USER GUIDE No. 36

The Eppendorf Xplorer® Electronic Pipette Family – Versatile Adjustment

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Abstract

Piston-stroke pipettes with an air cushion are subject to environmental factors that affect the reproducibility of pipetting results, such as temperature, air pressure or air humidity. In addition, liquids whose physical properties differ significantly from those of water may also lead to incorrect dispensing volumes. These factors make it necessary to be able to adjust the devices to different physical conditions. Thanks to pre-programmed adjustments and the option to temporarily adjust the pipette in one, to or three points via digital input, the Eppendorf Xplorer electronic pipette family* reduces such effects to a minimum.

* includes Eppendorf Xplorer, Xplorer plus and Xplorer plus Move It® adjustable tip spacing pipettes

Introduction

Since air-cushion pipettes are mainly used for pipetting of aqueous solutions, they are calibrated with distilled water as a test medium. Depending on the density of the particular liquid used in the workflow, the air volume over the liquid expands in different ways. Consequently, incorrect liquid volumes may, under certain circumstances, be aspirated into the tip when pipetting non-aqueous solutions. Liquids with a high vapor pressure, such as organic solvents, cannot be dispensed with the level of accuracy specified for distilled water either. The air pressure, which is dependent on the height of the location above sea level, is a further factor to be considered during dispensing operations with air-cushion pipettes.

Adjustment

Solutions whose physical properties is very different from waterwith regard to density, viscosity, surface tension and/or vapor pressure may produce incorrect dispensing volumes. To account for this, piston-stroke pipettes with an air-cushion require adjustment options. If the density of a solution changes by approximately 10% (e.g., due to salt concentration), the aspirated volume will change by approximately 0.2% – provided other relevant properties of the liquid do not change at the same time.

Another reason for changing the factory settings can be, for example, the altitude of the location at which the pipette is used. If the pipette is used at an extremely high altitude, it must be adjusted to the ambient air pressure. At 1,000 meters above sea level, the volume error of a 100 µL pipette is about -0.3%. In addition, when using pipette tips that significantly differ from standard tips in their geometry (such as elongated tips like epT.I.P.S.® long), adjusting the pipette can also improve dispensing accuracy.

In contrast to calibration, which involves determining the measured random (precision) and systematic (accuracy) errors from the nominal value and which does not require any alterations that will permanently change the dispensing system, performing an adjustment will change the device for all subsequent dispensing operations.
Changes made to the adjustment do not affect dispensing precision. Precision can only be improved by exchanging parts. It is also considerably affected by handling errors.
The actual volume of a pipette can be checked by weighing as follows:

$$\text{ACTUAL volume} = \frac{\text{Mean value of the weighings}}{\text{Density of liquids at weighing temperature}}$$

If the set volume corresponds to the actual volume, no correction is necessary.
If there is a difference between the actual volume and the set volume, make sure to check the following factors before readjusting a pipette:

> Is any liquid dripping from the tip?
> Is the pipette tip fitted so as to be leak-proof?
> Is the tip cone undamaged?
> Are the piston and the cylinder leak-proof?
> Does the temperature of the pipetted liquid correspond to the temperature of the device and the ambient air?
> Is the weighing location free from drafts?
> Does the work method and pipetting speed permit complete aspiration and dispensing of the liquid?
> Has the correct value for "Density liquids at weighing temperature" been used for the calculation of the actual volume?
> Is the pipette volume setting correct?
> Is the balance sufficiently sensitive (balance resolution 0.001 mg) for very small volumes (< 10 µL)?
> Were original epT.I.P.S. pipette tips with the correct volume used as test tips?

The factory setting of Eppendorf Xplorer pipettes may only be changed after all of the points listed above have been thoroughly checked and the pipette volume setting is still different from the measured volume.
The Eppendorf Xplorer pipette family offers several individual adjustment options that can be used as an alternative to adjusting the pipette, depending on the application.

Adjustment options

The following adjustment options are available for selection:
Liquid type ethanol 75% or glycerol 50%
When this adjustment option is selected, the factory setting is changed by an internal factor that considers the density of ethanol or glycerol. This means that the substance can be dispensed with greater accuracy (smaller systematic error) with the Xplorer pipette.

epT.I.P.S. long
This enables the pipette to be adjusted to the different lengths of a pipette tip (such as the elongated "L" variants of epT.I.P.S. 20 µL, 1,250 µL, 5 mL or 10 mL). When this adjustment option is selected, the tip geometry of the longer tip is considered in the internal volume calculation. With the adjustment, users will receive the same accuracy with elongated tips as with the standard tip counterpart (test tip). This option can also be applied when using tips exceeding the maximum volume of the pipette, e.g., 300 µL epT.I.P.S for a 5 – 100 µL pipette. When using the following tips, dispensing accuracy can be increased with this function:

