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Handbook of Medical Laboratory Technology

A *Book* for DMLT Students

As per the Latest Syllabus and Guidelines

Nanda Maheshwari

Foreword
Shamim Sheikh

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CHAPTER

3 Laboratory Glassware

INTRODUCTION

Laboratory glassware refers to a variety of equipment made of glass used for scientific experiments and other work in science. It is found in abundance in laboratories and comes in all shapes and sizes. Though, it has become preferable in recent years to substitute glass vessels for cheaper, more durable and less fragile plastic materials, some substances and experiments or applications still require the use of glassware.

The reasons for these are manifold. Firstly, glass is relatively inert, meaning it will not react with the chemicals or substances placed inside and thereby upset or skew the results. It is also transparent, allowing for easy monitoring, and heat-resistant, allowing for high temperatures. Furthermore, it is easy to shape and mold into any form required.

TYPES OF GLASS USED

Different types of glass are used to produce laboratory glassware. Each glass variety has specific properties that make it suited to different applications.

- *Borosilicate glass*: The most commonly used type of glass used is borosilicate. It is naturally transparent and can withstand high heat and thermal shock.
- *Quartz glass*: It is often also referred to as fused silica as it contains only silica. Quartz glass can withstand very high temperatures and is transparent in certain parts of the electromagnetic spectrum.
- *Fritted glass*: Fritted glass is a porous type through which gas or liquids can pass. It is often used to filter items in laboratories.
- *Silanized glass*: This type of glass is coated to prevent organic materials adhering to it.
- *Amber glass*: It is darkened to block out ultraviolet (UV) and infrared radiation, thereby making it ideal for storing fluids.

TYPES OF GLASSWARES

Volumetric glassware are most commonly used in biochemistry laboratories. Volumetric glassware are specialized pieces of glassware which are used to measure volumes of liquids very precisely in quantitative laboratory work.

Here are some of the different types of glass instruments used in laboratories **(Fig. 3.1)**:

- *Bulb and graduated pipettes*: These are used to transport specific amount of fluids from one place to another.
- *Burettes*: These are used to dispense exact quantities of liquid into another vessel.

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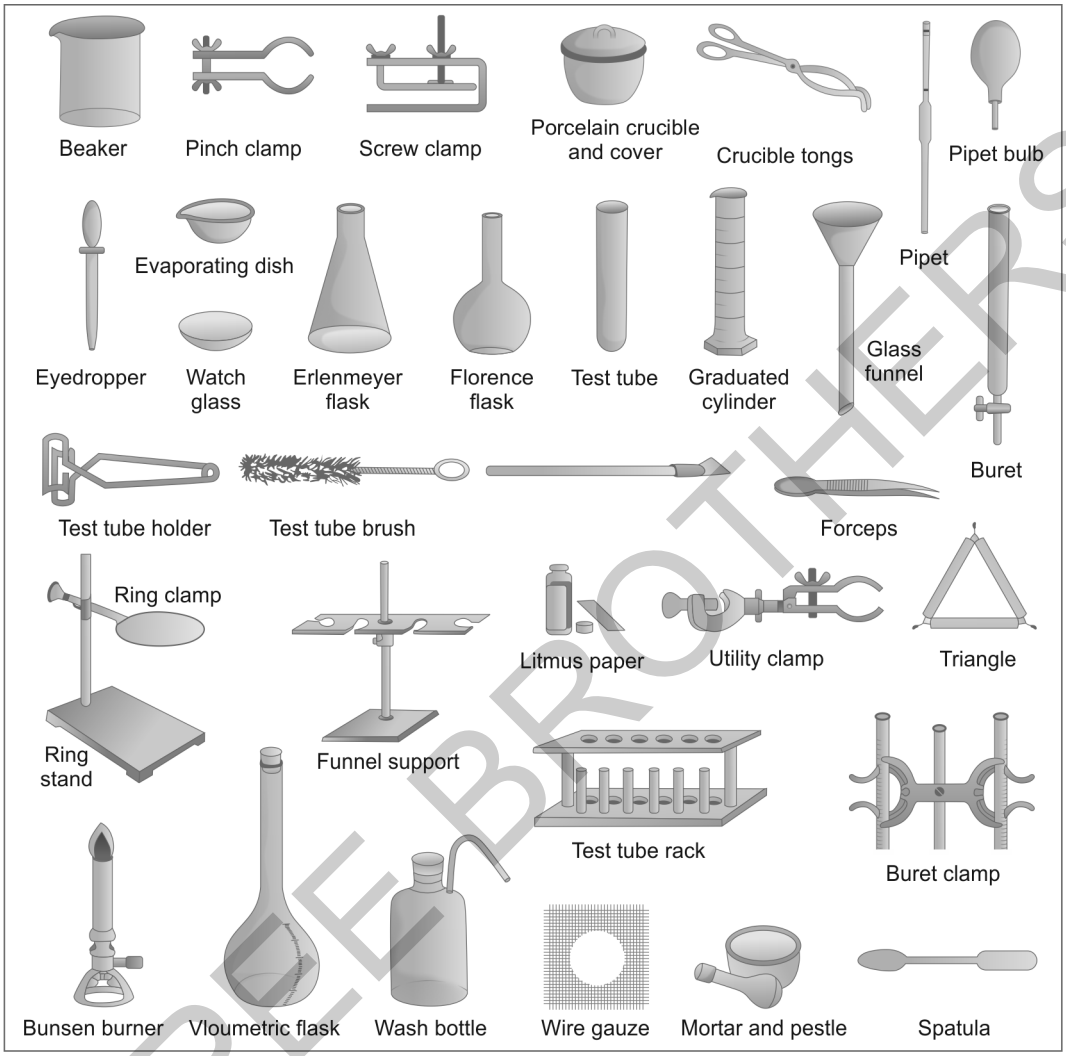

