

ERRATA

Page 7

7.6

Error: Three-phase capacitor $I_N = \frac{Q_N}{\sqrt{3} U_N} \times 10^{-3}$ or $\frac{Q_B}{\sqrt{3} U_L} \times 10^{-3}$

Correct: Three-phase capacitor $I_N = \frac{Q_N}{\sqrt{3} U_N} \times 10^3$ or $\frac{Q_B}{\sqrt{3} U_L} \times 10^3$

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

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Low-voltage power capacitors

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International 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 Japan Electrical Manufacturers' Association (JEMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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

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Low-voltage power capacitors

Introduction This Japanese Industrial Standard has been prepared based on IEC 60831-1 *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V—Part 1 : General—Performance, testing and rating—Safety requirements—Guide for installation and operation* published in 1996 as the second edition and IEC 60831-2 *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V—Part 2 : Ageing test, self-healing test and destruction test* published in 1995 as the second edition, but some modification and addition are made thereon.

In this Standard, the portions with sidelines or underlined with dots mean the matters not stated in the corresponding International Standards or modified matters.

1 Scope This Japanese Industrial Standard specifies phase advance metallized capacitors to be used indoors in a circuit at an a.c. voltage not exceeding 600 V and at power frequency being connected in parallel to the load, for the purpose of power factor improvement (hereafter referred to as “capacitors”).

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

IEC 60831-1 : 1996 *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V—Part 1 : General—Performance, testing and rating—Safety requirements—Guide for installation and operation* (MOD)

IEC 60831-2 : 1995 *Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V—Part 2 : Ageing test, self-healing test and destruction test* (MOD)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of coming into effect (or publication) is given to these referred standards, only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter are not applied. The normative references without the indication of the year of coming into effect (or publication) apply limiting only to the most recent edition (including amendments).

JIS C 2318 *Polyethylene terephthalate (PET) films for electrical purposes*

Remarks : IEC 60674-3-2 : 1992 [*Specification for plastic films for electrical purposes—Part 3 : Specifications for individual materials—Sheet 2 : Requirements for balanced biaxially oriented polyethylene terephthalate (PET) films used for electrical insulation*] is corresponding to the above JIS.

JIS C 2320 *Electrical insulating oils*

Remarks : IEC 60296 : 1982 [*Specification for unused mineral insulating oils for transformers and switchgear. Amendment No. 1 (1986)*],

IEC 60465 : 1988 [*Specification for unused insulating mineral oils for cables with oil ducts*],

IEC 60836 : 1988 [*Specification for silicone liquids for electrical purposes*],

IEC 60867 : 1993 [*Insulating liquids—Specification for unused liquids based on synthetic aromatic hydrocarbons*],

IEC 60963 : 1988 [*Specification for unused polybutenes*] are corresponding to the above JIS.

JIS C 2330 *Polypropylene films for electrical purposes*

JIS C 3307 *600 V Polyvinyl chloride insulated wires*

JIS C 3316 *Polyvinyl chloride insulated wires for electrical apparatus*

JIS C 3342 *600 V Polyvinyl chloride insulated and sheathed cables*

JIS G 3303 *Tinplate and blackplate*

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

- a) **self-healing** When a part of dielectric breaks down, minute area of the electrode adjacent to the broken down point disappears, thus the function as a capacitor is instantaneously recovered. The self-healing means such recovery phenomenon.
- b) **metallized capacitor** A capacitor which employs metal deposit by evaporation as the electrodes so that the self-healing is possible.
- c) **capacitor element or element** A minimum unit of a capacitor consisting of a pair of electrodes and a dielectric insulating them.
- d) **case** A container to accommodate a capacitor element.
- e) **case enclosure** An enclosure of the case made of resin or other insulating materials.
- f) **lead-out terminal** A terminal to bring out the conductor from the element to the exterior of the case.
- g) **connection terminal** A terminal for connecting wiring to the lead-out terminal.
- h) **lead wire** A wiring lead conductor attached to the lead-out terminal or connection terminal of a capacitor.
- i) **discharge resistor** A resistor to be connected across the terminals of a capacitor for discharging the residual charge when the capacitor is disconnected from the power source.

