Verification Procedure
for
Accuracy and Precision

(defined for Users to incorporate in SOPs)
In accordance with ISO8655 Standard

Contents

In this document the word "tip" is used in the generic sense, where tip is the disposable part that must be used with the pipette: for Distriman this means "DistriTip", for Microman "capillary-piston" and for Pipetman "Gilson Diamond Tip".

Glossary

adjustment	manufacture of an apparatus within appropriate tolerances, or the supplier's setting of the apparatus, ensuring the metrological performance, as specified in the applicable part of ISO 8655.
calibration	set of operations that establish the relationship between the dispensed volume and the corresponding nominal or selected volume of the apparatus.
maximum permissible error	upper or lower permitted extreme value for the deviation of the dispensed volume from the nominal volume or selected volume of a piston-operated volumetric apparatus.
systematic error	difference between the dispensed volume and the nominal volume or selected volume of the piston-operated volumetric apparatus.
random error	scatter of the dispensed volumes around the mean of the dispensed volumes.
uncertainty of measurement	parameter, associated with the dispensed volume, that characterizes the dispersion of the volumes that could reasonably be attributed to the dispensed volume.
nominal volume	volume specified by the manufacturer and used for identification and for indication of the measuring range.

This document describes a verification procedure for the following Gilson pipettes: Pipetman® Ultra (Single and Multichannel), Pipetman® Concept (Single and Multichannel), Pipetman® P, Pipetman® Neo, Pipetman® F, Pipetman® 8X200, Microman® and Distriman®.

The procedure is for verifying pipette performance using gravimetric tests of repeated aspirate and dispense cycles with distilled water (grade 3, ISO 3696), in controlled conditions. The test conditions and methods described herein are fully compatible with ISO 8655 and are often stricter than those specified in the international standard, as are the expected results for maximum permissible errors, which are tabulated in the Appendix.

So, adherence to this procedure assures conformity to Gilson's specifications for accuracy (systematic error) and precision (random error) and to ISO requirements.

The procedure, which for small volumes includes a correction for evaporation loss, evaluates the total system of pipetting: pipette, tip, and operator. Therefore the procedure must be carried out by suitably qualified and trained technicians. In calculating the volumes from balance readings, corrections are made for the temperature and air pressure when the test was made (Z-factor, refer to page 15).

Although the document does not directly concern itself with other tests performed by the user, the method and calculations described herein may be applied in other tests, outside the scope of this document. Users shall establish a regular testing routine at least once a year for their piston pipettes according to: accuracy and precision requirements, frequency of use, number of operators using the pipette, number of operations on each occasion of use and the nature of the liquids being dispensed.

In the case of Pipetman Ultra and Pipetman Concept, the number of cycles can be the basis of your regular testing routine.

Environmental Conditions

The test shall be carried out in a draught-free room with a stable environment.

The test room (laboratory) shall have humidity and temperature control so that the atmospheric conditions of the environment where the procedure will take place and the temperature of the equipment used are stable and homogeneous before and during the procedure.

The use of a chart recorder is recommended.

The temperature of the pipettes being verified and the distilled water (grade 3, ISO 3696) used in the gravimetric test should have stabilized before the procedure commences.

The pipettes, water and test apparatus should have been placed in the test room at least 2 hours before starting the tests.

Ideally, verification takes place under the following conditions:

1) Temperature (t)

ISO 8655 recommends that the gravimetric tests take place where the ambient and water temperature (t) are stable (± 0.5 °C) between 15 °C and 30 °C. Gilson recommends a range between 20 °C and 23 °C with a constant temperature (± 0.5 °C) between the beginning and the end of gravimetric tests. It is recommended to put water and pipettes at least 2 hours in the calibration room to reach an equilibrium with the room conditions. Z-factor is used to convert mass into volume according to temperature and pressure.

2) Relative humidity (RH)

ISO 8655 states that the RH must be greater than 50%. However, Gilson recommends that a humidity range of between 50% and 75% be maintained throughout the verification procedure. In all cases, the evaporation rate will be evaluated for volumes ⩽50 µL.

3) Barometric pressure

Gilson's tests should take place at 1013 ± 25 hPa. The barometric pressure in the test room shall be recorded to the nearest 0.5 kPa. Z-factor is used to convert mass into volume according to temperature and pressure.

Pipette Operation

Consistency of pipetting technique contributes significantly to the reproducibility of the results of the Verification Procedure. Inexperienced technicians can cause substantial variations in apparent pipette performance. For meaningful test results, the technicians must be well-trained and qualified.

You should operate the pipette according to the instructions given in the user's guide of the pipette under test. Attention should be given to maintain a steady rhythm when aspirating and dispensing samples, speed and smoothness when pressing and releasing the push-button, and tip immersion depth. The test cycle time shall be kept to a minimum. It should not exceed 60 s.

Training

The Verification Procedure described in this document must be carried out by a suitably qualified technician. We strongly recommend that the technician succefully completes a suitable Gilson training program. Please contact your local Gilson distributor for details.

In accordance with the instructions given in its user's guide, the pipette under test must be clean (refer to the decontamination procedure), correctly assembled (refer to the user's guide), and fitted with a new Gilson tip before starting the Verification Procedure.

