APPLICATION NOTE No. 197

The Eppendorf Research® plus pipette – Lightweight, Reliable and Ergonomic

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Abstract

In today's research environment, attention on pipettes no longer focuses exclusively on precision and accuracy; instead, user-friendly operating features, which reduce strain during pipetting, have moved into the foreground. Therefore, ergonomics plays an important role for the user. Primarily aspects are the weight of the pipette and the forces required during use. Included in the handling force are, among others, the force required for attachment and securing as well as ejection of the pipette tip. The new mechanical pipettes of the pipette family Eppendorf Research plus have demonstrated optimal performance in all those areas.

Introduction

Continuous new demands on pipettes and related dispensing devices have given rise to a number of different dispensing systems. While these instruments had initially been devised for specific applications, they are now being used in a variety of different areas. Due to the trend towards having to manage larger numbers of samples of reduced volume, increasingly comfortable pipetting and dispensing systems have evolved. The mechanical piston-stroke pipettes Eppendorf Research plus are equipped with a number of remarkable patented functions.

Spring-loaded tip cone
Eppendorf pipettes are based on a novel principle, a so-called spring-loaded tip-cone [Fig.1].
During attachment and securing of the pipette tip onto the cone the extra force exerted is compensated by the spring loaded tip cone. This signals the tight fit of the tip. Thus, on the one hand, a significantly decreased force is needed to achieve optimal fit, while on the other hand this limitation of force will facilitate the subsequent tip ejection. In addition, the spring loading of multichannel pipettes yields a significantly better tip fit as well as optimized tip alignment, thus eliminating the need for manual adjustment of individual tips.

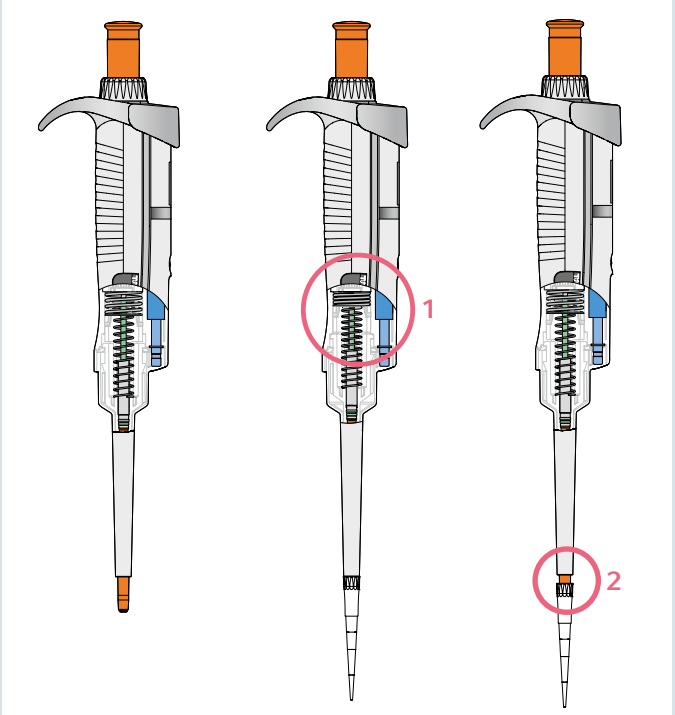

Figure 1: Spring loading of the tip cone (1) improves the fit of the pipette tip during attachement (2).

Forces and weight

In comparison with the predecessor model, the Eppendorf Research, the pipetting forces and extra stroke forces of the Research plus pipettes are reduced [Fig. 2 and 3].

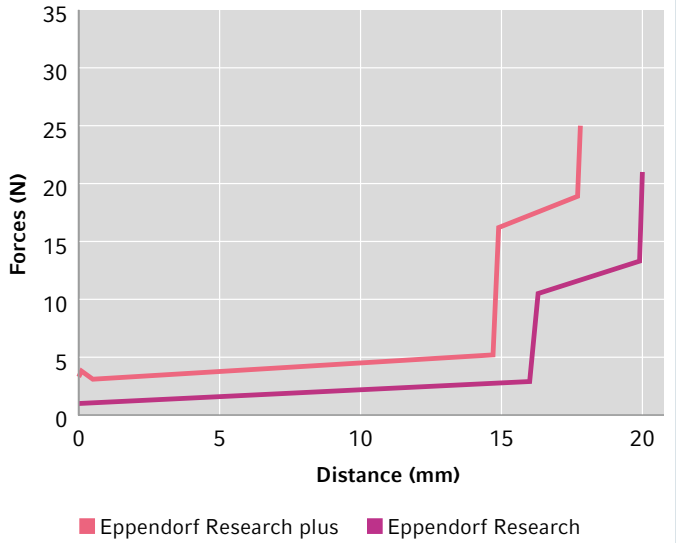

Figure 2: Comparison of pipetting forces (without tip ejection)

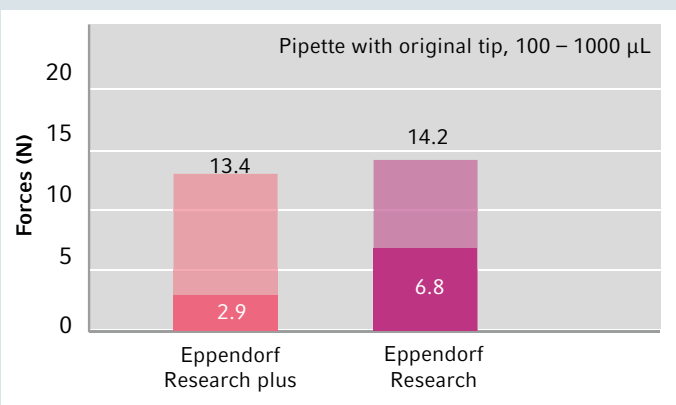

Figure 3: Comparison of blow out forces (1 kg =̂ 9.81 N)
The columns show the pipetting forces (lower part) and the blow out forces (upper part).
Reference: Eppendorf AG, Quality Assurance, data determined using Zwick force transducer, Zwick/Roell model Z005

Furthermore, the ejection force was measured for each pipettes with the assigned pipette tip at an obtainable attachement force of 50 N [Fig. 5]. With the Research plus, this attachement force (50 N) cannot be reached due to the spring loaded tip cone. As a result, the tip can not be forced onto the cone. This ensures low ejection forces regardless of the force applied for tip attachment.