- j) **capacitor with a built-in safety device** A metallized capacitor accommodating a device which can disconnect the capacitor from the power source if any abnormality develops inside the capacitor, in order to increase its safety.
- k) **capacitor with safety mechanism** A metallized capacitor whose element provides the function to disconnect the abnormal part from the power source, if any abnormality develops inside the capacitor, in order to increase its safety.
- l) **rated voltage (U_N)** The r.m.s. value of sinusoidal voltage which can be applied continuously across terminals of a capacitor.
- m) **circuit voltage (U_L)** The voltage between lines of a circuit to which an installation consisting of a combination of a series reactor and a capacitor is to be connected. This voltage is used as the reference for calculation of the rated voltage and rated capacitance.
- n) **rated frequency (f_N)** The frequency for which service of the capacitor is determined.
- o) **rated capacitance (C_N)** The rated value of total capacitance of a capacitor at 20 °C.
- p) **rated capacity (Q_N)** The reactive power when the rated voltage at the rated frequency is applied to the rated capacitance, which is calculated from the following formula:

$$Q_N = 2\pi f_N C_N U_N^2 \times 10^{-9}$$

where, Q_N : rated capacity (kvar)
 f_N : rated frequency (Hz)
 C_N : rated capacitance (μF)
 U_N : rated voltage (V)

- q) **rated installation capacity (Q_B)** The designed reactive power of an installation consisting of a combination of a series reactor and a capacitor when the rated voltage at the rated frequency is applied.
- r) **rated current (I_N)** The r.m.s. value of current when the rated voltage at the rated frequency is applied to the rated capacitance or rated capacity, which is obtained from the calculation formula of 6.6.
- s) **ambient temperature** The temperature of air in a place where the capacitor is installed.
- t) **highest ambient temperature** Limit of high ambient temperature at which the capacitor is capable of operating without trouble.
- u) **lowest ambient temperature** Limit of low ambient temperature at which the capacitor is capable of operating without trouble.
- v) **cooling air temperature** The temperature of air measured at a place about 0.1 m apart from the capacitor container at a height $\frac{2}{3}$ from the bottom during operation of capacitor. If the capacitors are placed in parallel at a spacing not more than 0.2 m, this is the temperature at the center of spacing during operation of the capacitor bank.

- w) **permissible highest voltage**⁽¹⁾ Limit of the overvoltage at the rated frequency which can be continuously applied across the terminals of a capacitor at which the capacitor is able to be operated practically with no trouble⁽²⁾, but momentary overvoltage is not included.

Notes (1) Permissible highest voltage includes the following overvoltages:

- a) Overvoltage due to variation of the source voltage.
- b) Overvoltage due to characteristics of the apparatus in which the capacitor is installed.

(2) "Practically with no trouble" means not to shorten the life remarkably, and the performance is not necessarily complied with the specified value at the rated condition.

- x) **permissible largest current**⁽³⁾ Limit of the overcurrent which can be passed continuously through the terminals of a capacitor at which the capacitor is able to be operated practically with no trouble.

Note (3) Permissible largest current includes the following overcurrents:

- a) Current increased due to the higher harmonic current of the circuit.
- b) Current increased due to short-time overvoltage not more than the permissible highest voltage.
- c) Current increased due to plus side tolerance on the rated capacitance.

- y) **interphase capacitance unbalance factor of three-phase capacitor** A factor calculated from the following formula:

$$\alpha = \frac{C_L}{C_S} \times 100$$

where, α : interphase capacitance unbalance factor (%)

C_S : minimum capacitance between terminals (μF)

C_L : maximum capacitance between terminals (μF)

- z) **loss factor** Ratio of capacitor loss value (kW) relative to capacitor capacity value (kvar).
- aa) **receiving facility** An electrical installation established for receiving electrical energy.
- ab) **acceptance inspection** The tests which are carried out on all capacitors before shipment.
- ac) **type inspection** The tests which are carried out on representative capacitors to certify that the capacitors are in conformity with the specified requirements.

