Thermo Scientific Pipetting Guide

Tips for Good Laboratory Pipetting

Part of Thermo Fisher Scientific

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Thermo Scientific Pipetting Guide

Contents

Thermo Scientific Over 35 Years of Innovation

A leader in pipetting

For over 35 years we have led the way in liquid handling products and microplate instrumentation. We have always ensured that innovation, ergonomics, accuracy, precision and safety are key aspects of our products' designs. In 1971 we introduced Thermo Scientific Finnpipettes, the world's first continuously variable micropipettes. In 1976 we introduced the world's first multichannel pipette. Since then we have continuously improved our pipettes, always leading the way with ergonomic design. Over the last 35 years, innovations such as the improved finger rest, soft-touch tip ejection and super blow-out have made Finnpipettes increasingly user-friendly. Our intensive research program and commitment to our customers forms the foundation for future innovations. The new demands in pipette applications are the key drivers of our product development. To date, over 3 million Finnpipettes have been sold in 150 countries. Thanks to our extensive R&D and feedback from the field, Finnpipettes are the preferred choice for optimal liquid handling results, with our multichannel pipettes being the market leader worldwide.

Most clinical and research laboratories are equipped with manual or electronic pipettes for dispensing liquids. The amount of liquid can range from ml's to below 1 µl, especially when using expensive reagents. In all cases, the dispensing must be accurate and precise to guarantee good research results. Not only the pipette but also the tip plays a crucial role as these two form together the pipetting system.

As pipetting is often a repetitive task, the pipettes must be designed so that the risk of hand and upper limb stress is minimized.

We offer a wide range of high-quality manual and electronic pipettes and pipette tips to ensure good laboratory pipetting. In this guide we will outline some practical aspects of pipetting to help you to get the best possible results.

Pipetting terms

The following terms are used throughout this guide and in instructions for use. We will explain them briefly:

Aspirate – to draw up the liquid into the pipette tip

Dispense – to discharge the liquid from the tip

Blow-out – to discharge the residual liquid from the tip

Calibration check – to check the difference between the dispensed liquid and the selected volume

Adjustment – altering the pipette so that the dispensed volume is within the specifications

Types of pipettes

There are two types of pipettes: air displacement and positive displacement pipettes.

Both types of pipettes have a piston that moves in a cylinder or in a capillary. In air displacement pipettes, a certain volume of air remains between the piston and the liquid. In positive displacement pipetting, the piston is in direct contact with the liquid.

Air displacement pipettes are meant for general use with aqueous solutions. Positive displacement pipettes are used for high viscosity and volatile liquids.

Air displacement pipetting

Air displacement pipetting, used for standard pipetting applications, is highly accurate. However, conditions such as atmospheric pressure as well as the specific gravity and viscosity of the solution may have an effect on the performance of air displacement pipettes.

How does an air displacement pipette work?

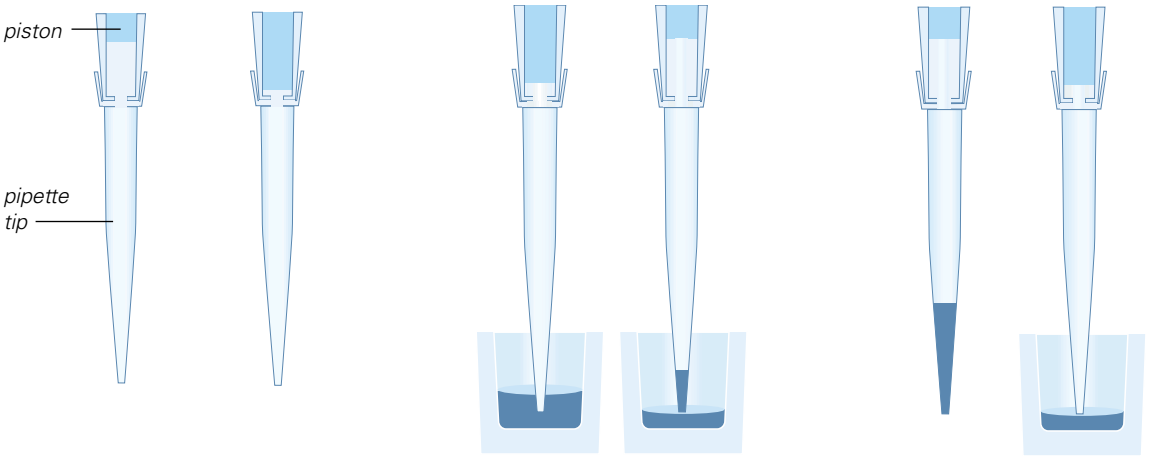
1. The piston moves to the appropriate position when the volume is set.

2. When the operating button is pressed to the first stop, the piston expels the
same volume of air as indicated on the volume setting.

3. After immersing the tip into the liquid, the operating button is released.

This creates a partial vacuum and the specified volume of liquid is aspirated into the tip.

4. When the operating button is pressed to the first stop again, the air dispenses the liquid. To empty the tip completely the operating button is pressed to the second stop (blow out).



