Procedure for Evaluating Accuracy and Precision of Rainin Pipettes

Factory-Approved Method for Using Gravimetric Analysis

RAININ®
INSTRUMENT CO., INC.

CONTENTS

For Technical Information, call 800-543-4030 FAX: 781-938-1152

For Service Information, call 800-662-7027 FAX: 781-935-7631

For detailed information on troubleshooting and repairing Pipetman, request Rainin publication **AB-14,** *Pipetman Care & Maintenance*, or download from website.

FOREWORD

Scope

This document describes the factory-approved method for determining pipette performance using gravimetric analysis. Adherence to this method by Rainin's Pipette Service Department assures conformity to original manufacturer's conditions and specifications.

The document covers two methods:

- ***2 Volumes x 4 Weighing Factory Method*** confirms pipette accuracy and precision for new pipettes It is also used for pipettes serviced following recalibration and repair through Rainin's Express Repair and Performance Verification programs.

- ***3 Volumes x 10 Weighing Method*** confirms pipette accuracy and precision for pipettes serviced through Rainin's Performance Verification program.

These procedures are applicable to all Rainin and Pipetman pipettes and have been adopted for use with other manufacturer's pipettes.

DEFINITIONS

accuracy: The closeness of a measured volume to the true volume as specified by the volume setting of the pipette. Also known as "mean error".

calibration: The fine adjustment of the piston stroke length for mechanical pipettes.

evaporation rate: An estimate of water loss due to evaporation during the weighing procedure. Evaporation rates are calculated when evaluating pipettes using 6- and 7-place balances. See *Microvolume Procedures* (page 7) for more information.

gravimetric analysis: The general procedure based upon the determination of the weight of water samples as delivered by the pipette. Values are corrected for evaporation, then true mass and volume are calculated simultaneously, based upon the knowledge of the density of water at specific temperatures with corrections for air buoyancy (Z-factor*).*

precision: The closeness of agreement among the individual weighings. Also known as standard deviation, reproducibility and repeatability.

prerinse: A double rinse of a pipette tip with testing medium. Repeat prerinse whenever a new tip is applied or weighing cycle time has been interrupted.

Z-factor: Conversion factor (µL/mg) incorporating the density of water when buoyed in air as a function of temperature and pressure. For Rainin's laboratory conditions, the Z-factor is 1.0031 at 1 A.T.M. (See table on page 4).

CALCULATIONS

MEAN WEIGHT: Result expressed in mg.

$$\bar{w} = \frac{\sum_{i=1}^{n} w_i}{n}$$

$\bar{w}$ = mean weight
n = number of measurements
w_i = individual weighings

MEAN VOLUME: The mean weight result with corrections for evaporation and Z-factor. Expressed in µL.

$$\bar{v} = (\bar{w} + \bar{e}) \times Z$$

$\bar{w}$ = mean weight (mg)
$\bar{v}$ = mean volume
$\bar{e}$ = evaporation rate (mg)
Z = Z-factor

MEAN ERROR: The difference between the mean volume of actual measurements and the true value as specified by the volume setting of the pipette. Expressed in µL.

$$E = \bar{v} - v_o$$

E = mean error
$\bar{v}$ = mean volume
v_o = volume setting

As a percentage

$$E\,\% = \frac{\bar{v} - v_o}{v_o} \times 100$$

STANDARD DEVIATION: Quantifies the magnitude of scatter due to random error.

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

s = standard deviation
n = number of weighings
$\bar{w}$ = mean weighing
w_i = individual weighings

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

$$S\,\% = \frac{S}{\bar{v}} \times 100$$

Laboratory

Maintain the following laboratory conditions at least 2 hours prior to and throughout the evaluation procedure. Ensure balances, water, pipettes and tips are properly equilibrated to ambient conditions. Balances should be turned on a minimum of one hour before use.

- **Temperature** 21.5 ± 1.0°C
- **Relative Humidity** 45–75%
- **Conditioning** Keep the room circulating fan permanently on to prevent temperature surges. Drafts should be minimized.
- **Illumination** Use diffused light of sufficient intensity. Avoid direct sunlight.
- **Chronicle** Use a temperature and humidity chart recorder for measuring conformity to specifications. Retain records for traceability.