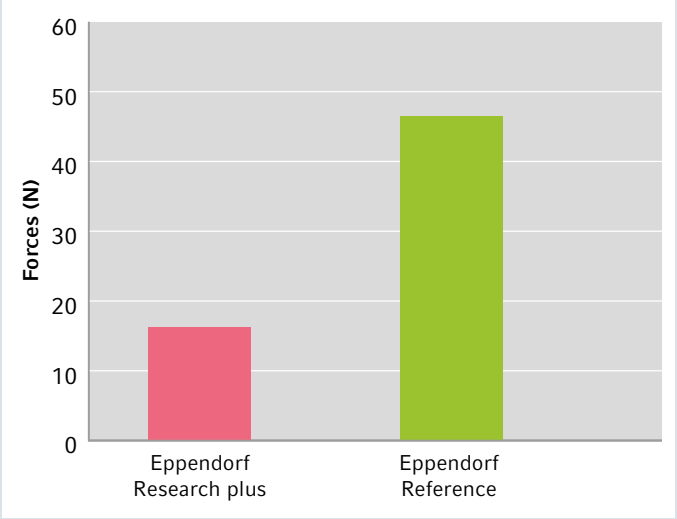

Figure 4: Ejection force at an obtainable attachment force of 50 N

In comparison with pipettes, the Research plus pipette has become much lighter [Fig. 5].

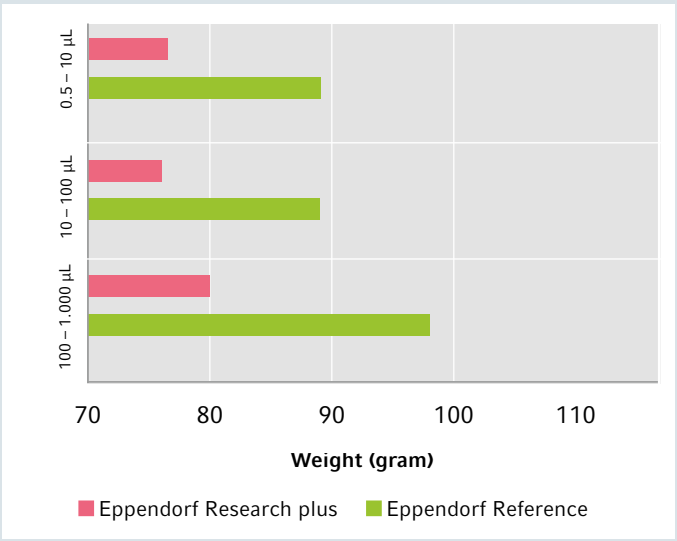

Figure 5: Ejection force at an obtainable attachment force of 50 N

Novel piston material

In order to reduce the handling forces as well as the weight of the Research plus pipettes, high quality synthetic materials were used in the production of pipette pistons of the 20 µL (yellow) to 10 mL volume range. The material PPS (polyphenylene sulfide, Fortron) was used for the cylinder, the piston rod is made from PEI (polyetherimide), and the washer is made from EPDM (ethylene-propylene-diene-rubber). Through the use of these tried and tested materials, in combination with the novel method of production of the pipette piston, an extremely easy forward and backward sliding of the piston was achieved. All synthetic materials used were subjected to chemical resistance testing over an extended period of time (100,000 strokes) using different substances, such as ethanol, acetone, concentrated hydrochloric acid and nitric acid. During this test phase, all plastics demonstrated very good chemical resistance.
For more information about the resistance against chemicals and decontaminating reagents please refer to chemical resistance tables on www.eppendorf.com.
Furthermore, they showed high temperature resistance.
The pistons of pipettes of the volume range 0.1–20 µL (gray) are made from corrosion-free vanadium steel, as in previous generations.

Reliability test

In the context of the reliability test, the following tests listed below were performed with the Research plus pipettes:

> 100,000 x tip attachment
> 100,000 x tip ejection strokes
> 200,000 x strokes including excess stroke
> 50,000 x volume adjustment
> 250 x pulling off of the ejection case
> 200 x detachment and re-attachment of the lower part
> 175 autoclave cycles (121 °C, 1 bar, 20 min.)

The number of respective tests chosen corresponds to an average 5 year use of the pipette. Additional tests included change of the adjustment, falling tests and gravimetric tests according to EN ISO 8655. The results showed that the new pipette family by Eppendorf meets testing requirements in all capacities and did not show any signs of damage or impairment following testing.

In the meantime, the function as a precision measuring device is only one demand placed upon a pipette. In the future, other additional features of a pipette will be important factors in deciding whether a certain pipette is suitable for specific applications.
The Research plus pipette meets present and future requirements, such as reduction of handling force and weight, as well as tip attachment force in a unique fashion. In summary, its design and ergonomics are definitely forward-looking.

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