APPLICATION KNOWLEDGE

Liquid Handling with Bottle-Top Instruments:

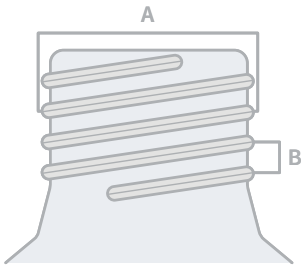
Solutions for special applications

Introduction

Bottle-top dispensers and bottle-top burettes enable liquid handling directly from bottles, canisters or other containers.
The bottle-top concept saves time in the laboratory and ensures greater safety since no intermediate steps are required. For many laboratory applications, bottle-top instruments can be used universally.
In this technical note, we present solutions for applications that are particularly challenging due to the media or container being used.

Bottle adapters

The Dispensette®, seripettor®, and Titrette® are attached to a container of medium via a GL45 internal thread. The connection element on liquid handling instruments is called a valve block adapter and this is firmly connected to the instruments. The GL45 thread is a common size for glass or plastic laboratory bottles from many different manufacturers. Laboratory chemical suppliers often use bottles with a smaller thread diameter, such as 40 mm. Plastic canisters, on the other hand, often have threads with larger diameters, such as 50 mm or 60 mm. In order to attach BRAND bottle-top instruments to a variety of different media containers, bottle adapters that adapt the GL45 thread of the instruments to the media container thread are required. To determine the thread size of a bottle and choose the right bottle adapter, the outer diameter of the thread (A) and the thread pitch (B) are measured.
Another characteristic of a thread is its shape. GL-threads are round, while S-threads have the shape of a saw tooth. However, due to the tolerances, S- and GL-threads are usually compatible with one another. Alternatively, BRAND provides a document on its website with adapter templates.



Determining the thread size of a bottle

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BRAND offers a selection of thread adapters for common thread sizes in the laboratory. For bottle adapters with a bottle thread diameter less than 32 mm, the bottle adapter GL 32 – 33 (Item No. 704396) must be inserted. One possible combination would be Dispensette® S (valve block adapter GL45) on bottle adapter GL 32 – 33 (Item No. 704396) on bottle adapter GL 28/ S 28 (Item No. 704328) on a media bottle with GL 28 thread.

You can find our adapter templates at **shop.brand.de**

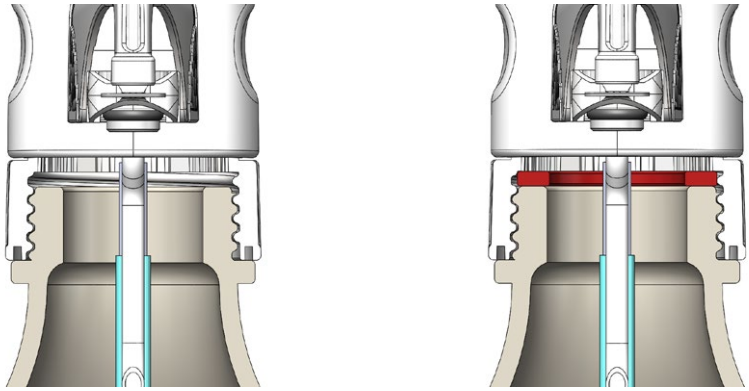
If there is no suitable adapter for a screw-top bottle or canister, you can use the following solution:

The bottleneck (canister opening) must have a diameter of at least 40 mm. A hole with a diameter of 32 mm is drilled into the original screw cover of the container. The adapter GL 28 / S 28 (704328) is inserted into the hole from the bottom. Adapter GL 32 – 33 (704396) is screwed onto the adapter GL 28 / S 28. The distance between the knurls of the adapters, which results from the thickness and shape of the original cover, must not exceed 10 mm to ensure a secure interlocking of the threads. Depending on the application, the contact surfaces should still be sealed with a suitable material. Screw the Dispensette®, seripettor® or Titrette® onto adapter GL 32 – 33, ensuring that it fits securely.

