

JIS

JAPANESE INDUSTRIAL STANDARD

Enclosed sensitive switches

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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 general industrial purpose enclosed sensitive switches of not more than 20 A rated current (thermal) for use in circuits of not more than 500 V a.c. at a frequency of 50 Hz or 60 Hz or of not more than 250 V d.c. (hereafter referred to as the "switches"). However, this standard does not cover such special switches as those of explosion-proof construction and filled with gas in their cases.

Remarks: Applicable Standards are shown in Attached Table 1.

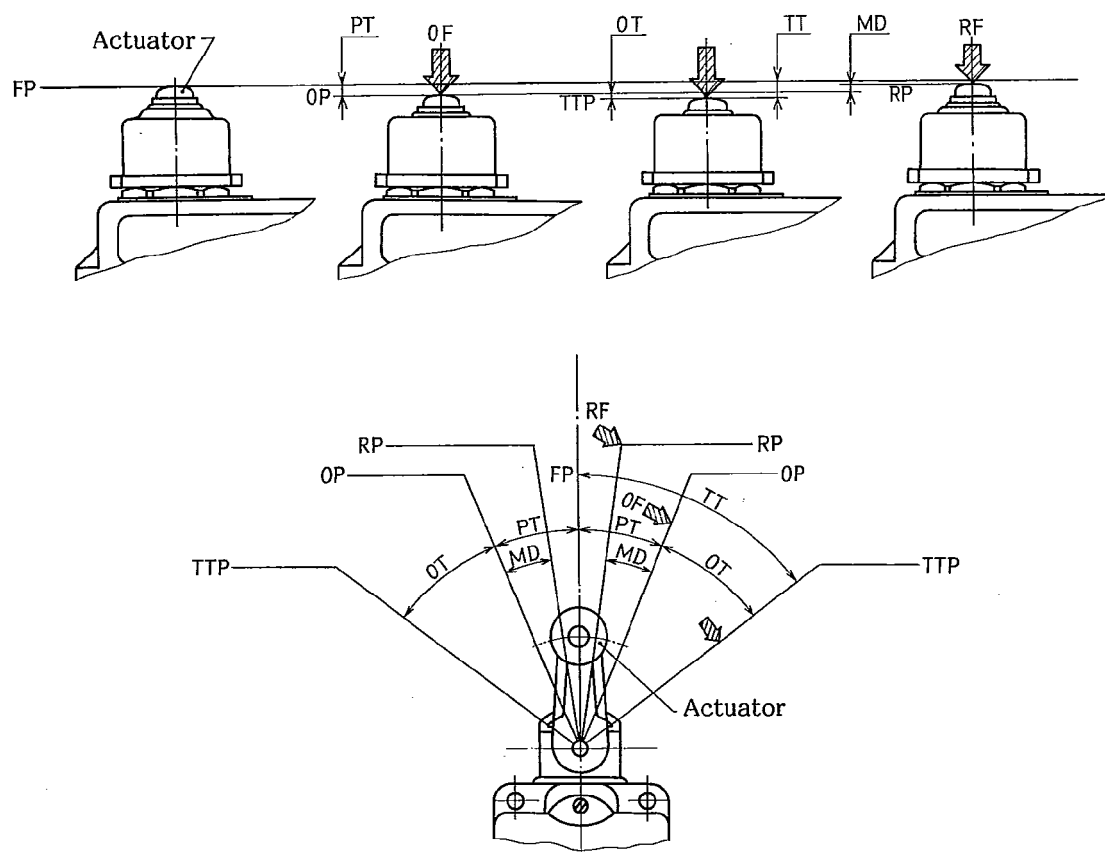
2. Definitions

For the purpose of this Standard, the following definitions apply (see Fig. 1):

