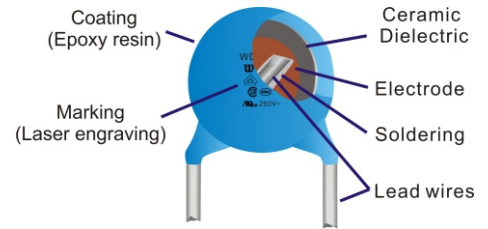


**INTRODUCTION**

- Complies with IEC60384-14
- Single Layer AC Disc Safety Capacitor
- Coated with flame-retardant epoxy resin (conforming to UL94V-0)
- Lead with tin plated copper wire, inert metal copper or silver as a coating after the electrode, see diagram
- Halogen-free available



**RECOGNITIONS** : made for RFE by UL/VDE/CQC shop Welson

Approved monogram	Country	Standards	Rated Voltage		Certification Number	
			KL (X1Y2)	WD (X1Y1)	KL (X1Y2)	WD (X1Y1)
	USA	UL 60384-14	X1 : 500Vac Y2 : 500Vac	X1 : 760Vac Y1 : 500Vac	E104572	
	Canada					
	Germany	EN60384-14 (0565-1-1) : 2014-04 EN60384-14: 2013-08 IEC 60384-14 ed. 4	X1 : 440Vac Y2 : 300Vac	X1 : 660Vac Y1 : 500Vac	40016156	4016157
						Korea
	China	GB/T 6346.14-2015	X1 : 400Vac Y2 : 250Vac	X1 : 400Vac Y1 : 250Vac	CQC03001008380	CQC03001008379

**ELECTRICAL CHARACTERISTICS**

Characteristics	WD type (X1 Y1)	KL type (X1 Y2)
Capacitance range	1pF to 0.01uF	1pF to 0.015uF
Rated voltage	X1: 660/400Vac; Y1: 500/250Vac	X1: 440/400Vac; Y2: 300/250Vac
Dielectric strength	4000Vac (50Hz-60Hz, 50mA max.) for 1 minute.	2500Vac (50Hz-60Hz, 50mA max.) for 1 minute.
Capacitance (CR)	Within the specified tolerance. Y5P, Y5U, Y5V, X7R measured at 1kHz±20% ----- C0G, SL measured at 1MHz±20% Both are 1Vrms, 25	
Dissipation Factor (tanδ) or Q Value	SL and C0G: Q ≥ 400+20CR (CR < 30pF) Q ≥ 1000 (CR ≥ 30pF) Measured condition see "Capacitance"	Y5P, Y5U, X7R: tanδ: 0.025 max.   Y5V: tanδ: 0.050 max.
Insulation resistance	10,000MΩ minimum at 500VDC for 1 minute.	
Operating temperature	-55°C to 125°C	