Because the quality of the tip used is a significant factor in ensuring that a pipette performs to specifications, tip selection is specially important in verification procedure.

For example, all models of Pipetman are calibrated at the factory using Gilson Diamond tips, which are of the highest quality. Therefore, for Pipetman, you must only use the Gilson Diamond tips when carrying out the gravimetric test to have the best performance and results.

Pipette model	Volume range	Tips	Filter Tips
P2, P2N, U2 P10, P10N, U10 C10, C8x10, C12x10	0.2 µL to 2 µL 1.0 µL to 10 µL 0.5 to 10 µL	D10, DL10	DF10, DFL10
P20, P20N, U20 U8x20, U12x20	2 µL to 20 µL 1 µL to 20 µL	DL10 D200	DF30
P100N P100, U100, C100 C8x100, C12x100	10 µL to 100 µL 20 µL to 100 µL 5 µL to 100 µL 5 µL to 100 µL	D200	DF100
P200 F2 to F200* P200N, U200 P8x200	50 µL to 200 µL 2 µL to 200 µL 20 µL to 200 µL 20 µL to 200 µL	D200	DF200
U8x300, U12x300 C300 C8x300, C12x300	20 µL to 300 µL	D300	DF300
P1000N P1000, U1000 F250 to F1000	100 µL to 1000 µL 200 µL to 1000 µL 250 µL to 1000 µL	D1000	DF1000
C1200 C8x1200, C12x1200	100 µL to 1200 µL	D1200	DF1200
P5000, U5000 F5000 C5000	1 mL to 5 mL 5 mL 0.5 mL to 5 mL	D5000	
P10ml, U10ml, C10ml	1 mL to 10 mL	D10ml	

**: Not valid with filter tips D200.*

To ensure the integrity of the Verification Procedure, all of the measuring instruments: balances, hygrometer and thermometers should be checked regularly.

Balance

Information on suitable balances (some of which have more than one sensitivity range) is available from the International Organization of Legal Metrology (OIML). Appropriate balances, conforming to OIML R76-1, should be used. Balances should be serviced, calibrated and certified by qualified technicians using weights traceable to an internationally recognized authority (OIML).

Nominal Volume (µL)	Display (mg)	Balance Sensitivity
< 100	0.001	10^{-6}g
100 µL to 1000	0.01	10^{-5}g
> 1000	0.1	10^{-4}g

Note: These requirements are more rigorous than those specified in ISO 8655-6, Table 1.

The sensitivity of the balance chosen must be consistent with the accuracy required, which is one tenth of the deviation to be assessed.

For Pipetman (all models) and Microman, select the sensitivity according to the pipette's nominal volume (see table).

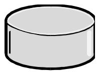
For Distriman, test volumes are specified for each DistriTip model according to specific aliquot volumes (choose the sensitivity accordingly).

The table on which the balance is placed must be equipped with a marble surface plate that is independent of the perimeter, to avoid transmitting vibrations. For the same reason, the table must not be in contact with a wall. Avoid placing the balance near to a window or near to a door to avoid too long a response time for the balance and irregular evaporation caused by drafts or greenhouse effects.

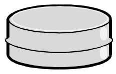
Thermometer, Hygrometer, and Barometer

Use a calibrated thermometer to measure the water temperature at the beginning and at the end of each test series. Use a thermometer with a maximum uncertainty of measurement of 0.2 °C. The hygrometer shall have a standard maximum uncertainty of 10% and the barometer a standard uncertainty of less than or equal to 0.5 kPa.

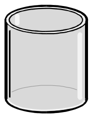
Lid



Lid



Pot A

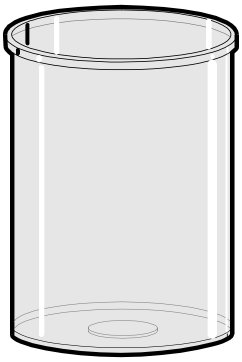


Ref: 95F10018

Pot B

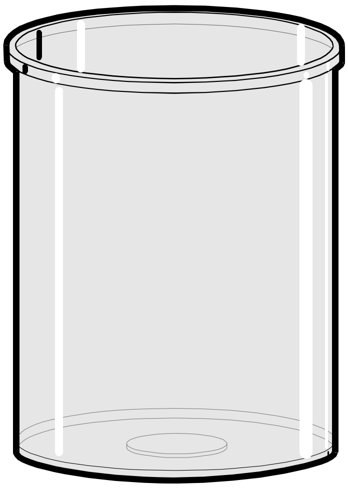
Ref: 544301006

Pot C



Ref: F1090303

Pot D



Ref: F1490343

Weighing Containers

Special containers are used to receive water from the test pipette during weighing. Controlling evaporation during the gravimetric test is essential. To minimize evaporation, Gilson uses custom-designed cylindrical flat-bottomed weighing containers made of nonporous plastic.

A Weighing Kit (ref: F144700) consisting of four sizes of container (Pot A, B, C, and D), filters (ref: F123854) for cleaning them and tweezers (ref: F144706), is available from Gilson. Individual components of the kit are available as spares.

