Spotlight

Laboratory Consumables

Don't compromise on Accuracy & Precision – Quality Pipette Tips are Crucial to Optimal Performance of a Pipetting System

Amanda Cooper, Anachem Ltd , Amanda.Cooper@mt.com, Anachem, Anachem House, 1 & 2 Titan Court, Laporte Way, Luton, Bedfordshire, LU4 8EF

The work performed in clinical, research and quality control laboratories can be majorly impacted by a single droplet or sample so small it can hardly be seen. Thus, it is critical to evaluate all of the components comprising the pipetting system, in order to maximise accuracy and reproducibility of volume delivery when using micropipettes. However, even with the highest quality, regularly calibrated pipettes the choice of pipette tip used is also crucial to accuracy and performance.

The ISO 8655-2 standard states: 'The maximum permissible errors always apply to the total system of piston pipette and tip.'

The accuracy and reproducibility tolerances for pipettes are determined by the manufacturers using quality tips that are designed specifically for their instruments.

In these days of budget pressures some labs try to stock a single tip type for all brands of pipette. Companies that do not manufacture pipettes sell so-called 'universal' tips professed as 'one tip fits all' for this purpose. Due to the variety of shapes and plastic compositions of tip holders in the pipette population, these economy brands unfortunately often end up being a universal compromise.

Choosing the Right Pipette Tips

Normally manufacturers recommend and produce pipette tips specifically made to the design requirements of their instruments. The delivery of performance is determined by the physical attributes of the tips. The tip fit and complete delivery of the measured sample are the two most important aspects to be considered.

Tip Fit

The shape of the tip, in particular the sealing collar that comes in contact with the pipette's shaft or tip cone must form a proper seal that will allow the plunging action to create a vacuum without leaks. This is a function of the number of gripping ribs, the location of the ribs, the length of the collar and the location of the contact points on the pipette shaft or tip cone.

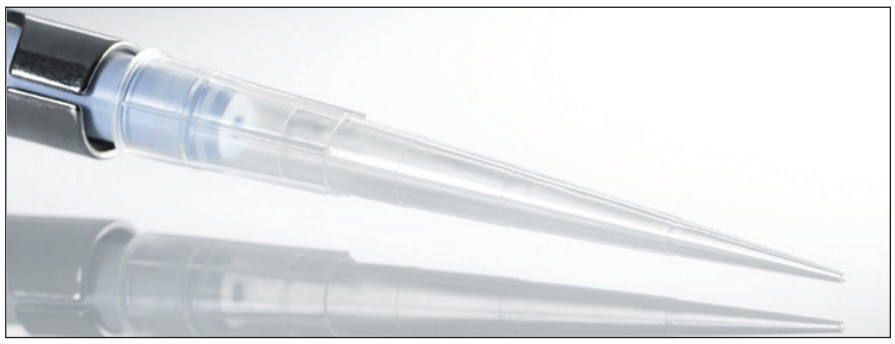

Figure 1. Pipette Shaft and Tip.

Softness or Brittleness of the Plastic

The plastic used to manufacture pipette tips needs to be able to conform to the shape of the pipette shaft or tip cone and the tip must stay attached; plastic too soft will deform and lose its ability to seal, while too hard a plastic will lack the elasticity to conform to the shaft or tip cone and will eventually force itself down off of the instrument. In addition hard plastics will not conform to any imperfections in the pipette shaft that accumulate over the course of everyday use. Without a perfect seal, leaks will develop around the tip/shaft interface; this will result in decreased volume delivery. In fact, it is also possible, for tips that are made of plastic that is too hard, to eventually damage the pipette shaft or tip cone of certain instruments. They can develop annular grooves that are cut into the plastic of the shafts; due to the removal of plastic at the points of contact eventually the tips can no longer seal properly.

Consequently the use of cheap, hard or brittle tips may result in higher maintenance costs for pipettes, making these tips a false economy.

Factors dependent on tip geometry can influence both accuracy and precision. Low quality or cheap tips may not fit the pipette properly and are a major cause of poor performance.

Ergonomic Aspects of Tip Fit

Tip quality, fit dimensions and user technique all greatly affect the forces required to apply a standard tip onto a pipette.

The multi fit capability of 'universal' tips is achieved through the use of a conical-shaped seal area. The pipette being forced into the tip forms a seal. In order to ensure a proper seal users often have to bang the pipette into the tip several times.