### ■ CAPACITANCE CHART

Class	X1 Y2 ( KL type )						X1 Y1 ( WD type )					
	C0G (C)	SL (L)	Y5P (B)	X7R (X)	Y5U (E)	Y5V (F)	C0G (C)	SL (L)	Y5P (B)	X7R (X)	Y5U (E)	Y5V (F)
Capacitance (pF)	1.0	G	G	G			G	G	G			
	1.5	G	G	G			G	G	G			
	2.2	G	G	G			G	G	G			
	3.3	G	G	G			G	G	G			
4.7	G	G	G			J	J	I				
5.1	G	G	G	G		J	J	I	I			
6.8	J	J	I			K	K	J				
10	J	G	I	G		K	G	J	J			
12		G	I	G			G	J	J			
15		G	I	G			G	J	J			
18		G	I	G			G	J	J			
20		G	I	G			G	J	J			
22		G	I	G			G	J	J			
27		J	I	G			G	J	K			
30		J	I	G			G	J	K			
33		J	I	G			G	J	K			
36		J	I	G			G	K	K			
39		J	I	G			G	K	K			
47		K	I	G			L	K	K			
56		K	K	G			L	K	K			
68		K	K	G			L	K	K			
82		K	K	G			L	K	K			
100			G	G				K	K	G		
120			G	G				K	K	G		
150			G	G				K	K	G		
180			G	G				K	K	G		
220			G	G				K	K	G		
270			G	G				K	K	G		
330			G	G	E			K	K	G		
390			J	I	E			K	K	G		
470			J	I	E	E		K	K	G	G	
560			J	I	E	E		K	K	G	G	
680			J	I	E	E		K	L	G	G	
820			J	J	E	E		L	L	I	G	
860			J	J	E	E		L	L	I	G	
1000			L	J	G	G		N	N	I	G	
1200			L	M	G	G		N	N	I	G	
1500			N	M	I	I		O	O	K	I	
1800			N		I	I		R	R	K	J	
2000			O		J	I		R	R	K	J	
2200			O		J	I		R	R	L	J	
2700					L	I				L	K	
2800					L	J				L	K	
3000					L	J				M	L	
3200					L	J				M	L	
3300					L	J				M	L	
3600					M	K				O	M	
3900					M	K				O	M	
4000					M	K				O	M	
4700					N	L				Q	M	
5000					N	L				Q	N	
5500					N	L				Q	N	
5600					O	L				Q	N	
6000					O	M				S	N	
6800					O	M				S	N	
8000					R	N				S	Q	
8200					R	N				S	Q	
8600					S	N				S	R	
9000					S	O				T	R	
10000					S	O				U	R	
15000					U	Q						
Lead Spacing (F) (±1.0mm)	5.0 & 7.5 & 10.0						7.5 & 10.0					
Thickness (T) max.	6.0mm						6.0mm					
Capacitance Tolerance	Below 10pF: ±0.25pF or ±0.50pF; 10pF~100pF: ±5% or ±10%; Over 100pF: ±10% or ±20%											
Coating	Epoxy resin (UL94V-0)											
Body Color	Blue											

■ **HOW TO ORDER**

5 - KL F 472 M AC2K5 10 Y 5  
(1) (2) (3) (4) (5) (6) (7) (8)

1. **Type Code:** KL class X1-Y2 ; WD class X1-Y1

2. **Temperature Characteristic:**

Code	Temp. Coefficient	Code	Temp. Coefficient	Code	Temp. Coefficient
C	C0G	B	Y5P	E	Y5U
S	SL	X	X7R	F	Y5V

3. **Capacitance Code:**

Expressed by three-digit alphanumeric. The unit is pico-farad (pF). The first and second figures are significant digits, and the third figure expresses the number of zeros which follow the two numbers. If there is a decimal point in between first two figures, it is expressed by the capital letter "R". See below examples:

Code	Capacitance	Code	Capacitance	Code	Capacitance
5R1	5.1 pF	100	10 pF	472	4700 pF
8R0	8 pF	101	100 pF	103	0.1 uF

4. **Capacitance Tolerance Code**

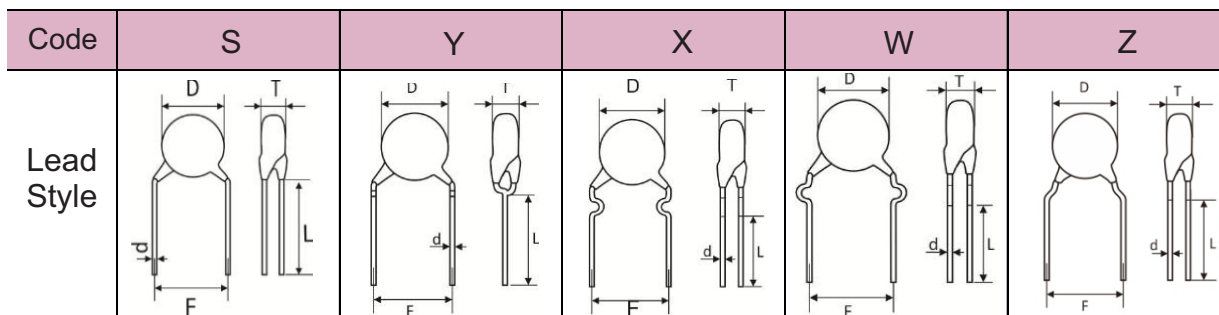
Code	Tolerance	Code	Tolerance	Code	Tolerance
C	± 0.25pF	J	± 5%	M	± 20%
D	± 0.50pF	K	± 10%	Z	+80/-20%