Fig. 3.1: Common glassware in laboratory.

- *Beakers*: Simple containers used to hold samples and reagents.
- *Volumetric flasks*: Similar to beakers, these are used to hold samples, but usually come in a conical or spherical shape with a tapering neck.
- *Condensers*: Specifically used to cool heated liquid or gas.
- *Retorts*: These are used for distillation purposes.
- *Funnels*: The tapered neck of a funnel allows easy pouring of a liquid into a narrow orifice.
- *Petri dishes*: Shallow dishes used to culture living cells.
- *Graduated cylinders*: Similar to beakers, these cylindrical vessels have volumetric markings to allow for monitoring of volume.
- *Vials*: Small bottles used to store samples or reagents.
- *Slides*: Used to hold items under a microscope for inspection and study.
- *Stirring rods*: Used to mix solvents and samples together.

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- *Desiccators*: A container designed to absorb moisture from a substance.
- *Drying pistols*: Similar to a desiccator, the pistol is a more direct method of removing moisture from a sample.
- *Pipettes*: A pipette is used to measure small amount of solution very accurately. Two types of pipettes commonly used are: (1) Transfer pipettes, and (2) Measuring pipettes.
  a. Transfer pipettes include volumetric pipettes and are designed to deliver accurately a fixed volume of liquid such as standard solutions and nonviscous samples, and consist of a cylindrical bulb joined at both ends to narrowed glass tubing. These pipettes are allowed to drain by gravity.
  b. The second type of pipette is the graduated or measuring pipette. Two kinds are available: (1) The Mohr pipette and (2) The serological pipette. Mohr pipette is calibrated between two marks on the stem, and the other has graduation marks down to the tip. Some types of serological pipettes are marked of blow-out, these types need to blow-out the remaining drops of liquid in the tip. Mohr pipette deliver between their calibration marks.
  Measuring pipettes are principally used for the transfer of reagents and are not generally considered accurate enough to pipette samples and standards. Volumetric pipettes are more accurate than measuring pipettes.
  Aqueous solutions form a curved surface when placed in a container. This surface is called a meniscus. To accurately read the level of liquid in a piece of glassware, it is important that eye be on the same level as the surface of the liquid in order to avoid parallax errors. The level of the liquid is then read at the bottom of the meniscus.
  c. *Automatic pipetting systems*: For the delivery of especially small volumes (0.5 µL–5 mL) of solutions, automatic pipettors and fitted polypropylene tips can be used. Set the digital micrometer to the desired volume using the adjustment knob. Attach a disposable tip to the shaft of the pipette.

