

JAPANESE INDUSTRIAL STANDARD

JIS C 5141-1991

Fixed aluminium electrolytic capacitors with non-solid
electrolyte for use in electronic equipment

ERRATA

Page	Position	Wrong	Correct
13	Performance, Variation rate of capacitance, No. 5 in Table 11	$\pm 1.5\%$	$\pm 15\%$
16	Informative reference, Twisting strength of screw termination, No. 6 in Table 11	20 N·m(0.20 kgf·m)	2.0 N·m(0.20 kgf·m)
54	Difference in rated voltage exceeding 200V, Acceptance number, Group 2 _B , in Table 3, Annex 2	2 ⁽⁶⁾	2 ⁽⁷⁾

Remarks: This errata is for correcting the first edition of this Standard.

Japanese Standards Association

JIS

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Fixed aluminium electrolytic capacitors with non-solid electrolyte for use in electronic equipment

Ⓔ JIS C 5141—1991

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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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Fixed aluminium electrolytic capacitors
with non-solid electrolyte for use
in electronic equipment

C 5141-1991

1. Scope

This Japanese Industrial Standard specifies polarized aluminium electrolytic capacitors with non-solid electrolyte employing aluminium oxide film as the dielectric mainly used in d.c. circuit (hereafter referred to as "capacitors") based on JIS C 5140.

Remarks 1. The following Standards are cited in this Standard.

JIS C 0805-Packaging of Electronic Components on Continuous Tapes (Components with Axial Type and Radial Wire Lead Terminals)

JIS C 2809-Flat Quick-Connect Terminals

JIS C 5101-General Rules of Fixed Capacitors for Electronic Equipment

JIS C 5102-Test Methods of Fixed Capacitors for Electronic Equipment

JIS C 5140-General Rules of Fixed Electrolytic Capacitors for Use in Electronic Equipment

JIS C 5700-General Rules for Reliability Assured Electronic Components

JIS Z 9015-Sampling Inspection Procedures and Tables by Attributes with Severity Adjustment (Receiving Inspection Where a Consumer Can Select Suppliers)

2. Corresponding international standards are given below.

IEC 384-4 (1985) Fixed capacitors for use in electronic equipment. Part 4: Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte

IEC 384-4-1 (1985) Fixed capacitors for use in electronic equipment. Part 4: Blank detail specification: Aluminium electrolytic capacitors with non-solid electrolyte. Assessment level E.

3. The units and numerical values given in { } in this Standard are based on the traditional units and are appended for informative reference.

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2. Definitions

For the purpose of this Standard, the definitions given in JIS C 5140 apply.

3. Type designation

3.1 Structure of type designation The type designation shall be structured by arranging the symbols as given below.

Symbol denoting kind of capacitor	Symbol denoting style	Symbol denoting character- istic	Symbol denoting rated voltage	Symbol denoting nominal capacit- ance	Symbol denoting tolerance on capacitance
3.2.1	3.2.2	3.2.3	3.2.4	3.2.5	3.2.6

Example CE 04 WG 1H 100 M

Symbol denoting grade	Symbol denoting failure rate level	Symbol denoting size of case	Symbol denoting processing of lead wire termination
3.2.7	3.2.8	3.2.9	3.2.10

Example C X Q0B1 T

3.2 Symbols

3.2.1 Kind of capacitor The symbol denoting kind of capacitor shall be CE.

3.2.2 Style The symbols denoting style shall be as given in Table 1.

Table 1. Style

Symbol	Outline	Enclo- sure	Termination		Sleeve	Remarks
			Kind	Direction		
02	Cylind- rical	Metal case	Lead wire	Opposite	With	—
04				Same		
331			Internal thread			
332			External thread			
621			Soldering lug			
622			Quick-connect terminal (male tub)			

Table 1. (Continued)

Symbol	Outline	Enclosure	Termination		Sleeve	Remarks
			Kind	Direction		
692			For printed circuit board (self-standing type)	2 terminations		Each forms one element, and the termination without connection shall be as given in Attached Fig. 7
693				3 terminations		
694				4 terminations		
695				5 terminations		

3.2.3 Characteristic The symbol denoting characteristic shall consist of a combination of two English capital letters, one representing the difference in applicable performance; test item and test conditions and the other representing the category temperature range, as shown in Table 2.