5. **Minimum Test Voltage (AC) :** X1Y2 = AC2K5, X1Y1 = AC4KV

6. **Lead Spacing (F)**

Code	Lead spacing (F)	Code	Lead spacing (F)
5	5.0±0.8mm	7	7.5±0.8mm
6	6.35±0.8mm	10	10.0±0.8mm

7. **Lead style**



8. **Lead length & package style:**

Omitted for un-cut bulk pack or Code L

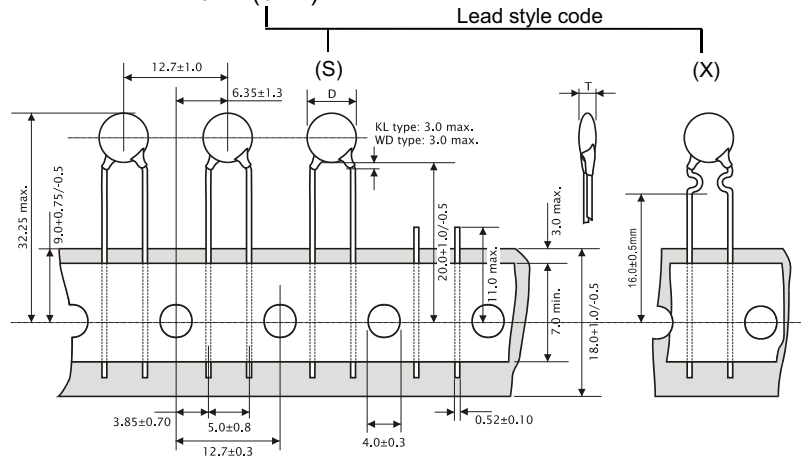
5 = 5+/-1mm, bulk pack, 6 = 6+/-1mm ... etc. (cut leads only available in bulk pack)

A = Taped & Ammo pack, R = Taped & on Reel

■ **TAPING SPECIFICATION**

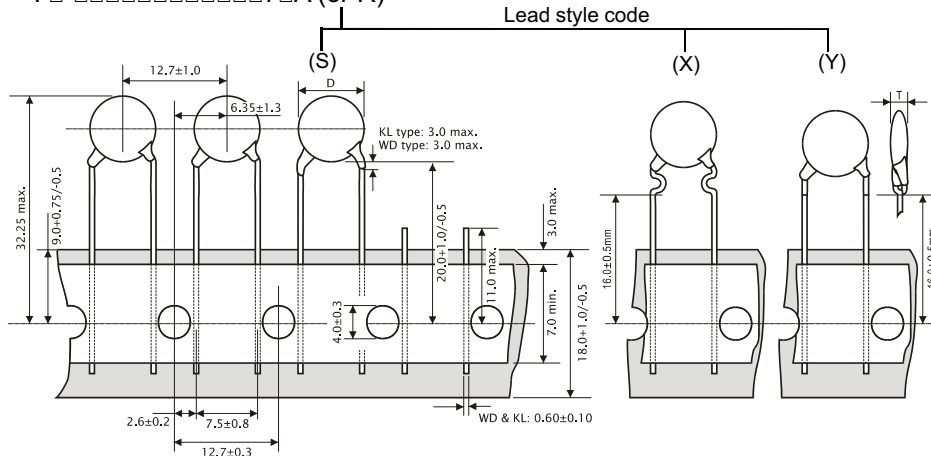
Lead spacing (F): 5mm

P/N : □-□□□□□□□□□□5□A (or R)



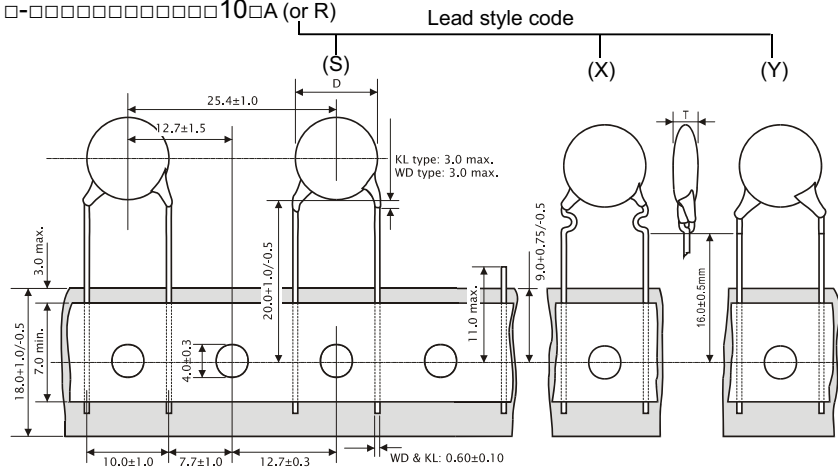
Lead spacing (F): 7.5mm

P/N : □-□□□□□□□□□□7□A (or R)



