



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 8500 : 2001

(BAJ/JSA)

Primary batteries : General

ICS 29.220.10

Descriptors : primary batteries

Reference number : JIS C 8500 : 2001 (E)

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 the Battery Association of Japan (BAJ)/the Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

In this revision comparison of **JIS C 8500** with International Standards **IEC 60086-1** and **IEC 60086-2**, preparation of **JIS** conforming with International Standards, and to make proposal of International Standard draft based on **JIS** easy are taken as the principal object.

Date of Establishment: 1984-03-01

Date of Revision: 2001-03-20

Date of Public Notice in Official Gazette: 2001-03-21

Investigated by: Japanese Industrial Standards Committee
Divisional Council on Electricity

JIS C 8500:2001, First English edition published in 2001-12

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Printed in Japan

Primary batteries : General

Introduction This Japanese Industrial Standard has been prepared based on IEC 60086-1 *Primary batteries—Part 1 : General* published in 1996 as the eighth edition and IEC 60086-2 *Primary batteries—Part 2 : Specification sheets* published in 1997 as the ninth edition, but some parts are modified and items and contents not specified in the International Standards are added.

The portions underlined with dots mean the modification of or addition to the International Standards.

This Standard has been revised repeatedly following to the progress of batteries and battery application products. This Standard has been revised by taking easy use by the consumer and elimination of ambiguity into consideration.

1 Scope This Japanese Industrial Standard specifies general matters for primary batteries. If there is any difference between this Standard and any one of the detail specifications given below, the relevant detail specification shall precede.

- a) JIS C 8501 Carbon zinc batteries
- b) JIS C 8511 Alkaline primary batteries
- c) JIS C 8512 Manganese dioxide lithium primary batteries

Remarks : The International Standards corresponding to this Standard are given below. The symbols denoting the degree of correspondence are IDT (identical), MOD (modified) and NEQ (not equivalent) based on ISO/IEC Guide 21.

IEC 60086-1 : 1996 *Primary batteries—Part 1 : General* (MOD)

IEC 60086-2 : 1997 *Primary batteries—Part 2 : Specification sheets* (MOD)

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

JIS B 7502 Micrometer callipers

JIS B 7507 Vernier, dial and digital callipers

JIS C 8501 Carbon zinc batteries

JIS C 8511 Alkaline primary batteries

JIS C 8512 Manganese dioxide lithium primary batteries

JIS Z 8703 Standard atmospheric conditions for testing

3 Definitions For the purposes of this Standard the following principal definitions apply:

- a) **primary cell** A source of electrical energy which is obtained by the direct conversion of chemical energy, is not designed to be charged by other electrical energy sources, and is a structural unit of a battery. Hereafter, this is referred to as "cell".

- b) **dry (primary) battery** A primary battery in which the electrolyte is made unspillable.
- c) **primary battery** A battery consisting of one cell or plural cells which provides a case, terminals and a marking.
- d) **electrolyte** A medium which conducts ions at electrochemical reaction in a battery. There are an electrolyte in which the material is dissolved in water and the one in which the material is dissolved in a non-aqueous solvent, the later is sometimes called non-aqueous electrolyte.
- e) **open circuit voltage (OCV) (Off-load voltage)** The voltage appearing across both terminals of a battery under unloaded state.
- f) **closed circuit voltage (CCV) (on-load voltage)** The voltage appearing across both terminals of a battery under loaded state.
- g) **nominal voltage** The voltage of a battery specified based on the voltage intrinsic to the battery system.
- h) **terminals** The part of a battery to which external circuit is connected.
- i) **load resistance** The resistance which is connected across both terminals for performance test.
- j) **end-point voltage** The closed circuit voltage which is specified to show the completion of discharge during performance test.
- k) **discharge** A procedure by which a battery delivers current to an external circuit. The discharge can be continuous or intermittent.
- l) **duration** The period during which the closed circuit voltage of a battery does not fall the specified end-point voltage when the battery is discharged with the specified load resistance being connected. In the case of intermittent discharge, this means the total sum of net discharge periods not including the rest periods.
- m) **minimum average duration** The minimum value of the average value calculated on the durations when samples of the specified number (9 pieces) are discharged. The minimum average duration shall be specified in the detail specification.
- n) **expiry month and year of recommended use** The month and year up to which a battery operates normally and satisfies the characteristic value of minimum average duration specified in the detail specification when the battery is subjected to the specified duration test.
 Informative reference : This has the same meaning with “year and month or week of manufacture, which may be in code, or the expiration of a guarantee period, in clear” stated in IEC Standard.
- o) **initial test** The test commenced within two months counted from the month of manufacture.
- p) **storage** A procedure to allow sample batteries to stand under specified conditions for the purpose of “test after storage”.

