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Eppendorf Research® 3 neo Pipettes: Adaptability Meets Ergonomics and Reliability.

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Executive Summary

The Eppendorf Research® 3 neo pipette offers a range of features designed to improve efficiency and user comfort, providing enhanced adaptability and functionality for pipetting tasks. This white paper examines its key innovations, such as the volume adjustment gear shift, a dual-speed mechanism, allowing users to choose between "fast" and "easy" modes for optimized speed or comfort. Beyond volume adjustment, users can benefit from temporary calibration adjustment and the new ColorTag marking rings, which provide flexible and efficient pipette identification. Additional features like the shorter operating button improve ergonomic handling, while the reliable volume lock prevents accidental adjustments. By reducing manual effort and enhancing usability, the Research 3 neo sets a new standard in pipette design, ensuring reliable performance across various applications.

Introduction

In modern laboratories, the demand for equipment that combines efficiency, adaptability, and user comfort is ever-increasing. As scientific research advances, so does the need for tools that support these evolving requirements. The Eppendorf Research® 3 neo pipette emerges as a response to this demand, embodying a new generation of pipetting technology that prioritizes user-centric design and operational versatility.

The Research 3 neo is not just a pipette; it reflects the ongoing efforts of Eppendorf to improve the working conditions of lab scientists through thoughtful instrument design and functionality improvements. By integrating features such as a volume adjustment gear shift mechanism and extensive customization options, this pipette addresses the diverse needs of different researchers worldwide. This white paper examines the practical features of the Research 3 neo, focusing on how its design and functionality can make laboratory tasks easier, more efficient, and more comfortable.

New features of Eppendorf Research 3 neo pipettes

The Research 3 neo pipette is equipped with several new features that enhance both its functionality and user experience. Among these, the dual-speed volume adjustment mechanism stands out, offering "fast" and "easy" modes to accommodate different pipetting preferences. Complementing this is the shorter operation button, which contributes to the pipette's ergonomic design by reducing strain during use. Reliability is further ensured with the inclusion of a volume lock, preventing accidental changes and maintaining consistency in experiments.

Additionally, Eppendorf introduced their ColorTag marking rings with the Research 3 neo, allowing users to personalize all their Eppendorf pipettes and dispensers for easy identification and organization. These features collectively provide users with the flexibility to tailor their pipetting experience, whether they prefer rapid adjustments, ergonomic handling, or secure volume settings, making the Research 3 neo a versatile and user-friendly choice in any laboratory setting.

Figure 1: Research 3 neo and its new features.

Enhancing efficiency and accuracy: Adaptable features of the Research 3 neo

The new Research 3 neo pipette introduces a range of customization options that go beyond traditional methods of marking and labeling. Previously, customization was limited to self-made labels or designated areas for marking. However, the Research 3 neo expands these possibilities, offering users diverse ways to tailor the pipette to their unique preferences and requirements. This section explores the innovative features that enable users to personalize their pipette.

1. Volume gear shift: Choose faster or easier adjustment
This latest generation of air-cushion pipettes features a dual-speed volume adjustment mechanism (like a gear shift), catering to a wide range of pipetting needs and preferences. It offers users the flexibility to switch between a "fast" and an "easy" mode.

In "fast" mode, users can adjust volume settings with significantly fewer turns, potentially saving up to 40% of time and effort, depending on individual adjustment habits. For instance, adjusting from 100 µL to the highest volume setting in the 1000 µL variant requires only five turns, as opposed to the roughly nine turns needed with the Research plus pipette model. This efficiency is illustrated in Figure 2, highlighting the time-saving advantage and reduced manual effort due to fewer turns associated with the new mechanism.
Conversely, the "easy" mode is designed for user comfort and ease of use, especially beneficial during extended pipetting sessions or when frequent small volume adjustments are necessary. This mode requires 50% less torque, (torque refers to the force needed to turn the volume adjustment button), as depicted in Figure 3, making it suitable for one-handed operation and reducing strain on the working hand.

