Eppendorf Research® plus

Operating manual

eppendorf

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U.S. Pat. No.

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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 Product description

1.1 Features

The Research plus pipettes are piston-stroke pipettes that operate according to the air-cushion principle.

When the control button is pressed, the piston in the pipette moves in the same direction. If the control button and the piston are moved upwards, the liquid can be aspirated into the pipette tip. With the downward movement of the piston, the liquid is dispensed (measuring stroke).

Blow-out occurs if the downward piston stroke exceeds the first stop.

Depending on the Research plus pipette it is possible to dispense volumes from 0.1 µL to 10 mL.

The Research plus family consists of single-channel and multi-channel pipettes (8 and 12-channels) with variable volume settings, as well as single-channel fixed-volume pipettes. You can find a list of all available models of the Research plus in the "Technical Data" section.

All Research plus pipettes are fully autoclavable.

You can adjust the Research plus pipettes. The side viewing window displays the change in the adjustment.

When attaching a pipette tip, the spring-loading action of the tip cone is activated (exceptions 5 mL and 10 mL pipettes).

1.2 Delivery package

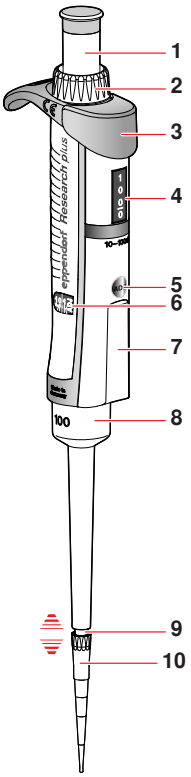
The Research plus delivery package contains:

Pcs.	Description
1	Research plus operating manual
1	Certificate
1	Adjustment tool (Allen key with a blue handle)
1	Mini CD
1	Black locking ring for single-channel pipettes ≤ 1,000 µL
5	Red adjustment seal
5	Protective filters for 5 mL and 10 mL pipettes
1	Pipette key for opening the lower part (5 mL and 10 mL)
1	O-ring tool for cutting the O-rings (only multi-channel 100 µL and 300 µL)
1	Safety plug tool
1	Pin for loosening the safety plug

1 Product description

1.3 Main illustration

1.3.1 Research plus single-channel



1 Control button
The control button and the trays of the matching epT.I.P.S. pipette tips have the same color.

2 Volume adjustment ring
To set the volume for the variable pipettes.

3 Ejector
The ejector moves the ejector sleeve and ejects the pipette tip.

4 Volume display (only variable pipettes)
The set volume is read from top to bottom.

5 Adjustment opening
The adjustment opening is fitted with the gray adjustment seal before delivery.

6 Adjustment display
Set to "0" before delivery.

7 Labeling field
Space for labels containing internal lab information. The serial number appears at the bottom.

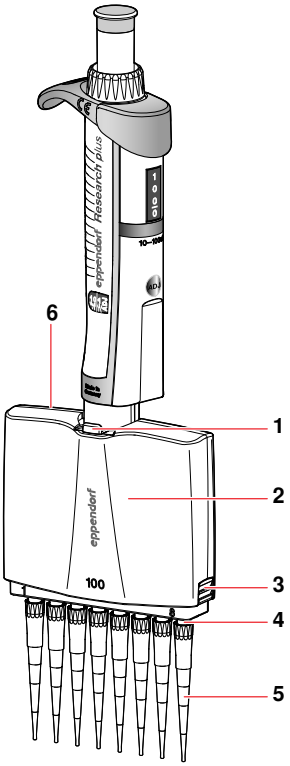
8 Ejector sleeve
Eject the pipette tips after use.

9 Spring-loaded tip cone
The spring loading action optimizes the force required for attaching and ejecting tips (no spring-loaded action with 5 mL and 10 mL pipettes). The 5 mL and 10 mL pipettes have an easily replaceable protection filter in the tip cone.

10 Pipette tip
The Research plus pipettes can only be used in combination with matching pipette tips. It is recommended to use epT.I.P.S.

1 Product description

1.3.2 Research plus multi-channel



For an explanation of the upper part of the pipette, refer to the main illustration of the single-channel pipette (see p. 5).

1 Lever

To loosen the multi-channel lower part.

2 Multi-channel lower part

The multi-channel lower part is freely rotatable. The lower part does not detach when it is rotated. The outer channels are labeled with the numbers 1 and 8 (or 12).

The multi-channel version has a piston for each channel so that fewer than 8 or 12 tips can also be fitted.

The lower part can be converted from an 8 to a 12-channel version with the same volume range. The multi-channel lower part can be opened, enabling you to replace or remove individual channels.

3 Latches on the right and left

To release the cover plate with the interior ejector rail.

4 Spring-loaded tip cones

The spring loading action optimizes the force required for attaching and ejecting tips.

5 Pipette tips

It is recommended to use epT.I.P.S.

6 Cover plate

Detachable cover plate with an interior ejector rail. The cover plate is opposite the side with the lever (1). In the view shown here, the cover plate is the rear side of the lower part.

1 Product description

1.4 Materials

CAUTION! Aggressive substances can damage the device, dispensing unit and accessories.

- Check for material compatibility before using organic solvents and aggressive chemicals.
- Follow the cleaning instructions (see *Cleaning* on p. 14).

The user-accessible components of the Research plus are made of the following materials:

Component	Material
External surfaces of the upper part	Purified polypropylene (PP), polycarbonate (PC), polyetherimide (PEI), foil
Exterior and interior of lower parts	Purified polypropylenen (PP), polyvinylidene fluoride (PVDF), polyetherimide (PEI), polyphenylene sulfide (PPS), polyetheretherketone (PEEK), polytetrafluorethylene (PTFE), ethylene-propylene-diene rubber (EPDM), silicone, steel (stainless steel and spring steel)

Pipette tip	Material
epT.I.P.S.	Polypropylene (PP)
epDualfilter T.I.P.S. filter	Polyethylene (PE)

2 Safety

2.1 Intended use

The Research plus is a lab device intended for dispensing liquids in the volume range from 0.1 µL to 10 mL, in combination with matching pipette tips. In vivo applications (applications in or on the human body) are not permitted.

The Research plus may only be operated by trained specialist staff. All users must have read the operating manual carefully and familiarized themselves with the device's mode of operation.

2.2 Warnings for intended use

WARNING! Damage to health due to handling infectious liquids and pathogenic germs.

- Observe the national regulations for handling these substances, the biological security level of your laboratory, the material safety data sheets and the manufacturer's application notes.
- Wear personal protective equipment (PPE).
- Follow the instructions regarding hygiene, cleaning and decontamination.
- For complete instructions regarding the handling of germs or biological material of risk group II or higher, please refer to the "Laboratory Biosafety Manual" (source: World Health Organization, current edition of the Laboratory Biosafety Manual).

WARNING! Damage to health due to toxic, radioactive or aggressive chemicals.

- Observe the national regulations for handling these substances as well as the material safety data sheets and manufacturer's application notes.
- Wear personal protective equipment (PPE).

CAUTION! Danger to persons from careless use.