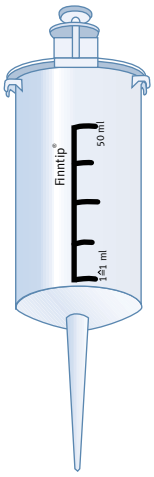
Positive displacement pipetting

The repeater pipette Thermo Scientific Finnpipette® Stepper uses the positive displacement principle. Stepper microsyringe tips have a piston inside a cylinder unit; these tips are disposable. This helps to avoid sample to-sample cross-contamination (also known as sample carry-over), and contamination due to the aerosol effect.

How does Thermo Scientific Finnpipette Stepper work?

1. The piston inside the tip moves up when filling the tip with liquid.

2. When the dispensing lever is pressed down, the piston moves down and the selected volume is dispensed. The dispensing lever has to be pressed once for each dispensing stroke (= step).



Finnpipette Focus

Finnpipette Stepper

General pipetting guidelines

Check your pipette at the beginning of your working day for dust and dirt on the outside. If needed, wipe with 70% ethanol.

• Check that you are using tips recommended by the manufacturer. To ensure accuracy, use only high-quality tips made from contamination-free polypropylene.

• Tips are designed for single use. They should not be cleaned for reuse as their metrological characteristics will no longer be reliable.

• Pre-rinsing (three - five times) the tip with the liquid to be pipetted improves accuracy. This is especially important when pipetting volatile compounds since it prevents liquid dropping out of the tip.

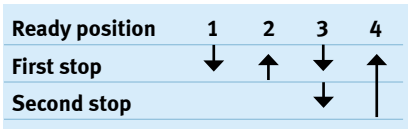
• Pipette parallel samples in a similar way.

• Avoid turning the pipette on its side when there is liquid in the tip. Liquid might go to the interior of the pipette and contaminate the pipette.

• Avoid contamination to or from fingers by using the tip ejector.

• Always store pipettes in an upright position when not in use. Finnpipette stands are ideal for this purpose.

Forward pipetting



Yes: when pipetting and mixing a sample or reagent into another liquid.

The forward technique is recommended for aqueous solutions like buffers, diluted acids or alkalis.

Otherwise **no:** formation of bubbles or foam in the tip or in the test tube or well.

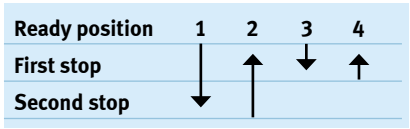
1. Press the operating button to the first stop.

2. Dip the tip into the solution to a depth of 1 cm, and slowly release the operating button. Withdraw the tip from the liquid, touching it against the edge of the reservoir to remove excess liquid.

3. Dispense the liquid into the receiving vessel by gently pressing the operating button to the first stop. After one second, press the operating button to the second stop. This action will empty the tip. Remove the tip from the vessel, sliding it along the wall of the vessel.

4. Release the operating button to the ready position.

Repetitive pipetting



Yes: especially for adding of reagents into tubes or into the wells of a microtiter plate.

This technique is intended for repeated pipetting of the same volume.

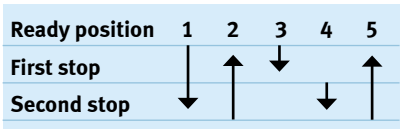
1. Press the operating button to the second stop.

2. Dip the tip into the solution to a depth of 1 cm, and slowly release the operating button. Withdraw the tip from the liquid, touching it against the edge of the reservoir to remove excess liquid.

3. Dispense the liquid into the receiving vessel by gently pressing the operating button to the first stop. Hold the button in this position. Some liquid will remain in the tip, and this should not be dispensed.

4. Continue pipetting by repeating steps 2 and 3.

Reverse pipetting



Yes: for pipetting of samples or reagents when no mixing into another liquid is required.

Reverse pipetting avoids the risk of splashing, foam or bubble formation.

The reverse technique is used for pipetting solutions with a high viscosity or a tendency to foam. This method is also recommended for dispensing small volumes. It is only possible with air displacement pipettes.

1. Press the operating button to the second stop.

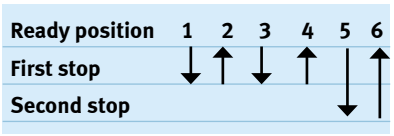
2. Dip the tip into the solution to a depth of 1 cm, and slowly release the operating button. This action will fill the tip. Withdraw the tip from the liquid, touching it against the edge of the reservoir to remove excess liquid.

3. Dispense the liquid into the receiving vessel by depressing the operating button gently and steadily to the first stop. Hold the button in this position. Some liquid will remain in the tip, and this should not be dispensed.

4. The liquid remaining in the tip can be pipetted back into the original solution or thrown away with the tip.

5. Release the operating button to the ready position.

Pipetting of heterogeneous samples



Yes: when prerinsing the tip is not possible and the full sample should be dispensed for correct analysis.

This technique is used for pipetting heterogeneous samples like blood or serum.

1. Press the operating button to the first stop. Dip the tip into the sample. Make sure the tip is sufficiently below the surface.

2. Release the operating button slowly to the ready position. This action will fill the tip with the sample. Remove the tip from the solution by sliding it along the wall of the vessel. Dip the tip into the target solution. Make sure the tip is sufficiently below the surface.

3. + 4. Press the operating button to the first stop and release slowly to the ready position. Do not remove the tip from the solution. Repeat this process until the interior wall of the tip is clear.

5. Remove the tip from the solution by sliding it along the wall of the vessel. Press the operating button to the second stop and completely empty the tip.

