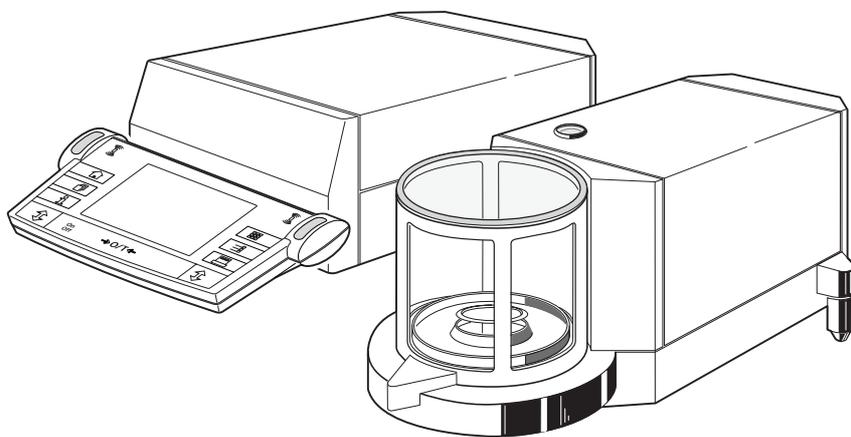


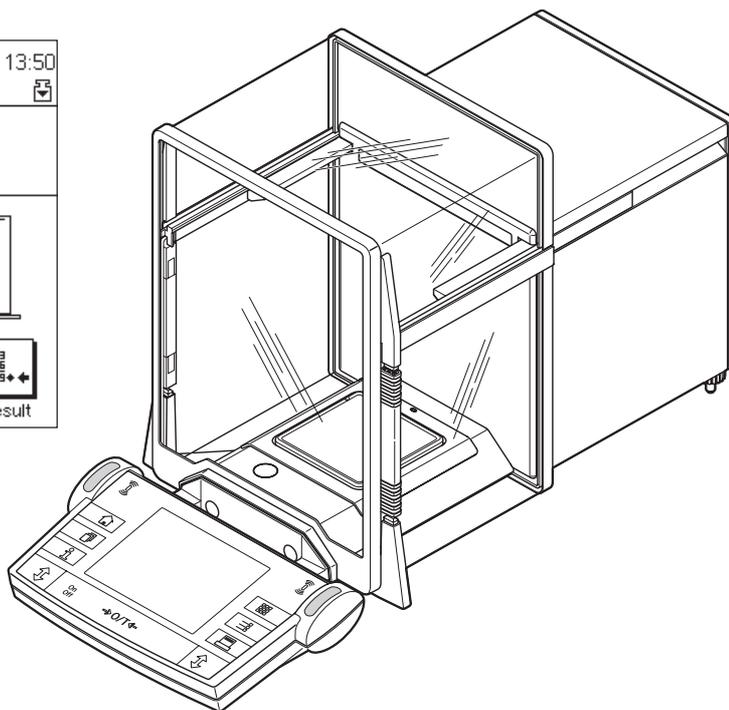
# Operating Instructions

## METTLER TOLEDO Pipette Check Application for AX and MX/UMX Balances

### Version 1.xx



 <b>Pipette Check</b> <span style="float: right;">28.Aug 2001 13:50</span>	
Home 	
<b>1.99576 g</b>	
Pipette	Pipette 1
Pipette SNR	1128489
Test Volume	200.00 ul
Temp 1	22.0 °C
 Start	  Result



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# 1 Introducing the "Pipette Check" application

Modern quality management systems based on standards such as ISO 9000, GLP, or GMP require volumetric measuring instruments to be regularly checked. The "Pipette Check" application makes it possible to use the METTLER TOLEDO AX or MX/UMX balances to check the volume of pipettes from any manufacturer.

## 2 Important notes

These instructions only describe how pipettes can be **checked**. If pipettes need to be calibrated after they have been checked, please consult the pipette manufacturer's instructions.

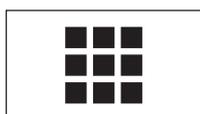
These instructions assume that you know how to use an AX or MX/UMX balance. You will find corresponding information in the **Operating Instructions for the AX and MX/UMX balances**, and it is assumed that you have already read these.

In the operating instructions you are now reading, you will find information about practical work with the "Pipette Check" application and the application-specific settings for this application. **You will find information about the non-application-specific system settings in Chapter 5 of the operating instructions for the AX and MX/UMX balances.**

For checking pipettes we recommend using the METTLER TOLEDO **"PC Volume Option 2" checking set**. This set includes a precision thermometer, a barometer, and a moisture trap, which minimizes evaporation. This makes it unnecessary to determine the rate of evaporation, and also makes the results more accurate.

In these instructions you will repeatedly encounter the measurement quantities **"Inaccuracy"** and **"Imprecision"**. "Inaccuracy" is the difference between the target value and the mean value of the values actually measured. Imprecision is a measure of the scatter of the volume values determined, which is in fact the relative standard deviation. This means that even if the "imprecision" is small (measured values are close to each other), the "inaccuracy" is large if the calculated mean value is far away from the target value. The opposite case can also occur if the values are far apart (large "imprecision") but their mean value is not far from the target value (small "inaccuracy"). Ideally, "inaccuracy" and "imprecision" should be as small as possible. You will find further information about these two measurement quantities, as well as useful tips and advice, in the **"Good Pipetting Practice" application brochure** which you can order from your authorized METTLER TOLEDO representative.

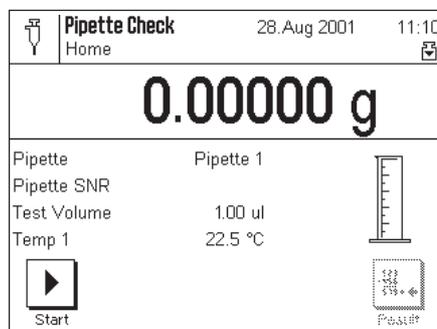
## 3 Selecting the "Pipette Check" application



Pipette Check

If the "Pipette Check" application is not already active, touch the «» key. In the selection window, touch the symbol for the application.