Using Micropipettes

Micropipettes **(Fig. 3.2)** are utilized in the laboratory to transfer small quantities of liquid, usually down to 0.1 µL.

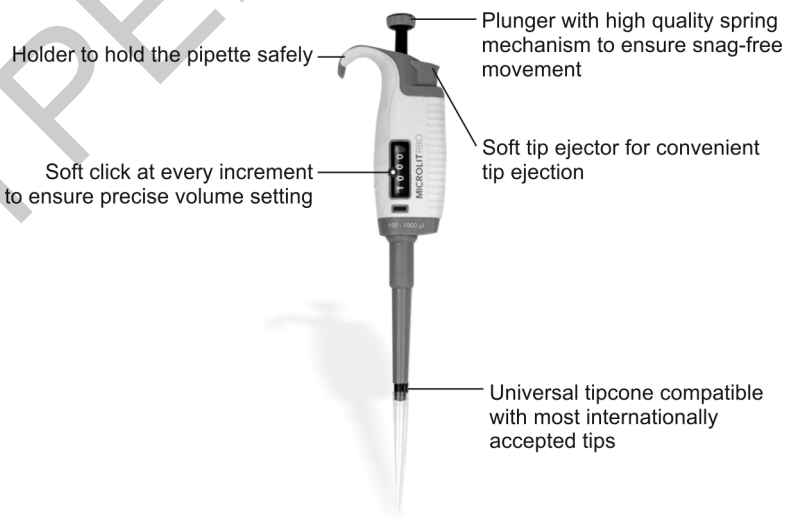

Fig. 3.2: Micropipette.

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Following steps should be followed for exact measurement of a substance using micropipette.

- Examine micropipette. At the top it has a plunger that can be pushed in to empty the micropipette, next to the plunger is an ejector one can use to eject the plastic tip from the end of the micropipette. Along the side, it has a volume adjustment wheel use to adjust the volume the pipette will take up or contain.
- Look at the volume dial along the side of the micropipette. Micropipettes measure volumes in microliters. Determine what the volume is set to at present and adjust that volume with the volume adjustment wheel to reach the appropriate or desired volume.
- Insert the end of the micropipette shaft into one of the plastic tips in plastic tip box. Do not handle the plastic tip with fingers.
- Depress the plunger with thumb until you reach the first stop (first solution).
- Insert the plastic tip of the pipette just below the surface of the fluid or water in your beaker.
- Release thumb pressure on the plunger, slowly and gently, drawing fluid into the plastic tip of the micropipette. Once the plunger has traveled all the way out, remove the pipette tip from the solution.
- Transfer the pipette to the receiving vessel/beaker/microfuge tube and place the tip just below the surface of the fluid in the receiving vessel. Do not submerge it completely.
- Depress the plunger slowly and gently to expel all the fluid in the micropipette tip. This time, continue to apply pressure after the first stop until you reach the second stop.
- Remove the pipette tip from the solution. Then release thumb pressure on the plunger of the pipette.
- Follow lab's protocol for disposing of the micropipette tips.

CLEANING OF GLASSWARE

Laboratory procedures require exact methods and should include good glassware cleaning to ensure excellent lab results. In all instances labware should be physically clean, including both chemical residue free and grease free, and in many cases even be sterile. A glassware that is used in precise measuring of liquids should have fully wettable surfaces. A good test is to use distilled water and see if the water wets all the inner surfaces equally. Grease or residues will not only contaminate the reaction and test results but will also alter the measurement of the liquids.

Good cleaning practices should also be accompanied by good inspection of the glass surfaces for chips, cracks, or abrasions which will cause mechanical failure.

