

JIS

JAPANESE INDUSTRIAL STANDARD

**General rules of fixed
capacitors for use in
electronic equipment**

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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General rules of fixed capacitors for
use in electronic equipment

C 5101-1995

1. Scope This Japanese Industrial Standard is the generic specification of fixed capacitors mainly used for electronic equipment (hereafter referred to as "capacitors"), and specifies the bases for common requirements for all capacitors and for requirements to be specified in sectional specifications of fixed capacitors for use in electronic equipment (hereafter referred to as "sectional specifications") and in detail specifications of fixed capacitors for use in electronic equipment (hereafter referred to as "detail specifications").

Remarks 1. The following standards are cited in this Standard:

- JIS B 0205 Metric coarse screw threads
 - JIS B 0207 Metric fine screw threads
 - JIS C 0801 Color code for electronic parts
 - JIS C 0805 Packaging of electronic components on continuous tapes (components with axial type and radial wire lead terminals)
 - JIS C 0806 Packaging of electronic components on continuous tapes (surface mounting devices)
 - JIS C 5001 General rules for electronic components
 - JIS C 5002 Environmental requirements for electronic components
 - JIS C 5003 General test procedure of failure rate for electronic components
 - JIS C 5102 Test methods of fixed capacitors for use in electronic equipment
 - JIS C 5602 Glossary of passive components for electronic equipment
 - JIS Z 8601 Preferred numbers
 - JIS Z 9015 Sampling inspection procedures and tables by attributes with severity adjustment (receiving inspection where a consumer can select suppliers)
2. The International standards corresponding to this Standard are given below:
- IEC 62 (1992) Marking codes for resistors and capacitors
 - IEC 63 (1963) Preferred number series for resistors and capacitors
 - IEC 384-1 (1982) Fixed capacitors for use in electronic equipment
 - Part 1: Generic specification
 - Amendment 2 (1987) Amendment 3 (1989)
 - Amendment 4 (1992)

2. Definitions For the purpose of this Standard, the definitions given in JIS C 5001 and JIS C 5602 shall apply.

The principal terms and symbols are given below.

- (1) kind of capacitor Classification of capacitors by materials of dielectric and construction of electrode, as well as by purpose of its use.
Example: Fixed plastic film capacitor for electronic equipment, nonsolid aluminum foil dry electrolytic capacitor for electronic equipment, and so on.
- (2) fixed capacitor A capacitor which is so constructed that with the electrode facing area, electrode spacing and dielectric constant of the dielectric are fixed, and has no mechanism to change the capacitance.
- (3) rated capacitance (C_R) Nominal value of capacitance.
- (4) tangent of loss angle ($\tan \delta$) Tangent of dielectric loss angle of a capacitor expressed as:

$$\tan \delta = \frac{R}{X} = 2\pi f C R$$

where, $\tan \delta$: tangent of loss angle

R : equivalent series resistance of capacitor (Ω)

X : reactance of capacitor (Ω)

f : measuring frequency (Hz)

C : capacitance of capacitor (F)

- (5) category temperature range The ambient temperature range at which a capacitor may be used continuously.
- (6) upper category temperature The maximum ambient temperature at which a capacitor may be used continuously.
- (7) lower category temperature The minimum ambient temperature at which a capacitor may be used continuously.
- (8) rated temperature (rated upper category temperature) The maximum ambient temperature at which a capacitor may be used continuously with the rated voltage applied to the capacitor.
- (9) rated voltage (U_R) The maximum peak voltage (sum of d.c. voltage and permissible a.c. peak voltage) which may be applied to a capacitor continuously at its rated temperature.

Remarks 1. As for a capacitor for a.c. power, the rated voltage means the effective value of a.c. voltage at a specified frequency which can be applied to a capacitor continuously.

2. As for a capacitor for pulses, the rated voltage means the peak value of voltage with specified frequency and waveform which can be applied to a capacitor continuously.

- (10) temperature derated voltage The maximum voltage which may be applied to a capacitor continuously at a temperature above the rated temperature (but within the upper category temperature).
- (11) category voltage (U_C) The maximum voltage which may be applied to a capacitor continuously at the upper category temperature.
- (12) characteristic A parameter which is particularly picked up from capacitor performances and expressed by quantitative or qualitative classification under certain conditions.
- (13) grade Classification by degree of guaranteeing a given performance of a capacitor under certain conditions.

Informative reference: This is called "assessment level" in sectional specifications based on IEC 384-1.

- (14) primary stage of manufacture The primary stage of manufacture which shall be managed by the manufacturer in the qualification approval of capacitors.

Informative reference: These terms are given in IEC 384-1.

3. System and priority of standards The standards of capacitors consist of the specifications stated below, and if there is any conflict among the individual specifications, priority shall be given in the numerical sequence indicated.

- (1) Detail specification
- (2) Sectional specification
- (3) Generic specification (JIS C 5101)
- (4) Basic specification (JIS C 5001)

Remarks: The sectional specifications are groups of specifications applicable to all kinds of capacitors classified in 4.2.1.