**Note:** If you do not wish to work with the current user profile, first select the desired profile with the «» key.



After you have selected the application, the display shown at left appears. You can adjust the settings to your needs as described in the sections that follow.

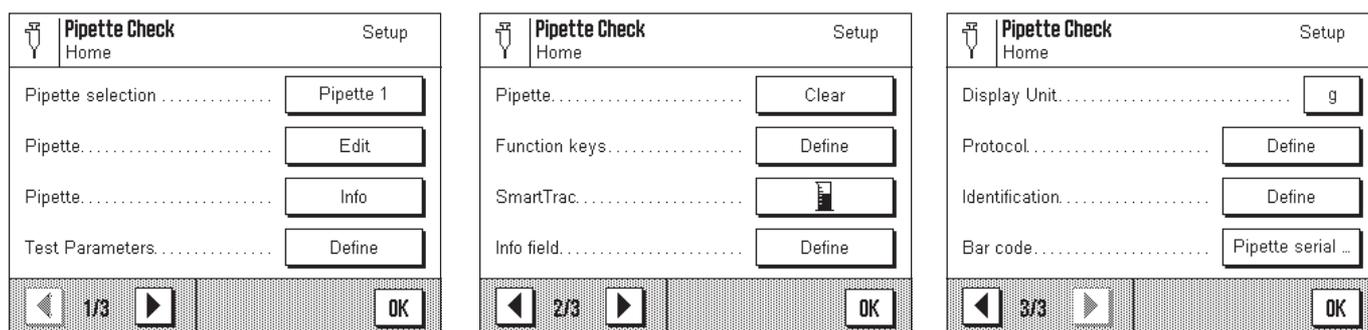
## 4 Settings for the "Pipette Check" application

A range of application-specific settings are available for the pipette check, which you can use to adjust the application to your needs.

**Note:** Your settings are valid for the active user profile. Because of this, make sure the desired profile has been selected before you make the settings.

### 4.1 Overview

The application-specific settings can be accessed with the «≡» key. After you touch this key, the first of 3 menu pages appears with the application-dependent settings for the pipette check:



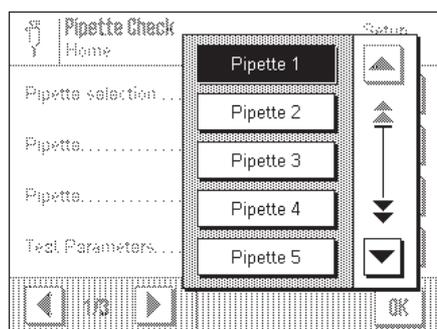
Some of the possible settings are identical to those for the "Weighing" application (see Operating Instructions for AX and MX/UMX Balances, Chapter 6). Only those settings which are different are described below. These apply to the following menus:

- "Pipette Selection": In this menu you select the pipette you wish to check or whose data you wish to enter (Section 4.2).
- "Pipette (Edit)": In this menu you enter the data for your pipettes (Section 4.3).
- "Pipette (Info)": With this menu you can display the data for the selected pipette and print it out (Section 4.4).
- "Test Parameters": In this menu you make the settings for the pipette check (Section 4.5).
- "Pipette (Clear)": In this menu you can clear the data for a pipette (Section 4.6).
- "Function keys": A number of special function keys are available for the pipette check (Section 4.7).
- "Info field": Additional information fields are available for the pipette check (Section 4.8).
- "Protocol": Additional reporting information is available for the pipette check (Section 4.9).
- "Bar code": Bar coding can be used to identify the pipette (Section 4.10).

In the sections that follow we explain the specific settings for the "Pipette Check" application in detail.

### 4.2 Selecting the pipette

In this menu you select the pipette you wish to check, or whose data you wish to enter or change.



The "Pipette Check" application can manage up to 20 pipettes. Select the desired pipette from the list.

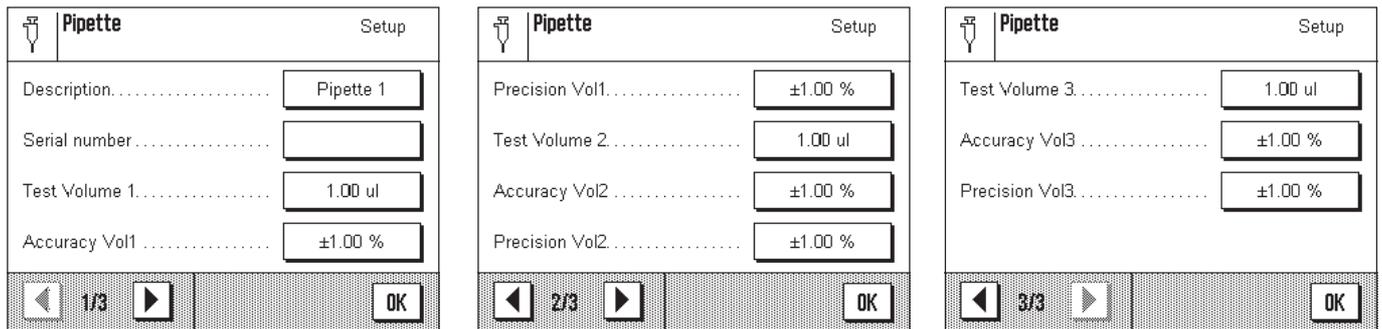
**Note:** The standard descriptions of the pipettes ("Pipette 1" ... "Pipette 20") can be changed (Section 4.3.2).

### 4.3 Entering or changing the data for a pipette

Before you can check a pipette, its data must be known. The data can be taken from the pipette manufacturer's specification sheets. This data can be subsequently changed at any time.