- Always wash glass labware immediately after use. If a thorough cleaning is not immediately possible, always allow the glassware to soak. If not cleaned immediately some residues may be difficult to remove.
- Most new glassware are slightly alkaline and should be washed upon receipt and generally can be soaked in a 1% hydrochloric acid(HCL) or nitric acid (HNO_3) solution before wash and distilled water rinse.
- Never soak for long periods in strong alkaline solutions as it will damage the glass.
- Always follow up a soap or acid wash with a good distilled water rinse.
- Always use soft brushes with a wooden or soft plastic handle to avoid abrasion. Do not use wire brushes or brushes with a wire core as it can abrade the glass.

Glass Cleaners

A detergent such as a nonabrasive dishwasher soap will also work well. Always use soft brushes. Always rinse glass well and do a final distilled water rinse. If you need to do an

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acid wash, always rinse the soap off the glass completely or it may cause a reaction and leave a film on the glass.

- Alconox is the best as it is not abrasive. It is anionic detergent which consists primarily of a homogeneous blend of sodium linear alkyl aryl sulfonate, alcohol sulfate, phosphates, and carbonates.
- *Chromic acid or Chromerge*: It is a great cleaner and also removes organic residues. Use gloves and well-ventilate the area when using chromic acid as it is a carcinogen and very corrosive. Make sure metal clamps or flanges are removed. It is best to fill the vessel or soak the item in the solution for a short time in a plastic tub so that the wash material can be added, then rinse immediately several times before proceeding to a detergent wash.
- Occasionally, strong acid washes are necessary for certain types of precipitates or residues. This method should only be used when absolutely necessary. Always remember disposal of seriously stained glass maybe a less troublesome and less expensive course of action than using strong acid washes. One other caution is that strong acid or Chromerge type washes may damage the graduation markings.
- *Removal of grease*: Grease is best removed by boiling the glass in a weak solution of sodium carbonate. Acetone or any other organic solvent can also be used, followed by running tap water and distilled water rinses.
  - For permanganate stains, use a mixture of equal 3% sulfuric acid and 3% hydrogen peroxide.
  - For iron stains, use a solution containing one part hydrochloric acid and one part water.
  - For blood stains, use 3% solution of hydrogen peroxide.
- *Ultrasonic cleaners*: Ultrasonics is a good method of cleaning glassware. Ultrasonic cleaners that are heated will be the best and generally with a mild detergent they will clean most residues off of glassware.
- *Rinsing*: Glassware should always have a water rinse after any cleaning procedure followed by a distilled water rinse. It is best to give smaller pieces such as test tubes a soaking rinse followed by a distilled water soaking rinse.
- *Drying*: Oven drying at 100°C is best for all glassware. If not convenient, rack drying will work.
- *Steam autoclaving or sterilizing*: Proper protocol for steam autoclaving of borosilicate glassware is 15–20 minutes at 100–120°C. Always leave closures off or loose during autoclaving.
- *Inspection after cleaning*: Always inspect all glassware before steam autoclaving for cracks, chips, or damage. The autoclave procedure will cause glassware to break, if already damaged.

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- Includes the latest laboratory techniques on automation in various sections of the laboratory.

Nanda Maheshwari MSc BEd is presently working as a Lecturer at Damyanti DMLT and Advance DMLT Institute, Mumbai, Maharashtra, India. She started her career as a Laboratory Technician. She further completed various diplomas in Laboratory Technology, Food and Nutrition, Biomedical Instrumentation, etc. Owing to her keen interest in academics, she took up teaching as a profession. She built an exemplary career as a Lecturer and Visiting Faculty for various colleges all over Maharashtra. During her career, she interacted with many students and realized that many paramedic students come from a vernacular medium and hence face difficulty in understanding the subject from complex medical books as reference material. With the intention of helping such students, she thought of writing books on the subject with a simpler format and lucid content. She has successfully written books on subjects like *Clinical Pathology, Hematology and Blood Banking, Clinical Microbiology and Parasitology* and *Clinical Biochemistry*, which are extremely helpful and popular because of the usage of easy language without compromising on information and content. Her books have been widely appreciated by students and teachers and have proven to be highly successful as course-learning material. These books are recommended by many universities and educational councils for paramedical and undergraduate courses.

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