BS EN 61821:2011

BSI Standards Publication

Electrical installations for lighting and beaconing of aerodromes — Maintenance of aeronautical ground lighting constant current series circuits

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National foreword

This British Standard is the UK implementation of EN 61821:2011. It is identical to IEC 618121:2011. It supersedes BS EN 61821:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/97, Aeronautical ground lighting.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting constant current series circuits

(IEC 61821:2011)

Installations électriques pour l'éclairage et le balisage des aérodromes - Maintenance des circuits série à courant constant pour le balisage aéronautique au sol
(CEI 61821:2011)

Elektrische Anlagen für Beleuchtung und Befeuerung von Flugplätzen - Wartung von Konstantstrom-Serienstromkreisen für Flugplatzbefeuerungsanlagen
(IEC 61821:2011)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 97/153/FDIS, future edition 2 of IEC 61821, prepared by IEC/TC 97 "Electrical installations for lighting and beaconing of aerodromes" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61821:2011.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-08-03
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2014-11-03

This document supersedes EN 61821:2003.

EN 61821:2011 includes the following significant technical changes with respect to EN 61821:2003:

a) addition of references to normative references;

b) addition of notes in Clauses 5, 6 and 7;

c) modification of pre-work procedures in item e) of 7.2.2.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61821:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61822	NOTE Harmonized as EN 61822.
IEC 61823	NOTE Harmonized as EN 61823.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60903	-	Live working - Gloves of insulating material	EN 60903	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES – MAINTENANCE OF AERONAUTICAL GROUND LIGHTING CONSTANT CURRENT SERIES CIRCUITS

FOREWORD

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International Standard IEC 61821 has been prepared by IEC technical committee 97: Electrical installations for lighting and beaconing of aerodromes.

This second edition cancels and replaces the first edition published in 2002. It is a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of references to normative references;

b) addition of notes in Clauses 5, 6 and 7;

c) modification of pre-work procedures in item e) of 7.2.2.

The text of this standard is based on the following documents:

FDIS	Report on voting
97/153/FDIS	97/154/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This International Standard contains the management, safety and procedural requirements specific to the maintenance of an aeronautical ground lighting (AGL) constant current series circuit and has taken into consideration existing national standards, requirements and practices. The maintenance activities are required to ensure that the AGL constant current series circuit continues to meet the operational requirements and minimize the occurrence of operational failures.

To conform to this International Standard it should be demonstrated to the relevant bodies that the requirements have been satisfied and therefore that the clause objective(s) has (have) been met.

NOTE Examples of relevant bodies would include the following:

- certification and licensing authorities;
- safety regulators;
- notified bodies for international or European directives;
- national standards bodies.

ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES – MAINTENANCE OF AERONAUTICAL GROUND LIGHTING CONSTANT CURRENT SERIES CIRCUITS

1 Scope

This International Standard applies to the maintenance of AGL constant current series circuits.

This International Standard

- covers constant current series circuits for AGL installed at aerodromes and heliports;
- concentrates on providing the safety requirements for the maintenance of an AGL constant current series circuit. It is recognized that AGL constant current series circuits of different design characteristics and parameters are in existence;
- is mainly concerned with safety to persons by specifying the rules and fundamental principles for the maintenance of AGL constant current series circuits;
- is not intended to apply to AGL primary series circuits supplied directly from a mains constant voltage source;
- is not intended to be used for public street lighting, roadway lighting or any other installation requiring the use of constant current series circuits.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60903, *Live working – Gloves of insulating material*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
aerodrome authority
organization accountable for the operational safety and security of persons, aircraft operations and facilities at an aerodrome

NOTE Temporally the occupational safety for third party personal, contracted for AGL work on non-operational areas, can be delegated to the third party contractor if the evidence of professional skills, knowledge of the behavior rules and the separation to the airport operation area is given and documented.

3.2
AGL constant current series circuit
apparatus configured as an electrical circuit designed to produce and operate with a constant current, independent of specified load variations, in order to provide a specified light for aeronautical purposes

3.3
AGL operator
person responsible for the control of the AGL to permit the safe movement of aircraft

3.4
caution sign
non-metallic safety sign attached to equipment conveying a warning against interference with such equipment

3.5
constant current regulator
CCR
apparatus which produces a current output at a constant r.m.s. value independent of variations in the constant current series circuit load, input voltage and service conditions as specified

3.6
contractor
organization or person(s) given a written order to provide a service or undertake specified work

3.7
dead
free from any electrical connection to a source of potential difference and from electric charge; not having a potential different from that of the earth

3.8
earthed
connected to the general mass of earth in such a manner as to ensure at all times an immediate discharge of electrical energy without harm

3.9
electrical equipment
anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distributes, control, store, measure or use electrical energy

3.10
harm
physical injury or damage to the health of people either directly, or indirectly, as a result of damage to property or to the environment

[ISO/IEC Guide 51, 3.3, modified]

3.11
hazard
potential source of harm

NOTE The term includes hazards to persons arising within a short time scale (for example, fire and explosion) and also those that have a long-term effect on a person's health (for example, release of a toxic substance).

[ISO/IEC Guide 51, 3.5, modified]

3.12
hazardous event
occurrence, with possible hazardous consequences, arising as the result of a hazardous condition

3.13
hazard sign
non-metallic safety sign that conveys a warning against risk of harm

3.14
isolate
disconnect and separate electrical equipment from the normal source(s) of electrical energy in such a way that the disconnection and separation is secure

3.15
live
electrically connected to a source of electricity or which has acquired a charge by other means

3.16
maintenance
act of diagnosing and physically repairing, or preventing, equipment failures

3.17
personal protective equipment
equipment used to protect persons from harm in the working environment

NOTE Personal protective equipment includes such items as special tools, protective clothing, insulating screening, safety harnesses and safety signs.

