Requirements and Eppendorf Solutions for Blood Dosage

Ulrike Gast, Nadine Mellies (corresponding author)
Eppendorf SE, Hamburg, Germany

Overcoming the Challenge of High Viscosity when Pipetting Blood
How do you effectively pipette blood given its high viscosity? The answer is as short as it is simple: Use a positive displacement system. Because blood flows more like ketchup than water, you need such a system for accurate dosing [1]. If you use an air-cushion system, you need to consider that your dosing will not be as accurate (see table 1). Applying reverse pipetting significantly reduces aspiration of air bubbles and residues in the tip, leading to more accurate pipetting results when using air-cushion pipettes.

Table 1: Overview of blood properties and their influence on dosing with air-cushion pipettes

Property	Problem	Consequence
Viscous liquid	Liquid only rises slowly in the pipette tip	Dosed volume too small: dosing inaccurate
Higher density than water	Air-cushion expands	Loss of sample material: dosing inaccurate
Foaming liquid	Dosing difficult due to bubble formation	Dosed volume too small: dosing inaccurate
Potentially infectious	Risk of contamination	Cross-contamination of samples, health risk for user
Blood sampling from sample vessel (e.g., Vacutainer®)	Tip and/or liquid handling tool touch sample vessel wall	Cross-contamination of samples, health risk for user

Overall Requirements for Liquid Handling Systems

Due to its composition of whole blood, blood plasma and serum, blood demands special requirements from the liquid handling tool: Blood is viscous and wetting, and it foams easily; it's also potentially infectious. Blood's constituents, such as aqueous components and proteins, as well as solids such as blood cells and cell debris, considerably influence blood's flow properties. For this reason, you should use a positive displacement system when accurate blood dosing is required. This system enables you to accurately dispense blood with a reduced risk of contamination as the liquid is sealed off in positive displacement tips like in a syringe.

If accuracy only plays a minor role in your dosing work, air-cushion pipettes are also suitable. You should, however, ensure you use simple and efficient decontamination methods, with wipe disinfection preferred for pipettes without large depressions. In addition, the components of the liquid handling system (tool, tip, box) should be autoclavable. If you adapt the shape of the pipette tip to accommodate blood sampling from, e.g., Vacutainer® systems, you can avoid contaminating the tip and the liquid handling tools (e.g., pipette cone), thus reducing the risk of contamination. Pipette tips with two filter layers significantly reduce the risk of aerosol-related contamination. If you do not use filter tips in the laboratory, consider using one-button pipettes. They reduce the risk of contamination as the piston – and thus the aerosol-carrying air stream – only has one upward movement rather than two.

Eppendorf product solutions

Tab. 2: Eppendorf Manual Liquid Handling product recommendations for healthcare applications.

