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उच्च-वोल्टता के स्विचगियर और नियंत्रणगियर

भाग 102 प्रत्यावर्ती धारा वियोजक भू-सम्पर्कन स्विच

Indian Standard

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR

PART 102 ALTERNATING CURRENT DISCONNECTORS AND EARTHING SWITCHES

ICS 29.130.10

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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For other types of earthing switches, flame or metallic particles such as might impair the insulation level of the earthing switch shall not be projected beyond the boundaries specified by the manufacturer and shall not endanger the operator.

6.101.3 Conditions of the earthing switch after the making test

After performing the specified operations, the mechanical parts including parts related to the electrical field control (for example field electrode of a GIS earthing switch) and insulators of the earthing switch shall be practically in the same condition as before. Only the short-circuit making performance may be impaired.

In case of doubt, a condition test according to 6.2.11 of IEC 60694 is applicable.

NOTE Only light welding of contacts is permitted which means that the earthing switch can be operated under the conditions given in 4.8 up to and including 4.10, and 5.5 and 5.6, with the rated values for power operated devices, and with 120 % of the values given for manually operated devices in 5.105.

6.102 Operating and mechanical endurance tests

For three-phase disconnectors operated by one mechanism, where applicable, the terminal load shall be applied to all terminals simultaneously.

6.102.1 General test conditions

The tests shall be made at any convenient ambient air temperature at the place of test. The supply voltage shall be measured at the terminals of the operating devices with full current flowing. Auxiliary equipment forming part of the operating device shall be included.

6.102.2 Contact zone test

This test shall be made in order to prove satisfactory operation of divided support disconnectors (according to figures 1 and 2), in the various positions of the fixed contact within the limits of the rated contact zone according to 4.102. With the device in the open position, the fixed contact shall be placed in the following positions (according to figures 1 and 2), h being the highest position (stated by the manufacturer) of the fixed contact above the mounting plane:

a) at a height of h on the vertical axis of the assembly;

b) at a height of $h - z_r$ on the same axis;

c) at a height equal to h and displaced from the axis horizontally by $+y_r/2$;

d) at a height equal to h and displaced from the axis horizontally by $-y_r/2$.

The subscript, r, indicates the rated value assigned to the disconnector by the manufacturer.

With the device in the open position, the fixed contact shall be placed in the following positions, x_r being the total amplitude of movement of the fixed contact in the x-direction.

e) at a distance equal to $+x_r/2$;

f) at a distance equal to $-x_r/2$.

In each position, the device shall close and open correctly.

6.102.3 Mechanical endurance test

6.102.3.1 Test procedure

The mechanical endurance test shall consist of 1 000 operating cycles with, where applicable, 50 % of the rated static terminal load applied to the three-phase disconnector or earthing switch in direction $Fa1$ or $Fa2$ (figures 7 and 8), without voltage on, or current through the main circuit. For disconnectors having two or three insulators and a normally horizontal isolating gap, the 50 % rated static terminal load shall be applied at both sides of the disconnector, but in opposite directions. For disconnectors and earthing switches with one insulator (operating insulators not being taken into consideration) the terminal load shall be applied to only one side of the disconnector or earthing switch.

The closed and open positions shall be attained during each operating cycle.

During the test the specified operation of the control and auxiliary contacts and position indicating devices (if any) shall be verified according to 5.104 and according to 5.4 of IEC 60694.

The tests shall be made on disconnectors and earthing switches equipped with their own operating mechanisms. During the tests lubrication in accordance with the manufacturer's instructions is permitted, but no mechanical adjustment or other maintenance is allowed.

On a disconnector or earthing switch having a power-operated mechanism

- 900 close-open operating cycles shall be made at rated supply voltage and/or rated pressure of compressed gas supply;
- 50 close-open operating cycles at the specified minimum supply voltage and/or minimum pressure of compressed gas supply;
- 50 close-open operating cycles at the specified maximum supply voltage and/or maximum pressure of compressed gas supply.

These operations shall be made at a rate such that the temperatures of the energized electrical components do not exceed the values given in table 3 of IEC 60694.