Testing Medium

Non-aerated deionized water is used as the standard in gravimetric analysis.

VALUE FOR Z (µL/MG), AS A FUNCTION OF TEMPERATURE AND PRESSURE, FOR DISTILLED WATER AT 1 ATM.

TEMP °C	ACTUAL Z-FACTOR
15.0	1.0020
15.5	1.0020
16.0	1.0021
16.5	1.0022
17.0	1.0023
17.5	1.0024
18.0	1.0025
18.5	1.0026
19.0	1.0027
19.5	1.0028

TEMP °C	ACTUAL Z-FACTOR
20.0	1.0029
20.5	1.0030
21.0	1.0031
21.5	1.0032
22.0	1.0033
22.5	1.0034
23.0	1.0035
23.5	1.0036
24.0	1.0038
24.5	1.0039

TEMP °C	ACTUAL Z-FACTOR
25.0	1.0040
25.5	1.0041
26.0	1.0043
26.5	1.0044
27.0	1.0045
27.5	1.0047
28.0	1.0048
28.5	1.0050
29.0	1.0051
29.5	1.0052
30.0	1.0054

Fluctuation in room temperature and humidity will adversely affect balance stability and evaporation rates. A stringently-controlled environment assures reliable data.

EQUIPMENT

Balances

Appropriate 4-, 5-, 6-, and 7-place balances are selected to measure pipette performance. The sensitivity of the balance chosen must be equal to or less than one-tenth of the smallest deviation to be assessed.

SENSITIVITY(g)	DISPLAY	APPLICABLE MODELS BY NOMINAL VOLUME (µL)
10^{-7}	0.0000 mg	2, 10
10^{-6}	0.000 mg	20, 25
10^{-5}	0.00 mg	100, 200, 250
10^{-4}	0.0 mg	1000, 2000, 2500, 5000, 10 mL

Work Stations

Balances are stationed on marble tables to minimize vibration. A black mat is positioned in front of the weighing chamber to expose droplets and create a cleaner environment. Each balance is directly coupled with a computer and Rainin software for data acquisition, statistical computation, and report production. Balances are regularly serviced and certified by Mettler technicians.

Balance Certification

Balances are regularly serviced and certified by Mettler technicians using weights traceable to the National Institute of Standards and Technology (NIST). Rainin senior technicians routinely qualify balances between service calls using NIST-traceable weights and confirm balance parameters such as stability, integration time and levels.

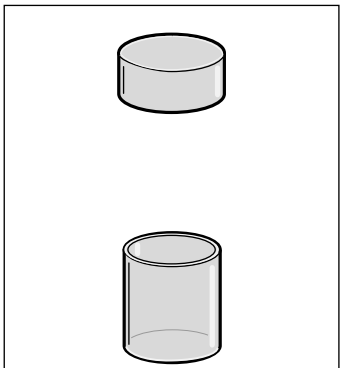
Tips

Rainin pipettes are designed and calibrated using Rainin FinePoint™ and LTS™ tips. Failure to use the original manufacturer's recommended tips may result in poor pipette performance.

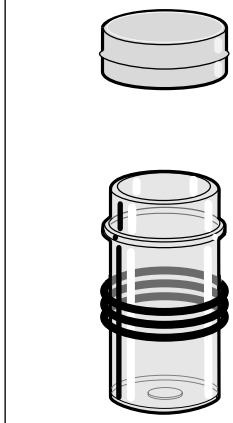
Using a 4-place balance to calibrate a Pipetman P-20 can result in error three times greater than the pipette specification. Why? The 4-place balance inaccuracy is significantly larger than the inaccuracy of a P-20. Always use the right balance for the job.

