IEC 61557-5

Edition 3.0 2019-07
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures –
Part 5: Resistance to earth

IEC 61557-5:2019-07 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 5: Resistance to earth

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b) subclauses in Clause 4 restructured and aligned with other parts of the series;
c) limits for reduced voltages 25 V RMS or 35 V peak removed from 4.5;
d) requirements for clamps added;
e) marking for rated voltages to earth and measurement category added to Clause 5;
f) warning about absence of hazardous voltage added in Clause 5;
g) the term "percentage operating uncertainty" replaced by "operating uncertainty" in Clause 6;
h) equation for uncertainty corrected in Table 1;
i) new Annex A on test measurements with loop clamps added.

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FDIS	Report on voting
85/685/FDIS	85/696/RVD

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 5: Resistance to earth

1 Scope

This part of IEC 61557 specifies the requirements ~~for~~ applicable to measuring equipment for measuring the resistance to earth using an AC voltage.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60364-6:2016, *Low voltage electrical installations – Part 6: Verification*

IEC 61010-1:~~2001~~2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016[1]

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61243-3, *Live working – Voltage detectors – Part 3: Two-pole low-voltage type*

IEC 61557-1:2019, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms, definitions and symbols given in IEC 61557-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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[1] A consolidated version of this publication exists, comprising IEC 61010-1:2010 and IEC 61010-1:2010/AMD1:2016.

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

~~**3.1**~~
~~**series interference voltage**~~
~~extraneous voltage superimposed on the measuring voltage~~

~~**3.2**~~
~~**auxiliary earth electrode**~~
~~additional earth electrode for a current required for the purpose of measurements~~

~~**3.4**~~
~~**probe**~~
~~additional earth electrode used as a probe for sampling potentials during measurements~~

3.1
resistance to earth
R_A
real part of the impedance to earth

Note 1 to entry: resistance to ground (US).

Note 2 to entry: IEC 60364-6 uses the term "earth resistance", which is considered to be the same.

[SOURCE: IEC 60050-195:1998, 195-01-18, modified – Notes 1 and 2 to entry and a symbol have been added.]

3.2
disturbance voltage
voltage produced between two points on two separate conductors by an electromagnetic disturbance, measured under specified conditions and superimposed on the measuring voltage

[SOURCE: IEC 60050-161:1990, 161-04-01, modified – in alignment with the use in this document; in addition, the deprecated term "interference voltage" has been deleted.]

3.3
earth electrode
conductive part, which may be embedded in a specific conductive medium, for example concrete or coke, in electric contact with the Earth

[SOURCE: IEC 60050-195:1998, 195-02-01, modified – The US variant, "ground electrode" has been omitted.]

3.4
earth electrode terminal
connection point for a probe connected to the earth electrode to be tested and that is used for the injection of the test current required for the purpose of measurement

Note 1 to entry: In accordance with the requirements of this document, earth electrode terminals are marked "E".

3.5
earth electrode probe terminal
connection point for a probe connected to the earth electrode to be tested and that is used as a voltage probe either connected direct to or nearest to the earth electrode for sampling potentials during measurement

Note 1 to entry: In accordance with the requirements of this document, earth electrode probe terminals are marked "ES".

3.6
auxiliary earth electrode terminal
terminal for connection to an additional temporary earth electrode that is used for injection of a test current required for the purpose of measurements

Note 1 to entry: In accordance with the requirements of this document, auxiliary earth electrode terminals are marked "H".

3.7
auxiliary earth electrode resistance
R_H
resistance of an additional earth electrode ~~through which current flows that is required for the purpose of measurements~~

3.8
probe electrode terminal
additional temporary earth electrode used as a voltage probe for sampling potentials during measurements

Note 1 to entry: According to the requirements of this document, probe electrode terminals are marked "S".