When the volumes to be tested are less than 200 µL, Gilson uses weighing containers equipped with lids (see below).

Pot A container and lid, both of which must be manipulated using tweezers to avoid handwarming, for volumes up to 20 µL.

Pot B container and lid for volumes from 20 to 200 µL. This container is fitted with P 5000 O-rings to avoid hand-warming.

Pot C container (50 mm x 35 mm) for volumes from 200 to 5000 µL.

Pot D container (70 mm x 50 mm) for volumes greater than 5000 µL.

Water

The liquid used for testing must be distilled or deionized water grade 3 (degassed) conforming to ISO3696 at room temperature. To avoid fluctuations in water temperature, use a large container as a water reservoir (Pot C or Pot D). The reservoir should contain sufficient water for all of the tests.

Procedure Summary

The Verification Procedure certifies both pipette accuracy and precision. Environmental conditions, test equipment, and other qualifications previously described in this document should be implemented to assure the validity of the test results.

After pre-rinsing the tip, record ten individual weighings per selected volume. For variable volume pipettes, three volume settings are selected per pipette model based on the pipette's useful volume range (nominal, approximately 50 % and minimum volume or 10 % of the nominal volume). For fixed volume pipettes (Pipetman F) only the nominal volume is used.

1 Set the pipette to its test volume (see table opposite).

2 Estimate the evaporation loss (for small volumes).

3 Perform the gravimetric test: record the weighings on the Verification Procedure Report.

4 Perform the calculations: record the results on the Verification Procedure Report.

5 Compare the results with the accuracy and precision specifications given in the user's guide of the test pipette.

Multichannel Pipettes

Note: Gilson recommends simplifying the process by fitting a tip to the tested channel, only.

According to ISO 8655-6, *"For the purpose of the test, each channel shall be regarded as a single channel and reported as such"*. Consequently, for each of the following procedures: fill all channels simultaneously when aspirating the test liquid, then expel only the test liquid aspirated by the channel being tested into the weighing vessel.

Test Volumes

	Minimum Volume (µL)	Mid Range Volume (µL)	Nominal Volume (µL)
Pipetman			
P2N	0.2	1	2
P2, U2	0.5	1	2
P10, U10, P10N	1	5	10
P20, U20, P20N	2	10	20
P100N	10	50	100
P100, U100	20	50	100
P200N	20	100	200
P200, U200	50	100	200
P1000N	100	500	1000
P1000, U1000	200	500	1000
P5000, U5000	1000	2500	5000
P10ml, U10ml	1000	5000	10000
Microman			
M10	1	5	10
M25	3	10	25
M50	20	-	50
M100	10	50	100
M250	50	125	250
M1000	100	500	1000
Distriman			
DistriTip Micro	2	5	10
DistriTip Mini	20	50	100
DistriTip Maxi	200	500	1000
Pipetman Multichannel			
8X200	20	100	200
Pipetman Ultra Multichannel			
8x20	2	10	20
12x20	2	10	20
8x300	30	150	300
12x300	30	150	300
Pipetman Concept			
C10	1	5	10
C100	10	50	100
C300	30	150	300
C1200	120	600	1200
C5000	500	2500	5000
C10ml	1000	5000	10000
Pipetman Concept Multichannel			
C8x10, C12x10	1	5	10
C8x100, C12x100	10	50	100
C8x300, C12x300	30	150	300

Estimating the Evaporation Rate (Mass Loss/Cycle)

Weighing requires special care, for small volumes (< 50 µL, according to ISO 8655) use tweezers and weighing containers fitted with lids (Pot A). The goal is to minimize, control and quantify evaporation loss during the weighing cycle.

Apart from the design of the weighing vessel, the test cycle time is important. Evaporation is estimated by performing a series of four simulated weighings, repeating the weighing cycle without dispensing to the weighing container. The total difference attributable to evaporation is calculated and divided by 4 to obtain an average. The rate is expressed in mg/cycle (or for one cycle the loss may be expressed in mg).

For example, evaporation rates usually range for Pot A between 0.010 mg to 0.025 mg per weighing cycle. Recalculate the evaporation rate every 4 hours or whenever ambient conditions change (temperature, pressure, and humidity).

1 Add water to the weighing container until it is about one-third full.

2 Fit the weighing container with its lid and use tweezers to place it on the balance pan.

3 Using the pipette, aspirate a sample from the reservoir at the test volume setting.

4 Tare the balance and remove the weighing container from the balance pan.

5 Use tweezers to remove the lid.

6 Dispense the sample into the reservoir or to waste, *not the weighing container.*

7 Fit the weighing container with its lid and use tweezers to put it back on the balance pan.

8 Record the result e_1.

9 Repeat steps 3 through 8 three times to obtain e_2, e_3, and e_4.

10 Calculate the loss/cycle: $\overline{e} = | e_1 + e_2 + e_3 + e_4 | /4$ (mg).

11 The evaporation loss/cycle e (mg) should be added to the mean mass before calculating the mean volume.

Gravimetric Test

*Note *: ISO recommends that the orifice of the tip be immersed to between 2 mm and 3 mm below the surface of the water. However, you should first consult the user's guide for the model of Gilson pipette that you are testing.*

According to ISO 8655-6: *"The test shall be carried out in a draught-free room with stable environment."*

1 Place distilled or deionized water from the container in the weighing vessel to a depth of at least 3 mm.* (Refit lid for Pot A and B.)