Lead spacing (F): 10.0mm

P/N : □-□□□□□□□□□□10□A (or R)



### SPECIFICATION AND TEST METHOD

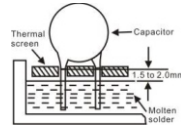
1. Please measure with the ambient temperature of  $25 \pm 2^\circ\text{C}$ , relative humidity of 45~85 percent.
2. Please measure in this order: Capacitance, DF, IR, Test voltage
3. Measurement of voltage of high-voltage capacitors should be based on  $150\text{V}/\mu\text{s}$  rate, rise from 0V voltage. The test of time can be increased to test the voltage start time. Measuring the end of the capacitor should discharge.

No.	Item	Specification	Testing Method																												
1	Appearance and Dimensions	No marked defect on appearance form and dimensions are within specified range.	The capacitor should be visually inspected for evidence of defect. Dimensions should be measured with slide calipers.																												
2	Marking	To be easily legible	The capacitor should be visually inspected																												
3	Capacitance (CR)	Within specified tolerance	The capacitor and dissipation factor should be measured at $25 \pm 1^\circ\text{C}$ with $1 \pm 0.2\text{KHz}$ (char. C & L: $1 \pm 0.2\text{MHz}$ ) and $AC5\text{V(r.m.s.)}$ max.																												
4	Dissipation Factor ( $\tan \delta$ ) or Q Value	Char.		Specification																											
		C, S		$Q \geq 400 + 20\text{CR}$ (CR < 30pF) $Q \geq 1000$ (CR $\geq 30\text{pF}$ )																											
		X, B, E		$\tan \delta: 0.050$ max.																											
		F	$\tan \delta: 0.075$ max.																												
5	Insulation Resistance (I.R.)	10,000M $\Omega$ min.	The insulation resistance should be measure with DC500 $\pm 50\text{V}$ within 60 $\pm 5$ sec. of charging. The voltage should be applied to the capacitor through a resistor of 1M $\Omega$ .																												
6	Between Lead Wires	No failure	<p>The capacitor should not be damaged when test voltages of Table 1 are applied between the lead wires for 60 sec. (Charge/Discharge current =50mA)</p> <table border="1"> <caption>&lt; Table 1 &gt;</caption> <thead> <tr> <th>Type</th> <th>KL</th> <th>WD</th> </tr> </thead> <tbody> <tr> <td>Test Voltage</td> <td>AC2500V</td> <td>AC4000V</td> </tr> </tbody> </table>	Type	KL	WD	Test Voltage	AC2500V	AC4000V																						
	Type	KL	WD																												
Test Voltage	AC2500V	AC4000V																													
Body Insulation	No failure	<p>First, the terminals of the capacitor should be connected together. Then, as shown in figure at right, a metal foil should be closely wrapped around the body of the capacitor to the distance of about 3 to 4mm from each terminal.</p> <p>Then, the capacitor should be inserted into a container filled with metal balls of about 1mm diameter. Finally, AC voltage of Table 2 is applied for 60 sec. between the capacitor lead wires and metal balls.</p> <table border="1"> <caption>&lt; Table 2 &gt;</caption> <thead> <tr> <th>Type</th> <th>KL</th> <th>WD</th> </tr> </thead> <tbody> <tr> <td>Test Voltage</td> <td>AC2500V</td> <td>AC4000V</td> </tr> </tbody> </table>	Type	KL	WD	Test Voltage	AC2500V	AC4000V																							
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Test Voltage	AC2500V	AC4000V																													
7	Temperature Characteristics	<table border="1"> <thead> <tr> <th>Char.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>Within <math>\pm 10\%</math></td> </tr> <tr> <td>X</td> <td>Within <math>\pm 15\%</math></td> </tr> <tr> <td>E</td> <td>Within <math>+20\%</math> / <math>-55\%</math></td> </tr> <tr> <td>F</td> <td>Within <math>+30\%</math> / <math>-80\%</math></td> </tr> </tbody> </table> <p>(Temp range: <math>-25</math> to <math>+85^\circ\text{C}</math>)</p> <table border="1"> <thead> <tr> <th>Char.</th> <th>Temperature Coefficient</th> </tr> </thead> <tbody> <tr> <td>C</td> <td><math>0 \pm 30\text{ppm}/^\circ\text{C}</math></td> </tr> <tr> <td>S</td> <td><math>+350</math> to <math>-1000\text{ppm}/^\circ\text{C}</math></td> </tr> </tbody> </table> <p>(Temp range: <math>-25</math> to <math>+85^\circ\text{C}</math>)</p>	Char.	Capacitance Change	B	Within $\pm 10\%$	X	Within $\pm 15\%$	E	Within $+20\%$ / $-55\%$	F	Within $+30\%$ / $-80\%$	Char.	Temperature Coefficient	C	$0 \pm 30\text{ppm}/^\circ\text{C}$	S	$+350$ to $-1000\text{ppm}/^\circ\text{C}$	<p>The capacitance measurement should be made at each step specified in Table 3.</p> <table border="1"> <caption>&lt; Table 3 &gt;</caption> <thead> <tr> <th>Step</th> <th>Temperature (<math>^\circ\text{C}</math>)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><math>20 \pm 2</math></td> </tr> <tr> <td>2</td> <td><math>-25 \pm 2</math></td> </tr> <tr> <td>3</td> <td><math>20 \pm 2</math></td> </tr> <tr> <td>4</td> <td><math>85 \pm 2</math></td> </tr> <tr> <td>5</td> <td><math>20 \pm 2</math></td> </tr> </tbody> </table>	Step	Temperature ( $^\circ\text{C}$ )	1	$20 \pm 2$	2	$-25 \pm 2$	3	$20 \pm 2$	4	$85 \pm 2$	5	$20 \pm 2$
Char.	Capacitance Change																														
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4	$85 \pm 2$																														
5	$20 \pm 2$																														