- (1) enclosed sensitive switch A sensitive switch which is enclosed in a metal case for its protection against external forces, water, oil, dust, etc.
- (2) sensitive switch A miniaturized switch having a microgap and a snap-action mechanism which is operated by a specified force through a specified travel, being enclosed in a case and provided with an external actuator.
- (3) actuator The integral part of the sensitive switch to which an external mechanical force is to be applied. Movement of the actuator causes the snap-action mechanism to function, and let the moving contact(s) to close and open the switch.
- (4) actuator stopper The part of the switch provided to limit the movement of the actuator in the operating direction of the switch.
- (5) free position (symbol: FP) The position of the actuator, when no external mechanical force is applied to it.
- (6) operation position (symbol: OP) The position of the actuator, at the instant when an increasing applied force has just caused the snap-action mechanism to operate to reverse the moving contact at the free position.
- (7) total travel position (symbol: TTP) The position of the actuator, when the actuator reaches to the actuator stop.
- (8) release position (symbol: RP) The position of the actuator, at the instant when a decreasing applied force causes the snap-action mechanism to revert to its initial state, to bring the moving contact at the operating position to the free position.
- (9) pre-travel (symbol: PT) The distance or angle between the free position and the operating position.
- (10) over-travel (symbol: OT) The distance or angle between the operating position and the total travel position.

- (11) movement differential (symbol: MD) The distance or angle between the operating position and the release position.
- (12) total travel (symbol: TT) The distance or angle between the free position and the total travel position, which is the sum of pre-travel and over-travel.
- (13) operating force (symbol: OF) The force which must be applied to the actuator to cause it to move from the free position to the operating position.
- (14) release force (symbol: RF) The value to which the actuating force must be reduced in order to permit the actuator at the total travel position to return to its release position.
- (15) repeatability of operating position The difference of the maximum value and the minimum value of the operating position of a switch, when the switch is repeatedly operated.
- (16) rated voltage The voltage that is determined in combination with the current and taken as the basis for the design and use of the switch.
- (17) rated current (thermal) The current that a switch can continuously carry within the specified temperature-rise limit, under no on/off operation.
- (18) making/breaking current The current that can be made or broken at the rated voltage under the specified category load conditions.

Fig. 1. Positions of Actuator and Symbols



3. Standard Service Conditions

Standard service conditions shall be as given below. However, no freezing or dewing shall occur.

- (1) Ambient temperature -10 to +55°C
- (2) Relative humidity 45 to 85 %
- (3) Altitude not more than 2000 m

4. Classification

The switches shall be classified into the categories given in Tables 1 to 5 and Attached Figs. 1 to 21, according to the enclosing case, mounting method, sensitive switch, actuator and number of actuators.

The type designation of a switch shall be composed of the combination of characters and numerals in the order as exemplified below.

Example:	M	1	Z1	P2	2
	Enclosing case	Mounting method	Sensitive switch	Actuator	No. of actuators
	(Character)	(Numeral)	(Character and numeral)	(Character and numeral)	(Numeral)

- (1) Enclosing Cases Enclosing cases shall be classified by their shapes and represented by the characters shown in Table 1.

Table 1. Representation of Enclosing Cases

Code	Enclosing case	Attached Fig.
N	Side type	1, 2
E	Split type	3 to 6
F	Even type	7, 8
L	Vertical type	9 to 16
M	Multi-plunger type	17 to 21

- (2) Mounting Methods Mounting methods shall be represented by the numerals shown in Table 2.

Table 2. Representation of Mounting Methods

Code	Mounting method
1	Face mount method
2	Left-handed face mount method (¹)
3	Right-handed face mount method (²)
4	Bottom mount method

Notes (¹) This means a switch having only one mounting face and the actuator is on the left-hand side when viewed from front of the enclosing case.

(²) This means a switch having only one mounting face and the actuator is on the right-hand side when viewed from front of the enclosing case.

- (3) Sensitive Switches Sensitive switches shall be represented by the characters and numerals shown in Table 3.

Table 3. Representation of Sensitive Switches

Character and numeral	Sensitive switch according to JIS C 4505
Z1	Z1G
Z4	Z4G
D3	D3G
A5	A5G
V1	V1F
V3	V3F
T2	T2G T2H
T3	T3G T3H
S1	S1G S1H
S2	S2G S2H

Remarks: The numerals in the first column correspond to the rated currents (thermal) of the switch and denote the following:

1 ... 1 A 3 ... 10 A 5 ... 20 A
2 ... 5 A 4 ... 15 A

- (4) Actuators Actuators shall be represented by the characters and numerals as shown in Table 4.