3.18
prove dead
demonstrate with the use of test equipment that no electrical potential liable to cause harm is present

3.19
risk
combination of the probability of occurrence of harm and the severity of that harm

[ISO/IEC Guide 51, 3.2]

3.20
risk assessment
1. systematic quantitative assessment of the magnitude of the threat to safety induced by the accumulation of controlled and unresolved residual hazards;

2. integrated analysis of the risks inherent in a product, system or facility and their significance in an appropriate context

3.21
test equipment
equipment to undertake particular tests, that is suitable for the use for which it is provided, that is maintained in a condition suitable for that use, and that is properly used

3.22
test/testing (of electrical equipment)
1. providing a sequence of operations or the measuring of electrical characteristics of live electrical equipment (for example, diagnostic testing of faulty equipment);

2. applying voltages, currents or signals for the purposes of providing insulation, continuity or other characteristic of isolated electrical equipment (for example, before a permanent electrical installation is energised from the normal source(s) of electrical energy)

3.23
work/working (on electrical equipment)
installing, dismantling, assembling, maintaining, testing or repairing of electrical equipment

4 Competence of persons

4.1 Objective

The objective of the requirements of this clause is to ensure that persons who have responsibility for any activity, or are directly engaged in the maintenance of AGL constant current series circuits are competent to discharge those duties or perform those tasks.

NOTE It is recommended that the appropriate administration or aerodrome authority encourage the development of a formal and structured competency training programme(s). The training programme(s) should consist of multiple tiers that enhance progressively a person's skills and ensure a recognised level of competency for those persons who have satisfactorily completed the programme(s).

4.2 Requirements

In accordance with national legislation, all persons involved in any activity, including management and maintenance activities, shall have the appropriate and verifiable training, technical knowledge, experience and qualifications relevant to the specific duties they have to perform. In particular, where involved in work on constant current series circuits, they shall be knowledgeable of the specific risks and the safety procedures involved in the work. The training, experience and qualifications of all persons involved in any activity shall be justified taking into account all the relevant competence factors. The justification shall be recorded in appropriate documentation.

NOTE The following competence factors should be addressed when assessing and justifying the competence of persons carrying out their duties:

- engineering appropriate to the application area;
- engineering appropriate to the technology (for example, mechanical, electrical/electronic/software engineering);
- safety engineering appropriate to the technology;
- knowledge of the legal and safety regulatory framework;
- knowledge of the operational aspects related to the AGL system at the aerodrome;
- the consequences in the event of a failure of a constant current series circuit;
- the consequences of failure to adhere to safety procedures when working on constant current series circuits;
- the novelty of the design, design procedures or application;
- previous experience relevant to the specific duties to be performed and the technology being employed;
- relevance of qualifications to the specific duties performed.

5 Management of maintenance activities

NOTE Additional informative guidance material for management of maintenance activities is included in Annex A.

5.1 Objective

The objective of the requirements of this clause is to detail the roles and responsibilities of those personnel engaged in maintenance activities on or near AGL constant current series circuits and the procedures to ensure that safety are addressed.

5.2 Requirements

5.2.1 Organizational roles and responsibilities

The aerodrome authority shall appoint one or more named persons to manage, supervise or undertake specific maintenance tasks. Those persons shall be identified on any applicable record or other documentation associated with the task. All persons involved in work on the AGL shall be aware of

- their role and responsibilities;
- their duties and how to perform those duties;
- the procedures to be followed;

- contingency working arrangements.

The content of this clause is a minimum requirement.

NOTE IEC/TS 62143 contains details of requirements for the safety management of an AGL system at an aerodrome.

5.2.2 Use of contractors

The aerodrome authority retains full accountability under these requirements for all work undertaken on an AGL constant current series circuit by a contractor. This accountability shall include where the AGL constant current series circuit, or part of it, is to be under the control of a contractor. The aerodrome authority shall ensure that all other organisations, including the users and operators of the AGL and other applicable aerodrome facilities, are notified prior to the commencement of the work and the procedures used. Contractors and other non-aerodrome employees shall follow the safety rules and procedures provided by the aerodrome authority (see 5.2.4).

5.2.3 Maintenance policy

5.2.3.1 Concept

A maintenance policy shall be produced and implemented. The maintenance policy shall include the following aspects:

- the maintenance philosophy, that includes and takes account of
  - the maintenance objectives;
  - the operational requirements;
  - the maintenance resources;
- a maintenance schedule and procedures (see 5.2.4), which includes
  - planned, controlled, conditional and corrective maintenance programmes;
  - post-maintenance activities;
  - the modification or upgrading of equipment;
- reference to the maintenance procedures (see 5.2.4);
- reference to specific safety procedures (see 6.2.1);
- the management of records and documentation (see 7.2.6);
- the provision of spares, tools, test and safety equipment (see 6.2.4 and 6.2.5);
- inspections (see 7.2);
- provision for the review and amendment of the maintenance policy.

NOTE Maintenance activities can be described as

- planned, where prescribed tasks are carried out on a routine basis;
- controlled, where an analysis of the equipment is carried out in order to minimize the amount of planned maintenance required;
- conditional, where the maintenance requirements have changed during the life of the equipment;
- corrective, in order to restore equipment to the required operational state.

5.2.3.2 Operational aspects

The maintenance of AGL equipment shall consider the objectives of aerodrome operations and address the impact on such operations whilst maintenance activities are being carried out.

NOTE For example, the following should be considered:

- the withdrawal of operational facilities and the closing of movement areas to aircraft operations prior to works;

- the return of operational facilities and movement areas when operationally necessary even though the works may not be completed;
- the raising of a notice to airmen (NOTAM) where work will affect the availability of operational facilities;
- procedures for entering and being recalled from active operational areas;
- precautions to prevent the possibility of foreign object damage (FOD) to aircraft by maintenance (particularly vehicles) and excavating plant;
- procedures for communication with the AGL operator before, during and after works.

5.2.4 Maintenance procedures

5.2.4.1 Procedures manual

Maintenance procedures that instruct on the correct and safe method of maintenance shall be provided for each maintenance activity that is to be undertaken on the AGL. The maintenance procedures shall be contained in a suitable document (for example, an AGL operation and maintenance plan, see IEC/TS 62143) and shall be provided and used at all times. A copy of the maintenance procedures shall be made available to all AGL maintenance personnel and any contractors' representative(s). They shall read and understand the maintenance procedures and their implication to both themselves and others. Ignorance of the procedures shall not be accepted as an excuse for neglect of responsible action or failure to implement them. The aerodrome authority shall keep an appropriately controlled record of this action.