continue ...

**SPECIFICATION AND TEST METHOD** (continue ...)

No.	Item	Specification	Testing Method								
8	Solderability of Leads	Lead wire should be soldered with uniform coating on the axial direction over 3/4 of the circumferential direction.	The lead wire of a capacitor should be dipped into molten solder for 2±0.5 sec. The depth of immersion is up to about 1.5 to 2.0mm from the root of lead wires.  Temp. of solder: Lead Free Solder (Sn-3Ag-0.5Cu) 245±5°C H63 Eutectic Solder (Pb37/Sn63) 235±5°C								
9	Soldering Effect (Non-Preheat)	Appearance	No marked defect								
		Capacitance change	C, S: ±5% or 1pF, whichever is larger B: ±10% X, E, F: ±20%								
		I.R.	1,000MΩ min								
		Dielectric Strength	Per Item 6								
10	Soldering Effect (On-Preheat)	Appearance	No marked defect								
		Capacitance change	C, S: ±5% or 1pF, whichever is larger B: ±10% X, E, F: ±20%								
		I.R.	1,000MΩ min								
		Dielectric Strength	Per Item 6								
11	Vibration Resistance	Appearance	No marked defect								
		Capacitance	Within the specified tolerance								
		tan δ or Q	Per Item 4								
12	Humidity (Under Steady State)	Appearance	No marked defect								
		Capacitance change	C: Within ±2.5% S: Within ±5% X, B, E: Within ±10% F: Within ±15%								
		tan δ or Q	<table border="1"> <thead> <tr> <th>Char.</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>C, S</td> <td>Q ≥ 275+5/2C<sub>R</sub> (C<sub>R</sub> &lt; 30pF) Q ≥ 350 (C<sub>R</sub> ≥ 30pF)</td> </tr> <tr> <td>X, B, E</td> <td>tan δ: 0.050 max.</td> </tr> <tr> <td>F</td> <td>tan δ: 0.075 max.</td> </tr> </tbody> </table>	Char.	Specification	C, S	Q ≥ 275+5/2C <sub>R</sub> (C <sub>R</sub> < 30pF) Q ≥ 350 (C <sub>R</sub> ≥ 30pF)	X, B, E	tan δ: 0.050 max.	F	tan δ: 0.075 max.
			Char.	Specification							
			C, S	Q ≥ 275+5/2C <sub>R</sub> (C <sub>R</sub> < 30pF) Q ≥ 350 (C <sub>R</sub> ≥ 30pF)							
X, B, E	tan δ: 0.050 max.										
F	tan δ: 0.075 max.										
I.R.	3,000MΩ min										
Dielectric Strength	Per Item 6										
13	Humidity Loading	Appearance	No marked defect								
		Capacitance change	C: Within ±2.5% S: Within ±5% X, B, E: Within ±10% F: Within ±15%								
		tan δ or Q	<table border="1"> <thead> <tr> <th>Char.</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>C, S</td> <td>Q ≥ 275+5/2C<sub>R</sub> (C<sub>R</sub> &lt; 30pF) Q ≥ 350 (C<sub>R</sub> ≥ 30pF)</td> </tr> <tr> <td>X, B, E</td> <td>tan δ: 0.050 max.</td> </tr> <tr> <td>F</td> <td>tan δ: 0.075 max.</td> </tr> </tbody> </table>	Char.	Specification	C, S	Q ≥ 275+5/2C <sub>R</sub> (C <sub>R</sub> < 30pF) Q ≥ 350 (C <sub>R</sub> ≥ 30pF)	X, B, E	tan δ: 0.050 max.	F	tan δ: 0.075 max.
			Char.	Specification							
			C, S	Q ≥ 275+5/2C <sub>R</sub> (C <sub>R</sub> < 30pF) Q ≥ 350 (C <sub>R</sub> ≥ 30pF)							
		X, B, E	tan δ: 0.050 max.								
F	tan δ: 0.075 max.										
I.R.	3,000MΩ min										
Dielectric Strength	Per Item 6										
			The capacitor should be firmly soldered to the supporting lead wire and vibrated at a frequency range of 10Hz to 55Hz, 1.5mm in total amplitude, with about a 1 minute rate of vibration change from 10Hz to 55 Hz and back to 10Hz. Apply for a total of 6 hrs., 2 hrs each in 3 mutually perpendicular directions.  Set the capacitor for 500±12 hrs., at 40±2°C in 90 to 95% relative humidity.  Post-treatment: Capacitor should be stored for 1 to 2 hrs. at room condition.								



continue ...