6. Release the operating button to the ready position.

Tip information

Pipette tips are part of the complete pipetting system, and the quality of both pipette and tip are important. Thermo Scientific Finntips are designed using our knowledge of liquid handling and are made of high-quality raw materials.

Thanks to the unique sealing-end design, Finntips form a leak proof seal with the tip cone of the pipette. This prevents leakage and guarantees optimum accuracy and precision. The surfaces of Finntips are uniformly smooth and hydrophobic. This minimizes surface wetting and allows complete dispensing of the liquid.

The Finntip® range covers basic and special tips, including wide orifice tips, stepper tips and other special models and so offers a suitable tip for most applications.

Recommendations for pipetting different compounds

Solution/ compound	Examples	Pipette	Tip	Pipetting technique	Comments
Aqueous solution	Buffers, diluted salt solutions	Air displacement	Standard	Forward	
Viscous solution	Protein and nucleic acid solutions, glycerol, Tween 20/40/60/80	Air displacement Positive displacement	Standard or wide orfice Positive displacement	Reverse	Pipette slowly to avoid bubble formation.
Volatile compounds	Methanol, hexane	Air displacement Positive displacement	Filter Positive displacement	Reverse	Pipette rapidly to avoid evaporation. Carbon filter tips prevent vapor going into the pipette very effectively
Body fluids	whole blood, serum	Air displacement	Standard or wide orifice tip	Pipetting of hetero-geneous samples	Residual liquid can be found on the outer surface of the tip. Wipe the tip against the edge of the vessel to remove this liquid before dispensing.
Nucleotide solutions	Gonomic DNA, PCR products	Air displacement Positive displacement	Filter or wide orifice Positive displacement	Forward	For genomic DNA wide orifice tips can be used to eliminate mechanical shearing.
Radioactive compounds	^{14}Carbonate, ^{3}H-thy-midine	Air displacement Positive displacement	Filter Positive displacement	Forward	
Acid/alkalis	H_2SO_4, HCl, NaOH	Air displacement	Filter	Forward	
Toxic samples		Air displacement Positive displacement	Filter Positive displacement	Forward or reverse	

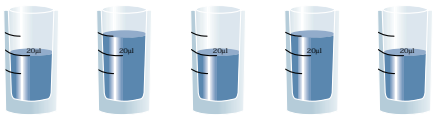
Ensuring Optimum Performance

Error-free pipetting requires both precision and accuracy. A number of factors can affect these specifications. These form the main quantitative parameters for evaluating pipette performance.

What are accuracy and precision?

For example when the set volume is 20 µl:

Accurate, but not precise: The mean volume is the correct (set) volume, but the separate pipettings differ from the set volume.

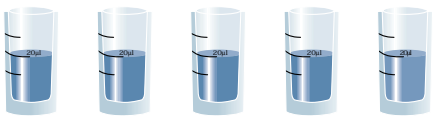


Accurate, but not precise

Precise, but not accurate: There is no variation between the separate pipettings,but the mean volume differs from the set volume.

Precise, but not accurate

Accurate and precise: The mean volume is the set volume and there is no variation between the different pipettings.



Accurate and precise

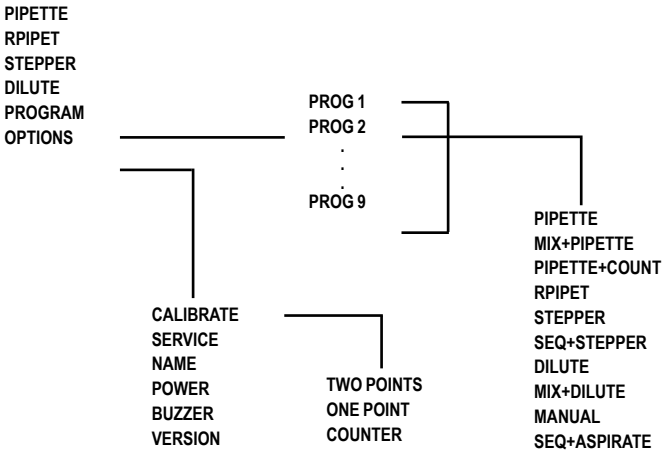
Usage of Thermo Scientific Finnpipette Novus

Finnpipette Novus is an electronically assisted pipette for a wide range of liquid handling operations. Thanks to the electronic motor and electronic control, pipetting is easy and comfortable, yet still fast and accurate. It operates on the air displacement principle and uses detachable, disposable tips, which are easy to remove with a soft touch tip ejector.

The guiding and easy user-interface is very fast to learn. The adjusted delivery volume is clearly indicated in the LCD display on top of the handle. The long lasting Lithium-Ion -battery is always charged with rapid charge technique. If needed, the battery can be charged over the lunch hour.

The adjustable, index finger operated pipetting trigger uses natural hand movement, increasing comfort and reducing the risk of repetitive stress injuries.

The menu map of Finnpipette Novus is shown below.



PIPETTE = forward pipetting

RPIPET = reverse pipetting or repetitive pipetting

STEPPER = repeated dispensing of a selected volume. The minimum stepper volume is 5% of the maximum volume e.g. for FP Novus 1-10 µl the minimum stepper volume 0.5 µl.