3.9
probe electrode resistance
R_S
~~earth electrode~~ resistance of an additional earth electrode ~~used as a probe for sampling potentials during measurements~~

4 Requirements

~~The following requirements as well as those given in IEC 61557-1 shall apply.~~

4.1 General

In addition to the requirements of IEC 61557-1:2019, Clause 4, the requirements of Clause 4 of this document shall apply.

4.2 Output voltage

The output voltage present across the terminals E and H shall be an AC voltage ~~without a d.c. component~~.

~~The frequency and the waveform shall be chosen so that electrical interference, particularly from installations operating with system frequency, will not adversely influence the measurement result to an excessive degree.~~

~~**4.2** If the influence of interference voltages from distribution systems as a.c. currents or as d.c. currents exceeds the requirements of 4.3, this shall be stated by the manufacturer in the operating instructions.~~

~~**4.3** The maximum percentage operating uncertainty within the measurement range to be marked or stated shall not exceed ±30 % with the measured value as fiducial value, as determined in accordance with Table 1.~~

4.3 Disturbance voltage

Values of influencing voltages caused by AC or DC currents from distribution systems shall be stated by the manufacturer in the operating instructions and shall be used for the calculation in Table 1.

4.4 Permissible resistance of probe and auxiliary earth electrode

The measuring equipment shall be capable of determining whether the maximum permissible resistances of the probes and auxiliary earth electrodes are exceeded.

4.5 Electrical safety

No hazardous touch voltages shall appear during the measurements. This can be achieved by a suitable design of the source for the output voltage by:

~~– limiting the open-circuit value of the output voltage to an r.m.s. value of 50 V or a peak value of 70 V;~~

~~NOTE The open-circuit voltage during measurements in agricultural plants should not exceed an r.m.s. value of 25 V or a peak value of 35 V.~~

~~– limiting the r.m.s. (peak) value of the short-circuit current to 3,5 mA (5 mA) when the value of the voltage exceeds 50 V (70 V) or 25 V (35 V).~~

~~When no compliance with the above condition exists, then an automatic disconnection of the measurement process shall operate within a time period permissible according to Figure 1 of IEC 61010-1.~~

– limiting the open-circuit value of the output voltage to 50 V AC RMS or 70 V peak;

– or, limiting the short-circuit output current to 3,5 mA AC RMS or 5 mA peak in the event that the output voltage value could exceed U_L;

– if the output voltage source does not comply with either of the above requirements, automatic disconnection of the output voltage source shall operate within a permissible time period, in accordance with IEC 61010-1:2010/AMD1:2016, Figure 2.

Terminals shall be rated for voltages less than or equal to 50 V or, at the minimum, for a working voltage equal to the nominal voltage of the distribution system and measurement category II in accordance with IEC 61010-2-030.

In the event of ratings less than or equal to 50 V, a warning shall be given in the operating instructions to check the absence of hazardous voltage on the earthing system with a two-pole low-voltage detector according to IEC 61243-3.

Test leads and accessories in accordance with IEC 61010-031, except for earth spikes/rods, shall, at the minimum, correspond to the rating of the terminals.

~~**4.6** The user shall not be exposed to a voltage exceeding the permissible touch voltage and the measuring equipment shall recover within specification, when any plug or socket of the measuring equipment, intended for connection to the distribution system's power supply is connected to 120 % of its nominal voltage. Protective devices shall not be activated.~~

4.6 Clamps intended to measure earth loop resistances according to IEC 60364-6:2016, Annex C, Clause C.3

Clamps intended to measure the earth loop resistance in accordance with IEC 60364-6:2016, Annex C, Clause C.3, whether attached to the instrument or stand alone, shall be specified according to IEC 61010-2-032 as Type A or Type B.

If specified for Type A, the rating shall, at a minimum, be for measurement category II.

If specified for Type B, the rating shall, at a minimum, be for measurement category II and a warning shall be given in the operating instructions to check in advance the absence of hazardous voltages on the earthing system with voltage testers according to IEC 61243-3.