Any questions of safety shall be raised with the aerodrome authority who shall have the matter investigated and satisfactorily resolved before the applicable work commences.

In all appropriate work areas, there shall be access to the following items:

- a copy of the maintenance procedures;
- instructions and details of procedures designed to protect personnel;
- applicable safety equipment;
- all relevant and appropriate drawings of the equipment and its identification and location;
- all relevant service manuals;
- local safety and operational procedures.

5.2.4.2 Authorization procedures

The aerodrome authority shall determine which activities require authorization, who is able to give the authorization, how the authorization, including written permission, is to be obtained, and all other safety procedures associated with the activity. One method, a safe system of work involving the issuance of permits/sanctions, is illustrated in Annex A. The authorization procedures shall be outlined explicitly in a suitable document.

5.2.5 Admittance to AGL work areas

When entering an AGL indoor work area, all persons shall sign a logbook. The logbook shall be located in the work area.

NOTE 1 Such work areas may include sub-stations, switchrooms, plant and machinery rooms, AGL control centres, diesel generator rooms and electrical workshops.

NOTE 2 The logbook should contain the following information:

- time of entry;
- name and signature of all persons present;
- reason for visit;
- permit/sanction serial number (if applicable, see 5.2.4.2 and Annex A);
- brief detail of the work to be carried out;
- time of exit.

6 Safety requirements

NOTE Additional informative guidance material for management of maintenance activities which have impact on safety to personnel engaged in maintenance activities is included in Annex A.

6.1 Objective

The objective of the requirements of this clause is to detail the measures to ensure operational safety and safety to personnel engaged in maintenance activities on or near AGL constant current series circuits.

6.2 Requirements

6.2.1 Safety procedures

The aerodrome authority shall perform a risk assessment of all work to be performed on AGL constant current series circuits. A risk assessment shall include, *inter alia*, the determination of the required manning level to complete the work safely. Care shall be taken to ensure that maintenance equipment and other materials do not present a hazard to aircraft. The completed risk assessments shall be contained in a suitable document and retained by the aerodrome authority. They should be reviewed and updated periodically or whenever necessary, for example, due to a hazardous event.

Safety procedures shall be developed that take into account the completed risk assessment for the work and shall consider

- that work shall not be performed on live electrical conductors or equipment, except where special procedures shall be implemented to prevent harm (see 6.2.2);
- that, where required, authorization to perform work or testing on AGL electrical equipment shall be obtained prior to that work commencing and that the authorization shall remain valid for the duration of the work (see 5.2.4.2 and Annex A);
- that power shall always be assumed to be on and electrical equipment is live until the true condition is determined (see 7.2.2);
- that, unless determined otherwise by a risk assessment, at least two persons shall be assigned to carry out maintenance work on AGL electrical equipment;
- that maintenance procedures shall begin only after a visual inspection has been made and possible hazards have been identified, evaluated in a risk assessment and recorded (see 7.2.2);
- that a specific safety training for personnel is provided;
- that a safety protection device is intended to prevent hazards. The deliberate disconnection of such device shall only be authorized in accordance with specific safety procedures (see 6.2.3.2);
- the use of safety signs and instructions (see 6.2.3.3);
- the availability of earth terminals and other safety facilities (see 6.2.3.4);
- that some electrical equipment is exposed to weather and moisture and may develop electrical shock hazards through damage from lightning or insulation deterioration from exposure (see 6.2.3.5);
- that all tools and test equipment shall be appropriate for the task (see 6.2.4);
- the use of appropriate safety equipment (see 6.2.5);
- the periodic inspection and/or calibration of tools, test and safety equipment (see 6.2.4 and 6.2.5);
- that electrical equipment shall not be returned to operational service without verifying that it is functioning correctly and that all the maintenance activities have been satisfactorily completed (see 7.2.5).

6.2.2 Live working

No work of any kind shall be performed on live AGL constant current series circuits unless the aerodrome authority has undertaken a risk assessment and provided procedures that have been assessed by that authority as safe. In this case, all practical precautions to prevent harm shall be taken.

Fault finding or testing on live electrical equipment shall only be undertaken when it is unreasonable for the electrical equipment to be made dead. Any subsequent repair shall not be performed on live electrical equipment.

6.2.3 Safety checks

6.2.3.1 Securing the work area

Electrical equipment covers shall be replaced and doors closed whenever electrical equipment is left unattended. If electrical equipment door locks are provided they shall be left locked with keys made available for authorized use. Any electrical equipment in the vicinity of the work in progress that cannot be made dead shall be identified and appropriate precautions shall be taken to prevent any additional hazard.

6.2.3.2 Safety protection devices

Fault diagnosis may require defeating interlocks or the removal of covers to give access to live electrical equipment (see 6.2.2). On such occasions testing shall be limited to the use of appropriate test equipment and shall follow a formalized procedure. This procedure may include a written checklist, agreed routines or any other precautions deemed necessary to maintain safety. Where interlocks have been defeated or covers removed for test purposes, the interlocks shall be re-instated and covers replaced at the earliest opportunity. The safety protection devices shall be re-set, tested and verified as operating correctly before the electrical equipment is returned to operational service.

6.2.3.3 Safety signs

The working area shall be screened off by suitable barriers and indicated by appropriate signs. Caution signs shall be affixed to all switchgear controlling the electrical equipment which has been made dead and on which work is proceeding. Hazard signs shall also be attached on, or adjacent to, live electrical equipment and at the limits of the area in which work may be carried out. In all cases a safety or job tag shall be securely attached at the point of isolation giving the name of the person who carried out the isolation procedure, essential contact telephone number(s) and date and time of isolation. If any test equipment or electrical equipment under test cannot be placed within the screened area, it shall be separately screened. Any safety signs that are not in use shall be stored in the appropriate place. A sign or placard, giving details of emergency resuscitation in the event of electric shock and first aid, shall be displayed in AGL indoor work areas where persons may be at risk of electric shock.