DILUTE = dispensing of two selected volumes (between the first and the second liquid an air buffer is aspirated)

PROGRAM

Programs are stored settings that can be edited, stored and retrieved. In the program mode additional functions are available:

MIX+PIPETTE = this function adds automatic mixing after normal pipetting

PIPETTE+COUNT = this function adds automatic count number to pipetting

SEQ+STEPPER = the sequential stepper mode enables serial dispensing of different volumes (opposite to the normal stepper mode where only one fixed volume can be dispensed).

MIX+DILUTE = this function adds automatic mixing after diluting

MANUAL = in this mode it is possible to measure volumes. In the manual mode only slower speeds are available to ensure a quick stop. The slow pipetting speed is useful e.g. when applying fixative to cells where a regular speed would damage the cells. The manual mode can also be used for titration.

SEQ+ASPIRATE = the sequential aspirate mode enables serial aspirating of different volumes.

Factors Affecting the Accuracy of Air Displacement Pipettes

Temperature

Temperature has many effects on pipetting accuracy. The factor that has the greatest effect is the temperature difference between the used delivery device and liquid. The air gap (dead air volume) between the liquid surface and the piston experiences thermal expansion effects according to the case. This either reduces or increases the liquid amount aspirated into the tip along with other effects.

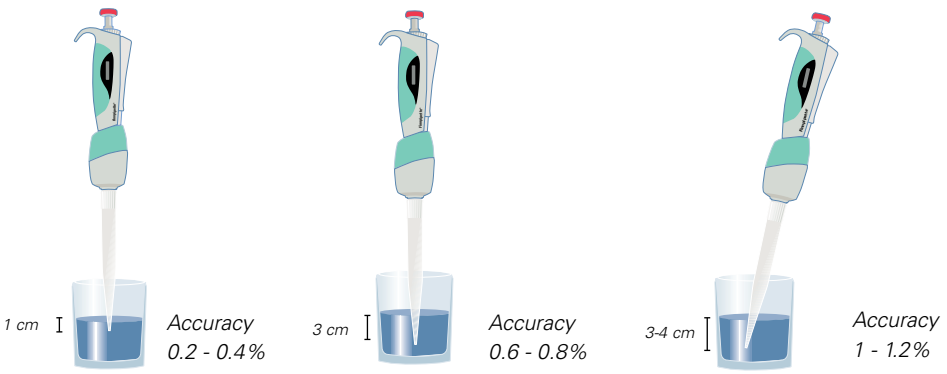
Density

The density (mass/volume ratio) affects the liquid volume that is aspirated into the tip. A smaller dose of liquid with higher density than water is aspirated compared to similar operation with water. With lower density liquids the effect is the opposite. This is caused by the flexible dead air volume along with the earth gravity. The density of liquids varies also according to the temperature. Typically the density for water is 0.998 kg/dm^3, for ethanol 0.79 kg/ dm^3 and for sulfuric acid (95-98% H_2SO_4) 1.84 kg/dm^3 (the values apply at temperature of 20 °C).

Altitude

The geographic altitude affects the accuracy through air pressure. The air pressure decreases in higher altitudes and the conversion factor Z decreases as well. Also, with some liquids the boiling point decreases quite close to room temperature, which will increase the evaporation loss dramatically.

Pipetting position (e.g. when using a 1-10 ml pipette)



1. Pipette held vertically, tip immersed about 1 cm into the liquid.

2. Pipette held vertically, tip immersed about 3 cm into the liquid.

3. Pipette held at a 30-40° angle, tip immersed about 3-4 cm into the liquid.

Preventing cross-contamination

Pipette-to-sample

A contaminated pipette or contaminated tips can cause contamination of samples.

Prevention:

• Use sterilised tips or sterilised filter tips and if possible autoclave the pipette.

• Change the tip after pipetting of each sample.

Sample-to-pipette

Samples or aerosols from samples can enter the cone of the pipette.

Prevention:

• Keep the pipette vertical when pipetting in order to prevent liquid from running into the pipette body.

• Release the push-button slowly.

• To avoid aerosol contamination, use filter tips or use a positive displacement pipette and tips.

• Store the pipette vertically.

Sample-to-sample (carry-over)

The remains of sample A can mix with next sample B inside the tip and may cause a false test result.

Prevention:

• Change the tip after each sample.

• If you suspect that your pipette is contaminated, autoclave or clean your pipette (see "Maintenance of your Finnpipette" and "Autoclaving",

Maintenance of your Thermo Scientific Finnpipette

Finnpipettes are easy to service in the laboratory. All Finnpipettes come with detailed instructions on how to disassemble the pipette. Instructions for routine in-lab maintenance are also included.

• Daily checking: At the beginning of each workday, the pipette should be checked for dust and dirt on the outside surfaces. Particular attention should be paid to the tip cone. No other solvents except 70% ethanol should be used to clean the pipette.

• Short-term service: If the pipette is used daily, it is recommended to check the calibration every three months.

• Long-term service: If the pipette is used daily it should be serviced every six months.

Please see the Instructions for Use manual for maintenance instructions. You can find the latest version of the manuals from www.thermo.com/finnpipette.

Autoclaving

Please, follow these instructions carefully in order to avoid damage to tips and pipettes.

1. Autoclave (steam sterilize) tips at 121°C (248°F) for 20 minutes. Immediately after autoclaving, the tips are moist. Allow moisture to evaporate before using the tips, preferably overnight.

