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JAPANESE INDUSTRIAL STANDARD

General rules for control switches

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General rules for control switches

C 4520-1991

1. Scope

This Japanese Industrial Standard specifies general requirements for control switches ⁽¹⁾ intended for use in circuits of not more than 600 V a.c. (with a frequency of 50 Hz or 60 Hz) or 250 V d.c. (hereafter referred to as the "switches").

Note ⁽¹⁾ The term control switch herein refers to switches with contacts installed in control circuits of industrial switch gear and control gear for the purpose of controlling, signalling, interlocking, etc. Switches manufactured for use exclusively with said gears and not for use independently are not included.

Remarks 1. The standards cited in this Standard are shown in Attached Table 1.

2. The corresponding international standard is shown below.

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 purposes of this Standard the following principal definitions apply:

(1) Terms for switches

(1.1) manual control switch A control switch intended to be operated by man, including the switches stated below.

(a) button switch A manual control switch for which contacts are closed or opened by pushing or pulling a button.

(b) locker switch ⁽²⁾ A manual control switch for which the handle moves like a see-saw, and the contacts are opened or closed by pushing one end of the handle with the tip of a finger.

Note ⁽²⁾ Locker switches are sometimes called see-saw switches.

(c) slide switch A manual control switch for which the contacts are closed or opened by the sliding motion of the handle.

(d) rotary switch A manual control switch for which the circuit is changed by a motion where a moving contact comes into contact with fixed contacts circularly arranged along the rotation of the handle.

- (e) selector switch (with cylindrical cam) A manual control switch for which the contacts are closed or opened by the movement of a cam in the axial direction of a handle by rotation of the handle.
- (f) cam switch (with disk cam) A manual control switch for which the contacts are closed or opened by the movement of a cam provided in the contact element, due to rotation of the handle.
- (g) drum switch A manual control switch for which the moving contacts are formed on a cylindrical surface coaxial with the handle rotating axis, and closing or opening of associated circuits is made by a sliding motion of the moving contacts and fixed contacts due to rotation of the handle.
- (h) digital switch ⁽³⁾ A manual control switch for which the contacts are closed or opened by rotation of the relevant wheel marked with a letter.

Note ⁽³⁾ Digital switches are sometimes called thumb-wheel switches.

- (i) toggle switch A manual control switch for which the contacts are closed or opened by operating the handle in two opposite directions with a finger.
- (j) joy-stick switch A manual control switch for which the contacts are closed or opened by angular displacement of the handle to two or more positions with the hand.
- (k) trigger switch A manual control switch for which the contacts are closed or opened by operation of a trigger type handle.
- (l) foot switch A manual control switch for which the contacts are closed or opened by force exerted by the foot on a pedal or button.
- (1.2) detecting control switch A control switch which operates by detecting the instant when a predetermined condition is achieved, including the switches stated below.
 - (a) limit switch A detecting control switch which operates at a predetermined position in the mechanical travel of the device.
 - (b) pressure switch A detecting control switch which operates at the instant when the pressure of a gas or liquid reaches a preset value.
 - (c) float switch A detecting control switch which operates at a preset level of a liquid by means of a float placed on the liquid surface.

(2) Terms for components

- (a) contact element A unit consisting of contacts, terminals, etc. necessary to close and open a circuit arranged on an insulating material.

- (b) actuating system ⁽⁴⁾ The whole of the operating means which transmits the actuating force to the contact element.

Note ⁽⁴⁾ For detecting control switches, this is sometimes called the actuator.

- (c) actuator The movable part of the actuating system to which an external actuating force is directly applied. The actuator may take the form of a handle, knob, lever, key, button, etc.

- (d) enclosure The external covering providing a certain degree of protection for switches other than open type switches.

(3) Terms for ratings

- (a) rated insulation voltage (U_i) The voltage which is the basis of the insulation design and which the dielectric withstand voltage and the insulation distances are referred.
- (b) rated operational voltage (U_o) The voltage which can be used, combined with the rated operational current, under the specified conditions (making and breaking capacities, make-break frequency, and electrical durability).
- (c) rated thermal current (I_{th}) The current which can be passed through the closed contacts at a temperature rise not exceeding the specified value.
- (d) rated operational current (I_o) The current which can be used at the rated operational voltage under the specified conditions (making and breaking capacities, make-break frequency, and electrical durability).