2 Record the test conditions (ambient and water temperature, relative humidity, barometric pressure).

3 Select the test volume of your variable-volume piston pipette.

4 Fit the tip or capillary/piston assembly to the pipette (the manufacturer specifications are valid only when test executed with the manufacturers tips).

5 Wet pipette tip five times to reach equilibrium in the dead air volume (not needed for Distriman and Microman), but do not take into account for calculations.

One test cycle should take less than 1 min.

A consistent rhythm during weighing operation should be maintained.

Repeat these steps

6 Change tip.

7 Pre-wet the tip once.

8 Pipette the test volume.

9 Determine tare mass (reset balance).

10 Remove the lid if needed (using the tweezers for pot A)

11 Open balance door, retrieve weighing container, deliver sample, refit its lid, if needed, using the tweezers, replace on the balance and close the door.

12 After allowing display to stabilize and record the mass.

13 Repeat the test cycle until ten measurements have been recorded as a series of masses m_1 to m_{10}.

14 For sample below or equal to 50µl, estimate evaporation loss by repeating steps 8 to 10 exactly as a normal sample weighing but without actually adding any sample to the weighing container. Record absolute value (ei) and repeat several (m) times.

15 Record the test conditions (ambient temperature, relative humidity, barometric pressure). Check that values are still within recommended limits.

Formulae

$t = (t_1 + t_2)/2$

1 Calculate the mean temperature (*t*) of the distilled water (rounded to the nearest 0.5 °C).

$B = (B_1 + B_2)/2$

2 Use the average barometric pressure (*B*) and mean temperature (*t*) to find the corresponding *Z-factor* from the table.

$V_i = Z\,(m_i + \bar{e})$

V_i = individual volumes (µL)

m_i = individual masses (mg)

$\bar{e}$ = evaporation loss (mg)

Z = Z-factor (µL/mg)

3 Multiply the weighings (mg), after any required correction for evaporation, by the *Z-factor* to obtain a series of volumes (µL).

$$\bar{V} = \frac{\sum_{i=1}^{n} V_i}{n}$$

V_i = individual volumes

$\bar{V}$ = mean volume

n = number of weighings

4 Compute the mean volume from the series of volumes (µL).

$e_s = \bar{V} - V_s$

e_s = systematic error

$\bar{V}$ = mean volume

V_s = selected volume

$e_s = 100\,(\bar{V} - V_s)/V_s\ \%$

5 Calculate the systematic error, which is the difference between the mean volume of actual measurements and the true value as specified by the volume setting of the pipette (selected volume). For fixed volume pipettes, replace V_s with V_o = nominal volume.

Accuracy may be expressed in µL or ...
... as a percentage.

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

V_i = individual volumes (calculated as above)

$\bar{V}$ = mean volume

n = number of measurements

s = repeatability standard deviation

6 Calculate the random error, which is the closeness of agreement between individual weighings. Quantifies the magnitude of scatter due to random error. Also known as Repeatability Standard Deviation (RSD).

$CV = 100 \times s/\bar{V}$

As a percentage, also known as coefficient of variation (CV).

Z= Conversion factor (µL/mg)
t = Average temperature (°C)
B = Air pressure (kPa)

Z-factor

Z correction factors for distilled water as a function of test temperature and air pressure.

t (°C) / *B* (kPa)	80	85	90	95 *Z* (µL/mg)	100	101.3	105
15.0	1.0017	1.0018	1.0019	1.0019	1.0020	1.0020	1.0020
15.5	1.0018	1.0019	1.0019	1.0020	1.0020	1.0021	1.0021
16.0	1.0019	1.0020	1.0020	1.0021	1.0021	1.0021	1.0022
16.5	1.0020	1.0020	1.0021	1.0021	1.0022	1.0022	1.0022
17.0	1.0021	1.0021	1.0022	1.0022	1.0023	1.0023	1.0023
17.5	1.0022	1.0022	1.0023	1.0023	1.0024	1.0024	1.0024
18.0	1.0022	1.0023	1.0023	1.0024	1.0025	1.0025	1.0025
18.5	1.0023	1.0024	1.0024	1.0025	1.0025	1.0026	1.0026
19.0	1.0024	1.0025	1.0025	1.0026	1.0026	1.0027	1.0027
19.5	1.0025	1.0026	1.0026	1.0027	1.0027	1.0028	1.0028
20.0	1.0026	1.0027	1.0027	1.0028	1.0028	1.0029	1.0029
20.5	1.0027	1.0028	1.0028	1.0029	1.0029	1.0030	1.0030
21.0	1.0028	1.0029	1.0029	1.0030	1.0031	1.0031	1.0031
21.5	1.0030	1.0030	1.0031	1.0031	1.0032	1.0032	1.0032
22.0	1.0031	1.0031	1.0032	1.0032	1.0033	1.0033	1.0033
22.5	1.0032	1.0032	1.0033	1.0033	1.0034	1.0034	1.0034
23.0	1.0033	1.0033	1.0034	1.0034	1.0035	1.0035	1.0036
23.5	1.0034	1.0035	1.0035	1.0036	1.0036	1.0036	1.0037
24.0	1.0035	1.0036	1.0036	1.0037	1.0037	1.0038	1.0038
24.5	1.0037	1.0037	1.0038	1.0038	1.0039	1.0039	1.0039
25.0	1.0038	1.0038	1.0039	1.0039	1.0040	1.0040	1.0040
25.5	1.0039	1.0040	1.0040	1.0041	1.0041	1.0041	1.0042
26.0	1.0040	1.0041	1.0041	1.0042	1.0042	1.0043	1.0043
26.5	1.0042	1.0042	1.0043	1.0043	1.0044	1.0044	1.0044
27.0	1.0043	1.0044	1.0044	1.0045	1.0045	1.0045	1.0046
27.5	1.0045	1.0045	1.0046	1.0046	1.0047	1.0047	1.0047
28.0	1.0046	1.0046	1.0047	1.0047	1.0048	1.0048	1.0048
28.5	1.0047	1.0048	1.0048	1.0049	1.0049	1.0050	1.0050
29.0	1.0049	1.0049	1.0050	1.0050	1.0051	1.0051	1.0051
29.5	1.0050	1.0051	1.0051	1.0052	1.0052	1.0052	1.0053
30.0	1.0052	1.0052	1.0053	1.0053	1.0054	1.0054	1.0054