Table 4. Representation of Actuators

Character and numeral	Actuator
P1	Push-plunger type
P2	Roller-plunger type
P3	Crest-plunger type
L1	Roller-lever type (with full turn of less than 70 degrees)
L2	Roller-lever type (with full turn of not less than 70 degrees)
L3	Adjustable roller-lever type
L4	Pin-lever type
S1	Coil-spring type
F1	Twin roller-lever type

- (5) Number of Actuators The number of actuators shall be represented by the numerals shown in Table 5.

Table 5. Representation of Number of Actuators

Numeral	No. of actuators
No numeral	1
2	2
4	4
6	6
8	8

(6) Protective System

- (a) Classification by Protective System Classification by protective system shall be as shown in Table 6.

Table 6. Classification by Protection

Protective system against solid foreign bodies		Protective system against water	
Classification	1st symbol	Classification	2nd symbol
Dustproof type	6	Rainproof type	3
		Watertight type	6
		Immersionproof type	7

Remarks: Designation character (IP), 1st symbol and 2nd symbol are expressed in series.

Example: IP 6 7
 └── 2nd symbol
 └── 1st symbol

- (b) Protective System against Oil Protective systems against oil shall apply to all enclosing cases except E type.
- (c) Protective Systems and their Application Relations of enclosing cases to protective systems shall be as shown in Table 7.

Table 7. Protective Systems of Enclosing Cases

Characters of enclosing case	Protective system
N	IP X3 ⁽⁴⁾
E	IP 66
F	IP 66
L ⁽³⁾	IP 67
M	IP X7 ⁽⁴⁾

Notes ⁽³⁾ Protective systems for switches shown in Attached Figs. 9 and 10 shall be IP X7.

⁽⁴⁾ When 1st symbol is shown as X, protective system against solid foreign bodies is not provided.

5. Ratings

5.1 Rated Voltages The rated voltages shall be as shown in Table 8.

Table 8. Rated Voltages

Unit: V					
a.c. or d.c.	Rated voltages				
a.c.	125	250	500		
d.c.	8	14	30	125	250

5.2 Rated Currents (thermal) The rated currents (thermal) shall be as shown in Table 9.

Table 9. Rated Currents (thermal)

Unit: A					
Rated currents (thermal)					
1	5	10	15	20	

6. Performance

6.1 Repeatability of Operating Position The repeatability of operating position shall be not more than the values shown in Table 10, when the test of 8.2.2 is carried out.

Table 10. Repeatability of Operating Position

Category of switch (Number of Attached Fig.)	Repeatability of operating position
1, 3, 4, 7, 9, 10, 17, 18, 19, 20, 21	0.1 mm
2, 5, 6 and 8	0.3 mm
11, 12, 13 and 15	1 degree
14 and 16	Not specified

6.2 Insulation Resistance The insulation resistance shall be not less than 100 M Ω , when the test of 8.2.3 is carried out.

6.3 Dielectric Voltage When the test of 8.2.4 is carried out, the specimen shall be withstand the test voltage.

6.4 Contact Resistance The contact resistance shall be not more than 100 m Ω , when the test of 8.2.5 is carried out.

6.5 Robustness The robustness shall be such that the following requirements are satisfied, when the test of 8.2.6 is carried out.

- (1) The operating characteristics shall not deviate from the values shown in Attached Figs. 1 to 21 by more than 30 %.
- (2) The insulation resistance shall be not less than 100 M Ω .
- (3) The specimen shall not show any damage detrimental to service.

6.6 Temperature Rise The temperature rise shall be not more than 50°C, when the test of 8.2.7 is carried out.

6.7 Make and Break Operation The make and break operations shall be such that the following requirements are satisfied, when the test of 8.2.8 is carried out.

