

JIS

JAPANESE INDUSTRIAL STANDARD

**AC load break switches
with tripping device
for 3.3 kV or 6.6 kV**

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

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AC load break switches with tripping
device for 3.3 kV or 6.6 kV

C 4607-1991

1. Scope

This Japanese Industrial Standard specifies the high voltage a.c. load break switches with tripping device (hereafter referred to as switches) of rated current 600 A or under, and dependent manual operation or dependent electric power operation to be used in three-phase circuits of rated voltage 3.3 kV or 6.6 kV, frequency 50 Hz or 60 Hz and short-circuit current 12.5 kA or under.

- Remarks 1. A three-phase switch, may, as it is, be used in a single-phase circuit without trouble.
2. This standard is not applicable to the switches for motors, capacitors, electric furnaces, etc. which are frequently to be opened and closed. However, if the number of times of opening and closing is within the range specified in this standard, this standard may be applied to such switches subject to the agreement between the parties concerned.
3. Applicable standards are as follows:
- JIS C 4601-Ground Relay Set for 6600 V or 3300 V Consumer
- JIS C 4605-AC Load Break Switches for 3.3 kV or 6.6 kV
- JIS C 4609-Directional Ground Relay Set for 6.6 kV Consumer

2. Definitions

For the purposes of this standard, the following definitions apply, in addition to those specified in 2. (definitions) of JIS C 4605.

- (1) tripping type high-voltage a.c. load break switch A high-voltage a.c. load break switch with a release or tripping device.
- (2) over-current locking type high-voltage a.c. load break switch A high-voltage a.c. load break switch with a tripping device.
- (3) high-voltage a.c. load break switch with release A high-voltage a.c. load break switch having a release.

- (4) tripping device A control device of the switch having an over-current locking function which locks the switch from being automatically opened while an over-current exceeding the locking current is flowing through the switch, as well as having any one or two of the following tripping functions.
- (a) Ground-fault trip
 - (b) Over-current stored energy trip
 - (c) Ground-fault stored energy trip
- (5) locking current The current at which the over-current locking functions of an over-current locking type switch initiate (effective value).
- (6) ground-fault trip The tripping operation which opens a switch automatically if the current of the circuit is less than the locking current when ground-fault current flows through the switch.
- (7) over-current stored energy trip The tripping operation which locks the switch once by the energy of the accidental current then opens the switch automatically under non-live condition after the operation of the breaking device in the source side, when an accidental current equal to or more than the locking current passes through the switch due to an overload or short-circuit accident.
- (8) ground-fault stored energy trip The tripping operation which locks the switch once by the energy of the ground-fault current then opens the switch automatically under non-live condition after the operation of the breaking device in the source side, when a ground-fault current passes through the switch due to ground-fault accident.
- (9) release A device which opens the switch automatically, by the trip command given from outside of the switch.
- (10) operating device A device which treats and transmits the energy which directly operates the movable contacts of a switch.
- (11) voltage trip system A system in which the switch is tripped by direct application of the specified a.c. voltage or d.c. voltage to the release of the switch.
- (12) capacitor trip system A system in which the switch is tripped by the application of the energy of a capacitor being charged from the specified a.c. voltage to the release of the switch.
- (13) rated overload breaking current The limit of the overload current which can be broken under a specified condition.
- (14) rated ground-fault breaking current The limit of the ground-fault current which can be broken under a specified condition.

- (15) opening time The time from the instant that the release of a switch under closed condition is energized, until the arcing contacts (where no arcing contacts are provided, the main contacts) have separated.
- (16) arcing time The time from the instant of separation of the arcing contacts (where no arcing contacts are provided, the main contacts), until the instant when the main current has been broken in all poles. If in the case where a particular pole is considered, the time from the instant of separation of the arcing contacts (where no arcing contacts are provided, the main contacts) of the pole, until the instant when the main current has been broken in that pole.
- (17) break time The sum of the opening time and the arcing time.
- (18) handle-free type A construction which enables the switch to trip, even if the handle is fixed on the closing position.

3. Service conditions

The service conditions shall be in accordance with 3. (service conditions) of JIS C 4605.

