Thermo Scientific Finnpipette Finntip

Good Laboratory Pipetting Guide

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Good Laboratory Pipetting Guide

Contents

Good Laboratory Pipetting Guide

Over 35 Years of Innovation

A leader in pipetting

For over 35 years, our goal has been to help customers in research and clinical laboratories to improve the speed, accuracy and precision of their pipetting.

Since the introduction of the first continuously variable micropipette in 1971, more than three million Thermo Scientific Finnpipettes have been sold in 150 countries. During this time, we have listened to customer feedback to develop a wide variety of innovative models that are increasingly easy and comfortable to use.

This guide outlines pipetting techniques and other practical information to help you achieve the best possible performance from your Finnpipette®.

Pipettes and Pipetting

How pipettes work?

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

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

Both pipette types have a piston that moves in a cylinder or 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 pipetting

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

How an air displacement pipette works?

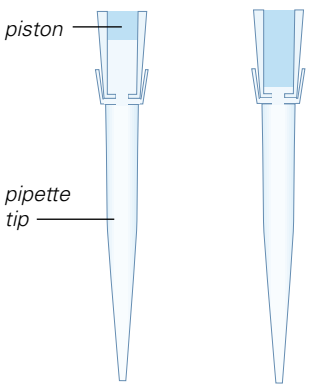
1. The piston moves to the appropriate position when the volume is set.

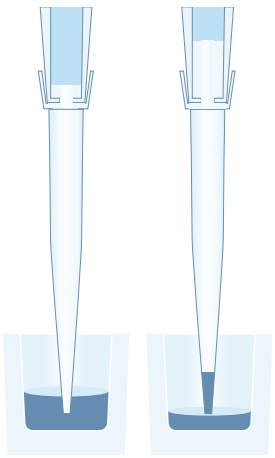
2. When the operating button is pressed to the first stop, the piston expels the same volume of air as indicated on the volume setting.

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

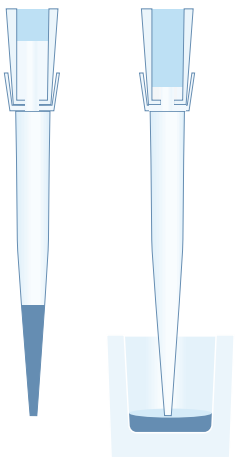
This creates a partial vacuum, and the specified volume of liquid is aspirated into the tip.

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).





Aspirating the liquid (steps 1-3)



Dispensing the liquid (step 4)

Pipettes and Pipetting

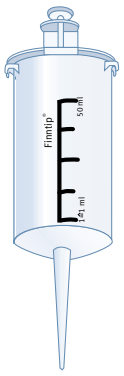
Positive displacement pipetting

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

How the Thermo Scientific Finnpipette Stepper works.

1. The piston inside the tip rises when filling the tip with liquid.

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



Pipetting terminology

The following terms are used throughout this guide.

Aspirate – to draw the liquid up 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 settings so that the dispensed volume is within the specifications

Recommendations for pipetting different compounds

Solution/ compound	Examples	Pipette	Tip	Pipetting tech-nique	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	
Acids/alkalis	H_2SO_4, HCl, NaOH	Air displacement	Filter	Forward	
Toxic samples		Air displacement Positive displacement	Filter Positive displacement	Forward or reverse	

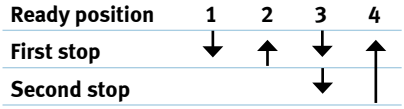
Pipettes and Pipetting

Getting started

- 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 to five times) the tip with the liquid to be pipetted improves accuracy. This is especially important when pipetting volatile compounds since it prevents liquid from dripping 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 get into the interior of the pipette and contaminate the pipette.
- Avoid contamination to or from hands by using the tip ejector.
- Always store pipettes in an upright position when not in use. Finnpipette stands are ideal for this purpose.

Pipetting techniques

Forward pipetting



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

The forward technique is recommended for aqueous solutions, such as 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.

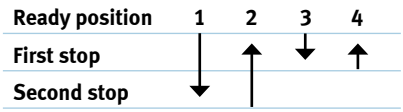
2. Dip the tip into the solution to a depth of 1 cm, and slowly release the operating button. Withdraw the tip from the liquid, touching it against the edge of the reservoir to remove excess liquid.

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.

Pipettes and Pipetting

Repetitive pipetting



Yes: Especially for adding reagents into tubes or into the wells of microplates.

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

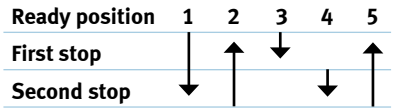
1. Press the operating button to the second stop.

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 samples or reagents when no mixing into another liquid is required.

Reverse pipetting avoids the risk of splashing, and 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 can also be used with air displacement pipettes.