From an ergonomic perspective, when jamming a pipette into a tip, the user typically exerts a level of force that is well beyond the pipette's intended design. The pipette is gripped tightly with a 'clenched fist' causing unnecessary tension in the forearm and hand muscles, as well as contact stress in the palm of the hand. While this excess force is considered by some as preferable to the tip falling off during use, the ergonomic effects and risk of work related upper limb disorder must not be overlooked.

The forces necessary to remove the pipette tip may also be increased. Due to the tip being 'banged' onto the pipette originally, the user then needs to apply additional force to the tip ejector mechanism in order to detach the tip from the pipette, further worsening contact stress on the users thumb and increasing the exertion of the thumb muscles. A comparison of the manufacturers recommended tip dimensions and the dimensions of alternate tips should be considered when selecting pipette tips. The chosen tip should fit tightly onto the pipette, ensuring accurate sealing with minimal force and without needing to bang the pipette into the tip. RAININ's LiteTouch Tip Ejection System (LTS) is a unique cylindrical tip cone shape rather than the standard conical shape. This design provides a positive stop shelf that eliminates over insertion and creates a strong consistent seal with minimum force across a small area.

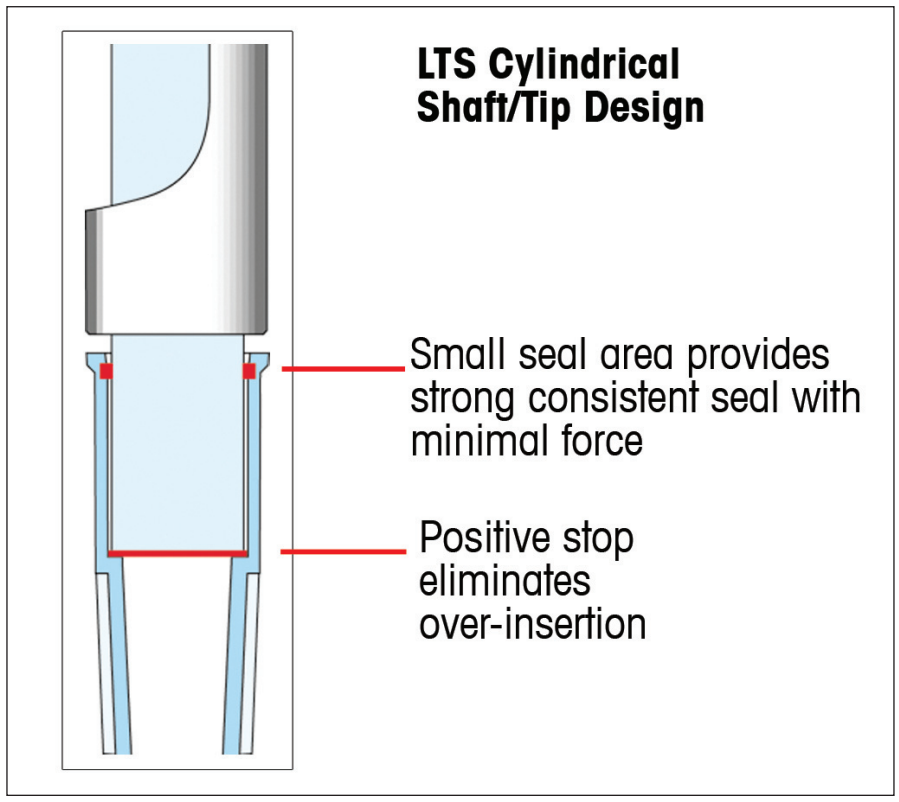

Figure 2. The RAININ LiteTouch Pipette Tip System.

Quality of the Tip Geometry

Smoothness of the plastic is a function of the quality of the tip mould and the efficiency of the moulding process. Moulds that are not replaced with adequate frequency or are poor quality will produce tips with burrs and surface roughness that is capable of retaining liquid. The thickness of the tip wall is also important. Sample delivery is less consistent with thick rigid tips. Pipettes tips such as RAININ's BioClean tips have very fine points and thin-wall construction giving improved flexibility to ensure complete liquid dispensing to the very last drop.

Ensure no Experimental Interference

Conducting successful experiments is vital to every pipette user. To achieve this, pipette tips have to be completely inert and must not interfere with samples in any way. Therefore, being contamination-free is no longer enough. Pipette tips also need to be free of any bioactive components.

