

# JIS

**JAPANESE INDUSTRIAL STANDARD**

**Directional Ground Relay Set  
for 6.6 kV Consumer**

**JIS C 4609—1990**

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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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Directional Ground Relay Set  
for 6.6 kV Consumer

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1. Scope

This Japanese Industrial Standard specifies the directional ground relay set which consists of a zero-phase-sequence current transformer, zero-phase-sequence reference input device, and a directional ground relay (this relay is referred to as "relay" hereafter), which is installed at the power receiving point of a consumer of 6.6 kV of such a system that the one-line ground-fault current is less than 30 A.

2. Definitions

For the purpose of this Standard the following principal definitions apply:

- (1) zero-phase-sequence input device A device which produces the relay input which is used as the reference for finding out, from the voltage to ground, that the ground fault occurs in the load side or power supply side of the point where the zero-phase-sequence transformer is installed.
- (2) operate value of voltage The value of zero-phase-sequence primary voltage at which the relay operates.
- (3) operate value of current The value of zero-phase-sequence primary current at which the relay operates.
- (4) set This means to determine the reference of operation by a certain device.
- (5) operate This means that a relay performs a prescribed duty.
- (6) reset This means that a relay returns to the function at its original position.

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Applicable Standards:

JIS C 0911-Vibration Testing Procedure for Electric Machines and Equipment

JIS C 0912-Shock Testing Procedure for Electric Machines and Equipment

JIS C 3611-Insulated Wires for Cubicle Type Unit Substation for 6.6 kV Receiving

## Reference Standards:

JIS C 4601-Ground Relay Set for 6600 V or 3300 V Consumer

JIS C 4602-Overcurrent Relay for 6.6 kV Receiving

### 3. Service Conditions

3.1 Standard Service Conditions The standard service conditions mean the service conditions given below, and directional ground relay sets shall be used under these conditions unless otherwise specified.

- (1) The ambient temperature is -20 to + 50°C. Provided no icing occurs.
- (2) The relative humidity is 30 to 80 %.
- (3) The altitude does not exceed 2000 m.
- (4) The place where no vibration, shock or inclination is anticipated.
- (5) The place where the relay set will not exposed to explosive dust, flammable dust, other excess dust, flammable gas, corrosive gas, ignitable vapor, salt mist or water drops.

3.2 Special Service Conditions The special service conditions means that the relay set is used under the conditions other than that specified in 3.1. Under such conditions special construction and function are necessary in some cases, therefore special care shall be taken for application of special service conditions.

### 4. Ratings

The ratings of relays, and zero-phase-sequence transformers and zero-phase-sequence input devices used in combination with relays shall be as follows:

- (1) Relay Rated control voltage a.c. 110 V (only for relays with a.c. voltage circuit)  
Rated frequency 50 Hz or 60 Hz
- (2) Zero-phase-sequence Current Transformer Highest voltage 6.9 kV  
Rated primary current 100 A, 200 A, 300 A, 400 A, 600 A and 1000 A  
Rated frequency 50 Hz or 60 Hz
- (3) Zero-phase-sequence Input Device Rated voltage 6.6 kV  
Rated frequency 50 Hz or 60 Hz.

### 5. Performances

5.1 Operate Value of Current Characteristic When the test is carried out as specified in 7.3, the operate value of current shall fall within a range  $\pm 10$  % from the set value of current.

5.2 Operate Value of Voltage Characteristic When the test is carried out as specified in 7.4, the operate value of voltage shall fall within a range of  $\pm 25\%$  from the set value of voltage.

5.3 Phase Characteristic When the test is carried out as specified in 7.5, the phase at which the relay operates and the phase at which the relay does not operate shall fall within the respective range clearly stated by the manufacturer.

5.4 Operating Time Characteristic When the test is carried out as specified in 7.6, the operating time shall fall within the range of values shown in Table 1.

Table 1. Operating Time Characteristic

| Test current         | Operating time |
|----------------------|----------------|
| 130 % of set current | 0.1 to 0.3     |
| 400 % of set current | 0.1 to 0.2     |

5.5 Heavy Ground-fault Current Characteristic When the test is carried out as specified in 7.7, the heavy ground-fault current characteristic shall be as follows:

- (1) When the test is carried out as specified in 7.7 (1), the relay shall operate surely.
- (2) When the test is carried out as specified in 7.7 (2), the relay shall not operate.

5.6 Inertia Characteristic When the test is carried out as specified in 7.8, the relay shall not operate.

5.7 Influence of Load Current When the test is carried out as specified in 7.9, the operating range of relay shall fall within the range of values given in Table 2.

Table 2. Influence of Load Current

| Rated primary current<br>A       | Operate value range of relay when zero-phase-sequence current is superposed on rated primary current % |
|----------------------------------|--------------------------------------------------------------------------------------------------------|
| Up to and including 200          | 80 to 120 of set value of current                                                                      |
| Over 200 up to and including 600 | 70 to 130 of set value of current                                                                      |
| Over 600                         | 50 to 150 of set value of current                                                                      |

5.8 Influence of Control Voltage When the test is carried out as specified in 7.10, the operate value of current shall fall within a range of  $\pm 10\%$  from the operate value of current at the rated control voltage.

