

## Application-Specific Requirements for Consumables in the Laboratory

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### Abstract

The demands placed on consumables made of plastic (such as pipette tips) are constantly increasing. They must be able to withstand high mechanical and thermal loads, have a high resistance to chemicals and a high degree of purity. The purity of pipette tips with regard to heavy metals (e.g., cadmium) has been a fundamental requirement for a long time and has been taken into account by many manufacturers. Likewise, sterility and biological purity has increasingly become a basic prerequisite for working with consumables. Especially in the fields of biology, pharmacy and medicine, there is a significantly growing need for higher degrees of purity with regard to nucleic acids, RNases and pyrogens.

### Working in trace analysis

All plastics used in the production of consumables should meet controlled purity requirements. They must have certain properties that are required by the manufacturing process. The consumables should externally and functionally not be subject to any recognizable signs of aging. The raw materials (PP, PE) can be used to manufacture consumables that meet the requirements of modern pipetting systems. To color the micro test tubes and pipette tips, high quality consumables use organic dyes that do not contain any heavy metals.

Consumables normally can be used in inorganic trace analysis. This also holds for the colored tips and micro test tubes. In cases of uncertainty, such consumables should be checked by letting them leach for several hours in strong inorganic acid. In organic analytics (gas chromatography, thin layer chromatography) the additives can exert a disturbing effect if they can be dissolved out of the plastic. Whether this is possible depends on the solvent used and the additives. It is recommended that a blind sample always be analyzed. Directly before use, the tips should be rinsed several times with the pure solvent to eliminate soluble substances that can be found on the surface.

### Working with infectious material

Important prerequisites for pipetting infectious liquids are:

- Pipetting with a tip ejection mechanism
- Pipette tips that can directly be attached to the pipette from the box
- Autoclavable pipettes
- Sterilized pipette tips with an integrated filter (filter tips).

### Working with radioactive material

Working with radioactive liquids requires pipettes with a tip ejection mechanism and tips inserted in boxes. The isotope workplace should contain a set of appropriate pipettes and accessories that remain at the given location. It is recommended that complicated operational procedures first be tested in a »cold« run. This will provide early detection of inadequacies in the equipment that is available at the workplace. Contaminated consumables must be collected and disposed of in accordance with the Radiation Protection Ordinance. Commercially available laboratory cleaners can be used for the required decontamination of the pipettes. The piston of the pipettes must be relubricated after a cleaning procedure.

### Working in the PCR laboratory

Because of the extreme sensitivity of the polymerase chain reaction (PCR), special precautions must be taken in a PCR laboratory to reduce the risk of contamination by native or amplified nucleic acids during test preparation. Therefore, the individual operations, especially the preparation and the processing of the samples after amplification, should occur in separate rooms or work areas. This spatial separation also holds for the devices and materials used in the laboratory. This means that the pre- and post-PCR laboratories should each have specific pipettes, tips and disposable tubes that are permanently found at these locations. Pipettes and tips that have once been used for a post-PCR step should no longer be used in the pre-PCR laboratory.

Ideally, the pipetting of PCR samples should occur under a closed PCR hood with an integrated UV lamp. If such a hood is unavailable in the laboratory, a specific workplace with its own set of suitable pipettes should be established which is exclusively used for the preparation of the PCR reaction. One should only use disposable materials that are free of DNA, DNases and RNases. Especially for the preparation of PCR samples the use of filter tips is recommended to keep the hazard of aerosol contamination as small as possible. When pipetting a reaction sample, care should be taken to ensure that the addition of the DNA to be amplified does not occur until all other reagents have been added to the micro test tube to avoid cross contaminations. To avoid contaminations in a PCR laboratory, gloves should always be worn when working and they should be replaced with a new pair at each change between the pre- and post-PCR laboratory. Furthermore, all work surfaces must be cleaned at regular intervals with large quantities of distilled water or diluted sodium hypochlorite solution.

### Working in the sterile laboratory

The manual pipettes of the newest generation are fully autoclavable. Thereby, the user is ensured that on the one hand valuable cultures will not be contaminated and on the other hand dangerous microorganisms will not be carried over. Several manufacturers offer tips in autoclavable boxes, which have the following characteristics:

- During autoclaving, steam enters the interior of the box.
- After autoclaving, the box can be dried in a short period of time.

Consumables that have already been presterilized by the manufacturer have the advantage of being immediately usable and also have the manufacturer's guarantee of sterility. Sterilization occurs through irradiation or treatment with gas and not through autoclaving. Sterility through autoclaving does not necessarily also signify purity since autoclaving does not remove or inactivate completely contaminations like DNA, RNases or pyrogens.

