

## The Benefits of Electronic Dispensing: How to Choose the Correct Dispenser?

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*All laboratories, whether industrial, research, diagnostics or chemical laboratory, need to dispense liquid. No matter if the laboratory is for research, service, production or quality control, dispensing needs to be done accurately, often repetitively with very small volumes. Dispensed liquid varies from blood and buffers to toxic chemicals and soil samples. Even if there are strict demands for performance, dispensing device selection is seldom a well thought out decision.*

*From the wide selection of dispensing devices, it may be difficult to find the most suitable instrument. However, choosing the right products for each application enhances reliability, adds speed and diminishes cross-contamination. Every manufacturer emphasises ease-of-use and flexibility, but which dispenser should one choose? This clearly depends on volume(s), sample, application, and requirements for performance. In the following are listed a few criteria in choosing a dispenser.*

**“AN ELECTRONIC DISPENSER REDUCES THE WORKLOAD AND IMPROVES THE ACCURACY AND PRECISION IN DISPENSING, INDEPENDENT ON USER.”**

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### AUTOMATIC OR HAND-HELD DISPENSER?

The demand for higher and higher throughput is a concern in all laboratories today and fully automated instruments would seem like the best choice. However, many laboratories need to establish several research or screening programs differing significantly from each other, both in application and volume range. Different samples regarding toxicity, risk of contamination and viscosity make the choice even more important – and difficult. Money is always a limiting factor as well.



Figure.1. Selection of dispensers available on the market.

Semi-automated instruments offer affordable price and flexibility. However, many instruments have tubing needing thorough cleaning and priming with excess of liquid that might be expensive or hazardous. Hand-held electronic dispensers offer multiple functions and speeds - and use positive displacement tips. These tips contain two parts - a thin-walled tip barrel and a precision-moulded plastic piston - in one disposable combination (Figure 1). They have been developed especially for precise and contamination-free dispensing of hazardous, volatile, corrosive or viscous liquids. Moreover, several personal instruments can be purchased with the money spent for one common automated instrument.

### HAND-HELD DISPENSERS

Hand-held dispensers can be roughly divided into four categories:

1. Manual dispensers
2. Manual dispensers with electronic display
3. Electronic dispensers with manual tip removal
4. Electronic dispensers with electronic tip ejection

Most manual dispensers have common design pattern. The tips are manually secured and a manual adjusting mechanism is used to select a limited amount of volumes and repetitions. A selection table of different tip sizes, volumes and repetitions is used to select the optimum dispensing series.

The dosing button is manually lifted up to aspirate liquid and then dispensed by repeated manual downward thumb pressings. The tip must be removed manually after use. Semi-manual dispenser has more options in volumes and repetitions, but also requires purpose made tips that are recognised by the dispenser.

Recently, electronic hand-held dispensers (Table 1) have concurred laboratories as continuous pipetting with high-force manual devices cause more and more often Repetitive Strain Injuries.

Health and Safety Officers have realised the high cost of work-related injuries and the impact absence of a scientist can have on a research project, and recommend electronic devices. On the other hand, flexibility, affordable price, and speed make them often the best choice.

### ERGONOMICS

A dispenser may be used only for short periods of time but many research projects require dispensing at an intensive pace. In many laboratories technicians perform repetitive dispensing tasks for a full working day several days a week throughout the year. An electronic dispenser reduces the workload and improves the accuracy and precision in dispensing, independent on user.

All manufacturers claim that their dispensers are ergonomic, but there are clear differences in design (Figure 1.). An electronic dispenser is slightly heavier than a mechanical, but the balance and diminished workload compensates the weight and other features make dispensing faster and easier.

The award-winning ergonomic design of the Biohit eLINE® range has been carefully planned: The eLINE electronic dispenser (Figure 2.) fits comfortably in hand, and the ergonomic finger support and light weight reduce fatigue. The actuating button sits conveniently under the thumb in natural position, not on the back of the pipettor or too close to tip ejection button like in many other models.