Detail specifications and sectional specifications are hereafter comprehensively referred to as "capacitor standard".

4. Type designation

4.1 Structure of type designation Type designation shall be expressed as shown in the arrangement stated below.

The example given is based on a fixed tantalum solid electrolytic capacitor for electronic equipment.

Symbol denoting kind	Symbol denoting style	Symbol denoting characteristics	Symbol denoting rated voltage	Symbol denoting rated capacitance	Symbol denoting tolerance on capacitance	Symbol denoting grade	Symbol denoting failure rate level	Symbol denoting other necessary items
4.2.1	4.2.2	4.2.3	4.2.4	4.2.5	4.2.6	4.2.7	4.2.8	4.2.9
Example: CS	02	HB	1H	476	K	E	M	B

4.2 Symbols

4.2.1 Kind of capacitor The symbol denoting kind of capacitor shall be presented by two or three English capital letters.

The first letter shall be the English capital letter C indicating "capacitor" and the second letter shall be an English capital letter other than I, N, O, R, X and Z. Capacitors shall be classified by the main materials of the dielectric and kinds of electrode.

The combination of the first and the second letters shall be as given in Table 1.

The third letter shall be used only when subdividing the classification of Table 1. It shall be an English capital letters other than I, O and R, and shall be used in the specification in the capacitor standard.

Remarks: CN is used for a connector, and CR for a composite part, therefore they are not used for capacitors.

Table 1. Kind of capacitor

Sym- bol	Kind of capacitor	Main materials of dielectric	Kind of electrode
CA	Aluminium solid electrolytic capacitor	Aluminium oxide film	Aluminium solid electrolyte
CC	Ceramic capacitor (type 1)	Ceramics	Coated metal film
CE	Aluminium nonsolid electrolytic capacitor	Aluminium oxide film	Aluminium nonsolid electrolyte
CF	Metallized plastic film capacitor	Plastic film	Vapour deposited metal film, or combination of vapour deposited metal film and metal foil
CG	Ceramic capacitor (type 3)	Ceramics	Coated metal film
CK	Ceramic capacitor (type 2)		
CL	Tantalum nonsolid electrolytic capacitor	Tantalum oxide film	Tantalum nonsolid electrolyte
CM	Mica capacitor	Mica	Coated metal film and/or metal foil
CQ	Plastic film capacitor	Plastic film	Metal foil
CS	Tantalum solid electrolytic capacitor	Tantalum oxide film	Tantalum solid electrolyte
CU	Metallized mixed film capacitor	Combination of different plastic films	Vapour deposited metal film, or combination of vapour deposited metal film and metal foil
CW	Mixed film capacitor		Metal foil

4.2.2 Style The symbol denoting style shall be presented by two numerals as given in Attached Table 1. However, it may be specified in the capacitor standard that a third numeral is added to these two numerals to discriminate the connection of elements, existence of insulation, attachment method, electrodes, construction, and so on.

Remarks: The style shall be classified by outline, enclosure system, kind of termination, direction of termination, presence of connecting sleeve, and presence of mounting structure.

4.2.3 Characteristics The symbol denoting characteristics shall be presented by two or three English capital letters other than I and O, and shall be specified in the capacitor standard. However, the last letter which indicates category temperature range shall be as specified in Table 2.

Table 2. Category temperature range

Unit: °C

Symbol	Category temperature range °C	Symbol	Category temperature range °C
A	− 55 to + 155	G	− 44 to + 85
B	− 55 to + 125	J	− 25 to + 85
C	− 55 to + 100	K	− 25 to + 70
D	− 55 to + 85	P	− 55 to + 105
E	− 40 to + 125	Q	− 40 to + 105
F	− 40 to + 100	R	− 25 to + 105

Remarks: The symbols are based on Table 1 of JIS C 5002. However, P, Q and R are the symbols specified by this Standard (JIS C 5101).

4.2.4 Rated voltage The symbol denoting rated voltage shall be presented by the combination of two alphanumerical characters; the first one is a numeral and the second one is an English capital letter as given in Table 3.

Table 3. Rated voltage

Unit: V

First character	Second character									
	A	B	C	D	E	F	G	H	J	K
0	1.0	1.25	1.6	2.0	2.5	3.15	4.0	5.0	6.3	8.0
1	10	12.5	16	20	25	31.5	40	50	63	80
2	100	125	160	200	250	315	400	500	630	800
3	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
4	10000	12500	16000	20000	25000	31500	40000	50000	63000	80000

Remarks: The first character represents power of 10 by which the number indicated by the second character is multiplied, and the second characters correspond to R 10 preferred numbers specified as the basic numerals in JIS Z 8601.

Examples: 0J ... 6.3 V 1H ... 50 V 2D ... 200 V

4.2.5 Rated capacitance The symbol denoting rated capacitance shall be expressed by three numerals. The first and second numerals shall represent the significant figures of rated capacitance in picofarad (pF) or microfarad (μF), and the third numeral shall represent the number of zeros following the significant figures. If there is a decimal point, it shall be expressed by an English capital letter R, and in this case, all the minerals are significant figures.