Prior to commencing the tests, the manufacturer shall state the parameters to be used as comparators before and after the test series, for example:

- operating time;
- maximum energy consumption;
- for disconnectors with manual mechanisms only, registration of the maximum operating forces;
- verification of satisfactory operation of the auxiliary contacts and position indicating devices, if applicable.

For manually operated disconnectors and earthing switches, the handle may, for convenience of testing, be replaced by an external power-operated device. In this case, it is not necessary to vary the supply voltage. As an alternative to direct measurement, as required by 5.105, the force may be calculated from the input power taking into consideration the operating speed.

6.102.3.2 Verification of successful operation

Before and after the mechanical endurance test programme one of the following test series shall be performed without the static terminal load applied:

- five close-open operating cycles at the minimum supply voltage and/or pressure;
- five close-open operating cycles at the maximum supply pressure for operation (only for gas or liquid operated disconnectors or earthing switches);
- five close-open manual operations (only for hand-operated disconnectors and earthing switches).

During these operating cycles the operating characteristics such as operating time and maximum energy consumption shall be recorded or evaluated. With disconnectors having manual mechanisms only, the maximum forces shall be recorded. Satisfactory operation of the auxiliary contacts and position indicating devices (if any) shall be verified.

The variation between the mean values of each parameter, as required in 6.102.3.1, measured before and after the mechanical endurance test, shall be validated by the manufacturer and included into the test report.

After the test, all parts, including contacts, shall be in good condition and shall not show undue wear; see also 4.4.3, point 6, of IEC 60694.

The main circuit resistance shall be measured before and after the mechanical endurance test. The resistance shall not vary by more than 20 % from the value measured before the test.

For gas-insulated disconnectors and earthing switches, a tightness test before and after the mechanical endurance test shall be performed.

Since the influence of ambient temperature has to be considered, the temperature shall be recorded.

6.102.4 Operation during application of the rated static mechanical terminal load

Twenty operating cycles with the rated power supply shall be made with the rated mechanical static terminal load applied at both terminals:

- longitudinal load applied in direction Fa1 or Fa2;
- perpendicular load applied in direction Fb1 or Fb2, both in the same direction;
- Fc simulates the downward forces caused by the weight of the connecting conductors. With flexible conductors, the weight is included in the longitudinal or perpendicular forces.

For only manually operated disconnectors and earthing switches the number of operating cycles may be reduced to 10.

For disconnectors with a horizontal isolating gap, the load shall be applied on both sides at the same time.

The disconnector may be adjusted before the test and after having been loaded with 50 % of the rated longitudinal or transversal mechanical terminal force.

During each operation the disconnector or earthing switch shall close and open correctly.

For verification, before and after the complete sequence of operating cycles, 6.102.3.2 and the appropriate comparators as required in 6.102.3.1 for mechanical endurance tests, are applicable.

6.102.5 Extended mechanical endurance tests

The tests defined in this subclause shall be performed on disconnectors class M1 and M2.

In the case of disconnectors and earthing switches in GIS, the enclosure shall not be opened during the test.

Disconnectors being frequently operated, for example those operating in conjunction with circuit-breakers, require extended mechanical endurance tests which shall be carried out as follows:

a) The extended mechanical endurance tests programme shall consist of a number of close-open operations carried out in accordance with 6.102.1 and 6.102.3.1.

   According to the service requirements, one of the following number of operating cycles shall be performed:

   - 2 000 (for disconnectors class M1);
   - 10 000 (for disconnectors class M2).

   After each series of 1 000 operating cycles, or at maintenance intervals, the operating characteristics shall be recorded or evaluated.

   Between the specified test series, some maintenance such as lubrication and mechanical adjustment is allowed and shall be performed in accordance with the manufacturer's instructions. Change of significant sub-components, such as contacts, is not permitted.

   The programme of maintenance during the tests shall be defined by the manufacturer before the tests and recorded in the test report.

b) Before and after the total test programme mechanical tests shall be performed and the operating characteristics shall be verified as required in 6.102.3.2.