Consumables, which in addition to their sterility also have a high degree of purity, are free of:

- Pyrogens (e.g., endotoxins)
- ATP
- DNA
- RNases
- DNases
- PCR inhibitors

### Purity grades

The constantly growing diversity of requirements in the daily routine of the laboratory requires different purity criteria at a consistently high quality level for consumables. For these purposes, the manufacturer Eppendorf has introduced different purity grades (Fig. 1):

- Eppendorf Quality
- PCR clean
- Eppendorf Biopur
- PCR clean, sterile and pyrogen-free
- Sterile
- Protein-free

Eppendorf grades for tips, tubes, plates and accessories

						
<b>Continuous quality control for the following relevant criteria:</b>						
Function, tightness, precision	●	●	●	●	●	●
Low wetting	●	●	●	●	●	●
High chemical resistance	●	●	●	●	●	●
High thermal resistance	●	●	●	●	●	●
High resistance to centrifugation forces* <sup>1</sup>	●	●	●	●	●	●
High transparency	●	●	●	●	●	●
Precisely shaped	●	●	●	●	●	●
<b>Lot testing*<sup>2</sup> (certified) for the following purity criteria:</b>						
Human DNA-free			●		●	●
DNA-free (Human- + bacterial DNA)						●
DNase-free			●		●	● NEW!
RNase-free			●		●	●
PCR-inhibitor-free			●		●	● NEW!
ATP-free						●
Pyrogen-free (endotoxin-free)		● NEW!			●	●
Sterile (Ph.Eur./USP)		●			●	●
<b>Eppendorf products</b>						
<b>Tips</b>						
epT.I.P.S. <sup>®</sup> Standard + Box + Set	●					
epT.I.P.S. <sup>®</sup> Reloads	●		●			
epT.I.P.S. <sup>®</sup> Racks						●
epT.I.P.S. <sup>®</sup> Singles						● <sup>3</sup>
ep Dualfilter T.I.P.S. <sup>®</sup>					●	
Eppendorf Combitips <sup>®</sup> plus	●					● <sup>3</sup>
epT.I.P.S. <sup>®</sup> LoRetention	●		●		●	
epT.I.P.S. <sup>®</sup> Motion	●	●				
epT.I.P.S. <sup>®</sup> Motion filtertips		●	●			
<b>Tubes</b>						
Eppendorf Safe-Lock Tubes	●		●			● <sup>3</sup>
3810X	●		●			
DNA + Protein LoBind Tubes			●			
PCR Tubes (PCR + <i>real-time</i> PCR)			●			
Cap Strips (PCR + <i>real-time</i> PCR)			●			
<b>Plates and accessories</b>						
Deepwell Plates + Microplates		●	●			
Protein LoBind Deepwell Plates			●			
DNA LoBind Deepwell Plates			●			
Eppendorf twin.tec <sup>®</sup> PCR Plates (PCR + <i>real-time</i> PCR)			●			
Eppendorf twin.tec <sup>®</sup> microbiology PCR Plates						●
Heat Sealing Film + Foil			●			
PCR, Storage Films + Foils			●			
Plate Lid		●	●			
UVette <sup>®</sup>	●		● <sup>4</sup>			

\*1 For accurate details regarding resistance to centrifugation, please refer to the respective product pages ([www.eppendorf.com](http://www.eppendorf.com)).

\*2 Batch-specific certificate can be downloaded from [www.eppendorf.com/certificates..](http://www.eppendorf.com/certificates..) \*3 Individually packaged. \*4 Additionally free of protein (protein-free).

Fig. 1: Eppendorf purity grades for consumables

### Quality of Eppendorf Consumables

The purity grade “Eppendorf Quality” which is the basis of all Eppendorf consumables requires the continuous control of the quality criteria: function, seal tightness and precision. During production, the products are closely and continuously monitored for form, dimensions and appearance as well as with regard to the essential functions. All production steps through completion of the product and packaging are automated (Fig. 2). This virtually eliminates manual interventions and all resulting risks through contamination.



**Fig. 2:** Fully automatic sorting of Combitips into blister packs under clean-room conditions.

The arrival of PCR and many additional molecular biological methods in laboratories, clinics and research requires new purity criteria:

- The minute quantities of genetic material that are used in these experiments must be protected against degrading enzymes (DNases and RNases). This means that the consumables must be free of these impurities.
- Consumables that make contact with the PCR reaction sample must be free of PCR inhibitors that would prevent amplification.
- It must be ensured that the plastic consumables are free of contaminating nucleic acids. Human DNA is of primary concern since it can be passed on to the consumables during the production process.

The purity grade “PCR clean” is essentially achieved by not even letting contamination to develop. Therefore, the corresponding plastic consumables are manufactured

under clean-room conditions. The manufacturing areas are spatially separated and only personnel in protective clothing are granted access.

Furthermore, all production processes are nearly completely automated. The testing procedure used is the certified lot-specific product testing by an independent laboratory for the absence of human DNA, DNases, RNases and PCR inhibitors.

To meet the highest demands of medicine, the pharmaceutical and food industries in a manner comparable to that of molecular biology and cell technology, the purity grade “Eppendorf Biopur” was defined [1]. All consumables available in this highest purity grade (namely pipette tips, dispenser tips, PCR plates and micro test tubes) are guaranteed to be sterile and free of pyrogens, RNases, DNases, human and bacterial DNA, ATP and PCR inhibitors. Each lot of these products is examined in an independent laboratory for all the named purity criteria. This is guaranteed by lot-specific certificates.

This highest biological purity grade is achieved by very stringent control of all production steps until the final product and the subsequent irradiation or treatment with gas (Fig. 3). This is guaranteed by a fully automated manufacturing process under clean-room conditions. This excludes contamination of the consumables with microorganisms, nucleic acids, proteins, polysaccharides, etc. through contact with humans.



**Fig. 3:** Packing of consumables with Eppendorf purity grade Eppendorf Biopur prior to sterilization

## References

[1] Eppendorf Userguide No. 42. [www.eppendorf.com](http://www.eppendorf.com)

The Eppendorf logo consists of the word "eppendorf" in a bold, lowercase, blue sans-serif font.

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