Sealing ring

It is important to know that there is always a certain gap along the thread turns of thread connections. This is necessary for minimizing the friction produced when the threads are screwed together and for balancing tolerances. The sealing ring is used to seal the valve block of a Dispensette® or Titrette® against the upper edge of the bottleneck. Depending on the bottle, the upper edge of the bottleneck would otherwise have no contact with the valve block of the Dispensette® or Titrette®. This is useful, for example, when a drying tube is being used, since moisture can penetrate into the bottle along the thread turns. The sealing ring also provides additional security. For example, when media is being transported, it can splash onto the junction between the bottleneck and the valve block adapter.

Thread connections: gap between threads shown in red



Left: Dispensette® without sealing ring; right: Dispensette® with sealing ring (shown here in red for illustration purposes)

Drying tube

Bottle-top dispensers and bottle-top burettes come with a ventilation channel, which ensures that the pressure inside the media bottle is the same as the ambient pressure.
If the inside of the bottle were to be hermetically sealed from the ambient atmosphere, a vacuum would be created in the bottle as removal of the medium increases. Depending on the vapor pressure of the medium, it would begin to evaporate as a result. At the very least, the dispensing process would be impaired by the vacuum in the bottle.
The drying tube is used when the medium must be protected from the penetration of moisture or carbon dioxide from the air. The drying tube is a plastic tube with a screwed-on elbow piece and removable closure cap with hose nozzle.
The tube is screwed onto the valve block of the dispensette or titrette where the ventilation channel is sealed with a perforated plug on delivery.

The drying tube must be filled with a solid reagent that is suitable for the application. Adding a bit of mineral wool into the tube is recommended as a filter material so that the solid material or its dust cannot enter the bottle.

Dispensette® with drying tube

Binding water:

Water content in organic solvents that increases over time can have a disturbing effect on the chemical reaction or the analytical procedure. In hygroscopic aqueous media, such as concentrated sulphuric acid, the concentration changes.
Silica gel (made from silicone dioxide) and a molecular sieve with pore size 4Å (made of zeolites), used individually or in combination, are a good drying agent for air since they do not dissolve when the water content increases. Silica gel in combination with a humidity indicator is also referred to as blue gel or orange gel. As the water content changes, the changing color makes it easy for the user to tell when the drying tube filling has expired.

Binding CO_2:

When CO_2 from the air dissolves in water, carbonic acid forms. If the solution is a base, for example an aqueous sodium or potassium hydroxide solution, the CO_2 is bound as a carbonate, which changes the content of the base via a neutralization reaction. This is particularly a problem when the base solution is a titration medium, since titrating a solution with an unknown content leads to erroneous results. In addition, carbonates that are by comparison poorly soluble can break down in the solution – for example in an ethanolic potassium hydroxide solution. In turn, the precipitates then form salt crystals which can wear out the piston of the instruments faster and lead to leaky ball valves.
To bind the CO_2 from the air, granulated absorbers such as soda lime can be used. Soda lime consists primarily of calcium hydroxide and sodium hydroxide, with an indicator also mixed in.

Binding odors:

The Dispensette® is a laboratory instrument and should therefore also be operated in a laboratory environment that includes technical ventilation with sufficient air exchange. In practice; however, local and temporary exposure to strong smelling compounds may occur. A drying tube filled with activated carbon can provide relief in these situations.

Venting stopper for microfilters with Luer cone:

If you use the Dispensette® bottle-top dispenser to dispense sterile media, for example nutrient solutions for cultivating microorganisms, the instrument should first be autoclaved. Instructions on preparing instruments can be found in the operating manual. The venting stopper for microfilters with Luer cone is used to attach a microfilter over the Luer cone.
If you use the Dispensette® bottle-top dispenser to dispense a sterile media, such as a nutrient solutions for cultivating microorganisms, the instrument should first be autoclaved.