1. Press the operating button to the second stop.

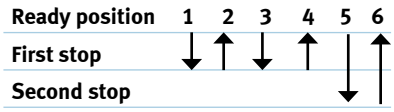
2. Dip the tip into the solution to a depth of 1 cm, and slowly release the operating button. This action will fill the tip. Withdraw the tip from the liquid, touching it against the edge of the reservoir to remove excess liquid.

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, such as 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 it 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.

Pipettes and Pipetting

Pipetting in different applications

Variable volume air displacement single channel pipettes are the most used laboratory instruments. Because of its versatility and wide volume range, the same pipette can be used for multiple applications. By changing the tip type from, for example, a standard tip to a wide bore tip enables dispensing viscous liquids more accurately. Other tip types for special applications are gel loading tips and purity certified tips.

Multichannel pipettes are most commonly used in microplate applications, such as ELISA, PCR or cell culture. Manual multichannel pipettes offer instant usability for small scale multichannel work. Multichannel pipettes are available as 8- or 12-channel versions to work with 96-well microplates and as a 16-channel version to work with 384-well microplates.

In applications where a lot of repetitive pipetting is performed, an electronic pipette provides a huge ergonomic benefit. The Thermo Scientific Finnpipette Novus is a versatile laboratory workhorse which can be programmed to perform most laboratory tasks. The most commonly used function of electronic pipettes is the aliquoting of a reagent into multiple doses (stepper mode). By using a multichannel electronic pipette and stepper mode in microplate filling, the time used for filling the plate can be reduced from several minutes to less than a minute.

Serological pipettes are used in cell and tissue culture applications and in general laboratory liquid dosage, when over one ml volumes are pipetted. Serological pipettes are made of glass or polystyrene. Plastic, disposable pipettes are useful in applications where sterility is a requirement. Pipetting aids, such as the Thermo Scientific Finnpipette C1, help to aspirate and dispense liquids accurately and with precision. The speed of both aspiration and dispensing can be adjusted separately to work with a variety of liquids.

A bulk reagent dispenser is a reliable and easy tool for dispensing reagents directly from the reagent bottle. A dispenser offers speed and accuracy with no extra working steps in everyday liquid dispensing.

The Finnpipette Stepper works on the positive displacement principle. The non-air contact offers benefits when working with viscous or volatile liquids. The same handle can be used with different volume tips.

Finnpipette F1

Finnpipette F1 Multichannel

Finnpipette Novus

Finnpipette C1

Finnpipette Dispenser

Finnpipette Stepper

Pipettes and Pipetting

Selecting the tip

A standard tip is a multipurpose tip for all laboratory applications to meet all kinds of performance requirements, ranging from very high accuracy to plain reagent dispensing with greater tolerance.

A filter tip is beneficial when the assay is sensitive to cross-contamination or the sample can contaminate the lower part of the pipette. The filter prevents liquid from splashing accidentally inside the pipette and aerosols from penetrating into the pipette tip cone during pipetting. We offer both self-sealing barrier and non-self-sealing filter tips. Both tip types are designed to prevent cross-contamination. The barrier tip blocks the filter if any liquid touches the filter which is very beneficial in an over-aspiration situation.

In applications demanding the highest level of purity, sterile standard tips and filter tips are free of human DNA, DNase, RNase and endotoxins. A rack of tips is individually bagged and then sterilized either by gamma radiation or e-beam. In an extremely sensitive application, a single-wrapped tip can be used.

Special tips, such as wide bore tips, are very user-friendly for viscous liquids and when dispensing macro molecules or cells. Nanoliter dispensing can also be done with a disposable tip, Thermo Scientific Finntip Pocket, which offers 50 nl and 250 nl dispensing in suspended DMSO. Stepper tips can be used in applications requiring 0.5 ml to 50 ml repetitive dispensing.

The Thermo Scientific Finntip has a lot of different packaging options. The most used is the rack format, since the tips are easily available and attaching the tip is convenient without using your hands. The very useful space-saving refill kit contains a lot of tips in one pack to be used with racks. Bag tips are offered with a handy zip-lock mechanism to close the bag after taking a tip.

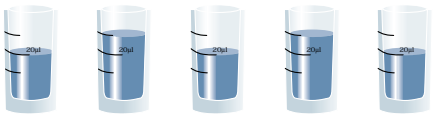
Ensuring optimum performance

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?