- q) **test after storage** The test commenced within 2 weeks after the storage.
- r) **leakage resistance** Such a performance that a battery withstands the leakage of electrolyte to outside in a specified test.
- s) **over discharge** The discharge which is continued further after drop of closed circuit voltage below the end-point voltage.
- t) **type inspection** An inspection which is carried out to decide whether the quality of a product satisfies the characteristics shown in the design or not.
- u) **acceptance inspection** An inspection which is carried out to decide whether a product of the same design and manufacture with that already passed the type inspection satisfies the characteristics considered necessary at the acceptance or not.

4 Classification

4.1 Classification by battery system Batteries are classified as stated in Table 1 according to the kinds of materials for positive electrode, negative electrode and electrolyte, and each system has an inherent electrochemical system code except carbon zinc batteries.

Table 1 Classification by battery system

Battery system	Battery system code	Positive electrode	Electrolyte	Negative electrode	Nominal voltage of cell V	Applicable JIS
Carbon zinc battery	No code	Manganese dioxide	Ammonium chloride, zinc chloride, water	Zinc	1.5	Carbon zinc batteries (JIS C 8501)
Wet air battery	A	Oxygen			1.4	—
Carbon monofluoride lithium primary battery	B	Carbon monofluoride	Lithium salt, non-aqueous solvent	Lithium	3	—
Manganese dioxide lithium primary battery	C	Manganese dioxide			3	Manganese dioxide lithium primary batteries (JIS C 8512)
Thyonyl chloride lithium primary battery	E	Thyonyl chloride	Lithium salt, non-aqueous inorganic		3.6	—
Iron disulfide lithium primary battery	F	Iron disulfide	Lithium salt, non-aqueous solvent		1.5	—
Copper (II) oxide lithium primary battery	G	Copper oxide			1.5	—
Alkaline manganese battery	L	Manganese dioxide	Alkali metal, hydroxide, water	Zinc	1.5	Alkaline primary batteries (JIS C 8511)
Air zinc battery	P	Oxygen			1.4	
Silver oxide battery	S	Silver oxide			1.55	

Remarks : The nominal voltage of a battery in which plural cells are combined and connected in series, is the product of the nominal voltage of the cell stated in Table 1 and the number of cells or parallel strips of cells connected in series.

4.2 Classification by shape and dimension of cell The shapes of cells are round, square and flat and denoted by shape codes R, S and F respectively. The shape and dimensions of a cell are expressed by combining the numerals denoting the size, i.e. the dimension symbol, after appropriate English capital letter. The combination of shape symbol and dimension symbol is called shape-dimension symbol.

4.3 Classification of batteries by shape and dimension The shapes of batteries are round and non-round. The shape code of round battery is R and that of non-round battery is P. The shape and dimensions of a battery are expressed by combining the numerals denoting the size i.e. the dimension code, after appropriate English capital letter as shown in Table 2. However, in the case of batteries to which

inherent code denoting shape and dimensions is assigned, either of the inherent code or the shape and dimension code may be applied.

Table 2 Codes denoting shapes and dimensions of batteries, and maximum dimensions

