IEC 60974-10

Edition 3.0 2014-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Arc welding equipment –
Part 10: Electromagnetic compatibility (EMC) requirements

Matériel de soudage à l'arc –
Partie 10: Exigences de compatibilité électromagnétique (CEM)

IEC 60974-10:2014-02(EN-FR)

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60974-10 has been prepared by IEC technical committee 26: Electric welding.

This third edition cancels and replaces the second edition published in 2007 and constitutes a technical revision.

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

- inclusion of optional use of a decoupling network and a load outside the test chamber;
- inclusion of an alternative test setup for portable equipment;
- inclusion of test conditions for complex controls, liquid cooling systems and arc striking and stabilizing devices;
- update of the applicable limits related to the updated reference to CISPR 11;
- exclusion of the use of narrow band relaxations for RF emission limits;

- update of the applicable limits for harmonics and flicker and inclusion of flow-charts related to the updated reference to IEC 61000-3-11 and IEC 61000-3-12;
- update of the requirements for voltage dips related to the updated reference to IEC 61000-4-11 and IEC 61000-4-34;
- update of the informative annex for installation and use;
- inclusion of symbols to indicate the RF equipment class and restrictions for use.

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

FDIS	Report on voting
26/519/FDIS	26/526/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 list of all the parts of the IEC 60974 series, under the general title *Arc welding equipment*, can be found on the IEC web site.

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.

ARC WELDING EQUIPMENT –

Part 10: Electromagnetic compatibility (EMC) requirements

1 Scope

This part of IEC 60974 specifies

a) applicable standards and test methods for radio-frequency (RF) emissions;

b) applicable standards and test methods for harmonic current emission, voltage fluctuations and flicker;

c) immunity requirements and test methods for continuous and transient, conducted and radiated disturbances including electrostatic discharges.

This standard is applicable to equipment for arc welding and allied processes, including power sources and ancillary equipment, for example wire feeders, liquid cooling systems and arc striking and stabilizing devices.

NOTE 1 Allied processes are, for example, plasma cutting and arc stud welding.

NOTE 2 This standard does not specify basic safety requirements for arc welding equipment such as protection against electric shock, unsafe operation, insulation coordination and related dielectric tests.

Arc welding equipment type tested in accordance with, and which has met the requirements of, this standard is considered to be in compliance for all applications.

2 Normative references

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

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60974-1, *Arc welding equipment – Part 1: Welding power sources*

IEC 60974-6, *Arc welding equipment – Part 6: Limited duty equipment*

IEC 61000-3-2:2005, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
Amendment 1:2008
Amendment 2:2009

IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC 61000-3-11:2000, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12: Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≥ 75 A per phase*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-34, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*[1]
Amendment 1:2010

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Ancillary equipment – Conducted disturbances*

CISPR 16-1-4, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 concerning EMC and the relevant phenomena, given in IEC 60050-851 on arc welding equipment and in IEC 60974-1, as well as the following, apply.

3.1
click
disturbance which exceeds the limit of continuous disturbance no longer than 200 ms and which is separated from a subsequent disturbance by at least 200 ms

Note 1 to entry: Both intervals are related to the level of the limit of continuous disturbance.

[1] There exists a consolidated edition 5.1 (2010) that includes Edition 5 and its Amendment 1.

Note 2 to entry: A click may contain a number of impulses, in which case the relevant time is that from the beginning of the first to the end of the last impulse.

3.2
CDN
coupling/decoupling network

3.3
EUT
equipment under test

3.4
idle state
operating state in which the power is switched on and the welding circuit is not energized

Note 1 to entry: For some types of equipment there is no idle state, but an operating state preceding arc striking, when the welding circuit is energized.

Note 2 to entry: Idle state is different from standby mode, when the power is switched off.

3.5
portable, adj
capable to be carried by one person

Note 1 to entry: Portability is typically specified by the equipment manufacturer based on the intended use, the equipment design and/or local regulation.