#### 4.3.1 Overview of pipette definition

After you touch the "Pipette Edit" key the first of 3 menu pages appears with the settings for the pipette definition.



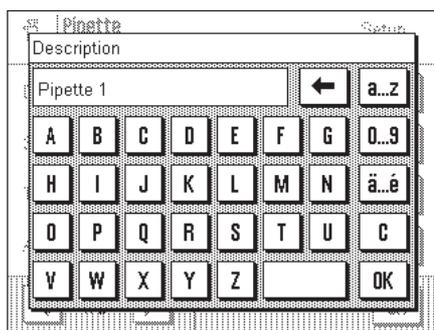
The following settings are available:

- "Description": In this menu you can specify the description for the selected pipette (Section 4.3.2).
- "Serial number": In this menu you enter the serial number for the selected pipette (Section 4.3.3).
- "Test volume (1/2/3)": 3 test volumes can be specified for each pipette (Section 4.3.4).
- "Accuracy vol. (1/2/3)": The permitted inaccuracy must be entered for each of the 3 test volumes (Section 4.3.5).
- "Precision vol. (1/2/3)": The permitted imprecision must be entered for each of the 3 test volumes (Section 4.3.5).

We explain these settings to you in detail in the sections that follow.

#### 4.3.2 Specifying or changing the description of a pipette

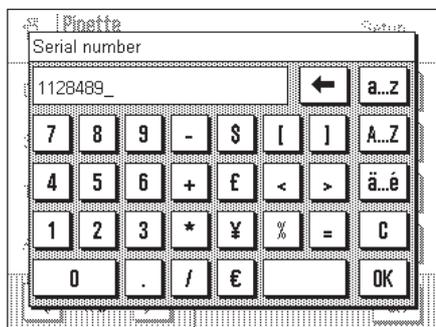
The "Pipette Check" can manage up to 20 pipettes, and you can give a separate description to each of them.



If you wish to use your own descriptions, make sure they cannot be confused: the application does not check them !

### 4.3.3 Entering the serial number of the pipette

It is advisable to enter the serial number because it allows unambiguous identification of each pipette.

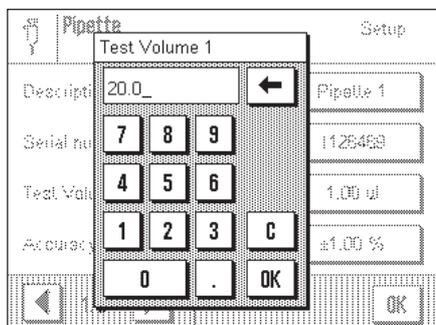


On METTLER TOLEDO VoluMate and MultiMate pipettes the serial number is visible when the ejector button is pressed.

**Note:** If there is a bar code reader connected to your balance, you can configure the application so that the serial number does not have to be entered manually (Section 4.10).

### 4.3.4 Specifying test volumes

For each pipette 3 different test volumes can be specified whose inaccuracy and imprecision are to be determined.

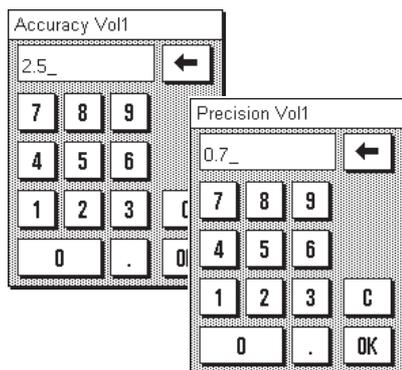


The test volumes recommended by the manufacturer are usually 10%, 50%, and 100% of the nominal volume of the pipette.

You can use the test volumes stated by the manufacturer. If there are tolerances in your working environment which relate to a specific volume which is pipetted very frequently you can, of course, also specify this value as the test volume.

### 4.3.5 Entering limit values for inaccuracy and imprecision

For each of the previously specified test volumes, the limit values for inaccuracy and imprecision must be entered.

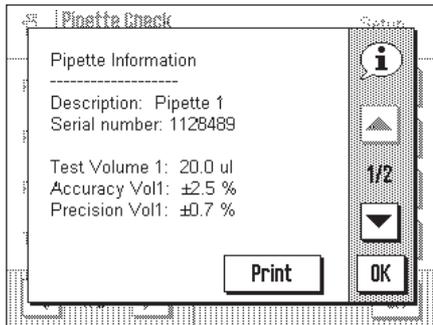


The allowable tolerances for inaccuracy and imprecision depend on the manufacturer and model. You will find corresponding information on the data sheets for your pipette. You can, of course, also enter your own values according to your working instructions.

Note that the maximum allowable inaccuracy is usually entered as a plus/minus range (e.g.  $\pm 2.5\%$ ) and must be entered in this form. The allowable limit value for imprecision is usually specified as a single value (e.g.  $\leq 0.7\%$ ) and must be input in this form.

## 4.4 Displaying and printing the pipette definitions

You can display the selected pipette by touching the "Pipette **Info**" key.

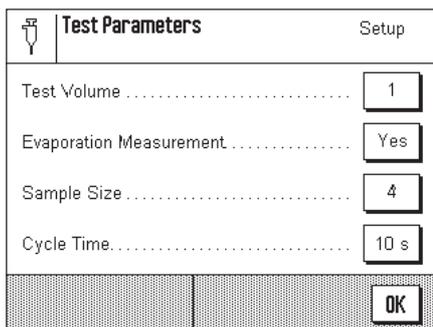


The display shows all the data you entered in the pipette definition (Section 4.3).

If a printer is connected, you can print out the data by touching the "**Print**" key.