Weighing Vessels

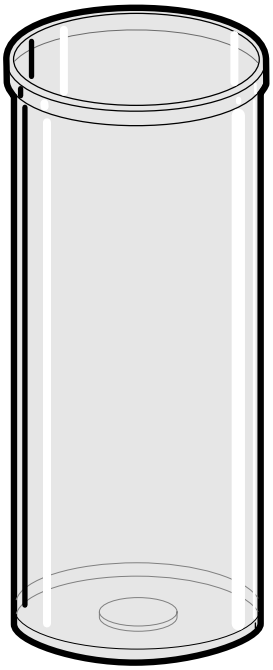
Cylindrical weighing vessels are constructed of non-porous plastic with flat bottoms. Some vessels have covers to minimize evaporation. Rubber O-rings prevent the transfer of heat from hands. The micro-volume vessel should be handled using forceps only. See page 7 for more information. A Weighing Kit consisting of all three vessel types and forceps is available and recommended.(Catalog No. **WK-1**)



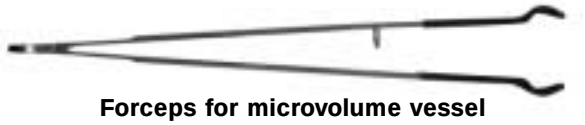
Micro-Volume Vessel and Cover for use with 6- and 7-place balance
Note: Two vessels and forceps required.



Vessel and Cover for use with 5-place balance
Note: Rubber O-rings



Vessel for use with 4-place balance



Forceps for microvolume vessel

Weighing Kit
Catalog No. WK-1

Controlling evaporation is essential when evaluating micro-volume pipettes. Rainin uses a custom-designed micro-volume vessel to control this variable.

MICRO-VOLUME PROCEDURES

Evaluating micro-volume pipettes (i.e. less than 50 µL) requires special procedures and equipment. This procedure must be followed whenever 6- and 7-place balances are used for determining pipette performance. The goal is to minimize, control and quantify evaporation loss during testing.

Two Vessel Method

Two micro-volume vessels with covers are used for each 6- and 7-place balance. Partially fill one vessel with approximately 100 µL of water. Set the other vessel aside. Water should cover the entire bottom surface of the first vessel. This vessel may now be used for weighings. During testing, droplets accumulating on the inner wall should be mixed into the 100 µL of water frequently.

When approximately 1/3 full, discard the entire contents of the first vessel, dry it with a lint-free material, and set it aside. Retrieve the unused vessel and partially fill with water as described above. Alternate vessels throughout the entire evaluation process or whenever sample is splashed on the cover.

Estimating the Evaporation Rate

Evaporation is estimated by running a series of four simulated weighings, only duplicating the weighing cycle without the addition of sample liquid to the vessel. Measure the total weight difference due to evaporation and divide by 4 to obtain an average. The rate is expressed in mg.

SIMULATED WEIGHING PROCEDURE

1. Fill the micro-volume vessel one-third full with water.
2. Cover the vessel and place in balance using forceps.
3. Using a pipette, aspirate a sample at full volume setting from the reservoir.
4. Tare the balance and remove the vessel.
5. Remove cover with forceps.
6. Dispense sample into the reservoir, *not the micro-volume vessel.*
7. Cover the micro-volume vessel and return it to the balance.
8. Record the result e_1 (negative value).
9. Repeat steps 3 through 8 three times to obtain e_2, e_3 and e_4.
10. Calculate the rate: $\bar{\mathbf{e}} = -(e_1 + e_2 + e_3 + e_4)/4$
11. Round to the nearest 0.005 mg, and convert to a positive value.
12. The evaporation rate $\bar{\mathbf{e}}$ should be added when calculating the mean volume of each real sample weighing.

Evaporation rates usually range between 0.010 – 0.025 mg per weighing cycle. Recalculate the evaporation rate every 4 hours or whenever ambient conditions change.

Qualifying a Technician

To qualify for assessing pipette performance a technician must first successfully complete three different proficiency trials in sequence for each pipette model.

■ **Precision Trial:** Using an accurate pipette, take thirty weighings at each volume setting. Volume settings are generally 10, 50 and 100% of nominal. Calculate the standard deviation. If results are 1/3 less than precision specifications (min. 3 consecutive pipettes), continue to the next trial.

