

EBOOK

How Does Your Choice of Tube Affect Sample Integrity?

EVERYTHING YOU NEED TO KNOW ABOUT CHOOSING THE RIGHT TUBES FOR YOUR SAMPLES



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Introduction

In a high-stakes laboratory environment, every component plays a pivotal role in the integrity of research and the efficiency of operations. Among these components, the selection of tubes for sample storage and handling is not to be taken lightly. The right tube can dramatically enhance the quality of long-term storage, facilitate automation, streamline workflows like aliquoting, serve as reliable single-use consumables, and ultimately, translate into considerable time and cost savings for research projects.

Sample storage and handling requires a variety of tubes, each designed to meet specific needs related to the sample type, storage conditions, handling procedures, and analysis methods. Let us review the anatomy of high-quality sample tubes designed for such uses, and what to look for when choosing your tubes.

Sample Tubes and Vials: A Crash Course

Shapes and Formats of Tubes

Conical Tubes: These are perhaps the most common type of tubes used in laboratories for sample preparation and storage. They have a conical bottom which helps in pellet formation during centrifugation.

Round Bottom Tubes: These tubes have a rounded bottom and are often used in flow cytometry and in situations where complete sample recovery is important.

Non-Leaching Tubes: These tubes are designed to prevent the leaching of chemicals from the tube material into the sample. This is crucial for samples that will be used in sensitive assays or stored for long periods. They are made of ultra-high purity polymers.

Coded Tubes: These tubes come with codes for automated tracking and are compatible with robotic handling systems. They are essential in high-throughput environments for reducing manual errors and improving efficiency.

Centrifuge Tubes: Designed to withstand extremely high centrifugal forces, these tubes are used for separating very small particles and molecules at high speeds. They are typically made from polycarbonate or polypropylene.



Sample Tubes and Vials: A Crash Course cont.

Microcentrifuge Tubes: These small tubes (usually 2.0 mL) are used for DNA, RNA, and protein work. Made from polypropylene, they can withstand high-speed centrifugation forces.

PCR Tubes and Strips: These are small tubes or strips of tubes used specifically for PCR (Polymerase Chain Reaction) applications. They are designed to fit into thermal cyclers and are made from thin-walled polypropylene to assist thermal transfer and withstand the thermal cycling conditions while amplifying DNA fragments for cloning or sequencing.

Screw-Cap Tubes: These are designed for the long-term storage of biological samples. They have an automation-friendly secure screw cap that ensures the sample is sealed off from the environment, preventing evaporation and contamination.

Cryopreservation Tubes: Cryovials are vials specifically designed for cryogenic storage, these tubes can withstand very low temperatures and are safe for use with vapor-phase LN2 (liquid nitrogen). They often have a screw cap with a gasket to prevent leakage and are designed to withstand sample expansion during freezing.

Importance of Material Selection

Knowing what you need out of a tube is the first step in determining the material best suited for your sample. There are a range of materials designed for specific needs, including handling, freezing, and long-term storage.

Physical Properties

Chemical Resistance: Resistance to chemicals and solvents prevents the tube from breaking down or leaching chemicals into the sample.

Temperature Stability: Materials must withstand the temperatures of the processes they will be used in, from autoclaving to cryogenic storage.

Optical Clarity: In applications like flow cytometry, material clarity is crucial for accurate measurements.

Non-binding Surface: Some applications require tubes with treated or naturally low-binding surfaces to prevent proteins or DNA from sticking to the tube walls, ensuring complete sample recovery.



Importance of Material Selection cont.

Sealing: Proper sealing is essential to prevent leakage or evaporation, which can compromise samples and lead to inaccurate test results. Three types of seals are available – friction, adhesive, or thermally-bonded. Trustworthy friction caps and closures or properly applied heat or adhesive foils that create an airtight seal are crucial in maintaining specimen integrity and preventing cross-contamination between samples.

Material

Polypropylene (PP): Widely used for its chemical stability, resistance to heat, and suitability for cryogenic storage.

Polycarbonate (PC): Used for rigidity in certain two-shot PCR microplates to prevent distortion during thermal cycling.

Polystyrene (PS): Often used for tubes where optical clarity is important, such as in flow cytometry.

Ultra-High Purity or Medical Grade Polymers: Free from extractables and leachables, these tubes are recommended for long-term storage.

Matching Storage Requirements to Specimen Types

Quality tubes play a crucial role in maintaining long-term sample stability, as biospecimens have unique storage requirements, such as temperature, light exposure, and protection from contaminants. High-quality tubes are purposefully designed and manufactured to meet these specific conditions, providing an optimal environment for sample preservation, and saving valuable time and money on your research.

High grade tubes are often constructed using materials that are inert, non-reactive, and resistant to degradation, minimizing the risk of sample contamination, chemical reactions, and leaching of harmful substances. For large-scale, long-term studies, where the volume of samples can reach upwards of a million, the use of tubes that lack extractables and leachables is critical.