## 4.5 Specifying the test parameters

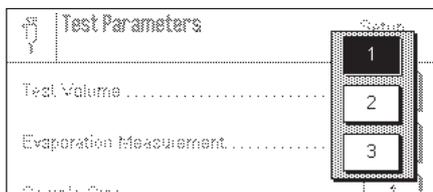
Before starting each test cycle you must specify the test parameters.



In the "**Test Parameters**" menu the following settings are available:

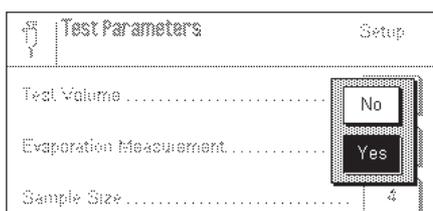
- "Test Volume"**: Specifies the test volume to be used for carrying out the check (Section 4.5.1).
- "Evaporation Measurement"**: Specifies whether the check should be carried out with or without evaporation measurement (Section 4.5.2).
- "Sample Size"**: Specifies the size of the check (Section 4.5.3).
- "Cycle Time"**: Specifies the time that should be available for a measurement (Section 4.5.3).

### 4.5.1 Selecting the test volume



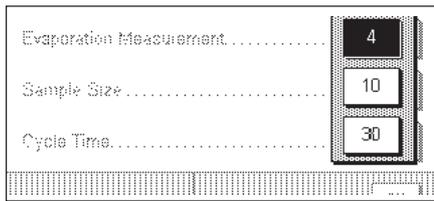
Before each test cycle you must tell the application which of the 3 predefined test volumes you wish to use for the test. You will find information about defining the test volume in Section 4.3.4.

### 4.5.2 Evaporation measurement



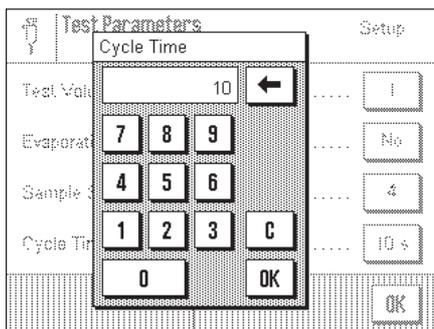
You can activate evaporation measurement. The application then performs an additional operation which compensates for measurement errors which may be caused by evaporation. This makes the results more accurate.

### 4.5.3 Determining the sample size



You can use this setting to specify how many measurements should be performed for the selected test volume before the measurement cycle is complete.

### 4.5.4 Setting the cycle time

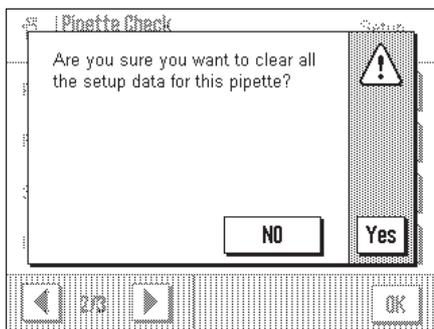


The cycle time controls the testing process. It determines how much time you have between the individual measurements to pipette liquid into the sample container before the balance starts to measure. The cycle time should be kept as short as possible, to minimize evaporation and speed up the testing process.

The setting range for the cycle time is 1 to 100 seconds.

### 4.6 Clearing the data for a pipette

Clearing all the data is a quick way of resetting a pipette to the factory settings.

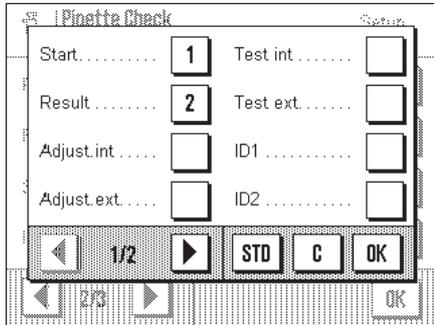


**Important:** Before you clear the data, make sure you have selected the right pipette!

To clear the data for a pipette, touch the "Clear Pipette" key. Answer the question "Are you sure?" with "Yes" if you want to clear the data, otherwise touch "NO".

## 4.7 Special function keys for the pipette check

The function key menu contains additional settings for the pipette check.



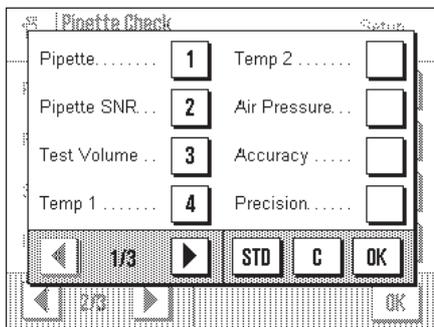
The following application-specific function keys for the pipette check can be selected on the first page of the menu:

- "**Start**": You use this function key to start the pipette check, **so it absolutely must be activated!**
- "**Result**": You can use this function key to display the result of a pipette check (statistics). **Note:** If no results are present in the statistics, the key is shown gray and cannot be operated.

The remaining function keys are on the first and second menu pages and are already known from the "Weighing" application. Only the "**Start**" and "**Result**" keys are activated at the factory.

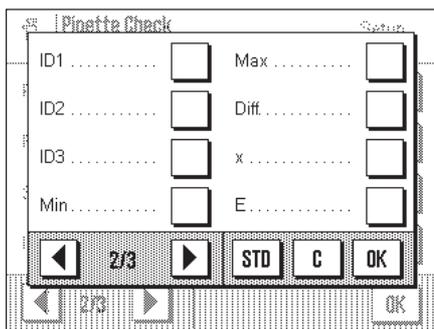
## 4.8 Special information fields for the pipette check

The information field menu contains additional settings for the pipette check.