[SOURCE: IEC 60050-151:2001, 151-16-47, modified – update of the note]

3.6
small equipment
equipment, either positioned on a table top or standing on the floor which, including its cables fits in a cylindrical test volume of 1,2 m in diameter and 1,5 m above the ground plane

[SOURCE: CISPR 11:2009, Amendment 1:2010, 3.10]

4 General test requirements

4.1 Test conditions

Tests shall be carried out on completely assembled equipment representative of the series production. Tests shall be performed within the specified operating conditions given in IEC 60974-1 or IEC 60974-6, and at the rated supply voltage and frequency. Results obtained for RF emission and immunity at 50 Hz are valid for the same model operating at 60 Hz and vice versa.

4.2 Measuring instruments

The measuring equipment shall comply with the requirements of CISPR 16-1-1 and the standards referred to in Tables 1, 2 and 3 as applicable.

4.3 Artificial mains network

Measurement of the mains terminal disturbance voltage shall be made using an artificial mains network, if commercially available, consisting of 50 Ω/50 µH V-network as specified in CISPR 16-1-2.

The artificial network is required to provide a defined impedance at RF across the mains supply at the point of measurement and also to provide for isolation of the equipment under test from ambient noise on the power lines.

4.4 Voltage probe

A voltage probe as specified in CISPR 16-1-2 shall be used when the artificial mains network cannot be used. The probe is connected sequentially between each line and the reference earth. The probe shall consist of a blocking capacitor and a resistor such that the total resistance between the line and earth is at least 1 500 Ω. The effect on the accuracy of measurement of the capacitor or any other device which may be used to protect the measuring receiver against dangerous currents shall be either less than 1 dB or allowed for in calibration.

4.5 Antennas

In the frequency range from 30 MHz to 1 GHz, the antenna(s) used shall be as specified in CISPR 16-1-4. Measurements shall be made for both horizontal and vertical polarization. The nearest point of the antenna(s) to the ground shall be not less than 0,2 m.

4.6 Load-decoupling network

If a shielded chamber is required and the load is situated outside the shielded chamber, a load-decoupling network connected to the outside load via suitable RF filters shall be used inside the chamber. A 150 Ω CDN AF 2, as specified in IEC 61000-4-6, suitable for the respective load current and voltage, shall be used. The RF port of the CDN shall be terminated with 50 Ω.

5 Test setup for emission and immunity

5.1 General

Emission and immunity testing of equipment that is not portable shall be carried out on equipment configured in accordance with Figure 1. For portable equipment, either the test setup given in Figure 1 or the test setup given in Figure 2 shall be used. Arc welding equipment tested in one of these configurations shall be considered to have met the necessary requirements of this standard.

In any situation where it is necessary to re-test the equipment to show compliance with this standard the test setup originally chosen shall be used in order to guarantee consistency of the results, unless it is agreed by the manufacturer to do otherwise.

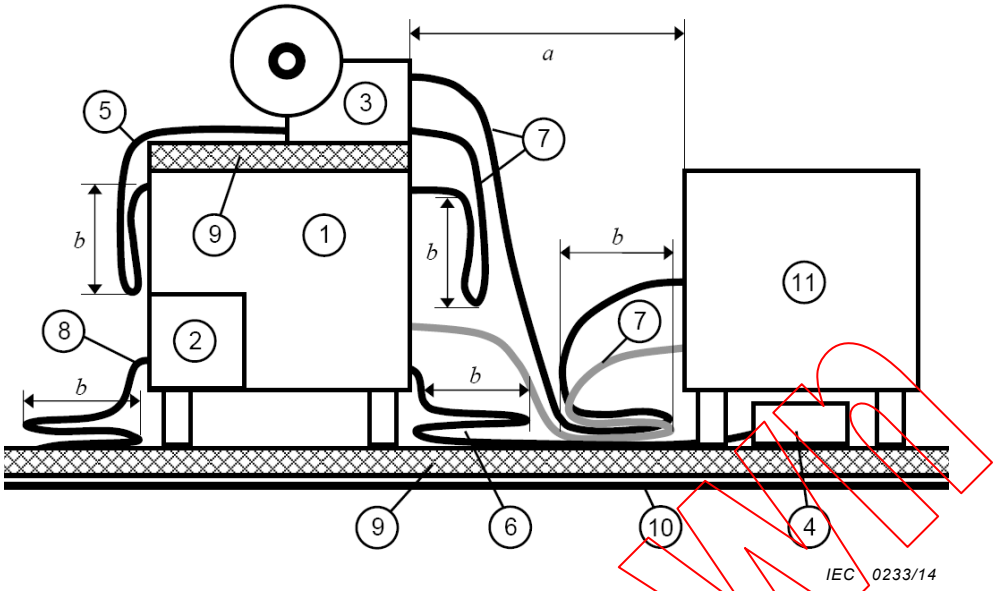
For RF emission, EM field immunity, common mode immunity, and fast transient immunity tests the following dimensions apply:

In Figure 1, a shall be 1 m

In Figures 1 and 2, b shall be 0,4 m or less

In Figure 2, h shall be 0,8 m

Dimensions a, b and h are undefined for all other tests.



Key

1	Welding power source	7	Welding cable (bundled)
2	Liquid cooling system	8	Input supply cable (bundled)
3	Wire feeder	9	Insulation
4	Remote control	10	Reference ground plane
5	Interconnection cable (bundled)	11	Conventional load or load decoupling network
6	Remote control cable (bundled)		

a Distance between power source and load or load decoupling network

b Cable bundle length

NOTE 1 Items 2, 3, and 4 are ancillary equipment, as applicable, and are typically positioned as specified by the equipment manufacturer.

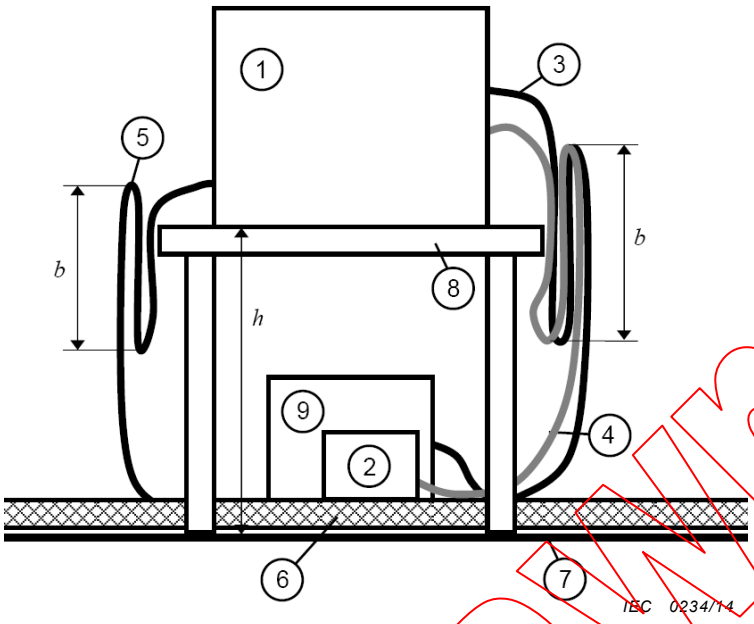
NOTE 2 Insulation (item 9) is placed between items 1 and 3 if specified by the manufacturer.

Figure 1 – Test set-up 1 for arc welding equipment

If due to the design of the arc welding equipment, these tests cannot be carried out as described, the manufacturer's recommendations (for example, temporary bypassing or disablement of control circuits) should be followed in order to match these test objectives. Any temporary changes to the arc welding equipment shall be documented.

If ancillary equipment can be connected to the welding power source, then the welding power source shall be tested with the minimum configuration of ancillary equipment necessary to exercise the ports. If the welding power source has a large number of similar ports or ports with many similar connections, then a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered.

For mains terminal voltage disturbance tests the welding power source shall be connected to the electricity supply using the V-network specified in 4.3 whenever possible. The V-network shall be located so that its closest surface is no less than 0,8 m from the nearest boundary of the equipment under test. The input cable shall have a minimum length of 2 m.