- Never point the opening of a Research plus fitted with pipette tip at yourself or anyone else.
- Only initiate dispensing if it is safe to do so.
- For all dispensing tasks, make sure that you are not endangering yourself or anyone else.

CAUTION! Poor safety due to incorrect accessories and spare parts.

The use of accessories and spare parts other than those recommended by Eppendorf may impair the safety, functioning and precision of the device. Eppendorf cannot be held liable or accept any liability for damage resulting from the use of incorrect or non-recommended accessories and spare parts or from the improper use of such equipment.

- Only use accessories and original spare parts recommended by Eppendorf.

NOTICE! Damage to device from missing pipette tips.

- Only use the Research plus with fitted pipette tips.
- When using standard tips (without a filter): use the 1 - 10 mL and 0.5 - 5 mL pipettes only **with** the protection filter inserted.

2 Safety

NOTICE! Carry-over, contamination and incorrect dispensing results due to the incorrect use of pipette tips.

The pipette tips are for single use only. Prolonged use can have a negative impact on dispensing tasks.

- Use the pipette tips only once.
- Do not autoclave the epT.I.P.S. Dualfilter.

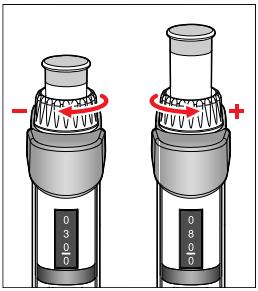
NOTICE! Incorrect dispensing volume for special liquids and from temperature differences.

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.

3 Operation

3.1 Setting the volume (only Research plus variable)



- Turn the volume setting ring as depicted to adjust the volume.

The height of the control button changes as the volume is adjusted.

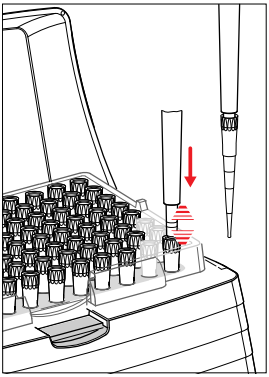
The numbers on the volume display are to be read from the top to the bottom. The decimal places are below the hyphen.

The volume is displayed up to 1 000 µL in µL. For the 5 mL and 10 mL sizes, the volume is displayed in mL.

We recommend to adjust the volume setting from a higher value to a lower value. If required, turn beyond the required value and then back again.

3.2 Using pipette tips

The liquid to be dosed is aspirated into pipette tips. It is recommended to use epT.I.P.S. The epT.I.P.S. pipette tips are available in different purities, as tips with and without a filter and as special tips. When using liquids whose surface tension is lower than that of water (e.g., due to the presence of a wetting agent in the liquid), the use of the special tips epT.I.P.S. LoRetention is recommended.



The pipette is only functional if a pipette tip has been attached. You can either attach the pipette tip by hand or directly insert the end of the pipette into a tip held in the tip storage box. If attaching a pipette tip by hand, it must be handled in such a way to avoid contamination and heating of the pipette tip.

The color of the control button of the Research plus matches the color of the epT.I.P.S. tray.

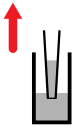
- If you are using pipette tips without a filter, insert the protection filter into the 5 mL and 10 mL pipettes.
- If you are using the 5 mL or 10 mL epDualfilter T.I.P.S., remove the protection filter in the pipette. This also applies to 5 mL / 10 mL filter tips of other manufacturers. The filters can interfere with each other. The backpressure of the two filters makes it difficult to exactly identify the first stop (see p. 11).
- Fit the suitable pipette tip(s) on the tip cone, applying light pressure.

The pipette tip is securely attached to the tip cone when it responds with spring-loaded action (exceptions: no spring-loading action for 5 mL and 10 mL single-channel pipettes)

You can deactivate the spring loading action of the tip cone in the case of single-channel pipettes (see p. 17).

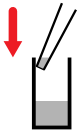
3 Operation

3.3 Aspirating liquid

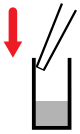


1. The liquid to be aspirated must be taken from a suitable vessel. For multi-channel pipettes, we recommend the reagent reservoir "Tip-Tub".
2. Press down the control button to the first stop (measuring stroke).
3. Immerse the pipette tip(s) vertically approx. 4 mm into the liquid.
4. To aspirate liquid, allow the control button to slide back slowly. Maintain the immersion depth, so that no air is aspirated accidentally.
5. In the case of large volumes: before removing the pipette tip from the liquid, wait for approx. 3 seconds. To ensure maximum precision and accuracy, we recommend to wet each new tip initially by aspirating and dispensing the liquid one to three times. Only then should pipetting commence.
6. Remove the tip(s) slowly from the liquid.
7. Wipe the tip(s) slowly against the tube wall to ensure that no outer wetting remains on the tip.

3.4 Dispensing liquid



1. Place the tip(s) on the tube wall at an angle.
2. Press the control button slowly until the first stop (measuring stroke) and wait until the flow of liquid stops.



3. To empty the tip(s) completely, press down the control button until the second stop (blow-out).
4. Hold down the control button and wipe the tip(s) against the tube inner wall.
5. Let the control button slide back slowly outside of the tube.
6. To eject the tips, press the ejector.

Pipette tips are for single use only.

4 Troubleshooting

4.1 Error search

Symptom	Possible cause	Solution
Liquid is dripping from the tip and/or the dispensed volume is incorrect.	• The tip is loose or the pipette tip is poorly fitted.	▶ Press the tip on firmly, use epT.I.P.S. If using 5 mL and 10 mL epDualfilter T.I.P.S., do not use protection filters in the pipette.
	• Liquid with high vapor pressure and/or different density.	▶ Wet the tip several times and adjust the pipette for the liquid used.
	• Pipetted too quickly.	▶ Move the control button slowly.
	• The tip is withdrawn from the liquid too quickly.	▶ Slowly remove the tip with a time delay (approx. 3 seconds) from the liquid.
	• Liquid aspirated with blow-out and dispensed with blow-out.	▶ Repeat dispensing correctly.
	• The piston is soiled or damaged.	▶ Clean the piston, relubricate slightly and/or replace.
	• The tip cone is damaged.	▶ Replace the lower part or channel.
	• The O-rings of the tip cones are damaged.	▶ Replace the O-rings (only 100 µL, 300 µL multi-channel).
The control button jams and does not move smoothly.	• The piston is soiled. • The seal is soiled. • The pipette is blocked.	▶ Clean the lower part. ▶ 5 mL and 10 mL sizes: replace the protection filter.
The adjustment seal has been removed; the adjustment display has been changed.	• The pipette has been adjusted for another liquid.	▶ Adjust the pipette for the liquid used (see *Adjusting pipettes* on p. 22).
No spring-loading action of the tip cone when taking up pipette tips.	• Spring-loading action is blocked by a locking ring.	▶ Remove the locking ring again.
	• The use of a 5 mL or 10 mL pipette.	No remedy. The tip cone does not respond with spring-loaded action in combination with these sizes.