6.2.3.4 Earthing facilities

Earth connections shall be installed and maintained in conformance with the installation instructions. Earth connections, including devices for providing the temporary connection of an earth, shall be tested and the measurement recorded on a regular basis.

NOTE This test should take into account seasonal variations in the soil and should be performed on a nine-month cycle.

6.2.3.5 Proving circuit is dead

Where necessary (see 6.2.2), appropriate measures shall be taken to assure that the circuit on which work is to be performed is dead. The circuit should be earthed during the time taken to do the work (see 7.2.2 e)).

NOTE A constant current series circuit may be live even when no voltage is detected at the test point.

6.2.3.6 Environmental factors

Electrical equipment that is normally covered but has to be exposed as a necessary result of the maintenance activities shall be protected from water and other undesirable elements. Work in exposed areas shall take account of adverse weather conditions, flora and fauna. No work on an AGL constant current series circuit shall take place in the presence of lightning.

6.2.4 Tools and test equipment

Appropriate tools and test equipment shall be used at all times. All test equipment shall be calibrated and be in good working order.

6.2.5 Safety equipment

Safety equipment shall be provided, worn and used wherever necessary. Adequate training in the use, safe keeping and inspection of safety equipment shall be given to the user. Before and after each occasion of use, the user shall inspect safety equipment for visible defects and any suspect item shall be withdrawn and replaced. Periodic inspections shall be recorded in a suitable document.

6.2.6 Personal protective equipment

Where required (see 6.2.1 and 6.2.2) rubber boots, insulating gloves, insulating mats and other appropriate personal protective equipment shall be readily available at all times. Insulating gloves shall be tested in accordance with IEC 60903 and shall be indelibly marked with the date of the test. Insulating gloves tested more than 12 months previously shall not be used and shall either be mutilated to prevent re-use or returned for testing.

NOTE Where insulating gloves are to be used for replacing lamps, potential heat hazards should be taken into consideration.

7 AGL maintenance procedures

NOTE Additional informative guidance material for management of maintenance activities which have impact on safety to personnel engaged in maintenance activities is included in Annex A.

7.1 Objective

The objective of the requirements of this clause is to detail the procedures to ensure operational safety and safety to personnel engaged in maintenance activities on or near AGL constant current series circuits.

7.2 Requirements

7.2.1 General

Where appropriate, manufacturer's recommendations shall be used for the maintenance of specific electrical equipment including CCRs, AGL series transformers, and light fittings. Defective electrical equipment shall be removed from service and appropriately marked.

7.2.2 Pre-work procedures

The following procedures shall be carried out prior to any work commencing:

a) where necessary, permission to commence work shall be obtained from the AGL operator and/or an authorization shall be issued (see 5.2.4.2);

b) a pre-work visual inspection shall be carried out prior to commencing work in order to

- locate and identify equipment, including safety devices;
- locate applicable documentation (see 7.2.6);
- locate tools, test and safety equipment;
- identify any potential hazards;

c) permanent and temporary earth connections shall be checked (see 6.2.3.4) and applied where necessary;

d) where necessary, safety signs shall be placed in the correct position;

e) where necessary (see 6.2.2), the electrical equipment to be worked on shall be electrically isolated by the following procedure;

   i) the relevant AGL electrical equipment shall be positively identified;

   ii) the remote control of AGL equipment shall be disabled;

   iii) the input power to all relevant CCRs shall be removed and secured. An appropriate method of preventing the re-energising of circuits or electrical equipment that is under maintenance shall be incorporated. To secure against re-energisation of power the operating mechanism shall be either lockable, or be in a secure area;

   iv) all applicable electrical equipment shall be proved dead by using appropriate current and voltage test equipment. The test equipment shall be proved operative before and after the test;

   v) the primary series circuit shall be disconnected from the CCR output terminals using an appropriate disconnector. The conductors at the open ends of the primary series circuit shall be shorted together and earthed;

   vi) all disconnectors shall be securely locked in an electrically isolated and earthed condition.

NOTE 1 The use of a safety key or mechanical interlock system is an effective method of preventing unauthorized re-energisation of electrical equipment.

NOTE 2 For testing purposes an earth may be temporarily removed.

7.2.3 AGL constant current series circuits

Tests for the commissioning of a new constant current series circuit installation and operational tests for specific AGL electrical equipment are included in the applicable national and IEC standards. The procedures and tests described in these standards shall be followed where appropriate to the maintenance policy. Frequent checks, as set by the aerodrome authority, of the series circuit insulation resistance shall be undertaken. If a significant difference from the last recorded value is measured or a marked deterioration trend is noticed, the cause shall be identified and any problem rectified.

NOTE Examples of IEC standards regarding AGL electrical equipment for constant current series circuits are IEC 61822 and IEC 61823 which contain detailed information on constant current regulators and AGL series transformers respectively.

Earth connections that have been applied for the purpose of performing maintenance may be temporarily removed if necessary to perform specific tests. The earth connections shall only be disconnected whilst those tests are being performed and shall be reconnected upon completion of the tests.

7.2.4 Cables

Cables shall be positively identified, isolated and proved dead before cutting or disconnection. Whenever practical, cables that are no longer in use shall be positively identified, proven dead using appropriate current and voltage test equipment and removed. The test equipment shall be verified before and after the test. Cables that cannot be removed immediately shall be appropriately marked at both ends and at any point of access. The ends of the conductors shall, where possible, be shorted together and earthed.

7.2.5 Completion of work

A post-work inspection shall be carried out on the completion of any work and prior to returning the electrical equipment to operational service in order to verify that

a) the electrical equipment, including the operation of system interlocks, has been tested for correct operation, is fully serviceable and in an operational state;

b) the remote control of AGL equipment has been restored;

c) all relevant organizations and persons have been informed of the re-energisation and serviceability of the equipment;

d) all the maintenance activities and any changes to the AGL are recorded in the appropriate documentation and the documentation is stored in the appropriate location;

e) safety signs have been removed;

f) all test and safety equipment are serviceable and returned to their correct storage location;

g) earth connections are removed or re-installed as appropriate, equipment covers and safety devices are re-installed;

h) the area is clean and tidy and clear of all non-essential equipment.

