SARTORIUS

Application Note

July 12, 2021

Keywords or phrases:
Electronic Pipette, Ergonomic Pipetting, RT-PCR, Pipetting Forces

Benefits of an Ergonomic and Electronic Pipette for RT-PCR

Paulus Artimo[1], Sandra Söderholm[2]
[1] Product Management, Sartorius Biohit Liquid Handling, Helsinki, Finland
[2] Lab Essentials Applications Development, Sartorius Biohit Liquid Handling, Helsinki, Finland

Correspondence
Email: lhinfo.finland@sartorius.com

Abstract

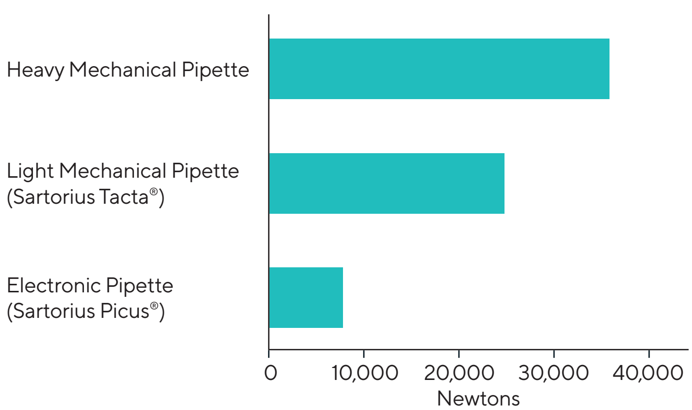
Ergonomic pipettes have been proven to reduce pipetting error in long pipetting series. The ergonomic benefits go even further with an electronic pipette that has fully electronic operations and eliminates most of the physical work required for pipetting. This application note is a follow-up to our previous finding (Teye, 2018) and provides new data to show that pipetting with a fully electronic and ergonomic pipette produces highly reproducible results, even in long periods of use.

Introduction

Pipetting ergonomics has emerged as an important consideration in the research laboratory, especially during the past year when diagnostic laboratories were forced to work for long hours due to the global SARS-CoV-2 pandemic. Laboratory personnel who work long days pipetting are susceptible to fatigue, which in turn has a negative influence on data accuracy (Yung, 2017). Importantly, daily pipetting for long durations is associated with increased risk of developing repetitive strain disorders (Björksten, 1994).

Using a mechanical pipette consists of individual and relatively light actions, like piston control and tip ejection (12.3–15 N and 14.3–28 N, respectively) that add up to significant workload during hours of operation. Conversely, an electronic pipette is operated by the simple pushing of buttons (1.3–3 N) and letting the motors do most of the physical work. In a 3-hour pipetting series, these operations accumulate to 24.5 kN with an ergonomic Tacta® and 35.5 kN with a heavy-to-operate mechanical pipette, compared to 7.4 kN with an electronic Picus® pipette—this results in 70–80% less total force required to operate the pipette (Figure 1).

Figure 1
Pipetting Workload Comparison

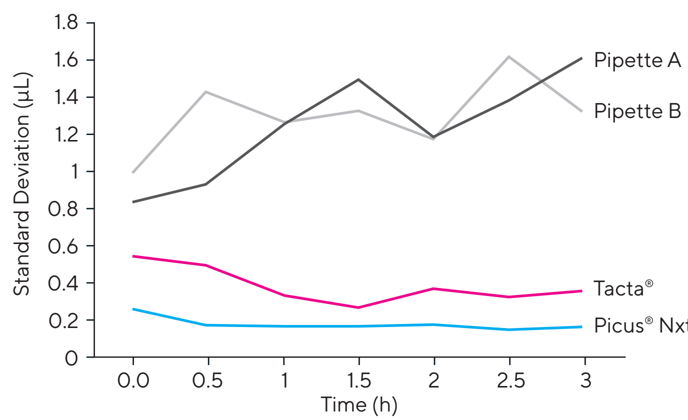


Note. The workload resulting from 3 hours of constant pipetting, covering the entire pipetting cycle (tip attachment-aspirating-dispensing-tip ejection). Newtons (N) is used to quantify the amount of force required to perform the physical operations of pipetting. Reported numbers were determined by our technical team.

Results and Discussion

Here, we report the results of an experiment comparing dispensing accuracy using the Tacta® mechanical pipette and the Picus® pipette. Our data covers the volume ranges used in routine RT-PCR sample preparations (Figures 2 and 3). The benefit of ergonomics in pipetting accuracy is clear; the standard deviations of dispensing with ergonomic pipettes such as Tacta® and Picus® were low and did Not increase with increasing pipetting time. By contrast, the standard deviations of the larger and heavier pipettes increased with prolonged use (Figure 2). We believe this difference is because the non-ergonomic pipettes require more force to operate, which is difficult to sustain over a long period.