4 Troubleshooting

To avoid dispensing errors, check the precision and accuracy of the Research plus at regular intervals. The "PICASO" program (from Version 2.3) is available to determine the permitted measured systematic and random errors. If the pipette is used at an extremely high location, it must be adjusted to the ambient air pressure. A SOP (Standard Operation Procedure) for checking pipettes can be found on the Research plus CD and on our website www.eppendorf.com.

NOTICE! Aggressive substances can damage the pipette, pipette tips and the accessories.

- Check for material compatibility before using organic solvents and aggressive chemicals.
- Follow the cleaning instructions.

- All single and multi-channel lower parts are wear parts. Clean them after contamination, use of aggressive chemicals and/or heavy stress. If the lower parts are worn or damaged, replace the respective parts.
- Faulty dispensing results are sometimes due to lack of maintenance.

5.1 Cleaning

NOTICE! Damage to device from unsuitable cleaning fluids or sharp or pointed objects

Unsuitable cleaning fluids can damage the surfaces and printing.

- Never use corrosive cleaning fluids, strong solvents or abrasive polishes.
- Note the information on chemical resistance (see the Research plus CD).
- Do not use acetone to clean the Research plus.
- Do not use sharp objects to clean the Research plus.

Remove any contamination on the outside of the Research plus as follows:

- Wet a cloth with a mild cleaning fluid and water and remove the contamination.
- To remove heavy contamination resulting from liquid penetration, disassemble the lower part of the pipette (see *Research plus disassembly and assembly* on p. 17) and clean it with demineralized water.

Relubricate the piston sealing rings after contamination, use of aggressive chemicals and/or heavy stress. Remove the old grease before relubricating.

Only use the grease specified in the ordering information (see the enclosed CD).

5 Maintenance

5.2 Sterilizing or disinfecting the pipette

NOTICE! Damage to device from incorrect handling.

- Do not use any additional disinfectants, decontamination agents or sodium hypochlorite during autoclaving or UV exposure.
- When autoclaving make sure that the temperature does not exceed 121 °C.
- Before using disinfecting agents or decontaminating agents, test for material compatibility and check the manufacturer's instructions about chemical resistance. Consider also the material of the pipette.

5.2.1 Autoclaving

All Research plus pipettes are completely steam autoclavable.

Before autoclaving

1. Remove any contamination from the exterior and in the lower part (see *Research plus disassembly and assembly* on p. 17).
2. If you remove existing grease, slightly relubricate the piston seal using only the grease specified in the ordering information (see the enclosed CD).

Procedure

Follow the operating manual of the autoclave manufacturer.

1. Autoclave at: 121 °C; 20 minutes; 1 bar overpressure
2. When placing the Research plus into the autoclave, make sure that the temperature at the pipette does not exceed 121 °C.
3. You can put the Research plus into the autoclave as a whole unit or with the lower part removed. Do not disassemble the lower part.
4. For 5 mL and 10 mL pipettes: remove the old protection filter. Add a new protection filter and install it after autoclaving. Autoclave the protection filter only once.
5. If lower parts have been removed, make sure that no lower parts are confused during reassembly. (Tip: Use one plastic beaker per pipette).

After autoclaving

- Cool the pipette down to room temperature and leave to dry.
- For 5 mL / 10 mL pipettes: the protection filter swells during autoclaving. Slightly compress the protection filter when inserting it into the tip cone.

  The piston does not need to be relubricated after autoclaving. If autoclaving is carried out as described above, no gravimetric testing or adjustment is necessary.

5 Maintenance

5.2.2 Disinfection

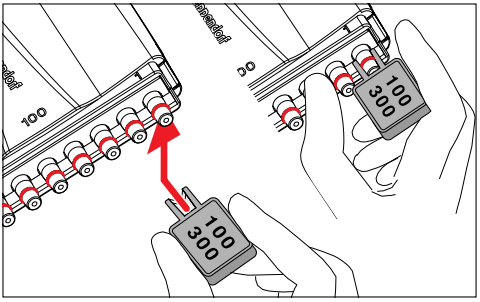
- Carefully wipe off the outer surfaces with disinfectant, DNA/RNA decontamination agents or 70% isopropanol.
- You can wipe the outside of the tip cone and the ejector sleeve with a sodium hypochlorite solution of 4%.
- After the exposure time of the sodium hypochlorite solution has elapsed, remove thoroughly with demineralized water.

The Research plus pipettes may be temporarily subjected to the UV light of a sterile bench (≥254 nm).

5.3 Replacing O-rings

The 100 µL and 300 µL multi-channel lower parts are equipped with O-rings. These are wear parts. Replace old, worn or damaged O-rings. Defective O-rings result in the incorrect positioning of the tips and in dispensing errors.

5.3.1 Removing the O-ring



1. Push the opening of the O-ring tool (included in the delivery package) against the tip cone from the side so that the sharp edge in the opening of the O-ring tool is positioned on top of the o-ring. Do not slide the O-ring tool onto the cone!
2. Supporting the O-ring tool with your thumb, push it firmly against the tip cone.
   This O-ring is cut in one place.
3. Remove the O-ring tool and the O-ring from the tip cone.

5.3.2 Mounting a new O-ring

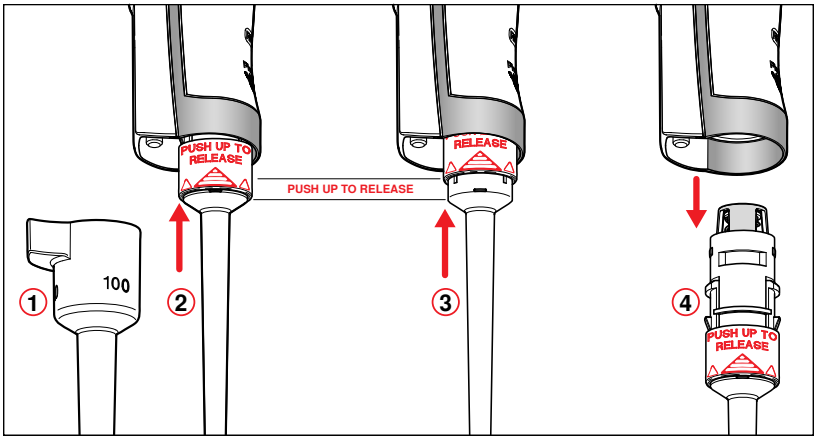
1. Fit the mounting aid (shortened pipette tip, included in the delivery package of the O-rings) on the tip cone.
2. Push the new O-ring over the tip onto the tip cone.
3. Check that the pipette tips are correctly positioned. Ensure that the tips are tightly sealed and properly aligned.

5 Maintenance

5.4 Research plus disassembly and assembly

5.4.1 Single-channel up to 1 000 µL

Removing the lower part



1. Keep the ejector pressed and remove the ejector sleeve ①.
2. ② and ③: on the lower part, slide the ring marked "**PUSH UP TO RELEASE**" up by about 5 mm until the lower part comes off.
3. ④: take the lower part out of the upper part.

Deactivating the spring-loading action: installing the locking ring

For the following dispensing tasks it can be helpful to deactivate the spring loading action of the tip cone.

- A pipette tip is to be used for a long period.
- The pipette tip is slightly bended during dispensing.