Results can be affected by additives in the virgin polypropylene, such as the detergent DiHEMDA and releasing agent oleamide, commonly used by manufacturers of pipette tips. These bioactive components can adversely affect the outcome of experiments.

To ensure pipette tips are free from any contamination it is important that the manufacturer employs a rigorous production process. From the raw material selection to clean room production and including extensive testing and safe packaging all these elements are vital in ensuring pipette tips are contamination free. RAININ pipette tips are manufactured under BioClean conditions in class 100, 000 clean rooms. They are some of the purest and safest tips currently available on the market and are tested and proven free of bioactive components so will have zero interference on your results.

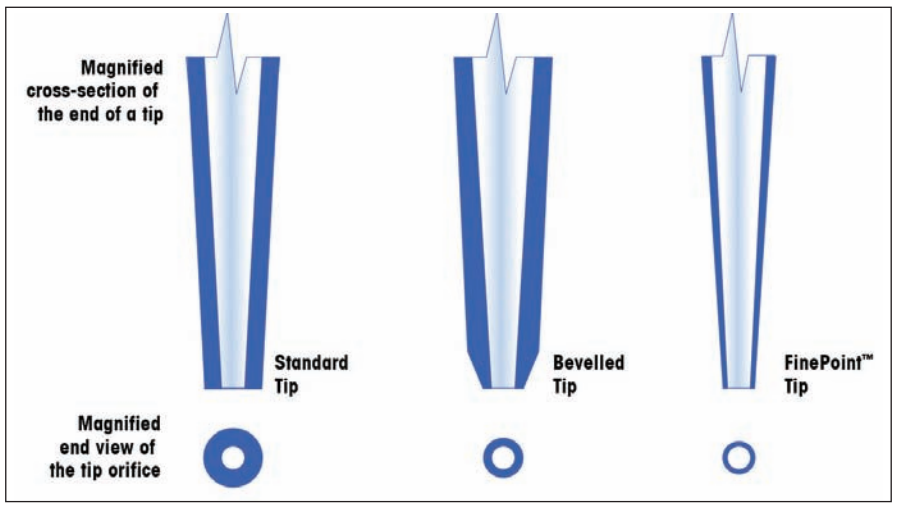

Figure 3. Tip dimension comparison.

Specific Applications

It is not always possible to use the manufacturer's tips due to the requirements imposed by certain applications. For example, when performing the LAL test, end users often find themselves constrained by the choice of available pyrogen free tips. Aerosol resistant filter tips are another speciality tip that prevents contamination of the pipette shaft/tip cones. These are vital in techniques such as PCR, sequencing, handling of infectious or hazardous materials such as radioactivity and other biological procedures where trace carryover would cause experimental results to be invalid. Other speciality tips include Gel-loading, extra-length tips, wide and small bore tips which are also necessary in some procedures. Unfortunately it is not always possible to find all of these tips produced by the pipette manufacturer.

Validating Tip Performance

As laboratories may need to use tips other than those recommended by the manufacturer, it is important to make the selection of alternative tips carefully.

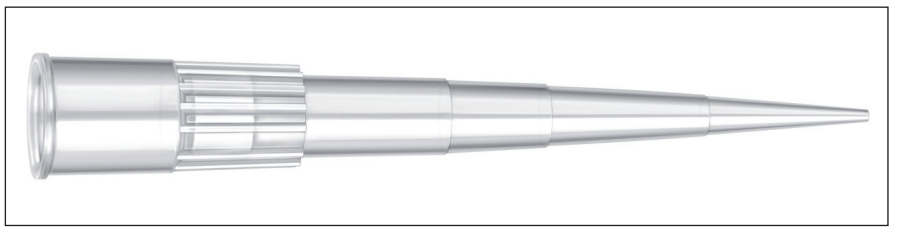

Figure 4. Standard Pipette Tip.

Just because a manufacturer is marketing a tip as being specific to a given pipette brand do not assume that it will actually perform in the same way as the manufacturers own tips. As with any critical component of precision equipment, tip performance should be evaluated to conform to Good Laboratory Practices.

This is a simple process:

1. Calibrate the pipette using the manufacturer's recommended tips. Confirm that the instrument meets the manufacturer's specified tolerances across the whole recommended range of use.
2. Take a sample of the alternative pipette tips and measure the instrument's performances at the middle and end points of the recommended volume range.
3. Compare the results with those of the manufacturers recommended tips.