- (1) The operating characteristics shall not deviate from the values shown in Attached figs. 1 to 21 by more than 30 %.
- (2) The insulation resistance shall be not less than 10 M Ω .
- (3) The specimen shall withstand the test voltages, except for the part between terminals of the same pole.
- (4) The contact resistance shall be not more than 2 Ω .

6.8 Resistance to Shock The resistance to shock shall be such that the following requirements are satisfied, when the test of 8.2.9 is carried out.

- (1) Any closed contact shall not open exceeding a period of 1 ms.
- (2) Any open contact shall not close exceeding a period of 1 ms.

6.9 Resistance to Vibration The resistance to vibration shall be such that the following requirements are satisfied, when the test of 8.2.10 is carried out.

- (1) Any closed contact shall not open exceeding a period of 1 ms.
- (2) Any open contact shall not close exceeding a period of 1 ms.

6.10 Salt Spray The salt spray shall cause such results that the following requirements are satisfied, when the test 8.2.11 is carried out.

- (1) The operating characteristics shall not deviate from the values shown in Attached Figs. 1 to 21 by more than 30 %.
- (2) The insulation resistance shall be not less than 10 M Ω .
- (3) The specimen shall withstand the test voltages. However, the part between terminals of the same pole is excluded.
- (4) Any mechanical damage and rust detrimental to service shall not appear.

6.11 Damp, Heat (Cyclic) The resistance to damp, heat (cyclic) shall be such that the following requirements are satisfied, when the test of 8.2.12 is carried out.

- (1) The operating characteristics shall not deviate from the values shown in Attached Figs. 1 to 21 by more than 30 %.
- (2) The insulation resistance to be not less than 10 M Ω .
- (3) To withstand the test voltages, except for the part between terminals of the same pole.
- (4) Any mechanical damage and rust detrimental to service shall not appear.

6.12 Resistance to Cold and Heat The resistance to cold and heat shall be such that the following requirements are satisfied, when the test of 8.2.13 is carried out.

- (1) The operating characteristics shall not deviate from the values shown in Attached Figs. 1 to 21 by more than 30 %.
- (2) The insulation resistance shall be not less than 10 M Ω .
- (3) The specimen shall withstand the test voltages. However, the part between terminals of the same pole is excluded.
- (4) Any mechanical damage and rust detrimental to service shall not appear.

6.13 Protection

6.13.1 Protection against Intrusion of Solid Foreign Bodies The protection against intrusion of solid foreign bodies shall satisfy the protection shown in Table 11, when the test of 8.2.14 (1) is carried out.

Table 11. Protection against Intrusion of Solid Foreign Bodies

1st symbol	Degree of intrusion of solid foreign bodies
6	Talc powder shall not intrude inside.

6.13.2 Protection against Intrusion of Water The protection against intrusion of water shall satisfy the protection shown in Table 12, when the tests specified in 8.2.14 (2), (3) and (4) are carried out.

Table 12. Protection against Intrusion of Water

2nd symbol	Degree of intrusion of water
3	Any leaking of water that interferes with the normal operation not to occur
6	No water intrudes inside
7	No water intrudes inside

6.13.3 Protection against Intrusion of Oil The protection against intrusion of oil shall not allow intrusion of oil into the interior of switch, when the test of 8.2.14 (5) is carried out.

7. Construction, Dimensions and Materials

7.1 General Construction The switches shall have correct forms, shall be strong and shall meet the following requirements:

- (1) All parts shall move smoothly.
- (2) The actuator and transmission mechanism shall be constructed so as to function certainly and to withstand against mechanical shock, vibration, etc.
- (3) The gaps or joints through which any fluid can flow shall be constructed so as to ensure tightness, by means of a synthetic rubber seal or a component of equivalent effect.
- (4) The enclosing case shall be of such a construction that there is an ample space in the inside to permit easy connection to wires and an insulation is provided between live metal parts and the inside wall of the enclosing case which is dead metal part. However, if there is an ample insulation distance between the live metal parts and the inside wall of the enclosing case being dead metal part, the insulation is not necessarily be provided.