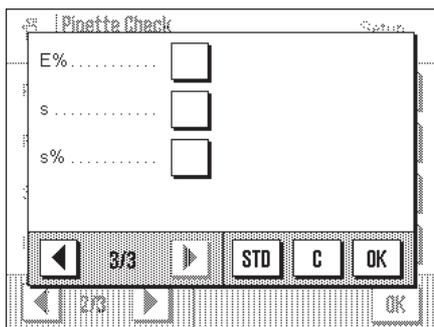
The following information fields for the pipette check can be selected on the first page of the menu:

- "**Pipette**": Description of the pipette to be checked.
- "**Pipette SNR**": Serial number of the pipette to be checked.
- "**Test Volume**": Test volume selected for the test cycle.
- "**Temp 1**": Sample temperature entered at start of test cycle.
- "**Temp 2**": Sample temperature entered at end of test cycle.
- "**Air Pressure**": Barometric pressure entered.
- "**Accuracy**": Maximum allowable inaccuracy for the current test volume.
- "**Precision**": Maximum allowable imprecision for the current test volume.



The following information fields for the pipette check can be selected on the second page of the menu:

- "**Min.**": Minimum volume determined during the test cycle.
- "**Max.**": Maximum volume determined during the test cycle.
- "**Diff.**": Calculated difference between the minimum and maximum volumes.
- "**x**": Average value of the volumes determined in the test cycle.
- "**E**": Imprecision determined in the test cycle (value in µl).



Further information fields for the pipette check can be selected on the third page of the menu:

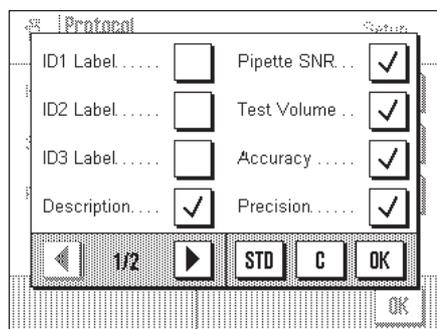
- "**E%**": Inaccuracy determined in the test cycle (percentage value).
- "**s**": Imprecision determined in the test cycle (value in µl).
- "**s%**": Imprecision determined in the test cycle (percentage value).

All other information fields are the same as for the "Weighing" application.

- Factory setting:** Info fields "**Pipette**", "**Pipette SNR**", "**Test Volume**", and "**Temp 1**" are activated.

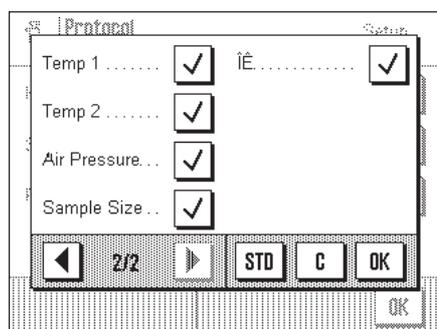
## 4.9 Special report information for the pipette check

The "Protocol" menu contains special settings for reporting pipette checks.

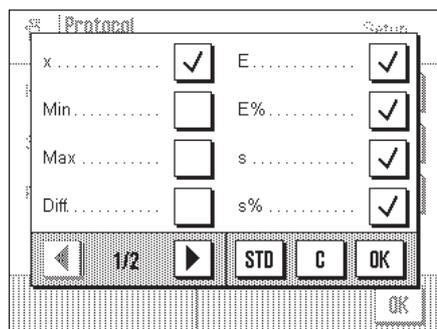


The submenu containing the options for **reporting individual values** has additional items of information for reporting the pipette check:

- "Description": Name of the pipette being checked.
- "Pipette SNR.": Serial number of the pipette being checked.
- "Test volume": Selected test volume for the test cycle.
- "Accuracy": Maximum allowable inaccuracy for the current test volume.
- "Precision": Maximum allowable imprecision for the current test volume.



- "Temp 1": Temperature entered for sample at the start of the test cycle.
- "Temp 2": Temperature entered for sample at the end of the test cycle.
- "Air Pressure": Barometric pressure entered.
- "Sample Size": Number of measurements performed.
- "Volume Values": All volume values are reported individually.



The submenu containing the options for **reporting the results** has additional items of information for reporting the pipette check:

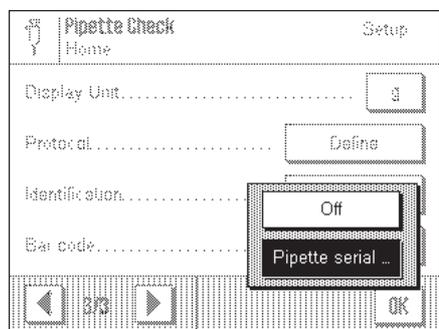
- "x": Average value of the volumes determined in the test cycle.
- "Min.": Minimum volume determined in the test cycle.
- "Max.": Maximum volume determined in the test cycle.
- "Diff.": Difference between minimum and maximum volumes.
- "E": Inaccuracy determined in test cycle (in  $\mu\text{l}$ ).
- "E%": Inaccuracy determined in test cycle (as percentage).
- "s": Imprecision determined in test cycle (in  $\mu\text{l}$ ).
- "s%": Imprecision determined in test cycle (as percentage).

All other information items on the report are the same as for the "Weighing" application.

**Factory setting:** All information items relating specifically to pipette checks (except "Min.", "Max.", and "Diff.") are activated.

