

April, 2005

ERRATA

Page 15

4.4.2 (2)

Error : the creepage distance may be reduced to 0.8 of the value given in Table 8.

Correct : the creepage distance may be reduced to 0.8 of the value given in Table 9.

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

Japanese Standards Association

JAPANESE INDUSTRIAL STANDARD
JIS C 0704 : 1995
Insulation test for control gear

May, 1998

ERRATA

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Example 6

In line 2 from the bottom of the paragraph " Example 6 ",

Error g_2 and $l_2 \geq 1$ mm for:

Correct g_2 and $l_2 \geq 2$ mm for:

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In line 1 of the paragraph " Example 7 ",

Error When I and barrier are not deemed as one body

Correct When I and rib are not deemed as one body

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In line 1 of the paragraph " Example 11 ",

Error $G = d_2 + d_1$

Correct $G = d_2 + d_3$

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

JIS

JAPANESE INDUSTRIAL STANDARD

Insulation test for control gear

JIS C 0704—1995

Translated and Published

by

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

1. Scope This Japanese Industrial Standard specifies insulation distances, insulation resistances and dielectric withstand voltages of control gears⁽¹⁾ used in a circuit at a frequency of 50 Hz or 60 Hz, and an a.c. voltage not exceeding 1000 V or d.c. voltage not exceeding 1500 V.

Note ⁽¹⁾ Control gears herein stated mean such apparatus as contactors, resistors, control switches, limit switches, relays (for motor protection, control), terminal blocks, and devices composed thereof, including those incorporating semiconductors. However, wiring devices, receiving and distribution equipment and outdoor equipment are excluded.

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

JIS B 7411 Etched-stem liquid-in-glass thermometers, total immersion type

JIS C 0010 Environmental testing. Part 1: General and guidance [IEC 68-1: 1988]

JIS C 1302 Insulation resistance testers

JIS C 8306 Testing methods for wiring devices

JIS Z 8806 Methods of humidity measurement

2. The International Standards corresponding to this Standard are given below.

IEC 439-1 (1985) Low-voltage switchgear and controlgear assemblies. Part 1: Type-tested and partially type-tested assemblies

IEC 664-1 (1992) Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests

IEC 664-3 (1992) Insulation coordination for equipment within low-voltage systems. Part 3: Use of coatings to achieve insulation coordination of printed board assemblies

IEC 947-1 (1988) Low-voltage switchgear and control-gear. Part 1: General rules

IEC 947-4-1 (1990) Low-voltage switchgear and control-gear. Part 4: Contactors and motor-starters. Section One - Electromechanical contactors and motor-starters

IEC 947-5-1 (1990) Low-voltage switchgear and control-gear. Part 5: Control circuit devices and switching elements. Section One - Electromechanical control circuit devices

2. Definitions For the purpose of this Standard, the following significant definitions shall apply:

- (1) insulation distance This means the distance between parts to be insulated each other and consists of clearance and creepage distance.
- (2) clearance The shortest space distance between two insulated bare live parts.
- (3) creepage distance The shortest distance along a surface of an insulation in contact with two bare live parts.
- (4) clearance to earth The clearance between any bare live part and any dead metallic part.
- (5) creepage distance to earth The creepage distance between any bare live part and any dead metallic part.
- (6) insulated metallic body which becomes live due to insulation deterioration (accidentally dangerous part) An insulated metallic body accessible by an operator which may become alive due to charging caused by deterioration of insulation based on deposit of dust on the insulator, failure of the insulator, etc.

Example: Insulated metallic case, insulated metallic operating handle, etc.
- (7) rated insulation voltage (U_i) A voltage taken as the basis of insulation design and to which insulation distances and dielectric withstand voltages are referred.
- (8) rated operational voltage (U_e) A voltage used at the rated operational current under the specified conditions (making and breaking current capacities, switching frequency and electrical switching durability).
- (9) rated operational current (I_e) A current used at the rated operational voltage under the specified conditions (making and breaking current capacities, switching frequency and electrical switching durability).

- (10) rated thermal current (I_{th}) A current which can be passed continuously, without exceeding the value specified in temperature rise, through a control gear under a certain operating state.
- (11) working voltage The highest r.m.s. value of the a.c. voltage or the highest value of the d.c. voltage which may occur across any insulation when the rated operating voltage is applied. However, transient ones are disregarded.
- (12) surge voltage A non-periodic transient over-voltage caused by closing and opening of a switch, line failure, and lightning.
- (13) rated impulse withstand voltage (U_{imp}) The peak value of an impulse voltage of prescribed waveform and polarity which the equipment is capable of withstanding without failure under specified conditions of test.
- (14) main circuit All the conducting parts of a control gear included in circuits which transmit main electric energy.
- (15) control circuit The control circuit means all conducting parts included in circuits which perform controls, measurements or the like.
- (16) macro-environment (surrounding environmental conditions) The environment of the room or location in which the equipment is installed and used.
- (17) micro-environment The immediate environment of the insulation which particularly influences the dimensioning of the creepage distances.
- (18) pollution degree The degree of pollution in the micro-environment which determines the insulation performances of the equipment.
- (19) homogeneous field An electric field which has an essentially constant voltage gradient between electrodes.
- (20) inhomogeneous field An electric field which has not an essentially constant voltage gradient between electrodes.
- (21) functional insulation Insulation which is necessary for the proper functioning of the equipment.
- (22) basic insulation Insulation applied to live parts to provide basic protection against electric shock.

