

KS

KOREAN INDUSTRIAL STANDARD

Capacitors for Electrical Apparatus

KS C 4805 : 2002

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KS C 4805 : 2002
(MOD KS C IEC 60252)

Capacitors for Electrical Apparatus

1. Scope

This Korean Industrial Standard specifies capacitor ⁽¹⁾ with less than 1000V single-phase alternating current of rated voltage at common frequency on the followings:

- a) One used by connecting to winding wire of inducing electromotor used in single-phase circuit ⁽²⁾
- b) One used by connecting to room lamp circuit with the aim of power factor improvement ⁽³⁾

Annotation

- ⁽¹⁾ Capacitors mentioned here refers to one using paper-plastic film being impregant as conductor or mixed material of these or non-impregnant plastic film by using deposition metal membrane or metal foil.
- ⁽²⁾ This shall not be applied to electrolysis capacitor for alternating current used only for starting electromotor. Also, this shall not be applied to capacitor used for power factor improvement by connecting to electromotor in parallel.
- ⁽³⁾ Part of capacitor not aiming for power factor improvement, although it is included in the same capacitor case as one for power factor improvement, shall be excluded.

Remarks

The standard correspondent to this standard shall be as follows:

KS C IEC 60252

Alternating current motor capacitor

KS C IEC 61048

General requirements on the safety of capacitor used for room lamp circuit

KS C IEC 61049

Requirements on the performance of capacitor used for fluorescent lamp and discharging lamp

2. Normative References

The standards specified in the following contain provisions which, through reference in this text, constitute provisions of this standard. The most recent editions of the standards shall be applied.

KS C 1307	High-insulation resistor
KS C 2301	Electric insulating oil
KS C 2331	Capacitor foil paper

KS C 2332	Metal paper for condenser
KS C 2344	Polyester film for electricity
KS C 2374	Polypropylene for electricity
KS D 6705	Aluminum and aluminum foil

3. Definition

Definition of main terminology used for this standard shall be as follows:

a) Self-recovery

In case of a part of conductor is dielectric breakdown, the ability of capacitor is restored momentarily as extremely thin electrode area close to destruction point is exterminated

b) Deposition Electrode Capacitor

Capacitor that can recover itself with the structure in which one of capacitor paper and plastic film or mixed material of these is conductor having deposition metal as electrode

c) Foil Electrode Capacitor

Capacitor that loses its capability and cannot recover itself with the structure in which one of capacitor paper and plastic film or mixed material of these is conductor having deposition metal as electrode, when a part of conductor is in dielectric breakdown

d) Device

Minimum constituent unit of capacitor consisting of electrode parts and conduct insulation

e) Case

Container that contains device of capacitor

f) Closed (1)

Structure protecting capacitor device from outside air by being closed by case

g) Closed (2)

One closed by case at opening entry part and charging material and structure protecting capacitor device from outside air by omitting case and wrapping with resin or molding

h) Terminal

Iron or lead line in order to connect wiring by pulling conducting line from device to outside of case

i) Bushing

Insulating metal case and terminal when pulling conducting line from device to outside of case

j) Discharging Resistor

Resistor connected between terminals of capacitor for discharging remaining charge in case of separating capacitor exclusively from power

k) Capacitor Imbedded with Safety Device

In case of creating abnormality inside of capacitor in order to raise safety of capacitor, one imbedded with device that can separate capacitor from power

l) Capacitor Attached with Safety Instrument

In case of creating abnormality inside of capacitor in order to raise safety of deposition electrode capacitor, one with device having capability that can separate capacitor from power

m) Stable Short-circuit

In case creating a state of short-circuit as abnormality inside of capacitor, the state that there is no smoke or notable leakage of impregnant, and terminal voltage is connected almost to zero.

n) Rated Frequency

Frequency determined for the use of capacitor

o) Rated Voltage

The effective value of sine wave voltage that can be consecutively permitted between terminals of capacitor, and the voltage that is indicated on the case

p) Rated Electrostatic Volume

Electrostatic volume of capacitor at 20°C that is indicated on the case. The unit is micro farad (μF)

q) Rated Current

The value estimated from rated frequency, rated electrostatic volume and rated voltage by using the following equation:

$$I = 2\pi fCU \times 10^{-6}$$

Here, I : Rated current (A)

f : Rated frequency (Hz)

C : Rated electrostatic volume (μF)

U : Rated voltage (V)

r) Rated Volume

The value estimated from rated frequency, rated electrostatic volume and rated voltage by using the following equation:

The unit is var.

$$Q = 2\pi fCU^2 \times 10^{-6}$$

Here,

Q : Rated volume (var)

f : Rated frequency (Hz)

C : Rated electrostatic volume (μF)

U : Rated voltage (V)

s) Conducting Time Classification

Time aimed in design, in order to plan reasonably in accordance with use time of used instrument

t) Maximum Permissible Temperature

Limit of temperature permissible at maximum temperature part of capacitor case, when capacitor and instrument with capacitor are in normal operation, and their temperature becomes consistent

u) Minimum Surrounding Temperature

Limit of low temperature side of surrounding temperature that can permit maximum permissible voltage to capacitor without difficulty

v) Maximum Permissible Voltage ⁽⁴⁾

Excessive voltage limit of rated frequency that does not cause practical difficulty ⁽⁵⁾, even though being consecutively permitted between terminals of capacitor. However, momentary voltage shall not be included.

Annotation

⁽⁴⁾ The following excessive voltage shall be included in maximum permissible voltage:

- 1) Excessive voltage by changes in power voltage
- 2) Excessive voltage by characteristics of instrument attaching capacitor

⁽⁵⁾ "Not cause practical difficulty" refers not to reach the state reducing considerably life expectancy, and performance and the like may not be agreed necessarily with the specified value in rating state.

w) Maximum Permissible Current ⁽⁶⁾

Limit of excessive current with no practical difficulty even though being flown consecutively between terminals of capacitor

Annotation

⁽⁶⁾ The following excessive current shall be included in maximum permissible current:

- 1) Current increased by high-frequency current of circuit
- 2) Current increased by momentary excessive voltage with less than maximum permissible voltage
- 3) Current increased by permissible error at the plus side on rated electrostatic volume

x) Maximum Permissible Volume ⁽⁷⁾

Maximum volume (var) limit not causing practical difficulty even though using capacitor consecutively

Annotation

⁽⁷⁾ The following increase volume (var) shall be included in maximum permissible volume (var):

- 1) Volume increased by high-frequency voltage of circuit
- 2) Volume increased by momentary excessive voltage with less than maximum permissible voltage
- 3) Volume increased by permissible error at the plus side on rated electrostatic volume

y) Loss Rate

Ratio of capacitor loss (W) on the volume value (var) of capacitor

z) Acceptance-Delivery Examination

Rot examination when shipping and purchasing consisting of non-destruction test

aa) Format Examination

Examination used for certification and regular inspection consisting of total test, including destruction test.

4. Standard Use State

Standard use state shall be as follows, and capacitor shall be used in this state as long as there is no particular specification:

a) Minimum Surrounding Temperature

Minimum surrounding temperature shall be -25°C or -10°C

b) Relative Moisture

Relative moisture shall be less than 85%

c) Altitude

Altitude shall be as follows:

- 1) One used in induction electromotor is less than 2000m
- 2) One used in room lamp circuit is less than 3000m

5. Excessive Load Use Condition

Excessive load use condition shall be as follows:

1) Maximum Permissible Voltage

Maximum permissible voltage shall be 110% of rated voltage.

2) Maximum Permissible Current

Maximum permissible current shall be 130% of rated current.

3) Maximum Permissible Volume

Maximum permissible volume shall be 135% of rated volume.

6. Type

6.1 Type by Use

Type by use shall be as in Table 1.

Table 1 Classification by use

Use	Symbol
For electromotor	MC
For room lamp	LC

6.2 Constitution of Device, Closed Structure, Safety Structure and Type by Whether or Not Discharging Resistance

Constitution of device, closed structure, safety structure and type by whether or not discharging resistance are as in Table 2.

Table 2 Type by structure of device, closed structure, security structure and whether or not discharging resistance

Structure of device	Closed structure	Symbol	Security structure	Symbol	Discharging resistance
Deposited electrode capacitor	Closed(1)	SH(1)	Security device imbedded	P1	Exist (symbol R) Not exist
			Security device attached	P2	
			Not exist	-	
	Closed(2)	SH(1)	Security device attached	P2	
			Not exist	-	
Foil electrode capacitor	Closed(1)	NH(1)	-	-	
	Closed(2)	NH(1)	-	-	

7. Rating

Rating is as in Table 3.

