

ISOLATOR AND EARTH SWITCH TESTING SP0514

1. PURPOSE AND SCOPE

The purpose of this Standard Work Practice (SWP) is to standardise and prescribe the method for testing of isolators and earth switches. This includes air insulated exposed switchgear (such as a single or double break air break switch) as well as enclosed switchgear (such as an oil insulated RMU). Motor drive mechanisms and auxiliary switch functions are included in this SWP.

Fuse switches may also be tested using this SWP, noting however that the fuse must be replaced by a temporary bridging link prior to contact resistance measurement.

2. STAFFING RESOURCES

Adequate staffing resources with the competencies to safely complete the required tasks as per 8 Level Field Test Competency - 2597616.

These competencies can be gained from, but not limited to any or all of the following:-

- Qualifying as an Electrical Fitter Mechanic
- Qualifying as a Technical Service Person
- Training in the safe use of relevant test equipment.

Requirement for all live work:

- Safety Observer (required for all “live work” as defined in the ESO Code of Practice for Managing electrical risks in the workplace).

All resources are required to:

- Have appropriate Switching and Access authorisations for the roles they are required to perform and have the ability to assess and maintain relevant exclusion zones from exposed live electrical apparatus
- Hold current licences for any vehicles and equipment they may be required to operate.

Required Training

Staff must be current in all Statutory Training relevant for the task.

All workers must have completed Field Induction or have recognition of prior Ergon Energy Field Experience.

Contractors must have completed Ergon Energy's Generic Contractor Worker Induction.

3. DOCUMENTATION

HazChat – On-site Risk Assessment

EQL SWMS – Safe Work Method Statements

EQL Health and Safety Policy – 692225

Electrical Safety Rules 2022 – 6503074

8 Level Field Test Competency - 2597616

Circuit Breaker Testing – 2934536

ITP Isolator / Earth Switch - 2948512

Queensland Electricity Entity Standard for Safe Access to High Voltage Electrical Apparatus (SAHV - Orange Book) - 2904212

Standard for Handling of Sulphur Hexafluoride (SF6) - 2949681

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Standard for Maintenance Acceptance Criteria - 2928929

Standard for Minimum Commissioning Test Requirements - 3061890

Substation Primary Plant and Secondary Systems Field Testing – 2902800

4. KEY TOOLS AND EQUIPMENT

Test Equipment within calibration date, tested and tagged – megger (10kV), ductor, high voltage test set.

Safety Barriers.

HVIA Operating Equipment – PEDs, Live Line Tester, Class 0 gloves. All equipment to be inspected and confirmed within test date prior to use.

Additional PPE as required: Leather work gloves, class 00 gloves, hearing protection, safety eyewear. All PPE to be inspected and confirmed within test date (where applicable) prior to use.

Sun protection to be used when working outdoors.

5. WORK PRACTICE STEPS

5.1. Carry out an on site risk assessment

Prior to performing this activity any hazards associated with prerequisite tasks at the worksite shall be identified and assessed with appropriate control measures implemented and documented in accordance with the HazChat and using the EQL SWMS.

If any risks cannot be managed or reduced to an acceptable level, do not proceed with the task and seek assistance from your Supervisor.

5.2. All work to be done with Isolator/Earth Switch de-energised

All of the tests described in this SWP should be carried out with the Isolator/Earth Switch de-energised and appropriate control measures in place (e.g. barriers, matting) to prevent inadvertent contact with adjacent live plant or breaching exclusion zones. Furthermore, the Electrical Safety Rules 2022 – 6503074 is applicable at all times for isolation and earthing.

Issue a Test Permit and follow the requirements of the Electrical Safety Rules.

As described in Substation Primary Plant and Secondary Systems Field Testing – 2902800, particular safety risks applicable to Isolators/Earth Switches include:

- Contact with high voltage at primary connections.
- High fault current at primary connections.
- Initiation of other protection or control functions by change in state of auxiliary contacts.
- Operating the switch at current levels exceeding the rated capacity – for example breaking capacitive current.
- Induced voltages and currents from nearby energised / loaded plant.

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5.3. Assessment Criteria

Unless stated, refer to Standard for Maintenance Acceptance Criteria - 2928929 for minimum acceptance values for each test.

5.4. Record Identification Details

- Manufacturer's name, manufacturer's type description and manufacturer's serial number.
- Plant/Asset number.
- Rated voltage.
- Rated nominal and short-circuit current and duration.
- Insulating medium.

5.5. Visual Inspection of Isolator/Earth Switch Condition

Inspect the plant for any sign of damage. Confirm that the insulating medium level/pressure is correct before commencing tests and that assembly is complete and no transport bracing has been left in place.

Inspect the external surfaces and ensure the plant is clean and dry.

Check all control wiring connections for adequate labelling. The connections should be unambiguous, legibly and adequately marked.

5.6. Auxiliary and Control Circuit Voltage Withstand

The Isolator/Earth Switch auxiliary and control circuitry shall be subjected to a 1 minute power frequency withstand test at 2kV to confirm insulation integrity under the following conditions.

- a) If the Isolator/Earth Switch is new and HV testing has not been verified as satisfactorily completed at the manufacturer's works.
- b) If the Isolator/Earth Switch is aged or refurbished and the wiring has been substantial modified.

Power frequency withstand test is **NOT** required under the following conditions
- c) If the Isolator/Earth Switch is aged or refurbished and minimal wiring changes have occurred.
- d) If the Isolator/Earth Switch is new and HV testing has been verified as satisfactorily completed at the manufacturer's works.