■ **Accuracy Trial:** Take four weighings at each volume setting. Volume settings are generally 10, 50 and 100% of nominal. Calculate the mean volume. If comparative mean differences are consistently less than 1/3 of the accuracy specification (min. 3 consecutive pipettes), continue to the next trial.

■ **Calibration Trial:** Using a number of purposely miscalibrated mechanical pipettes, the trainee calibrates each pipette according to Rainin's calibration procedure. A senior technician then re-verifies each unit for compliance to published specification. If a minimum of 14 consecutive pipettes pass, the trainee is qualified to evaluate and calibrate this model. Repeat procedure for other models/volume ranges.

Pipette Operation

Consistency in all aspects of a pipetting procedure will significantly contribute to reproducibility.

1. When picking up a sample, immerse the end of the disposable tip beneath the liquid surface within the following ranges:

IMMERSION DEPTH (mm)	APPLICABLE MODELS
1-2	up to 10 µL
2-3	10 to 100 µL
2-4	100 to 1000 µL
2-6	1000 to 2000 µL
6-10	2000 µL or more

2. Prerinse tips whenever critical reproducibility is required.

3. Maintain consistency in the following areas:
   - pipetting rhythm from sample to sample.
   - speed and smoothness when you press and release the push button.
   - push button pressure at the first stop.
   - angle and immersion depth.

4. Always operate a pipette in a vertical position.

5. Dispense sample by touching the tip end against the side wall of the receiving vessel to ensure complete sample flow.

With Pipetman pipettes, always wind the micrometer 1/3 revolution above the desired volume setting and then return clockwise. This will minimize errors in volume delivery due to mechanical backlash.

2 VOLUMES X 4 WEIGHING FACTORY METHOD

This method confirms pipette accuracy and precision for new pipettes and for pipettes serviced through Rainin's Express Repair and Performance Verification programs. Many customers consider this method satisfactory for periodically checking pipette performance. Conditions, procedures and qualifications previously described in this document should be implemented to assure validity of test results.

Description

After prerinsing the tip, record four individual weighings per volume setting. Use a new tip for each volume setting. Two volume settings should be tested for each model, beginning with the minimum setting first, as specified in the table below. (Testing at any one volume is not sufficient to assess proper calibration of a variable volume pipette.) Holding or hand warming the pipette shaft should be avoided throughout the test procedure.

Volume Settings

1. For new pipettes and pipettes serviced through Rainin Express Repair.

PIPETTE TYPE	PIPETTE MODEL BY NOMINAL VOLUME	VOLUME SET % OF NOMINAL MIN	MAX
Rainin	All models	10%	100%
Pipetman	10, 20, 10ML, and 200-M8	10%	100%
	100, 1000, 5000	20%	100%
	2, 200	25%	100%

2. For pipettes serviced through the Verification and Calibration Plan of Rainin's Performance Verification program.

PIPETTE TYPE	PIPETTE MODEL BY NOMINAL VOLUME	VOLUME SET % OF NOMINAL MIN	MAX
Rainin	All models	10%	100%
Pipetman	All models except 200	10%	100%
	200	25%	100%

Results

Calculate the mean volume and standard deviation for each volume setting using the formulas on page 3. Compare results to specifications on pages 13-14 and determine conformity.

Individual weighings are calculated by subtracting the balance tare reading from the sample reading. Consistent rhythm during weighing operations should be maintained.

This method confirms pipette accuracy and precision for pipettes serviced through Rainin Performance Verification and Extended Calibration program. Customers requiring higher confidence levels of measured results prefer this method. Conditions, procedures, and qualifications previously described in this document should be implemented to assure validity of test results.

Description

After prerinsing the tip, record ten individual weighings per volume setting. Change tips between each volume setting. Three volume settings are selected per pipette model based on the pipette's working range as specified in the table below. Holding or hand warming of the pipette shaft should be avoided throughout the procedure.

Volume Settings

For pipettes serviced through the Calibration with Extended Measurement Plan of Rainin's Performance Verification program.

PIPETTE TYPE	PIPETTE MODEL BY NOMINAL VOLUME	VOLUME SET % OF NOMINAL MIN	MID	MAX
Rainin	All models	10%	50%	100%
Pipetman	All models except 200	10%	50%	100%
	200	25%	50%	100%

Results

Calculate the mean volume and standard deviation for each volume setting using the formulas on page 3. Compare results to specifications on pages 13-14 to determine conformity.

