



MICROPIPETTE

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Abstract

In this SOP, the principle of operation of micropipettes and the comparison between typical types of micropipettes are discussed. The construction of typical micropipettes is presented. The available micropipette at the lab and working procedure is documented.

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1 Micropipette Principle of Operation

1.1 Purpose [1]

Micropipette is a lab apparatus that allows for precise liquid displacement. It aspirates a designated volume of liquid in the unit of microliters, displaced as μl on the micropipette display. The usage of micropipettes is helpful when an accurate and small amount of liquid is needed to be aspirated and dispensed.

1.2 Assembling Micropipette [1]

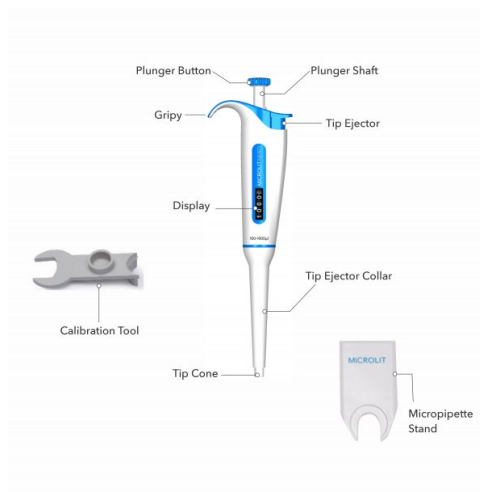


Figure 1: Components of a Manually Adjustable Micropipette

The typical version of the micropipette available at the CaYPT lab is shown in Figure 1. The entire package contains the micropipette stand, micropipette tips, calibration tool, and the main micropipette plunger. The micropipette stand is to be positioned and perpendicularly taped (with the mounting tape given) onto a chosen surface. The micropipette tip is to be securely placed on top of the tip cone, which allows the micropipette to store the liquid during usage. The calibration tool allows for calibration adjustment when needed, it can be used as a calibration wrench by placing it around the plunger and rotating counterclockwise (decrease the volume aspirated/dispensed) or clockwise (increase the volume aspirated/dispensed) [4]. After the assembling and calibrations are done, the main micropipette body will be ready to be used.

1.3 General Mechanism of Micropipette [2]

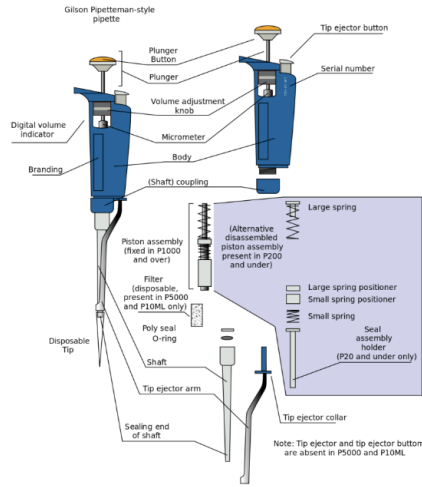


Figure 2: Schematic of an air displacement pipette

The overall idea of all types of micropipettes' operation principle is the same. For example, the internal springs of an air displacement pipette allow for piston-driven air displacement, which leads to the exchange of air and liquid once the piston moves vertically (driven by the motion of pressing down/releasing the plunger button). The vacuum created by the upward motion of the piston (when the plunger button is pressed down) allows the liquid to move upwards into the tip as the plunger button is released, which can then be dispensed by having the plunger button pressed down again [3].

2 Comparison Between Typical Model [3]

The micropipettes can first be divided into two major types: single-channel micropipettes and multi-channel micropipettes. Single-channel micropipettes provide a greater range of capacities, whereas multi-channel micropipettes offer greater efficiency in dispensing liquid, which is typically used to create multiple samples at the same time. [5] The micropipettes can then be classified into smaller types: Air displacement micropipettes, positive displacement micropipettes, electronic micropipettes, microfluidic pipettes, robot operated micropipettes, and fixed micropipettes [3]. While most of the above micropipette types work with similar piston systems, the microfluidic pipette works differently. The microfluidic micropipette is generally built with an inlet, an outlet, a microfluidic channel, a control valve, and a control valve inlet; some analytical microfluidic micropipette also has a pressure gauge, compressed air tank, pneumatic control, as well as x-y-z stage controller links to it. This type of micropipette is widely used for cell mechanics studies on acoustic, magnetic, and optical actuation [6]. Electronic micropipettes and robot-operated micropipettes are micropipettes that use electricity as their power source, which have higher accuracy than manual micropipettes. To further analyze the differences between the operation principles of the micropipettes, the following pairs of micropipettes are compared: air displacement micropipettes to positive displacement micropipettes and adjustable air displacement micropipettes to fixed micropipettes.