3. Standard service conditions

The standard service conditions shall be as stated below, and switches shall, unless otherwise specified, be used under these conditions.

- | | |
|--------------------------------|---|
| (1) <u>Ambient temperature</u> | Indoor service - 5 to + 40°C
Outdoor service - 25 to + 40°C |
| (2) <u>Relative humidity</u> | 45 to 85 % |
| (3) <u>Attitude</u> | Not more than 2000 m |

4. Classification

- 4.1 Classification of switches Switches are classified as given in Table 1.

Table 1. Classification of switches

Classification of switches		Applicable sub-clause in definition
Manual control switches	Button switch	(1.1) (a)
	Locker switch	(1.1) (b)
	Slide switch	(1.1) (c)
	Rotary switch	(1.1) (d)
	Selector switch	(1.1) (e)
	Cam switch	(1.1) (f)
	Drum switch	(1.1) (g)
	Digital switch	(1.1) (h)
	Toggle switch	(1.1) (i)
	Joy-stick switch	(1.1) (j)
	Trigger switch	(1.1) (k)
	Foot switch	(1.1) (l)
Detecting control switches	Limit switch	(1.2) (a)
	Pressure switch	(1.2) (b)
	Float switch	(1.2) (c)

4.2 Classification and designation of protective structures

4.2.1 Classification of protective structures Protective structures shall be classified according to a combination of the degree of protection against penetration by solid objects (the first characteristic numeral) shown in Table 2 and the degree of protection against ingress of water (the second characteristic numeral) shown in Table 3. If protection against oil or corrosion is necessary, the type of protection of Table 4 shall be added to the above notation.

Table 2. Degree of protection against penetration by solid objects

First characteristic numeral	Degree of protection
0 (Open type)	Protection against ingress of solid objects is not considered.
3 (Semi-enclosed type)	The tip of solid objects with a diameter exceeding 2.5 mm shall not penetrate into the interior.
4 (Totally enclosed type)	The tip of solid objects with a diameter exceeding 1.0 mm shall not enter into the interior.
5 (Dust protected type)	Dust shall not enter into the interior to such an extent that the prescribed operation or safety of the switch is impaired.
6 (Dust tight type)	No ingress of dust.

Table 3. Degree of protection against ingress of water

Second characteristic numeral	Degree of protection
0 (Open type)	Protection against ingress of water is not considered.
1 (Drip-proof type I)	Vertically falling water drops shall have no harmful effects.
2 (Drip-proof type II)	Water sprayed at an angle up to 15° on either side of vertical shall have no harmful effects.
3 (Spray-proof type)	Water sprayed at an angle up to 60° on either side of vertical shall have no harmful effects.
4 (Splash-proof type)	Water splashed against the enclosure from any direction shall have no harmful effects.
5 (Jet-proof type)	Water projected in jets against the enclosure from any direction shall have no harmful effects.
6 (Water tight type)	Water projected in powerful jets against the enclosure from any direction shall not cause ingress of water.
7 (Immersion-proof type)	Ingress of water shall not occur when the enclosure is immersed in water at a specified pressure for a specified duration.

Table 4. Types of protection structures against oil or corrosion

Type of protective structure	Degree of protection
Oil-proof type	Oil drops or mist from any direction shall have no harmful effects.
Oil-tight type	Oil drops or mist from any direction shall not penetrate into the interior.
Corrosion-proof type	Service in a slightly corrosive environment shall have no harmful effects.

4.2.2 Designation of protective structures The designation of protective structures shall consist of a letter symbol (IP) denoting the code of protection, the first characteristic numeral and the second characteristic numeral.

The protection against oil or corrosion shall be stated after the second characteristic numeral.

If either the first or the second characteristic numeral is not specified, X shall be marked in the omitted position.