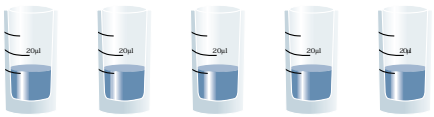
For example, when the set volume is 20 µl:

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



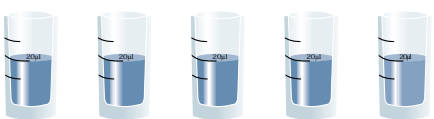
Accurate, but not precise

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

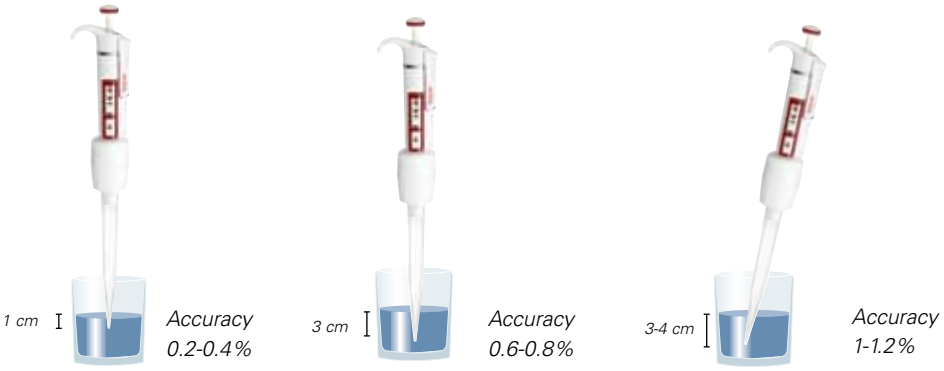
Accurate and precise: The mean volume is the set volume and there is no variation between the different pipettings.



Accurate and precise

Pipettes and Pipetting

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^{o} angle, tip immersed about 3-4 cm into the liquid.

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 also varies 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 the 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.

Pipettes and Pipetting

Pipetting ergonomics

We have pioneered the design of ergonomic pipettes, including the Thermo Scientific Finnpipette F-series. Created in cooperation with ergonomics specialists, this lightweight, user-friendly pipette has light pipetting and tip ejection forces that reduce pipetting stress.

Manual pipetting creates a muscoskeletal load on the neck, shoulders and upper limbs that can lead to repetitive stress injuries. Here are tips that can help minimize the risk of injuries.

Recommendations for ergonomic pipetting

- Select an appropriate pipette for the task. Use an electronic pipette to fill 96- or 384-well plates, especially for long pipetting sessions.
- Arrange pipettes, racks and other accessories so that you can easily reach them.
- Use a chair with adjustable height and adjust the chair so that you have a good working posture. An armrest and footrest can help reduce fatigue.
- Keep your wrists straight and use a relaxed grip while pipetting.
- Take a 1 to 2 minute break is recommended after every 20 minutes.
- If possible, switch between your right and left hand every now and then
- Change body position, if possible (sitting/standing).

More information

References

Björksten, M.G., Almby, B., Jansson, E.S., 1994. Hand and shoulder ailments among laboratory technicians using modern plunger-operated pipettes. Applied Ergonomics 25, pp. 88–94.

Fredriksson K. 1995. Laboratory work with automatic pipettes: a study on how pipetting affects the thumb. Ergonomics 38, pp. 1067-1073.

Jones R. L. and D. Eagleson. 2001. Ergonomic considerations in the development of a class II, type A/B3 biological safety cabinet. American Clinical Laboratory 20 (4), pp. 37-42.

Lintula M. and N. Nevala. 2006. Ergonomics and the usability of mechanical single-channel liquid dosage pipettes. International Journal of Industrial Ergonomics 36, pp. 257–263.

Links

Lab Workers - Take Pain Out of Pipetting. Occupational Health Branch (OBH) publication. Available at http://www.cdph.ca.gov/programs/hesis/Documents/labwork.pdf

Reducing the Risk of Muscoskeletal Injury in Healthcare Laboratory Technologists Performing Pipetting Tasks. Occupational Health & Safety Agency for Healthcare (OHSAH) Publication. Available at http://www.ohsah.bc.ca/media/30-PU-Pipetting.pdf http://www.ergonomics.ucla.edu/Tips_Pipette.html

Decontamination Guidelines

Definitions*

- Decontamination – Any process for removing and/or killing microorganisms. The same term is also used for removing or neutralizing hazardous chemicals and radioactive materials.
- Disinfection – A physical or chemical means of killing microorganisms, but not necessarily spores.
- Sterilization – A process that kills and/or removes all classes of microorganisms and spores.

Pipette cleaning

Cleaning requirements depend on pipette use and the liquid. The chemical compatibility of the pipette should be checked prior to cleaning. When necessary, protective clothing, goggles and disposable gloves should be worn. Cleaning guidelines for Finnpipettes are given in Table 1.