While the 3 volumes x 10 weighing method provides a higher confidence level of measured results, the cost in time and money is often unwarranted when a pipette is subjected to preventive maintenance, a standard feature of Rainin's Performance Verification program. To learn more, request Technical Report 9804, *Comparison of Ten vs Four Weighing Method,* or download from the website.

2 Volumes x 4 Weighing Factory Method

New Rainin Pipette

Performance Check Report

Identification

Model:	L-200
Serial No.:	B910254TA
Rainin Tip No.:	RT-L200

Operating Conditions

Technician:	TK
Balance No.:	AE163
Balance Sensitivity (g):	0.00001
Correction Factor (µl/mg):	1.0001
Correction for Evaporation:	0.000
Temperature °C:	21.6 ± 1.0

Gravimetric Data

Volume Setting (µl):	20	200
Weighings (mg):	19.98	198.41
	19.98	198.60
	19.91	198.54
	20.04	198.56
Mean (mg):	19.99	199.53
Mean (µl):	20.04	199.15
Precision (±sd):	0.064	0.112

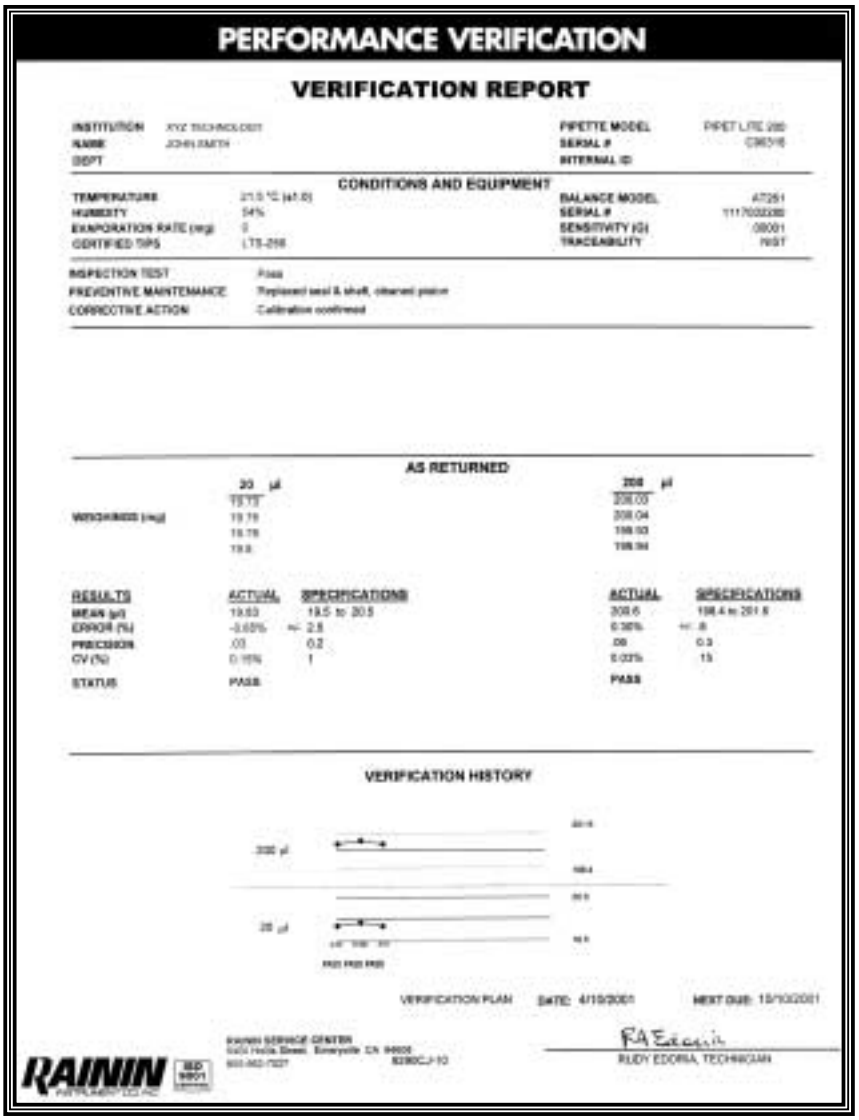
Results

Low Volume Setting (µl):	20	Pass
High Volume Setting (µl):	200	Pass

Gravimetric data has been converted from mg to µl for distilled water. This pipette is in conformity with specifications.

