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Piston pipettes

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Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Classification, type and channel	2
5 Requirements for measuring performance	4
5.1 Maximum permissible errors for fixed-volume piston pipettes	4
5.2 Maximum permissible errors for variable-volume piston pipettes	6
5.3 Maximum permissible errors for multi-channel piston pipettes	6
6 Performance test	6
7 Calibration	6
8 Marking	6
Annex A (normative) Test method	7
Annex B (normative) Z correction factor for conversion of buoyancy correction value and mass to volume	15
Annex C (informative) Calibration method and uncertainty evaluation	17
Annex JA (informative) Comparison table between JIS and corresponding International Standards	26

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Measuring Instruments Federation (JMIF)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS K 0970 : 1989** is replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Piston pipettes

Introduction

This Japanese Industrial Standard has been prepared based on the first editions of ISO 8655-2 and ISO 8655-6 published in 2002, but modifying some of their technical contents to reflect the actual usage of the product in the Japanese market.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standards have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the air-displacement and direct-displacement single-channel and multi-channel piston pipettes, designed as a volumetric apparatus to draw up and deliver their specified nominal volume. It is not applicable to piston burettes, piston diluters, piston dispensers, volumetric pipettes, measuring pipettes and micro syringes.

NOTE : The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 8655-2 : 2002 *Piston-operated volumetric apparatus — Part 2 : Piston pipettes*

ISO 8655-6 : 2002 *Piston-operated volumetric apparatus — Part 6 : Gravimetric methods for the determination of measurement error* (Overall evaluation : MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) listed below shall be applied.

JIS K 0211 *Technical terms for analytical chemistry (General part)*

JIS Z 8103 *Glossary of terms used in measurement*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in JIS K 0211 and JIS Z 8103, and the following apply.

3.1 nominal volume

volume specified by the manufacturer, and the greatest volume selectable for varia-

ble-volume piston pipette

3.2 useful volume range

volume range specified by the manufacturer for variable-volume piston pipette

3.3 selected volume

certain dispensing volume selected from the useful volume range

3.4 dispense

a series of operation to draw up and deliver the liquid into another container by using a piston pipette

3.5 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 pipette

3.6 systematic error

mean value of difference between the dispensed volume and the selected volume of the piston pipette

3.7 random error

non-repeatable scatter of the dispensed volumes around the mean of the dispensed volumes

3.8 calibration

set of operations that establish the relationship between the value realized by mass and density and the corresponding selected volume of the apparatus using gravimetric method (weighing method)

NOTE : Calibration requires no operation which permanently modifies the apparatus.

3.9 uncertainty of measurement

parameter, associated with the measurement result, that characterizes the dispersion of the volumes that could reasonably be attributed to the measured quantity

4 Classification, type and channel

Classification, types and channels of piston pipettes are as shown in Table 1 and as described in the following. The fundamental structure is illustrated in Figure 1.

Table 1 Classification, type and channel of piston pipettes

Classification	Smaller classification	Type	Channel
Air-displacement (type A)	—	Fixed-volume	Single-channel
		Variable-volume	Single-channel
			Multi-channel
Direct-displacement (type D)	Reusable type (type D1)	Fixed-volume	Single-channel
	Disposable type (type D2)	Variable-volume	Single-channel

a) Classification

- 1) **Air-displacement (type A)** The piston pipette having a body of air contained between the piston and the surface of the liquid.
- 2) **Direct-displacement (type D)** The piston pipette of which the piston is in direct contact with the surface of the liquid for drawing up and delivering the liquid. Either the piston or the capillary, or both may be reusable (type D1) or disposable (type D2).

NOTE : A piston that reciprocates inside the cylinder is also referred to as the plunger.

b) Type

- 1) **Fixed-volume** The piston pipette designed to deliver a fixed volume. It can be either of a single fixed volume type which has one nominal volume or of multiple fixed volume type having two or more nominal values between which the users can select and switch.
- 2) **Variable-volume** The piston pipette with variable volume, designed to deliver volumes selectable by the users. Its nominal volume is the maximum selected volume.

c) Channel

- 1) **Single-channel** The piston pipette having the single piston structure.
- 2) **Multi-channel** The piston pipette composed of multiple pistons that operate in a coordinated manner.

