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Edition 2.0 2007-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Withdrawn

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

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

IEC 60974-10:2007

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ARC WELDING EQUIPMENT –

Part 10: Electromagnetic compatibility (EMC) requirements

FOREWORD

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International Standard IEC 60974-10 has been prepared by IEC technical committee 26: Electric welding.

This second edition cancels and replaces the first edition published in 2002 and amendment 1 (2004) and constitutes a technical revision.

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

– application of more stringent r.f. emission limits for the idle state;
– mandatory classification of arc starting and stabilizing devices as Class A equipment;
– additional immunity tests (surges and r.f. common-mode currents);
– inclusion of informative Annex B, containing the applicable emission limits for information of the user of the standard.

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

CDV	Report on voting
26/341/CDV	26/356/RVC

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 maintenance result 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- withdrawn,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.

The contents of the corrigendum of June 2011 have been included in this copy.

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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 (r.f.) 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 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 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*

IEC 60050-851, *International Electrotechnical Vocabulary – Chapter 851: Electric welding*

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

IEC 60974-3, *Arc welding equipment – Part 3: Arc striking and stabilizing devices*

IEC 60974-6, *Arc welding equipment – Part 6: Power sources for manual metal arc welding with limited duty*

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

IEC 61000-3-3:1994, *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*[1]

Amendment 1 (2001)
Amendment 2 (2005)

[1] There exists a consolidated edition 1.2 (2005) that includes edition 1 and its amendments 1 and 2.

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IEC/TS 61000-3-4, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

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 61000-3-12:2004, *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*

CISPR 11:2003, *Industrial, scientific and medical (ISM) radio-frequency equipment – Radio disturbance characteristics – Limits and methods of measurement*

CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

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 – Ancillary equipment – Radiated disturbances*

3 Terms and definitions

For the purposes of this document, the terms and definitions related to EMC and to the relevant phenomena contained in IEC 60050-161, the terms and definitions related to arc welding equipment contained in IEC 60050-851 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

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NOTE 1 Both intervals are related to the level of the limit of continuous disturbance.

NOTE 2 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
idle state
operating state in which the power is switched on and the welding circuit is not energized

NOTE For some types of equipment, there is no idle state, but a welding state preceding arc striking.

4 General test requirements

4.1 Test conditions

Tests shall be carried out within the specified operating conditions for the apparatus, as given in IEC 60974-1 or IEC 60974-6, and at its rated supply voltage and frequency. Results obtained for r.f. 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 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 r.f. 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 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.

5 Test set-up for emission and immunity

5.1 General

Emission and immunity testing shall be carried out on equipment configured in accordance with Figure 1. Arc welding equipment tested in such a configuration shall be considered to have met the necessary requirements of this standard.

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.

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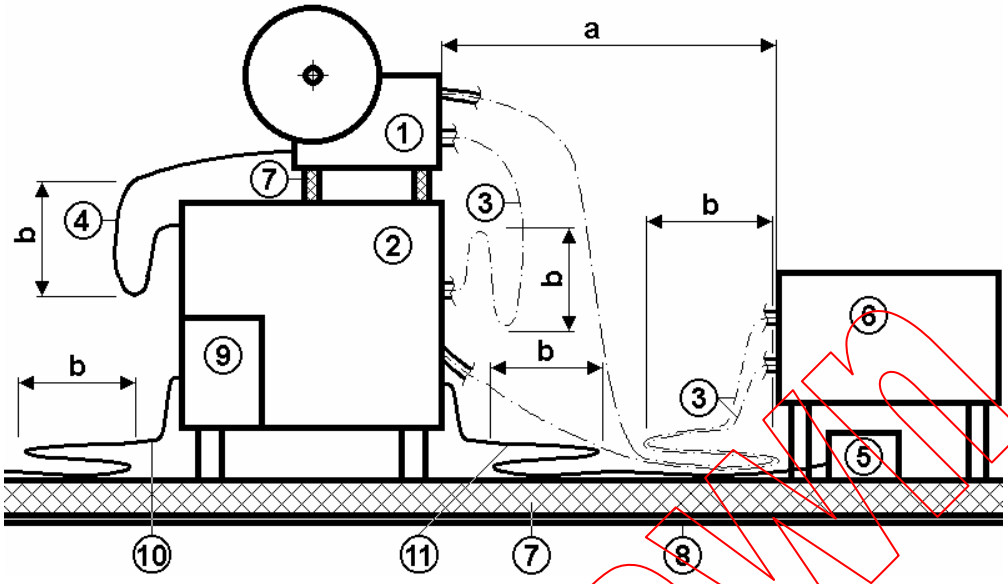
The configuration of the equipment under test shall be noted in the test report.

