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Practical Titration: The Eppendorf Top Buret in Use

Dr. Nadine Mellies, Simon Plate, Eppendorf SE, Hamburg, Germany

Abstract

Titration is a method to determine the concentration of a substance in a solution. This is done usually by gradually adding a reagent of known concentration to the solution until a reaction is completed, which is often indicated by a color change or an electrical measurement. Buffers with a defined concentration equilibrium are essential in laboratory and industrial applications to control pH values in biological and chemical processes. Stable and effective buffers are produced by dropwise addition of diluted salt solutions, acids, or bases. The slow dosing allows the concentration value to be monitored precisely. If added too quickly, the buffer might exceed its capacity and might not work effectively. Adding drop by drop minimizes this risk and allows the added solution to be evenly distributed in the mixture to produce a stable and effective buffer. With a burette like the Eppendorf Top Buret, small volumes can be accurately dispensed and measured.

This White Paper provides a concise profile of the instrument, detailing its intended use, properties, and operation, including best practices and pitfalls in terms of usage.

Eppendorf Top Buret Profile

What do you need the Top Buret for in the lab?
The Eppendorf Top Buret is a laboratory device used to titrate solutions in which a concentration equilibrium is set. This is usually revealed by indicators that change color.

What kind of liquid is used with the Top Buret?
Titration with the Top Buret is primarily done with diluted salt solutions as well as diluted acids and bases in concentrations up to max. 1 mol/L.

Good to know: These media are not nearly as aggressive as their concentrated versions, so the use of ETFE/PTFE adapters is not necessary – except for a good feeling.

How does the Top Buret operate?
The Top Buret is a bottle-top dispenser which features a continuous, pulse-free dispensing of the titration solution. It can dispense volumes between 10 µL and 999.9 mL, but max. 2.5 mL and 5.0 mL per fully rotated dispensing wheel of the Top Buret M and Top Buret H, respectively.

Good to know: If the supply bottle with the titration solution does not fit on the Top Buret straight away, use a suitable thread adapter to assemble the instrument to the bottle.

What materials is the Top Buret made of?
Various materials are used in the Top Buret, but only some of them come into direct contact with the dispensed liquid:

Table 1: Materials of construction for Eppendorf Top Buret bottle-top burettes.

Direct contact with dispensing liquid		No contact with dispensing liquid	
Abbreviation	**Material**	**Abbreviation**	**Material**
Boro 3.3	Borosilicate glass 3.3	FKM	Fluororubber
ETFE	Ethylene-tetrafluoroethylene copolymer	PA	Polyamide
FEP	Tetrafluoroethylene-perfluoropropylen copolymer	PEST	Polyester
PFA	Perfluoroalkoxy copolymer	PP	Polypropylene
PTFE	Polytetraflourethylene	PPS	Polyphenylene sulfide
Pt-Ir	Platinum iridium	POM	Polyoxymethylene
		PVDF	Polyvinylidene fluoride
		SST	Stainless steel

The Top Buret in Use: Best Practices

Solutions for titration with the Top Buret should have certain physical properties (see Table 2).

Table 2: General parameters for titratable solutions with the Eppendorf Top Buret.

Physical property of the liquid	Max. value
Concentration	1 mol/L
Vapor pressure	50 kPa
Density	2.2 g/cm^3
Temperature	15 °C – 40 °C

Common titration media
The Top Buret is resistant to most solutions conventionally used for titration and can be used for the following titration media with a max. concentration of 1 mol/L (see Table 3).

Good to know: For the titration of hygroscopic liquids, it is recommended to use a drying tube with a suitable moisture absorber like silica gel (1-3 mm particle size), $CaCO_2$ or NaOH pills (5 mm in diameter for CO_2 absorption) (see Figure 1).

Figure 1: Top Buret with drying tube filled with a moisture absorber.

Table 3: List of common titratable solutions with the Eppendorf Top Buret.*

A	Acetic acid	P	Potassium dichromate solution
	Ammonium iron(II) sulfate solution		Potassium hydroxide solution
	Ammonium thiocyanate solution		Potassium iodate solution
B	Barium chloride solution		Potassium permanganate solution
	Bromid bromate solution		Potassium thiocyanate solution
C	Caustic potash solution	S	Silver nitrate solution
	Caustic soda		Sodium arsenite solution
	Cerium(IV) sulfate solution		Sodium carbonate solution
E	EDTA solution		Sodium chloride solution
H	Hydrochloric acid		Sodium hydroxide solution
I	Iron(II) sulfate solution		Sodium nitrite solution
	Iodine solution		Sodium thiosulfate solution
N	Nitric acid		Sulfuric acid
O	Oxalic acid	T	Tetra-n-butylammonium hydroxide solution
P	Potassium bromate solution	Z	Zinc sulfate solution
	Potassium bromide bromate solution		

*This information is valid for usage only. Storage might lead to crystal formation. Rinse device daily when the reagent used is subject to crystallization.

The Top Buret in Use: What to Avoid

Unsuitable titration media

Some liquid types are not suitable for titration with the Eppendorf Top Buret and might damage the instrument (see Table 4).

Table 4: Media unsuitable for titration with the Eppendorf Top Buret.

Liquids/Solutions which…	Example
… attack ETFE, FEP, PFA, PTFE or Boro 3.3.	Sulfuric acid (H_2SO_4)
… contain hydrofluoric acid.	Hydrofluoric acid (HF)
… have low ignition temperatures.	Carbon disulfide (CS_2)
… with solid particles and can clog or damage the device.	Activated carbon
… form insoluble deposits and decomposing solutions.	Biuret reagent
… represent fuming acids or highly concentrated alkaline solutions/bases.	Hydrochloric acid (HCl), Sodium hydroxide (NaOH)
… react catalytically with platinum iridium.	Hydrogen peroxide (H_2O_2)
… are prone to crystallization.	Iodine solution

Autoclaving
The dispenser must not be autoclaved!

Good to know: In fact, a titration device does not have to be autoclavable. Autoclaving is a crucial process in laboratories for sterilization and decontamination of media, instruments, glassware, or waste. By applying heat under pressure, an autoclave destroys harmful biological pathogens. Since such solutions are not used for titration, but rather salt solutions, as well as diluted acids and bases, there is no need to autoclave instruments used for titration.

Liquids and crystallization
Leaving the Top Buret mounted on the supply bottle is convenient and saves time. However, long-term use with crystalline liquids can damage the device due to crystal formation. As these crystals form, they can adhere to the inner surfaces of the device and its tubes, potentially causing blockages or interfering with the accurate measurement of liquid volumes.
Regular cleaning and maintenance are crucial to prevent this issue. Always consider the type of liquid used for the titration and if it can harm the device in the long term.

Good to know: Clean the Top Buret daily, if highly crystalline liquid is titrated.

Please visit the Top Buret product page for product article numbers, technical specifications, accessories and service offerings:

www.eppendorf.link/top-buret

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