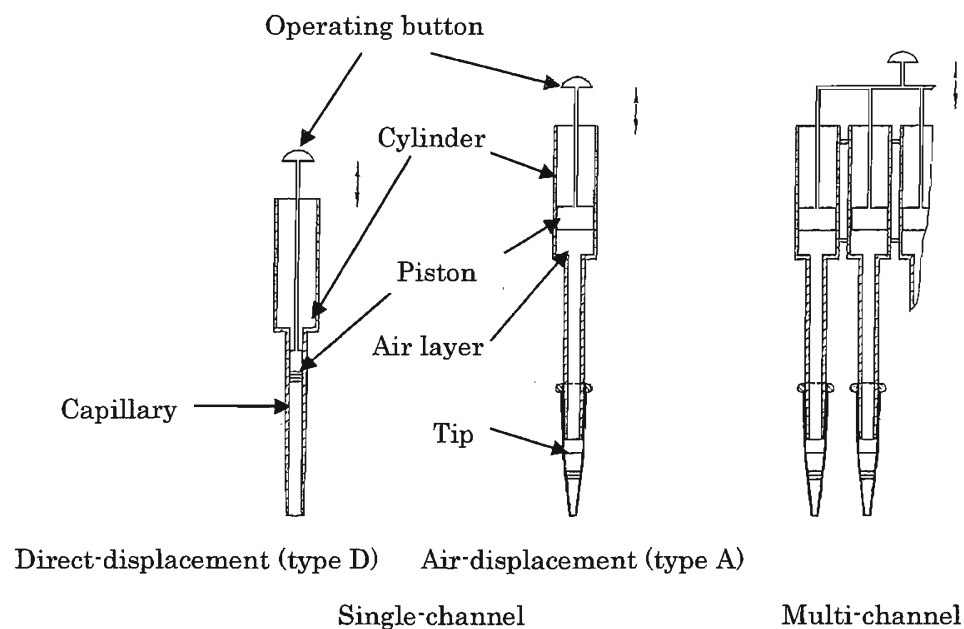


Figure 1 Example of fundamental structure

5 Requirements for measuring performance

5.1 Maximum permissible errors for fixed-volume piston pipettes

The maximum permissible errors for fixed-volume piston pipettes shall be as follows.

- a) For air-displacement piston pipettes (type A) and for direct-displacement piston pipettes of reusable type (type D1), the maximum permissible errors of Table 2 apply.

Table 2 Maximum permissible errors for air-displacement (type A) and direct-displacement (type D1) piston pipettes

Nominal volume	Maximum permissible systematic error		Maximum permissible random error	
μl	$\pm\%$	$\pm\mu\text{l}^{\text{a)}$	$\pm\%^{\text{b)}$	$\pm\mu\text{l}^{\text{c)}$
1	5.0	0.05	5.0	0.05
2	4.0	0.08	2.0	0.04
5	2.5	0.12	1.5	0.07
10	1.2	0.12	0.8	0.08
20	1.0	0.2	0.5	0.1
50	1.0	0.5	0.4	0.2
100	0.8	0.8	0.3 ^{d)}	0.3 ^{d)}
200	0.8	1.6	0.3 ^{d)}	0.6 ^{d)}
500	0.8	4	0.3	1.5
1 000	0.8	8	0.3	3
2 000	0.8	16	0.3	6
5 000	0.8	40	0.3	15
10 000	0.6	60	0.3	30
20 000	0.6	120	0.3	60

Notes ^{a)} Expressed as the deviation of the mean of a tenfold measurement from the nominal or selected volume shown in A.5.4.
^{b)} Expressed as the relative standard deviation of a tenfold measurement shown in A.5.5.
^{c)} Expressed as the repeatability standard deviation of a tenfold measurement shown in A.5.5.
^{d)} For piston pipettes of reusable type (type D1), the maximum permissible random error shall be 0.4 %.

- b) For direct-displacement piston pipettes of disposable type (type D2), maximum permissible errors of Table 3 apply.