2. All Finnpipette Focus and Digital models can be autoclaved (steam sterilized) in one piece at 121°C (248°F) for 20 minutes. The tip cone modules of Finnpipette Novus and Finnpipette BioControl can also be autoclaved.

3. After autoclaving, the pipette must be cooled at room temperature for at least two hours before use.

4. Check the calibration after every autoclave treatment.

UV resistance

Finnpipette Focus and Digital models are UV resistant. The handle however might change colour from grey to light yellow. If the inner parts of the pipette are exposed to UV light, please check that there is sufficient grease on the piston and O-rings.

Calibration of Pipettes

All Finnpipettes are factory calibrated and adjusted to give the volumes as specified with water. During factory calibration, the performance is checked with 5 weighings at both the minimum and maximum volumes of the volume range. A calibration report is included with every pipette. Normally, the pipettes do not need adjustment, but they are constructed to permit re-adjustment for liquids of different temperature and viscosity.

Calibration of pipettes means determining the difference between the dispensed volume and the selected volume. Adjustment means altering the pipette so that the dispensed volume is within the specifications.

Calibration of pipettes in a quality system

The main objective of pipette calibration in a quality system is to ensure that dispensing is carried out with the intended accuracy. Very often the error limits are taken from the manufacturer's specifications, although far less accuracy is needed to perform the task. It should be kept in mind that in a laboratory environment (uncontrolled) the manufacturer´s specifications may not be achieved. Therefore every user should define their own acceptance limits, according to the application and the ambient conditions. Another option is to use the acceptance limits stated in the standards e.g. EN ISO 8655 multiplied by two. The actual standard specifications, and if the highest accuracy is needed, the manufacturer's specifications, should be used only when testing can be performed in a controlled environment using distilled or deionised water.

Device requirements and test conditions

An analytical balance must be used. The scale graduation value of the balance should be chosen according to the selected pipette volume.

Pipette specifications according to EN ISO 8655

The EN ISO 8655 standard gives the accuracy and precision limits as both absolute and relative values. The values are specified for fixed single channel air displacement pipettes. With variable volume pipettes, the nominal volume is the maximum selectable volume. The µl limit of the nominal volume applies to every selectable volume throughout the volume range. For example, for a 10-100 µl pipette the maximum permissible accuracy limit is 0.8 µl and the maximum permissible precision limit is 0.3 µl. With multichannel pipettes these values are further doubled.

The EN ISO 8655 specifications are shown in the table below.

Procedure to check calibration

The pipette is checked with the maximum volume (nominal volume) and with the minimum volume or 10% of the maximum volume, whichever is higher. For example, Finnpipette 0.5-10 µl is tested at 10 µl and 1 µl. A new tip is first prewetted 3-5 times and a series

Volume range	Readability (mg)	Weighing capacity (g)	Sartorius model number (example)	Article description
under 10 µl	0.001	5.1	MC5	Standard version
under 10 µl	0.001	5.1	MC5 / VF988	Special version with special draft shield and humidity trap
10 – 100 µl	0.01	210	ME215S	Standard version
10 – 100 µl	0.01	210	ME215S / VF2397	Special version with special draft shield
above 100 µl	0.01 / 0.02 / 0.05	60 / 110 / 210	ME215P	Standard version

of ten pipettings is performed with both volumes. With multichannel pipettes, both volumes are tested with the two edge channels.

A pipette is always adjusted for delivery (EX) of the selected volume. If the calculated results are within the selected limits, the adjustment of the pipette is correct.

Formulas for calculating results

Conversion of mass to volume

$V = (w + e) \times Z$

V = Volume (µl) w = Weight (mg)
e = Evaporation loss (mg)
Z = Conversion factor for mg/µl conversion

Evaporation loss can be significant with low volumes. To determine mass loss, dispense water into the weighing vessel, note the reading and begin timing with a stop watch. Check how much the reading decreases during 30 seconds. Compare this to the pipetting. Typically, pipetting time might be 10 seconds and the mass loss is 2 mg. If an evaporation trap or lid on the vessel is used, an evaporation correction is unnecessary.

Conversion factor Z is for calculating the density of water suspended in air at a test temperature and pressure. See the conversion table on page 74.

Accuracy (systematic error)

Accuracy is the difference between the dispensed volume and the selected volume of a pipette.

$A = \bar{V} - V_0$

A = Accuracy $\bar{V}$ = Mean volume
V_0 = Nominal volume

Accuracy can be expressed as a relative value:

$A\% = 100\% \times A / V_0$

Precision (random error)

Precision refers to the repeatability of the pipettings. It is expressed as standard deviation (s) or coefficient of variation (cv). In addition to the features of the pipette, laboratory practice and user experience are the main factors affecting precision.

$$s = \sqrt{\frac{\sum_{i=1}^{n} (v_i - \bar{v})^2}{n - 1}}$$

s = Standard deviation
$\bar{v}$ = Mean volume
n = Number of measurements
v_i = Single measurement result (i = 1...n)

Standard deviation can be expressed as a relative value as cv.