Pipetting System Information

Pipette

Serial number: ______________________ **Calibration date:** ________

Model: ______________________ **Manufacturer:** ______________________

Pipette owner: ____

Number of channels: ______________________ **Status:** ______________

Tips

Tip model: ____________ **Manufacturer:** __________ **Batch number:** __________

Environmental Factors

Temperature air (°C): ______________ **Pressure (hPa):** ______________

Hygrometry (%): ______________ **Temperature water (°C):** ______________

Z-factor: ______________ **Evaporation (Yes/No):** ______________

General Information

Decontamination (Yes/No): ____________ **Repair (Yes/No):** ______________

Adjustment (Yes/No): ____________ **Basis of adjustment (Ex/In):** ____________

Statistics Summary

Selected Volume (µL)	Mean Volume (µL)	Systematic error Results Es (µL)	Systematic error Results Es (%)	Systematic error Target µL	Systematic error Target %	Systematic error Status	Random error Results SD (µL)	Random error Results CV (%)	Random error Target SD (µL)	Random error Target CV (%)	Status
V_{min}	$V_{mean,min}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
V_{int}	$V_{mean,int}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
V_{nom}	$V_{mean,nom}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –

or

Channel #	Selected Volume (µL)	Mean Volume (µL)	Systematic error Results Es (µL)	Systematic error Results Es (%)	Systematic error Target µL	Systematic error Target %	Systematic error Status	Random error Results SD (µL)	Random error Results CV (%)	Random error Target SD (µL)	Random error Target CV (%)	Status
1	V_{min1}	$V_{mean,min1}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
1	V_{int1}	$V_{mean,int1}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
1	V_{nom1}	$V_{mean,nom1}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
...	V_{min}	$V_{mean,min}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
...	V_{int}	$V_{mean,int}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
...	V_{nom}	$V_{mean,nom}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
N	V_{minN}	$V_{mean,minN}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
N	V_{intN}	$V_{mean,intN}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –
N	V_{nomN}	$V_{mean,nomN}$	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –

SD: Standard Deviation
CV: Coefficient of Variation
Es: Systematic Error

Calibration Details

Selected Volume	Minimum Volume (value µL)	Mid Range Volume (value µL)	Nominal Volume (value µL)
1	V_{a1} _ _ _ _ _ _ _ _	V_{b1} _ _ _ _ _ _ _ _	V_{c1} _ _ _ _ _ _ _ _
2	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _
3	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _
4	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _
...	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _
10	V_{a10} _ _ _ _ _ _ _ _	V_{b10} _ _ _ _ _ _ _ _	V_{c10} _ _ _ _ _ _ _ _

or

Ch. #	Selected Volume	Minimum Volume (value µL)	Mid Range Volume (value µL)	Nominal Volume (value µL)
1	*1*	$V_{a1,1}$ _ _ _ _ _ _ _	$V_{b1,1}$ _ _ _ _ _ _ _ _	$V_{c1,1}$ _ _ _ _ _ _ _
	2	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	3	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	4	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	...	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	10	$V_{a1,10}$ _ _ _ _ _ _ _	$V_{b1,10}$ _ _ _ _ _ _ _	$V_{c1,10}$ _ _ _ _ _ _ _
i	*1*	$V_{ai,1}$ _ _ _ _ _ _ _	$V_{bi,1}$ _ _ _ _ _ _ _ _	$V_{ci,1}$ _ _ _ _ _ _ _
	2	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	3	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	4	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	...	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	10	$V_{ai,10}$ _ _ _ _ _ _ _	$V_{bi,10}$ _ _ _ _ _ _ _ _	$V_{ci,10}$ _ _ _ _ _ _ _
N	*1*	$V_{aN,1}$ _ _ _ _ _ _ _	$V_{bN,1}$ _ _ _ _ _ _ _ _	$V_{cN,1}$ _ _ _ _ _ _ _
	2	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	3	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	4	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	...	_ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _
	10	$V_{aN,10}$ _ _ _ _ _ _ _	$V_{bN,10}$ _ _ _ _ _ _ _	$V_{cN,10}$ _ _ _ _ _ _ _

Pipetman P / Neo

Here are comparative tables for maximum permissible errors between ISO 8655 and Gilson. ISO 8655 maximum permissible errors are very wide, so as to have a conformity-basis for all pipettes. At Gilson our knowledge and kno-how allows us to be more stringent, which means the best pipette-performance.