Table 3 Maximum permissible errors for direct-displacement piston pipettes of disposable type (type D2)

Nominal volume	Maximum permissible systematic error		Maximum permissible random error	
μl	$\pm\%$	$\pm\mu\text{l}^{\text{a)}$	$\pm\%^{\text{b)}$	$\pm\mu\text{l}^{\text{c)}$
5	2.5	0.13	1.5	0.08
10	2.0	0.2	1.0	0.1
20	2.0	0.4	0.8	0.16
50	1.4	0.7	0.6	0.3
100	1.5	1.5	0.6	0.6
200	1.5	3	0.4	0.8
500	1.2	6	0.4	2
1 000	1.2	12	0.4	4

Notes ^{a)} Expressed as the deviation of the mean of a tenfold measurement from the nominal or selected volume shown in A.5.4.
^{b)} Expressed as the relative standard deviation of a tenfold measurement shown in A.5.5.
^{c)} Expressed as the repeatability standard deviation of a tenfold measurement shown in A.5.5.

- c) For fixed-volume piston pipette with the intermediate nominal volumes between those given in Tables 2 and 3, the absolute values for the next greater nominal volume shall apply.

5.2 Maximum permissible errors for variable-volume piston pipettes

In the case of variable-volume piston pipettes, the nominal volume is the greatest possible user-selectable volume over the entire useful range which is specified by the manufacturer. For air-displacement (type A) piston pipettes and direct-displacement piston pipettes of reusable type (type D1), the maximum permissible errors of Table 2 apply. For direct-displacement piston pipettes of disposable type (type D2), the maximum permissible errors of Table 3 apply.

5.3 Maximum permissible errors for multi-channel piston pipettes

For multi-channel piston pipettes, the maximum permissible errors of Table 2, multiplied by 2, apply.

6 Performance test

The performance test shall be carried out according to Annex A. Conversion of mass to volume is performed as shown in A.5.3 using the correction specified in Annex B, and then the systematic error and random error are calculated according to A.5.4 and A.5.5, respectively. These values shall not exceed the maximum permissible errors specified in Tables 2 and 3.

NOTE : The test method described in Annex A can be used in practical use environment.

7 Calibration

For calibration, if performed, the uncertainty of the obtained values shall be calculated for evaluation. Example of this method is shown in Annex C.

8 Marking

The following information shall be marked on the piston pipettes.

- a) Number of this Standard
- b) Nominal volume or useful volume range
- c) Unit of measurement (μl or ml)
- d) Supplier's name and/or trademark
- e) Supplier's apparatus name or type
- f) Apparatus identification serial number or an equivalent unique identifier

Annex A (normative)

Test method

A.1 Apparatus

A.1.1 Weighing device

The analytical balance used for weighing of mass shall satisfy the performance requirements in Table A.1 corresponding to the selected volume of the apparatus under test.

Table A.1 Requirements for balance for respective selected volumes

Selected volume ^{a)} of apparatus under test V	Requirements for balance		
	Resolution mg	Repeatability and linearity ^{b)} mg	Standard uncertainty of measurement ^{c)} mg
$1\ \mu\text{l} \leq V \leq 10\ \mu\text{l}$	0.001	0.002	0.002
$10\ \mu\text{l} < V \leq 100\ \mu\text{l}$	0.01	0.02	0.02
$100\ \mu\text{l} < V \leq 1\ 000\ \mu\text{l}$	0.1	0.2	0.2
$1\ \text{ml} < V \leq 10\ \text{ml}$	0.1	0.2	0.2
$10\ \text{ml} < V \leq 20\ \text{ml}$	1	2	2
Notes ^{a)} For practical purposes, the nominal volume may be used to choose the balance. ^{b)} Checked by catalogue, specifications or calibration certificate provided by the manufacturer. ^{c)} If the standard uncertainty of measurement of the balance is known, e.g. from the balance calibration certificate, this may be used instead of the repeatability and linearity. The standard uncertainty of measurement shall not be more than three times the resolution.			

A.1.2 Temperature measuring instrument

The temperature measuring instrument shall be as follows.

- Thermometer (in liquid)** A thermometer with a standard uncertainty of 0.1 °C or under.
- Thermometer (room temperature)** A thermometer with a standard uncertainty of 0.2 °C or under.

A.1.3 Hygrometer

A hygrometer with a standard uncertainty of 10 % or under.

A.1.4 Barometer

A barometer with a standard uncertainty of 5 hPa or under.