If applicable, any relevant work authorization issued shall be cancelled and the electrical equipment shall only be re-connected and re-energised on the satisfaction and instruction of the person appointed by the aerodrome authority to be responsible for the work (see 5.2.4.2).

7.2.6 Records and documentation

All activities and work carried out on the AGL constant current series circuit shall be recorded in a suitable log or other form of documentation. Each entry shall be identified by a reference that allows traceability of all coherent activities that have taken place. All relevant records and documentation shall be made available at places of work. The documentation shall record, *inter alia*, the following:

a) the activity that has taken place;

b) the results of any measurements or tests that have been performed;

c) details of any repair or corrective action;

d) details of any work that has been carried over to another task;

e) the date and time of the activity;

f) the name of the persons who carried out the activity.

NOTE IEC/TS 62143 contains details of the type of documentation appropriate for the maintenance of AGL.

Annex A
(informative)

Maintenance organisation model

A.1 General

The purpose of this annex is to outline a framework for the management of AGL maintenance work at an aerodrome. An organizational structure is suggested, for which roles and responsibilities are defined, and a flow chart is provided to enable the development of maintenance processes and procedures. This annex is intended to be complementary to the requirements of the clauses of this International Standard and does not replace them.

A.2 Organizational structure

A.2.1 General

The organizational structure illustrated in Figure A.1 represents a suitable hierarchy for the maintenance of AGL at an international aerodrome or for a maintenance organization that serves many aerodromes. Figure A.1 identifies the key personnel and their roles are defined in the following section. The organization with overall accountability for the AGL, the aerodrome authority, or the appropriate line management appoints this personnel. Where a person is responsible for several teams (i.e. in a co-ordinating role), suitable lines of communication should be established. The organizational structure may be adapted by amalgamating roles for use at smaller aerodromes where the complete resources may not be available. The aerodrome authority may appoint an external (third-party) maintenance organization to provide the personnel, facilities and equipment to undertake the maintenance activities; however, the requirements of 5.2.2 shall apply.

Competency should be a major factor in the appointment of personnel and continuous assessment and training of each person should be undertaken to maintain competency levels. A culture of safety awareness and seeking continuous improvement among staff at all levels within the structure is also important.

Procedures should be in place to cater for unexpected staff changes and deputation when authorization to perform work is required.

A.2.2 Explanation of roles

A.2.2.1 General

For the purposes of this annex, the roles of participants in the maintenance organization model are explained as follows.

A.2.2.2 Co-ordinating authorizing engineer

An authorizing engineer who co-ordinates the actions of other authorizing engineers and acts as a focal point for health and safety information and other guidance.

A.2.2.3 Authorizing engineer

An engineer whose nomination has been approved by the aerodrome authority to be responsible for the management, implementation and monitoring of the safe systems of work on AGL electrical equipment, including the appointment of an authorized person.

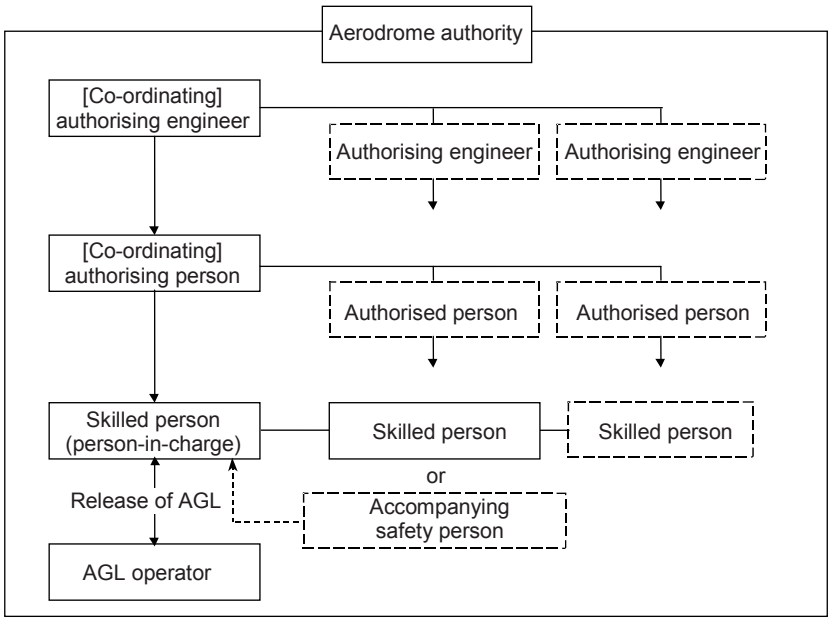

Figure A.1 – AGL maintenance organisation structural diagram

A.2.2.4 Co-ordinating authorized person

An authorized person who co-ordinates the actions of other authorized persons.

A.2.2.5 Authorized person

A person who has been appointed in writing by the authorizing engineer on behalf of the aerodrome authority to be responsible for any work undertaken on AGL electrical equipment, including the practical implementation and operation of the safe system of work.

NOTE Any number of authorized persons may be appointed but only one is to be responsible for the work at an aerodrome at any one time or period of duty (see A.2.3.3).

A.2.2.6 Skilled person

A person, approved by an authorized person, with sufficient technical skills and knowledge or experience to perform maintenance tasks satisfactorily and prevent harm which electricity may create in the person's working environment.

A.2.2.7 Person-in-charge

A skilled person who has accepted a permit to work, sanction to test, or a standing instruction (see Clause A.3) from the authorized person and is responsible for the safe execution of the work or tests specified.

A.2.2.8 Accompanying safety person

A person not directly involved in the work or test that has adequate knowledge, experience and ability to recognize and warn of a hazard and aid in the prevention of harm.

A.2.3 Roles and responsibilities

A.2.3.1 Authorizing engineer

The authorizing engineer is the manager and central point of contact for all AGL maintenance work within their organization and should report directly to the senior management of the aerodrome authority. The authorizing engineer's main role is to ensure that the AGL maintenance rules and procedures are correctly applied to all AGL maintenance activities. The authorizing engineer must therefore be given adequate authority and resources to ensure that these rules and procedures will be followed.