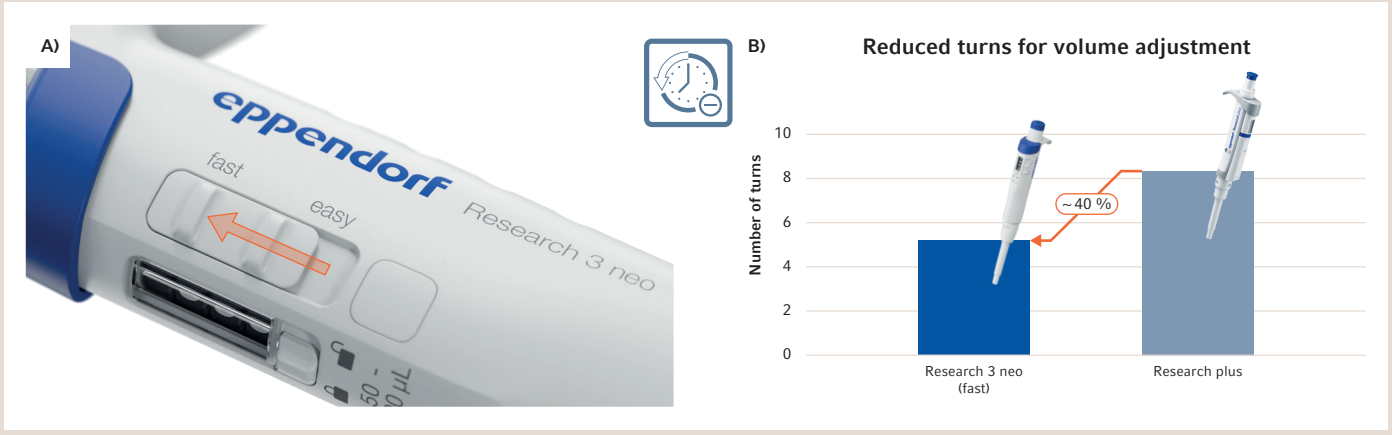

Figure 2: Time-saving volume adjustment with Research 3 neo:
A) Volume adjustment in „fast" mode demands fewer turns, allowing quicker adjustments. **B) Efficiency comparison of volume adjustment between the 1000 µL Research 3 neo and Research plus models.** Adjusting from 1000 µL to 100 µL, and vice versa, requires 5.2 turns with the Research 3 neo, compared to 8.5 turns with the Research plus, reducing turns by about 40%.

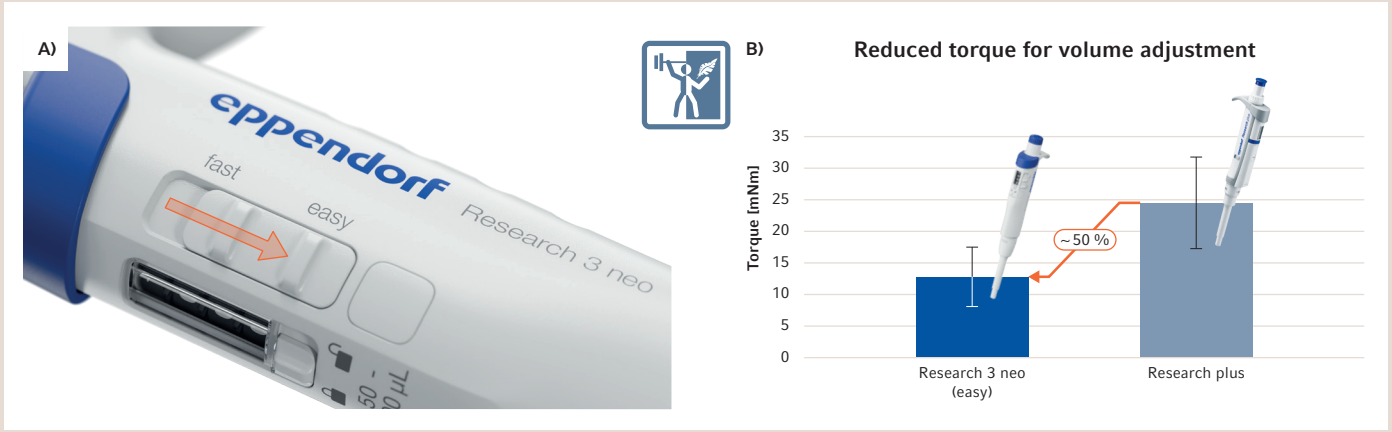

Figure 3: Effort-reducing volume adjustment with Research 3 neo:
A) Volume adjustment in „easy" mode requires less force. Suitable for one-handed operation **B) Torque comparison for volume adjustment** Comparative analysis of torque required for volume adjustments between the Research 3 neo and Research plus 1000 µL models. The Research 3 neo demonstrates a significant reduction in torque demand, requiring approximately 50% less torque than the Research plus. (Average torque measurement for volume adjustments from 10% to 100% of the nominal volume and vice versa. All volume variants were tested with n ≥ 3 pipettes, the average reduction of approx. 50% also applies to other volume variants (data not shown).)

Barely a twist: How Research 3 neo's torque compares to everyday tasks

To contextualize the low torque required to adjust the volume of the Research 3 neo in "easy" mode, the diagram in Figure 4 compares it to everyday tasks and the forces they demand. This comparison highlights that adjusting the volume of Research 3 neo pipettes requires minimal effort, making it the least demanding activity among those depicted in the diagram. The torque needed is notably lower than that of the Research plus model, requiring less than one-fifth the effort needed to turn a light knob, and is over 50% easier than opening a plastic bottle.