$cv = 100\% \times s/\bar{v}$

ISO 8655 error limits for single channel air displacement pipettes

Nominal volume	Maximum permissible systematic error (ACC)		Maximum permissible random error (CV)	
µl	±%	±µl	%	µl
1	5,0	0,05	5,0	0,05
2	4,0	0,08	2,0	0,04
5	2,5	0,125	1,5	0,075
10	1,2	0,12	0,8	0,08
20	1,0	0,2	0,5	0,1
50	1,0	0,5	0,4	0,2
100	0,8	0,8	0,3	0,3
200	0,8	1,6	0,3	0,6
500	0,8	4,0	0,3	1,5
1000	0,8	8,0	0,3	3,0
2000	0,8	16,0	0,3	6,0
5000	0,8	40,0	0,3	15,0
10000	0,6	60,0	0,3	30,0

Conversion Table

Values of the conversion factor Z (µl/mg), as a function of temperature and pressure, for distilled water.

Temperature °C	Air pressure kPa*						
	80	85	90	95	100	101	105
15,00	1,0017	1,0018	1,0019	1,0019	1,0020	1,0020	1,0020
15,50	1,0018	1,0019	1,0019	1,0020	1,0020	1,0020	1,0021
16,00	1,0019	1,0020	1,0020	1,0021	1,0021	1,0021	1,0022
16,50	1,0020	1,0020	1,0021	1,0021	1,0022	1,0022	1,0022
17,00	1,0021	1,0021	1,0022	1,0022	1,0023	1,0023	1,0023
17,50	1,0022	1,0022	1,0023	1,0023	1,0024	1,0024	1,0024
18,00	1,0022	1,0023	1,0023	1,0024	1,0025	1,0025	1,0025
18,50	1,0023	1,0024	1,0024	1,0025	1,0025	1,0026	1,0026
19,00	1,0024	1,0025	1,0025	1,0026	1,0026	1,0027	1,0027
19,50	1,0025	1,0026	1,0026	1,0027	1,0027	1,0028	1,0028
20,00	1,0026	1,0027	1,0027	1,0028	1,0028	1,0029	1,0029
20,50	1,0027	1,0028	1,0028	1,0029	1,0029	1,0030	1,0030
21,00	1,0028	1,0029	1,0029	1,0030	1,0031	1,0031	1,0031
21,50	1,0030	1,0030	1,0031	1,0031	1,0032	1,0032	1,0032
22,00	1,0031	1,0031	1,0032	1,0032	1,0033	1,0033	1,0033
22,50	1,0032	1,0032	1,0033	1,0033	1,0034	1,0034	1,0034
23,00	1,0033	1,0033	1,0034	1,0034	1,0035	1,0035	1,0036
23,50	1,0034	1,0035	1,0035	1,0036	1,0036	1,0036	1,0037
24,00	1,0035	1,0036	1,0036	1,0037	1,0037	1,0038	1,0038
24,50	1,0037	1,0037	1,0038	1,0038	1,0039	1,0039	1,0039
25,00	1,0038	1,0038	1,0039	1,0039	1,0040	1,0040	1,0040
25,50	1,0039	1,0040	1,0040	1,0041	1,0041	1,0041	1,0042
26,00	1,0040	1,0041	1,0041	1,0042	1,0042	1,0043	1,0043
26,50	1,0042	1,0042	1,0043	1,0043	1,0044	1,0044	1,0044
27,00	1,0043	1,0044	1,0044	1,0045	1,0045	1,0045	1,0046
27,50	1,0045	1,0045	1,0046	1,0046	1,0047	1,0047	1,0047
28,00	1,0046	1,0046	1,0047	1,0047	1,0048	1,0048	1,0048
28,50	1,0047	1,0048	1,0048	1,0049	1,0049	1,0050	1,0050
29,00	1,0049	1,0049	1,0050	1,0050	1,0051	1,0051	1,0051
29,50	1,0050	1,0051	1,0051	1,0052	1,0052	1,0052	1,0053
30,00	1,0052	1,0052	1,0053	1,0053	1,0054	1,0054	1,0054

**1kPa = 10 hPa*

On-line pipette calibration

We offer an easy-to-use pipette calibration calculator at www.thermo.com/finnpipette. This can be found from the Finnpipette product pages or by using the search option **pipette calibration**. Procedures how to check the calibration and how to adjust the pipette are included. Briefly, do ten pipettings with the lower calibration volume and ten pipettings with the nominal volume. According to ISO 8655, with multichannel pipettes both volumes should be tested with all channels. Enter the weighing results into the fields. For multichannel pipettes, the channel number can be entered into the serial number field. Press the "Calculate" button to calculate the accuracy and precision. If the results are within the limits, the adjustment of the pipette is correct. If not, the pipette has to be readjusted with the lower volume and checked again.

