

Volumetric Glassware Use - General

Clean glassware is important in every experiment. It is exceptionally important that volumetric glassware (burets, pipets and volumetric flasks) be scrupulously clean, otherwise errors in volume determination may be made. One sure sign that glassware is dirty is the formation of water droplets on the inside wall of the glassware. If after cleaning with soap, water and a brush, water droplets form you probably did not clean the glassware well enough and should repeat the washing until no droplets form when rinsed with distilled water.

One other general point to note about volumetric glassware is the method required to read the volume. Water will wet the surface of a clean glass column and form a concave meniscus. To make a reading the experimenter should place a uniform background behind the liquid (a piece of white paper will serve this purpose). In this way the meniscus will be clearly outlined. The liquid level should be read at the bottom of the meniscus. The meniscus should be read at eye level to prevent errors due to parallax, the apparent change in position of an object resulting from the change in position from which it is viewed. Use this process every time a reading is made from volumetric glassware (see Figure 1).

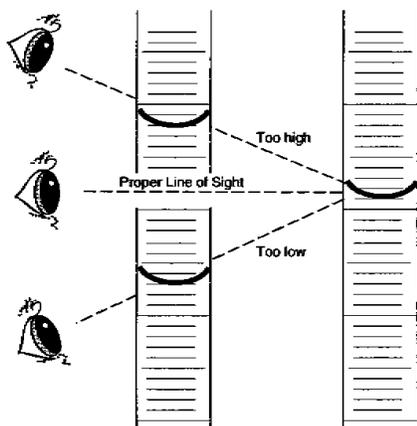


Figure 1: How the changing the angle of view for reading a meniscus introduces error.

The Buret

Burets can be used to measure volumes up to 50 mL with both precision and accuracy. Because they are calibrated to the tenth of a mL, volumes can be recorded to the hundredth decimal place. The volume dispensed by a buret is determined by measuring the level of solution in the buret at the beginning of the experiment

(the initial reading) and again after the appropriate amount of solution has been dispensed (the final reading). The difference between these two readings corresponds to the volume actually dispensed.

Filling a buret

Once the buret is cleaned, place it in a buret stand and rinse it with distilled water (be sure the water runs through the tip as well). Close the stopcock. Condition the buret by rinsing with the solution to be used. Pour a 5 mL portion from a beaker or flask, not a large reagent bottle, through a funnel into the buret. Tilt the buret horizontally, rocking and rotating it until all its walls have been washed. Do not use your finger to cover the open end of the buret! Turn the buret upright and drain the solution through the tip. Repeat this rinsing; then fill the buret with solution, above the 0 mL mark. Finally, open the stopcock and allow the solution to flow until there are no bubbles remaining in the tip. If the level of the solution is far below the 0 mL mark you should add more solution. (Note: It is not necessary to have the level at an exact volume such as 0.00 or 1.00) Make sure to remove the funnel after filling the buret. This is because drops of solution may fall from it into the buret after you have taken an initial reading.

Reading a Buret

When reading a buret, remember to read it against a uniform background and to have the meniscus at eye-level. Also be sure to include uncertainty in any buret reading. Always record buret readings to two decimal places. If the bottom of the meniscus is at the 7.00 mL mark, record it as 7.00 mL not 7 mL.

Dispensing a Solution

When a solution is being dispensed from a buret grasp the stopcock in a manner that gives you control over the stopcock. In any case, you want the grip to be as comfortable as possible. It will be necessary to dispense liquids a drop or two at a time. It is possible to adjust the stopcock to allow a flow rate of 1 drop every second. Also if you rapidly turn the stopcock through 180°, the volume dispensed can be as little as 0.02 mL.

Keep the receiving vessel near enough to the buret tip so that solution does not splatter. However, do not insert the tip directly into the solution in the receiving vessel.

The Volumetric Pipet

Volumetric pipets also measure volumes with precision and accuracy. But unlike a buret, a given pipet can only measure one volume, depending on its size. For this reason, a pipet has only one calibration mark. A pipet bulb is used to draw solution up into the pipet, and gravity is used to drain it.

Measuring liquids with a pipet

Begin with the pipet that has been cleaned. Squeeze a pipet bulb and carefully place it on the end of the pipet. Inset the tip of the pipet into a beaker containing the solution to be pipetted. Slowly release the pressure on the pipet bulb and draw the solution into the pipet. When the pipet is half full, quickly remove the pipet bulb and place your index finger over the end of the pipet. Remove the tip of the pipet from the solution and tilt the pipet to rinse the inside walls. As with the buret, do not cover the open end of the pipet with your finger while rinsing the walls! Place the tip over an empty beaker and allow the solution to drain into the beaker. Repeat this rinsing again to fully condition the pipet.

After the pipet has been conditioned, using the bulb, draw the solution into the pipet above the calibration mark etched in the neck of the pipet. Again, quickly remove the bulb and place your index finger over the end. The meniscus should be above the etched line. Hold the tip of the pipet against the bottom of the container and gently ease the pressure of your index finger. Allow the level to fall until the bottom of the meniscus is even with the etched mark. Increase pressure with your index finger to hold the solution at that level. Move the pipet to the container to which you are transferring the solution, and release your finger and allow the solution to drain freely. When all the solution has drained, touch the tip of the pipet to the side of the container, to remove the last drop, and continue. (Note: do not blow the solution out of the tip of the pipet. It has been calibrated to include the small volume that remains in the tip after all the solution has drained.)

The Volumetric Flask

A volumetric flask is used when it is necessary to know both precisely and accurately the volume of the solution that is being prepared. Like volumetric pipets, volumetric flasks come in different sizes, depending on the volume of the solution being prepared. Each flask, because it measures only one volume, has only one calibration mark (on the neck of the flask). When used in conjunction with a pipet, a volumetric flask can be used to prepare a dilute solution from a more concentrated one.

Preparing a Diluted Solution using a Volumetric Flask

Begin with a clean flask. Rinse it well with distilled water. Use a volumetric pipet to deliver the appropriate volume of concentrated solution to the volumetric flask. Add distilled water to the flask, using a funnel or wash bottle, until the level reaches the neck of the flask. At this point, add water more slowly. Finally, add water drop by drop until the bottom of the meniscus is even with the calibration mark. Stopper the flask tightly, invert it and shake to obtain a homogeneous solution. Repeat the inversion and shaking process several times.

Preparing a Solution using a Solid Solute

A solution of known concentration can also be prepared by placing a known mass of solute in a volumetric flask and diluting to the mark with distilled water. Using weighing paper, measure the appropriate mass of solute on the Mettler Balance. Be sure to record the mass to four decimal places. Carefully transfer the solid to the flask. Add a small amount of water and swirl to dissolve the solid. After the solid is completely dissolved, fill the flask to the mark as previously described. It is very difficult to dissolve the solid once the flask is filled to the mark, so make sure it is all dissolved before you fill to the mark. Stopper the flask tightly, invert it and shake to obtain a homogeneous solution. Repeat the inversion and shaking process several times.