Eppendorf Research® plus

User Adjustment

eppendorf

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U.S. Pat. No.

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4,961,350

For user adjustment with adjustment display, spring to reduce force for tip fitting and for further features patents are pending.

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1 User adjustment

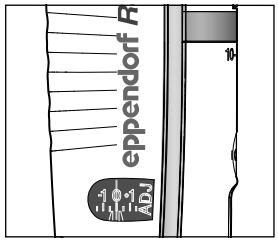
The piston stroke of Research plus pipettes with adjustable volume settings can either be changed by user adjustment or by factory adjustment.

Users cannot change the factory adjustment of Research plus fixed volume pipettes. Only user adjustment is available.

This document provides information about when you should change the user adjustment and what needs to be considered during the process. User adjustment is especially useful if the Research plus adjustment should only be changed for a limited period of time. You can reset the adjustment to the original state with the adjustment tool at any time. The process of how to change the factory adjustment of a Research plus with adjustable volume setting is described in the document *Factory Adjustment* on the Research plus CD.

Make sure to read the general notes (see *General notes on user and factory adjustment settings on p. 4)*.

If the user adjustment has been changed, this is displayed by the adjustment display on the side of the Research plus.



1.1 Adjusting pipettes

NOTICE!

Incorrect dispensing volume for special liquids and from temperature differences.

Solutions which differ greatly from water in terms of their physical data, or temperature differences between the pipette, pipette tip and liquid can result in incorrect dispensing volumes.

- Avoid temperature differences between pipette, pipette tip and liquid.
- Make sure that the temperature is constant, between 20 and 25 °C and at ±0.5 °C.
- Check the dispensing volume and readjust the pipette in case of deviations.

The systematic and random errors recorded on delivery can be found in the *Certificate of Conformity*. This certificate is included in the delivery. Changes to the factory adjustment will render the certificate void.

1.1.1 General notes on user and factory adjustment settings

The Research plus was adjusted, tested and fitted with a gray adjustment seal with the abbreviation "ADJ" before delivery. The adjustment display on the side reads "0".

Changing the adjustment of the Research plus is sometimes recommended for solutions which are very different from water with regard to their density, viscosity, surface tension and/or vapor pressure etc. If the density of an aqueous solution changes by approximately ±10%, for example because of the salt concentration, the volume changes by approximately ±0.2%. This statement does not apply if other relevant properties of the liquid also change.

If the pipette is used at extremely high altitudes, it must be calibrated to the ambient air pressure. At 1 000 m above sea level, the volume error of a 100 µL pipette is about –0.3%.

When using special tips, that is, tips that significantly differ from standard tips in their geometry, changing the adjustment can improve the dispensing accuracy (systematic error). The CD Research plus contains adjustment tips for epT.I.P.S. long.

Adjustment changes can be reset by simple steps.

1 User adjustment

In addition to changing the user adjustment, a Research plus with variable volume setting can be permanently changed by altering the factory adjustment .

Changes made to the user or factory adjustment do not affect dispensing precision (random error). Precision can be improved by exchanging worn parts. Precision is also considerably affected by handling.

Before changing the adjustment or factory calibration, you must check the existing dispensing volume.

The actual volume can be checked by weighing:

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

The density of distilled water is approx. 0.9982 mg/µL at 20 °C and 0.9965 mg/µL at 27 °C.

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 of distilled water, please check the following:

- Is there any liquid dripping from the tip?
- Is the pipette tip fitted leak-proof?
- Is the tip cone undamaged?
- Are the piston and the cylinder leak-proof?

  Adequate leak tightness is ensured when no drop is formed at the pipette tip after aspiration of the nominal volume with distilled water and a waiting time of approx. 15 s. Hold the pipette vertically, making sure not to touch the pipette tip. Prewet the tip several times in the case of nominal volumes ≤ 20 µL.
- Does the temperature of the pipetted liquid correspond to:
  - the temperature of the device?
  - the ambient air temperature?
- 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 numerical value for "Density liquids at weighing temperature" been used for the calculation of the actual volume?
- Is the set volume correct?
- For very small volumes (<10 µL): is the fine balance sufficiently sensitive (balance resolution: 0.001 mg)?
- Were original epT.I.P.S pipette tips used for testing?

  Information as to which pipette tip must be used as a test tip for checking the technical data can be found in the "Technical Data" chapter of the operating manual.

No adjustment changes are allowed unless you can answer all the questions with "yes". In all other cases, the problems associated with the questions answered with "no" must be eliminated. If the problem is remedied by exchanging a complete lower part or other parts that have an effect on the volume, proper assembly must be verified by carrying out a gravimetric test. Information on the systematic and random errors to be met can be found in the "Technical Data" chapter.