5 Marking and operating instructions

5.1 Marking

In addition to ~~the marking in accordance with~~ IEC 61557-1:2019, 5.1 and 5.2, the following information shall be provided on the measuring equipment:

– measurement range within which the maximum operating uncertainty applies;
– frequency of the output voltage;
– ~~Designation~~ name of the terminals (if applicable):
  – E: terminal for the earth electrode;
  – ES: terminal for the probe electrode placed nearest to the earth electrode;
  – S: terminal for the probe electrode;
  – H: terminal for the auxiliary earth electrode;
– marking for terminals H, S, E and ES according to the requirements of 4.5;
– rated voltage to earth or measuring category and maximum voltage to earth followed by the symbol according to IEC 61010-1:2010, Table 1, symbol 12.

5.2 Operating instructions

~~The operating instructions shall state the following in addition to the statements in IEC 61557-1.~~

~~**5.2.1** The range of applications (e.g. for agricultural plants or others) for the equipment for measuring earth resistance.~~

~~**5.2.2** If applicable, the influence of series interference voltages that are larger than the values stated under 4.3.~~

~~**5.2.3** A statement relating to the correct operation of the hand-driven generator (if provided).~~

~~**5.2.4** The designations of terminals when different from 5.1.3.~~

In addition to IEC 61557-1:2019, 5.3, the following information shall be provided in the operating instructions:

– the range of applications (e.g. for industrial plants or others) for the equipment for measuring resistance to earth;
– the influence of series disturbance voltages that are larger than the values stated in 4.3, if applicable;
– a statement relating to the correct operation of the hand-driven generator (if provided);
– the designations of terminals when different from those specified in 5.1;
– if applicable, a warning shall be given in the operating instructions that in the case of Type B clamps the absence of hazardous voltages on the earthing system shall be checked with two-pole low-voltage detector according to IEC 61243-3.

6 Tests

6.1 General

In addition to IEC 61557-1:2019, Clause 6, the following tests shall be ~~executed~~ performed.

6.2 Operating uncertainty

The maximum operating uncertainty within the measurement range to be marked or stated shall ~~be~~ not exceed ±30 % with the measured value as fiducial value, as determined in accordance with Table 1~~. In this process, the intrinsic uncertainty shall be determined~~ under the following reference conditions:

– nominal value of the supply voltage;

– nominal ~~r.p.m.~~ r/min of the hand-driven generator when used as a supply;

– nominal frequency of the power supply in the case of mains-operated measuring equipment according to ~~4.3~~ 6.2;

– reference temperature 23 °C ± 2 °C;

– reference position in accordance with the manufacturer's statement;

– resistances of probes and auxiliary earth electrodes at least 100 Ω;

~~– interference voltage 0 V.~~

– disturbance voltage less than 1 V.

~~The operating uncertainty thus evaluated shall not exceed the limits specified in 4.3.~~

Table 1 – Calculation of operating uncertainty

Intrinsic uncertainty or influence quantity	Reference conditions or specified operating range	Designation code	Requirements or test in accordance with the relevant parts of IEC 61557	Type of test
Intrinsic uncertainty	Reference conditions	A	~~Part 5, subclause 6.1~~ IEC 61557-5:2019 6.2	R
Position	Reference position ±90° approximately	E_1	~~Part 1, subclause 4.2~~ IEC 61557-1:2019, 4.2	R
Supply voltage	At the limits stated by the manufacturer	E_2	~~Part 1, subclauses 4.2, 4.3~~ IEC 61557-1:2019, 4.2, 4.3	R
Temperature	0 °C and 35 °C (± 2°)	E_3	~~Part 1, subclause 4.2~~ IEC 61557-1:2019, 4.2	T
Series ~~interference~~ disturbance voltage	See ~~4.2 and~~ 4.3	E_4	~~Part 5, subclauses 4.2, 4.3~~ IEC 61557-5:2019, 4.3	T
Resistance of the probes and auxiliary earth electrodes	0 R_A to 100 ~~×~~ R_A but ≤ 50 kΩ as defined by the manufacturer	E_5	~~Part 5, subclause 4.3~~ IEC 61557-5:2019, 6.2	T
System frequency	between 99 % and 101 % of the nominal frequency	E_7	~~Part 5, subclause 4.3~~ IEC 61557-5:2019, 6.2	T
System voltage	between 85 % and 110 % of the nominal voltage	E_8	~~Part 5, subclause 4.3~~ IEC 61557-5:2019, 6.2	T
Operating uncertainty	$B = \pm\sqrt{A^2 + \frac{4}{3}\sum_i E_i^2}$		~~Part 5, subclause 4.3~~ IEC 61557-5:2019, 6.2	R

Key

A = intrinsic uncertainty

~~E_n~~ E_i = variations

R = routine test

T = type test

F = fiducial value

$$B\,[\%] = \pm\frac{B}{F} \times 100\ \%$$

The operating uncertainty shall apply under the rated operating conditions given in IEC 61557-1 and the following:

– injection of series ~~interference~~ disturbance voltages with system frequencies of 400 Hz, 60 Hz, 50 Hz, 16 $^2/_3$ Hz (± 5 %) or with DC voltage respectively across the terminals E (ES) and S or to the earth resistance loop. The RMS value of the series ~~interference~~ disturbance voltage for equipment with auxiliary probes shall be 3 V (± 5 %);

– for equipment using current clamps, the presence of interfering disturbances shall be clearly indicated if the influence quantity ~~will~~ exceeds the specified value of the variation E_4 and of the operating uncertainty. An example of a test configuration for injection of the series disturbance voltages can be found in Annex A;

– resistance of the auxiliary earth electrode and of the probe~~s~~ electrodes: 0 to 100 times R_A but ≤ 50 kΩ;

– system voltages between 85 % and 110 % of the nominal voltage and between 99 % and 101 % of the nominal system frequency for measuring equipment with a mains supply and/or measuring equipment deriving its output voltage directly from the distribution system.

6.3 Electrical safety

Check whether the conditions for the open-circuit voltage, short-circuit current and disconnect delay stated under 4.5 are met in each of the measurement ranges (routine test).

Check whether exceeding the permissible maximum resistances for probes and auxiliary earth electrodes is indicated (type test).

~~**6.4** The overload protection in accordance with 4.6 shall be tested *(type test)*, when any plug or socket of the measuring equipment, intended for connection to the distribution system's power supply is connected to 120 % of its nominal voltage. Protective devices shall not be activated.~~

~~**6.5** Compliance with the tests in this clause shall be recorded.~~

Annex A
(informative)

Recommended test configuration for earth loop clamps

A.1 General

This annex gives a recommended test configuration to inject a series disturbance voltage less than 1 V to measuring circuits of earth fault loop clamps.

A.2 Test purpose

Influence of current flow on resistance measurement (see Figure A.1 for test arrangement).

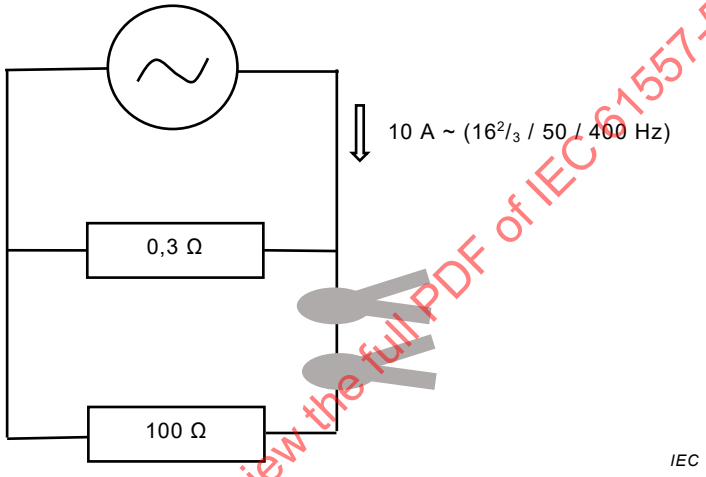

Figure A.1 – Test arrangement

NOTE For measurement circuit ranges above 100 Ω, the values of resistances and of the current can be changed accordingly.

A.3 Test result

Load	No current	10 A; 16,67 Hz	10 A; 50 Hz	10 A; 400 Hz
Reading	107,2 Ω	108,4 Ω	108,6 Ω	109,4 Ω
Change of reading	Reference value	1,12 %	1,31 %	2,05 %

Bibliography

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

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NORME INTERNATIONALE

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Part 5: Resistance to earth

Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection –
Partie 5: Résistance à la terre

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES –

Part 5: Resistance to earth

1 Scope

This part of IEC 61557 specifies the requirements applicable to measuring equipment for measuring the resistance to earth using an AC voltage.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60364-6:2016, *Low voltage electrical installations – Part 6: Verification*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016[1]

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61243-3, *Live working – Voltage detectors – Part 3: Two-pole low-voltage type*

IEC 61557-1:2019, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms, definitions and symbols given in IEC 61557-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

[1] A consolidated version of this publication exists, comprising IEC 61010-1:2010 and IEC 61010-1:2010/AMD1:2016.

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
resistance to earth
R_A
real part of the impedance to earth

Note 1 to entry: resistance to ground (US).

Note 2 to entry: IEC 60364-6 uses the term "earth resistance", which is considered to be the same.

[SOURCE: IEC 60050-195:1998, 195-01-18, modified – Notes 1 and 2 to entry and a symbol have been added.]

3.2
disturbance voltage
voltage produced between two points on two separate conductors by an electromagnetic disturbance, measured under specified conditions and superimposed on the measuring voltage

[SOURCE: IEC 60050-161:1990, 161-04-01, modified – in alignment with the use in this document; in addition, the deprecated term "interference voltage" has been deleted.]

3.3
earth electrode
conductive part, which may be embedded in a specific conductive medium, for example concrete or coke, in electric contact with the Earth

[SOURCE: IEC 60050-195:1998, 195-02-01, modified – The US variant, "ground electrode" has been omitted.]

3.4
earth electrode terminal
connection point for a probe connected to the earth electrode to be tested and that is used for the injection of the test current required for the purpose of measurement

Note 1 to entry: In accordance with the requirements of this document, earth electrode terminals are marked "E".

3.5
earth electrode probe terminal
connection point for a probe connected to the earth electrode to be tested and that is used as a voltage probe either connected direct to or nearest to the earth electrode for sampling potentials during measurement

Note 1 to entry: In accordance with the requirements of this document, earth electrode probe terminals are marked "ES".

3.6
auxiliary earth electrode terminal
terminal for connection to an additional temporary earth electrode that is used for injection of a test current required for the purpose of measurements

Note 1 to entry: In accordance with the requirements of this document, auxiliary earth electrode terminals are marked "H".

3.7
auxiliary earth electrode resistance
R_H
resistance of an additional earth electrode

3.8
probe electrode terminal
additional temporary earth electrode used as a voltage probe for sampling potentials during measurements

Note 1 to entry: According to the requirements of this document, probe electrode terminals are marked "S".

3.9
probe electrode resistance
R_S
resistance of an additional earth electrode

4 Requirements

4.1 General

In addition to the requirements of IEC 61557-1:2019, Clause 4, the requirements of Clause 4 of this document shall apply.

4.2 Output voltage

The output voltage present across the terminals E and H shall be an AC voltage.

4.3 Disturbance voltage

Values of influencing voltages caused by AC or DC currents from distribution systems shall be stated by the manufacturer in the operating instructions and shall be used for the calculation in Table 1.

4.4 Permissible resistance of probe and auxiliary earth electrode

The measuring equipment shall be capable of determining whether the maximum permissible resistances of the probes and auxiliary earth electrodes are exceeded.

4.5 Electrical safety

No hazardous touch voltages shall appear during the measurements. This can be achieved by a suitable design of the source for the output voltage by:

– limiting the open-circuit value of the output voltage to 50 V AC RMS or 70 V peak;
– or, limiting the short-circuit output current to 3,5 mA AC RMS or 5 mA peak in the event that the output voltage value could exceed U_L;
– if the output voltage source does not comply with either of the above requirements, automatic disconnection of the output voltage source shall operate within a permissible time period, in accordance with IEC 61010-1:2010/AMD1:2016, Figure 2.

Terminals shall be rated for voltages less than or equal to 50 V or, at the minimum, for a working voltage equal to the nominal voltage of the distribution system and measurement category II in accordance with IEC 61010-2-030.

In the event of ratings less than or equal to 50 V, a warning shall be given in the operating instructions to check the absence of hazardous voltage on the earthing system with a two-pole low-voltage detector according to IEC 61243-3.

Test leads and accessories in accordance with IEC 61010-031, except for earth spikes/rods, shall, at the minimum, correspond to the rating of the terminals.

4.6 Clamps intended to measure earth loop resistances according to IEC 60364-6:2016, Annex C, Clause C.3

Clamps intended to measure the earth loop resistance in accordance with IEC 60364-6:2016, Annex C, Clause C.3, whether attached to the instrument or stand alone, shall be specified according to IEC 61010-2-032 as Type A or Type B.

If specified for Type A, the rating shall, at a minimum, be for measurement category II.

If specified for Type B, the rating shall, at a minimum, be for measurement category II and a warning shall be given in the operating instructions to check in advance the absence of hazardous voltages on the earthing system with voltage testers according to IEC 61243-3.

5 Marking and operating instructions

5.1 Marking

In addition to IEC 61557-1:2019, 5.1 and 5.2, the following information shall be provided on the measuring equipment:

– measurement range within which the maximum operating uncertainty applies;
– frequency of the output voltage;
– name of the terminals (if applicable):
  – E: terminal for the earth electrode;
  – ES: terminal for the probe electrode placed nearest to the earth electrode;
  – S: terminal for the probe electrode;
  – H: terminal for the auxiliary earth electrode;
– marking for terminals H, S, E and ES according to the requirements of 4.5;
– rated voltage to earth or measuring category and maximum voltage to earth followed by the symbol according to IEC 61010-1:2010, Table 1, symbol 12.

5.2 Operating instructions

In addition to IEC 61557-1:2019, 5.3, the following information shall be provided in the operating instructions:

– the range of applications (e.g. for industrial plants or others) for the equipment for measuring resistance to earth;
– the influence of series disturbance voltages that are larger than the values stated in 4.3, if applicable;
– a statement relating to the correct operation of the hand-driven generator (if provided);
– the designations of terminals when different from those specified in 5.1;
– if applicable, a warning shall be given in the operating instructions that in the case of Type B clamps the absence of hazardous voltages on the earthing system shall be checked with two-pole low-voltage detector according to IEC 61243-3.

6 Tests

6.1 General

In addition to IEC 61557-1:2019, Clause 6, the following tests shall be performed.

6.2 Operating uncertainty

The maximum operating uncertainty within the measurement range to be marked or stated shall not exceed ±30 % with the measured value as fiducial value, as determined in accordance with Table 1 under the following reference conditions:

– nominal value of the supply voltage;
– nominal r/min of the hand-driven generator when used as a supply;
– nominal frequency of the power supply in the case of mains-operated measuring equipment according to 6.2;
– reference temperature 23 °C ± 2 °C;
– reference position in accordance with the manufacturer's statement;
– resistances of probes and auxiliary earth electrodes at least 100 Ω;
– disturbance voltage less than 1 V.

Table 1 – Calculation of operating uncertainty

Intrinsic uncertainty or influence quantity	Reference conditions or specified operating range	Designation code	Requirements or test in accordance with the relevant parts of IEC 61557	Type of test
Intrinsic uncertainty	Reference conditions	A	IEC 61557-5:2019 6.2	R
Position	Reference position ±90° approximately	E_1	IEC 61557-1:2019, 4.2	R
Supply voltage	At the limits stated by the manufacturer	E_2	IEC 61557-1:2019, 4.2, 4.3	R
Temperature	0 °C and 35 °C (± 2°)	E_3	IEC 61557-1:2019, 4.2	T
Series disturbance voltage	See 4.3	E_4	IEC 61557-5:2019, 4.3	T
Resistance of the probes and auxiliary earth electrodes	0 R_A to 100 R_A but ≤ 50 kΩ as defined by the manufacturer	E_5	IEC 61557-5:2019, 6.2	T
System frequency	between 99 % and 101 % of the nominal frequency	E_7	IEC 61557-5:2019, 6.2	T
System voltage	between 85 % and 110 % of the nominal voltage	E_8	IEC 61557-5:2019, 6.2	T
Operating uncertainty	$B = \pm\sqrt{A^2 + \frac{4}{3}\sum_i E_i^2}$		IEC 61557-5:2019, 6.2	R

Key

A = intrinsic uncertainty

E_i = variations

R = routine test

T = type test

F = fiducial value

$$B\,[\%] = \pm\frac{B}{F} \times 100\,\%$$

The operating uncertainty shall apply under the rated operating conditions given in IEC 61557-1 and the following:

– injection of series disturbance voltages with system frequencies of 400 Hz, 60 Hz, 50 Hz, 16 2/3 Hz (± 5 %) or with DC voltage respectively across the terminals E (ES) and S or to the earth resistance loop. The RMS value of the series disturbance voltage for equipment with auxiliary probes shall be 3 V (± 5 %);

– for equipment using current clamps, the presence of interfering disturbances shall be clearly indicated if the influence quantity exceeds the specified value of the variation E_4 and of the operating uncertainty. An example of a test configuration for injection of the series disturbance voltages can be found in Annex A;

– resistance of the auxiliary earth electrode and of the probe electrodes: 0 to 100 times R_A but ≤ 50 kΩ;

– system voltages between 85 % and 110 % of the nominal voltage and between 99 % and 101 % of the nominal system frequency for measuring equipment with a mains supply and/or measuring equipment deriving its output voltage directly from the distribution system.

6.3 Electrical safety

Check whether the conditions for the open-circuit voltage, short-circuit current and disconnect delay stated under 4.5 are met in each of the measurement ranges (routine test).

Check whether exceeding the permissible maximum resistances for probes and auxiliary earth electrodes is indicated (type test).

Annex A
(informative)

Recommended test configuration for earth loop clamps

A.1 General

This annex gives a recommended test configuration to inject a series disturbance voltage less than 1 V to measuring circuits of earth fault loop clamps.

A.2 Test purpose

Influence of current flow on resistance measurement (see Figure A.1 for test arrangement).

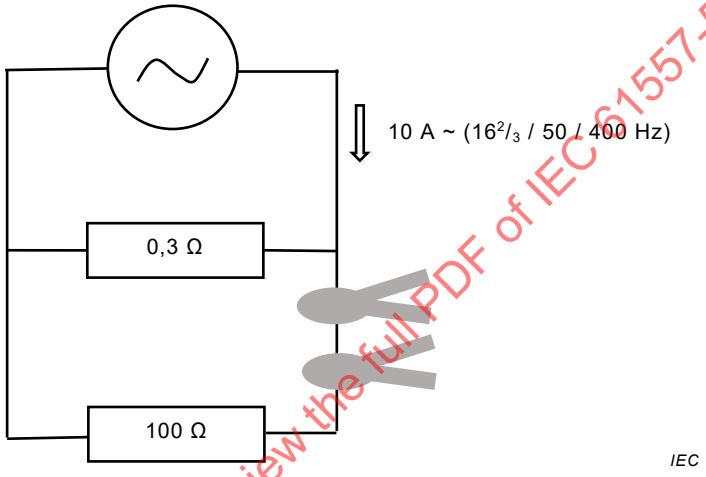

Figure A.1 – Test arrangement

NOTE For measurement circuit ranges above 100 Ω, the values of resistances and of the current can be changed accordingly.

A.3 Test result

Load	No current	10 A; 16,67 Hz	10 A; 50 Hz	10 A; 400 Hz
Reading	107,2 Ω	108,4 Ω	108,6 Ω	109,4 Ω
Change of reading	Reference value	1,12 %	1,31 %	2,05 %

Bibliography

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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SÉCURITÉ ÉLECTRIQUE DANS LES RÉSEAUX DE DISTRIBUTION BASSE TENSION AU PLUS ÉGALE À 1 000 V C.A. ET 1 500 V C.C. – DISPOSITIFS DE CONTRÔLE, DE MESURE OU DE SURVEILLANCE DE MESURES DE PROTECTION –

Partie 5: Résistance à la terre

AVANT-PROPOS

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La Norme internationale IEC 61557-5 a été établie par le comité d'études 85 de l'IEC: Equipements de mesure des grandeurs électriques et électromagnétiques.

Cette troisième édition annule et remplace la deuxième édition parue en 2007. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) modification des définitions et symboles de l'Article 3;

b) réorganisation des paragraphes de l'Article 4 et alignement sur les autres parties de la série;

c) suppression des limites de tensions réduites de 25 V (valeur efficace) ou de 35 V (valeur de crête) en 4.5;

d) ajout d'exigences relatives aux pinces;

e) ajout du marquage relatif aux tensions assignées à la terre et à la catégorie de mesure à l'Article 5;

f) ajout d'un avertissement relatif à l'absence de tension dangereuse à l'Article 5;

g) remplacement du terme "incertitude de fonctionnement en pourcentage" par "incertitude de fonctionnement" à l'Article 6;

h) correction de l'équation relative à l'incertitude dans le Tableau 1;

i) ajout de l'Annexe A relative aux mesures d'essai avec des pinces de boucle.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
85/685/FDIS	85/696/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Cette Norme internationale doit être utilisée conjointement avec l'IEC 61557-1:2019.

Une liste de toutes les parties de la série IEC 61557, publiées sous le titre général *Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

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SÉCURITÉ ÉLECTRIQUE DANS LES RÉSEAUX DE DISTRIBUTION BASSE TENSION AU PLUS ÉGALE À 1 000 V C.A. ET 1 500 V C.C. – DISPOSITIFS DE CONTRÔLE, DE MESURE OU DE SURVEILLANCE DE MESURES DE PROTECTION –

Partie 5: Résistance à la terre

1 Domaine d'application

La présente partie de l'IEC 61557 spécifie les exigences applicables aux appareils de mesure destinés à mesurer la résistance à la terre en utilisant une tension alternative.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60364-6:2016, *Installations électriques à basse tension – Partie 6: Vérification*

IEC 61010-1:2010, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 1: Exigences générales*
IEC 61010-1:2010/AMD1:2016[1]

IEC 61010-2-030:2017, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-030: Exigences particulières pour les appareils équipés de circuits d'essai ou de mesure*

IEC 61010-2-032, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-032: Exigences particulières pour les capteurs de courant, portatifs et manipulés à la main, de test et de mesure électriques*

IEC 61243-3, *Travaux sous tension – Détecteurs de tension – Partie 3: Type bipolaire basse tension*

IEC 61557-1:2019, *Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection – Partie 1: Exigences générales*

3 Termes et définitions

Pour les besoins du présent document, les termes, définitions et symboles de l'IEC 61557-1 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

[1] Il existe une version consolidée de cette publication, comprenant l'IEC 61010-1:2010 et l'IEC 61010-1:2010/AMD1:2016.