The consequences of choosing a tube that fails to protect your sample can be costly. For example, a single SBS format microplate containing novel compounds that will enter a drug discovery screening process could have cost as much as \$6,000 to produce, according to a Senior Research Scientist at a top pharma company. Protecting and storing these compounds correctly as part of a compound library is of vital importance, making the choice of storage tube critical.



Consider Label Security

Maintaining a secure chain of custody for samples is non-negotiable in biobanking and compound management. Using properly labeled tubes with permanent, high-contrast codes ensures that samples can be accurately tracked and identified throughout their lifecycle, even in challenging conditions such as frost or condensation. This is crucial for both long-term storage and rapid sample retrieval in high-throughput settings, where any misidentification can lead to substantial delays and financial implications.

High-quality tubes often come with pre-printed or customizable labels that resist fading, smudging, or detaching. Better still are [2D-coded tubes](#) with the codes either laser-etched or molded into position. With this approach, there is no possibility of the sample tube being misidentified, ensuring that sample information remains legible throughout the storage and testing process.

One step beyond that are [tri-coded tubes](#) that carry indelible 2D-, 1D-, and human readable tube identities. Even more impressive, these tubes are designed to be readable without the need to remove them from their racks, with the help of the [Ziath Tube and Rack Code Reading Systems](#), which streamlines the process of sample identification and retrieval.



Workflow Optimization: Aliquoting and Single-Use Consumables

Another important feature of quality tubes is their compatibility with various laboratory processes and analytical techniques. For example, certain samples require specific tube types to facilitate distinct processing steps, such as tubes designed specifically for centrifugation. Superior sample tubes are engineered to withstand the rigors of centrifugation, freezing, thawing, and other handling procedures, without compromising samples or introducing potential result-affecting variables.

Workflow efficiency in the laboratory, especially for tasks such as aliquoting, saves critical time and labor. When working in these delicate conditions, quick processing and easy sample retrieval can make all the difference. For maximum sample recovery while liquid handling, it helps to use specifically designed tubes, like the [1.6ml Maximum Recovery](#) tube, which has a unique bottom design specifically created to maximize recovery and minimize reagent wastage to gain cost savings.

For PCR experiments, it is crucial to use tubes that are free from contaminants like DNase, RNase, pyrogens, and endotoxins, and tailored for efficiency in sample collection, transport, and direct analysis. Innovative tubes like the [Cap2™ 0.2ml Dual-Cap Sample Collection PCR Tube](#), which offer a dual-cap design to facilitate immediate processing using both manual and automated techniques from collection to analysis, are ideal for streamlining genetic testing workflows.

In addition to sample stability, integrity, and compatibility, high-quality tubes also contribute to the overall efficiency and productivity of laboratory workflows. Well-designed tubes are easy to handle, open, and close, minimizing the risk of spills, breakages, or sample loss.

Less Time, Less Money, More Samples

Choosing the right tubes for specific laboratory applications can also mean significant cost and time savings. For example, using tubes compatible with automated systems, where the entire contents of the rack can be read quickly, can reduce manual labor, and speed up sample processing. Pairing external thread tubes with automated racks also offers greater working volume and a higher density of storage, enabling researchers to maximize the use of space in storage facilities. This is particularly beneficial when handling large sample sizes, as it reduces the physical footprint of stored samples and can lead to savings on storage costs.

The integration of automated systems in the laboratory has revolutionized sample handling, saving considerable amounts of time in the lab. Products like Azenta's [IntelliXcap capper/decapper](#), which can de-cap a rack of 96 tubes in as little as 20 seconds, exemplify how advanced automation can lead to increased throughput without risking sample integrity.

Selecting tubes designed for controlled rate freezing can prevent sample degradation during the freezing process. Controlled rate freezing ensures that the sample freezes uniformly, avoiding the formation of ice plugs that can lead to tube breakage and sample loss. It not only maintains the integrity of the sample but also minimizes the risk of having to repeat experiments due to compromised samples, thus saving considerable time and resources.

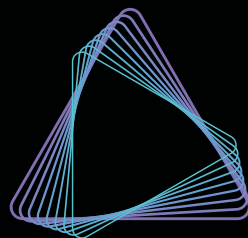


Choosing More Than Just a Tube

Strategic selection of tubes for both long-term storage and short-term use is a critical component of laboratory management that can have profound implications for the efficiency and economy of research. By investing in the right tubes for specific applications—whether for automation compatibility, workflow optimization, secure sample storage, or cost and time efficiency—laboratories can ensure the integrity of their samples while maximizing their resources. Quality sample tubes lead to reliable and reproducible results, supporting scientific advancements and improving patient care in various fields, including clinical diagnostics, biomedical research, and pharmaceutical drug discovery.



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