**SPECIFICATION AND TEST METHOD** (continue ...)

No.	Item	Specification	Testing Method						
14	Appearance	No marked defect	<p>Impulse Voltage: Each individual capacitor should be subjected to a 5kV (Type X1Y1: 8kV) impulses for three times. After the capacitors are applied to life test.</p> <p>Apply a voltage of Table 4 for 1000 hrs. at 125+2/-0°C, and relative Humidity of 50% max.</p> <p style="text-align: center;">&lt; Table 4 &gt;</p> <table border="1" style="margin: auto;"> <tr> <th colspan="2">Applied Voltage</th> </tr> <tr> <td colspan="2" style="text-align: center;">AC425V (r.m.s.), except that once each hour the Voltage is increased to AC1000V (r.m.s.) for 0.1 sec.</td> </tr> </table> <p>Post-treatment: Capacitor should be stored for 1 to 2 hrs. at room condition</p>	Applied Voltage		AC425V (r.m.s.), except that once each hour the Voltage is increased to AC1000V (r.m.s.) for 0.1 sec.			
	Applied Voltage								
	AC425V (r.m.s.), except that once each hour the Voltage is increased to AC1000V (r.m.s.) for 0.1 sec.								
	Capacitance change	C: Within ±2.5% S: Within ±5% X, B, E: Within ±10% F: Within ±15%							
I.R.	3000MΩ min								
	Life Test	Dielectric Strength	Per Item 6						
15	Flame Test	The capacitor flame discontinues as follows.	<p>The capacitor should be subjected to applied flame for 15 sec. And then removed for 15 sec. until 5 cycles are completed.</p> <table border="1" style="margin: auto;"> <thead> <tr> <th>Cycle</th> <th>Time (sec.)</th> </tr> </thead> <tbody> <tr> <td>1 to 4</td> <td>30</td> </tr> <tr> <td>5</td> <td>60</td> </tr> </tbody> </table>	Cycle	Time (sec.)	1 to 4	30	5	60
		Cycle		Time (sec.)					
1 to 4	30								
5	60								
16	Robustness of Terminations	Tensile	<p>Fix the body of the capacitor and apply a tensile weight gradually to each lead wire in the radial direction of the capacitor up to 10N and keep it for 10±1 sec.</p>						
		Bending	<p>Each lead wire should be subjected to 5N weight and then a 90° bend, at the point of egress, in one direction, return to original position, and then apply a 90° bend in the opposite direction at the rate of one bend in 2 to 3 sec.</p>						
17	Active Flammability	The cheese-cloth should not be on fire	<p>The capacitor should be individually wrapped in at least one but not more than two complete layers of cheese-cloth. The capacitor should not be subjected to 20 discharges. The interval between successive discharges should be 5 sec. The UAC should be maintained for 2 minutes after the last discharge.</p> <p>C1, 2 : 1uF ± 10% C3 : 0.33uF ± 5%, 10KV, Ct : 3uF ± 5%, 10KV Cx : Capacitor under test F : Fuse, Rated 10A R : 100? ± 5% Ur : Rated Voltage Ut : Voltage applied to Ct. L1 to 4 : 1.5mH ± 20%, 16A Rod core choke</p>						