Code denoting shape and dimension		Maximum dimension mm				Popular name of shape (informative)	Example of representative expression (informative)
Inherent code	Designation	Diameter	Overall height	Length	Width		
R03	—	10.5	44.5	—	—	TAN-4 type	R03, LR03
R1	—	12.0	30.2	—	—	TAN-5 type	R1, LR1
R6	—	14.5	50.5	—	—	TAN-3 type	R6P, R6PU, LR6
R14	—	26.2	50.0	—	—	TAN-2 type	R14P, R14PU, LR14
R20	—	34.2	61.5	—	—	TAN-1 type	R20P, R20PU, LR20
R41	R736	7.9	3.6	—	—	—	LR41, SR41, PR41
R43	R1142	11.6	4.2	—	—	—	LR43, SR43
R44	R1154	11.6	5.4	—	—	—	LR44, SR44, PR44
R48	R754	7.9	5.4	—	—	—	SR48, PR48
R54	R1130	11.6	3.05	—	—	—	LR1130, SR1130
R70	R536	5.8	3.6	—	—	—	PR536
R-1/3N	R11108	11.6	10.8	—	—	—	CR-1/3N
R123A	R17345	17.0	34.5	—	—	—	CR123A
R2	R15H270	15.6	27.0	—	—	—	CR2
2R5	—	—	45.0	34.0	17.0	—	2CR5
R-P2	—	—	36.0	35.0	19.5	—	CR-P2
6F22	—	—	48.5	26.5	17.5	9 V-KAKU type	6F22Y
—	R2450	24.5	5.00	—	—	—	CR2450
—	R2430	24.5	3.00	—	—	—	CR2430
—	R2032	20.0	3.20	—	—	—	CR2032
—	R2025	20.0	2.50	—	—	—	CR2025
—	R2016	20.0	1.60	—	—	—	CR2016
—	R1620	16.0	2.00	—	—	—	CR1620
—	R1616	16.0	1.60	—	—	—	CR1616
—	R1220	12.5	2.00	—	—	—	CR1220
—	R1216	12.5	1.60	—	—	—	CR1216

Remarks 1 The batteries stated in this table include the enclosure, and can be used as they are.

2 The designations are those based on Nomenclature Section 2 of IEC 60086-1 (1996).

3 For a round cell having the same dimensions with a battery in this table, the same symbol as that for the battery is used.

5 Designation The method for assigning designation is specified in Annex 1.

5.1 Nomenclature of cells The codes denoting shape and dimensions are arranged consecutively after the battery system code.

5.2 Nomenclature of primary batteries When the battery consists of a cell, the nomenclature of cell is used without modification. When the battery consists of two or more cells in series, the battery is expressed by placing the number of cells

in front of battery system code. The codes denoting classification by grade of carbon zinc batteries (S, C, P or PU) are placed at the end of the code denoting shape and dimension.

Example 1 R20P: A carbon zinc battery of grade P consisting of an R20 cell

Example 2 LR20: An alkaline manganese battery consisting of an R20 cell

Example 3 SR44: A silver oxide battery consisting of an R44 cell

Example 4 PR44: An air-zinc battery consisting of an R44 cell

Example 5 6F22: A non-round carbon zinc battery in which 6 flat cells of F22 are piled and connected in series

Example 6 CR2025: A manganese dioxide lithium primary battery with maximum size of diameter 20.0 mm and overall height 2.50 mm consisting of an R2025 primary battery

Example 7 2CR5: A non-round battery in which 2 manganese dioxide lithium primary batteries are connected in series

6 Nominal voltage The nominal voltage of each battery system is stated in Table 1.

7 Performances

7.1 Open circuit voltage The open circuit voltages of cells shall be as stated in Table 3, when the tests are carried out in accordance with 11.4.4.

Table 3 Open circuit voltage

Battery system	Battery system code	Open circuit voltage V	
		Maximum	Minimum
Carbon zinc battery	No code	1.725	1.50
Wet air battery	A	1.55	—
Carbon monofluoride lithium primary battery	B	3.70	—
Manganese dioxide lithium primary battery	C	3.70	3.00
Thyonyl chloride lithium primary battery	E	3.90	—
Iron disulfide lithium primary battery	F	1.83	—
Copper (II) oxide lithium primary battery	G	2.30	—
Alkaline manganese battery	L	1.65	1.45
Air zinc battery	P	1.68	1.30
Silver oxide battery	S	1.63	1.50

Remarks : The minimum of open circuit voltage is for informative reference.

7.2 Minimum average duration The minimum average duration shall be not shorter than the specified time, when the test is carried out in accordance with 11.4.5.

7.3 Leakage resistance When the tests are carried out in accordance with 11.4.6 a) and 11.4.6 b), there shall be no leakage of liquid found out by visual examination.

7.4 Dimensional stability The dimensions of batteries shall satisfy the specified values stated in the relevant detail specification.

8 Shapes and dimensions For the dimensions of a battery, at least the diameter (or length and width) and the overall height shall be determined. Further detail dimensions shall be specified as needed.

