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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical installations for lighting and beaconing of aerodromes – AGL series transformers

Installations électriques pour l'éclairage et le balisage des aérodromes – Transformateurs série utilisés pour l'éclairage et le balisage aéronautique au sol

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Installations électriques pour l'éclairage et le balisage des aérodromes – Transformateurs série utilisés pour l'éclairage et le balisage aéronautique au sol

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CONTENTS

FOREWORD 4
1 Scope 5
2 Normative references 5
3 Definitions and abbreviated terms 5
3.1 Definitions 5
3.2 Abbreviated terms 6
4 General requirements 7
4.1 Classification 7
4.2 Rated current 7
4.3 Earthing 7
4.4 AGL construction 7
4.5 Encapsulation 8
4.6 Earthing 8
4.7 Service conditions 8
4.8 Electrical characteristics 8
4.9 Temperature rise 9
5 Type and routine tests 10
5.1 Type tests 10
5.2 Routine tests 11
6 Test requirements 11
6.1 Introduction to electrical testing 11
6.2 Tests under load 12
6.3 Short circuit current 13
6.4 Open circuit voltage 13
6.5 AC leakage current test 13
6.6 DC leakage current cycling test 15
6.7 Shock tests 16
6.8 Temperature rise 17
6.9 Gas tightness test 18
6.10 Physical size demonstration 18
7 Routine tests 18
7.1 Ratio test 18
7.2 Earth continuity test 18
7.3 Leakage current test 18
8 Marking 19
Annex A (normative) Connector descriptions and interface dimensions 20
Bibliography 22

Figure 1 – Tests under load 12
Figure 2 – Primary a.c. leakage current test 14
Figure 3 – Secondary a.c. leakage current test 14
Figure 4 – Primary d.c. leakage current 16
Figure 5 – Secondary d.c. leakage current 16
Figure 6 – Lead rigidity test 17

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Figure A.1 – Style 2 primary plug 20
Figure A.2 – Style 9 primary receptacle 20
Figure A.3 – Style 8 secondary receptacle 21
Figure A.4 – Style 7 secondary receptacle 21

Table 1 – Transformer characteristics 9
Table 2 – Encapsulation method type tests 10
Table 3 – Electrical characteristic type tests 11
Table 4 – Routine tests 11
Table 5 – DC leakage current test limits 15
Table A.1 – Interface dimensions for Figures A.1 and A.2 20
Table A.2 – Interface dimensions for Figures A.3 and A.4 21

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ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES – AGL SERIES TRANSFORMERS

FOREWORD

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International Standard IEC 61823 has been prepared by IEC technical committee 97: Electrical installations for lighting and beaconing of aerodromes.

This bilingual version (2016-11) corresponds to the English version, published in 2002-12.

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

FDIS	Report on voting
97/94/FDIS	97/95/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.

The French version of this standard has not been voted upon.

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 2006. At this date, the publication will be

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

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ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES – AGL SERIES TRANSFORMERS

1 Scope

This standard specifies the characteristics of aeronautical ground lighting series transformers (AGLST) used in aeronautical ground lighting for 6,6 A series circuits, at a service voltage of up to 5 kV, supplied by constant current regulators up to 30 kVA in rating.

AGL series transformers provide power to airport lighting luminaires or other loads (resistive) from their secondary circuits. The AGL series transformers provide continuity of the series circuit in the event of a loss of the load on the transformer, and electrical isolation between the primary circuit supplied by a constant current regulator, and the secondary circuit connected to the load under conditions defined in this standard.

An AGL series transformer is be able to withstand a permanent short or open-circuit secondary series circuit.

Specifications for similar series transformers intended for any primary or secondary currents other than 6,6 A, or to supply alternative voltages, constant power, reactive loads, etc., are not included in this standard.

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 60085, *Thermal evaluation and classification of electrical insulation*

IEC 61822, *Electrical installations for lighting and beaconing of aerodromes – Constant current regulators*

ISO 48, *Rubber, vulcanised or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

3 Definitions and abbreviated terms

3.1 Definitions

For the purposes of this standard the following definitions apply.

Where the terms voltage and current are used, they shall be r.m.s. values unless otherwise stated.

3.1.1
AGL series transformer
aeronautical ground lighting series transformer, as specified in this standard

3.1.2
ambient temperature
the temperature of the air or other medium surrounding the AGL series transformer; for testing purposes, a temperature of (20 ± 5) °C

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3.1.3
nominal power
arbitrarily selected values of power used in this standard for convenience to refer to AGL series transformers with different characteristics

3.1.4
rated frequency
the frequency or frequency range for which the AGL series transformer is designed to operate

3.1.5
rated power
the range of powers for which each AGL series transformer is suitable.

NOTE The low and high values of these ranges are given in Table 1.

3.1.6
rated primary current
the current at which the primary of the AGL series transformer is designed to operate

3.1.7
rated secondary current
the current at which the secondary of the AGL series transformer is designed to operate

3.1.8
routine test
test for the purpose of checking manufactured products for compliance with this standard

3.1.9
service voltage
the maximum primary or secondary voltage at which the AGL series transformer is designed to operate

3.1.10
type test
a test to confirm that the product design and production processes are capable of providing products that meet the requirements of this standard

3.1.11
type test sample
a sample consisting of one or more similar samples used for a type test

3.2 Abbreviated terms

AC1	Source of mains power
AC2	High voltage a.c. source
AGLST	AGL series transformer
DC1	Source of d.c. power
CCR	Constant current regulator as specified in IEC 61822
I_1, I_2	Primary and secondary currents respectively, as measured by ammeters or equivalent devices
U_1, U_2	Primary and secondary voltages respectively, as measured by voltmeters or equivalent devices
P_1, P_2	Active power measurements or calculations of respectively the primary and secondary circuits of an AGL series transformer

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4 General requirements

4.1 Classification

There are seven types of AGL series transformers specified in this standard, defined by their nominal power, namely 30 W, 45 W, 65 W, 100 W, 150 W, 200 W and 300 W. See Table 1 for the required characteristics.

4.2 Rated current

The rated primary and secondary currents shall be 6,6 A.

4.3 Earthing

AGL series transformers may be provided with or without an earthing connection.

4.4 AGL construction

The AGL series transformers shall have two electrically and physically separate windings, one primary and one secondary, wound on a magnetic core. The polarity of the windings shall be such that the primary plug corresponds to the large socket of the secondary receptacle.

All internal electrical connections shall be permanent, e.g. by compression high-pressure crimping, high-temperature soldering, welding, etc.

The shapes of the transformers are optional provided they meet all the requirements of this standard. Sharp edges shall be avoided.

The AGL series transformer including all connector leads shall be able to be inserted through the open end of a cylinder 20 cm in diameter by 25 cm long, and shall easily and totally fit inside such a cylinder.

The transformers shall be designed so that they may be installed and will perform to the requirements of this standard in any orientation.

The AGL series transformers shall be provided with two single-conductor primary leads and a two-conductor secondary lead.

4.4.1 Primary connection leads

The AGL series transformers shall be connected to the AGL primary series circuit cable by two insulated, multi-stranded, copper conductors, with at least a 6 mm^2 cross section, and a length measured from the transformer housing to the face of the connector of 60^{+10}_{0} cm. The service voltage for the leads shall be 5 kV. One lead shall have a style 2 male plug at its end. The other lead shall have a style 9 female receptacle at its end. Unless otherwise agreed between the manufacturer and supplier, the connectors shall be provided with disposable shipping caps.

4.4.2 Secondary connection lead

The secondary lead shall consist of two insulated, multi-stranded, copper conductors with an overall jacket, each core of minimum cross section 2,5 mm^2, minimum service voltage 600 V, and a length measured from the transformer housing to the face of the connector of 120^{+10}_{0} cm. The lead shall have a type 2, class A, style 7 or style 8 female receptacle at its end. Unless otherwise agreed between the manufacturer and supplier, the connector shall be provided with a disposable shipping cap.

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4.5 Encapsulation

The AGL series transformer body, the connectors and the connection lead's sheaths, shall be made of compatible materials. The case shall be composed of material formed directly on the core and coil assembly, or by compound filling a container. The transformer shall be permanently encapsulated without cracks, holes, or internal voids as far as practical. The encapsulation of the transformer must form a watertight casing, and must bond with its connection leads so as to provide a completely waterproof assembly.

The encapsulation material shall have a durometer hardness IRHD (Shore A) of not less than 55 as measured in accordance with the test method of ISO 48.

The minimum thickness of the encapsulation over the internal components shall be 6,5 mm at all points of the surface, for any type of encapsulant.

The encapsulation materials shall be capable of withstanding acid and alkaline soils, as well as limited exposure to chemicals typically present on the aerodrome, including but not limited to oil, gasoline, and de-icing fluids. The encapsulating materials must resist limited UV exposure. These characteristics may be confirmed by testing material samples (only). The characteristics may be confirmed by tests sponsored by the transformer manufacturer, or by test results supplied by the materials manufacturer. These results may be applied to all AGL series transformers using the encapsulation material. If a transformer manufacturer uses more than one material for encapsulation, each such material shall meet these requirements.

4.6 Earthing

The magnetic core shall not be connected to earth or to either of the primary or secondary electrical circuits.

AGL series transformers may be provided with or without an earthing connection. If an earthing connection is provided, it shall be connected to that side of the secondary winding of the transformer which is connected to the larger socket of the secondary connector. The earthing connection must have a water barrier within the transformer body.

4.7 Service conditions

The ambient temperature range shall be –40 °C to +55 °C.

AGL series transformers shall be suitable for continuous outdoor service when installed within enclosures or by direct earth burial.

AGL series transformers shall be capable of operation when completely submerged in water for the life of the transformer.

4.8 Electrical characteristics

4.8.1 Secondary current

With the primary current I_1 at 6,6 A, the secondary current I_2 shall be within ±1 % of the primary current in the range between the low and high load in ohms given in Table 1.

4.8.2 Power factor

With the primary current I_1 at 6,6 A, and the nominal load in ohms (see Table 1) connected to the secondary, the power factor shall be not less than 95 %.

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4.8.3 Efficiency

With the primary current I_1 at 6,6 A, and the nominal load in ohms (see Table 1) applied to the secondary, the efficiency shall be not less than 80 % for AGL series transformers whose nominal rating is 30 W, not less than 85 % for AGL series transformers whose nominal rating is 45 W, 65 W or 100 W, and not less than 90 % for AGL series transformers whose nominal rating is above 100 W.

4.8.4 Short circuit secondary current

With the primary current I_1 at 6,6 A, the secondary short circuit current shall not exceed 6,8 A for all AGL series transformers.

4.8.5 Open circuit secondary voltage

With the primary current I_1 at 6,6 A, and with the secondary circuit open, the voltage at the secondary connector terminals shall not exceed the limits given in Table 1.

4.8.6 Characteristics

To allow for lamp power tolerances and losses in the circuit connecting the lamps to the AGL series transformers, the permanent acceptable load on the secondary may vary from the nominal value between the low and high limits given in Table 1.

Table 1 – Transformer characteristics

Nominal power W	Rated power W		Load (resistive) Ω			Maximum open circuit voltage V
	Low	High	Low (maximum)	Nominal	High (minimum)	50 Hz and 60 Hz
30	25	40	0,57	0,69	0,92	20
45	35	60	0,80	1,03	1,38	20
65	50	85	1,15	1,49	1,95	30
100	80	125	1,84	2,30	2,87	40
150	120	178	2,75	3,44	4,13	60
200	160	230	3,67	4,59	5,28	70
300	220	338	5,05	6,89	7,81	110

NOTE Tolerance on loads is ±1 %.

4.9 Temperature rise

The temperature rise of the transformer shall be determined using the resistance method. The temperature rise shall not exceed the maximum temperature permitted by the insulation class, according to IEC 60085, of the most critical insulation, less 60 °C. The transformer shall be operated in air at ambient temperature, with primary current set at 6,6 A, under each of the following conditions:

- high resistive load, see Table 1;
- short circuit;
- open circuit.

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5 Type and routine tests

5.1 Type tests

The type tests are divided into two groups, which apply respectively to the encapsulation method (see 5.1.1), and to the electrical characteristics of each transformer (see 5.1.2).

5.1.1 Encapsulation method type tests

The following tests shall be successfully completed for three samples of one type from each family of AGL series transformers, where a family is defined as AGL series transformers of the same physical size (e.g. made in the same mould), differing only in characteristics which will not effect the physical performance. Such differences would include, but are not necessarily limited to:

- primary and/or secondary connector configurations;
- length of primary and/or secondary leads;
- electrical construction (e.g. number of turns, number of laminations or core size).

Before beginning, each AGL series transformer to be tested shall have its connector dimensions confirmed as being in accordance with the tolerances given in Annex A.

Table 2 – Encapsulation method type tests

Sequence	Test	Reference
1	Physical size demonstration	6.10
2	Initial ratio	6.2.1 and 6.2.1.1
3	Shock tests (impact and lead rigidity)	6.7
4	Gas tightness	6.9
5	Final ratio	[a]
6	AC leakage current test	6.5
7	DC leakage current cycling test	6.6

[a] The transformer shall first be subjected to the “warm-up” procedure in accordance with 6.2.1. Then the primary current I_1 shall be set between 6,58 A and 6,62 A, and the value recorded. The secondary current I_2 shall be measured. This value shall be adjusted by multiplying by the measured primary current in this sequence divided by the measured primary current in sequence 2. The resulting value shall not be different from the secondary current measured in sequence 2 by more than ±67 mA.

The encapsulation type tests shown in Table 2 shall be carried out in the sequence given.

If one or more of the three test transformers fails any one of the tests, the full test sequence shall be repeated with three new samples.

The results of these tests shall be recorded and kept for future reference.

5.1.2 Electrical characteristic type tests

These tests shall be run on three samples of each type. Types which are essentially the same electrically, differing only in characteristics that will not materially effect the electrical performance, may be covered by a test on one representative type. Such differences would include, but not necessarily be limited to,

- primary and/or secondary connector configurations;
- lead lengths;
- with and without earth connection.

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Table 3 – Electrical characteristic type tests

Sequence	Test	Reference
1	Ratio, power factor and efficiency under load	6.2
2	Short circuit	6.3
3	Open circuit	6.4
4	AC leakage current	6.5
5	Temperature rise	6.8

The electrical type tests shown in Table 3 shall be carried out in the sequence given.

If one or more of the three test transformers fails any one of the above tests, the full test sequence shall be repeated with three replacement transformers.

The results of these tests shall be recorded and kept for future reference.

5.2 Routine tests

All of the AGL series transformers manufactured shall be subjected to the tests shown in Table 4.

Any transformer that fails any of the tests in Table 4 shall be discarded.

The results of these tests shall be recorded and kept for future reference. These results may include pass/fail only.

Table 4 – Routine tests

Test	Reference
Ratio	7.1
Earthing continuity (if earth connection supplied)	7.2
Leakage current test – either d.c. or a.c.	7.3

6 Test requirements

6.1 Introduction to electrical testing

6.1.1 Safety

During these tests, lethal voltages and high energy levels may be developed. It is essential that the operators and witnesses be aware of the appropriate safety provisions.

6.1.2 Power

All testing shall be with a sinusoidal waveform of the rated frequency of the device, (50 Hz ± 1) Hz or (60 Hz ± 1) Hz. If a transformer is rated for both 50 Hz and 60 Hz, all electrical tests shall be carried out at both frequencies.

6.1.3 Loads

When resistors are used as loads for a transformer, they shall be of very low inductance, not more than 0,25 µH per ohm of resistance. They shall also be inherently temperature stabilized, or their temperature shall be stabilized, and the resistance value confirmed, prior to measurements being taken.

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6.1.4 Measurement

All measuring instruments shall read r.m.s.

High impedance voltage measurement equipment shall be used (at least 1 MΩ).

When measuring the current ratio, the primary and secondary currents shall be measured simultaneously.

Allowances shall be made for the power consumption of any meters if this is material to the results.

Metering shown in Figures 1, 2, 3, 4, and 5 is only suggestive. Other forms of metering may be used if they accomplish the same objective.

6.2 Tests under load

6.2.1 Warm-up procedure

The transformer shall be connected as shown in Figure 1. The AC1 source shall be set between 6,58 A and 6,62 A, and the load *R* to the nominal value as given in Table 1. The transformer shall be in ambient temperature air lying on its largest flat surface on a dry solid wooden plate at least 30 mm thick. This warm-up shall continue for a minimum of 6 h, after which the tests of 6.2.1.1 and 6.2.1.2 shall be carried out.

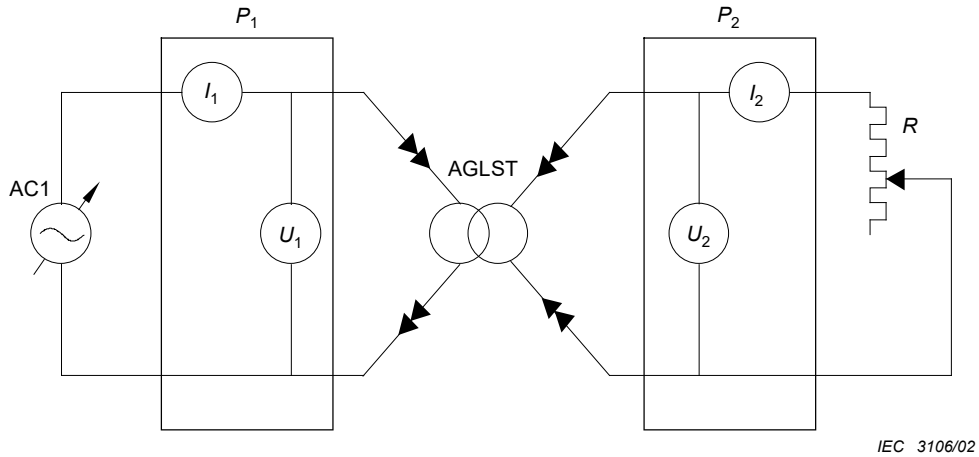

Figure 1 – Tests under load

6.2.1.1 Ratio measurement polarity

The input current I_1 shall be set between 6,58 A and 6,62 A, and the value recorded. The secondary current I_2 shall be within ±67 mA of the measured primary current for each of the low, nominal, and high values of load given in Table 1.

6.2.1.2 Power factor and efficiency

The load *R* shall be set at the nominal load ±1 % given in Table 1, and the voltage, current, and power of both the primary and the secondary circuits shall be measured and recorded.

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6.2.1.2.1 Power factor

The power factor shall be measured directly, or calculated as follows:

$$PF = P_1 / I_1 \times U_1$$

where

PF is the power factor;

P_1 is the primary power in watts;

I_1 is the primary current in amperes;

U_1 is the primary voltage in volts.

The value of the power factor shall be not less than 0,95.

6.2.1.2.2 Efficiency

The efficiency shall be measured directly, or calculated as follows:

$$\text{Efficiency} = P_2 \times 100 / P_1$$

where

P_1 is the primary power in watts;

P_2 is the secondary power in watts.

The efficiency shall be not less than 80 % for AGL series transformers whose nominal rating is 30 W, not less than 85 % for AGL series transformers whose nominal rating is 45 W, 65 W, or 100 W and not less than 90 % for AGL series transformers whose nominal rating is above 100 W.

6.3 Short circuit current

The transformer shall be at ambient temperature and be connected as shown in Figure 1.

The primary current I_1 shall be set between 6,58 A and 6,62 A.

The load R shall be a short circuit presenting a voltage drop of less than 0,1 V as measured at the secondary connector of the sample.

The secondary current shall be not more than 6,8/6,6 times the measured primary current.

6.4 Open circuit voltage

The transformer shall be at ambient temperature, and connected as shown in Figure 1.

The load R shall be removed (open circuit).

The primary current shall be set between 6,58 A and 6,62 A.

The voltage U_2 shall be not more than the value given in Table 1.

6.5 AC leakage current test

The transformer's primary and secondary leads shall be connected to the corresponding connectors of primary and secondary leads. No additional protection such as tape or compound shall be used on the connectors. The transformer including all connectors shall be immersed in a tank of tap water at ambient temperature.