### 4.10 Using bar code data in the pipette check

The "Bar Code" menu contains additional settings for processing bar code data:



- "Off":** Either no bar code reader is connected, or the bar code data should not be used.
- "Pipette serial number":** The bar code data is interpreted as the serial number of the pipette.
- Factory setting:** **Pipette serial number.**

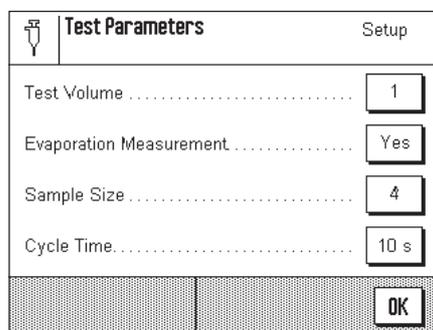
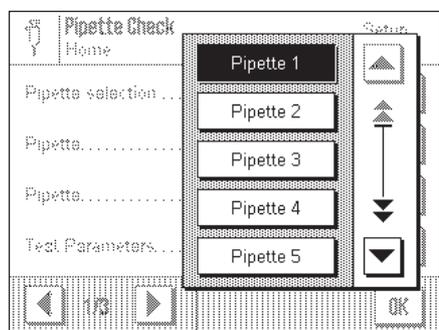
## 5 Working with the "Pipette Check" application

This chapter explains how to work with the "Pipette Check" application in practice. It is assumed that the "Pipette Check" application has been selected and the application-specific settings have been made (Chapter 4).

If you have equipment to minimize water evaporation, you should install it. You should have a precision thermometer and a barometer at the ready. **Important:** The test liquid, sample container, pipette, and pipette tip should be acclimatized!

### 5.1 Preparing for the check

The following operations must be performed before each pipette check:

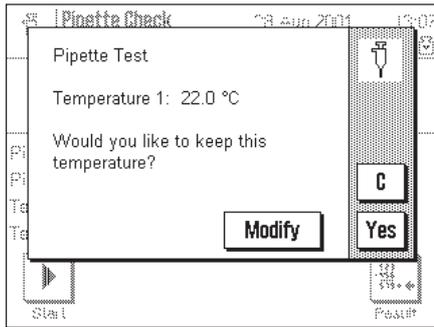


- Select the pipette to be checked.
- **Specify the test parameters:**
  - Test volumes (1, 2, or 3)
  - Evaporation measurement (with/without)
  - Sample size (4, 10, or 30)
  - Cycle time (1 ... 100 seconds)
- **Note the current sample temperature and air pressure.**
- **Set the volume on the pipette** to match the selected test volume.

### 5.2 Performing the pipette check



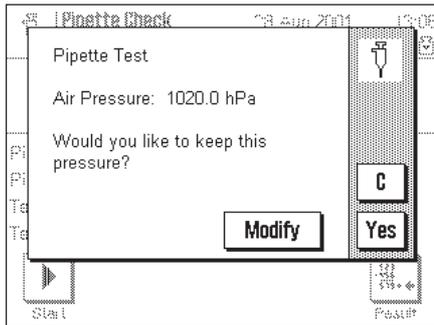
Touch the "Start" function key to start the pipette check.



The application prompts you to enter the **current temperature** of the test liquid. (It should be the same as the ambient temperature.)

If the current temperature is the same as the temperature shown, you can accept this value with the **"Yes"** key, otherwise touch the **"Modify"** key.

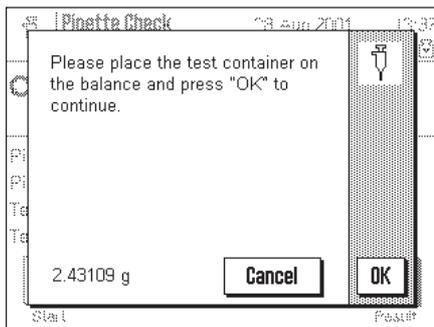
If you want to terminate the check at this point, touch the **"C"** key.



You are now prompted to enter the **current barometric air pressure**.

If the current air pressure is the same as the pressure shown, you can accept this value with the **"Yes"** key, otherwise touch the **"Modify"** key.

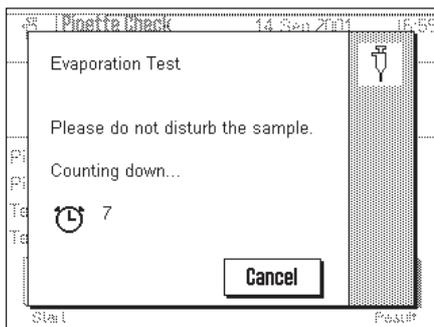
If you wish to terminate the check at this point, touch the **"C"** key.



The application prompts you to place a container of test liquid on the balance. This operation is necessary to **tare the balance**.

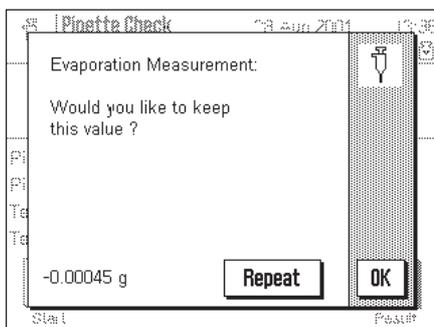
Place the container of test liquid on the balance.

Touch the **"OK"** key to start taring, or **"Cancel"** if you want to terminate the check at this point.



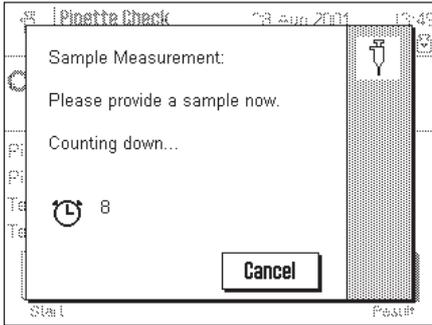
The message shown at left **only** appears if you are performing a pipette check with **evaporation measurement**.

The application calculates the evaporation that takes place during the selected cycle time. The calculated evaporation value is subsequently used to correct the results by compensating for measurement errors which occur due to evaporation.



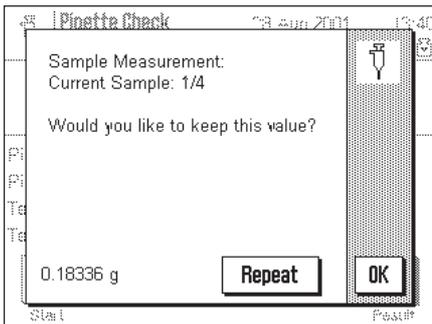
When the evaporation measurement is complete, you are asked whether you wish to accept the evaporation value. If the value does not appear to be plausible, you should repeat the evaporation measurement.