When batteries are tested under the test conditions specified in this Standard, the dimensions of batteries shall conform to the prescribed dimensions. When the detail shape is specified by means of the dimensions, the basic shape is any one of those illustrated in Figs. 1 to 4. The meanings of dimensional code are stated below. The dimensions shall be specified in the detail specification.

A : overall height of battery

B : distance between contact terminals excluding pip

A/B : overall height of battery when the difference between *A* and *B* is within 0.1 mm

C : outer diameter of flat contact surface in negative terminal

D : diameter of concave provided at the center of negative terminal

E : recess of negative terminal from enclosure

F : diameter of positive terminal within the specified projection height

G : height of projected flat surface excluding the pip from the next higher part in positive terminal

K : height of projected flat surface in negative terminal

L : diameter of negative terminal within the specified projection height

M : diameter of negative terminal

N : diameter of positive terminal

ϕ : diameter of battery

ϕP : eccentricity of positive terminal relative to cylindrical side face of battery

R : radius

W : width of battery

Recesses are permitted in the negative flat contact surface defined by dimensions *C* and *D* for batteries having the shape shown in Fig. 1, provided that batteries placed end to end in series make electrical contact with each other and that the contact separation is an integral multiple of the contact separation for one battery.

The following conditions must be satisfied:

$C > F$ (maximum)

F (minimum) $> D$

$G > E$

Asymmetry (on right and left) of shape in Fig. 1 means that the two kinds of shape exist on each of upper part and lower part. For batteries complying with Fig. 1, the flat negative contact is not necessarily recessed. When the flat negative contact surface forms the lowest part of the battery, A and B are both measured from this surface and hence dimension E is zero.

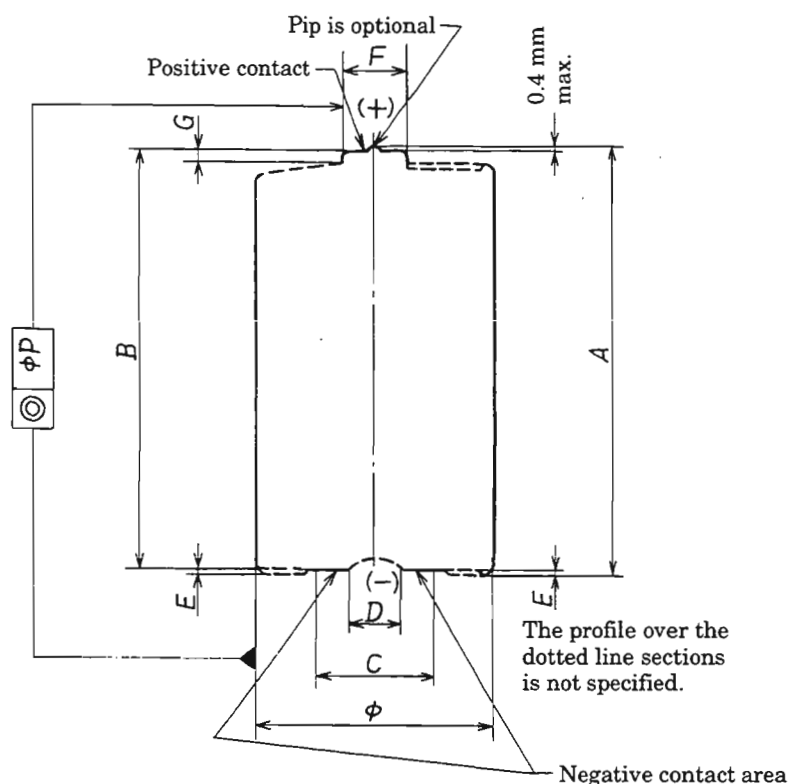
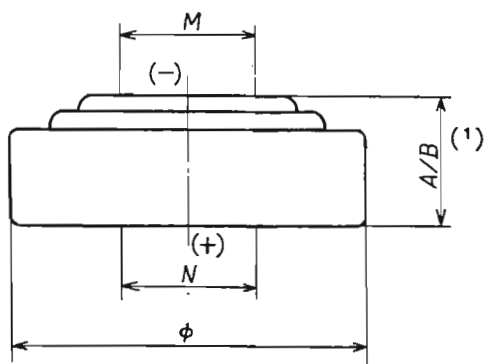


Fig. 1 Cap and base terminals



Note (1) In Figs. 2 and 3, the difference between overall height A and contact separation B shall be within 0.1 mm.