Within the area for which the authorizing engineer has been appointed, the authorizing engineer is to

a) implement, administer, monitor and audit the application of AGL maintenance rules and procedures;

b) provide the in-depth experience and professional support to the aerodrome authority, AGL operators and authorized persons;

c) appoint, on behalf of the aerodrome authority or their nominated maintenance organization, one authorized person as the co-ordinating authorized person (see A.2.2.4). If the maintenance organization is responsible for more than one aerodrome then one co-ordinating authorized person is to be appointed per aerodrome;

d) nominate and re-nominate sufficient authorized persons to provide the necessary cover for the AGL installations on the aerodrome(s);

e) be satisfied that the prospective authorized persons have appropriate qualifications and training, are familiar with the aerodrome and are able to demonstrate adequate knowledge of each system, installation and type of equipment for which authorization is envisaged;

f) issue each authorized person, on appointment or re-appointment, a certificate of appointment as an authorized person for a pre-determined period;

g) define in writing, using drawings and diagrams as appropriate, the exact extent of the AGL installations for which each authorized person is responsible, keeping appropriate records for each aerodrome;

h) maintain a register of all authorized persons and their areas of responsibility. The register is to include details of the persons with whom the authorized persons are to communicate and co-operate, in order to co-ordinate and regulate the assessment of risk, the generation of safety programmes and sequences of safe systems of work;

i) audit the performance and record the operational experience of each authorized person at regular intervals. The audits are to pay particular attention to the operating and permit system records and are to formally advise on any training or retraining that is required and whether it is required immediately or before the next audit;

j) suspend, if considered necessary, the appointment of an authorized person and withdraw the certificate of appointment;

k) investigate all reported hazardous events involving electrical systems and installations within the area of appointment;

l) accept the introduction of new work that is to be incorporated into the AGL maintenance policy or a new installation of electrical equipment. Before accepting responsibility for the new work the authorizing engineer should visit the site of the new work, inspect the documentation, view the work and form an opinion on the safety and suitability of the work for its intended purpose. If the new work is not considered satisfactory, the issue of an operational restriction may be considered, else the introduction of the new work is not to be accepted.

NOTE An operational restriction is a written instruction, issued by the authorizing engineer, a manufacturer or a supplier of equipment, that modifies or prohibits the normal operating procedures associated with a particular type of equipment, system or installation but permits limited use of the equipment.

A.2.3.2 Co-ordinating authorizing engineer

Where the aerodrome authority or appointed maintenance organization is responsible for more than one aerodrome and employs more than one authorizing engineer, one of the authorizing engineers is to be appointed by the organization as the coordinating authorizing engineer. The coordinating authorizing engineer is, in addition to the responsibilities contained in A.2.3.1, to

a) co-ordinate the actions of the other authorizing engineers;

b) act as a focal point for health and safety information and other guidance relating to authorizing engineers;

c) audit the performance of authorizing engineers.

A.2.3.3 Authorized person

The authorized person on duty is solely responsible for the practical implementation and operation of the AGL maintenance rules and procedures for the AGL installations for which the authorized person has been appointed. On matters relating to the AGL maintenance rules and procedures, the authorized person's instructions should be mandatory. In the case of dispute, the authorized person is to refer the matter to the authorizing engineer for adjudication. More than one authorized person may be appointed for an AGL installation; however, only one person is to undertake the role of authorized person at any one time or period of duty. In this case it may be necessary to appoint a coordinating authorized person (see A.2.3.4). Each transfer of responsibility between authorized persons is to be formally recorded.

The authorized person is to

a) ensure so far as is reasonably practicable that all personnel within the aerodrome undertaking work or testing on AGL electrical equipment observe and comply with the AGL maintenance rules and procedures;

b) issue and cancel permits, sanctions, and standing instructions (see Clause A.3) in accordance with the AGL maintenance rules and procedures, noting that these documents are only to be issued for equipment for which the authorized person is appointed;

c) withdraw permits, sanctions, and standing instructions if anyone fails to follow the AGL maintenance rules and procedures, or if an unexpected hazard is present;

d) co-operate and co-ordinate with the AGL operator for the release of the equipment for the maintenance work and, if necessary, access to operational areas;

e) inspect any protective equipment for satisfactory and safe operation, for which the authorized person is responsible, before it is used;

f) inform the authorizing engineer (or, if applicable, coordinating authorized person) of any defects in equipment and of any hazardous conditions or practices that are observed in the course of the authorized persons duties;

g) inform the authorizing engineer (or, if applicable, coordinating authorized person) of any hazardous event;

h) supervise or undertake electrical isolation, cable detection or location work within the geographical area of the authorized person's appointment;

i) be satisfied that a prospective skilled person has appropriate qualifications, training and adequate knowledge of the AGL installation and equipment;

j) appoint sufficient skilled persons to undertake the necessary work on the AGL;

k) issue each skilled person, on appointment or re-appointment, a certificate of competency as a skilled person for a pre-determined period;

l) audit the performance and record the operational experience of each skilled person at regular intervals;

m) suspend, if considered necessary, the appointment of a skilled person and withdraw the certificate of competency.

A.2.3.4 Co-ordinating authorized person

In addition to the role of an authorized person (as outlined in A.2.3.3), the coordinating authorized person is to

a) co-ordinate the actions of all authorized persons and act as the focal point for authorized persons on matters related to health and safety, particularly on matters relating to the prevention of harm;

b) ensure that protective equipment and test equipment for which authorized persons are responsible is formally listed in a register, is regularly inspected, calibrated and maintained in good condition;

c) inform the authorizing engineer of any hazardous event that is reported by an authorized person;

d) periodically examine maintenance records to ensure that necessary work has been undertaken satisfactorily;

e) periodically examine all formal registers and logs to ensure that they are properly kept;

f) periodically examine the AGL installation record drawings to ensure that they are current and correct.