Model (Reference)		Volume (µL)	Maximum Permissible Errors Gilson Systematic error (µL)	Gilson Random error (µL)	ISO 8655 Systematic error (µL)	ISO 8655 Random error (µL)
P2 (F144801)	Min	0.2	± 0.024	≤ 0.012	± 0.08	≤ 0.04
P2N (F144561)		0.5	± 0.025	≤ 0.012	± 0.08	≤ 0.04
U2 (F21021)	Max.	2	± 0.030	≤ 0.014	± 0.08	≤ 0.04
P10 (F144802)	Min.	1	± 0.025	≤ 0.012	± 0.12	≤ 0.08
P10N (F144562)		5	± 0.075	≤ 0.030	± 0.12	≤ 0.08
U10 (F21022)	Max	10	± 0.100	≤ 0.040	± 0.12	≤ 0.08
P20 (F123600)	Min.	2	± 0.10	≤ 0.03	± 0.20	≤ 0.10
P20N (F144563)		5	± 0.10	≤ 0.04	± 0.20	≤ 0.10
U20 (F21023)		10	± 0.10	≤ 0.05	± 0.20	≤ 0.10
	Max.	20	± 0.20	≤ 0.06	± 0.20	≤ 0.10
P100 (F123615)	Min.	10	± 0.35	≤ 0.10	± 0.80	≤ 0.30
P100N (F144564)		20	± 0.35	≤ 0.10	± 0.80	≤ 0.30
U100 (F21024)		50	± 0.40	≤ 0.12	± 0.80	≤ 0.30
	Max.	100	± 0.80	≤ 0.15	± 0.80	≤ 0.30
P200 (F123601)	Min.	20	± 0.50	≤ 0.20	± 1.60	≤ 0.60
P200N (F144565)		50	± 0.50	≤ 0.20	± 1.60	≤ 0.60
U200 (F21025)		100	± 0.80	≤ 0.25	± 1.60	≤ 0.60
	Max.	200	± 1.60	≤ 0.30	± 1.60	≤ 0.60
P1000 (F123602)	Min.	100	± 3	≤ 0.6	± 8	≤ 3.0
P1000N (F144566)		200	± 3	≤ 0.6	± 8	≤ 3.0
U1000 (F21026)		500	± 4	≤ 1.0	± 8	≤ 3.0
	Max.	1000	± 8	≤ 1.5	± 8	≤ 3.0
P5000 (F123603)	Min.	1000	± 12	≤ 3	± 40	≤ 15
and		2000	± 12	≤ 5	± 40	≤ 15
U5000 (F21027)	Max.	5000	± 30	≤ 8	± 40	≤ 15
P10ml (F161201)	Min.	1 mL	± 30	≤ 6	± 60	≤ 30
and		2 mL	± 30	≤ 6	± 60	≤ 30
U10ml (F21028)		5 mL	± 40	≤ 10	± 60	≤ 30
	Max.	10 mL	± 60	≤ 16	± 60	≤ 30

Pipetman Ultra

Only for Pipetman Neo. (green)

Except for Pipetman Neo. (blue)

***Systematic error**: expressed as the deviation of the mean of a tenfold measurement from the nominal or selected volume (see ISO 8655-6).*