Eppendorf Xplorer Nominal volume Volume range	**Color code Eppendorf Xplorer rocker**	**epT.I.P.S long adjustment is valid for**		
		Color code epT.I.P.S.	**Model epT.I.P.S.**	**Length epT.I.P.S.**
10 µL 0.5 µL – 10 µL	Medium gray	Light gray	20 µL	46 mm
100 µL 5 µL – 100 µL	Yellow	Orange	300 µL	55 mm
1,000 µL 50 µL – 1,000 µL	Blue	Dark green	1,250 µL Long	103 mm
1,200 µL 50 µL – 1,200 µL	Green	Dark green	1,250 µL Long	103 mm
5 mL 0.2 mL – 5 mL	Violet	Violet	5 mL Long	175 mm
10 mL 0.5 mL – 10 mL	Turquoise	Turquoise	10 mL Long	243 mm

Geographic altitude
The mean air pressure of a location depends on its height above sea level. When testing an air-cushion pipette, it is thus important to take fluctuations in pressure into account. At higher altitudes with a lower air pressure, the aspiration volume of an air-cushion pipette is reduced.
The pipette stroke of Xplorer pipettes can easily be corrected taking into account the air pressure at the respective altitude. The "Geographic altitude"adjustment function allows the altitude to be adjusted in increments of 250 m (820 ft). The maximum altitude that can be selected is 5,000 m.

The adjustment options **Liquid Type, epT.I.P.S.** long and **Geographic Altitude** can be combined with each other. The Xplorer plus version also allows password protection of adjustments.

Factory settings
A pipette that has been adjusted can be reset to the original settings using the "Reset to Factory Settings" adjustment option at any time.

Adjustment

Another possibility of adjusting the Xplorer is to use the "Individual adjustment" function. With this option, the gradient or axis intercept is changed, taking into account the exact density of the solution to be dispensed. One-point, two-point or three-point adjustment are available for selection. To create the weighing results, it is necessary to use a fine balance with a high resolution. Dispensing volumes below 10 µL require a balance with a resolution of 0.001 mg. The arithmetic operations required for the correction are automatically performed by the Xplorer pipette during the one-to-three-point adjustment, so that the user does not have to carry out any complicated calculations.

One-point adjustment

After entering the density, the selected volume and the corresponding weighing result, the Xplorer determines a correction factor. The factor is only valid for the selected volume and the selected work technique (speed, prewetting, wall dispensing method, etc.).

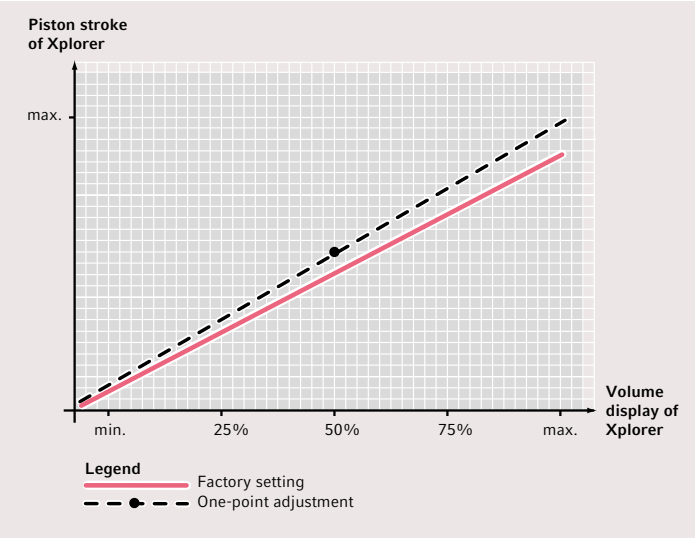

Fig 1: Example of the piston-stroke correction of a one-point adjustment

In this example, the factory piston-stroke setting is increased by a factor (fig.1). Strictly speaking, the correction only applies to the testing volume, but it is used for the entire volume range. The correction is different to that for a mechanical pipette.
A correction with a factor results in a smaller stroke correction for a small volume than for a large volume.

In the case of a mechanical pipette, the stroke can only be changed by a fixed volume (fig. 2). This volume change applies to the entire measurement range of the mechanical pipette. The existing adjustment is changed in parallel by a fixed amount.

Two-point adjustment

After you input the density, two different volumes and the corresponding weighing results, the Xplorer determines a correction factor. The factor applies to the volume range between the tested volumes and only for the selected work technique. However, the factor is also used here for the entire volume range, that is, also below and above the two measuring points (fig. 3).