General Guidelines for Decontaminating Pipettes

Liquid Handling	Special features	Decontamination
Aqueous solutions and buffers	Pipettes are calibrated with distilled water.	Open pipette, rinse contaminated parts well with distilled water, and allow to dry at maximum 60°C in a dryer compartment. Lubricate piston if neccessary using the grease that comes with the pipette.
Acids	It is advisable to occasionally rinse the lower part of the pipette with distilled water if high-concentration acids are pipetted frequently. Using Filtertips is also recommended.	The plastics used in Finnpipettes are acid resistant. However, aerosols from the acids can enter the lower part of the pipette and affect the performance of the pipette. Clean as described above in “Aqueous solutions and buffers”.
Alkalis	It is advisable to occasionally rinse the lower part of the pipette with distilled water if high-concentration alkalis are pipetted frequently. Using Filtertips is also recommended.	The plastics used in Finnpipettes are alkali resistant. However, aerosols from the alkalis can enter the lower part of the pipette and affect the performance of the pipette. Clean as described above in “Aqueous solutions and buffers”.
Potentially infectious liquids	To avoid contamination, Filtertips should be used. Alternatively, positive displacement systems can be used.	Use 70% ethanol to disinfect. The tip cone and tip ejector can be left in an ethanol bath overnight. Autoclave according to instructions. Viruses and spores can be inactivated by wiping the the pipette with a tissue moistened with 5% sodium hypochlorite. Moisten a clean tissue with distilled water and wipe the surface well.
Cell cultures	To guarantee sterility, Thermo Filtertips should be used.	Proceed as described above with “potentially infectious liquids”.
Organic solvents	1. Density is different than that of water. Therefore, it is necessary to adjust the pipette. 2. Pipetting should be carried out rapidly, due to the high vapor pressure and changes in the wetting pressure. 3. After pipetting is finished, open the pipette and allow the liquid to evaporate.	The evaporation process* is normally sufficient for liquids with a high vapour pressure. Alternatively, immerse the contaminated parts in detergent. Rinse well with distilled water and dry at maximum 60°C in a dryer compartment. Lubricate piston if neccessary using the grease that comes with the pipette. *(as described in 3.)
Radioactive solutions	To avoid contamination, Filtertips should be used. An alternative would be to use positive displacement systems.	Open pipette and place contaminated parts in complex solutions or special cleaning solutions. Rinse well with distilled water and dry at maximum 60°C in a dryer compartment. Lubricate piston if neccessary using the grease that comes with the pipette.
Proteins	To avoid contamination, Filtertips should be used. An alternative would be to use positive displacement systems.	Open pipette, rinse pipette with detergent. Rinse well with distilled water and dry at maximum 60°C in a dryer compartment. Lubricate piston if neccessary using the grease that comes with the pipette.
Nucleic acids	To avoid contamination, Filtertips or positive displacement systems should be used	If you have an autoclavable pipette, autoclave it according to the manufac-torer's instructions. Otherwise open pipette, wipe with 90% ethanol, followed by 2 M sodium acetate and again 90% ethanol.

Chemical Compatibility of Plastics

These are general guidelines, not performance guarantees. Factors such as concentration, temperature and length of exposure can affect performance.

Chemical Class	Polypropylene (PP)	Polyethylene (HD-PE)	Polyvinylidene fluoride (PVDF)	Silicone	Polystyrene (PS)
	Finntip BioMate (nose cone)	**Plungers** (Finntip Stepper, Finntip PDP)	**Tip cones** (BioControl, Finnpipette Focus, Digital, Novus)	**BioMate** (adaptor)	**Microtiter microplates**
Acid, mineral					
Boric acid	Good	Good	Good	Good	Good
Chlorosulphuric acid	Poor	Fair	Fair	-	-
Hydrogen chloride 20%	Good	Good	Good	Fair	Good
Hydrogen chloride 25%	Good	Good	Good	Fair	Fair
Hydrogen fluoride 25%	Good	Good	Good	Poor	-
Nitric acid 70%	Fair	Good	Good	Poor	Poor
Perchloric acid	Fair	Good	Good	Poor	Good
Phosphoric acid 1%	Good	Good	Good	-	Good
Phosphoric acid 10%	Good	Good	Good	-	Good
Sulphuric acid 50%	Good	Good	Good	Poor	Good
Sulphuric acid 98%	Poor	Good	Good	Poor	Poor
Acid, organic					
Acetic anhydride	Fair	Good	Poor	Poor	Poor
Formic acid concentrate	Good	Good	Good	Fair	Fair
Lactic acid	Good	Good	Good	Good	Good
Maleic acid	Good	Good	Good	-	Good
Palmitic acid	Good	Good	Good	Poor	Good
Salicylic acid	Good	Good	Good	-	Good
Tannic acid	Good	Good	Good	Fair	Good
Alcohol					
Allyl alcohol	Good	Good	Good	-	Good
Amyl alcohol	Good	Good	Good	Poor	Good
Ethanol	Good	Good	Good	Fair	Good
Ethylene glycol 60%	Good	Good	Good	Good	Good
Ethylene glycol 100%	Good	Good	Good	Good	Good
Furfuryl alcohol	Good	Good	Good	Good	Poor
Glycerol	Good	Good	Good	Good	Good
Isobutanol	Good	Good	Good	Good	Good
Methanol	Good	Good	Good	Good	Poor
Aldehyde					
Acetaldehyde	Good	Good	Good	Fair	Poor
Formaldehyde 37%	Good	Good	Good	Fair	Good
Aliphatic hydrocarbon					
Heptane	Fair	-	Good	Poor	Poor
Hexane	Fair	Poor	Good	Poor	Poor
Amide					
Dimethylformamide	Good	Good	Poor	Fair	Poor
Acrylamide	Good	Good	Good	-	Good
Amine					
Aniline	Good	Good	Good	Fair	Poor
Pyridine	Good	Good	Good	Poor	Poor
Triethanolamine	Good	Good	Good	-	Good
Aromatic hydrocarbon					
Benzene	Poor	Fair	Good	Poor	Poor
Toluene	Poor	Fair	Good	Poor	Poor
Base					
Aluminum hydroxide	Good	Good	Good	-	Good
Ammonia concentrate	Good	Good	Poor	-	Good
Calcium hydroxide	Good	Good	Fair	Good	Good
Potassium hydroxide 10%	Good	Good	Poor	Fair	Good
Sodium hydroxide 10%	Good	Good	Poor	Fair	Good