Requirement	Key aspect	Recommended Eppendorf product		Healthcare diagnostic work
		Liquid handling system: Air-cushion	**Liquid handling system: Positive displacement**	**Blood Dosage**
Dosing accuracy	**Maintenance and calibration:** Close-meshed inspection ensures high dosing accuracy.	> epServices for all pipettes	> epServices for all Multipette® multi-dispensers	
	Manual control of liquid movement: Smooth and balanced stroke of the operating button allows precise dispensing control.	> Eppendorf Reference® 2 family > Eppendorf Research® plus family	> Multipette® M4	
	Electronic control of liquid movement: Electronically controlled liquid aspirations and dispensings at predefined speeds allow maximum control.	> Eppendorf Xplorer® family	> Multipette® E3(x)	
	Challenging liquids: Increased accuracy for safe transfer of challenging liquids (foaming, viscous, aggressive)	> Eppendorf Xplorer® family with liquid adjustment > Eppendorf Xplorer® family with liquid types managed via Pipette Manager	> Multipette® M4 > Multipette® E3(x)	
	Liquid handling device and tips are a system: Using original pipette or dispenser tips enhances the reproducibility of pipetting results with maximum precision and accuracy.	> epT.I.P.S.® pipette tips	> Combitips® advanced dispenser tops	
	Dispenser tips: Integrated piston wipes the liquid from the inner surface of the tips during dispensing.	*not applicable due to construction principle (air-cushion)*	> Multipette® M4 > Multipette® E3(x)	
Contamination prevention	**Aerosol accumulation in the pipette cone:** Single-button operation of pipettes reduces aerosol-carrying air flow into the pipette cone.	> Eppendorf Reference® 2 family	*not necessary: sample is hermetically sealed within Combitips® advanced due to construction principle (positive displacement)*	
	Dispenser tips: Sample is hermetically sealed within the dispenser tip without aerosol formation.	*not applicable due to construction principle (air-cushion)*	Combitips® advanced dispenser tips for > Multipette® M4 > Multipette® E3(x)	
	Long-distance pipette tips: Select tip shape according to the vessel (e.g. Vacutainer®) to ensure easy access to your sample when working with deep, slim vessels.	> epT.I.P.S.® 5 mL L > epT.I.P.S.® 1,250 µL L	*not available*	
	Tips wrapping: Using individually sterile-packed tips helps to avoid contaminating the rest of a tip box.	> epT.I.P.S.® Singles	> individually blister-wrapped Combitips® advanced	
	Pipette filter tips: Filters of EPA class 12 according to ISO 1822 (equivalent to ISO 25 E according to DIN EN ISO 29463-5) prevent the entry of aerosols and biomolecules into the pipette cone.	> ep Dualfilter T.I.P.S.® > ep Dualfilter T.I.P.S.® SealMax®	*not necessary: sample is hermetically sealed within Combitips® advanced due to construction principle (positive displacement)*	
	Manual control of liquid movement: Smooth and balanced stroke of the operating button allows precise dispensing control.	> Eppendorf Reference® 2 family > Eppendorf Research® plus family	> Multipette® M4	
	Electronic control of liquid movement: Electronically controlled liquid aspirations and dispensings at predefined speeds allow maximum control.	> Eppendorf Xplorer® family	> Multipette® E3(x)	
	Purity of pipette and dispenser tips: Purchasing tips in required and externally certified purity from manufacturers ensures sample safety.	> epT.I.P.S.® in: PCR clean, PCR clean and sterile > ep Dualfilter® T.I.P.S. in: PCR clean and sterile > ep Dualfilter® T.I.P.S. SealMax® in: PCR clean and sterile	Combitips® advanced dispenser tips in: > PCR clean > Biopur	
Decontamination	**Pipette/Dispenser autoclavable**	> Eppendorf Reference® 2 family > Eppendorf Research® plus family > All lower parts of Eppendorf Xplorer® family	*not applicable*	
	Pipette/Dispenser tips autoclavable	> epT.I.P.S.® pipette tips	*not applicable*	
	Tips box/rack autoclavable	> epT.I.P.S.® Box (2.0)	> Combitips® advanced Rack (without consumables)	
	Using decontamination agents: Broad chemical resistance to common decontamination agents facilitates decontamination of devices.	> Eppendorf Reference® 2 family > Eppendorf Research® plus family > All lower parts of Eppendorf Xplorer® family	Decontamination with alcohol recommended > Multipette® M4 > Multipette® E3(x)	
	Advanced surface robustness: PTFE in surfaces strengthens cleaning and decontamination properties.	> Eppendorf Reference® 2 family > Eppendorf Research® plus family	*Surface does not contain PTFE.*	
	Smooth surface: Surface without interrupted surfaces or recesses enable easy and effective wipe disinfection.	> Eppendorf Reference® 2 family	*not applicable*	
Chemical resistance	**Robust chemical resistance**	> Eppendorf Reference® 2 family (1), [6] > Eppendorf Research® plus family (1), [7] > All lower parts of Eppendorf Xplorer® family	> Multipette® M4 [8]	
	Option: Advanced chemical resistance	Special lower part available with resistance to highly aggressive chemicals (e.g. TFA) > Eppendorf Reference® 2 variants (2) > Eppendorf Research® plus variants (2)	*not applicable*	
Leachables	**Certified absence of additives:** Plasticizer, biocides, slip agents cannot interfere with biological analyses.	> epT.I.P.S.® > ep Dualfilter T.I.P.S.® > ep Dualfilter T.I.P.S.® SealMax®	> Combitips® advanced	

> Light labelling: applicable, dark labelling: recommended
> Family includes all pipette variants (fixed and variable volumes, single- and multi-channel, Move It®)

(1) Variants > 20 µL without metal pistons, except 16- and 24-channel pipettes
(2) Available for Reference 2 and Research plus single-channel pipettes: 1,000 µL (color code: blue); 5 mL (color code: violet); 10 mL (color code: turquoise); available for Reference 2 single-channel pipettes only: 2.5 mL; 2 mL, fixed (color code for both: red).

References

[1] Dufey V, Art M, Henke Hanaë. Precise and Accurate Whole Blood Dispensing with Multipette® E3x and Combitips® advanced. Application Note No. 386. www.eppendorf.com

For more information, technical specifications and article numbers for Eppendorf pipettes, dispensers and pipette tips, visit **www.eppendorf.com/pipettes**.

Interested in learning more about requirements for liquid handling systems and suitable solutions in healthcare applications? Then take a look at White Paper No. 82 "What Really Matters: Manual Liquid Handling Tools for Healthcare Applications".

About Eppendorf

Since 1945, the Eppendorf brand has been synonymous with customer-oriented processes and innovative products, such as laboratory devices and consumables for liquid handling, cell handling and sample handling. Today, Eppendorf and its more than 5,000 employees serve as experts and advisors, using their unique knowledge and experience to support laboratories and research institutions around the world. The foundation of the company's expertise is its focus on its customers. Eppendorf's exchange of ideas with its customers results in comprehensive solutions that in turn become industry standards. Eppendorf will continue on this path in the future, true to the standard set by the company's founders: that of sustainably improving people's living conditions.

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