If the alternative tips allow the instrument to meet the manufacturers specified tolerances or the accuracy and reproducibility are sufficient to meet the end user's particular experimental needs, then the alternative tip may be suitable for use. Once an alternative tip has been selected, the end user should regularly check the shaft/tip cones for damage caused by the tips. If after continuous use the instruments show no damage, then the tips may be an acceptable alternative.

Choosing a Quality Manufacturer

RAININ is one pipette manufacture that provides an extensive range of pipette tips including specialist tips such as filter tips and gel-loading tips. Due to their high quality, the complete range of pipette tips will correctly fit a wide range of pipettes. All RAININ tips are manufactured from pure virgin polypropylene with no silicon, dyes of clarifying agents added and no releasing agents are used in the manufacturing process. This ensures there is no risk of additives interfering with applications such as PCR. They are manufactured by a fully automated process in a controlled environment where no raw materials are touched by human hands. They are certified free of DNase, RNase, DNA, Pyrogen and ATP contamination to support GLP and GMP regulations. RAININ tips are produced in its BioClean Class 100,000 clean rooms under strict ISO 9001 procedures to guarantee 100% clean, contamination free tips that will not detrimentally affect experimental or routine assays. All the pipette tips produced by RAININ are wrapped in medical-device quality plastic, in order to provide a complete shield against contamination.

Containers with hydrophobic coating

New drugs generate new challenges in the field of pharmaceutical packaging. "Biomolecules, for instance, are being used today in over 50% of all product developments in pharmaceutical therapy," said Dr Claudia Dietrich, Product Manager Vials Coating at **Schott**. "Biotech components are very effective but also cost intensive and highly sensitive," explained Dietrich. To preserve such products for a longer period of time, keeping their effectiveness stable and better protecting the highly effective and sensitive ingredients, pharmaceutical companies often use lyophilization.

The lyophilization process puts special demands on the packaging. At the Müllheim site in Germany, Schott produces special containers under the name Schott TopLyo™ with a hydrophobic coating. Coated on the inside surface and improved with geometric design, the containers offer optimum efficiency for the lyophilization process. Vials with these hydrophobic coatings have such homogeneous surfaces that lyophilized substances find it difficult to adhere to the inside walls of the vials.

"The result gives the lyophilization cake a better appearance and enables less disruption of dry material," said Dietrich. The coating is applied by the proprietary Schott PICVD technology – 'Plasma Impulse Chemical Vapor Deposition', in a validated and constantly inspected process. The entire layer is only 40 - 100 nanometers thick and therefore has no effect on the dimensions of the pharmaceutical container. It is stable to pharmaceutical processes such as washing, sterilisation and depyrogenization (heat treatment of 300°C).

The TopLyo vials have been designed with a special geometry to maximise strength and minimise breakage, and also to improve heat transfer during the lyophilization process. By cutting the processing time needed for freeze-drying, pharmaceutical companies save production costs.

The benefit for the customer is a lower rate of rejects caused by collapsed lyophilization cakes and a reduced risk of breakage. As both effects have an impact on processing costs, there is a financial advantage to use this product.

To increase patient safety for pharmaceutical and diagnostic products, Schott has developed an innovative laser-coding technology for the individual marking of pharmaceutical glass containers together with a team of experts from the pharmaceutical industry, glass tubing production, as well as software and vision inspection. This innovation can help pharmaceutical companies to develop a reliable Track Trace system from production to end customer and further reduce the risk of mix-up of vials and batches.

Circle no. 596

Legible Labelling for Easy Sample Identification

Thermo Fisher Scientific, Inc introduced its new Thermo Scientific ID Scribe Labware Identifier for the consistent and legible labelling of storage tubes, vials and other common labware. Sample misidentification due to misread handwriting is eliminated. The easy-to-use ID Scribe™ works with nearly any labware, permanently and legibly marking it for fast and mistake-free sample identification. Markings on labware labelled with the ID Scribe lasts for years. The instrument is supplied with a selection of different pen colours and a custom pen holder. Users can effectively colour-code specific samples for quick and easy identification.

As a cost-effective alternative to handwritten labels, the Thermo Scientific ID Scribe not only saves significant staff time, but also reduces repetitive strain injuries associated with hand-labelling, while using a consistent and legible style.

Circle no. 598