Fig. 2 Cap and case terminal (A)

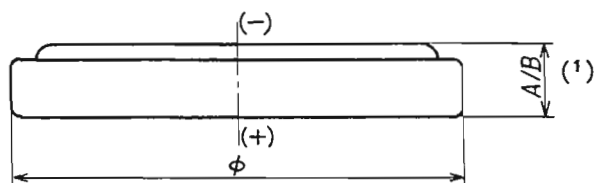


Fig. 3 Cap and case terminal (B)

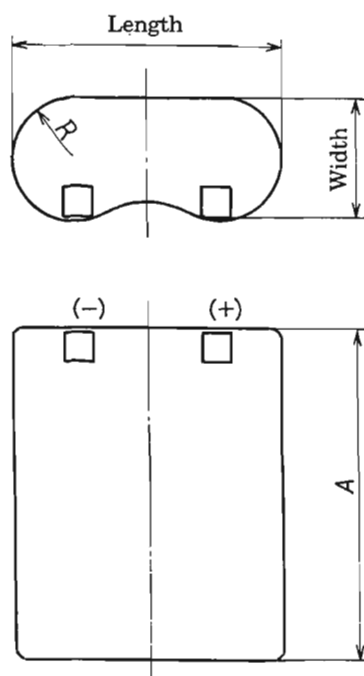


Fig. 4 Flat terminal

9 Terminals The terminal shall comply with any one of those specified below, be made of metallic material which ensure good electrical contact with the corresponding equipment, be coated with nickel, tin, etc. as needed and be free from rust or deformation detrimental to practical service. The dimensions of each part shall be specified in the detail specification. Drawings for shapes of terminals e) to i) shall also be specified in the detail specification.

- a) **Cap and base terminal** This type of terminal is used for batteries which have the shape illustrated in Fig. 1 and which have the cylindrical side of the battery insulated from the terminals.
- b) **Cap and case terminal** This type of terminal is used for batteries which have the shapes illustrated in Figs. 2 and 3, but in which the cylindrical side of the battery forms part of the positive terminal.
- c) **Flat terminal** This type of terminal consists of flat metal strips as shown in Fig. 4, and the electrical contact with the contact terminal of the apparatus is made by means of such an adequate contact mechanism as pressure contact.
- d) **Snap terminal** This type of terminal is illustrated in Fig. 5. This is a combination comprising of a positive stud (non-resilient) and negative socket (resilient) and shall be made of suitable metal so as to provide adequate electrical connection when joined to the corresponding parts of an external circuit. There are a non-resilient snap fastener (stud) and a resilient snap fastener (socket).
- e) **Screw terminal** This type of terminal is the one consisting of a combination of a threaded stud and metal nut(s) or insulated nut(s).
- f) **Flat spring terminal or spiral spring terminal** This type of terminal consists of flat metal strips or spirally wound wire which are in a form that provides pressure contact.

- g) **Socket terminal** This type of terminal is a suitable assembly of metal contacts, mounted in an insulating housing or holding device and adapted to receive corresponding pins of a mating plug.
- h) **Wire terminal** This type of terminal consists of single- or multi-strand flexible insulated tinned copper conductor. The insulation may be cotton winding or suitable plastic. The positive terminal wire covering shall be red and the negative black.
- i) **Spring clip terminal** This type of terminal is generally used with special batteries, when the corresponding parts of the external circuit are not precisely known. The material of terminal shall be spring brass or the equivalent.