Table 3 Rating

Rating	For electromotor					For room lamp	
Rated frequency	60						
Rated voltage	less than 1000						
Rated electrostatic volume	0.1 ~ 120						
Conducting time classification (symbol)	40000 (40D)	25000 (25D)	10000 (10D)	20000 (2D)	40000 (40D)		
Maximum surrounding temperature(℃) (symbol)	-10 (A)			-25 (B)			
Maximum permissible temperature(℃) (symbol)	55 (L)	60 (N)	65 (X)	70 (M)	75 (Y)	80 (H)	85 (Z)

8. Performance

8.1 Withstand Voltage

Withstand voltage shall endure this when testing in accordance with #10.3. However, intermittent self-recovery may be done when permitting test voltage between terminals of deposition electrode capacitor.

8.2 Electrostatic Volume

The value of electrostatic volume shall be within the range of permissible error that is indicated in capacitor on rated electrostatic volume when testing in accordance with #10.4.

Also, symbol correspondent to the permissible error of rated volume and each shall be as in Table 4.

Table 4 Electrostatic Volume Permissible Error

Electrostatic volume permissible error %	Symbol
+20 -5	W
±10	K
+10 -5	U
±5	J

8.3 Insulation Resistance

Insulation resistance shall be more than 2000M case of converting insulation resistance between terminal and case collectively to one terminal when testing in accordance with #10.5.

Annotation

(⁸) "Conversion of one terminal" refers to the real measured resistance value multiplied by the number of collective terminals.

8.4 Loss Rate and High-Temperature Loss Rate

Loss rate and high-temperature loss rate shall be less than the value agreed between people related to acceptance-delivery when testing respectively in accordance with #10.6 and #10.7.

8.5 Closed

Regarding being closed, there shall be no leakage [in case of liquid impregnant (⁹)] or generation of consecutive foam [in case of solid impregnant (¹⁰) and non-impregnant] when being applied to closed (1) capacitor and testing in accordance with #10.8.

Annotation

(⁹) Make one with diffuence at heating temperature of closed test a liquid impregnant

(¹⁰) Make one with diffuence at heating temperature of closed test a solid impregnant

8.6 Moisture-proof

Moisture-proof shall satisfy Table 5 when testing in accordance with #10.9.

Table 5 Performance After Moisture-proof Test

Test item	Performance after test
Appearance	Shall not be significant abnormality
Withstand voltage	Shall be in accordance with #8.1
Electrostatic volume	Change rate on initial value shall be $\pm 5\%$
Insulating resistance	Shall be more than 1/2 of the value specified in #8.3
High-temperature loss rate	Shall be less than 1.1 time of initial value. However, for capacitor using only plastic film on dielectric substance, the increased value shall be less than 0.5×10^{-3}

8.7 Durability

Durability shall satisfy Table 6 when testing in accordance with either of a) or b) of #10.10.

Table 6 Performance After Durability Test

Test item	Performance after test
Appearance	Shall not be significant abnormality
Electrostatic volume	Change rate on initial value shall be $\pm 5\%$. However, for one with security device, the change rate on initial value shall be $\pm 7\%$.
High-temperature loss rate	Shall be less than 1.2 time of initial value. However, for capacitor using only plastic film on dielectric substance, the increased value shall be less than 0.5×10^{-3}

8.8 Dischargeability

Dischargeability shall be less than 50V when being applied to capacitor imbedded with discharging resistor and testing in accordance with #10.11.

8.9 Self-recovery

Regarding self-recovery, there shall be no notable reduction in electrostatic volume when being applied to deposition electrode capacitor and testing in accordance with a) of #10.12 for electromotor and with b) of #10.12 for room lamp.

8.10 Security

Capacitor imbedded with security device or capacitor attached with security instrument shall satisfy Table 7 when being applied to capacitor attaching security instrument and testing in accordance with #10.13 for electromotor and with #10.14 for room lamp.

Table 7 Performance After Security Test

Test item		Performance after test	
		For electromotor	For room lamp
Appearance		Shall not be notable leakage of smoke composition and impregnant	
Withstand voltage between terminals		Shall be in accordance with #8.1 ⁽¹¹⁾	Shall be in accordance with #8.1
Current	Security device imbedded	Current flowing in capacitor shall be zero or stabilized short-circuited	Current flowing in capacitor shall be zero
	Security device attached	Current flowing in capacitor shall be nearly zero or stabilized short-circuited	Current flowing in capacitor shall be nearly zero
Withstand voltage between blanket terminal and case		Shall be in accordance with #8.1	

9. Structure

9.1 General Structure

Structure shall be easy to handle, and each part of it shall have enough intensity for practical use. Also, needed number of devices shall be contained in one case of capacitor, and terminal connected to wiring shall be installed in capacitor. However, attaching part and terminal cover shall be attached only in case of being needed in accordance with the agreement between people related to acceptance-delivery. Closed structure shall be as in Table 8.