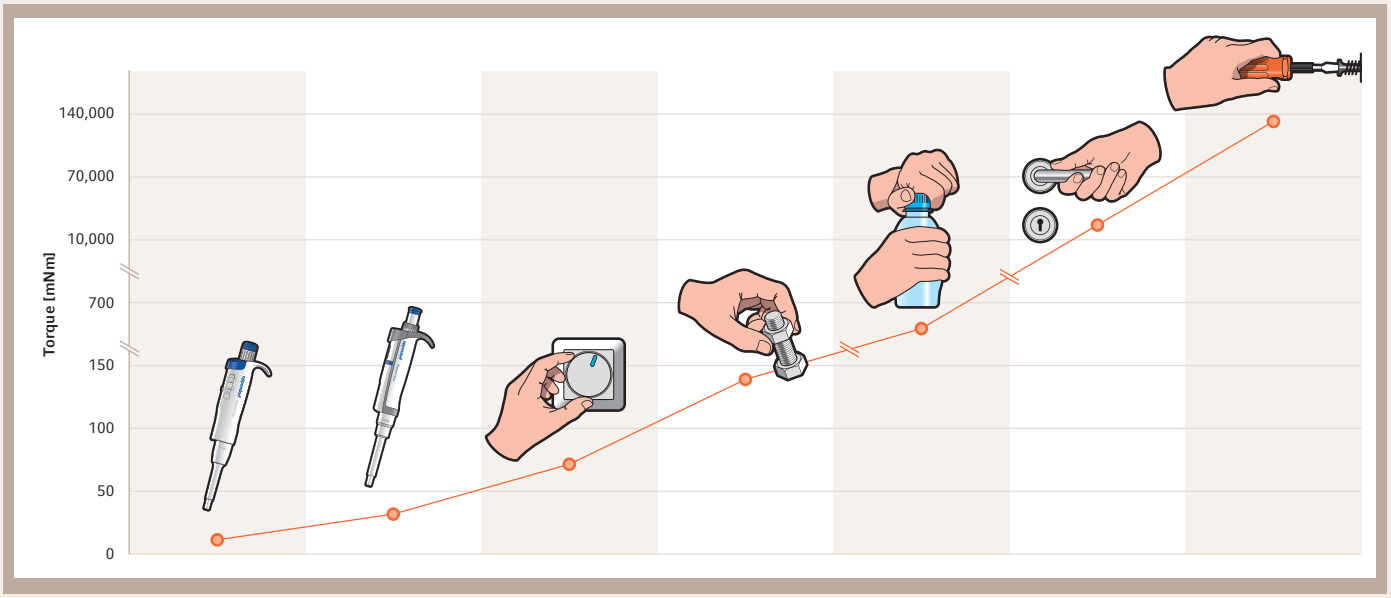

Figure 4: Torque comparison of everyday activities vs. volume adjustment with Research 3 neo.
This diagram compares the torque required for adjusting the volume on the Research 3 neo in "easy" mode with various everyday activities, such as turning a light dimmer knob [1], tightening a nut & bolt [2], opening a plastic bottle [3], turning a door handle [4], and screwing in screws [5]. Values shown are approximate and can vary based on specific circumstances like material, age, and maintenance.

The volume adjustment gear shift thus offers a versatile solution, enhancing user comfort across a range of applications, ensuring that the Research 3 neo is not only a tool of precision but also of ergonomic excellence. The user has the option to switch between "fast" and "easy" or decide on one gear depending on personal preference.

2. Distinctive identification:
Mark your pipette with ColorTag pipette marking rings
The new ColorTag marking rings (Figure 5) from Eppendorf offer a versatile and customizable solution for organizing laboratory equipment. Available in six different sizes and twelve vibrant colors, these flexible silicone rings are compatible with a wide range of Eppendorf products (**see Compatibility sheet**). While the accompanying table provides examples of pipettes variants suitable for each ColorTag size, the flexibility extends beyond pipettes to include devices like the Multipette® M4 and E3/E3x multi-dispensers, Varispenser® 2/2x bottle-top dispensers, and many more. ColorTag marking rings provide a flexible labeling system, allowing users to assign colors to pipettes and devices based on specific applications, laboratory settings, or individual users.

Figure 5: ColorTag marking rings for easy labeling and identification
Eppendorf ColorTag marking rings are available in various colors for quick pipette identification, enhancing lab efficiency and organization.

By assigning colors to different equipment, lab personnel can quickly identify and access the tools they need, reducing time spent searching and minimizing errors. The marking rings can also be used to indicate if a temporary adjustment has been made for more accurate pipetting with long tips or challenging liquids. Furthermore, ColorTag marking rings can be written on to signal when the next calibration is due or to specify the application for which the pipette is intended, enhancing organization and efficiency in the lab. Importantly, ColorTag rings are designed to withstand autoclaving (autoclaving uses steam under pressure to sterilize equipment), UV light, and H_2O_2 gas sterilization, ensuring durability and safety in sterile environments.