Example 1. IP 4 0

└── Second characteristic numeral
└── First characteristic numeral

Example 2. IP 6 5 oil-proof type

Example 3. IP 4 X

IP X 5

5. Ratings and grades

5.1 Rated insulation voltage The rated insulation voltage shall have the values given in Table 5.

Table 5. Rated insulation voltage

Unit: V

Rated insulation voltage				
30	60	125	250	600

5.2 Rated operational voltage The rated operational voltage shall have the values given in Table 6.

Table 6. Rated operational voltage

Unit: V

A.C. or D.C.	Rated operational voltage										
A.C.	6	12	18	24	50	100	110	200	220	400	440
D.C.	5	6	12	18	24	48	100	110	200	220	

5.3 Rated thermal current The rated thermal current shall have the values given in Table 7.

Table 7. Rated thermal current

Unit: A

Rated thermal current												
0.1	0.2	0.3	0.5	1	3	5	10	15	20	25	30	

5.4 Rated operational current The rated operational current shall have the values given in Table 8.

Table 8. Rated operational current

Unit	Rated operational current																			
mA	1	2	3	5	10	20	30	50												
A	0.1	0.2	0.3	0.4	0.5	0.7	1	2	3	4	5	6	7	8	10	15	20	25	30	

5.5 Classification by making and breaking capacities The classification by the making and breaking capacities and the examples of typical applications shall be as given in Table 9.

Table 9. Classification by making and breaking capacities

Type of current	Utilization category	Principal application
A.C.	AC-12	Control of resistive loads and semiconductor loads with isolation by photo coupler
	AC-13	Control of semiconductor loads with transformer insulation
	AC-14	Control of small electromagnetic loads ($\leq 72\text{VA}$)
	AC-15	Control of electromagnetic loads ($> 72\text{VA}$)
D.C.	DC-12	Control of resistive loads and semiconductor loads with isolation by photo coupler
	DC-13	Control of electromagnetic loads
	DC-14	Control of electromagnetic loads with economy resistors in circuit

Remarks: The classification shall be determined according to Table 27.

5.6 Classification by frequency of operating cycles Classification by the frequency of operating cycles shall be as given in Table 10.

Table 10. Classification by frequency of operating cycles

Frequency class index	01	0	1	2	3	4	5	6
Frequency of operating cycles (per hour)	3 600	1 800	1 200	600	300	150	30	6

Remarks: For multi-rated switches, one operating cycle (one closing and one opening) on a specific contact is counted as one cycle.

5.7 Classification by mechanical durability and electrical durability Classification by mechanical durability and electrical durability shall be as given in Table 11.

Table 11. Classification by mechanical and electrical durability

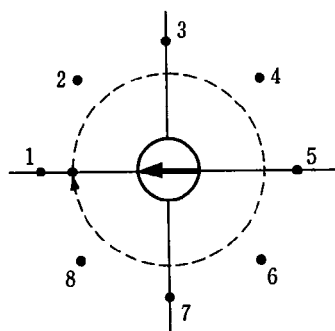
Class	Mechanical durability (in ten thousands of no-load operating cycles)	Class	Electrical durability (in ten thousands of on-load operating cycles)
0	1000	0	100
1	500	1	50
2	250	2	25
3	100	3	10
4	25	4	5
5	5	5	1
6	1	6	0.7

- Remarks**
1. The term "durability" used here is expressed by the number of operating cycles.
 2. In determining mechanical durability of a switch with multiple notches, the change-over on all the notches is counted as one cycle (refer to Fig. 1).
 3. In determining electrical durability, the total operating cycles of a specific contact is counted as is.
 4. Indication of combined durability is made by indicating both the mechanical durability class and the electrical durability class.

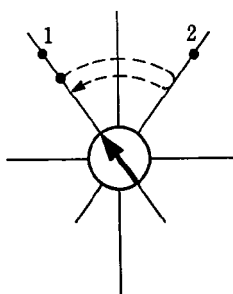
For example, a switch with a mechanical durability of 2.5 million cycles and an electrical durability of 500,000 cycles is called a switch with a mechanical durability of Class 2 and an electrical durability of Class 1, and denoted as a switch of durability Class 2-1.