18	Passive Flammability	The burning time should not exceed 30 sec. The tissue paper should not ignite.	<p>The capacitor under test should be held in the flame in the position which best promotes burning. Each specimen should only be exposed once to the flame. Time of exposure to flame : 30 sec.</p> <p>Length of flame : 12 ± 1mm Gas burner : Length 35mm min Inside Dia. 0.5 ± 0.1mm Outside Dia 0.9mm max. Gas : Butane gas Purity 95% min</p>						

continue ...

### ■ SPECIFICATION AND TEST METHOD (continue ...)

No.	Item	Specification	Testing Method																											
19	Temperature and Immersion Cycle	Appearance	No marked defect																											
		Capacitance change	C: Within $\pm 2.5\%$ S: Within $\pm 5\%$ X, B, E: Within $\pm 10\%$ F: Within $\pm 15\%$																											
		tan $\delta$ or Q	Per Item 4																											
		I.R.	3,000M $\Omega$ min																											
		Dielectric Strength	Per Item 6																											
			<p>The capacitor should be subjected to 5 temperature cycles, then consecutively to 2 immersion cycles.</p> <p style="text-align: center;">&lt; Temperature Cycle &gt;</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (<math>^{\circ}</math>C)</th> <th>Time (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-25+0/-3</td> <td>30</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>3</td> </tr> <tr> <td>3</td> <td>125+3/-0</td> <td>30</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>3</td> </tr> </tbody> </table> <p style="text-align: right;">Cycle time : 5 cycle</p> <p style="text-align: center;">&lt; Immersion Cycle &gt;</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (<math>^{\circ}</math>C)</th> <th>Time (min)</th> <th>Immersion Water</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>65+5/-0</td> <td>0<math>\pm</math>3</td> <td>Clean water</td> </tr> <tr> <td>2</td> <td>15</td> <td>15</td> <td>Salt water</td> </tr> </tbody> </table> <p style="text-align: right;">Cycle time : 2 cycle</p> <p>Pre-treatment: Capacitor should be stored at 85<math>\pm</math>2<math>^{\circ}</math>C for 1hr., and then placed at room condition for 24<math>\pm</math>2 hrs. before initial measurements.</p> <p>Post-treatment: Capacitor should be stored for 24<math>\pm</math>2 hrs. at room condition.</p>	Step	Temperature ( $^{\circ}$ C)	Time (min)	1	-25+0/-3	30	2	Room temperature	3	3	125+3/-0	30	4	Room temperature	3	Step	Temperature ( $^{\circ}$ C)	Time (min)	Immersion Water	1	65+5/-0	0 $\pm$ 3	Clean water	2	15	15	Salt water
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### ■ STORAGE ENVIRONMENT

Do not use or store capacitors in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. And avoid exposure to moisture. Store the capacitors where the temperature and relative humidity do not exceed 5 to 40 degree centigrade and 20 to 70%.