1 User adjustment

1.1.2 Changing the user adjustment

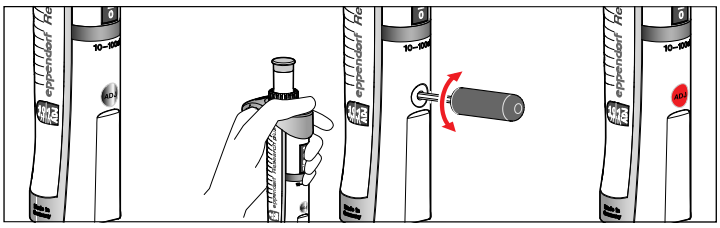
If the adjustment is changed, the volume changes by a certain value. Strictly speaking, the change only applies to the testing volume.

Auxiliary equipment

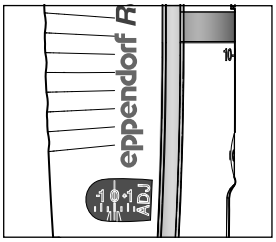
- Supplied adjustment tool (order no. 3120 633.006)
- Supplied red adjustment seal (ADJ)

Example

You readjust a 10 -100 µL pipette with a volume setting of 100 µL by 1 µL (1 µL ≙ 1%). If the volume setting is 10 µL, the pipette is also adjusted by 1 µL (≙ 10%).



1. Remove the gray adjustment seal.
2. Keep the ejector pressed.
3. Insert the adjustment tool (from the delivery package).
4. Turn the adjustment tool until the adjustment display shows the desired value.
5. Place the Research plus on a horizontal surface (table). When completing the adjustment, look absolutely vertically at the window and read the set value via the backsight in the viewing window.



6. Carry out weighings to verify accuracy and precision.
7. After the tests, close the opening with the red adjustment seal (from the delivery package).

If the adjustment is meant for a specific liquid, mark the pipette accordingly. Use the labeling area on the pipette for this purpose and write down the liquid and the volume. Carry out a gravimetric test for each adjustment change. Follow the test procedures of EN ISO 8655-2 and 8655-6. A SOP (Standard Operation Procedure) and further information on user and factory adjustment settings can be found on the Research plus CD and on our website www.eppendorf.com.

1 User adjustment

1.2 Volume change obtained by adjusting the adjustment display

Tab. 1: Single-channel Research plus

Nominal volume; color code	**+8 Δ µL**	**+4 Δ µL**	**–4 Δ µL**	**–8 Δ µL**
2.5 µL; dark gray	0.05 µL	0.025 µL	–0.025 µL	–0.05 µL
10 µL; medium gray	0.2 µL	0.1 µL	–0.1 µL	–0.2 µL
20 µL; light gray	0.4 µL	0.2 µL	–0.2 µL	–0.4 µL
10 µL, 20 µL; yellow	0.4 µL	0.2 µL	–0.2 µL	–0.4 µL
25 µL, 50 µL, 100 µL; yellow	2 µL	1 µL	–1 µL	–2 µL
200 µL; yellow	4 µL	2 µL	–2 µL	–4 µL
300 µL; orange	6 µL	3 µL	–3 µL	–6 µL
200 µL, 250 µL, 500 µL, 1000 µL; blue	20 µL	10 µL	–10 µL	–20 µL
5 mL; purple	100 µL	50 µL	–50 µL	–100 µL
10 mL; turquoise	200 µL	100 µL	–100 µL	–200 µL

Tab. 2: Multi-channel Research plus

Nominal volume; color code	**+8 Δ µL**	**+4 Δ µL**	**–4 Δ µL**	**–8 Δ µL**
10 µL; medium gray	0.2 µL	0.1 µL	–0.1 µL	–0.2 µL
100 µL; yellow	2 µL	1 µL	–1 µL	–2 µL
300 µL; orange	6 µL	3 µL	–3 µL	–6 µL

Explanation: The above stated Δ µL values are theoretical values and therefore informative only. They apply to every set volume in pipettes with adjustable volume settings. Depending on the mode of operation and other conditions (temperature, density etc.), the actual values can differ from the values above. This applies to all pipettes. Each change to an adjustment must be gravimetrically tested.

1 User adjustment

1.3 Setting values Research plus for 50% glycerine

Tab. 3: Single-channel Research plus

Nominal volume; color code	Nominal volume; adjustment display in position:	50% of the nominal volume; adjustment display in position:
2.5 µL; dark gray	No change of setting required	No change of setting required
10 µL; medium gray	No change of setting required	No change of setting required
20 µL; light gray	+1	No change of setting required
20 µL; yellow	+1	No change of setting required
100 µL; yellow	+1	+1
200 µL; yellow	+1	+1
300 µL; orange	+1	+1
1000 µL; blue	+1	+1
5 mL; purple	+1	+0.5
10 mL; turquoise	+2	+0.5

Tab. 4: Multi-channel Research plus

Nominal volume; color code	Nominal volume; adjustment display in position:	50% of the nominal volume; adjustment display in position:
10 µL; medium gray	No change of setting required	No change of setting required
100 µL; yellow	No change of setting required	No change of setting required
300 µL; orange	+0.5	+0.5

Explanation: The above settings are informative only since systematic and random errors are influenced by handling, the tip used and other issues (e.g. the temperature). The above settings were determined for a 50% (w/w) aqueous glycerine solution at room temperature. The glycerine solution used had a density of 1.1238 g/mL (=mg/µL) at 25 °C. The data was calculated for wall dispensing. The blow-out was triggered approx. 3 seconds after dispensing. The tips were not pre-wetted. A new tip was used for each dispensing operation. The work was carried out relatively quickly and thus under realistic conditions. It is essential to check the data according to your own work method.