Good = resistant, no effect
Fair = limited resistance, only for short exposure
Poor = not resistant
- = no data available

Chemical Compatibility of Plastics

Chemical Class	Polypropylene (PP)	Polyethylene (HD-PE)	Polyvinylidene fluoride (PVDF)	Silicone	Polystyrene (PS)
	Finntip BioMate (nose cone)	**Plungers** (Finntip Stepper, Finntip PDP)	**Tip cones** (BioControl, Finnpipette Focus, Digital SCP, MCP)	**BioMate** (adaptor)	**Microtiter microplates**
Ester					
Dibutyl phthalate	Fair	Good	Good	-	Poor
Ether					
Diethyl ether	Fair	Good	Poor	Poor	Poor
Polyalkylene glycol	Good	Good	Good	-	-
Polyethylene glycol	Good	Good	Good	-	-
Polyethylene sulfide	Good	Good	Good	-	-
Propylene oxide	Good	Good	Good	-	Poor
Halogenated hydrocarbon					
Bromochloromethane	Poor	Poor	Poor	Poor	Poor
Carbon tetrachloride	Fair	Poor	Good	Poor	Poor
2-Chloroethanol	Good	Good	Good	-	-
Chlorobenzene	Poor	Fair	Good	Poor	Poor
Chloroform	Fair	Fair	Good	Poor	Poor
Dichloroethane	Fair	Fair	Good	-	Poor
Heterocyclic compounds					
Tetrahydrofuran	Fair	-	Fair	Poor	-
Ketone					
Acetone	Fair	Good	Poor	Poor	Poor
2-Butanone	-	-	Poor	-	-
Methyl ethyl ketone	Good	Good	Poor	Poor	Poor
Phenol					
Phenol	Fair	Good	Good	Poor	Poor
Salt, inorganic					
Aluminum chloride	Good	Good	Good	Fair	Good
Aluminum fluoride	Good	Good	Good	Good	Good
Ammonium carbonate	Good	Good	Good	Fair	Fair
Barium chloride	Good	Good	Good	Good	Good
Calcium chloride	Good	Good	Good	Good	Good
Calcium sulphate	Good	Good	Good	-	Good
Copper (II) chloride 5%	Good	Good	Good	Good	Good
Iron (II) chloride	Good	Good	Good	Fair	Good
Iron (III) nitrate	Good	Good	Good	-	-
Iron (III) sulphate	Good	Good	Good	Fair	Good
Lithium bromide	Good	Good	Good	-	-
Magnesium chloride	Good	Good	Good	Good	Good
Magnesium (I) nitrate	Good	Good	Good	-	-
Mercury (II) chloride	Good	Good	Good	-	Good
Nickel nitrate	Good	Good	Good	Good	-
Potassium carbonate	Good	Good	Poor	-	Good
Potassium chlorate	Good	Good	Poor	Fair	-
Silver nitrate	Good	Good	Good	Good	Fair
Sodium carbonate	Good	Good	Good	Good	Good
Sodium fluoride	Good	Good	Good	-	-
Sodium hypochlorite 5%	Fair	Good	Fair	Fair	Good
Tin (II) chloride	Good	Good	Good	Fair	-
Tin (IV) chloride	Good	Good	Good	Fair	-
Zinc chloride	Good	Good	Good	Good	Good
Zinc sulphate	Good	Good	Good	Good	-
Miscellaneous					
Culture Media	Good	Good	Good	Good	Good
DEPC	Good	-	Good	Good	Good
DMSO	Good	Good	Poor	-	Good
Ficoll-Hypaque	Good	Good	Good	Good	Good
Sera	Good	Good	Good	Good	Good
Urea	Good	Good	Good	Fair	Good

Good = resistant, no effect
Fair = limited resistance, only for short exposure
Poor = not resistant
- = no data available

Customer support

You can enter your questions concerning Finnpipettes and Finntips to our Customer Support Desk. To do so, please go to our web site www.thermo.com/finnpipette -> Service & Support -> Customer Support Desk. You will have to register to be able to send your inquiries.

Troubleshooting

Defect	Possible reason	Solution
Leakage	Tip incorrectly attached Foreign particles between tip and tip cone	Attach firmly Clean tip cones attach new tips
	Foreign particles between the piston, the O-ring and the cylinder	Clean and grease O-ring and cylinder
	Insufficient amount of grease on cylinder and O-ring	Grease accordingly
	O-ring damaged	Change the O-ring
Inaccurate dispensing	Incorrect operation Tip incorrectly attached	Follow instructions carefully Attach firmly
	Calibration altered: e.g. caused by misuse	Recalibrate according to instructions
Inaccurate dispensing with certain liquids	Unsuitable calibration High viscosity liquids may require recalibration	Recalibrate with the liquids in question

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