Table 1. Cleaning guidelines for Finnpipettes

Pipetted liquids	Cleaning guidelines
Aqueous solutions and buffers	Open the pipette, rinse the contaminated parts thoroughly with distilled water, and allow to dry.
Acids and alkalis	It is advisable to clean the tip cone and the lower part of the tip ejector with distilled water more frequently if acids or alkalis are handled. Clean as described in "Aqueous solutions and buffers".
Organic solvents	Immerse the contaminated parts in a detergent solution such as Deconex® 12 Basic. Rinse thoroughly with distilled water and allow to dry.
Radioactive solutions	Open the pipette and place the contaminated parts in a strong detergent or cleaning solution. Rinse several times with distilled water and allow to dry. Decontamination should always be followed by confirming that radioactivity has been reduced to an acceptable level. All used cleaning materials are radioactive waste and must be disposed of according to regulations.
Proteins	Open the pipette, immerse the parts in a detergent solution, such as Deconex® 12 Basic. Rinse well with distilled water and allow to dry.
DNA, RNA	• DNA can be eliminated by immersing pipette parts in at least 3% (w/v) sodium hypochlorite for at least 15 minutes (2, 3). Rinse well with distilled water and allow to dry. • Treat the pipette parts with Thermo Scientific DNA AWAY (Cat. no. 7008 and 7009 according to instructions. • Exposure to ultraviolet (UV) light for 30-60 minutes will further reduce but not completely eliminate DNA contamination on the pipette surface (4). • No special treatment is required to remove RNA because it degrades rapidly and is sensitive to ubiquitous RNases.
DNase, Rnase	• RNase can be removed by first cleaning the pipette with a detergent solution, followed by thoroughly rinsing with water and then 95% ethanol to speed the drying process. Pipette parts are then soaked in a 3% hydrogen peroxide solution for 10 minutes. Finally, the parts are rinsed thoroughly with DEPC-treated water (5) and allowed to dry. • Treat the pipette parts with Thermo Scientific RNase AWAY (Cat. no. 7006 and 007) according to instructions. • DNase can be destroyed by autoclaving (15 min, 121°C).
Viruses, mycoplasma, bacteria and fungi	Ultraviolet (UV) radiation is a practical method for inactivating viruses, mycoplasma, bacteria and fungi. While Finnpipettes are UV resistant, the handles might change color from gray to light yellow. If the inner parts of the pipette are exposed to UV light, make sure that the piston and O-rings are sufficiently lubricated.

* Definitions comply with the WHO Laboratory biosafety manual (1).

Decontamination Guidelines

Before assembling the pipette, wipe the piston with 70% ethanol and lubricate with the lubricant that is provided with the pipette. When removing RNase, use a freshly opened ethanol bottle and prepare 70% ethanol in DEPC-treated water.

Pipette sterilization

Autoclaving is the simplest sterilization method if all pipette parts tolerate extreme heat. Pipettes should be autoclaved according to the manufacturer's instructions. To achieve sterility, a holding time of at least 20 minutes at 121°C (252°F) is required.

- Fully autoclavable Finnpipette models: F2, Focus and Digital.
- Autoclavable tip cones: Finnpette Novus, F3 and F1 (see Instructions for Use).

With the exception of the electronic Novus pipette handle, all Finnpipettes can be sterilized with STERRAD® and ethylene oxide treatments. The pipette should be disassembled before the sterilization treatment.

Chemical disinfection and sterilization

Chemical disinfectants or sterilants are used to decontaminate surfaces and equipment if autoclaving is not possible or practical. The choice of a chemical disinfectant or sterilant depends on the microorganisms of concern. Also, the chemical compatibility of the materials should be taken into account. Examples of chemical disinfectants or sterilants are listed in Table 2.

If the lower tip cone and the tip ejector of a pipette have to be chemically decontaminated, the pipette should be disassembled according to the Instructions for Use.

The handle and the dispensing button of the Finnpipette F1 are made of an antimicrobial polymer. Common laboratory disinfectants, such as 70% ethanol, Virkon® or 5% sodium hypochlorite, can be used to clean the surface without any effect on antimicrobial treatment.

Table 2. Examples of chemical disinfectants and sterilants

	Disinfection time (at 20°C)	Sterilization time (at 20°C)	Chemical compatibility with Finnpipettes
Hydrogen peroxide (7.5%)	30 min	6 h	Yes
Glutaraldehyde (2.5%)	20 – 90 min	10 h	Yes
Sodium hypochlorite (5%)	20 min	NA	Yes
Ethanol (70%)	10 – 30 min	NA	Yes

References

1. World Health Organization. 2004. Laboratory biosafety manual. 3rd edition. Geneva, Switzerland.

2. Kemp, B. M. and D. G. Smith. 2005. Use of DNase to eliminate contamination in ancient DNA analysis. Forensic Sci. Int. 10 (154), pp. 53-61.

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4. Cone, R. W. and M. R. Fairfax. 1993. Protocol for ultraviolet irradiation of surfaces to reduce PCR contamination. Genome Research 3, pp. S15-S17.