Deactivating this action can also be helpful for pipette tips which are not designed for the Eppendorf pipette tip cone.

The spring loading action of the tip cone can be deactivated by installing the locking ring. The locking ring is included in the delivery package.

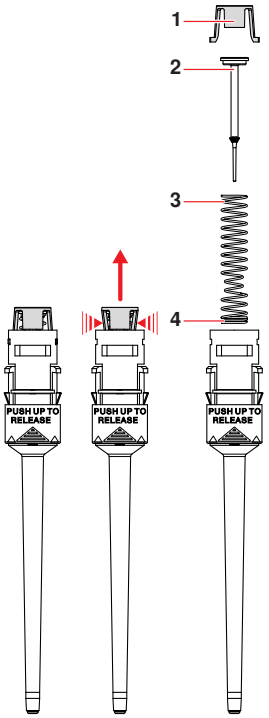
1. Push the black locking ring onto the lower part from the top. Slightly squeeze the clamps on the lower part when doing so.
2. Insert the lower part into the upper part until it engages audibly.
3. Keep the ejector pressed. The ejector rod protrudes from the upper part.
4. Fit the ejector sleeve onto the ejector rod. It is fitted correctly if it engages slightly.

Remove the locking ring to reactivate the spring-loading action.

5 Maintenance

Opening and assembling the lower part (≤1 000 µL)

To avoid confusion of parts, only disassemble and assemble one pipette at a time.



Opening the lower part:

1. On the piston mount (1) push the locking mechanisms together slightly.
2. Remove the piston mount.
3. Remove the piston (2) and the piston spring (3). The piston is under spring tension. Pistons and piston springs will look different for the individual volume versions.

Assembling the lower part:

1. Carefully guide the piston and the piston spring into the cylinder. Make sure that the piston is guided correctly in the piston spring and in the cylinder. There must not be any perceptible resistance. **Stop pushing as soon as any resistance is felt** This may indicate that the piston is not positioned correctly in the cylinder. There is a risk of bending the piston if too much force is applied. Carefully pull out the piston and repeat the process correctly. In the case of piston springs with double windings (4), these windings must point downwards.
2. Keep the piston and the piston spring pressed.
3. Keep the locking mechanisms on the piston mount pressed with the other hand.
4. Mount the piston mount in such a way that the two locking mechanisms engage in their retainers.
5. Gently press a pipette tip against the inserted piston. The piston must move down in the cylinder without any noticeable resistance.

Installing the lower part and ejector sleeve:

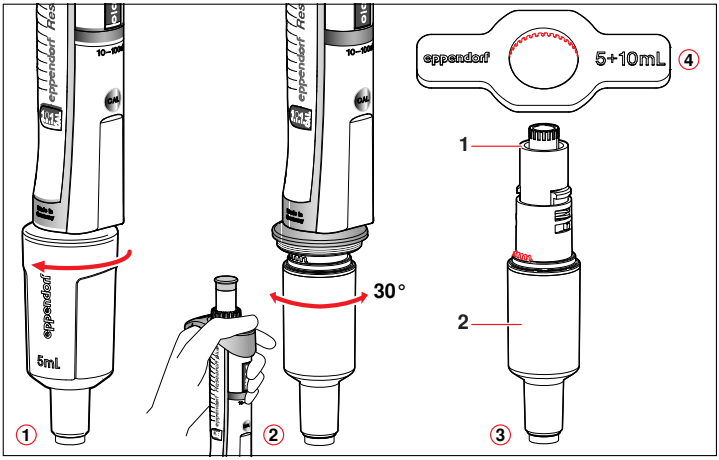
1. Insert the lower part into the upper part until it engages audibly.
2. Set the maximum volume and operate the control button several times. It must run smoothly and resistance-free.
3. Keep the ejector pressed. The ejector rod protrudes from the upper part.
4. Fit the ejector sleeve onto the ejector rod. It is fitted correctly if it engages slightly.
5. Carry out a gravimetric test of the systematic and random error (see *Technical data* on p. 35).

This test ensures that no parts were confused during assembly and that the pipette has been assembled correctly.

5 Maintenance

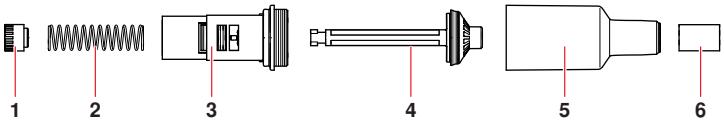
5.4.2 5 mL and 10 mL single-channel

Replace the protection filter in the tip cone after each contact with liquid or if it is frayed.



1. ①: unscrew the ejector sleeve.
2. ②: keep the ejector pressed and turn the lower part to the left or right by approximately 30°.
   The lower part is automatically released from the upper part.
3. ③: open the lower part: fit the pipette key ④ (included in the delivery package) onto the lower part. Hold the cylinder and unscrew it from the lower part.
   See the next figure.
4. Hold the piston (4) which is now partly visible in the lower part.
5. Push the piston mount (1) slightly downwards (3 mm) and turn it by 45°.
   The piston spring pushes the piston mount upwards. The lower part opens.

The lower part consists of the following:



1 5 mL / 10 mL piston mount	**2 Piston spring**
3 Upper part of the lower part	**4 Piston (with seal)**
5 Cylinder and tip cone	**6 Protection filter in the tip cone**

5 Maintenance

Before assembling the pipette, first install the piston mount, the piston spring and the piston in the upper part of the lower part. Further assembly is as shown in the figures. Carry out the procedure in reverse order. After the assembly:

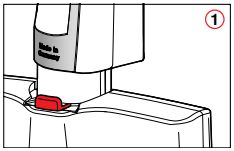
The assembly is performed in reverse order. After the assembly:

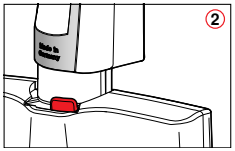
- Carry out a gravimetric test of the systematic and random error (see *Technical data* on p. 35).

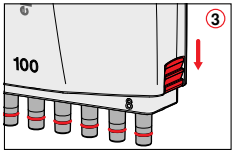
  This test ensures that no parts were confused during assembly and that the pipette has been assembled correctly.

5.4.3 Multi-channel

Loosen and open the 10 µL, 100 µL and 300 µL multi-channel lower part







1. ① and ②: slide the lever on the lower part to the left or right.

   This separates the lower part from the upper part so that it can be removed.
2. Put down the lower part with the lever facing downwards.
3. ③: slide the two latches (right and left at the side) down. Use a coin to do this.

   The lower part is still lying with the lever facing downwards.
4. Take off the cover plate with the integrated ejector rail.

Do **not** remove the ejector rail from the cover plate. The spring for the ejector rail could accidentally come off and get lost.