**Note:** If there is no weight loss, an error message is displayed and you must repeat the evaporation measurement, otherwise the pipette check will be terminated.



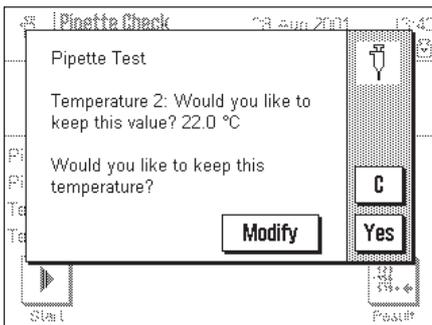
You are prompted to provide the **first sample**.

Draw the selected test volume of liquid from the sample container into the pipette. Then dispense the liquid from the pipette into the container on the balance. The timer shows a countdown of the time still left for you to perform this operation. When the cycle time runs out, the measurement value is determined.



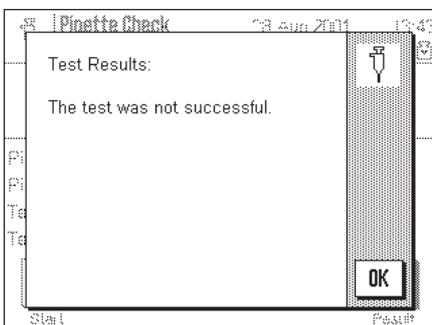
After the measurement value has been determined, you are asked whether you want to keep it.

If you do not want to keep the value, you should repeat the measurement.



You are then prompted to measure all the remaining samples (according to the sample size which was specified).

When the last sample has been measured, you are prompted to enter the current temperature of the test liquid. This is required because the temperature may have changed since the start of the pipette test. If this is the case, touch the **"Modify"** key and enter the correct temperature. The application makes the necessary correction to prevent distortion of the test results.

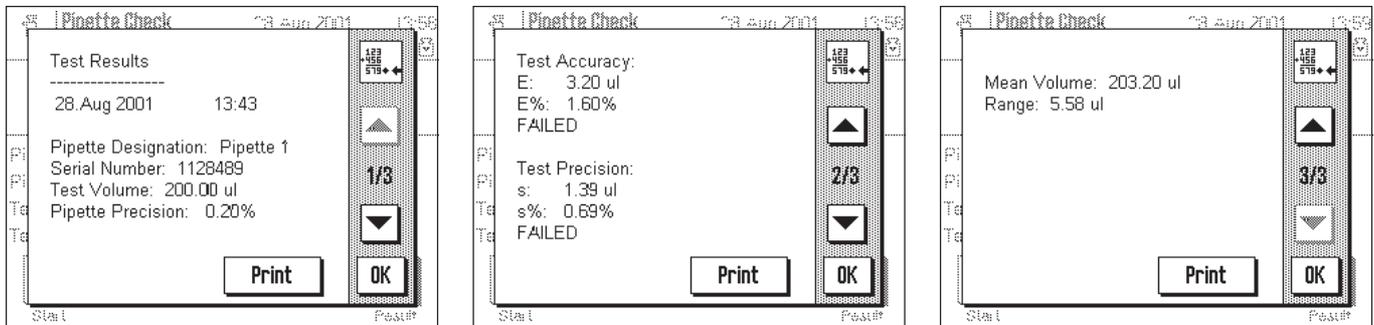


In a final step the application tells you the result of the pipette check. If the check was not successful (as in the example at left) you should display the test results as explained in the next chapter.

### 5.3 Displaying and printing the results

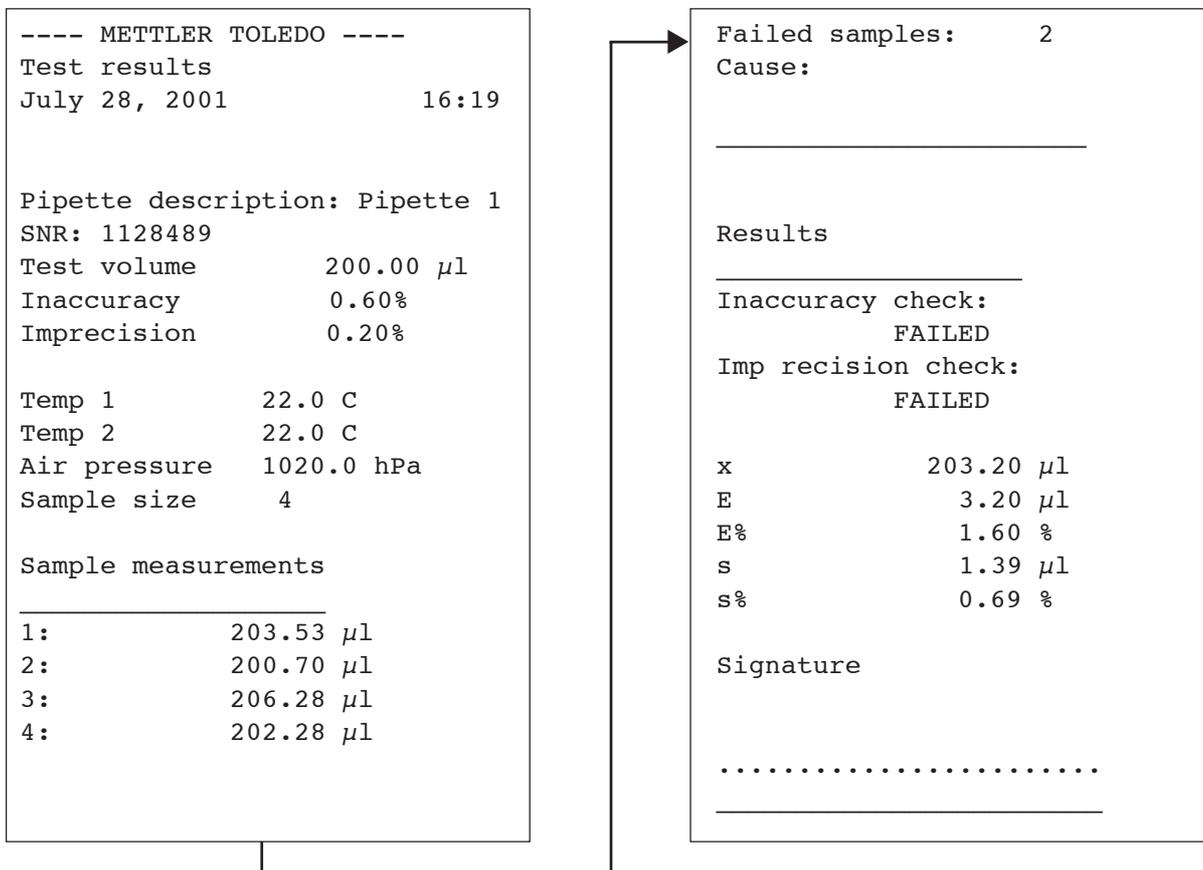
The detailed results of the last pipette check that was performed can be displayed and printed out.