Table 2. Characteristic

Item		Characteristic symbol							
		HQ	HR	HG	HJ	WQ	WR	WG	WJ
Content		Capacitor whose performances are stable for a longer period as compared with general capacitor				General capacitor			
Difference in test items and conditions	Surge voltage	To be tested at upper category temperature				To be tested at ordinary temperature			
	Change of temperature and immersion cyclic	Applicable				Not applicable			
	Low air pressure	Applicable				Not applicable			
	Loading at elevated temperature	2000 h with ripple current superposed				1000 h without ripple current superposed			
Category temperature range °C		-40 to +105	-25 to +105	-40 to +85	-25 to +85	-40 to +105	-25 to +105	-40 to +85	-25 to +85

Remarks: Other than mentioned in the table, the specified value of leakage current or the like differs in the first symbol H and W.

3.2.4 Rated voltage The symbol denoting rated voltage shall be as given in Table 3.

Table 3. Rated voltage and surge voltage

Symbol	Rated voltage V	Surge voltage V	Symbol	Rated voltage V	Surge voltage V
0G	4	5	2A	100	125
0J	6.3	8	2C	160	200
1A	10	13	2D	200	250
1C	16	20	2E	250	300
1E	25	32	2F	315	365
1V	35	44	2V	350	400
1H	50	63	2G	400	450
1J	63	79	2W	450	500

3.2.5 Nominal capacitance The symbol denoting nominal capacitance shall consist of three numerals.

The first and second numerals shall represent the significant figures of nominal capacitance in the unit of microfarad (μF), and the third numeral shall represent the number of zeros following the significant figures. However, if there is a decimal point, it shall be expressed by an English capital letter R, and in this expression all the numerals shall be significant figures.

Example: R10 0.1 μF R47 0.47 μF
 1R0 1.0 μF 2R2 2.2 μF
 100 10 μF 330 33 μF
 151 150 μF 472 4700 μF

3.2.6 Tolerance on capacitance The symbol denoting tolerance on capacitance shall be as given in Table 4.

Table 4. Tolerance on capacitance

Symbol	Tolerance on capacitance %
M	± 20
Q	$\begin{matrix} + 30 \\ - 10 \end{matrix}$
T	$\begin{matrix} + 50 \\ - 10 \end{matrix}$

3.2.7 Grade The symbol denoting grade shall be as given in Table 5.

The combination of this grade symbol and the first symbol of characteristic (difference in performance, test item and applicable conditions) shall be as given in Table 6.

Table 5. Grade

Symbol	Content of grade
B	A grade that needs quality assessment of "general level I"
C	A grade that needs quality assessment of "simplified level"
E	A grade that needs quality assessment of "general level II"
X	A grade for which quality assessment is not specified.

Remarks: General level I and simplified levels correspond to the general level and simplified level specified in JIS C 5700, respectively.

Informative reference: General level II corresponds to Assessment level E specified in IEC 384-4-1.

Table 6. Combination of grade symbol and first symbol of characteristic

Grade symbol	B	C	E		X
First symbol of characteristic	H	W	H	W	W

Informative reference: Capacitors of grade E having the first symbol of characteristic H correspond to the long-life grade capacitors specified in IEC 384-4, and capacitors with first symbol of characteristic W correspond to the general-purpose grade capacitors specified in IEC 384-4.

3.2.8 Failure rate level The symbol denoting failure rate level shall be as given in Table 7.

Table 7. Failure rate level

Symbol	Failure rate % 1000 h	Applicable grade
M	1.0	B, C, E
P	0.1	
R	0.01	
X	Not specified	B, C, E, X

3.2.9 Size of case The symbol denoting size of case (hereafter referred to as the "case symbol") shall consist of four characters.

The first and second characters express the nominal value of the case diameter and the third and fourth characters express the nominal value of case length (or height).

Each of the first and third characters shall consist of an English capital letter which expresses the basic numerical value in the unit of millimeters (mm) and each of the second and fourth characters shall be a numeral for power of 10 to be multiplied to the basic numerical value.

In Table 8, the sizes when the second and fourth characters are 0, 1 and 2 are shown.

Table 8. Case symbol and case size

Unit: mm

First and third characters	Second and fourth characters		
	When 0	When 1	When 2
A	1.0	10.0	100
B	1.1	11.0	112
C	1.3	12.5	125
D	1.4	14.0	140
E	1.6	16.0	160
F	1.8	18.0	180
G	2.0	20.0	200
H	2.2	22.4	224
J	2.5	25.0	250
K	2.8	28.0	-
L	3.0	(¹)30.0/31.5	
M	3.6	(¹)35.0/35.5	
N	4.0	40.0	
P	4.5	45.0	
Q	5.0	50.0	
R	5.6	56.0	
S	6.3	60.0/63.0(¹)	
T	7.0	71.0/76.0(¹)	
U	8.0	80.0	
V	9.0	90.0	

Note (¹) 30.0, 35.0, 63.0 and 76.0 are applicable for diameter only.