Key

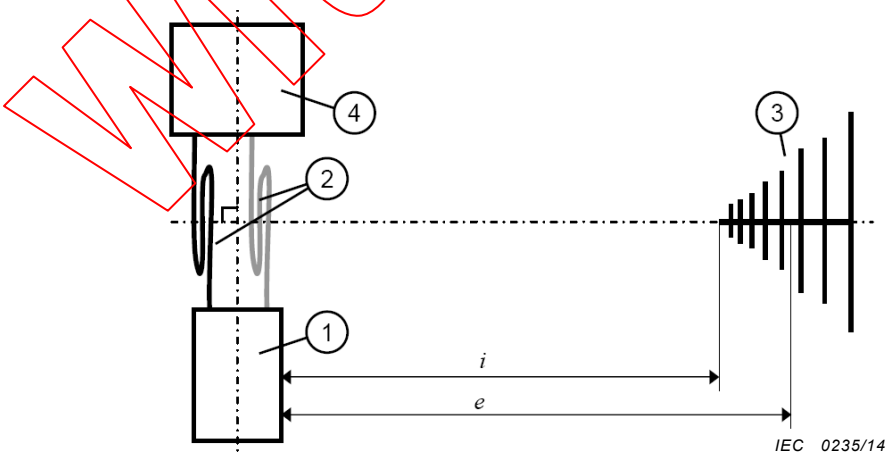
1	Arc welding equipment	6	Insulation
2	Remote control (under the table)	7	Reference ground plane
3	Welding cable (bundled)	8	Non-conductive table
4	Remote control cable (bundled)	9	Conventional load or load decoupling network (under the table)
5	Input supply cable (bundled)		

b Cable bundle length

h Non-conductive table height

NOTE Item 2 is ancillary equipment, as applicable.

Figure 2 – Test set-up 2 for portable arc welding equipment



Key

1	Arc welding equipment	3	Test antenna (horizontal polarization shown)
2	Welding cables (bundled)	4	Conventional load or load decoupling network

e Distance between the equipment under test and the radiation center of the antenna

i Distance between the equipment under test and nearest point of the antenna

Figure 3 – Top view of test setup as shown in Figure 1

The welding power source shall be connected to the conventional load by welding cables of suitable cross-section for the welding current, or the appropriate torch or electrode holder with adapter. The welding cables shall have a minimum length of 2 m.

If a load situated outside the shielded chamber is used, a load-decoupling network as defined in 4.6 shall be placed inside the shielded chamber. The load-decoupling network shall be terminated to the reference ground and connected to the outside load via suitable filters.

For RF emission tests using the test setup given in Figure 1, the welding power source shall be insulated by an insulating mat (or blocks) not greater than 12 mm thick or insulated by its own under-gear if appropriate.

For electromagnetic radiation disturbance and EM field immunity tests using the test setup as given in Figure 1, the welding power source and conventional load (or, if applicable, the load-decoupling network) shall be at one stationary position with respect to the test antenna as shown in Figure 3. The separation distance e in Figure 3 is defined in Clause 6 of CISPR 11:2009. The separation distance i in Figure 3 is defined in IEC 61000-4-3.

The cables shall be allowed to fall naturally to the ground plane. Excess cable length shall be folded to form separate bundles not exceeding 0,4 m in length, as far as practicable.

Specific test set-up geometries for immunity tests can be found in the basic standards referenced in Tables 1, 2 and 3.

The configuration of the equipment under test shall be noted in the test report.

5.2 Load

During the tests, the arc welding operation is simulated by loading the equipment with a conventional load as specified in IEC 60974-1. For RF emission tests that do not use a CDN, the conventional load shall be insulated by an insulating mat (or blocks) not greater than 12 mm thick or insulated by its own under-gear if appropriate.

5.3 Ancillary equipment

5.3.1 General requirements

Ancillary equipment shall be tested in conjunction with a welding power source. It shall be connected, installed and configured as recommended by the manufacturer.

Specific requirements for the operation of ancillary equipment are given below.

5.3.2 Wire feeders

Wire feeders shall be positioned on/by a welding power source as designed. Wire feeders, which can be located both inside or outside the welding power source enclosure, shall be placed outside. For RF emission tests, wire feeders designed to be placed on the floor shall be insulated from it, by an insulating mat (or blocks) not greater than 12 mm thick or insulated by its own under-gear, if appropriate.

The welding cable connecting the wire feeder to the welding power source shall be 2 m in length or longer, if required, to make the connection and be of suitable current rating. If a welding cable in excess of 2 m is provided by the manufacturer, the excess cable length shall be folded to form a bundle not exceeding 0,4 m in length, as far as practicable. A welding cable connection less than 2 m long shall be permitted if this is supplied with the equipment.