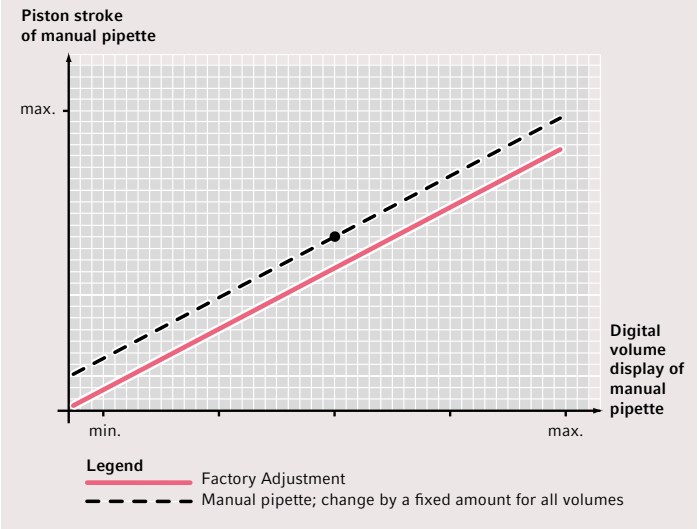

Fig 2: Example of the change in piston-stroke of a mechanical pipette

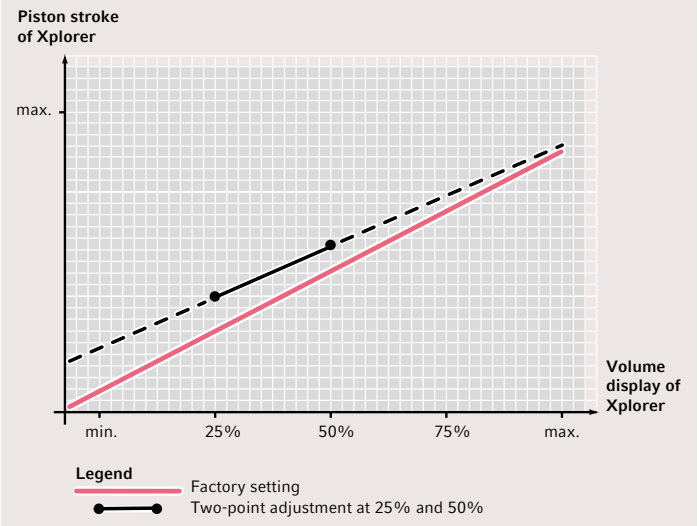

Fig 3: Example of a two-point adjustment

Three-point adjustment
After entering the density, three different volumes and the corresponding weighing results, the Xplorer determines two correction factors. The factors are correct from measuring point to measuring point in the selected volume regions and only for the selected work technique. However, the respective factor is also used below and above the first and third measuring point (fig.4).

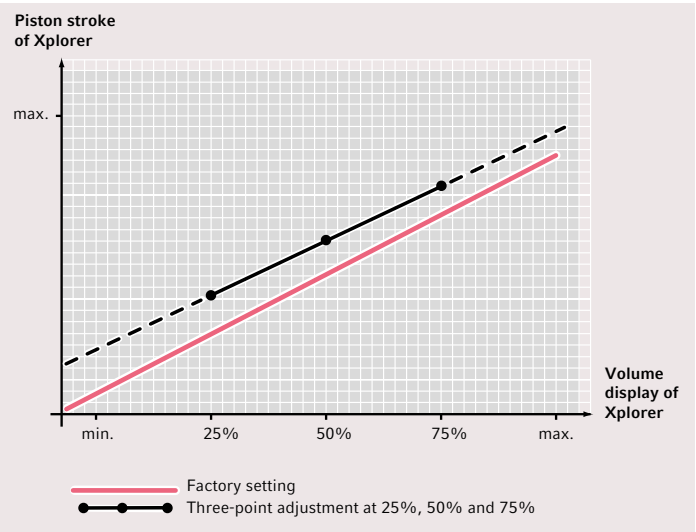

Fig. 4: Example of a three-point adjustment

In contrast to one-point and two-point adjustment, three-point adjustment is more accurate. If three significantly different volumes are used for calculating the two correction factors, the corrected volume range is considerably larger and thus more precise. However, three-point adjustment is more time-consuming.

It is necessary to carry out a gravimetric test for each Xplorer pipette with an individual adjustment.
This is the only way of ensuring that the selected adjustment meets the required measurement errors.
To ensure that other users are informed of the applied adjustment, each Xplorer pipette that has been manipulated via one-, two- or three-point adjustment must be additionally marked by a clearly visible label indicating the type of changes made.

The precise work technique relating to the individual adjustment options is described in the adjustment instructions of the Eppendorf Xplorer (plus) pipette (see Manual “Adjustment”).

Summary

Today, users expect more than just ease of use and precision from pipettes. Other features, such as simple volume adjustment, have become standard requirements for such devices. The Eppendorf Xplorer electronic pipette family meets these requirements in every respect, making it ideally suited for daily use in the lab.

For more information, technical specifications and ordering information for the Eppendorf Xplorer electronic pipettes, visit **www.eppendorf.com/xplorer.**

Software updates for Eppendorf Xplorer electronic pipettes are available at **www.eppendorf.com/software-downloads.**

Learn more about the added value of connected electronic pipettes managed via the VisioNize pipette manager

www.**eppendorf.com/visionize-pipette-manager.**

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