Fig. 1. Examples of one operating cycle

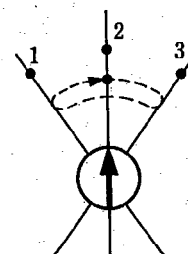
Switch which rotates
through the entire
circumference



Switch which rotates
through a part of
the circumference



Switch which resets
automatically



Remarks 1. ●-----> represents one operating cycle.

2. The numerals represent notch positions.

3. The direction of rotation shall be changed alternately for a switch which rotates through the entire circumference.

6. Performance

6.1 Strength The strength shall satisfy the following.

- (1) Strength of the actuating system (actuator) When the test for strength of the actuating system of manual control switches or the actuator of detecting control switches (pressure receiver of pressure switches) is carried out in accordance with 8.3 (1), there shall be no damage or other failure. This requirement does not apply to cabled float switches that comprise a switching mechanism tightly enclosed in the float.
- (2) Strength of the terminal part When the test for strength of the terminal part is carried out in accordance with 8.3 (2), there shall be no damage or other failure.
- (3) Strength of the enclosure When the test for strength of the enclosure is carried out on a switch with a protective structure other than open type in accordance with 8.3 (3), there shall be no damage or other trouble detrimental to service.

6.2 Operating force or actuating force The operating force of manual control switches or the actuating force of detecting control switches (actuating pressure for pressure switches) shall satisfy the values specified in the relevant detail specification, when the test is carried out in accordance with 8.4. However, float switches are excluded.

6.3 **Actuation** The detecting control switch shall operate surely when the predetermined condition is achieved.

6.4 **Temperature rise** When the test for temperature rise is carried out in accordance with 8.5, the temperature rise of the contacts, terminals, etc. shall not exceed the relevant values given in Table 12, the temperature rise of the parts accessible to man or combustible material shall not exceed the relevant values given in Table 13, and the temperature rise of the coil shall not exceed the relevant value given in Table 14. The limit of the reference ambient temperature is 40°C.

Table 12. Limit of temperature rise of contacts, terminals, etc.

Unit: °C

Position and material		Limit of the temperature rise (Thermometer method)
Contacts in air	Silver, silver alloys	Limited to a temperature which does not damage the adjacent part.
	Other metals ⁽⁵⁾	Limited to a temperature which does not impair the characteristics of the metal and the adjacent part.
	Copper, copper alloys	45 ⁽⁶⁾
Metal part in contact with insulation		Limited to a temperature which does not damage the insulation.
Terminal connected with external insulated conductor	Bare copper	60
	Bare brass	65
	Tin plated copper or brass	65
	Silver or nickel plated copper or brass	70 ⁽⁷⁾
	Other metals	The value determined by experience of use or life test. The temperature shall not exceed 65°C.

Notes ⁽⁵⁾ Other metals include gold alloy, platinum alloy, etc.

⁽⁶⁾ This shall be not more than 40°C for contacts which generate contact pressure by themselves, if a material of a low elastic limit (e.g., hard-drawn copper or brass) is used for the part which performs the spring action.

⁽⁷⁾ 70°C is employed based on use of P.V.C. insulated wires.

Table 13. Limit of the temperature rise of accessible parts

Unit: °C

Position and material		Limit of the temperature rise (thermometer method)
Handle	Metal	15
	Nonmetal	30
Part which is not held but is intended to be touched by the hand.	Metal	30
	Nonmetal	40
Part not necessary to be touched during normal operation.	Metal	40
	Nonmetal	50
Part not intended to be touched during normal operation.		(⁸)
Part of the enclosure adjacent to the cable entry.	Metal	40
	Nonmetal	50
Enclosure of the resistor		200 (⁸)

Note (⁸) Switches shall be protected against contact with combustible material or accidental contact by man.

Table 14. Limit of the temperature rise of the coil

Unit: °C

Position	Class of insulation	Limit of the temperature rise (resistance method)
Coil	Class A insulation	85
	Class E insulation	100
	Class B insulation	110

6.5 Insulation resistance The insulation resistance shall be not less than 10 MΩ, when the test is carried out as specified in 8.6.

6.6 Dielectric withstand voltage The switch shall withstand the test voltage, when subjected to the test of 8.7.

6.7 Contact resistance The contact resistance shall be not more than the values given in Table 15, when the test is carried out as specified in 8.8.