A.2.3.5 Skilled person

A skilled person is typically the person that will perform the maintenance work, including the assembling of tools and personal protective equipment, repair and testing of equipment, and the measurement, collection and recording of data. A skilled person may not deputise for an authorized person. A skilled person is to

a) undertake work in accordance with the approved AGL maintenance rules and procedures, while taking all safety measures necessary to prevent harm and to prevent damage to equipment;

b) be aware of the extent and limits of the work to be undertaken and of any constraints on the sequence or method of working;

c) be able to demonstrate competence to perform the required work activities and take reasonable care of their own and other people’s health and safety;

d) work only on or test equipment that is listed in his or her certificate of appointment;

e) be familiar with the types of installation and equipment that they are required to work on or test;

f) have an adequate knowledge of emergency first aid.

A.2.3.6 Person-in-charge

A skilled person who is appointed person-in-charge is to follow the authorized person’s instructions. Unless it is unavoidable, the person-in-charge should not leave the place of work until the work or test is completed. If the person-in-charge has to temporarily leave the place of work, the work or test is to be suspended and adequate safety precautions taken to prevent hazards. The work or test is not to be resumed until the person-in-charge has returned to the place of work.

Having accepted a permit or sanction, until the work or test is completed and the person-in-charge has signed Part 6 of the permit (see Figure A.4) confirming the work/test has been completed, the person-in-charge is to undertake or supervise only the specified work or test.

Neither the person-in-charge, nor any person under the direct control of the person-in-charge is to attempt to undertake any other duties.

A.2.3.7 Accompanying safety person

An accompanying safety person is to

a) have sufficient familiarity with site systems;

b) know how to disconnect the equipment being worked on from all supplies of electricity and how to switch off any test equipment or disconnect it from the electrical supply in a safe manner;

c) keep watch and prevent unauthorized interruption of the work;

d) know how to apply first aid;

e) know how to summon help;

f) be aware of the hazards present when working on AGL constant current series circuits.

A.3 Permits

The different types of AGL maintenance are outlined in the maintenance policy included in 5.2.3. Figure A.2 outlines a typical maintenance regime and the implementation of a permit system. The permit system is intended to control hazardous activities and to ensure that every care is taken to provide and maintain a safe working environment.

Not all work will require the isolation of electrical circuits or live testing and may be undertaken under the authority of the authorized person and in accordance with a standing instruction. A standing instruction would, typically, consist of a written authority issued by the authorized person, be valid for a specified period of not more than 12 months, and be accompanied by a detailed procedure, which includes co-ordination with the AGL operator. However, where specific work on live circuits or in potentially hazardous situations is to be undertaken, a safe work system such as the issuance of permits should be employed. Permits should outline the safety procedures and ensure that they are carried out and that risk is minimized.

Permits should be issued for the disconnection and isolation of live circuits, electrical distribution networks and live testing (a sanction-to-test) and should be issued only by the authorized person. Figures A.3 and A.4 illustrate an example of permit-to-test/sanction-to-test. The authorizing engineer, on behalf of the aerodrome authority, should determine which activities require the issue of a permit and the procedure to issue it, such as the following procedure.

a) A permit-to-work/sanction-to-test should be issued before any work is undertaken on an AGL constant current series circuit.

b) Only the authorized person should issue or cancel a permit-to-work/sanction-to-test.

c) A permit-to-work/sanction-to-test should be issued to the prospective person-in-charge of the work/test who, after reading its contents and agreeing to them, should sign a receipt and a duplicate.

d) The person-in-charge of the work/test should retain the permit/sanction in his/her possession at all times whilst work is being carried out. The authorized person should retain a duplicate of the permit/sanction.

e) The authorized person should cancel the permit-to-work/sanction-to-test before the equipment is made live.

f) A permit-to-work/sanction-to-test may be suspended. The suspension is initiated on the signature of the person-in-charge of the work/test and the authorized person. The suspension should only be cancelled on the signatures of both the authorized person and the person-in-charge of the work/test.

g) Records of all permit-to-work/sanction-to-tests that are issued should be recorded in the appropriate documentation. A record of on-going, suspended and cancelled permits/ sanctions should be kept in the same document. The record should include

- the serial number, date and time of issue of the permit-to-work/sanction-to-test;
- the name of the person the permit/sanction is issued to (the person-in-charge of the work/test);
- the name of the issuing person (the authorized person);
- the date and time of suspension and re-instatement of the permit/sanction (if applicable);
- the date and time of cancellation.

NOTE A permit-to-work and a sanction-to-test may be on separate forms.