Figure 2
Standard Deviation Comparison

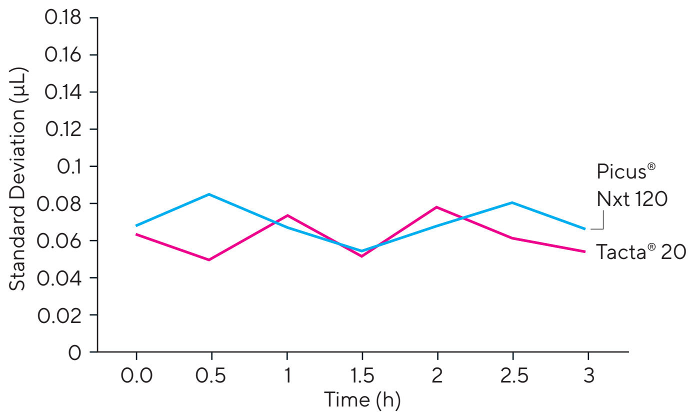


Note. Comparison of the standard deviation during a 3-hour pipetting series when dispensing with an electronic pipette (Picus® Nxt pipette), an ergonomic mechanical pipette (Tacta® pipette), and two commercial pipettes that are not optimized for ergonomics (Pipettes A and B). All pipettes had a nominal volume of 1,000 µL and were used at 10% nominal volume (100 µL). The data for Tacta® and A | B pipettes were originally published in Teye (2018). The Picus® Nxt data was collected in 2021 and is being presented for the first time here.

Next, we repeated the experiment using a volume, 20 µL, and pipettes (Tacta® 2–20 µL and Picus® Nxt 5–120 µL) that are relevant for an RT-PCR experiment (Figure 3). Surprisingly, the fully electronic pipette achieved the same low standard deviation as the mechanical pipette that has a six times smaller nominal volume. It is important to note that pipettes are most accurate and precise when used at their nominal or maximum volume. The performance accuracy we observed with the electronic pipette is achieved by removing the human variance factor from piston control.

Figure 3

Standard Deviation Comparison



Note. Comparison of standard deviations of an electronic pipette (Picus® Nxt pipette) and an ergonomic mechanical pipette during a 3-hour pipetting series. The pipettes used to dispense 20 µL in forward pipetting were the Tacta® single channel 2–20 µL pipette and the Picus® single channel 5–120 µL electronic pipette.

In addition to allowing standardization of pipetting across users and speeding up repetitive tasks, the Picus® allows users to concentrate on pipetting angles and proper tip positioning in the target vessel. This confidence in performance also helps alleviate some of the mental stress when pipetting small volumes during RT-PCR sample prep, or other preparations that demand precision in pipetting.

A fully electronic pipette improves pipetting results by reducing variance and user fatigue during long periods of use. The Picus® electronic pipette makes sample preparation comfortable by helping to achieve reliable results, being kind to the user's hand, and speeding up work.

Materials and Methods

Pipetting performance during 3 hours of pipetting using mechanical or electronic pipettes was tested by calculating the standard deviation of the pipetting results within 30-minute periods for each pipette. Each data point consists of at least 60 individual measurement points. All pipettes were tested using the matching manufacturer's tips. All pipettes were serviced and calibrated per manufacturer's instructions before testing.

References

Bjorksten, M. G., Almby, B., & Jansson, E. S. (1994). Hand and shoulder ailments among laboratory technicians using modern plunger-operated pipettes. *Applied Ergonomics 25*(2), 88–94.

Teye, M. (2018). How the Use of Ergonomic Pipettes and Good Pipetting Technique Can Improve the Quality of Assay Results. https://www.sartorius.com/en/pr/beverage-qc/how-the-use-of-ergonomic-pipettes-and-good-pipetting-technique-can-improve-the-quality-of-assay-results

Yung, M., Manji, R., & Wells, R. P. (2017). Exploring the relationship of task performance and physical and cognitive fatigue during a daylong light precision task. *Human Factors 59*(7), 1029-1047.

Germany
Sartorius Lab Instruments GmbH & Co. KG
Otto-Brenner-Strasse 20
37079 Goettingen
Phone +49 551 308 0

USA
Sartorius Corporation
565 Johnson Avenue
Bohemia, NY 11716
Phone +1 631 254 4249
Toll-free +1 800 635 2906

For additional information,
visit www.sartorius.com

Version 1 | 07 | 2021