4. Types of switch

The types of switch shall be, in addition to compliance with the specification of 4. (type of switch), JIS C 4605, as given in the following:

- (1) Types according to presence of tripping device
 - (a) Apparatus with tripping device (over-current locking type high-voltage a.c. load break switch)
 - (b) Apparatus without tripping device (high-voltage a.c. load break switch with release)
- (2) Types of tripping devices (symbol)
 - (a) Ground-fault trip type with over-current lock (LG)
 - (b) Ground-fault stored energy trip type with over-current lock (LSG)
 - (c) Over-current stored energy trip type (SO)
 - (d) Ground-fault trip type with over-current stored energy trip (SOG)
 - (e) Ground-fault stored energy trip type with over-current stored energy trip (SOSG)

Remarks: Symbols are derived from initials of the following terms respectively.

O: Over-current (with lock)
G: Ground
L: Lock
S: Storage

(3) Types of release

- (a) Voltage trip system
- (b) Capacitor trip system

5. Ratings

5.1 Rated voltage The rated voltage shall be in accordance with the specification of 5.1 (rated voltage) of JIS C 4605.

5.2 Rated frequency The rated frequency shall be in accordance with the specification of 5.2 (rated frequency) of JIS C 4605.

5.3 Rated current The rated current shall be in accordance with the specification of 5.3 (rated current) of JIS C 4605.

5.4 Rated short-time current and rated short-circuit making current These shall be in accordance with the specification of 5.4 (rated short-time current and rated short-circuit making current) of JIS C 4605.

5.5 Rated load current making and breaking capacity It shall be in accordance with the specification of 5.5 (rated load making and breaking capacity) of JIS C 4605.

5.6 Rated overload breaking current The value of rated overload breaking current and number of times of breaking shall conform to Table 1. However, the value of rated overload breaking current shall exceed the rated load current making and breaking capacity.

Table 1. Rated overload breaking current

Rated overload breaking current (symmetrical component effective value) A	Number of time of breaking
150 200 300 400 500 600 800	Class A 1 time
1000 1200	Class B 2 times
	Class C 3 times

5.7 Rated ground-fault breaking current It shall conform to Table 2.

Table 2. Rated ground-fault breaking current
Unit: A

Rated ground-fault breaking current
30

5.8 Rated control voltage It shall conform to Table 3. In the case of a.c., the frequency shall be 50 Hz or 60 Hz, and the voltage shall be expressed in effective value.

Table 3. Rated control voltage

Unit: V

Type of control device		Rated control voltage	
Operating device		A.C.	100 200
		D.C.	100
Release	Voltage trip system	A.C.	100 200
		D.C.	100
	Capacitor trip system	A.C.	100
Tripping device		A.C.	100

6. Performances

6.1 Resistance between main external connecting terminals of same phase When the switch has been tested in accordance with 8.2, the times specified in 6.1 (resistance between main external connecting terminals of same phase) of JIS C 4605 shall be satisfied.

6.2 Temperature rise When the switch has been tested in accordance with 8.3, the items specified in 6.2 (temperature rise) of JIS C 4605 shall be satisfied.

6.3 No-voltage opening and closing performance

6.3.1 Switching operation performance The switching operation performances shall conform to the following respective items.

- (1) Electric power switching operation performance The electric power operating type switch, when it has been subjected to the test in accordance with 8.4.1 (1), shall be capable of being opened and closed under the control voltage within the fluctuating range given in Table 4, and be free from abnormalities on any parts and performances.

Table 4. Fluctuating range of control voltage

Division of a.c. and d.c.	Fluctuating range of control voltage
D.C.	75 to 110 % of the value specified in Table 3
A.C.	85 to 110 % of the value specified in Table 3

- (2) Manual switching operation performance When the switch has been tested in accordance with 8.4.1 (2), the items specified in 6.3.1 (2) (dependent manual switching operation performance) of JIS C 4605 shall be satisfied.

6.3.2 Tripping performance The switch with release, when it has been subjected to the test in accordance with 8.4.2, shall be capable of being tripped without trouble, and the opening time of the switch body at the time shall be within 0.15 sec.