Model: L-200
Serial No.: B910254TA

Performance Verification Pipette



PERFORMANCE VERIFICATION

VERIFICATION REPORT

INSTITUTION: XYZ TECHNOLOGY
NAME: JOHN SMITH
DEPT

PIPETTE MODEL: PIPETLITE 200
SERIAL #: C96516
INTERNAL ID:

CONDITIONS AND EQUIPMENT

TEMPERATURE: 21.5 °C (±1.0)
HUMIDITY: 54%
EVAPORATION RATE (mg): 0
CERTIFIED TIPS: LTS-200

BALANCE MODEL: AT251
SERIAL #: 1117032280
SENSITIVITY (G): .00001
TRACEABILITY: NIST

INSPECTION TEST: Pass
PREVENTIVE MAINTENANCE: Replaced seal & shaft, cleaned piston
CORRECTIVE ACTION: Calibration confirmed

AS RETURNED

	20 µl	200 µl
WEIGHINGS (mg)	19.79	208.03
	19.79	208.04
	19.78	198.93
	19.8	198.94

RESULTS	ACTUAL	SPECIFICATIONS	ACTUAL	SPECIFICATIONS
MEAN (µl)	19.83	19.5 to 20.5	203.6	198.4 to 201.6
ERROR (%)	-0.85%	+/- 2.5	0.36%	+/- 8
PRECISION	.03	0.2	.09	0.3
CV (%)	0.16%	1	0.05%	15
STATUS	PASS		PASS	

VERIFICATION HISTORY

VERIFICATION PLAN DATE: 4/15/2001 NEXT DUE: 10/15/2001

RAININ

RAININ SERVICE CENTER
6400 Hollis Street, Emeryville CA 94608
800-962-7537
B280CJ-10

RUDY EDORIA, TECHNICIAN

3 Volumes x 10 Weighing Method

Performance Verification Pipette

PERFORMANCE VERIFICATION

CALIBRATION CERTIFICATE

INSTITUTION	XYZ TECHNOLOGY	PIPETTE MODEL	PIPET LITE 200
NAME	JANE SMITH	SERIAL #	D90613
DEPT		INTERNAL ID	0864

CONDITIONS AND EQUIPMENT

TEMPERATURE	21.5 °C (±1.0)	BALANCE MODEL	AT261
HUMIDITY	51%	SERIAL #	1117023801
EVAPORATION RATE (mg)	0	SENSITIVITY (G)	.00001
CERTIFIED TIPS	LTS-250	TRACEABILITY	NIST

INSPECTION TEST	Pass
PREVENTIVE MAINTENANCE	Replaced seal, cleaned piston
CORRECTIVE ACTION	Calibration confirmed

AS FOUND

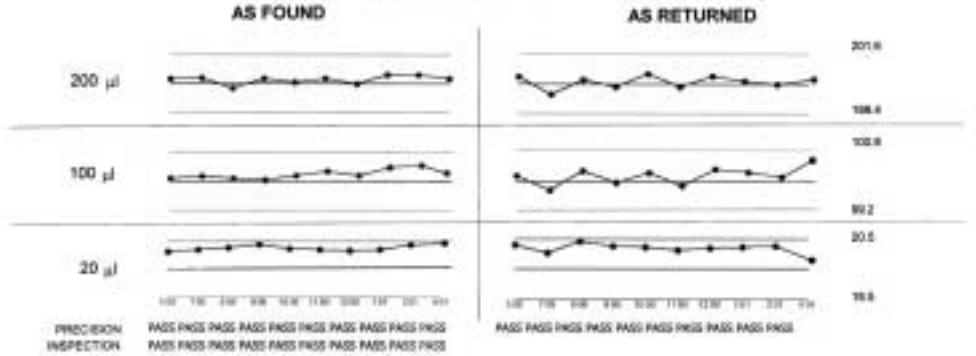
	20 µl	100 µl	200 µl
MEAN (µl)	20.46	100.22	200.22
PRECISION (est)	.03	.01	.02
STATUS	Pass	Pass	Pass