Remarks: Basic insulation does not necessarily include insulation used exclusively for functional purposes.

- (23) supplementary insulation Independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation.
- (24) enclosure Generic name of covering which provides protection of equipment against contact of human body with live parts and protection of equipment against certain external influences.

3. Normal service conditions and application categories

3.1 Normal service conditions Control gears shall be used under these conditions, unless otherwise specified.

(1) Ambient temperature The temperature shall be -5°C to 40°C , provided that its average value over a period of 24 h does not exceed $+35^{\circ}\text{C}$ and no freezing occurs. The ambient temperature means the temperature of air existing in the vicinity of the equipment if supplied without enclosure, or in the vicinity of the enclosure, if supplied with enclosure.

(2) Altitude 2000 m or less

(3) Relative humidity 45 % to 85 % No dew condensation

3.2 Application category

3.2.1 Classification by environmental conditions Control gears are classified according to the following items corresponding to the environment of installation location and the environment which influences the insulation.

(1) Macro-environment (surrounding environmental conditions) The macro-environment of a location where control gears are installed are classified into grades shown in Table 1.

Table 1. Macro-environment (surrounding environmental conditions)

Grade	Macro-environment (surrounding environmental conditions)	Exemplification
A	Place protected from the climate and where the temperature is controlled. . Few kinds and quantity of dust or external solid substances. . Few kinds and quantity of corrosive substances or pollutional substances.	. Clean and air conditioned room
B	Place protected from the climate but where the temperature and humidity are not controlled (including the heating to avoid decrease of ambient temperature). . No existence of dust. . Few kinds and quantity of corrosive substances or pollutional substances.	. Office, clean electric room
C	Indoor place protected from the climate but where the temperature and humidity are not controlled and things are exposed to external air. . Dust of medium degree exists. . Corrosive substances or pollutional substances originated from the environment exists.	. General factory facilities (no existence of excess humidity, influence of gas, dust, or deposition of metallic powder)

- (2) Micro-environment The micro-environment which influences the insulation of control gears is classified into the pollution degrees given in Table 2.

Table 2. Micro-environment

Pollution degree	Micro-environment	Exemplification
1	No pollution or only dry non-conductive pollution occurs.	• Inside of hermetic relay • Coated printed-circuit board • Hermetic micro-switch and proximity switch
2	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by dew condensation may be expected.	• Inside of relay with cover (small control relay) • Inside of operating control switch and micro switch • Printed-circuit board without coating
3	Conductive pollution occurs, or dry non-conductive pollution occurs which becomes conductive due to dew condensation.	• Electromagnet switch, terminal block

3.2.2 Classification of control gear without specified rated impulse withstand voltage by surge voltage Control gears without specified rated impulse withstand voltage are classified by the surge voltage as given in Table 3.

Table 3. Classification of control gear without specified rated impulse withstand voltage by surge voltage

Classification by surge voltage	Description of surge voltage
Class 1	Control gears used in a control circuit where there is no concern about deterioration of control gear due to surge voltage because of almost nonexistent surge voltage, or which is protected in such an extent that consideration about influence of surge voltage is not necessary. Example: CR surge absorbing circuit, control circuit protected with varistor, secondary side control circuit of a shielded transformer isolated from outside surges.

Table 3. (continued)

Classification by surge voltage	Description of surge voltage
Class 2	Control gears used in a control circuit where no higher surge voltage will occur. Example: Control circuit fed from power sources of general houses or offices.
Class 3	Control gears used in a control circuit where generally expected surge voltage is taken into account. Example: Control circuits of general factory facilities.

3.2.3 Classification of control gear with specified rated impulse withstand voltage by transient overvoltage and rated impulse withstand voltage (U_{imp}) Control gears with specified rated impulse withstand voltage are classified by the transient overvoltage as given in Table 4, and the reference values of rated impulse withstand voltage (U_{imp}) shall be as given in Table 5.