Examples: R50...0.5 pF (or μF), 1R0...1 pF (or μF), 1R5...1.5 pF (or μF), 150...15 pF (or μF), 151...150 pF (or μF)

Remarks: R50 and 1R0 may be denoted as 0R5 and 010 respectively, but it is recommended not to use such symbols.

4.2.6 Tolerances on capacitance The symbol denoting tolerances on capacitance shall be expressed by one English capital letter as given in Table 4. However, as for capacitors with rated capacitance of 10 pF or less, this symbol shall be as given in Table 5.

Table 4. Tolerances on capacitance
(for capacitance exceeding 10 pF)

Unit: %									
Symbol	B	C	D	F	G	J	K	M	N
Tolerance	± 0.1	± 0.25	± 0.5	± 1	± 2	± 5	± 10	± 20	± 30
Symbol	P	Q	S	T	V	Z			
Tolerance	+ 100 0	+ 30 - 10	+ 50 - 20	+ 50 - 10	+ 20 - 10	+ 80 - 20			

Table 5. Tolerances on capacitance
(for capacitance 10 pF or less)

Unit: pF					
Symbol	B	C	D	F	G
Tolerance	± 0.1	± 0.25	± 0.5	± 1	± 2

4.2.7 Grade The symbol denoting grade shall be expressed by one English letter as given in Table 6.

Table 6. Grade

Symbol	Description of grade
B	A general level applicable to capacitors for which the quality assurance program in Annex 1, quality level, test details, etc. are required at relatively higher levels.
C	A simplified level applicable to capacitors for which a level lower than the general level is required and some parts of test items may be omitted.
E	A level corresponding to the "assessment level E" in the corresponding International standard.
X	A level to which the quality assurance specified in Annexes is not applicable.

Informative reference: The "assessment level E" of corresponding International Standard in the row of symbol E means the "assessment level E" specified in the sectional specifications based on IEC 384-1.

4.2.8 Failure rate level The symbol denoting failure rate level shall be expressed by one English letter as given in Table 7.

Table 7. Failure rate level

Unit: %/1000 h

Symbol	Failure rate
M	1.0
P	0.1
R	0.01
S	0.001
X	Unspecified

4.2.9 Other necessary items Symbols denoting other necessary items shall be used when considered necessary to indicate performance, construction, materials that cannot be expressed by 4.2.1 to 4.2.8 and other necessary items. In such cases, applicable symbols shall be specified in capacitor standards. However, symbols specified in Table 7 shall not be used.

5. Rating

5.1 Category temperature range The category temperature range shall be as given in Table 2.

5.2 Rated voltage Rated voltage shall be expressed in volt (V), and the numerical values given in Table 3 shall be used.

5.3 Rated capacitance The rated capacitance shall be expressed in picofarad (pF) or microfarad (μ F), and a numeral selected from among the series of numbers E3 to E24 in Table 8 multiplied by 10^n (n is an integer) shall be used. However, as for capacitance of 10 pF or less, the numeral in Table 9 may be used.

Adoption of picofarad (pF) or microfarad (μ F) as the unit shall be specified in the relevant capacitor standard.

Table 8. E3 to E24 series of numbers

E3	1								2.2								4.7							
E6	1				1.5				2.2				3.3				4.7				6.8			
E12	1		1.2		1.5		1.8		2.2		2.7		3.3		3.9		4.7		5.6		6.8		8.2	
E24	1	1.1	1.2	1.3	1.5	1.6	1.8	2	2.2	2.4	2.7	3	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1

Table 9. Rated capacitance of 10 pF or less

Unit: pF

Numerical values for rated capacitance													
0.5	0.75	1	1.5	2	2.5	3	4	5	6	7	8	9	10

5.4 Tolerances on capacitance Tolerances on capacitance shall be expressed in percent (%) and classified into 15 kinds as given in Table 4. However, as for capacitors with rated capacitance of 10 pF or less, the tolerances shall be classified into 5 kinds as given in Table 5.

Remarks: Tolerance on capacitance of $\pm 5\%$ (J) is corresponding to rated capacitances of E24 series of numbers, that of $\pm 10\%$ (K) to rated capacitances of E12 series of numbers and that of $\pm 20\%$ (M) to rated capacitances of E6 series of numbers.

6. Materials, construction and dimensions

6.1 Materials Materials of each part which constitutes a capacitor shall be stable enough so that the functions of capacitor are satisfactory.

If necessary, requirements shall be specified in the relevant capacitor standard, for impregnant, filler materials, insulating materials, materials of enclosure, materials of termination, etc.

6.2 Construction The construction shall be specified in the relevant capacitor standards.

6.3 Dimensions

6.3.1 External dimensions Numerical values in R10 preferred numbers (specified in JIS Z 8601) multiplied by 10^n (n is an integer) numbers shall be used for external dimensions. In some special cases, however, numerical values in R20 preferred numbers multiplied by 10^n may be used.

The spacing between lead wire terminations in a capacitor with terminations in the same direction shall be $2.5N$ (N is a positive integer) mm.