Venting stopper with Luer cone without filter attached

With filter attached

Flexible discharge tubing

Work efficiently with flexible discharge tubing

When dispensing media with bottle-top dispensers, the sample cup is usually moved into position at the tip of the discharge cannula. In the case of small-volume sample containers, such as test tubes or cuvettes, which are placed in stands for better handling, it is advisable to do the opposite. This is where flexible discharge tubing comes in handy, as it can be moved to the sample container.

It should be noted that for small dispensing volumes, the piston must be depressed gently. Otherwise, there is a risk of over-dispensing due to the spit effect. The spit effect originates from the principle of mass inertia: the moving mass of the liquid to be dispensed has an inherent momentum which is proportional to the dispensing speed. To slow this momentum, the speed of the liquid must be reduced to zero, which occurs at both the upper and lower stopping points of the piston during the dispensing process. We describe the change of the momentum over time as a force whose magnitude depends on the acceleration – a negative sign is used when braking acceleration. If the liquid is traveling at a high speed at the reversal point of movement, and this speed is also abruptly reduced to zero, relatively high forces are produced in the system. In other words, you can say that the moved liquid wants to pull more liquid from the bottle until the forces are balanced again.
On one hand, these forces opposing the moving force are the friction forces between the liquid and the surfaces as well as the viscosity of the medium; on the other hand, they are the restoring forces of the valve spring in the discharge valve. If the movement force of the liquid is too high at the movement reversal point (minus the friction forces and viscosity) in comparison to the restoring force of the valve spring, the discharge valve opens for a fraction of a second and additional liquid flows through which is discharged as a “spit drop.” In practice, this drop increases the dispensed volume as the sample container is already under the tip of the discharge cannula or discharge tube at this time. Although the spit drop only amounts to a few microliters, it must be closely observed such as during calibration.
Important information: the described spit effect is universal and applicable to all dispensers on the market.

Bottle stand

It is always good practice to secure bottle-top instruments such as the Dispensette®, seripettor®, and Titrette® from falling over, especially when small or light bottles are being used. The existing metal laboratory rods that are fixed to the wall or furniture in many laboratories can be used to secure the bottle-top instrument in addition to sleeves and clamps. However, this solution is quite inflexible and quick repositioning of instruments requires a bit of practice – especially if clamps are not yet installed at the new position. The bottle stand from BRAND assists you with quick location changes. Instruments are securely connected to a base plate via a stand with clamp. The center of gravity is shifted downwards by the weight of the bottle holder and the base plate increases the standing surface.

Bottle stand to protect against tipping

Dispensette® drum extraction system

When you want to dispense media directly from drums or canisters, you are faced with two problems:

1. This uses up a lot of space on the worktable.
2. The Dispensette® is positioned quite high above the work table, which often makes it difficult to work ergonomically.

The Dispensette® drum extraction system provides a solution in this situation. The Dispensette® can be attached to a laboratory rod or a metal stand, or fixed directly to a wall or laboratory furniture with screws. These options secure the Dispensette® in place and saves space. The media container can be placed in a base cabinet or on the ground nearby. Media is transported via fluoropolymer tubing. Changing containers is facilitated by a coupling element with ball valve, which ensures that the medium cannot leak from the fluoropolymer tubing.

Dispensette® S connected with a barrel to a pipeline

Titrette® extraction system for Bag-in-Box packaging system

Titrette® extraction system for Bag-in-Box packaging system

(Titripac® is a registered trademark of Merck KGaA, Darmstadt, Germany)

In addition to bottles, ready-for-use titration media is offered in Bag-in-Box packaging. The advantage of Bag-in-Box packaging is that the titration solution is protected from light and the ambient atmosphere (i.e. its oxygen, carbon dioxide, and humidity). The packaging ensures that the content of the titration solution does not change and thus the analysis result is not flawed. Standard Bag-in-Box packaging systems already come with tubing and connectors or they are sold separately by titration media manufacturers. M6 thread connections are a common format used to connect to the adapter of the Titrette® extraction system. The Titrette® and the adapter are then fastened to a laboratory rod or metal stand via a fixture.

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