The circuitry shall be considered to have passed if no disruptive discharge occurs during the test.

Consideration shall be given where electronic components are used in the auxiliary and control circuitry. Different testing procedures and values maybe adopted subject to agreement by the Commissioning Engineer.

5.7. Measure Contact Resistance

Measurement shall be made using DC current of at least 50A (100A preferred) and less than the nominal current rating of the Isolator/Earth Switch. The test shall be conducted as close as practical to ambient temperature.

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A four wire ductor should be used for measuring the resistance of the main contacts.

To limit any hazardous voltage rise due to induction, always maintain an operator earth or working earth on one side of the isolator during this measurement

Caution: Do not pass measurement current through any current transformer connected to the isolator. A DC current may cause inadvertent protection operation, and may also leave a residual magnetism in the CT which adversely affects CT performance.

5.8. Measure Earth Switch Earth Connection Resistance

Measurement shall be made using a four wire ductor at a DC current of at least 50A (100A preferred). The test shall be conducted as close as practical to ambient temperature, and includes measurement of the contact resistance of the earth switch contacts plus the resistance to the main earth mat. Refer to Standard for Maintenance Acceptance Criteria - 2928929 for minimum acceptance values.

5.9. Measure Insulation Resistance

DC insulation tests are to be carried out between terminals of the Isolator/Earth Switch as detailed below. The voltage applied will be as per Standard for Maintenance Acceptance Criteria - 2928929 for a duration of 1 minute.

With the Isolator/Earth Switch in the closed position:

- A or a to Earth and all other terminals.
- B or b to Earth and all other terminals.
- C or c to Earth and all other terminals.

With the Isolator/Earth Switch in the open position:

(These measurements not required where the insulating medium is air and the isolating distance meets the requirements of AS2067 and AS2650).

- A to Earth and all other terminals.
- B to Earth and all other terminals.
- C to Earth and all other terminals.
- a to Earth and all other terminals (not required for earth switch).
- b to Earth and all other terminals (not required for earth switch).
- c to Earth and all other terminals (not required for earth switch).

A, B and C refer to one set of Isolator/Earth Switch high voltage terminals and a, b, and c refer to the other set of terminals (or the side of an earth switch permanently bonded to earth).

Refer to Standard for Maintenance Acceptance Criteria - 2928929 for minimum acceptance values.

5.10. Carry out HV Testing

AS 2067 specifies that a 90% power frequency withstand test be carried out on site after erection. The level of high voltage testing to be applied is therefore:

- a) Where no HV testing has been carried out at the manufacturer's works – 100%.

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- b) Where HV testing has been carried out at the manufacturer's works but subsequent assembly of the HV chamber / bushings is required on site – 90%.
- c) Where HV testing has been carried out at the manufacturer's works and no on-site assembly of the insulating component is required – No HV withstand test.
- d) If the Isolator/Earth Switch is aged or refurbished – 75%.

Where $U_m \leq 66\text{kV}$ the value of voltage applied shall be as per AS 2650-1986 as listed in the table below.

Where $U_m > 66\text{kV}$ the value of test voltage shall be in accordance with AS 2650-1986.

Note: The test voltage used may be limited by the output capability of the test equipment. In this case a reduced test voltage for an extended duration as specified in Table 11.1 of AS 2067 may be used.

The requirements of the test are satisfied if no disruptive discharge occurs.

An insulation resistance test is to be repeated after the HV withstand test to confirm that insulation degradation has occurred.

Application of a 1 minute power frequency withstand test is to be in accordance with AS 1931.1 between the load and line terminals of the Isolator/Earth Switch as detailed below.

Note: These connection arrangements have been specified for consistency with AS 2650 and the circuit breaker testing Circuit Breaker Testing SWP – 2934536.

With the Isolator/Earth Switch in the closed position:

A/a and C/c to Earth and all other terminals.

B/b to Earth and all other terminals.

With the Isolator/Earth Switch in the open position:

- A, B and C to Earth and all other terminals.
- a, b and c to Earth and all other terminals (not required for earth switches).

Nominal voltage of system (U_n) kV_{rms}	Highest Voltage for equipment (U_m) kV_{rms}	Rated Short term Power-frequency withstand voltage (PFVV) kV_{rms}
3.3	3.6	10
6.6	7.2	20
11	12	28
22	24	50
33	36	70
66	72.5	140

5.11. Carry out SF₆ Testing

For SF₆ insulated equipment, carry out testing for the following parameters as specified in Standard for Handling of Sulphur Hexafluoride (SF₆) - 2949681:

- Purity of SF₆
- Dew point.

Refer to Standard for Maintenance Acceptance Criteria - 2928929 for minimum acceptance values.

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5.12. Schedule of Tests

Refer to Standard for Minimum Commissioning Test Requirements - 3061890.

The table below summarises the circumstances in which different tests are typically carried out:

Test	New Isolator/Earth Switch	Aged or refurbished Isolator/Earth Switch
Auxiliary and Control Circuit Voltage Withstand	As per 5.6 (a) and (b)	As per 5.6 (c) and (d)
Main Contact Resistance	On-site test required.	
Earth Switch Earth Connection Resistance	On-site test required.	
Insulation Resistance	On-site test required.	
High Voltage Withstand	On-site test required if applicable.	
SF ₆ Tests	On-site test required if applicable.	

5.13. Complete Pre-Commissioning Checklist

A requirement for an Isolator/Earth Switch being placed in service for the first time or after refurbishment is that all checklists nominated in the Construction and Commissioning Tools have been completed.