On the contrary to manual tip removal in other models, the tip is ejected electronically and the buttons are placed precisely for minimal exertion. The design is symmetric allowing similar use with the left or right hand from various pipetting positions. Furthermore, the volume setting can be done electronically.



Figure.2. Versatile eLINE pipettor and dispenser family.

## CONVENIENCE AND ECONOMY

In a laboratory space is usually critical. A charging carousel holding and charging multiple instruments simultaneously saves space and is more cost-effective than separate charging stands. Unlike any other electronic dispenser, eLINE dispenser is part of a pipettor family: The dispenser can be purchased with or without the AC-adaptor and fitted into any eLINE charging stand or carousel together with eLINE electronic pipettors (Figure 2.). On the other hand, the customer can also choose direct plugging of the AC-adaptor, and even continue dispensing while charging.

## DISPENSING WITH MINIMUM FORCE

In manual dispensers the dosing button is manually lifted all the way up (approximately 5 cm) to aspirate the liquid and the thumb then moves up and down controlling the plunger in dispensing. The repeated lifting and thumb pressings of the operating button demand strong total force. The force needed for one full aspiration in mechanical dispensers is at least 15 times more compared to electronic dispensers. For dispensing one aliquot there is another 15-fold difference, which is repeated easily 100 times in a typical dispensing cycle. Moreover, with electronic dispenser, 100 x 100 µl can be done with single aspiration, whereas manual dispenser requires an additional aspiration and dispensing cycle, adding workload. This 15 N (1.5 kg) force for single dispensing may be done hundreds of times, many hours a day, several times a week - no wonder Repetitive Strain Injuries start to develop. With electronic dispensers, both the aspiration and dispensing force is practically eliminated as operation is controlled electronically by simply touching the operating buttons.



Figure.3. Light tip attachment and unique electronic tip ejection make eLINE dispenser the most ergonomic dispenser on the market.

## TIP INSERTION AND EJECTION

Tip insertion and removal in conventional dispensers demand more force and effort than expected. In most dispensers, even in electronic (Figure 1), a tip locking lever must first be opened, the tip must be pushed in its place firmly, and the lever then closed. The piston must be at its lowest position when opening the lever. In most advanced dispensers, such as eLINE dispenser, minimum force is required to attach the tip. The tip connector automatically clicks the tip smoothly in place when attaching the tip into the connector (Figure 3.). No pressing is needed. Moreover, the Biohit eLINE is the only electronic dispenser on the market that has an electronic tip ejector (Figure.3.). Only a light touch is needed to eject the tip. However, tip ejection with liquid in the tip is prevented for safety reasons. In all other dispensers, tip removal is done manually.

Table 1. Features of Biohit eLINE dispenser

Electronic Dispensers - Functionality	
Function	Biohit eLINE dispenser
Multiple dispensing	d
Pipetting	P
Diluting	dd
Sequential Dispensing	Sd
Automatic Multiple Dispensing	Ad
Multi Aspirating	SA
Titration	
Custom Mode (CST)	GL, Sr, SET
Speed selection	5
Tip insertion	Press for click
Tip ejection	Electronic
Direct charging through AC adaptor	Yes
Use during charging	Yes
Charging stand/Quick charging	Yes
Charging carousel	Yes
Volume range	1µl-50ml
Battery	NIMH
Display	LCD
Weight (g)	172
Length (mm)	195
Number of programming buttons	3
Location and use of operating button	Front/Thumb
TipGuide and Programming without tip	Yes
Tip recognition with manufacturer's own tips only	Yes
Fitting/Use of other manufacturers tips	Yes
Program-controlled reminders for service (GLP)	Yes

The tip ejector buttons locate either at the front of the handle, on both sides of the lower part, or most often, there is no real tip ejector at all and tips must be removed by opening the locking mechanism and pulling the tip out. This is not convenient with infectious, volatile or radioactive solutions. Being able to eject the tip without force directly to a waste container adds safety in work.

The tip ejection force even in most advanced electronic dispensers with mechanical tip ejection is on average 10 times more than in eLINE dispenser. In mechanical dispensers the difference is more than 20-fold requiring movement to many directions. Thus, when hundreds of tip removals/ejections are done daily, an electronic tip ejector is significantly reducing the risk for Repetitive Strain Injuries.