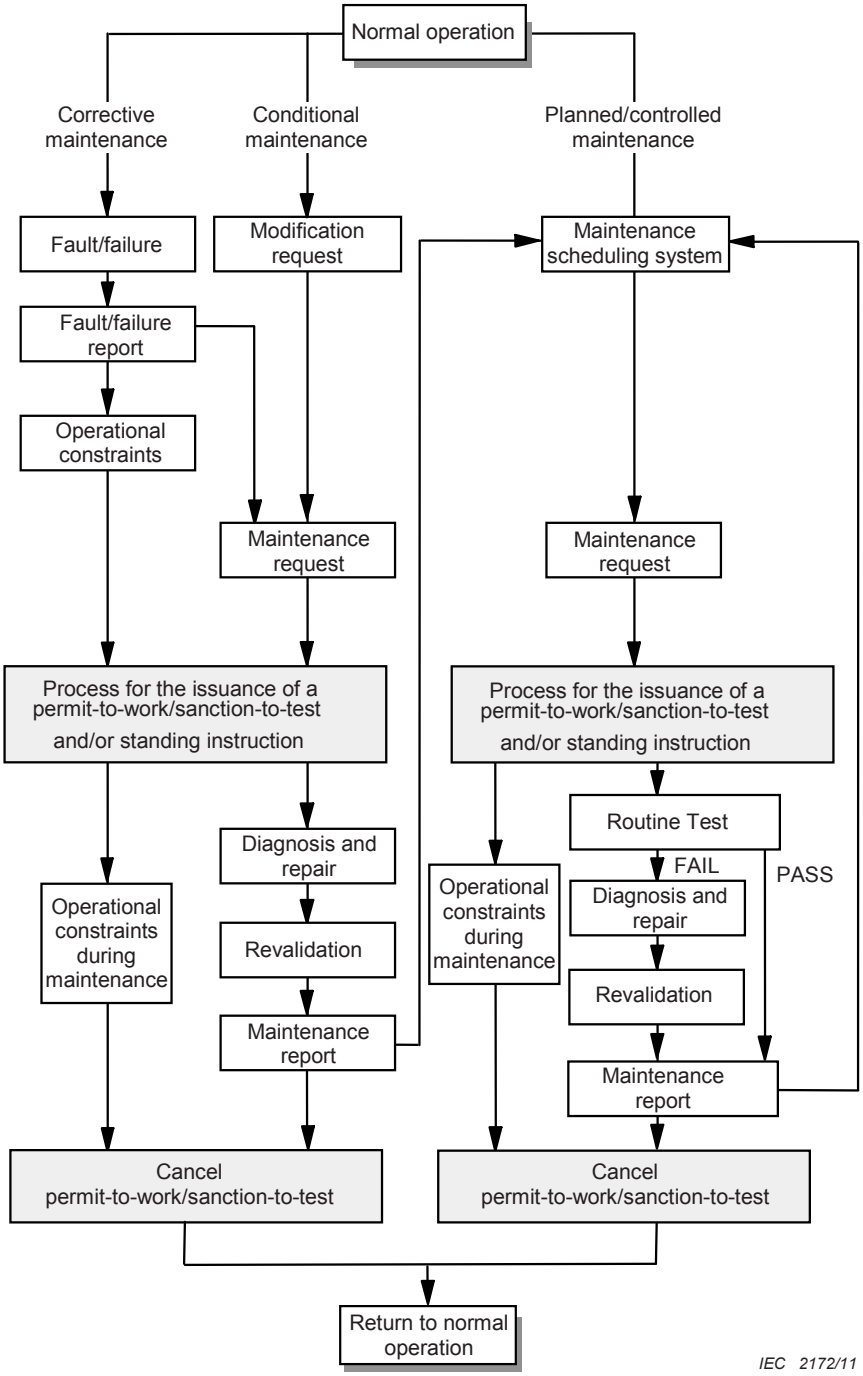

Figure A.2 – AGL constant current series circuit maintenance model

Permit-to-work/sanction-to-test (Part 1)	
1 ISSUE Issued to _____ being the person-in-charge of the work/test employed by _____ at _____	Serial No. _____ NOTE This permit is invalid without a serial number Name of authorized person _____
2 (i) Description of equipment to be worked on	
(ii) Points of isolation	
(iii) Point of application of circuit earths	
(iv) Caution and hazard sign location(s)	
(v) Other precautions to prevent access to or contact with live equipment	
(vi) Location of nearest live conductors	
(vii) Control circuits are/are not alive at Volts a.c./d.c. **WARNING: ALL OTHER PARTS OF THE AGL SYSTEM ARE HAZARDOUS**	
(viii) Work to be carried out, if testing state earths to be removed and whether to be replaced on completion	
DECLARATION I hereby declare that the equipment described is safe for the work/test detailed and will remain so until you have signed Part 4 of this permit/sanction. You are instructed to take charge of the work/test as described. Time _____ Date _____ Signed _____ Being the authorized person	
NOTE 1 The supervisor of the work/test shall a) acknowledge receipt of the permit/sanction by signing Part 3 of the copy held in the AGL maintenance log (permits/sanctions); b) retain the permit/sanction whilst the work/test is proceeding; c) retain the permit/sanction when the work/test is completed after signing Part 4 of the copy held in the AGL maintenance log (permits/sanctions). NOTE 2 The authorized person shall not energise the equipment until Part 5 of the copy in the AGL maintenance log (permits/sanctions) has been completed.	

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Figure A.3 – Example of a permit-to-work/sanction-to-test sheet

Permit-to-work/sanction-to-test (Part 2)

3 RECEIPT

I have read and I fully understand this permit-to-work/sanction-to-test. I am fully conversant with the work/test to be done.

I accept responsibility for carrying out the work/test on the equipment described.

No attempt by me or by any person under my control will be made to work on or test any other part of the AGL system.

Time _____ Date _____ Signed _____

Being the person-in-charge of the work/test

4 FINAL CLEARANCE CERTIFICATE

My part of the work/test is now finished and I declare that all persons under my charge have been withdrawn and warned that it is no longer safe to work on the equipment specified in this permit-to-work/sanction-to-test and all tools and test equipment are clear.

Time _____ Date _____ Signed _____

Being the person-in-charge of the work/test

5 CANCELLATION – strike out and initial all statements which are not correct

I have inspected the work and consider it satisfactorily completed.

I am satisfied that all temporary earth connections have been removed.

I am satisfied that all other permits/sanctions relating to the equipment are cancelled.

I have removed all circuit earths.

I have carried out or witnessed insulation tests.

I am satisfied that phasing is correct.

I have amended circuit labels as necessary.

I consider that the equipment is safe for reconnection to the AGL system.

Time _____ Date _____ Signed _____

Being the authorized person

6 SUSPENSION (when applicable)

(a) I confirm that all work by me is suspended and all persons under my charge have been withdrawn and warned that it is no longer safe to work on the equipment detailed on this permit-to-work/sanction-to-test.

I acknowledge that the circuit earths will be temporarily removed for the purpose of testing.

Time _____ Date _____ Signed _____

Being the person-in-charge of the work/test

(b) I acknowledge receipt of this permit-to-work/sanction-to-test for the purposes of carrying out testing during which time I will remove the circuit earth(s) when permitted to do so by the authorized person.

Time _____ Date _____ Signed _____

Being the authorized person

(c) I confirm that all testing is complete, that circuit earth(s) and protection devices have been re-instated to the authorised person's instructions.

Time _____ Date _____ Signed _____

Being the authorized person

(d) I acknowledge that all testing is complete, that circuit earth(s) have been re-instated and accept the return of this permit-to-work/sanction-to-test in its original form.

Time _____ Date _____ Signed _____

Being the supervisor of the work/test

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Figure A.4 – Example of a permit-to-work/sanction-to-test sheet

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