Table 4. Classification of control gears with specified rated impulse withstand voltage by transient overvoltage

Classification of transient overvoltage	Description of transient overvoltage
Category I	Electronic equipment circuit in which transient overvoltage is limited to an appropriately low level. Example: Protected electronic equipment • Electronic equipment fed through insulation transformer. • Level of specially protected electronic equipment. • Signal level of electronic equipment.
Category II	Mains of equipment • Equipment fed through fixed wiring (via receptacle). • Level of load (machinery and equipment).
Category III	Mains of power system • Equipment/device of fixed (wiring) facility where reliability and effectivity of equipment are required. Example: Switches of stationally wired facility and industrial equipment stationally wired as factory facility.
Category IV	Mains of power supply system • Equipment used for service entrance. Example: Switch gear such as primary overcurrent protector used in the main.

Table 5. Reference values of rated impulse withstand voltage (U_{imp}) correlating with rated operational voltage (U_e)

Unit: V

Maximum value of rated operational voltage (U_e) to earth	Reference value of rated impulse withstand voltage (U_{imp})			
	Transient overvoltage category			
	Category I	Category II	Category III	Category IV
50	330	500	800	1500
100	500	800	1500	2500
150	800	1500	2500	4000
300	1500	2500	4000	6000
600	2500	4000	6000	8000
1000	4000	6000	8000	12000

4. Insulation distance

4.1 Application of insulation distances The insulation distances shall be as specified in 4.2 and 4.3. However, the said specification does not apply to the items given below.

- (1) Apparatus used in the secondary circuit of an induction motor
- (2) Oil immersed apparatus
- (3) Caps and lamp holders of pilot lamp, and small sized indoor switches
- (4) Sealed parts of apparatus of hermetic construction where the withstand voltage is enhanced by use of vacuum or special gases
- (5) Clearance between open-circuited contacts of control gear without specified rated impulse withstand voltage

4.2 Minimum values of clearance

4.2.1 Control gear without specified rated impulse withstand voltage
Minimum value of clearance shall have at least the appropriate value corresponding to the pollution degree in micro-environment and rated insulation voltage shown in Table 6.

Table 6. Minimum value of clearance of control gear without specified rated impulse withstand voltage

Rated insulation voltage (U_i) V		Minimum value of clearance mm									
		Pollution degree in micro-environment									
		1		2		3					
D.C.	A.C.	$\begin{smallmatrix} (3) \\ L-L \end{smallmatrix}$	$\begin{smallmatrix} (4) \\ L-A \end{smallmatrix}$	$\begin{smallmatrix} (3) \\ L-L \end{smallmatrix}$	$\begin{smallmatrix} (4) \\ L-A \end{smallmatrix}$	$I < 15A(^2)$		$15A \leq I \leq 63A(^2)$		$63A < I(^2)$	
						$\begin{smallmatrix} (3) \\ L-L \end{smallmatrix}$	$\begin{smallmatrix} (4) \\ L-A \end{smallmatrix}$	$\begin{smallmatrix} (3) \\ L-L \end{smallmatrix}$	$\begin{smallmatrix} (4) \\ L-A \end{smallmatrix}$	$\begin{smallmatrix} (3) \\ L-L \end{smallmatrix}$	$\begin{smallmatrix} (4) \\ L-A \end{smallmatrix}$
$U_i \leq 12$	$U_i \leq 12$	0.2	0.2	0.4	0.4	2	3	2	3	3	5
$12 < U_i \leq 30$	$12 < U_i \leq 30$	0.4	0.4	1.0	1.0	2	3	2	3	3	5
$30 < U_i \leq 60$	$30 < U_i \leq 60$	0.5	0.5	1.0	1.0	2	3	2	3	3	5
$60 < U_i \leq 125$	$60 < U_i \leq 125$	0.5	0.5	1.5	1.5	3	5	3	5	5	6
$125 < U_i \leq 250$	$125 < U_i \leq 250$	1.0	1.0	2.0	3.0	3	5	3	5	5	6
$250 < U_i \leq 380$	$250 < U_i \leq 380$	1.5	1.5	3.0	3.0	4	6	4	6	6	8
$380 < U_i \leq 500$	$380 < U_i \leq 500$	2.0	2.0	4.0	4.0	6	8	6	8	8	10
$500 < U_i \leq 660$	$500 < U_i \leq 660$	-	-	-	-	6	8	6	8	8	10
$660 < U_i \leq 800$	$660 < U_i \leq 800$	-	-	-	-	10	14	10	14	10	14
$800 < U_i \leq 1500$	$750 < U_i \leq 1000$	-	-	-	-	14	20	14	20	14	20

Notes ⁽²⁾ The current means the rated thermal current (I_{th}).

⁽³⁾ The "L-L" is applicable to the clearance between bare live parts and between live parts and earthed metallic parts.

⁽⁴⁾ The "L-A" is applicable to the clearance between live parts and insulated metal parts which will become live parts due to deterioration of insulation.