Technical specifications subject to change.

1 User adjustment

1.4 Setting values Research plus for 45% cesium chloride

Tab. 5: Single-channel Research plus

Nominal volume; color code	Nominal volume; adjustment display in position:	50% of the nominal volume; adjustment display in position:
2.5 µL; dark gray	No data determined.	No data determined.
10 µL; medium gray	+6.5	+3.5
20 µL; light gray	+6.5	+2.5
20 µL; yellow	+6.5	+2.5
100 µL; yellow	+3	+3
200 µL; yellow	+2.5	+2
300 µL; orange	+2.5	+2.5
1000 µL; blue	+2	+2
5 mL; purple	+1.5	+1.5
10 mL; turquoise	+5	+4

Tab. 6: Multi-channel Research plus

Nominal volume; color code	Nominal volume; adjustment display in position:	50% of the nominal volume; adjustment display in position:
10 µL; medium gray	+3	+3
100 µL; yellow	+1	+1
300 µL; orange	+1	+1

Explanation: The above settings are informative only since systematic and random errors are influenced by handling, the tip used and other issues (e.g. the temperature). The above settings were determined for a 45% (w/v) aqueous cesium chloride solution at room temperature. The cesium chloride solution used had a density of 1.5010 g/mL (=mg/µL) at 22°C. The data were calculated for wall dispensing. The blow-out was triggered approx. 3 seconds after dispensing. The tips were not pre-wetted. A new tip was used for each dispensing operation. The work was carried out relatively quickly and thus under realistic conditions. It is essential to check the data according to your own work method.

Technical specifications subject to change.

1 User adjustment

1.5 Setting for the epT.I.P.S. 1 250 µL L and 10 mL L

The piston stroke in each Research plus has been optimized for the tip geometry of the respective epT.I.P.S. Using other tips may cause differences in the systematic errors (accuracy). When using epT.I.P.S. with the tray colors dark gray, medium gray and light gray with the matching Research plus in the color code gray, the differences in the systematic error are low so that a correction is not absolutely necessary. The same applies when using the tips with the tray color orange and the Research plus with the color code yellow. It also applies to tips with the tray color yellow and the Research plus with the color code orange.

Information on which tip is suitable for which pipette and whether the tip limits volume absorption is provided in the tables in the document *Ordering information* on the Research plus CD.

Very long tips or tips with a different shape can result in volume errors due to the filling height in the tip and the resulting air cushion between the liquid and the piston of the Research plus. These errors can be minimized by changing the user adjustment if very high demands are placed on systematic errors.

Changing the user adjustment accordingly in order to minimize the systematic error is possible with the following combinations:

- epT.I.P.S. 1250 µL L (length 103 mm, dark green) and Research plus 1000 µL color code blue
- epT.I.P.S. 10 mL (length 243 mm, turquoise) and Research plus 10 mL color code turquoise

The following two tables show the deviations and settings for the user adjustment for the Research plus with the following conditions:

- Use of demineralized water
- Pipetting at room temperature
- Tip prewetted
- Tip immersion depth approx. 5 mm
- Slow aspiration and dispensing of water
- Blow-out triggered approx. 2 seconds with a time delay
- Vertical aspiration if possible and wall dispensing at a slight tilt

1 User adjustment

Tab. 7: Allocation of Research plus and epT.I.P.S. 1 250 µL L and 10 mL L

Tip and pipette	Volume setting	Approximate deviation	Recommended user adjustment setting	Theoretical volume correction valid for the entire measuring range
epT.I.P.S. 1 250 µL L 103 mm, dark green **Research plus** 1000 µL, blue	1 000 µl 500 µl	-10 µL -9 µL	+4 +4	+10 µL +10 µL
epT.I.P.S. 10 mL L 243 mm, turquoise **Research plus** 10 mL, turquoise	10 mL 5 mL	-0.13 mL -0.05 mL	+5 +2	+0.125 mL +0.05 mL

In the case of epT.I.P.S. 10 mL L it is advisable to change the adjustment to the respective volume range used. For single dispensing operations you could also consider a correspondingly increased volume setting as an alternative.

Since the measured values depend greatly on your personal working method, carry out your own gravimetric tests to check all recommended settings for the user adjustment.

1 User adjustment

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