Furthermore, the switch of handle free type shall be operated without trouble even if the handle is fixed.

6.3.3 Trip-operation performance The over-current locking type switch, when it has been subjected to the test in accordance with 8.4.3, shall operate without trouble within the fluctuating range of the control voltage given in Table 4, and shall conform to the following respective items.

Furthermore, the switch of the handle free type shall be operated without trouble, even if the handle is fixed.

- (1) Over-current locking operation The over-current locking operations of the LG type and LSG type switches shall work when an over-current equal to or more than the locking current is passed through the main circuit, and the performances shall be as follows:
- (a) The operating current and operating time shall conform to Table 5, and the locking shall be disengaged before the current decreases to the rated value.

Table 5. Over-current locking operating time

Test main current	Operating time
Rated current x 1.0	No operation
Locking current x 1.0	Complete locking within 0.1 sec.

- (b) The locking current shall be a current between the rated current and the rated overload breaking current, and shall be the guaranteed value by the manufacturer.
- (c) The over-current locking operation shall have priority over the ground-fault trip operation, so that the switch shall be locked and shall not be opened.
- (2) Ground-fault trip operation The ground-fault trip operation of the LG type and SOG type switches, shall initiate when the ground-fault current exceeding the specified value flows through the main circuit, and the characteristics shall be as follows:

- (a) The operating current and the operating time shall conform to Table 6. The set current means the set value of operating current of the ground-fault relay, and the operating time means the time from commencement of the zero-phase-sequence current until all contacts of the switch body have separated.

Table 6. Ground-fault trip operating time

Test zero-phase-sequence current	Operating time
Set current $\times 0.8$	No operation
Set current $\times 1.3$	Within 0.4 sec.
Set current $\times 4.0$	Within 0.3 sec.

- (b) The set current value shall be 1000 mA or under, and three points of 200 mA, 400 mA and 600 mA shall be provided without fail.
- (3) Over-current stored energy trip operation The over-current stored energy trip operations of SO type, SOG type and SOSG type switches shall be initiated when an over-current equal to or more than the locking current flows through the main circuit, and the performances shall be as follows:
- (a) The operating current and the operating time shall conform to Table 7.

Table 7. Over-current stored energy trip operating time

Test main current	Operating time
Rated current $\times 1.0$	No operation
Locking current $\times 1.0$	① Preparation of stored energy trip is to be completed within 0.1 sec.
	② 0.5 sec. or more after the main circuit voltage has become no-voltage, the switch shall be opened.

- (b) The preparation of the over-current stored energy trip shall be disengaged before the main current is decreased gradually to the rated current.

- (c) The locking current shall be a current between the rated current and the rated over-load breaking current, and shall be the guaranteed value by the manufacturer.
- (d) The over-current stored energy trip operation shall have priority over the ground-fault trip operation, and the switch shall be opened after storing the energy.
- (4) Ground-fault stored energy trip operation The ground-fault stored energy trip operation of LSG type and SOSG type switches, shall be initiated when a ground-fault current exceeding the specified value passes through the main circuit, and the performance shall be as follows:
 - (a) Preparation of the ground-fault stored energy trip shall be completed by the current and time given in Table 8, and after a lapse of 0.5 s or over from the main circuit becomes no-voltage, the switch shall be opened.

Furthermore, the set current means the set value of operating current of the ground-fault relay.

Table 8. Preparing time for ground stored energy trip

Test zero-phase-sequence current	Preparing time for ground stored energy trip
Set current x 0.8	No operation
Set current x 1.3	Within 0.3 sec.
Set current x 4.0	Within 0.2 sec.

- (b) Preparation for ground-fault stored energy trip shall be disengaged, when the zero-phase-sequence current is decreased gradually, before it is decreased to 0.05 times the set current.
- (c) The set current shall be 1000 mA or under, and three points of 200 mA, 400 mA and 600 mA shall be provided without fail.
- (5) Temperature The trip operation shall conform to the requirements of (1) to (4) within the range of ambient temperature of Table 9.

Table 9. Range of ambient temperature
Unit: °C

Place of use	Range of ambient temperature
Indoor	-5 to +60
Outdoor	-20 to +60