## TIP RECOGNITION VS. TIPGUIDE

In manual dispensers a selection table must be used to select the volume (1 µl - 50 ml) and repetitions for each tip. In most electronic dispensers, the tip is automatically recognised and displayed first, after which the suitable aliquot and repetitions can be chosen. However, one must know in advance the best tip for the application, and usually there is more than 1 choice. For example, there are at least 3 choices to dispense 100 µl: for maximum precision the choice is 1.25 ml tip - with 2.5 ml tip repetitions increase from 11 to 23, and with 5 ml tip to 48, but precision decreases. Therefore, one should always decide in advance whether repetitions or precision is more important. As a safety feature tip recognition is practical, but it also limits users to specific manufacturer's tips, and programming can only be done after the tip has been inserted and recognised. In some electronic dispensers, other tips can be used, but tip recognition does not work. In addition, an additional tip adapter and the selection table must be used.

eLINE dispenser features a unique TipGuide- an automated software-based guide for tip selection. Programming is started simply by choosing the number of dispensings and volume. The TipGuide automatically suggests the possible tip choices, featuring the best choice first. The benefits of this system are convenience, correct tip choice from multiple options and no need for selection tables or calculation.

TipGuide also minimises the possibility of false choices and guides through selections. This saves a lot of time and makes it possible to use many different tips on the market. However, eLINE dispenser allows also selecting the tip first through another program offering unique versatility. Commonly used tip range can also be stored and service intervals determined and reminded through custom-program, which is not possible with other dispensers.

There are currently two different dispenser tip systems: Most mechanical dispensers use tips with gradation of 5 and tip content divided by 50. Most electronic dispensers use gradation of 20, divided by 100. There is no such thing as a universal tip that fits all dispensers and these two systems are not necessarily compatible with each other. When choosing the dispenser, one should find out which tips can really be used. In general, electronic dispensers offer more individual volume selections than mechanical dispensers, including odd dispensing volumes, such as 50,4 µl or 1.05 ml.

## FUNCTIONS AND EASE OF USE

Electronic dispensers have 4 to 6 different programs (Table 1). In addition to pipetting and dispensing, most have automatic dispensing with user-specific time intervals. Most advanced models have sequential dispensing, where aliquots of different volume can be dispensed. Only 2 models have multi-aspiration, which is very useful in aspirating for example supernatants from cell culture plates or potentially infectious samples, such as HIV-positive serum samples, from microplates. Usually, a dispenser with well-designed user interface, clear display and symbols is often easier to program. Another important feature is error feedback. In eLINE concept dispensing is microprocessor-controlled with optical feedback sensors guaranteeing the required piston movement. Should a failure occur, the system will notice it and give an error message.

## CONCLUSIONS

There are several types of dispensers on the market, from manual steppers to fully automated dispensing units. To find the right tool for each application one should determine the dispensing procedures, number of repetitions, modes/techniques and needed volumes. Money and number of technicians in the laboratory affect selection as well. However, the best decision comes always through try-out and evaluation.

A hand-held dispenser is at its best when repeatedly filling for example microplate wells or test tubes in long series. In a laboratory where thousands of dispensings must be done daily, an electronic dispenser adds flexibility and speed without need to spend much money. Dispensers can be used with almost any kind of liquids, especially with highly volatile, viscous, infectious or radioactive liquids. On the other hand, they significantly reduce the strain compared to mechanical dispensers. In fact, several laboratories have invested in personal hand-held dispensers instead of one common fully automated dispensing unit. Many have also changed all their mechanical dispensers to electronic in order to prevent the work-related upper limb disorders.

The ease-of-use, ergonomics and versatility of the Biohit eLINE dispenser makes it superior in today's laboratory work. It removes the majority of human error with unique TipGuide and an inexperienced user gets same performance as a well-trained technician. Most important, the Biohit eLINE offers a unique ergonomic feature - an electronic tip ejector. The workload it diminishes is unbelievable.

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