5. Sambrook, J., E. F. Fritsch and T. Maniatis. 1989. Extraction and purification of RNA. In: Molecular Cloning - A Laboratory Manual, 2nd edition. Cold Spring Habor Laboratory Press, New York.

Decontamination Guidelines

Preventing cross-contamination

Pipette-to-sample

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

Prevention:

- Use filter tips.
- Change the tip after pipetting each sample.
- Clean the pipette regularly.

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.

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, clean with a suitable method (see Table 1), and autoclave if needed.

Maintenance and Service

In order to maintain the pipette's optimal functionality, regular maintenance is necessary.

All the Finnpipettes are easy to service, and basic maintenance and calibration can be done by the user. However, time can be saved if our calibration service is used. For more information about our service offerings, see the Thermo Scientific pipette service and calibration offering on page 17.

Preparation

Before beginning maintenance, make sure the pipette is properly decontaminated. Check that you have the following materials available:

- Instructions for Use
- Service tool (if needed)
- Lubricant
- Small paintbrush
- Sponge
- Cotton swabs
- Common disinfectant (70% ethanol, Virkon® or 10% sodium hypochlorite)

Maintenance and Service

Maintenance intervals

Service intervals vary depending on how often the pipette is used and the liquids that are pipetted. Here are general guidelines on how to service your pipette and how often to do so.

Daily service procedure

It is recommended that the pipette is checked at the beginning of each day for dirt and dust. To clean a dirty pipette, wipe the surface with a sponge moistened with the disinfectant. Particular attention should be paid to the tip cone, which tends to come into contact with the pipetted liquid. The handle does not require further service and should not be immersed any disinfectant.

Pipettes should always be stored in an upright position to prevent residual liquid from entering into the tip cone. A pipette stand is ideal for this purpose, and several Finnpipette stand models are available.

Periodic service procedures

If the pipette is used daily, it should be cleaned and lubricated at least every three months. The service procedure starts with the disassembly of the pipette. Detailed instructions for the disassembly can be found in the Instructions for Use provided with each pipette. Depending on the Finnpipette model, a small service tool may be necessary for disassembly.

After disassembly, the piston, piston spring and the O-rings should be cleaned with a sponge moistened with 70% ethanol. The tip cone should also be checked for foreign particles. A cotton swab dampened with 70% ethanol is a good tool for cleaning the tip cone.

After cleaning, the piston, piston spring and the O-rings should be lubricated. A small paintbrush is a good tool for lubrication. Make sure there is enough grease on all parts. In the end, the pipette should be reassembled. It is recommended to check the correct order of the parts from the exploded pictures presented in the Instructions for Use. Spare part codes are also found in the same pictures. The calibration must always be checked after cleaning.

Some chemicals, such as organic solvents, affect certain parts of the pipette. Therefore, when pipetting these chemicals frequently, special attention should be paid to service.

Vapors from organic solvents may cause the O-rings to swell. When pipetting organic solvents frequently, open the lower part of the pipette and leave it open overnight to ensure proper airing. The O-rings should also be checked and lubricated weekly, and replaced if necessary to prevent leaking. Aerosols from acids and alkalis, on the other hand, affect greasing. Therefore, when pipetting acids and alkalis frequently, it is important to lubricate the piston, piston spring and the O-rings regularly. An additional O-ring and lubricant are provided with each Finnpipette, and they are also available as spare parts. Do not use any lubricant to grease the pipette other than the one provided with the pipette.

Filter tips are the best way to keep your pipette clean and to protect both your pipette and the sample from contamination. The filter prevents aerosols as well as any excess liquid or foreign particles from entering the pipette. Thermo Scientific Finntip filter tips are available in a wide volume range, ranging between 0.2-10000 µl. Thermo Scientific Finntip filter tips are certified sterile and free from DNA, DNase, RNase and endotoxin. They are ideal for all applications, especially for sensitive procedures, such as PCR.

Maintenance and Service

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 five 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 readjustment 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, for example, 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 deionized 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 on pages 21-22.

Procedure to check calibration

The pipette is checked with the maximum volume (nominal volume), 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 pre-wetted 3-5 times and a series 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.

Maintenance and Service

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, the 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.

The 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 20.

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 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 that affect precision.

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

s = Standard deviation
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.

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

Thermo Scientific Pipette Services: Calibration, preventive maintenance, and repair

We make it easy for you to maintain pipette performance over time, and to demonstrate GLP/GMP compliance by offering fast, expert-level calibration, preventive maintenance, and repair services for all Thermo Scientific pipettes, and for most other brands, too.

Through a network of direct service centers in the USA, France, Germany, the United Kingdom, and Japan, and authorized service providers in other regions, formally trained personnel guarantee factory-level service with secure data capture and analysis, and all the proper documentation needed to assure pipetting performance and establish GLP/GMP compliance.