Table 1. Air Displacement Micropipettes vs. Positive Displacement Micropipettes [7]

Air Displacement Micropipettes	Positive Displacement Micropipettes
<ul style="list-style-type: none"> – There is air in between the liquid and the piston. – The accuracy of the designated volume of liquid aspiration /dispensation may be affected by the temperature, the atmospheric pressure, and the specific gravity and viscosity of the liquid. 	<ul style="list-style-type: none"> – No gaps between the liquid and the piston; the liquid comes in direct contact with the piston. – Uses disposable capillaries instead of micropipette tips, which determine the designated amount of liquid aspiration along with the distance of the piston's movement.

Table 2. Adjustable vs. Fixed Micropipettes [8]

Adjustable Air Displacement	Fixed Micropipettes
<ul style="list-style-type: none"> – Able to work with a wide range of volumes. – More accurate at the maximum intake volume, less accurate as the intake volume decreases. 	<ul style="list-style-type: none"> – Only has one available intake volume. – Higher accuracy and consistency.

3 Micropipette in CaYPT Lab

The CaYPT lab has one Microlit Single Channel Variable Volume micropipette - RBO Series 100-1000 µl.

Official product page: <https://www.microlit.com/product/rbo-single-ch-variable-vol/>

User manual: <https://www.microlit.us/micropipette-product-guide/>

Order link: https://www.amazon.ca/Microlit-Lab-Micropipette-Single-Channel-Autoclavable/dp/B07C1DW8JX/ref=sr_1_5crid=2E95ADZUFXE4V&keywords=Microlit%2BSingle%2BChannel%2BVariable%2BVolume%2Bmicropipette&qid=1653513689&srefix=microlit%2BSingle%2Bchannel%2BVariable%2BVolume%2Bmicropipette%2B%2Caps%2C76&sr=8-5&th=1

Micropipette tips order link: https://www.amazon.ca/Microlit-Pipette-Tip-Box-1000ul/dp/B07QNZGPPF/ref=sr_1_14crid=1EYV4NY2R6CME&keywords=micropipette+tips&qid=1653513772&srefix=micropipette+tips+%2Caps%2C67&sr=8-14

4 General Procedure of Operation [1]

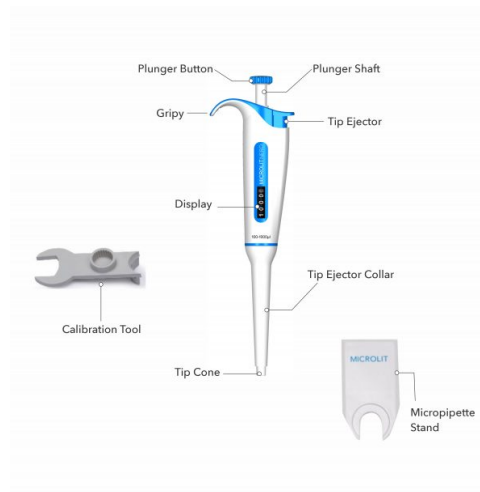


Figure 3: Thermocouple Circuit[?]

1. Press-fit a tip to the micropipette without directly touching the tip.
2. Press the plunger to the first stop, and immerse the pipette tip vertically in the liquid to aspirate the liquid into the tip.
3. Release the plunger while the tip is still in the liquid.
4. Place the micropipette at a steep angle.
5. Press the plunger to the first stop to dispense the liquid from the tip.
6. Press the plunger to the second stop to empty the tip completely.
7. Press the tip ejector button to remove the tip.

5 Calibration

Follow the procedure in the user manual. Calibration is especially important for adjustable micropipettes in order to maintain high accuracy.

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