AS RETURNED

	20 µl		100 µl		200 µl	
WEIGHINGS (mg)	20.02	20.09	100.08	100.23	199.46	199.58
	20.08	20.05	100.13	100.33	199.5	199.75
	20.1	20.06	100.15	100.3	199.56	199.68
	20.01	20.12	100.24	100.29	199.59	199.73
	20.03	20.08	100.24	100.3	199.52	199.76

RESULTS	ACTUAL	SPECIFICATIONS	ACTUAL	SPECIFICATIONS	ACTUAL	SPECIFICATIONS
MEAN (µl)	20.13	19.5 to 20.5	100.54	99.2 to 100.8	200.23	198.4 to 201.6
ERROR (%)	0.65%	+/- 2.5	0.54%	+/- .8	0.12%	+/- .8
PRECISION	.04	0.2	.08	.25	.11	0.3
CV (%)	0.20%	1	0.08%	.25	0.05%	.15
STATUS	PASS		PASS		PASS	

CALIBRATION HISTORY



CALIBRATION PLAN - EXTENDED DATE: 4/4/2001 NEXT DUE: 5/4/2001

RAININ INSTRUMENT CO, INC ISO 9001

RAININ SERVICE CENTER
5400 Hollis Street, Emeryville CA 94608
800-992-7027

7865DB-13

ALICE YEUNG, TECHNICIAN

SPECIFICATIONS

PIPETMAN

MODEL VOLUME	VOLUME SET µL	ACCURACY %	ACCURACY µL(±)	PRECISION %	PRECISION µL(≤)
P-2	0.2	12.0	0.024	6.0	0.012
	1	2.7	0.027	1.3	0.013
	2	1.5	0.030	0.7	0.014
P-10	1	2.5	0.025	1.2	0.012
	5	1.5	0.075	0.6	0.03
	10	1.0	0.1	0.4	0.04
P-20	2	7.5	0.15	2.0	0.04
	10	1.5	0.15	0.5	0.05
	20	1.0	0.2	0.3	0.06
P-100	10	3.5	0.35	1.0	0.1
	50	0.8	0.4	0.24	0.12
	100	0.8	0.8	0.15	0.15
P-200	50	1.0	0.5	0.4	0.2
	100	0.8	0.8	0.25	0.25
	200	0.8	1.6	0.15	0.3
P-200-M8	20	2.5	0.5	1.25	0.25
	100	1.0	1.0	0.5	0.5
	200	1.0	2.0	0.5	1.0
P-1000	100	3.0	3.0	0.6	0.6
	500	0.8	4.0	0.2	1.0
	1000	0.8	8.0	0.15	1.5
P-5000	500	2.4	12.0	0.6	3.0
	2500	0.6	15.0	0.2	5.0
	5000	0.6	30.0	0.16	8.0
P-10ML	1 mL	5.0	50.0	0.6	6.0
	5 mL	1.0	50.0	0.2	10.0
	10 mL	0.8	80.0	0.16	16.0

DISTRIMAN

MODEL VOLUME	VOLUME SET µL	ACCURACY %	ACCURACY µL(±)	PRECISION %	PRECISION µL(≤)
125 µL TIP	2	5.0	0.10	4.0	0.08
	5	2.5	0.125	1.5	0.075
	10	2.0	0.20	1.0	0.10
1250 µL TIP	20	4.0	0.80	1.0	0.2
	50	2.0	1.00	0.8	0.4
	100	1.0	1.00	0.6	0.6
12.5 mL TIP	200	3.0	6.0	0.5	1.0
	500	1.5	7.5	0.3	1.5
	1000	1.0	10.0	0.25	2.5