   The following tests shall also be performed:

   - contact zone test (6.102.2), if applicable;
   - verification of operation during application of rated static mechanical terminal loads (6.102.4), if applicable.

c) In addition after the total test programme, checks and tests shall be performed as follows:

   - verification of satisfactory operation with the minimum duration of the operating signal given by the manufacturer;
   - verification of the satisfactory condition of the mechanical travel limit stops;
   - verification of operation of the mechanical effort-limiting devices, if any.

d) After the total test programme, all parts, including contacts, shall be in good condition and shall not show undue wear in accordance with the relevant clauses of IEC 60694; see also 4.4.3, point 6 of IEC 60694.

Table 6 – Power frequency voltage tests

Test condition no.	Disconnector position	Voltage applied to	Earth connected to
1[a]	Closed	AaCc	BbF
2[a]	Closed	Bb	AaCcF
3	Open	ABC	abcF
4	Open	Abc	ABCF
5[b]	Open	ABC	Earthing switch

[a] If the insulation between poles is air at atmospheric pressure, test conditions nos. 1 and 2 may be combined, the test voltage being applied between all parts of the main circuit connected together and the base.

[b] Earthing switch in the position resulting in the shortest gap between the tip of the earthing blade and live parts of ABC.

When testing earthing switches, the test voltage shall be applied with the earthing switch in the open position:

- between adjacent insulated terminals with the bases earthed (e.g. A to B with F earthed);
- between all the insulated terminals connected together and the bases earthed (e.g. ABC to F earthed).

7.2 Dielectric test on auxiliary and control circuits

Subclause 7.2 of IEC 60694 is applicable.

7.3 Measurement of the resistance of the main circuit

Subclause 7.3 of IEC 60694 is applicable only to disconnectors.

7.4 Tightness test

Subclause 7.4 of IEC 60694 is applicable.

7.5 Design and visual checks

Subclause 7.5 of IEC 60694 is applicable.

7.101 Mechanical operating tests

Operating tests are made to ensure that the disconnectors or earthing switches show the specified operating behaviour within the specified voltage and supply pressure limits of their operating mechanisms.

During these tests, which are performed without voltage on, or current flowing through the main circuit, it shall be verified that the disconnectors or earthing switches open and close correctly when their operating mechanisms are energized.

The tests shall be performed according to 6.102.3.2. The mentioned test programme shall be performed only once.

During these tests no adjustment shall be made and the operation shall be faultless. The closed and open position shall be reached with the specified indication and signalling during each operating cycle.

After these tests, no parts of the disconnector or earthing switch shall be damaged.

For disconnectors and earthing switches with a rated voltage of 52 kV and above, the mechanical operating routine tests may be performed on sub-assemblies.

Where mechanical routine tests are performed on separate components, they shall be repeated at site on a complete assembled disconnector during the commissioning tests. The same total number of operations as specified in 6.102.3.2 shall be performed.

NOTE The mechanical operating test will not be representative for the operating conditions in the substation when complicated linkages are used between the point of operation and the switchgear and when the bearings are mounted to weak supports.

8 Guide to the selection of disconnectors and earthing switches

8.101 General

For the selection of disconnectors and earthing switches the following conditions and requirements at site should be considered:

- normal current load and overload conditions;
- existing fault conditions;
- static and dynamic terminal loads resulting from the substation design;
- use of rigid or flexible conductors to be connected to the disconnector or earthing switch or to which the separated contact is mounted;
- environmental conditions (climate, pollution, etc.);
- altitude of the substation site;
- required operational performance (mechanical endurance);
- switching requirements (bus-transfer current switching by disconnectors, induced current switching by earthing switches, short-circuit making capacity of earthing switches).

When selecting a disconnector or earthing switch due allowance should be made for the likely future development of the system as a whole so that the disconnector or earthing switch may be suitable not merely for immediate requirements, but also for those of the future.

National requirements enforcing deviation from this standard shall be stated in the tender documents.

8.102 Selection of rated values for normal service conditions

All rated characteristics and classes of a disconnector or earthing switch given in clause 4 shall be considered, as far as applicable, together with the following subclauses.

8.102.1 Selection of rated voltage and rated insulation level

The rated voltage of the disconnector or earthing switch should be chosen so as to be at least equal to the highest voltage of the system at the point where the disconnector or earthing switch is to be installed.