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6.5.1 Primary

The transformer shall be connected as shown in Figure 2. The AC2 source shall be adjusted to a minimum of 10 kV a.c., and applied for at least 1 min.

The measured value of I_1 shall not exceed 10 mA.

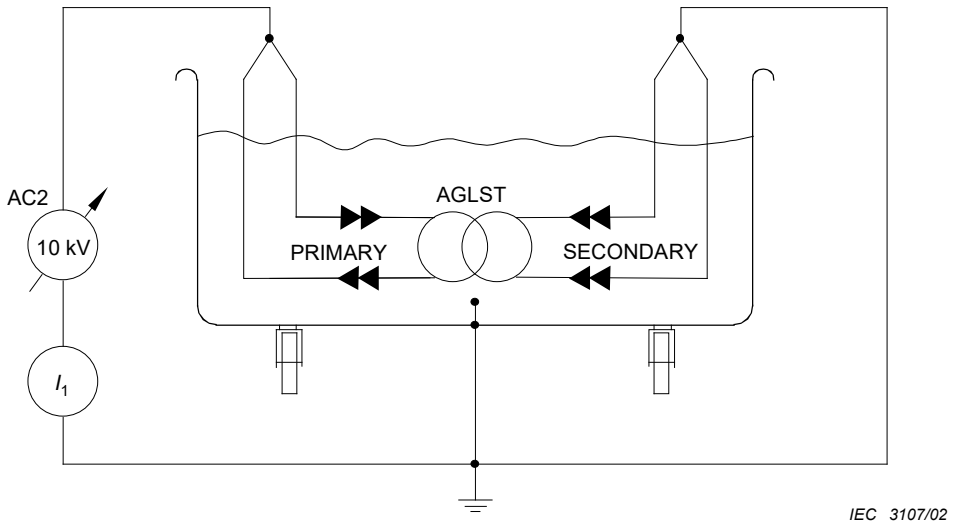

Figure 2 – Primary a.c. leakage current test

6.5.2 Secondary

The transformer shall be connected as shown in Figure 3. The AC2 source shall be adjusted to a minimum of 3,5 kV a.c., and applied for at least 1 min.

The measured value of I_1 shall not exceed 10 mA.

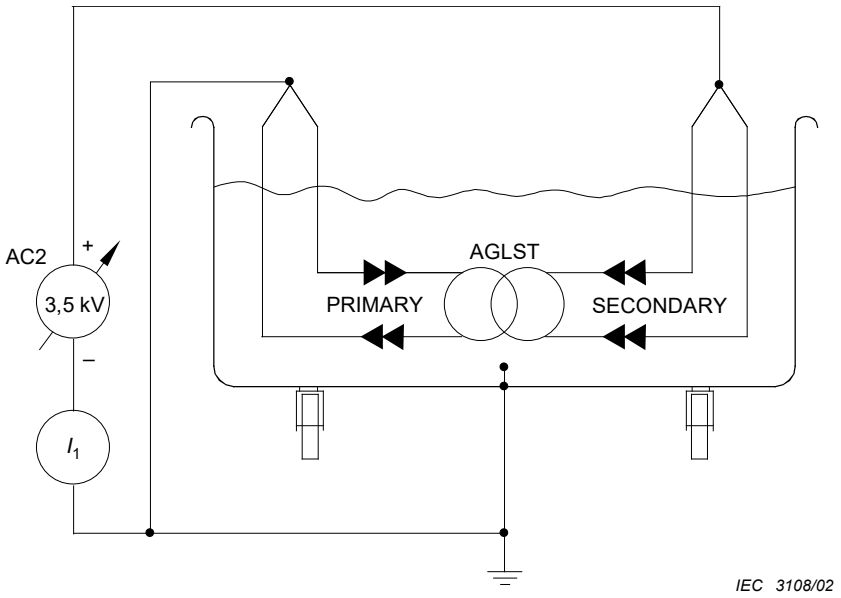

Figure 3 – Secondary a.c. leakage current test

Documents
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