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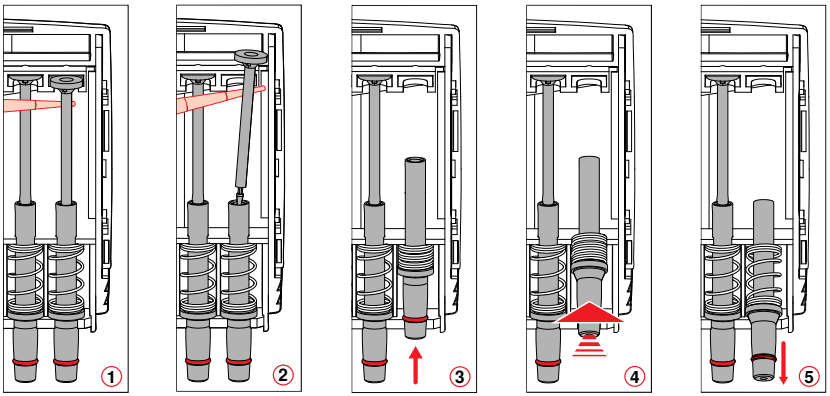
Removing and installing channels

Channels must only be removed and installed if the multi-channel lower part is separated from the upper part! The channels in the lower parts consist of a piston, a cylinder and a spring. The channels for 100 µL and 300 µL are equipped with an O-ring at the tip cone (see *Replacing O-rings* on p. 16).



1. ① and ②: position a pipette tip under the piston and carefully take the piston off the upper rail.
2. Carefully pull the piston out in an upward direction. **Do not bend the piston.**
3. Hold the tip cone at the lower end and push it slightly upwards ③.
   This compresses the spring.
4. ④: lift the tip cone slightly and release it from the lower rail.
5. ⑤: relax the spring by letting the tip cone slide back again above the lower rail.
6. ⑤: take the tip cone with the cylinder and the spring out of the upper rail.
   Before installation, slide the piston into the cylinder. Install the channels in reverse order.

Assembling the 10 - 300 µL multi-channel pipette

1. Fit the cover plate with the integrated ejector.
2. Push the latches upwards.
3. To mount, push the lower part into the upper part until it audibly engages.
4. Carry out a gravimetric test of the systematic and random error (see p. 35).
   This test ensures that no parts were confused during assembly and that the pipette has been assembled correctly.

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5.5 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.

5.5.1 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.

In addition to changing the user adjustment, a Research plus with variable volume setting can be permanently changed by altering the factory adjustment (see *Changing the factory adjustment* on p. 25).

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:

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

5 Maintenance

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.

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5.5.2 Changing the user adjustment

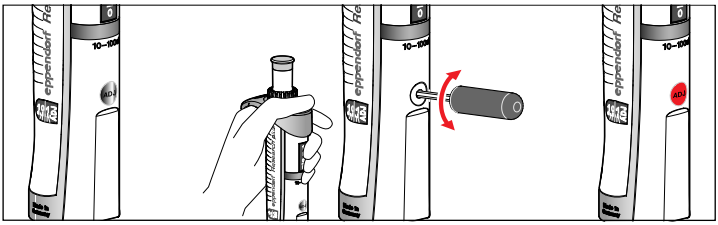
If the adjustment is changed, the volume changes by a certain value. Strictly speaking, the change only applies to the testing volume.

Auxiliary equipment

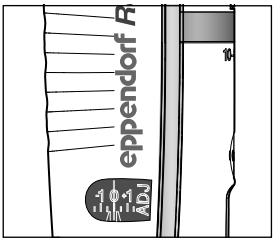
- Supplied adjustment tool (order no. 3120 633.006)
- Supplied red adjustment seal (ADJ)

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.

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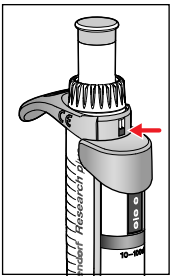
5.5.3 Changing the factory adjustment

Auxiliary equipment

- Supplied safety plug tool
- Supplied pin to loosen the safety plug

It is possible to change the factory adjustment with the corresponding accessories for a Research plus with variable volume setting. If the factory adjustment of the Research plus has been changed by a user, this can be recognized by a red safety plug behind the ejector. If the Research plus has been adjusted and calibrated by Eppendorf AG, this is indicated by a gray safety plug.



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

If the dispensing accuracy is only be to changed temporarily, the correct method is to change the user adjustment. Before changing the user or factory adjustment, observe the general notes (see *General notes on user and factory adjustment settings* on p. 22) and the associated gravimetric tests.

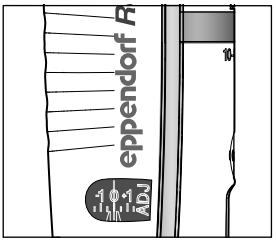
In the case of Research plus fixed-volume pipettes, modifications are only possible by changing the user adjustment (see *Changing the user adjustment* on p. 24).

5.5.4 Research plus variable - changing the factory adjustment

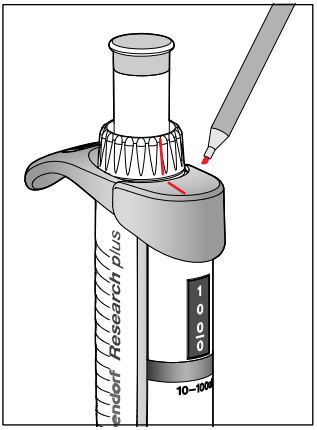
If a gravimetric test indicates that an error needs to be corrected and you are required to carry out a change to the factory adjustment, proceed as follows:

1. Check whether the adjustment display on the side is set to "0".

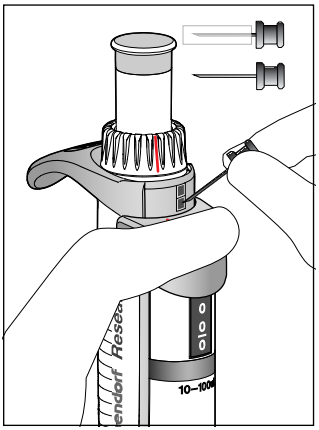
   If the adjustment display is not set to "0", you will first need to set it to "0" with the adjustment tool. In this case, instead of continuing with the factory adjustment changes, carry out a gravimetric test of the Research plus with the adjustment display set to "0".



2. Mark the volume setting ring and the ejector with a common mark with a pen. This mark serves as an orientation for factory adjustment changes. When changing the factory adjustment, you can turn the volume setting ring, without the volume display changing. The mark on the volume setting ring and the ejector informs you how far you have moved from the factory setting.



3. Keep the ejector pressed and remove the safety plug with the pin.



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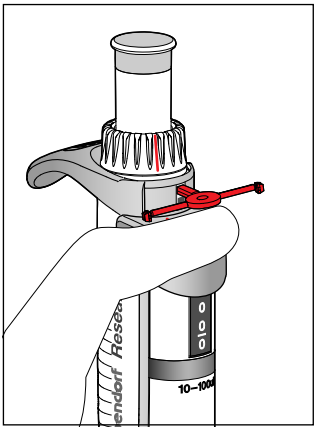
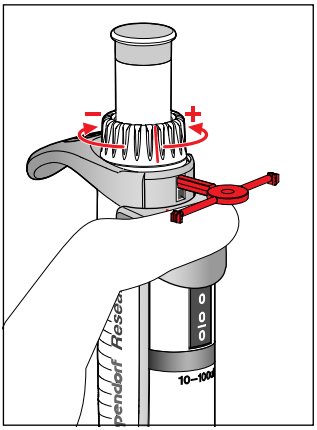
4. Continue to keep the ejector pressed. Insert the safety plug tool such that the counter locking mechanism is pushed down.



5. Turn the volume setting ring slightly to change the volume. Proceed as shown in the figure.



This results in the following approximate volume changes:

Single-channel				
Nominal volume **Color code**	**+½ revolution**	**+¼ revolution**	**–¼ revolution**	**–½ revolution**
2.5 µL dark gray	0.106 µl	0.053 µl	–0.053 µL	–0.106 µL
10 µL medium gray	0.53 µl	0.27 µl	–0.27 µL	–0.53 µL
20 µL light gray	1.06 µl	0.53 µl	–0.53 µL	–1.06 µL
20 µL yellow	1.07 µl	0.54 µl	–0.54 µL	–1.07 µL
100 µL yellow	5.4 µl	2.7 µl	–2.7 µL	–5.4 µL
200 µL yellow	10.8 µl	5.4 µl	–5.4 µL	–10.8 µL
300 µL orange	10.7 µl	5.4 µl	–5.4 µL	–10.7 µL
1 000 µL blue	54 µL	27 µL	–27 µL	–54 µL
5 mL purple	271 µL	135 µL	–135 µL	–271 µL
10 mL turquoise	542 µL	271 µL	–271 µL	–542 µL

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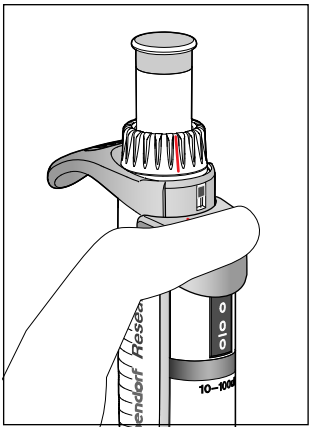
Multi-channel				
Nominal volume **Color code**	**+½ revolution**	**+¼ revolution**	**–¼ revolution**	**–½ revolution**
10 µL medium gray	0.53 µl	0.27 µl	–0.27 µL	–0.53 µL
100 µL yellow	5.4 µl	2.7 µl	–2.7 µL	–5.4 µL
300 µL orange	10.7 µl	5.4 µl	–5.4 µL	–10.7 µL

The values mentioned are theoretical values and are for orientation purposes only. The volume changes mentioned apply to each volume setting. For the volume change, you should first set the optimal value for 10% of the nominal volume and then carry out a gravimetric test. Afterwards carry out gravimetric tests to check 50% and 100% of the nominal volume with this setting. Change the selected setting again if necessary to achieve the best possible correction for all volumes. Use the error limits in accordance with ISO 8655-2 (see p. 31) and the technical data provided by Eppendorf AG (see p. 35) to decide whether the data obtained meets your requirements.

6. Slide the locking mechanism up and carry out a gravimetric test of the changes which have been made.

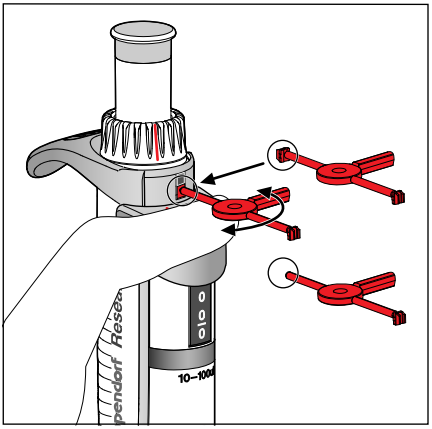


7. If the measured gravimetric values meet your requirements: Slide the locking mechanism up.

5 Maintenance

8. Insert the red safety plug on the tool into the opening of the Research plus and break it off from the tool.

   The red safety plug on the pipette indicates that the Research plus has been adjusted by the user. If the adjustment display had also been set to "0" before, you must close the opening with a new, red adjustment seal at the position for the adjustment seal.



9. Document the changes made and the measurements conducted. Remove the mark on the volume setting ring and the ejector. The red safety plug on the pipette indicates that the Research plus has been adjusted and calibrated by the user.

5 Maintenance

5.5.5 Error limits in accordance with ISO 8655-2

Error limits in accordance with ISO 8655-2 - Research plus variable single-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
0.1 - 2.5 µL Increment: 0.002 µL	dark gray 0.1 - 10 µL 34 mm	0.1 µL	± 100.0	± 0.1	± 75.0	± 0.075
		0.25 µL	± 50.0	± 0.125	± 30.0	± 0.075
		1.25 µL	± 10.0	± 0.125	± 6.0	± 0.075
		2.5 µL	± 5.0	± 0.125	± 3.0	± 0.075
0.5 - 10 µL Increment: 0.01 µL	medium gray 0.1 - 20 µL 40 mm	0.5 µL	± 24.0	± 0.12	± 16.0	± 0.08
		1 µL	± 12.0	± 0.12	± 8.0	± 0.08
		5 µL	± 2.4	± 0.12	± 1.6	± 0.08
		10 µL	± 1.2	± 0.12	± 0.8	± 0.08
2 - 20 µL Increment: 0.02 µL	light gray 0.5 - 20 µL L 46 mm	2 µL	± 10.0	± 0.2	± 5.0	± 0.1
		10 µL	± 2.0	± 0.2	± 1.0	± 0.1
		20 µL	± 1.0	± 0.2	± 0.5	± 0.1
2 - 20 µL Increment: 0.02 µL	yellow 2 - 200 µL 53 mm	2 µL	± 10.0	± 0.2	± 5.0	± 0.1
		10 µL	± 2.0	± 0.2	± 1.0	± 0.1
		20 µL	± 1.0	± 0.2	± 0.5	± 0.1
10 - 100 µL Increment: 0.01 µL	yellow 2 - 200 µL 53 mm	10 µL	± 8.0	± 0.8	± 3.0	± 0.3
		50 µL	± 2.0	± 0.8	± 0.6	± 0.3
		100 µL	± 0.8	± 0.8	± 0.3	± 0.3
20 - 200 µL Increment: 0.02 µL	yellow 2 - 200 µL 53 mm	20 µL	± 8.0	± 1.6	± 3.0	± 0.6
		100 µL	± 2.0	± 1.6	± 0.6	± 0.6
		200 µL	± 0.8	± 1.6	± 0.3	± 0.6

Error limits in accordance with ISO 8655-2 - Research plus variable single-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
30 - 300 µL Increment: 0.02 µL	orange 20 - 300 µL 55 mm	30 µL	± 13.0	± 3.9	± 5.0	± 1.5
		150 µL	± 3.0	± 3.9	± 1.0	± 1.5
		300 µL	± 1.3	± 3.9	± 0.5	± 1.5
100 - 1 000 µL Increment: 1 µL	blue 50 - 1 000 µL 71 mm	100 µL	± 8.0	± 8.0	± 3.0	± 3.0
		500 µL	± 2.0	± 8.0	± 0.6	± 3.0
		1 000 µL	± 0.8	± 8.0	± 0.3	± 3.0
0.5 - 5 mL Increment: 5 µL	purple 0.1 - 5 mL 120 mm	0.5 mL	± 8.0	± 40.0	± 3.0	± 15.0
		2.5 mL	± 1.6	± 40.0	± 0.6	± 15.0
		5.0 mL	± 0.8	± 40.0	± 0.3	± 15.0
1 - 10 mL Increment: 10 µL	turquoise 1 – 10 ml 165 mm	1.0 mL	± 6.0	± 60.0	± 3.0	± 30.0
		5.0 mL	± 1.2	± 60.0	± 0.6	± 30.0
		10.0 mL	± 0.6	± 60.0	± 0.3	± 30.0