Example: Q0A1 ... Diameter 5.0 mm Length 10 mm
 L1Q1 ... Diameter 30.0 mm Height 50 mm
 T1D2 ... Diameter 76.0 mm Height 140 mm

3.2.10 Processing of lead-wire termination The symbol denoting processing of lead-wire termination is employed when the lead-wire terminations are processed or the products are taped and shall consist of an English capital letter as shown in Table 9.

Table 9. Processing of lead-wire termination

Symbol	Classification by processing of lead-wire termination
F	Products with processed lead-wire termination
T	Taped products

4. Ratings

4.1 Category temperature range The category temperature range shall be as shown in Table 2.

4.2 Rated voltage and surge voltage The rated voltage and corresponding surge voltage shall be as given in Table 3.

4.3 Nominal capacitance The nominal capacitance shall be expressed in microfarad (μF) and the numerical values shall be 10^n (n is an integer) times the preferred number of E3 or E6 series given in Table 10.

Table 10. Preferred numbers of E3 and E6 series

E3	1.0		2.2		4.7	
E6	1.0	1.5	2.2	3.3	4.7	6.8

4.4 Tolerance on capacitance The tolerance on capacitance shall be as given in Table 4.

4.5 Permissible maximum ripple current The permissible maximum ripple current shall be expressed by the r.m.s. value of the maximum ripple current at 120 Hz which is permitted when the rated voltage is applied to the capacitor at the upper category temperature, and this current is subjected to agreement between the parties concerned with acceptance.

4.6 Combination of rated voltage and nominal capacitance for each style, each characteristic and each grade The combination of rated voltage and nominal capacitance for each style, each characteristic and each grade is subjected to agreement between the parties concerned with acceptance.

Further, the case size corresponding to this combination shall be chosen from Attached Figures 1 to 6, as agreed between the parties concerned with acceptance.

5. Performances and test methods

5.1 Test methods The test methods shall be as specified in JIS C 5102. However, the test methods of taping shall be as specified in JIS C 0805.

The test method when JIS C 0805 is not applicable and the test method of processed lead wire termination are subjected to agreement between the parties concerned with acceptance.

5.2 Voltage treatment If there is a provision for voltage treatment in the test methods of Table 11, the treatment shall be as given below.

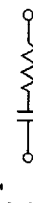
Prior to the initial measurements, a protective resistor of approximately $1\text{ k}\Omega$ is connected to the capacitor in series, a d.c. voltage equal to the rated voltage is applied for 1 h, and then the capacitor is discharged through a resistor of approximately $1\ \Omega/\text{V}$. Then the capacitor is allowed to stand under the standard conditions for 12 to 48 h.

5.3 Performances The performances shall be as specified in Table 11. However, performances relating to the taping and lead-wire processing of products with taping and processed lead-wire termination shall be as specified in JIS C 0805 or as agreed between the parties concerned with acceptance.

Table 11. Performance and test methods

No.	Item	First symbol of characteristic	Performance				Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
			H		W			
			B	E	C, X	E		
1	Current leakage	When product of C_R and U_R is not exceeding 1000 μC	Not more than 0.01 $C_R \cdot U_R \mu\text{A}$ or 1 μA whichever is the larger	Not more than 0.05 $C_R \cdot U_R \mu\text{A}$ or 5 μA whichever is the larger	As specified in 7.7. Voltage treatment: Carry out the voltage treatment of 5.2 in this Standard (JIS C 5141). However, if there is no dispute on the decision, this be omitted.		Series protective resistor: Approximately 1 k Ω . However, a resistor of smaller than 1 k Ω may be used so that the applied voltage reaches the rated voltage within 1 min. Applied voltage: Rated voltage Timing of measurement: Five minutes after the rated voltage is attained. However, if the current is below the specified value and further decrease or stability is recognized, the measuring time for judgement may be shortened.	
	When product of C_R and U_R is exceeding 1000 μC	Not more than 0.006 $C_R \cdot U_R \mu\text{A}$ +4 μA or 10000 μA whichever is the smaller	Not more than 0.03 $C_R \cdot U_R \mu\text{A}$ +20 μA or 10000 μA whichever is the smaller	Standard resistor in voltage drop method: 1000 $\pm$ 10 Ω				

Table 11. (Continued)