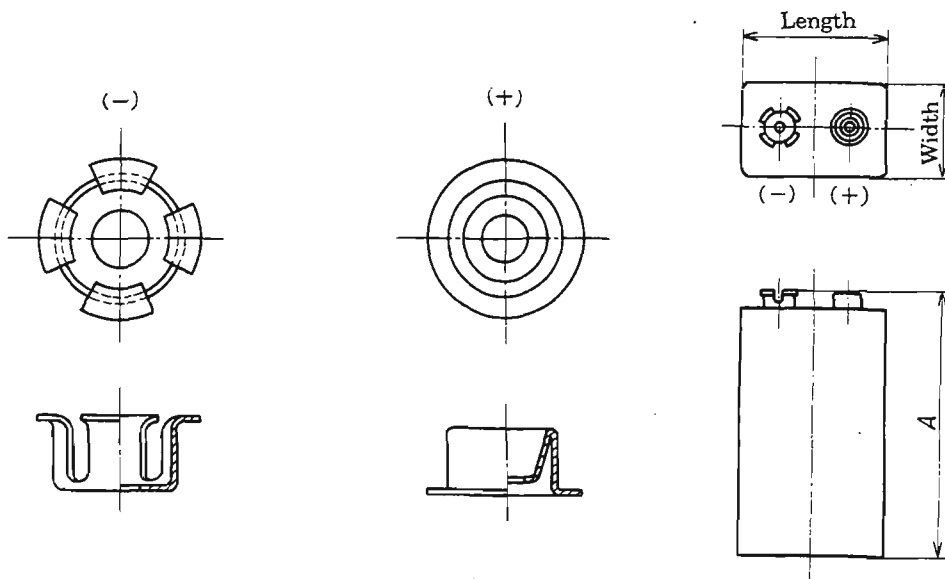


Fig. 5 Snap terminal

10 Appearance The appearance shall be such that there is no dirt, flaw nor deformation detrimental to practical service, and that the marking is not indistinct.

11 Tests

11.1 Classification of tests and test items The tests are classified into two i.e. the initial test and the test after storage (after storage of 12 months and at the expiry month and year of recommended use). The initial test items shall be open circuit voltage, leakage resistance, dimensions, terminals, appearance and duration, and after storage test items shall be open circuit voltage and duration.

11.2 Storage conditions and test conditions of sample batteries

11.2.1 Storage conditions The storage conditions of sample batteries shall be such that the temperature is $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and the relative humidity is $(65 \pm 20)\%$. However, during a short period not exceeding 3 months, the temperature may be $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

Air-zinc batteries shall be stored with the air inlet seal attached.

11.2.2 High-temperature storage conditions Unless otherwise specified, the high-temperature storage conditions of sample batteries shall be such that the temperature is $45\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and the relative humidity is not exceeding 70 % or that the temperature is $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and the relative humidity is not exceeding 70 %, and shall be specified in the detail specification.

11.2.3 Test conditions Unless otherwise specified, the test conditions of sample batteries shall be such that the temperature is the ordinary temperature of $20\text{ }^{\circ}\text{C} \pm 15\text{ }^{\circ}\text{C}$ and the relative humidity is the ordinary humidity of $(65 \pm 20)\%$ specified in JIS Z 8703.

11.3 Instruments and apparatus

11.3.1 Voltmeter The voltmeter shall have a tolerance not exceeding 0.25 % of its nominal voltage and an input resistance of 1 M Ω or more.

11.3.2 Load resistance The load resistance includes all resistances of external circuit and the tolerance thereon shall be $\pm 0.5\%$. The value of the discharge resistance, when the discharge conditions are newly specified, shall be selected from the values to the second place of decimals shown in Table 4 prepared based on the preferred number of E24 series or together with their multiples of 10^n (n is a positive or negative integer). The resistance shall not change exceeding the said tolerance of $\pm 0.5\%$ even when the resistor generates heat due to discharge.

Table 4 Load resistance

Unit : Ω

1.00	1.10	1.20	1.30	1.50	1.60	1.80	2.00
2.20	2.40	2.70	3.00	3.30	3.60	3.90	4.30
4.70	5.10	5.60	6.20	6.80	7.50	8.20	9.10

11.3.3 Dimension measuring apparatus The vernier calliper with a minimum readable scale of 0.05 mm and a measuring length of not more than 200 mm specified in JIS B 7507 or a measuring apparatus at least equivalent in accuracy shall be used as the dimension measuring apparatus. If the tolerance is specified to two places of decimals, the micrometer callipers specified in JIS B 7502 or a measuring apparatus at least equivalent in accuracy shall be used.

11.4 Test methods

11.4.1 Dimensions The dimensions shall be measured with the dimension measuring apparatus stated in 11.3.3.

11.4.2 Terminals The terminals shall visually examined for rusting and deformation.

11.4.3 Appearance The flaws, dirt and deformation on appearance and the marking shall be visually examined.