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Error limits in accordance with ISO 8655-2 - Research plus variable multi-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
0.5 - 10 µL Increment: 0.01 µL	medium gray 0.1 - 20 µL 40 mm	0.5 µL	± 48.0	± 0.24	± 32.0	± 0.16
		1 µL	± 24.0	± 0.24	± 16.0	± 0.16
		5 µL	± 4.8	± 0.24	± 3.2	± 0.16
		10 µL	± 2.4	± 0.24	± 1.6	± 0.16
10 - 100 µL Increment: 0.01 µL	yellow 2 - 200 µL 53 mm	10 µL	± 16.0	± 1.6	± 6.0	± 0.6
		50 µL	± 3.2	± 1.6	± 1.2	± 0.6
		100 µL	± 1.6	± 1.6	± 0.6	± 0.6
30 - 300 µL Increment: 0.02 µL	orange 20 - 300 µL 55 mm	30 µL	± 26.0	± 7.8	± 10.0	± 3.0
		150 µL	± 5.2	± 7.8	± 2.0	± 3.0
		300 µL	± 2.6	± 7.8	± 1.0	± 3.0

5.6 Decontamination before shipment

If you wish to return the pipette to Eppendorf AG or an Eppendorf AG service partner to be checked or repaired, please note the following:

CAUTION! Use of a contaminated device may result in personal injuries and damage to the device.

- Clean and decontaminate the Research plus before shipping or storage according to the cleaning instructions.
- Read the instructions regarding the decontamination certificate included on the Research plus CD or visit (www.eppendorf.com/decontamination).
- Enter the serial number of the Research plus in the decontamination certificate. This can be found at the lower end of the entry field.
- Enclose the fully-completed decontamination certificate for returned goods with the Research plus.

Hazardous substances are:

- solutions presenting a hazard to health
- potentially infectious agents
- organic solvents and reagents
- radioactive substances
- proteins presenting a hazard to health
- DNA

1. Please note the information in the document "Decontamination certificate for product returns". You can find it as a PDF file on our homepage www.eppendorf.com.
2. Enter the serial number of the Research plus in the decontamination certificate. This can be found at the lower end of the entry field.
3. With the shipment please include the completed and signed "Decontamination certificate for product returns" for each pipette.

6 Technical data

6.1 Research plus single-channel variable

Research plus variable single-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
0.1 - 2.5 µL Increment: 0.002 µL	dark gray 0.1 - 10 µL 34 mm	0.1 µL	± 48	± 0.048	± 12	± 0.012
		0.25 µL	± 12	± 0.03	± 6	± 0.015
		1.25 µL	± 2.5	± 0.031	± 1.5	± 0.019
		2.5 µL	± 1.4	± 0.035	± 0.7	± 0.018
0.5 - 10 µL Increment: 0.01 µL	medium gray 0.1 - 20 µL 40 mm	0.5 µL	± 8	± 0.04	± 5	± 0.025
		1 µL	± 2.5	± 0.025	± 1.8	± 0.018
		5 µL	± 1.5	± 0.075	± 0.8	± 0.04
		10 µL	± 1.0	± 0.1	± 0.4	± 0.04
2 - 20 µL Increment: 0.02 µL	light gray 0.5 - 20 µL L 46 mm	2 µL	± 5	± 0.1	± 1.5	± 0.03
		10 µL	± 1.2	± 0.12	± 0.6	± 0.06
		20 µL	± 1.0	± 0.2	± 0.3	± 0.06
2 - 20 µL Increment: 0.02 µL	yellow 2 - 200 µL 53 mm	2 µL	± 5	± 0.1	± 1.5	± 0.03
		10 µL	± 1.2	± 0.12	± 0.6	± 0.06
		20 µL	± 1.0	± 0.2	± 0.3	± 0.06
10 - 100 µL Increment: 0.1 µL	yellow 2 - 200 µL 53 mm	10 µL	± 3	± 0.3	± 1	± 0.1
		50 µL	± 1	± 0.5	± 0.3	± 0.15
		100 µL	± 0.8	± 0.8	± 0.2	± 0.2
20 - 200 µL Increment: 0.2 µL	yellow 2 - 200 µL 53 mm	20 µL	± 2.5	± 0.5	± 0.7	± 0.14
		100 µL	± 1	± 1	± 0.3	± 0.3
		200 µL	± 0.6	± 1.2	± 0.2	± 0.4

6 Technical data

Research plus variable single-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
30 - 300 µL Increment: 0.2 µL	orange 20 - 300 µL 55 mm	30 µL	± 2.5	± 0.75	± 0.7	± 0.21
		150 µL	± 1	± 1.5	± 0.3	± 0.45
		300 µL	± 0.6	± 1.8	± 0.2	± 0.6
100 - 1 000 µL Increment: 1 µL	blue 50 - 1 000 µL 71 mm	100 µL	± 3	± 3	± 0.6	± 0.6
		500 µL	± 1	± 5	± 0.2	± 1
		1 000 µL	± 0.6	± 6	± 0.2	± 2
0.5 - 5 mL Increment: 0.005 mL	purple 0.1 - 5 mL 120 mm	0.5 mL	± 2.4	± 12	± 0.6	± 3
		2.5 mL	± 1.2	± 30	± 0.25	± 6
		5.0 mL	± 0.6	± 30	± 0.15	± 8
1 - 10 mL Increment: 0.01 mL	turquoise 1 – 10 ml 165 mm	1.0 mL	± 3	± 30	± 0.6	± 6
		5.0 mL	± 0.8	± 40	± 0.2	± 10
		10.0 mL	± 0.6	± 60	± 0.15	± 15

6 Technical data

6.2 Research plus multi-channel variable

Research plus variable multi-channel						
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Testing volume**	**Error limits**			
			Error			
			Systematic		**Random**	
			± %	**± µL**	**± %**	**± µL**
0.5 – 10 µL Increment: 0.01 µL	medium gray 0.1 - 20 µL 40 mm	0.5 µL	± 12	± 0.06	± 8.0	± 0.04
		1 µL	± 8.0	± 0.08	± 5.0	± 0.05
		5 µL	± 4.0	± 0.2	± 2.0	± 0.1
		10 µL	± 2.0	± 0.2	± 1.0	± 0.1
10 – 100 µL Increment: 0.1 µL	yellow 2 - 200 µL 53 mm	10 µL	± 3.0	± 0.3	± 2.0	± 0.2
		50 µL	± 1.0	± 0.5	± 0.8	± 0.4
		100 µL	± 0.8	± 0.8	± 0.3	± 0.3
30 – 300 µL Increment: 0.2 µL	orange 20 - 300 µL 55 mm	30 µL	± 3.0	± 0.9	± 1.0	± 0.3
		150 µL	± 1.0	± 1.5	± 0.5	± 0.75
		300 µL	± 0.6	± 1.8	± 0.3	± 0.9