No.	Item	First symbol of characteristic	Performance				Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
			H		W			
			Grade	B	E	C, X		
2	Capacitance		Within specified tolerance				As specified in 7.8. Measuring conditions: 4 of Table 10.	Measuring frequency: 120 Hz + 20 % Measuring circuit: series equivalent circuit () Measuring voltage: 0.5 Vrms max. + 1.5 to 2.0 V d.c. If there is no dispute on the decision, superimposition of d.c. voltage may be omitted.
3	Tangent of loss angle	Rated voltage ≤ 10 V	0.5 max.				As specified in 7.9. Measuring conditions: 4 of Table 10.	
		10 V < rated voltage ≤ 25 V	0.35 max.					
		25 V < rated voltage ≤ 63 V	0.25 max.					
		Rated voltage > 63 V	0.2 max.					
			For a capacitor whose $C_R \cdot U_R$ is exceeding 100000 μC , the above value plus 0.02 for each 1000 μF (less than 1000 μF is rounded off to 1000 μF) is the limit (see Table 12).					

Remarks: In this table C_R indicates nominal capacitance in the unit of microfarad (μF) and U_R indicates rated voltage in the unit of volt (V).

The unit of the product $C_R \cdot U_R$ is micro coulomb (μC).

Table 11. (Continued)

No.	Item	First symbol of characteristic	Performance					Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
			H		W				
Grade			B	E	C, X	E			
4	Step 2	Lower category temperature -25°C	Impedance ratio				As specified in 7.12. Measuring method: Static method, Table 12 Step 1: Measurement of capacitance and impedance Step 2: Measurement of impedance Step 3: No measurement of electric performance Step 4: Measurement of current leakage, capacitance and tangent of loss angle Step 5: Not applied Measurement of impedance: As specified in 7.11. Measuring frequency: 120 Hz + 10 % Calculation of impedance ratio in step 2: Multiplier to the value at step 1	Temperature °C	Time at each step: Time until thermal equilibrium (temperature stability) is achieved. Measuring voltage of impedance: The value which has no effect on measured value through 1 min continuous application.
			Rated voltage and Z_{11}/Z_0	4 V max.	6.3 V $\leq$ 16 V max.	16 V $\leq$ 160 V max.			
	Step 4	Upper category temperature 85°C	Current Leakage				Upper category temperature 105°C	Upper category temperature + 2	Upper category temperature + 2
			Rated voltage and Z_{11}/Z_0	4 V max.	6.3 V $\leq$ 250 V max.	250 V $\leq$ 350 V max.			
Variation of characteristic by temperature			Remarks: For capacitors with rated voltage exceeding 350 V, the impedance ratio shall be as agreed between the parties concerned with acceptance.						

Table 11. (Continued)

No.	Item	Performance					Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)	
		First symbol of characteristic	H		W				
			Grade	B	E	C, X			E
5	Surge voltage	Appearance	No remarkable abnor- mality.					As specified in 7.14. Voltage treatment: Carry out the voltage treatment of 5.2 in this Standard (JIS C 5141). However, if there is no dispute on the decision, this may be omitted. Test temperature: Upper category temperature + 2°C for first symbol of characteristic H, and 15 to 35°C for W. Calculate protective resistance <i>R</i> from the following formula: $R \text{ (k}\Omega\text{)} = \frac{100 \pm 50}{C_R}$ Discharge: Not carried out Applied voltage: The surge voltage shown in Table 3 of this Standard (JIS C 5141)	Voltage application: 1000 cycles of charging for 30 + 5 s with a period of 6 + 0.5 min.
		Current leakage	To satisfy No. 1						
		Variation rate of capacitance	+ 1.5 % of the value before test						
		Tangent of loss angle	To satisfy No. 3						

Remarks: C_R indicates nominal capacitance on the unit of microfarad (μF).

Table 11. (Continued)

No.	Item	First symbol of characteristic	Performance				Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)							
			Performance												
			H	W											
Grade	B	E	C, X	E	As specified in 8.1	Kind of termination	Nominal diameter of wire (d) mm	Tensile force N{kgf}	Duration s						
	Such abnormalities as breakage, loosening shall not appear.														
6	Robustness of termination	Tensile strength of termination	Such abnormalities as breakage, loosening shall not appear.							Lead-wire termination	0.3 < d ≤ 0.5	5 {0.51}	10 ± 1		
			0.5 < d ≤ 0.8	10 {1.0}											
			0.8 < d ≤ 1.25	20 {2.0}											
			-	20 {2.0}											

Table 11. (Continued)