***Random error**: expressed as the repeatability standard deviation of a tenfold measurement (see ISO 8655-6).*

Pipetman Concept

Model (Reference)	Volume (µL)	Maximum Permissible Errors Gilson Systematic error (µL)	Gilson Random error (µL)	ISO 8655 Systematic error (µL)	ISO 8655 Random error (µL)
C10 (F31012)	Min. 0.5	± 0.040	⩽ 0.013	± 0.120	⩽ 0.080
	1	± 0.025	⩽ 0.012	± 0.120	⩽ 0.080
	5	± 0.060	⩽ 0.020	± 0.120	⩽ 0.080
	Max. 10	± 0.080	⩽ 0.025	± 0.120	⩽ 0.080
C100 (F31013)	Min. 5	± 0.35	⩽ 0.10	± 0.8	⩽ 0.30
	10	± 0.30	⩽ 0.10	± 0.8	⩽ 0.30
	50	± 0.38	⩽ 0.12	± 0.8	⩽ 0.30
	Max. 100	± 0.4	⩽ 0.15	± 0.8	⩽ 0.30
C300 (F31014)	Min. 20	± 0.80	⩽ 0.16	± 4.00	⩽ 1.50
	30	± 0.70	⩽ 0.20	± 4.00	⩽ 1.50
	150	± 0.90	⩽ 0.23	± 4.00	⩽ 1.50
	Max. 300	± 1.05	⩽ 0.30	± 4.00	⩽ 1.50
C1200 (F31015)	Min. 100	± 2.5	⩽ 0.4	± 16.0	⩽ 6.0
	120	± 2.4	⩽ 0.4	± 16.0	⩽ 6.0
	600	± 3.6	⩽ 0.8	± 16.0	⩽ 6.0
	Max. 1200	± 6.0	⩽ 1.2	± 16.0	⩽ 6.0
C5000 (F31016)	Min. 500	± 10	⩽ 2	± 40	⩽ 15
	2500	± 15	⩽ 4	± 40	⩽ 15
	5000	± 25	⩽ 7	± 40	⩽ 15
C10ml (F31017)	Min. 1000	± 25	⩽ 4	± 60	⩽ 30
	5000	± 30	⩽ 8	± 60	⩽ 30
	10000	± 50	⩽ 12	± 60	⩽ 30

Pipetman F

Model (Reference)	Volume (µL)	Maximum Permissible Errors Gilson Systematic error (µL)	Gilson Random error (µL)	ISO 8655 Systematic error (µL)	ISO 8655 Random error (µL)
F2 (F123770)	2	± 0.08	⩽ 0.03	± 0.08	⩽ 0.04
F5 (F123771)	5	± 0.10	⩽ 0.04	± 0.125	⩽ 0.075
F10 (F123772)	10	± 0.10	⩽ 0.05	± 0.12	⩽ 0.08
F20 (F123604)	20	± 0.20	⩽ 0.06	± 0.20	⩽ 0.10
F25 (F123775)	25	± 0.25	⩽ 0.07	± 0.50	⩽ 0.20
F50 (F123778)	50	± 0.40	⩽ 0.15	± 0.50	⩽ 0.20
F100 (F123784)	100	± 0.80	⩽ 0.25	± 0.80	⩽ 0.30
F200 (F123605)	200	± 1.60	⩽ 0.30	± 1.60	⩽ 0.60
F250 (F123787)	250	± 3.00	⩽ 0.75	± 4.00	⩽ 1.50
F300 (F123788)	300	± 3.50	⩽ 0.75	± 4.00	⩽ 1.50
F400 (F123789)	400	± 3.60	⩽ 0.80	± 4.00	⩽ 1.50
F500 (F123790)	500	± 4.00	⩽ 1.00	± 4.00	⩽ 1.50
F1000 (F123606)	1000	± 8.00	⩽ 1.30	± 8.00	⩽ 3.00
F5000 (F123607)	5000	± 30.00	⩽ 8.00	± 40.00	⩽ 15.00

Microman

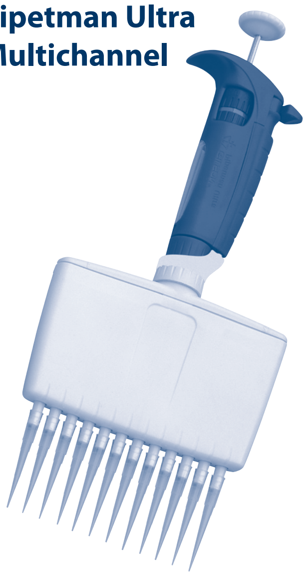
Model (Reference)	Volume (µL)	Gilson Systematic error (µL)	Gilson Random error (µL)	ISO 8655 Systematic error (µL)	ISO 8655 Random error (µL)
M10 (F148501)	Min. 1	± 0.09	⩽ 0.03	± 0.20	⩽ 0.10
	5	± 0.10	⩽ 0.03	± 0.20	⩽ 0.10
	Max 10	± 0.15	⩽ 0.06	± 0.20	⩽ 0.10
M25 (F148502)	Min. 3	± 0.25	⩽ 0.08	± 0.70	⩽ 0.30
	10	± 0.27	⩽ 0.08	± 0.70	⩽ 0.30
	Max. 25	± 0.30	⩽ 0.10	± 0.70	⩽ 0.30
M50 (F148503)	Min. 20	± 0.34	⩽ 0.20	± 0.70	⩽ 0.30
	Max. 50	± 0.70	⩽ 0.30	± 0.70	⩽ 0.30
M100 (F148504)	Min. 10	± 0.50	⩽ 0.20	± 1.50	⩽ 0.60
	50	± 0.75	⩽ 0.30	± 1.50	⩽ 0.60
	Max. 100	± 1.00	⩽ 0.40	± 1.50	⩽ 0.60
M250 (F148505)	Min. 50	± 1.50	⩽ 0.30	± 6.00	⩽ 2.00
	100	± 1.70	⩽ 0.30	± 6.00	⩽ 2.00
	Max. 250	± 2.50	⩽ 0.50	± 6.00	⩽ 2.00
M1000 (F148506)	Min. 100	± 3.00	⩽ 1.60	± 12.00	⩽ 4.00
	500	± 5.00	⩽ 2.50	± 12.00	⩽ 4.00
	Max. 1000	± 8.00	⩽ 4.00	± 12.00	⩽ 4.00