Touch the "Result" function key to open the Test Results window.



On the first page you will find the data for the pipette, as well as the test volume and the specified limit values for imprecision and inaccuracy (relative to the selected test volume). The second page shows the absolute and percentage values for inaccuracy and imprecision determined in the test, and whether or not the test was successful. On the third page you will find the mean volume which was calculated, and the difference between the smallest and largest volume.

By touching the "Print" key (or the «Print» key on the balance) you can print the results on a printer. Which values are printed depends on the reporting settings that were selected (Section 4.9). The example below illustrates the values that were printed out with the factory settings. You will find information about the meaning of the individual values in sections 4.8 and 4.9.



## 5.4 Formulas used with Pipette Check

### 5.4.1 The Mean Volume

Pipette Check uses the mean weight of the samples to derive the mean volume. The conversion takes into account the density of the test liquid, in this case distilled water, and the buoyancy of air.

The following formulas are used:

#### 1.1 Mean temperature: T (°C)

$$\begin{aligned} T1 &= \text{Temperature at the beginning of the test (°C)} \\ T2 &= \text{Temperature at the end of the test (°C)} \\ T &= (T1 + T2) / 2 \end{aligned}$$

#### 1.2 Density of distilled water as a function of temperature: DW (g/cm<sup>3</sup>)

$$\begin{aligned} T &= \text{Mean temperature (°C)} \\ DW &= \frac{999099 - 155.024 * (T-15) - 5.01145 * (T-15)^2}{10^6} \end{aligned}$$

#### 1.3 Density of air as a function of barometer pressure and temperature: DA (g/cm<sup>3</sup>)

$$\begin{aligned} T &= \text{Mean temperature (°C)} \\ B &= \text{Air pressure (hPa);} \\ &1.33322 \text{ hPa} = 1.33322 \text{ mbar} = 1 \text{ mmHg} \\ DA &= \frac{B / 2869}{T + 273.15} \end{aligned}$$

#### 1.4 Conversion factor: Z (μl/mg)

$$\begin{aligned} DA &= \text{Density of air (g/cm}^3\text{)} \\ DW &= \text{Density of water (g/cm}^3\text{)} \\ Z &= \frac{1 - DA / 8 \text{ (g/cm}^3\text{)}}{DW - DA} \end{aligned}$$

#### 1.5 Mean volume: MV (μl)

$$\begin{aligned} MW &= \text{Mean weight (mg)} \\ Z &= \text{Conversion factor} \\ MV &= MW * Z \end{aligned}$$

### 5.4.2 Statistics: Mean error (E, E%), standard deviation (s), coefficient of variation (CV) and Range (R)

The first statistics, **inaccuracy**, measures the difference between the nominal volume being tested and the calculated mean volume:

Mean error: E (μl)

$$\begin{aligned} NV &= \text{Nominal volume (μl)} \\ MV &= \text{Calculated mean volume (μl)} \\ E &= MV - NV \end{aligned}$$

Mean error as a percentage of nominal volume: E% (%)

$$\begin{aligned} E &= \text{Mean error (μl)} \\ NV &= \text{Nominal volume (μl)} \\ E\% &= \frac{100 * E}{NV} \end{aligned}$$

The second statistics, **imprecision**, measures how much the samples vary from one another:

Standard deviation: s (μl)

$$\begin{aligned} W_i &= \text{Individual weight values (mg)} \\ MW_i &= \text{Mean weight (mg) for } W_i \\ Z &= \text{Conversion factor} \\ n &= \text{Number of samples} \\ R &= \text{Range (see below)} \\ s &= \sqrt{\frac{\sum (W_i - MW_i)^2}{n - 1}} && * Z \text{ for } n > 4 \\ s &= R / 4 && \text{for } n = 4 \text{ (estimated)} \end{aligned}$$

Coefficient of variation: CV (%)

$$\begin{aligned} s &= \text{Standard deviation (μl)} \\ MV &= \text{Mean volume (μl)} \\ CV &= \frac{100 * s}{MV} \end{aligned}$$

Range: R (μl)

$$\begin{aligned} W_{MIN} &= \text{Lowest sample weight (mg)} \\ W_{MAX} &= \text{Highest sample weight (mg)} \\ Z &= \text{Conversion factor} \\ R &= (W_{MAX} - W_{MIN}) * Z \end{aligned}$$

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**Thank you.**



Subject to technical changes and to changes in the accessories supplied with the instruments.

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