6 Technical data

6.3 Research plus fix

Research plus fixed volume					
Model	**Test tip** **epT.I.P.S. Color code** **Volume range** **Length**	**Error limits**			
		Error			
		Systematic		**Random**	
		± %	**± µL**	**± %**	**± µL**
10 µL	medium gray 0.1 - 20 µL 40 mm	± 1.2	± 0.12	± 0.6	± 0.06
20 µL	light gray 0.5 - 20 µL L 46 mm	± 0.8	± 0.16	± 0.3	± 0.06
10 µL	yellow 2 - 200 µL 53 mm	± 1.2	± 0.12	± 0.6	± 0.06
20 µL		± 1.0	± 0.2	± 0.3	± 0.06
25 µL		± 1.0	± 0.25	± 0.3	± 0.08
50 µL		± 0.7	± 0.35	± 0.3	± 0.15
100 µL		± 0.6	± 0.6	± 0.2	± 0.2
200 µL		± 0.6	± 1.2	± 0.2	± 0.4
200 µL	blue 50 - 1 000 µL 71 mm	± 0.6	± 1.2	± 0.2	± 0.4
250 µL		± 0.6	± 1.5	± 0.2	± 0.5
500 µL		± 0.6	± 3	± 0.2	± 1
1 000 µL		± 0.6	± 6	± 0.2	± 2

Test conditions according to ISO 8655-1, 8655-2 and 8655-6 for piston-stroke pipettes with air cushion by means of a fine balance with evaporation protection, tested by the German gauging office.

Number of determinations: 10; water according to ISO 3696; 20 °C to 25 °C ±0.5 °C constant; with pre-wetted pipette tip; dispensing against the tube wall.

6 Technical data

6.4 Ambient conditions

	Temperature range	Relative humidity
Storage without transport packaging	–5 to 45 °C	10 to 95%
Operating conditions	5 to 40 °C	10 to 95%

Technical specifications subject to change.

7 Ordering information

The ordering information can be found on the Research plus CD.

Eppendorf offices

AUSTRALIA & NEW ZEALAND

Eppendorf South Pacific Pty. Ltd.
Phone: +61 2 9889 5000
Fax: +61 2 9889 5111
E-mail: Info@eppendorf.com.au
Internet: www.eppendorf.com.au

AUSTRIA

Eppendorf Austria GmbH
Phone: +43 (0) 1 890 13 64 - 0
Fax: +43 (0) 1 890 13 64 - 20
E-mail: office@eppendorf.at
Internet: www.eppendorf.at

BRAZIL

Eppendorf do Brasil Ltda.
Phone: +55 11 30 95 93 44
Fax: +55 11 30 95 93 40
E-mail:
eppendorf@eppendorf.com.br
Internet: www.eppendorf.com.br

CANADA

Eppendorf Canada Ltd.
Phone: +1 905 826 5525
Fax: +1 905 826 5424
E-mail: canada@eppendorf.com
Internet: www.eppendorfna.com

CHINA

Eppendorf China Ltd.
Phone: +86 21 38560500
Fax: +86 21 38560555
E-mail: market.info@eppendorf.cn
Internet: www.eppendorf.cn

CZECH REP. & SLOVAKIA

Eppendorf Czech & Slovakia s.r.o.
Phone: +420 323 605 454
Fax: +420 323 605 454
E-mail: eppendorf@eppendorf.cz
Internet: www.eppendorf.cz /
www.eppendorf.sk

FRANCE

Eppendorf France S.A.R.L.
Phone: +33 1 30 15 67 40
Fax: +33 1 30 15 67 45
E-mail: eppendorf@eppendorf.fr
Internet: www.eppendorf.fr

GERMANY

Eppendorf Vertrieb
Deutschland GmbH
Phone: +49 2232 418-0
Fax: +49 2232 418-155
E-mail: vertrieb@eppendorf.de
Internet: www.eppendorf.de

INDIA

Eppendorf India Limited
Phone: +91 44 42 11 13 14
Fax: +91 44 42 18 74 05
E-mail: info@eppendorf.co.in
Internet: www.eppendorf.co.in

ITALY

Eppendorf s.r.l.
Phone: +390 2 55 404 1
Fax: +390 2 58 013 438
E-mail: eppendorf@eppendorf.it
Internet: www.eppendorf.it

JAPAN

Eppendorf Co. Ltd.
Phone: +81 3 5825 2363
Fax: +81 3 5825 2365
E-mail: info@eppendorf.jp
Internet: www.eppendorf.jp

NORDIC

Eppendorf Nordic Aps
Phone: +45 70 22 2970
Fax: +45 45 76 7370
E-mail: nordic@eppendorf.dk
Internet: www.eppendorf.dk

SOUTH & SOUTHEAST ASIA

Eppendorf Asia Pacific Sdn. Bhd.
Phone: +60 3 8023 2769
Fax: +60 3 8023 3720
E-mail:
eppendorf@eppendorf.com.my
Internet: www.eppendorf.com.my

SPAIN

Eppendorf Ibérica S.L.U.
Phone: +34 91 651 76 94
Fax: +34 91 651 81 44
E-mail: iberica@eppendorf.es
Internet: www.eppendorf.es

SWITZERLAND

Vaudaux-Eppendorf AG
Phone: +41 61 482 1414
Fax: +41 61 482 1419
E-mail: vaudaux@vaudaux.ch
Internet: www.eppendorf.ch

UNITED KINGDOM

Eppendorf UK Limited
Phone: +44 1223 200 440
Fax: +44 1223 200 441
E-mail: sales@eppendorf.co.uk
Internet: www.eppendorf.co.uk

USA

Eppendorf North America, Inc.
Phone: +1 516 334 7500
Fax: +1 516 334 7506
E-mail: info@eppendorf.com
Internet: www.eppendorfna.com

OTHER COUNTRIES

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In touch with life

Your local distributor: www.eppendorf.com/worldwide

Eppendorf AG · 22331 Hamburg · Germany · Tel: +49 40 538 01-0 · Fax: +49 40 538 01-556
E-Mail: eppendorf@eppendorf.com
Eppendorf North America, Inc. · 102 Motor Parkway, Suite 410 · Hauppauge, NY 11788-5178 · USA
Tel: +1 516 334 7500 · Toll free phone: +1 800 645 3050 · Fax: +1 516 334 7506 · E-Mail: info@eppendorf.com

Application Support

Europe, International: Tel: +49 1803 666 789 · E-Mail: support@eppendorf.com
North America: Tel: +1 800 645 3050 ext. 2258 · E-Mail: techserv@eppendorf.com
Asia Pacific: Tel: +60 3 8023 6869 · E-Mail: support_asiapacific@eppendorf.com