- (5) The outside metal part of a switch shall be suitably treated for preventing rusting.
- (6) Sensitive switches shall conform to JIS C 4505.
- (7) The inlet for conduit tube shall be of a construction capable of accepting the parallel threads of JIS B 0202.

7.2 Dimensions and Operating Characteristics The dimensions and the operating characteristics of switches shall be as given in Attached Figs. 1 to 21.

7.3 Materials of Principal Parts The materials of principal parts of switches shall comply with the following requirements:

- (1) The enclosing case shall be made of the zinc alloy die casting of JIS H 5301, the aluminium alloy die casting of JIS H 5302 or a material at least equivalent thereto in quality.
- (2) The seal shall be made of the Type B or C industrial rubber packing material of JIS K 6380 or a material at least equivalent thereto in quality.
- (3) The insulation shall be made of the varnished cotton cloth of JIS C 2340 or a material at least equivalent thereto in insulating property.

8. Tests

8.1 Standard Conditions for Testing Unless especially specified, the switches shall be tested under the conditions below:

- (1) Ambient temperature $20 \pm 2^{\circ}\text{C}$
- (2) Relative humidity $65 \pm 5 \%$
- (3) Air pressure 101.3 kPa

However, if there is no dispute on the results of tests or judgement, the tests may be carried out within the limits of 5 to 35°C ambient temperature, 45 to 85 % relative humidity and 86 to 106 kPa air pressure.

8.2 Test Methods The tests shall be carried out in accordance with the following:

8.2.1 Construction Test In the construction test, the switches are examined for conformance to 7. and 11.

8.2.2 Test for Repeatability of Operating Positions In the test for repeatability of operating positions, the switch is set on a suitable test bed, the operating positions are measured 20 times under the conditions below, and the difference between the maximum and minimum of the values is calculated.

- | | | |
|-----|--|-------------------|
| (1) | Load | No load |
| (2) | Operating speed | 0.1 to 1 mm/s |
| (3) | Displacement of actuator from the operating position | 70 to 100 % of OT |

8.2.3 Insulation Resistance Test In the insulation resistance test the insulation resistance between two discontinuous terminals of the switch and that between each terminal and dead metal frame are measured with a 500 V d.c. insulation resistance tester.

8.2.4 Dielectric Withstand Voltage Test The dielectric withstand voltage test shall be carried out in such a manner that the substantially sinusoidal test voltages specified in Table 13 at 50 Hz or 60 Hz are applied to the relevant positions of measurement given in the same table for 1 min. Not more than $\frac{1}{2}$ the prescribed test voltage is applied first, then the voltage is raised up to the prescribed test voltage as rapidly as practicable within such limit that the voltage at every step can be read. However, in the case where a number of specimens are tested and no ambiguity is foreseen in judgement, the direct application of a test voltage equal to 110 % of that given in Table 13 for 1 s is acceptable as an alternative method.

Table 13. Parts to be Measured and Test Voltages

Unit: V

Position of measurement		Test voltage
Between terminals of the same pole	Categories S1, S2	600
	Others	1000
Between terminals of different pole	Categories T2, T3	
	Others	$2 E + 1000$
Between individual terminal and dead metal part		(E is the highest rated voltage for the switch)

8.2.5 Contact Resistance Test In the test the contact resistance is measured between the terminals. The contact resistance between the common terminal and the normally-closed terminal (for T type one, between the two normally-closed terminals) is measured with the actuator at the free position, and the contact resistance between the common terminal and the normally-open terminal (for T type one, between the two normally-open terminals) is measured with the actuator at the total travel position. The measurement shall be made by voltage drop method, by passing a current of 1 A at 6 to 8 V d.c., with the polarity (direction of the current) changed. After finding out the polarity (direction of the current) of higher contact resistance, the contact resistances shall be measured three times each in that polarity.

8.2.6 Robustness Test In the robustness test, the operating characteristics shown in 8.2.3 and Attached Figs. 1 to 21 shall be measured after carrying out the test in accordance with the following: