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# Improved ergonomics based on pipette tip selection

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## Abstract

Scientists and laboratory workers are constantly needing to pipette for long hours every day, moving tiny amounts of liquid over and over again. The need for ergonomic pipettes and pipette tips is quickly becoming a high priority for labs and scientists. To that aim, we studied the attachment and ejection forces for several 300 µL pipette tips on a Thermo Scientific™ Finnpipette™ F1 Single Channel Pipette and Finnpipette F1 Multichannel Pipette. The Thermo Scientific™ Finntip™ Flex™ Pipette Tip consistently provides users with one of the lowest forces for attachment and ejection, thereby reducing user strain. The data illustrates the Finntip Flex Pipette Tip as an effective ergonomic tool to help scientists reduce repetitive strain injuries (RSIs).


## Introduction

The consideration of ergonomics has become an important part of the laboratory. New tools and pipettes are being designed with the safety and comfort of the end-user as a high priority. Pairing these ergonomically designed pipettes with an ergonomic pipette tip can be just as important. Tip attachment can cause pain and inflammation in the wrist and elbow sometimes leading to tendonitis. Similarly, tip ejection can induce pain on the thumb side of the wrist, sometimes leading to tenoynovitis. These injuries can hamper the precision required when long days of pipetting are necessary.

To avoid these injuries, selecting the best pipette tip can be crucial. Thin-walled, soft, and flexible pipette tips are designed to fit the pipette cone securely while allowing for minimal attachment and ejection forces to be used. The purpose of this report is to highlight the lower forces needed when using the Finntip Flex Pipette Tip. To illustrate this, an independent lab was used to test the attachment and ejection forces of the Finntip Flex Tip and four alternative tips from other manufacturers on a 300 µL Finnpipette F1 Single Channel Pipette and a 300 µL Finnpipette F1 12-channel Pipette. For each variety of pipette tip, 50 tips were tested on each pipette to determine the attachment force and ejection force.

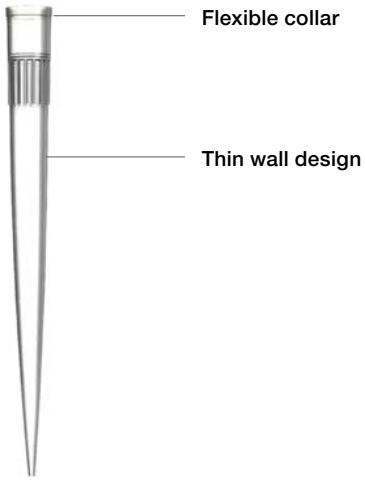



**Figure 1:** The thin wall and soft collar of the Finntip Flex Pipette Tips are optimally designed to fit Finnpipette Pipettes. This leads to lower attachment and ejections forces, making them more ergonomic.

| | Single channel attachment forces | | Single channel ejection forces | | Multichannel attachment forces | | Multichannel ejection forces | |
|---|---|---|---|---|---|---|---|---|
| | Mean (kg) | Result | Mean (kg) | Result | Mean (kg) | Result | Mean (kg) | Result |
| Finntip Flex | 0.938 | C | 0.696 | B | 2.958 | C | 0.686 | D |
| Manufacturer I | 1.068 | B | 0.576 | C | 2.918 | C | 0.758 | D |
| Manufacturer II | 1.002 | B, C | 0.692 | B | 2.61 | C | 0.932 | C |
| Manufacturer III | 1.066 | B | 0.63 | B, C | 5.4 | A | 1.346 | A |
| Manufacturer IV | 1.252 | A | 0.92 | A | 4.956 | B | 1.172 | B |

**Table 1. Pipette tips attachment and ejection forces using the Finnpipette F1 Single- and Multichannel Pipette.** Pipette tips are ordered for best overall performance (best on top). Finntip Flex and Manufacturer I Pipette Tips are considered best overall. They are both statistically the best for the multichannel attachment and ejection forces, while Finntip Flex Pipette Tip is the best for single channel attachment and Manufacturer I Pipette Tip is the best for single channel ejection. Means that have the same letter are statistically the same and those that have different letters are statistically different.

## Materials

- Thermo Scientific Finntip Flex 300 µL Pipette Tip (Cat. No. 94060510)
- Manufacturer I 300 µL Pipette Tip
- Manufacturer II 300 µL Pipette Tip
- Manufacturer III 300 µL Pipette Tip
- Manufacturer IV 300 µL Pipette Tip
- 300 µL Finnpipette F1 Single Channel Pipette (Cat. No. 4641090N)
- 300 µL Finnpipette F1 12-channel Multichannel Pipette (Cat. No. 4661070N)
- ergoPAK™ Portable Analysis Kit, including miniature and universal load cell

## Protocol for measuring force

Pipette tip attachment and ejection forces were tested using ergoPAK Portable Analysis Kit with miniature and universal load cell. A circular flat disc load cell test attachment was used to measure tip ejection force. A sample size of 50 was identified for each pipette tip. The pipette tips were consistent in volume, 300 µL tip.

A single factor ANOVA was performed to identify if there were significant differences between tip types ($\alpha = 0.05$). Tests were run assuming equal variances. A Tukey post hoc analysis was performed to determine which pipette tips were significantly different.

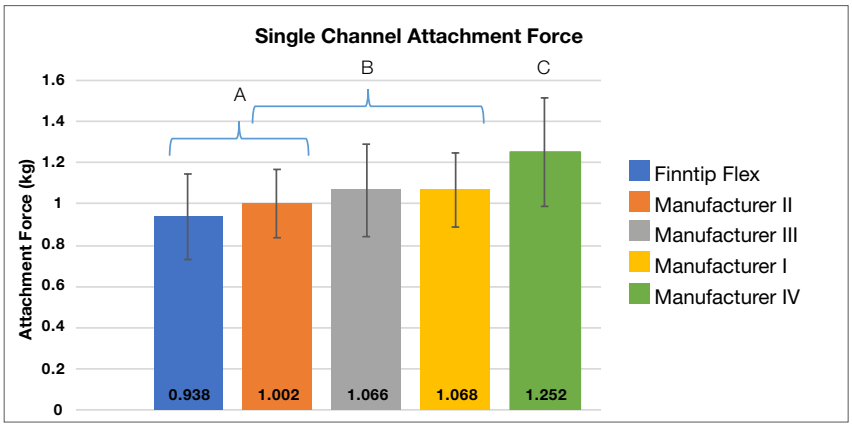
## Results

The ergonomic design of the pipette tips was tested in four different ways; force needed for attachment using a 300 µL Finnpipette F1 Single Channel Pipette, force needed for ejection using a 300 µL Finnpipette F1 Single Channel Pipette, force needed for attachment using a 300 µL Finnpipette F1 12-channel Pipette, and force needed for ejection using a 300 µL Finnpipette F1 12-channel Pipette. The Finntip Flex Tip was evaluated in comparison to four alternative manufacturers. All forces were measured by an independent lab using ergoPAK Portable Analysis Kit.

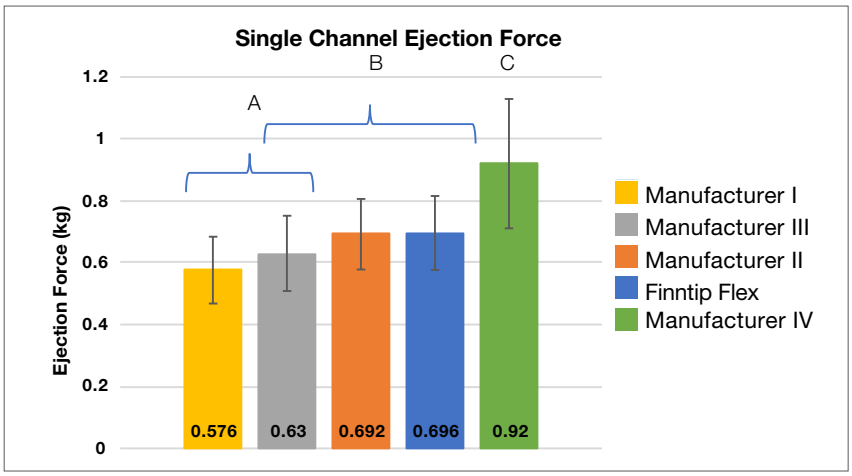
Table 1 shows the mean attachment and ejection forces for each of the pipette tips using the Finnipette F1 Single Channel Pipette and the Finnpipette F1 12-channel Pipette. The results for each test is ranked using a green-yellow-red scale with green indicating the best and red indicating the worst performer.

For each test, a single factor ANOVA was performed to identify significant differences between tip types and a Tukey post hoc analysis was performed to determine which pipette tips were significantly different. Means that have the same letter are statistically the same and those that have different letters are statistically different.

The performance for testing the attachment force using a single channel pipette has the pipette tips ranked; Finntip Flex, Manufacturer II, III, I, IV (Graph 1). The performance for testing the ejection force using a single channel pipette has the pipette tips ranked; Manufacturer I, III, II, Finntip Flex, Manufacturer IV (Graph 2).



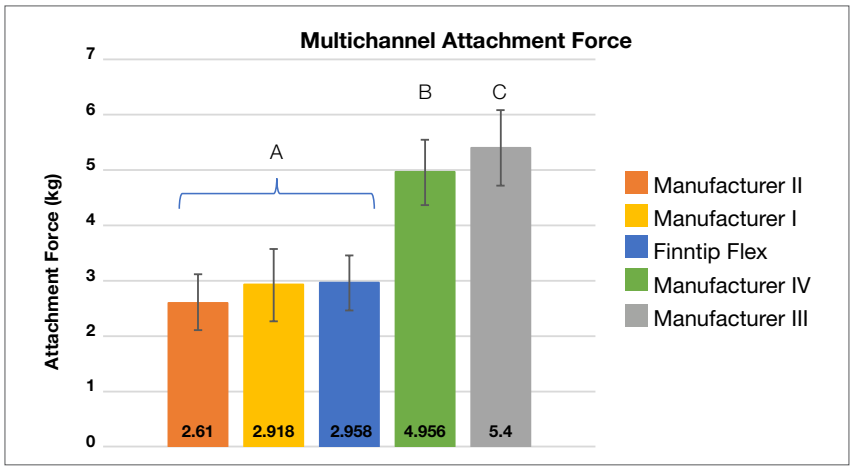

**Graph 1. Mean attachment force for each pipette tip using a Finnipette F1 Single Channel Pipette.** Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.



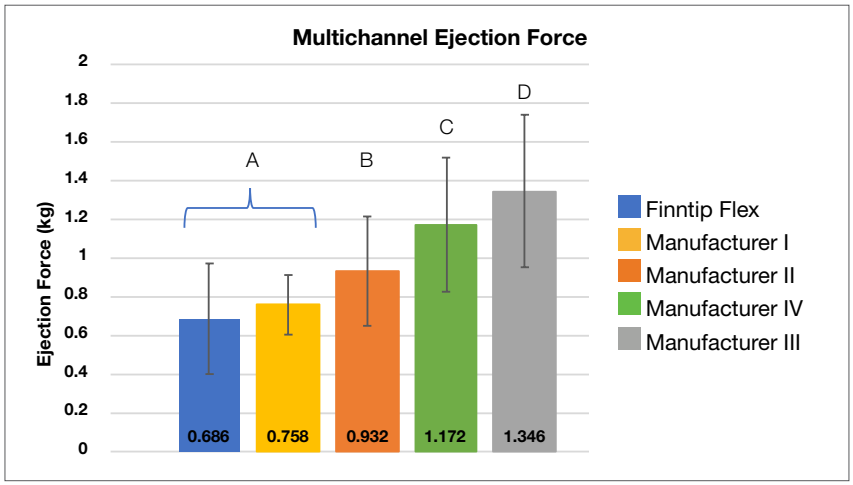

**Graph 2. Mean ejection force for each pipette tip using a Finnipette F1 Single Channel Pipette.** Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.

The performance for testing the attachment force using a 12-channel pipette has the pipette tips ranked; Manufacturer II, I, Finntip Flex, Manufacturer IV, III (Graph 3). The performance for testing the ejection force using a 12-channel pipette has the pipette tips ranked; Finntip Flex, Manufacturer I, II, IV, III (Graph 4). Taking into account the performance of each tip for each of the tests, the pipette tips are placed in order from best to least overall performance in Table 1; Finntip Flex, Manufacturer I, II, III, IV. Overall, the Finntip Flex and Manufacturer I Pipette Tip ranked the best. The Finntip Flex Tip had the lowest force for both single channel attachment and multi-channel ejection, and for multichannel attachment the FInntip Flex Pipette Tip is statistically the same as the lowest force.


Finnpipette™ F1 Multichannel Pipette




**Graph 3. Mean attachment force for each pipette tip using a Finnpipette F1 Multichannel Pipette.** Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.