5.9 Influence of Temperature When the test is carried out as specified in 7.11, the operate value of current shall fall within a range of  $\pm 20\%$  from the operate value of current at 20°C.

5.10 Burden of Control Power Supply When the test is carried out as specified in 7.12, the burden of the control power supply circuit shall not exceed 110 % of the value declared by the manufacturer.

5.11 Switching of Control Power Supply When the test is carried out as specified in 7.13, the relay shall not operate.

5.12 Resistance to Noise When the test is carried out as specified in 7.14, the relay shall not operate.

5.13 Insulation Resistance When the test is carried out as specified in 7.15, the insulation resistance shall be not less than 20 M $\Omega$  for the high voltage parts (the parts to be measured with an insulation resistance tester of rated voltage 1000 V), and not less than 5 M $\Omega$  for the low voltage parts (the parts to be measured with an insulation resistance tester of rated voltage 500 V).

5.14 Power Frequency Withstand Voltage When the test is carried out as specified in 7.16, no abnormalities shall be found in every part of the specimen.

5.15 Lightning Impulse Withstand Voltage When the test is carried out as specified in 7.17, no abnormalities detrimental to service shall be found in every part of the specimen.

5.16 Temperature Rise When the test is carried out as specified in 7.18, the temperature rise of each part of relay shall not exceed the relevant value of Table 3 and the relay shall show no abnormality.

Table 3. Limit of Temperature Rise

Unit: °C

| Position of measurement |                    | Temperature rise (limit of ambient temperature 40°C) |                    |
|-------------------------|--------------------|------------------------------------------------------|--------------------|
|                         |                    | Resistance method                                    | Thermometer method |
| Coil                    |                    | 55                                                   | 50                 |
| Resistor                | Internally mounted | -                                                    | 80                 |
|                         | Externally mounted | -                                                    | 150                |

### 5.17 Endurance

- (1) Mechanism When the test is carried out as specified in 7.19 (1), the relay, zero-phase-sequence current transformer and zero-phase-sequence reference input device shall show no abnormalities detrimental to service.
- (2) Contact When the test is carried out as specified in 7.19 (2), the contact shall show no abnormalities detrimental to service.

5.18 Vibration When the test is carried out as specified in 7.20, the relay shall not operate, and the operate value of current shall fall within a range of  $\pm 10\%$  from the set value of current.

5.19 Shock When the test is carried out as specified in 7.21, the relay shall not operate, and the operate value of current shall fall within a range of  $\pm 10\%$  from the set value of current.

5.20 Overcurrent Strength When the test is carried out as specified in 7.22, the zero-phase-sequence current transformer shall not be damaged thermally or mechanically, and the operate value of current shall fall within a range of  $\pm 10\%$  from the set value of current.

## 6. Construction and Terminal Marking

### 6.1 Construction

6.1.1 Relay The construction of relay shall comply with the following requirements:

- (1) The relay shall have enough mechanical and electrical strength for performing its duty and shall withstand ordinary temperature change, humidity change, mechanical vibration and shock.
- (2) The container which contains the internal element shall be so designed that dust will not enter its inside.
- (3) The reset of relay may be made by any of manual operation, automatic operation and external signal.
- (4) The operation of relay shall be indicated and shall be capable of being announced.
- (5) The operation indicator shall be so constructed that it does not return to its original position at the time of the relay operation.
- (6) The setting device shall be as follows:
  - (a) The setting of operate value of current shall be variable and at least the three points i.e. 200 mA, 400 mA and 600 mA shall be provided.

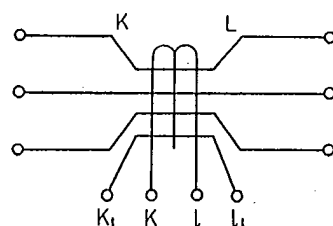
- (b) The setting of operate value of voltage may be either of fixed type or variable type.
- (7) A test push button or the equivalent device which can force the relay to operate shall be provided.
- (8) The termination shall be so constructed that a wire of 5.5 mm<sup>2</sup> or less can be connected easily and surely.
- (9) The metallic enclosure shall be capable of being grounded.

Remark: When the relay is used outdoors, it shall be contained in an enclosure adequate for waterproof.

6.1.2 Zero-phase-sequence Current Transformer The construction of zero-phase-sequence current transformer shall comply with the following requirements:

- (1) The transformer shall be made of materials of good quality, be robust mechanically and handled easily.
- (2) If the primary wires (including copper bars) are attached, the insulated wires for 6.6 kV (abbreviation KIP or KIC) specified in JIS C 3611 or the wires at least equivalent in dielectric strength shall be employed. These wires shall have a protruded part of at least 30 cm and so constructed that connection with other wires or the like can be done easily.
- (3) The  $K$ ,  $L$  and  $k$ ,  $l$  and the  $K'$ ,  $L$  and  $k'$ ,  $l'$  shown in Fig. 1 shall be so marked that subtractive polarity is attained.

Fig. 1. Terminal Marking of Zero-phase-sequence Current Transformer



- (4) A test wire shall be contained in the transformer and the terminals  $k$ , and  $l$ , shall be provided.
- (5) The outdoor transformer shall be made of weather resistant materials and so protected that the leakage current from the high voltage side does not influence on the secondary circuits.