Table 1: ColorTag specifications
This table provides an overview of the available ColorTag marking rings, detailing the various sizes, compatibilities with Eppendorf air-cushion pipettes, and color options (see www.eppendorf.link/ColorTag for an extended list of compatible Eppendorf products)

ColorTag size [mm]	ColorTag compatibility (examples)
19	single-channel lower part up to 1,000 µL
24	single-channel lower part 2 mL and single-channel or multi-channel upper part
27	single-channel lower part 5 mL
34	single-channel lower part 10 mL
50	8- and 16-channel lower part
73	16- and 24-channel lower part

Available in 12 colors		
light blue	light green	light green
neon blue	neon green	neon yellow
light orange	light pink	light violet
neon orange	neon pink	neon magenta

3. Advanced temporary adjustment:
Adapt your pipette for specific conditions
While precision and accuracy are standard expectations, typically calibrated for water at 20°C, the Research 3 neo empowers users to adapt their pipette through temporary adjustments, a function now upgraded from the Research plus pipette. With an easily accessible adjustment opening and the included tool, scientists can increase the pipetting accuracy for specific scenarios, such as using elongated tips, reverse pipetting, or handling liquids with unique properties. This adjustment process is shown in Figure 6 and detailed in the operating manual. Changes are indicated by numbers in the window below the adjustment opening. The solid adjustment cover is securely hinged to the pipette housing and can be easily opened using the included tool, ensuring straightforward handling. The design prevents the hinged cap from being lost and ensures it closes firmly once the temporary adjustment is set. A notable feature of the temporary adjustment is its ability to revert to the original settings within two seconds by simply turning the adjustment wheel back to zero. By using ColorTag marking rings, any modifications can be made immediately visible also from afar.

Figure 6: Illustration of the temporary adjustment opening on the Research 3 neo, featuring the window below that displays numerical indicators of any adjustments made. The provided tool is shown inserted into the adjustment opening, enabling changes to the temporary settings. Returning the indicator to zero restores the pipette to its factory calibration settings.

Enhancing user comfort: Ergonomic design of the Research 3 neo

In the context of ergonomics, designing a pipette that minimizes user fatigue, discomfort, and strain during prolonged use while enhancing efficiency and ease of operation is essential.

1. Minimizing physical effort and increasing focus
The gear shift system, as previously discussed, reduces physical effort by enabling lower torque when adjusting the volume. In addition, the Eppendorf Research 3 neo pipette combines innovative design with the trusted performance of the renowned Research plus pipette. As illustrated in Figure 7, the pipetting, blow-out, and ejection forces of the Research 3 neo remain consistent with those of the Research plus, ensuring a familiar experience for users. The low operating forces required during pipetting, blow-out, and tip ejection significantly enhance user comfort and efficiency, corresponding with the recommended force limits outlined in the European standard EN 1005-3:2002+A1:2008 [6]. Moreover, the clearly defined stop between pipetting and blow-out reduces mental load, and in combination with low forces, enhances sustained attention by allowing users to ignore distractions and maintain focus. This aligns with ergonomic principles that prioritize efficiency and concentration [7].

Quick dive: What are pipetting, blow-out, and ejection forces?

> **Pipetting force:** This is the force needed to press the operating button to the first stop point, necessary for drawing liquid into the attached tip and subsequently releasing it into another vessel.

> **Blow-out force:** This force is required to ensure complete emptying of the pipette tip after transferring liquid. The user presses the operating button to the second stop, known as the blow-out. This force is higher than the pipetting force, providing a tactile distinction between the first and second stops to ensure accurate liquid transfer.

> **Ejection force:** This force is used to discard pipette tips by pressing the ejector button. The spring-loaded tip cone, a well-known feature from previous mechanical pipette generations by Eppendorf compensates for extra force when attaching the pipette tip. This ensures a tight tip fit while reducing the force needed for tip ejection.

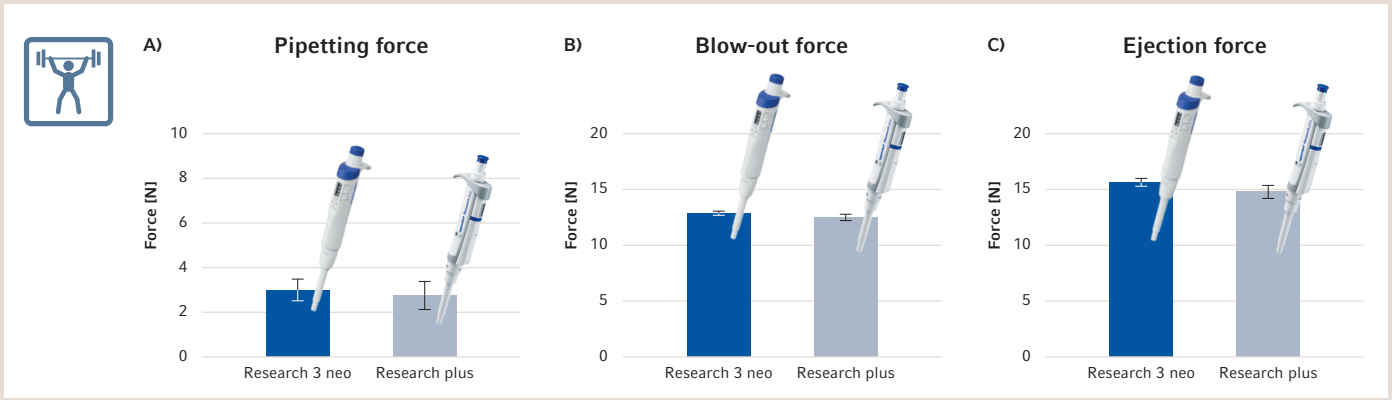

Figure 7: Operating and ejection force comparison of Research 3 neo and Research plus
This figure presents a comparison of the pipetting (a), blow-out (b), and ejection forces (c) between the Research 3 neo and Research plus pipette models. The pipetting and blow-out forces were measured with a Sauter Force Gauge FH100, with data averaged > 3 pipettes. Ejection forces were evaluated using a Zwick force transducer for each pipette, equipped with ep Dualfilter T.I.P.S.® SealMax® at a target attachment force of 50 N (average of 3 pipettes).

Barely a push: How Research 3 neo's forces compare to everyday tasks

To provide a practical sense of the low operating and ejection forces, the accompanying Figure 8 draws parallels between everyday tasks and the forces they require, illustrating that pipetting with the Research 3 neo is as effortless as turning on a light switch. Performing blow-out and ejection, while slightly more demanding than pipetting, is comparable to using an insulin pen. In general, the Research 3 neo is thoughtfully engineered to allow users to easily notice the different operating phases, such as the stop between completion of pipetting and the initiation of blow-out and the spring-loaded tip cone reduces the force needed for tip ejection.

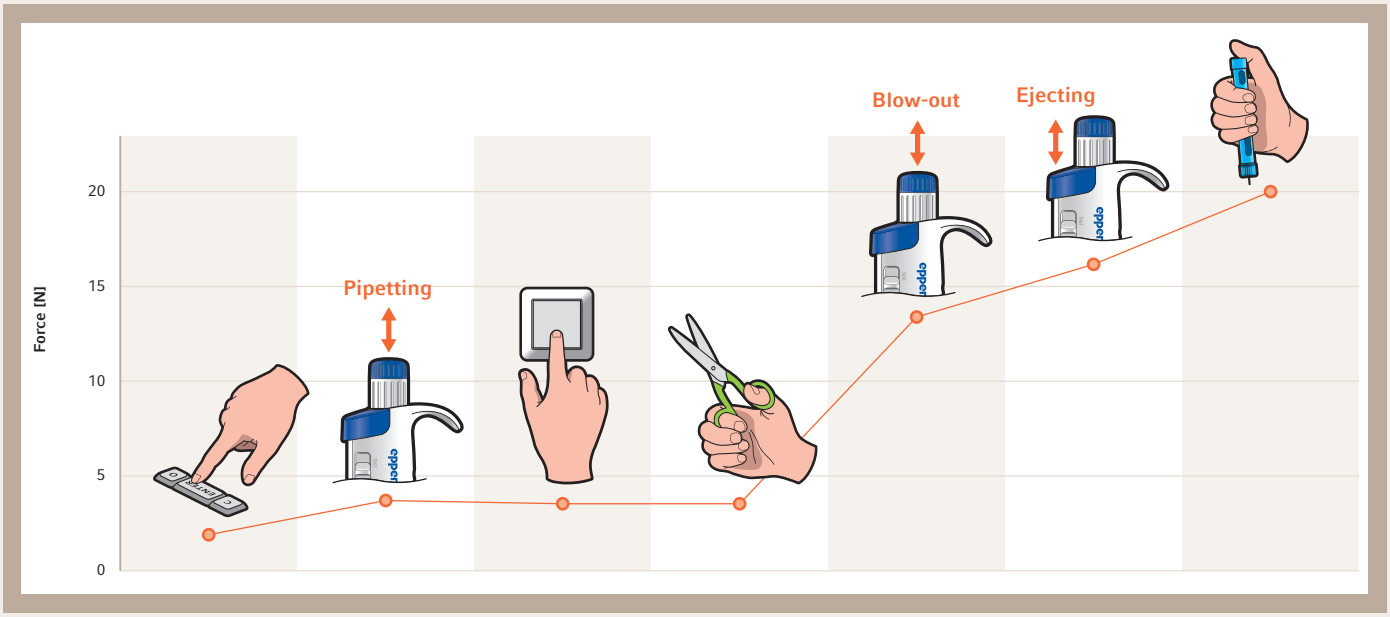

Figure 8: Force comparison of Research 3 neo and everyday activities.
This diagram compares the force required for pipetting, blow-out, and tip ejection with the Research 3 neo to everyday tasks. Pipetting with the Research 3 neo requires minimal force, like turning on a light switch [8], cutting with scissors [9], or slightly more than pressing a keyboard button [10], while blow-out and tip ejection demand less force than using an insulin pen [11] [12]. Values are approximate and may vary with material, age, and maintenance.

2. Enhancing comfort, handling, and button accessibility
The Research 3 neo introduces an operating concept without a separate volume adjust dial by integrating pipetting and volume adjustment into a single button (Figure 9).

This reorganized design significantly reduces the distance between the finger hook and the top of the operating button, facilitating easier thumb access and minimizing unusual or awkward hand positions, as shown in Figure 10. Users can effortlessly control both volume and pipetting with a single button.

Figure 9: Pipetting button with integrated volume adjustment.

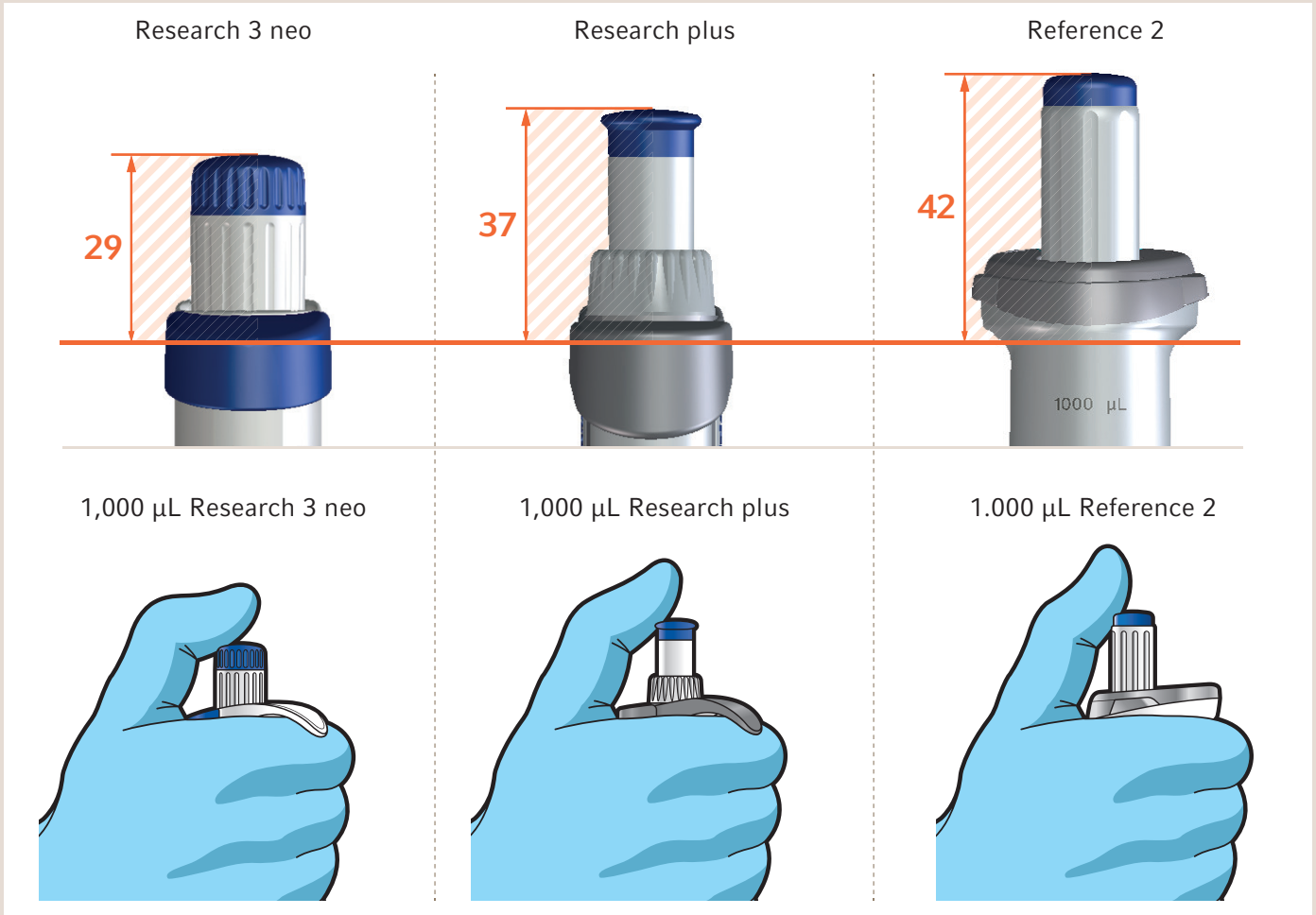

Figure 10: Reduced operating button distance
The illustration depicts the distance in millimeters between the finger hook and the top of the operating button for the Research 3 neo, Research plus, and Reference 2 pipette models. The Research 3 neo features a shorter distance, achieved by integrating pipetting and volume adjustment into a single button, while the Research plus uses separate operating elements for these functions. In contrast, the Reference 2 combines pipetting, volume adjustment, and tip ejection into one button. This design enhancement allows users to pipette more comfortably, even when the button is set to the nominal volume, which refers to the maximum volume that the pipette is designed to measure or transfer accurately.

The volume lock feature (Figure 11) prevents accidental changes and reduces the disruption of workflows by eliminating the need to frequently check the volume, which complements the ergonomic goal of enhancing user confidence and reducing stress during tasks. Additionally, the separate ejector button ensures that tip ejection does not occur during dispensing; both functionalities enhance sustained attention by minimizing distractions [13]. Furthermore, the Research 3 neo simplifies maintenance during manual cleaning. Its lower part can be easily detached, and reassembly is straightforward thanks to matching serial numbers on the lower and upper parts.
The Research 3 neo pipette maintains its lightweight nature from the Research plus pipette (data not shown) and introduces a new ergonomically curved design. Generously sized buttons with smooth edges ensure ease of handling. The magnifying volume window prominently displays four digits, facilitating easy reading of the volume during operation and further minimizing cognitive load [14,15].

3. Enhancing user experience and adaptability
The Research 3 neo pipette is equipped with a color-coded tip ejector and operation button, enabling quick recognition and easy matching with corresponding tips.
The integration of ColorTag marking rings further enhances labeling and organization, streamlining lab management and easing the mental effort needed for identification. These features adhere to ergonomics principles, aiming to improve efficiency by minimizing the effort required to distinguish between different pipettes or settings. Additionally, the design embodies the ergonomic principle of adaptability, accommodating both left- and right-handed users. It allows for temporary adjustments to meet diverse pipetting needs, adapting to user preferences and experimental requirements. Whether using longer pipette tips or handling various liquids, the design ensures ease of use and comfort.

Figure 11: Research 3 neo's volume lock feature
Slide the toggle right to adjust the volume (open lock symbol) or left to secure it (closed lock symbol).

Ensuring consistent performance: Reliability features of the Research 3 neo

Reliability and consistency in ergonomic design are crucial for enhancing user confidence, as they ensure tools function correctly and reduce anxiety. Consistent performance minimizes errors and workflow disruptions, maintaining efficiency in operations.

1. Assessing reliability through comprehensive testing
Building on the foundation of reliability and consistency in ergonomic design, the Eppendorf commitment to these principles is evident in the advanced design of the Research 3 neo.
The dedication of Eppendorf to reliability is further demonstrated through rigorous testing that simulates five years of typical use. However, this does not imply that the pipettes won't function beyond this period; it merely represents the minimum duration tested. In our calibration service, Eppendorf sometimes encounters pipettes that are over 20 years old and still operational. A detailed list of these extensive tests is provided in Table 2, highlighting evaluations conducted across all volume variants and multiple pipettes. These assessments meticulously examine the pipette's operational force, ejection force, torque, volume lock function, and gravimetric performance (gravimetric performance is how accurately a pipette dispenses liquid as measured by weight), ensuring that the Research 3 neo consistently upholds high standards of durability and reliability throughout its lifespan. To illustrate the thoroughness of these evaluations, Figure 12 presents just one of the more than ten reliability tests performed, focusing on a single volume variant. As noted, this test is conducted for all volume variants, underscoring the intensive nature of these assessments. Operational forces, such as pipetting and blow-out, are monitored to ensure stability over five years of use. The forces are evaluated at intervals of 40,000, 80,000, 120,000, and 200,000 operating button pushes, with the pipettes required to maintain performance within established limits.

Table 2: Reliability tests
This table outlines the key reliability tests conducted on the Research 3 neo pipettes. Each test simulates conditions that the pipette would typically encounter during an average of five years of use. The number of cycles for each test reflects the rigorous standards Eppendorf upholds to ensure the durability and reliability of our pipettes in real-world laboratory settings. It is important to note that the pipettes remain functional and within specifications even beyond these test cycles.

	Number of cycles	Reliability tests
	200,000	Usage of operating button – Pipetting & blow-out
	100,000	Tip attachment & ejection
	26,000	Volume adjustment
	10,400	Gear shift adjustment
	26,000	Volume lock adjustment

	Number of cycles	Reliability tests
	250	Pulling off the ejectior sleeve
	250	Detach & re-attachment of lower part
	175	Autoclave cycles (121 °C, 1 bar, 20 min)
> Additional tests: Drop tests, exposure to UV light, vaporized H_2O_2, and climate varations		

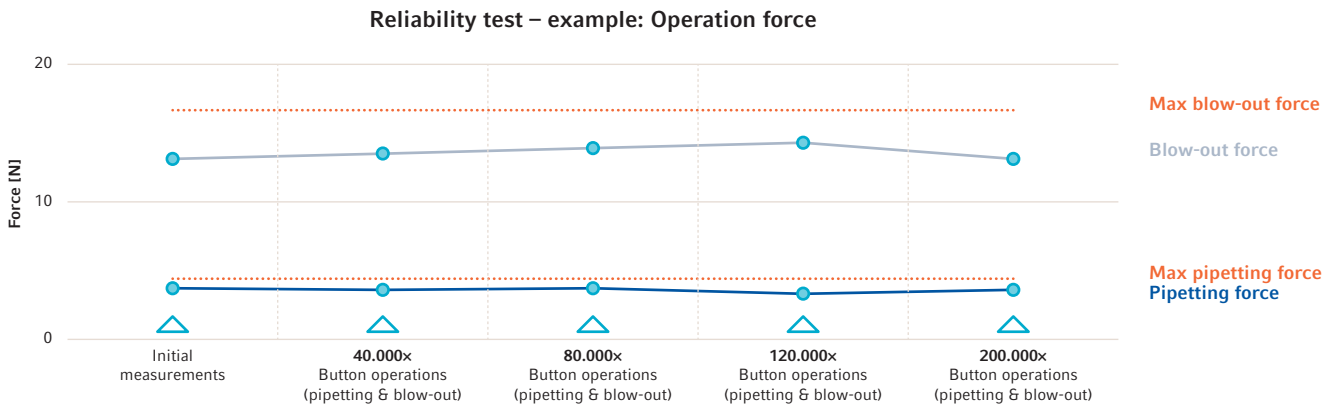

Figure 12: Ensuring consistent low operation forces: Five-year reliability testing of the Research 3 neo:
This figure presents exemplary data from reliability tests on the Research 3 neo pipette, highlighting pipetting (dark blue) and blow-out (grey) forces. These tests simulate five years of liquid transfer, involving cycles of 40,000x, 80,000x, 120,000x, and 200,000x pushing the operation button. The orange dotted lines indicate the acceptable limits for these forces. The results demonstrate that both pipetting and blow-out forces consistently remain within these limits. This data forms part of a broader series of tests conducted under various conditions and across multiple pipette models, emphasizing the comprehensive evaluation of the product's reliability.

2. Features enhancing reliability

In addition to rigorous testing, the Research 3 neo pipette incorporates features that enhance operational reliability. Its chemical resistance has been thoroughly tested and documented in the accompanying manual. The single-cast housing of the pipette ensures durability, allowing it to endure daily use while offering a comfortable feel in the hand. The robust design supports full autoclavability and H_2O_2 sterilization without disassembly, complemented by UV resistance to allow for sterilization via a variety of methods. Thoroughly tested for reliability, including enduring at least 175 autoclavability cycles, the Research 3 neo demonstrates its capability to withstand extensive use, as detailed in Table 2 of the reliability tests. These features collectively ensure that users can depend on the pipette for consistent performance in demanding laboratory environments.

3. Sustainability and longevity features

The Research 3 neo pipettes integrate sustainability as another aspect of their reliability, ensuring that users can depend on them to be environmentally responsible. To emphasize the commitment to sustainability, the Research 3 neo single-channel pipettes carry an ACT® label, which independently validates eco-friendly practices in their development, production, and lifecycle by the NGO My Green Lab®. Additionally, a wide range of spare parts is available to ensure the continued functionality and longevity of the pipettes.

Conclusion

The Eppendorf Research® 3 neo pipette introduces several new features designed to enhance adaptability, ergonomics, and reliability. Key features include:

Volume adjustment gear shift:

> This mechanism allows users to switch between "fast" and "easy" modes, optimizing speed and comfort. The "fast" mode significantly reduces the number of turns needed for volume adjustment, while the "easy" mode requires less torque, optimized for one-handed operation.

Shorter operating button:

> The pipette integrates pipetting and volume adjustment into a single button, reducing the distance of the operating button and enhancing ergonomic handling.

Volume lock:

> This feature prevents accidental volume changes, maintaining consistency in experiments and reducing disruption in workflows.

Low operating forces:

> The Research 3 neo retains the well-known low pipetting, blow-out, and ejection forces from the Research plus, ensuring user comfort and efficiency during use.

ColorTag marking rings:

> These rings come in various colors and sizes, allowing for quick identification and organization of pipettes and other lab equipment. They enable easy labeling for specific applications, enhancing efficiency and reducing errors.

Temporary adjustments:

> Users can make temporary adjustments to increase pipetting accuracy for specific conditions, such as using elongated tips or handling liquids with unique properties. These adjustments are easily reversible, ensuring flexibility and precision.

Reliability and durability:

> The Research 3 neo undergoes rigorous testing simulating five years of typical use, ensuring consistent performance and reliability. Features like chemical resistance, including H_2O_2 gas, UV resistance, and the ability to withstand autoclaving emphasize its durability.

Sustainability:

> The pipette carries an ACT® label, validating its eco-friendly practices in development and production. A wide range of spare parts is available to support its longevity.

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Since 1945, the Eppendorf brand has been synonymous with customer-oriented processes and innovative products, such as laboratory devices and consumables for liquid handling, cell handling and sample handling. Today, Eppendorf and its approximately 5,000 employees serve as experts and advisors, using their unique knowledge and experience to support laboratories and research institutions around the world. The foundation of the company's expertise is its focus on its customers. The exchange of ideas between Eppendorf and its customers results in comprehensive solutions that in turn become industry standards. Eppendorf will continue on this path in the future, true to the standard set by the company's founders: that of sustainably improving people's living conditions.

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