We offer both standard and custom service packages to meet the needs of individual customers, and in most major markets we also have the ability to bring our calibration, preventive maintenance, and repair services (minor repairs) directly to your facility. (Note: Minimum quantities apply for onsite services).

To learn more about Thermo Scientific Pipettes Services in your region, contact your local sales representative, or visit the following website: **www.thermoscientific.com/finnpipette**.

Chemical Resistance of Plastics

Plastics used in all* Finnpipettes and Thermo Scientific Finntips that come into contact with solutions or solution vapors:
PVDF: tip cones and ejectors
EPDM: O-rings
PE: Finntip® filters
PP: Finntips
Silicone: Finnpipette C1 silicone pipette gripper

Substance	PP	PE	PVDF	Silicone	EPDM
2-Butanone					
2-Chloroethanol					
Acetaldehyde					
Acetic acid 25-60 %					
Acetic anhydride					
Acetone					
Acrylamide					
Allyl alcohol					
Aluminum chloride					
Aluminum fluoride					
Aluminum hydroxide					
Ammonia concentrate					
Ammonium carbonate					
Amyl alcohol					
Aniline					
Barium chloride					
Benzene					
Boric acid					
Bromochloromethane					
Calcium chloride					
Calcium hydroxide					
Calcium sulphate					
Carbon tetrachloride					
Chlorobenzene					
Chloroform					
Chlorosulphuric acid					
Copper (II) chloride 5%					
Diethyl pyrocarbonate					
Dibutyl phthalate					
Dichloroethane					
Diethyl ether					
Dimethylformamide					
Dioxan					
DMSO					
Ethanol					
Ethylene glycol 100%					
Formaldehyde 37%					
Formic acid concentrate					
Furfuryl alcohol					
Glycerol					
Heptane					
Hexane					
Hydrogen chloride 25%					
Hydrogen fluoride 25%					
Hydrogenperoxide 30 %					
Iron (II) chloride					

Substance	PP	PE	PVDF	Silicone	EPDM
Iron (III) nitrate					
Iron (III) sulphate					
Isobutanol					
Isopropanol					
Lactic acid					
Lithium bromide					
Magnesium (I) nitrate					
Magnesium chloride					
Maleic acid					
Mercury (II) chloride					
Methanol					
Methyl ethyl ketone					
Nickel nitrate					
Nitric acid 70%					
Palmitic acid					
Perchloric acid					
Phenol					
Phosphoric acid 10%					
Polyalkylene glycol					
Polyethylene glycol					
Polyethylene sulfide					
Potassium carbonate					
Potassium chlorate					
Potassium hydroxide 10%					
Propylene oxide					
Pyridine					
Salicylic acid					
Serum					
Silver nitrate					
Sodium carbonate					
Sodium fluoride					
Sodium hydroxide 10%					
Sodium hypochlorite 5%					
Sulphuric acid 50%					
Sulphuric acid 98%					
Tannic acid					
Tetrahydrofuran					
Tin (II) chloride					
Tin (IV) chloride					
Toluene					
Trichloracetic acid					
Triethanolamine					
Urea					
Zinc chloride					
Zinc sulphate					

PP = Polypropylene
PE = Polyethylene
PVDF = Polyvinylidene fluoride
EPDM = Ethylene propylene diene rubber

= resistant, no effect
= limited resistance, only for short exposure
= not resistant
= no data available

* Finnpipette F1, F2, F3, Focus, Digital, Colour, C1 and Novus. Chemical compatibility chart for Finnpipette Dispenser is available upon request. Contact info.pipettes@thermofisher.com.