4 Standard service conditions The standard service conditions shall be as follows and unless otherwise specified, a capacitor shall be used under these conditions:

- a) **Highest ambient temperature** The highest ambient temperature shall be 45 °C, but the mean temperature shall not exceed 35 °C over 24 h and 25 °C over a year.

- b) **Lowest ambient temperature** The lowest ambient temperature shall be -25°C or -5°C .
- c) **Relative humidity** The relative humidity shall be not more than 85 %.
- d) **Altitude** The altitude of the location shall be not more than 2 000 m.

5 Overload service conditions

- a) **Permissible highest voltage** The permissible highest voltage shall be as indicated in Table 1. Provided that, application of a voltage exceeding 1.15 times the rated voltage does not exceed 200 times over the life of the capacitor.

Table 1 Permissible highest voltage and permissible duration

Multiplier to rated voltage	Permissible duration of application
1.10	8 h or less during 24 h
1.15	30 min or less during 24 h
1.20	5 min or less
1.30	1 min or less

- b) **Permissible largest current** The permissible largest current shall be 1.3 times the rated current. If the measured value of the capacitance is within its tolerance and in plus side, the excess portion is approved to be added to the current.

6 Classification of capacitors The capacitors shall be classified by the insulation construction, sealing construction, safety construction, and number of phases as shown in Table 2.

Table 2 Classification of capacitors

Element	Construction	Metallized capacitor	
	Symbol	SH	
Type of insulation construction ⁽⁴⁾		Type E, Type N1, Type N2	
Type of sealing construction	Construction	Sealing (1) ⁽⁵⁾	Sealing (2) ⁽⁶⁾
	Symbol	SH (1)	SH (2)
Classification by safety construction		With a built-in safety device, with safety mechanism	
Number of phases		Single-phase, three-phase, single-phase/three-phase (used for both phases)	

Notes ⁽⁴⁾ See 9 Construction.

⁽⁵⁾ Sealing (1) means that a capacitor is sealed by a case in order to protect the capacitor elements from the atmosphere.

⁽⁶⁾ Sealing (2) means that a capacitor is sealed by a case with opening and filler, or a capacitor is enclosed or molded with resin by omitting the case so that capacitor elements are protected from the atmosphere.

7 Ratings

7.1 Rated frequency The rated frequency shall be 50 Hz or 60 Hz or 50 Hz/60 Hz (used for both frequencies).

7.2 Number of phases The phase(s) shall be single-phase, three-phases or single-phase/three-phase (used for both phases).

7.3 Rated voltage The rated voltages shall be 200 V, 234 V, 400 V and 468 V.

The rated voltages 200 V and 400 V are mainly applicable for capacitors which are used being connected with the principal electrical equipment as the load, and 234 V and 468 V are mainly applicable for receiving installation.

Remarks : It is the standard practice to connect 6 % series reactor to the capacitor bank used in a receiving installation, and the rated voltage is calculated from the following formula by taking the voltage rise due to the series reactor into consideration:

$$U_N = \frac{U_L}{1 - L/100}$$

where, U_N : rated voltage (V)

U_L : circuit voltage (220 V or 440 V)

L : % reactance of the reactor used in combination with the capacitor. $L = 6$ is utilized.

7.4 Rated capacitance The rated capacitance shall be expressed in microfarad (μF), and shall comply with Table 3.

Applicable rated voltages are 200 V and 400 V, and rated frequency is 50 Hz/60 Hz (used for both frequencies).

Table 3 Rated capacitance

Rated voltage V	Rated frequency Hz	Number of phases	Rated capacitance μF
200	50 Hz/60 Hz (used for both frequencies)	Single-phase	10 15 20 30 40 50 75 100 150 200
		Three-phase	250 300 400 500 600 750 900 1 000
		Single-phase/ three-phase	50 75 100 150 200 250 300 400 500 600 750 900 1 000
400		Single-phase	5 7.5 10 15 20 25 30 40 50
		Three-phase	75 100 125 150 200 250
		Single-phase/ three-phase	

7.5 Rated capacity The rated capacity shall be expressed in kilovar (kvar) and shall be calculated from the following formula, and be as given in Table 4.

Applicable rated voltages are 234 V and 468 V, and the number of phases is three.