Table 8 Closed Structure

Item	Classification of closed structure		
	Closed (1)	Closed (2)	
Case	Metal case Non-metal case	Metal case with opening Non-metal case with opening	No case
Closed type	Soldering Packing Gluing Depositing	Resin charging	Wrapped by resin film or resin charging Wrapped with resin or mold
Dielectric substance	Capacitor paper and plastic film Plastic film Capacitor paper	Plastic film	
Impregnant	Liquid impregnant Solid impregnant Non- impregnant		

9.2 Device

Device of deposition electrode capacitor shall consist of metal paper for capacitor specified in **KS C 2332**, capacitor foil for conductor specified in **KS C 2331**, polyester film for electricity specified in **KS C 2344**, polypropylene film for electricity specified in **KS C 2374** or mixed substance of these or at least the equivalent.

Device of foil electrode capacitor shall consist by inserting polypropylene film for electricity specified in **KS C2374**, or at least the equivalent insulating material or mixed substance of these between aluminum foil specified **KS D 6705**, and at least the equivalent foil electrodes.

9.3 Case

Case shall be made of tin or other appropriate materials, have enough intensity to protect device, and be anti-rust processed with painting or appropriate methods, in case that there is worry of creating rust. The thickness of non-metal material shall be more than 0.8mm⁽¹²⁾. However, omit case in closed structure of being closed (2), and it is good to make it outer skin of device by wrapping with resin film or molding with resin. In this case, the thickness of outer skin shall be more than 0.8mm⁽¹²⁾.

Annotation

(¹²) In case the place where the capacitor is being used does not seem to harm human body, it is not necessary to meet the above requirement if agreed by both parties participating in delivery and receipt.

9.4 Impregnant

Impregnant shall be insulating oil specified in **KS C 2301**, wax type or at least one with the equivalent performance.

9.5 Charging Material

Charging material shall be resin, such as polyester, epoxy, polystyrene, or at least on with equivalent performance.

9.6 Terminal

Terminal shall be yellow copper that can connect wiring effectively, or at least practically the equivalent, and be one having enough, in consideration of mechanical intensity and current density. In case that there is worry of creating rust, it shall be anti-rust processed by painting or other methods.

Also, although drawing lead line can be terminal in closed (2) capacitor, the same consideration shall be done in this case.

9.7 Bushing

Bushing shall be made of magnetic container or other materials. In case of being attached to

capacitor, it shall have the structure with firm closed ability-withstand voltage and insulating ability.

9.8 Terminal Cover

Terminal cover shall be made of resin and other materials, shall be electrically safe and enough intensity, and shall have easy structure to be connected to wiring.

9.9 Attaching Entry

Attaching entry shall be made of tin or soft steel plate, resin and other materials, shall have good weatherability and enough mechanical intensity, and shall be anti-rust processed on metals, in which rust can be easily created. Attaching entry of resin case may be incorporated and formed with case or terminal cover.

10. Test

10.1 Test Condition

Test shall be conducted in temperature $(20 \pm 2)^{\circ}\text{C}$ and relative moisture $(65 \pm 5\%)^{\circ}\text{C}$. And in case that there is worry of having question on judgment, the test may be conducted in room temperature $(20 \pm 15)^{\circ}\text{C}$ and relative moisture $[(65 \pm 20)\%]^{\circ}\text{C}$.

10.2 Structure Test

For structure test, examine items specified in #9 and #13.

10.3 Withstand Voltage Test

For withstand voltage test, permit test voltage specified in Table 9 for the time specified in Table 9, and test if it endures close to 60Hz sine wave between collective terminals and case or terminals of other devices.

When permitting voltage, make sure that there shall be no worry of creating excessive voltage by over voltage, and the voltage shall be permitted for the designated time after reaching the designated test voltage within 10 seconds by permitting designated test voltage at the very first time or adding less than 1/2 of test voltage, and increasing it slowly.

Also, in case case consists of insulating material, wrap surface with metal foil or soak the case in conducting liquid, and test it between collected terminals.

The test in deposition electrode capacitors shall be done ahead of other tests.