Tip Compatibility Table

	Finntip (sterile and non-sterile)																Finntip Filter (sterile)																				
Finnpipette	10 micro	10 Flex micro	20 micro	50 micro	250 univ	200 ext	200 Flex	300	300 Flex	1000 Ext	1000	1000 Flex	1200 Flex	5 ml	10 ml	10 ml Flex Ext	10 Flex micro	10 micro	10 univ	20 micro	20 univ	30 Flex	30 univ	50 micro	100 Flex	100 Ext	100 univ	200 Flex	200 Ext	200 univ	300 Flex	300	1000 Ext	1000	1000 Flex	1200 Flex	5 ml	10 ml	10 ml Flex Ext
F1 0.2-2 µl	•	•	•	•													•	•		•				•														
F1 0.5-5 µl	•	•	•	•													•	•		•				•														
F1 1-10 µl micro	•	•	•	•													•	•		•				•														
F1 1-10 µl					•	•	•	•	•										•		•	•	•															
F1 2-20 µl micro			•	•																•				•														
F1 2-20 µl					•	•	•	•	•												•	•	•															
F1 5-50 µl micro				•																				•														
F1 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•								
F1 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•							
F1 20-200 µl					•	•	•	•	•																			•	•	•	•	•						
F1 30-300 µl								•	•																						•	•						
F1 100-1000 µl										•	•	•	•																				•	•	•	•			
F1 0.5-5 ml														•																							•		
F1 1-10 ml															•	•																						•	•
F1 8-ch 1-10 µl	•	•	•	•													•	•		•				•														
F1 12-ch 1-10 µl	•	•	•	•													•	•		•				•														
F1 8-ch 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F1 12-ch 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F1 8-ch 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F1 12-ch 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F1 8-ch 30-300 µl								•	•																						•	•						
F1 12-ch 30-300 µl								•	•																						•	•						
F1 16-ch 1-10 µl			•	•																•				•														
F1 16-ch 5-50 µl				•																				•														
F2 0.2-2 µl	•	•	•	•													•	•		•				•														
F2 0.5-5 µl	•	•	•	•													•	•		•				•														
F2 1-10 µl micro	•	•	•	•													•	•		•				•														
F2 1-10 µl					•	•	•	•	•										•		•	•	•															
F2 2-20 µl micro			•	•																•				•														
F2 2-20 µl					•	•	•	•	•												•	•	•															
F2 5-50 µl micro				•																				•														
F2 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 20-200 µl					•	•	•	•	•																			•	•	•	•	•						
F2 100-1000 µl										•	•	•	•																				•	•	•	•			
F2 0.5-5 ml														•																							•		
F2 1-10 ml															•	•																						•	•
F2 8-ch 1-10 µl	•	•	•	•													•	•		•				•														
F2 12-ch 1-10 µl	•	•	•	•													•	•		•				•														
F2 8-ch 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 12-ch 5-50 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 8-ch 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 12-ch 10-100 µl					•	•	•	•	•																•	•	•	•	•	•	•	•						
F2 8-ch 30-300 µl								•	•																						•	•						
F2 12-ch 30-300 µl								•	•																						•	•						
F2 16-ch 1-10 µl			•	•																•				•														
F2 16-ch 5-50 µl				•																				•														
Novus 1-10 µl micro	•	•	•	•													•	•		•				•														
Novus 1-10 µl					•	•	•	•	•										•		•	•	•															
Novus 5-50 µl micro				•																				•														
Novus 5-50 µl					•	•	•	•	•																•	•	•											
Novus 10-100 µl					•	•	•	•	•																•	•	•	•	•	•								
Novus 30-300 µl								•	•																						•	•						
Novus 100-1000 µl										•	•	•	•																				•	•	•	•			
Novus 0.5-5 ml														•																							•		
Novus 1-10 ml															•	•																						•	•
Novus 8-ch 1-10 µl	•	•	•	•													•	•		•				•														
Novus 12-ch 1-10 µl	•	•	•	•													•	•		•				•														
Novus 8-ch 5-50 µl					•	•	•	•	•																•	•	•											
Novus 12-ch 5-50 µl					•	•	•	•	•																•	•	•											
Novus 8-ch 30-300 µl								•	•																						•	•						
Novus 12-ch 30-300 µl								•	•																						•	•						
Novus 8-ch 100-1200 µl													•																							•			
Novus 16-ch 5-50 µl				•																				•														

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*

ISO 8655 error limits for single channel pipettes

Range	Volume	Maximum permissible systematic error (ACC)		Maximum permissible random error (CV)	
	µl	±µl	±%	µl	%
0.2-2 µl	2	0.080	4.00	0.040	2.00
	1	0.080	8.00	0.040	4.00
	0.2	0.080	40.00	0.040	20.00
0.3-3 µl	3	0.125	4.17	0.075	2.50
	1.5	0.125	8.33	0.075	5.00
	0.3	0.125	41.67	0.075	25.00
0.5-5 µl	5	0.125	2.50	0.075	1.50
	2.5	0.125	5.00	0.075	3.00
	0.5	0.125	25.00	0.075	15.00
0.5-10 µl	10	0.120	1.20	0.080	0.80
1-10 µl	5	0.120	2.40	0.080	1.60
	1	0.120	12.00	0.080	8.00
2-20 µl	20	0.20	1.00	0.10	0.50
	10	0.20	2.00	0.10	1.00
	2	0.20	10.00	0.10	5.00
3-30 µl	30	0.50	1.67	0.20	0.67
	15	0.50	3.33	0.20	1.33
	3	0.50	16.67	0.20	6.67
5-40 µl	40	0.50	1.25	0.20	0.50
	20	0.50	2.50	0.20	1.00
	5	0.50	10.00	0.20	4.00
5-50 µl	50	0.50	1.00	0.20	0.40
	25	0.50	2.00	0.20	0.80
	5	0.50	10.00	0.20	4.00
10-100 µl	100	0.80	0.80	0.30	0.30
	50	0.80	1.60	0.30	0.60
	10	0.80	8.00	0.30	3.00
40-200 µl	200	1.60	0.80	0.60	0.30
	100	1.60	1.60	0.60	0.60
	40	1.60	4.00	0.60	1.50
20-200 µl	200	1.60	0.80	0.60	0.30
	100	1.60	1.60	0.60	0.60
	20	1.60	8.00	0.60	3.00
30-300 µl	300	4.00	1.33	1.50	0.50
	150	4.00	2.67	1.50	1.00
	30	4.00	13.33	1.50	5.00
200-1000 µl	1000	8.00	0.80	3.00	0.30
	500	8.00	1.60	3.00	0.60
	200	8.00	4.00	3.00	1.50
100-1000 µl	1000	8.00	0.80	3.00	0.30
	500	8.00	1.60	3.00	0.60
	100	8.00	8.00	3.00	3.00
0.5-5 ml	5000	40.00	0.80	15.00	0.30
	2500	40.00	1.60	15.00	0.60
	500	40.00	8.00	15.00	3.00
1-5 ml	5000	40.00	0.80	15.00	0.30
	2500	40.00	1.60	15.00	0.60
	1000	40.00	4.00	15.00	1.50
1-10 ml	10000	60.00	0.60	30.00	0.30
	5000	60.00	1.20	30.00	0.60
	1000	60.00	6.00	30.00	3.00
2-10 ml	10000	60.00	0.60	30.00	0.30
	5000	60.00	1.20	30.00	0.60
	2000	60.00	3.00	30.00	1.50

ISO 8655 error limits for Multichannel Finnpipette fixed volume models

Range	Volume	Maximum permissible systematic error (ACC)		Maximum permissible random error (CV)	
	µl	±µl	±%	µl	%
1-10 µl	10	0.240	2.40	0.160	1.60
	5	0.240	4.80	0.160	3.20
	1	0.240	24.00	0.160	16.00
5-50 µl	50	1.00	2.00	0.40	0.80
	25	1.00	4.00	0.40	1.60
	5	1.00	20.00	0.40	8.00
10-100 µl	100	1.60	1.60	0.60	0.60
	50	1.60	3.20	0.60	1.20
	10	1.60	16.00	0.60	6.00
30-300 µl	300	8.00	2.67	3.00	1.00
	150	8.00	5.33	3.00	2.00
	30	8.00	26.67	3.00	10.00
50-300 µl	300	8.00	2.67	3.00	1.00
	150	8.00	5.33	3.00	2.00
	50	8.00	16.00	3.00	6.00
100-1200 µl	1200	32.00	2.67	12.00	1.00
	600	32.00	5.33	12.00	2.00
	100	32.00	32.00	12.00	12.00

ISO 8655 error limits for fixed volume Finnpipette fixed volume models

Range	Volume	Maximum permissible systematic error (ACC)		Maximum permissible random error (CV)	
	µl	±µl	±%	µl	%
Fixed 1 µl	1	0.050	5.000	0.050	5.000
Fixed 2 µl	2	0.080	4.000	0.040	2.000
Fixed 5 µl	5	0.125	2.500	0.075	1.500
Fixed 10 µl	10	0.120	1.200	0.080	0.800
Fixed 20 µl	20	0.20	1.00	0.10	0.50
Fixed 25 µl	25	0.50	2.00	0.20	0.80
Fixed 50 µl	50	0.50	1.00	0.20	0.40
Fixed 100 µl	100	0.80	0.80	0.30	0.30
Fixed 200 µl	200	1.60	0.80	0.60	0.30
Fixed 250 µl	250	4.00	1.60	1.50	0.60
Fixed 500 µl	500	4.00	0.80	1.50	0.30
Fixed 1000 µl	1000	8.00	0.80	3.00	0.30
Fixed 2000 µl	2000	16.00	0.80	6.00	0.30
Fixed 3000 µl	3000	40.00	1.33	15.00	0.50
Fixed 5000 µl	5000	40.00	0.80	15.00	0.30
Fixed 10 ml	10000	60.00	0.60	30.00	0.30

Thermo Scientific Finnpipette Warranty Registration

We offer an industry-leading five-year warranty for manual Finnpipettes and a two-year warranty for electronic Finnpipettes with web registration. All non-registered customers automatically obtain a three-year warranty for manual pipettes and one-year warranty for electronic pipettes.

To register, go to **www.thermoscientific.com/finnpipette** and select Pipette Warranty Registration.

Troubleshooting

Defect	Possible reason	Solution
Leakage	Tip incorrectly attached	Attach firmly
	Foreign particles between tip and tip cone	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	Follow instructions carefully
	Tip incorrectly attached	Attach firmly
	Calibration altered	Recalibrate according to instructions
Inaccurate dispensing with certain liquids	High viscosity liquids may require recalibration	Recalibrate with the liquids in question

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