No.	Item	Performance					Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)												
		First symbol of characteristic		H	W															
		Grade	B		E	C, X			E											
6	Bending strength of lead-wire termination (applicable for styles 02 and 04)						As specified in 8.1. Carry out this test following the tensile test of termination.	<table><tr><th>Nominal diameter of wire (d) mm</th><th>Bending force N {kgf}</th><th>Informative reference: Mass of weight kg</th></tr><tr><td>0.3 < d ≤ 0.5</td><td>2.5 {0.25}</td><td>0.25</td></tr><tr><td>0.5 < d ≤ 0.8</td><td>5 {0.51}</td><td>0.51</td></tr><tr><td>0.8 < d ≤ 1.25</td><td>10 {1.0}</td><td>1.0</td></tr></table> Suspend a weight corresponding to bending strength, bend the body through 90° and return it to the original position. Carry out these operations during 2 to 3 s and count it as one cycle. Carry out similar operations in the opposite direction and count it as two cycles. Test cycle: 2 cycles	Nominal diameter of wire (d) mm	Bending force N {kgf}	Informative reference: Mass of weight kg	0.3 < d ≤ 0.5	2.5 {0.25}	0.25	0.5 < d ≤ 0.8	5 {0.51}	0.51	0.8 < d ≤ 1.25	10 {1.0}	1.0
Nominal diameter of wire (d) mm	Bending force N {kgf}	Informative reference: Mass of weight kg																		
0.3 < d ≤ 0.5	2.5 {0.25}	0.25																		
0.5 < d ≤ 0.8	5 {0.51}	0.51																		
0.8 < d ≤ 1.25	10 {1.0}	1.0																		

Table 11. (Continued)

No.	Item	Performance					Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
		First symbol of characteristic		W				
		Grade	B	E	C, X	E		
6	Bending strength of lug termination (applicable for styles 621, 622, 692, 693, 694 and 695)						As specified in 8.1. Carry out this test following the tensile test of termination. Method: Method I	Minimum sectional area (s) mm ²
	Tensile force N{kgf}							
	Twisting strength of screw termination (applicable for styles 331 and 332)						0.5 < s ≤ 1	10 { 1.0 }
							1 < s	25 { 2.5 }
							Gradually apply a tensile force, in the weakest direction of termination, up to the specified force and maintain the force for 30 + 5 s. If the termination bends, return it to the original position and apply a force similarly in the opposite direction. Carry out such a series of operations once.	
							As specified in 8.1. Test condition: Condition 1 Carry out this test following the tensile test of termination.	Test torque of screw termination: 20 N·m{0.20 kgf·m} Duration: 10 to 15 s

Table 11. (Continued)

No.	Item	First symbol of characteristic	Performance				Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
			H	B	E	C, X		
7	Resistance to vibration	Capacitance (during test)	The measured values shall be stable					Mounting method: For style 02, fix the lead wire at a point 6 + 1 mm from the body, use a mounting device separately for the one with a diameter 14 mm or more or with a length 40 mm or more. For style 04, fix the lead wire at a point not more than 4 mm from the body, use mounting device separately for the one with a diameter 12.5 mm or more or with a length 25 mm or more. Fix capacitors of other styles by using mountign devices. Vibration frequency range: 10 to 55 Hz Sweeping time: Approximately 1 min for 10-55-10 Hz Direction and duration of vibration: 3 directions of X, Y and Z, each 2 h, 6 h in total
		Appearance	No remarkable abnormality.					
		Variation rate of capacitance	+ 5 % of the value before the test.					

Table 11. (Continued)

No.	Item	First symbol of characteristic	Performance				Test method (JIS C 5102)	Informative reference (Essential point of JIS C 5102)
			H		W			
		Grade	B	E	C, X	E		
8	Resist- ance to shock (appli- cable to grade E)	Appearance	-	No re- mark- able abnor- mality	-	No re- mark- able abnor- mality	As specified in 8.3. Test conditions: Half sine wave Peak acceleration: 490 m/s ² {50 G} Pulse duration: 11 ms Variation rate of capacitance: Varia- tion from the value before change of temperature cyclic test.	Relative velocity change: 3.4 m/s Mounting method: Mount the specimen by means of a mounting device so that the specified shock is applied to the body and termination.
		Variation rate of capacitance		Within + 5 % of the value before test	Within + 5 % of the value before test			
9	Solderability (not applicable to styles 331, 332 and 622)		At least 3/4 of the peripheral surface immersed shall be covered with new solder.				As specified in 8.4. Treatment of termina- tion: Not carried out Test method: Method 1	Kind of solder: H60A, H60S or H63A Flux: Ethanol solution of colophony (25 wt%) Temperature of solder: 235 + 5°C Duration of immersion into solder: 2 + 0.5 s Depth of immersion: A point 1.5 to 2.0 mm from root of termination with a thermal screen used. Speed of immersion: 25 + 2.5 mm/s