**Graph 4. Mean ejection force for each pipette tip using a Finnpipette F1 Multichannel Pipette.** Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.

## Conclusion

The Finntip Flex Pipette Tip was evaluated for its ergonomic design by measuring the attachment and ejection force needed when used with the Finnpipette F1 Single Channel Pipette and Finnpipette F1 Multichannel pipette. The Finntip Flex Tip had similar performance to the tip from Manufacturer I but was better than tips from Manufacturer II, III, and IV. Furthermore, the Finntip Flex Tip had the lowest force for single channel attachment and multi-channel ejection. The Finntip Flex Tip is designed to address ergonomic concerns. It has a softer collar that flexes and leads to lower attachment and ejection forces and is especially suited for multichannel pipettes. In addition to the ergonomic consideration of the Finntip Flex Tip, the racks are also designed to help users. The hinged lid allows easy one-handed use while the stable rack base design with rubber feet prevents the rack from sliding on the countertop or flipping over, improving stability and consistency of tip attachment. Finntip Flex Tips are designed and developed to work with the Finnpipette Single and Multichannel Pipettes, ensuring optimal ergonomics and pipetting accuracy and precision.

**Figure 3.** Finntip Flex 300 rack has a hinged lid and stable rack base to enhance ergonomics

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| Cat. No. | Description | Packaging Format |
|---|---|---|
| **11863420** | Finntip Flex 10 | 10x96/rack |
| **11873420** | Finntip Flex 10, sterile | 10x96/rack |
| **11873430** | Finntip Flex 10, Refill Starter kit | 20x96/refill+1x96/rack |
| **11883430** | Finntip Flex 10, Refill kit | 20x96/refill |
| **11883420** | Finntip Flex 10 | Bulk, 1000 tips/bag |
| **11833430** | Finntip Flex Filter 10, sterile | 10x96/rack |
| **11893420** | Finntip Flex 200 | 10x96/rack |
| **11803430** | Finntip Flex 200, sterile | 10x96/rack |
| **11893430** | Finntip Flex 200, Refill Starter kit | 20x96/refill+1x96/rack |
| **11803440** | Finntip Flex 200, Refill kit | 20x96/refill |
| **11813430** | Finntip Flex 200 | Bulk, 1000 tips/bag |
| **11843430** | Finntip Flex Filter 30, sterile | 10x96/rack |
| **11853430** | Finntip Flex Filter 100, sterile | 10x96/rack |
| **11863430** | Finntip Flex Filter 200, sterile | 10x96/rack |
| **11738184** | Finntip Flex 300 | 10x96/rack |
| **11748184** | Finntip Flex 300, sterile | 10x96/rack |
| **11798184** | Finntip Flex 300, Refill Starter kit | 20x96/refill+1x96/rack |
| **11708194** | Finntip Flex 300, Refill kit | 20x96/refill |
| **11842703** | Finntip Flex 300 | Bulk, 1000 tips/bag |
| **11852703** | Finntip Flex Filter 300, sterile | 10x96/rack |
| **11458479** | Finntip Flex 1000 | 10x96/rack |
| **11892703** | Finntip Flex 1000, sterile | 10x96/rack |
| **11865863** | Finntip Flex 1000, Refill Starter kit | 16x96/refill+1x96/rack |
| **11875863** | Finntip Flex 1000, Refill kit | 16x96/refill |
| **11872703** | Finntip Flex 1000 | Bulk, 1000 tips/bag |
| **11802713** | Finntip Flex Filter 1000, sterile | 10x96/rack |
| **10059682** | Finntip Flex 1200 | 10x96/rack |
| **11742245** | Finntip Flex 1200, sterile | 10x96/rack |
| **11813440** | Finntip Flex 1200, Refill Starter kit | 16x96/refill+1x96/rack |
| **11823440** | Finntip Flex 1200, Refill kit | 16x96/refill |
| **10774994** | Finntip Flex 1200 | Bulk, 1000 tips/bag |
| **11862703** | Finntip Flex Filter 1200, sterile | 10x96/rack |
| **10715305** | Finntip Flex 10ml Extended | Bulk, 100 tips/bag |
| **11425748** | Finntip Flex 10 ml Extended, sterile | Bulk, 50 tips/bag |
| **11475558** | Finntip Flex Filter 10 ml Extended, sterile | Bulk, 50 tips/bag |