Distriman

DistriTips Model (Reference)	Volume (µL)	Gilson Systematic error (µL)	Gilson Random error (µL)	ISO 8655 Systematic error (µL)	ISO 8655 Random error (µL)
125 µL	Min. 2	± 0.100	⩽ 0.080	± 0.20	⩽ 0.10
Micro (F164100)	5	± 0.125	⩽ 0.075	± 0.20	⩽ 0.10
Micro ST (F164130)	Max 10	± 0.200	⩽ 0.100	± 0.20	⩽ 0.10
1250 µL	Min. 20	± 0.80	⩽ 0.20	± 1.50	⩽ 0.60
Mini (F164110)	50	± 1.00	⩽ 0.40	± 1.50	⩽ 0.60
Mini ST (F164140)	Max. 100	± 1.00	⩽ 0.60	± 1.50	⩽ 0.60
12.5 mL	Min. 200	± 6.00	⩽ 1.00	± 12.00	⩽ 4.00
Maxi (F164120)	500	± 7.50	⩽ 1.50	± 12.00	⩽ 4.00
Maxi ST (F164150)	Max. 1000	± 10.00	⩽ 2.50	± 12.00	⩽ 4.00

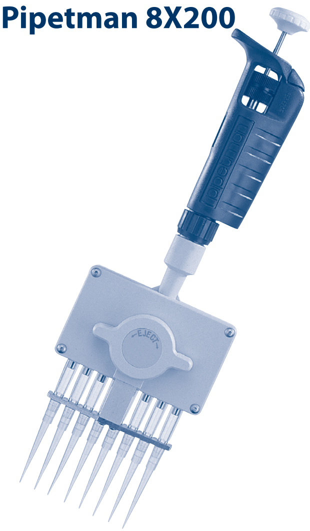
ST means Sterilized.

Pipetman Ultra Multichannel



Model (Reference)	Volume (μL)	Maximum Permissible Errors — Gilson: Systematic error (μL)	Gilson: Random error (μL)	ISO 8655: Systematic error (μL)	ISO 8655: Random error (μL)
8x20 (F21040)	Min. 1	± 0.10	≤ 0.08	± 0.40	≤ 0.20
and	2	± 0.10	≤ 0.08	± 0.40	≤ 0.20
12x20 (F21041)	10	± 0.20	≤ 0.10	± 0.40	≤ 0.20
	Max 20	± 0.40	≤ 0.20	± 0.40	≤ 0.20
8x300 (F21042)	Min. 20	± 1.00	≤ 0.35	± 8	≤ 3.00
and	30	± 1.00	≤ 0.35	± 8	≤ 3.00
12x300 (F21043)	150	± 1.50	≤ 0.60	± 8	≤ 3.00
	Max. 300	± 3.00	≤ 1.00	± 8	≤ 3.00

Pipetman 8X200



Model (Reference)	Volume (μL)	Maximum Permissible Errors — Gilson: Systematic error (μL)	Gilson: Random error (μL)	ISO 8655: Systematic error (μL)	ISO 8655: Random error (μL)
8x200 (F161004)	Min. 20	± 0.50	≤ 0.25	± 3.20	≤ 1.20
	50	± 0.50	≤ 0.25	± 3.20	≤ 1.20
	100	± 1.00	≤ 0.50	± 3.20	≤ 1.20
	Max. 200	± 2.00	≤ 1.00	± 3.20	≤ 1.20

Pipetman Concept Multichannel

Model (Reference)	Volume (μL)	Maximum Permissible Errors — Gilson: Systematic error (μL)	Gilson: Random error (μL)	ISO 8655: Systematic error (μL)	ISO 8655: Random error (μL)
C8x10 (F31032)	Min. 1	± 0.04	≤ 0.02	± 0.24	≤ 0.16
and	5	± 0.08	≤ 0.04	± 0.24	≤ 0.16
C12x10 (F31042)	Max. 10	± 0.10	≤ 0.06	± 0.24	≤ 0.16
C8x100 (F31033)	Min. 10	± 0.25	≤ 0.14	± 1.60	≤ 0.60
and	50	± 0.50	≤ 0.20	± 1.60	≤ 0.60
12x100 (F31043)	Max. 100	± 0.80	≤ 0.25	± 1.60	≤ 0.60
C8x300 (F31034)	Min. 30	± 1.00	≤ 0.18	± 8.00	≤ 3.00
and	150	± 1.50	≤ 0.38	± 8.00	≤ 3.00
C12x300 (F31044)	300	± 2.40	≤ 0.60	± 8.00	≤ 3.00

Associated Documents

Documents	Gilson Reference
Pipetman Ultra User's Guide	LT801441
Pipetman P User's Guide	LT801117
Pipetman Neo Addendum	LT801511
Pipetman F User's Guide	LT801118
Pipetman 8X200 User's Guide	LT801236
Pipetman Ultra Multichannel User's Guide	LT801462
Pipetman Concept User's Guide	LT801489
Microman User's Guide	LT801502
Distriman User's Guide	LT801285
Decontamination Procedure	LT802288

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