MICROMAN

MODEL VOLUME	VOLUME SET µL	ACCURACY %	ACCURACY µL(±)	PRECISION %	PRECISION µL(≤)
M-10	1	6.0	0.06	2.0	0.02
	5	2.5	0.10	0.6	0.03
	10	1.5	0.15	0.5	0.05
M-25	3	5.0	0.15	2.0	0.06
	10	1.7	0.17	0.8	0.08
	25	1.0	0.25	0.4	0.10
M-50	20	1.7	0.35	0.6	0.12
	50	1.0	0.50	0.3	0.15
M-100	10	5.0	0.50	2.0	0.20
	50	1.5	0.75	0.6	0.30
	100	1.0	1.00	0.4	0.40
M-250	50	3.0	1.50	0.4	0.20
	100	1.7	1.70	0.3	0.30
	250	1.0	2.50	0.2	0.50
M-1000	200	1.5	3.00	0.8	1.60
	500	1.0	5.00	0.5	2.50
	1000	0.8	8.00	0.4	4.00

RAININ PIPET-LITE, PIPET-PLUS, AND EDP3

MODEL VOLUME	VOLUME SET µL	ACCURACY %	ACCURACY µL(±)	PRECISION %	PRECISION µL(≤)
2	0.2	12.0	0.024	6.0	0.012
	1	2.7	0.027	1.3	0.013
	2	1.5	0.030	0.7	0.014
10	1	2.5	0.025	1.2	0.012
	5	1.5	0.075	0.6	0.03
	10	1.0	0.1	0.4	0.04
20	2	7.5	0.15	2.0	0.04
	10	1.5	0.15	0.5	0.05
	20	1.0	0.2	0.3	0.06
100	10	3.5	0.35	1.0	0.1
	50	0.8	0.4	0.24	0.12
	100	0.8	0.8	0.15	0.15
200	20	2.5	0.5	1.0	0.2
	100	0.8	0.8	0.25	0.25
	200	0.8	1.6	0.15	0.3
1000	100	3.0	3	0.6	0.6
	500	0.8	4	0.2	1.0
	1000	0.8	8	0.15	1.5
2000	200	3.0	6	0.60	1.2
	1000	0.8	8	0.20	2.0
	2000	0.8	16	0.12	2.4
5000	500	2.4	12	0.60	3
	2500	0.6	15	0.20	5
	5000	0.6	30	0.16	8
10ML	1 mL	5.0	50	0.60	6
	5 mL	1.0	50	0.20	10
	10 mL	0.8	80	0.16	16

RAININ EDP, EDP2, AND EDP-PLUS

MODEL VOLUME	VOLUME SET µL	ACCURACY %	ACCURACY µL(±)	PRECISION %	PRECISION µL(≤)
10 µL (E2 & EP only)	1	2.5	0.025	1.2	0.012
	5	1.5	0.075	0.6	0.03
	10	1.0	0.1	0.4	0.04
10 µL (black EDP only)	1	10.0	0.1	4.0	0.04
	5	2.0	0.1	2.0	0.04
	10	1.0	0.1	0.5	0.05
25 µL	2.5	6.0	0.15	2.0	0.05
	12.5	1.2	0.15	0.4	0.05
	25	1.0	0.25	0.3	0.075
100 µL	10	3.0	0.3	1.0	0.1
	50	0.8	0.4	0.2	0.1
	100	0.8	0.8	0.2	0.2
250 µL	25	2.0	0.5	0.6	0.15
	125	0.8	1.0	0.15	0.19
	250	0.8	2.0	0.15	0.38
1000 µL	100	3.0	3.0	0.6	0.6
	500	0.8	4.0	0.2	1.0
	1000	0.8	8.0	0.15	1.5
2500 µL	0.25 mL	3.2	8.0	0.8	2.0
	1.25 mL	0.8	10.0	0.16	2.0
	2.5 mL	0.8	20.0	0.12	3.0
10ML	1 mL	5.0	50.0	0.6	6.0
	5 mL	1.0	50.0	0.2	10.0
	10 mL	0.8	80.0	0.16	16.0

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AB-15 WEB R3 3.2001:5M