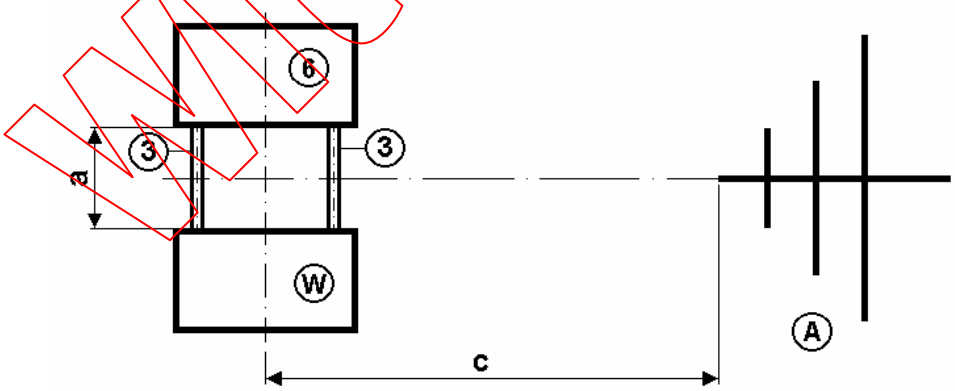


Key

1	Wire feeder	7	Insulation
2	Welding power source	8	Earthed ground plane
3	Welding cable (bundled)	9	Liquid cooling systems
4	Interconnection cable (bundled)	10	Input supply cable
5	Remote control	11	Remote control cable (bundled)
6	Conventional load		
a	= 1 m	b	≤ 0,4 m

NOTE Items 1, 5, 9 and 11 are ancillary equipment, as applicable.

Figure 1 – Typical arc welding equipment with a conventional load



Key

W	Arc welding equipment	A	Antenna
3	Welding cable	6	Conventional load
a	= 1 m	c	See IEC 61000-4-3 and 6.3.3

Figure 2 – Position of arc welding equipment and conventional load with respect to the antenna

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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 conducted r.f. emission 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.

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.

For r.f. emission tests 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 radiated emission and immunity tests, the welding power source and conventional load shall be positioned equidistant from the test antenna; see Figure 2.

The cables shall be allowed to fall naturally to the ground plane. Excess input, welding or torch cables shall be folded to and forth, as far as practicable, to form a bundle not exceeding 0,4 m in length.

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

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 r.f. emission tests 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 and installed as recommended by the manufacturer.

Specific requirements for wire feeders and remote controls 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 r.f. 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.

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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 shall be folded to and forth, as far as practicable, to form a bundle not exceeding 0,4 m in length. A welding cable connection less than 2 m long shall be permitted if this is supplied with the equipment.

The interconnection cable(s) between the wire feeder and the welding power source shall be of the type and length recommended by the manufacturer. Excess cable shall be folded to and forth, as far as practicable, to form a bundle not exceeding 0,4 m in length.

A welding torch, as recommended by the manufacturer, may be used instead of a welding cable to make the connection from the wire feeder to the conventional load.

5.3.3 Remote controls

If a welding power source is capable of operating with a remote control, it shall be tested with the remote control connected, which is expected to give the highest emissions and/or lowest immunity. The remote control shall be placed on, and insulated from, the ground plane beside the load, where possible. For r.f. emission tests, the insulation shall not be greater than 12 mm thick. Remote controls designed to be attached to the arc welding equipment during use shall be placed as intended.

Excess cable shall be folded to and forth to form a bundle not exceeding 0,4 m in length, as far as practicable.

6 Emission tests

6.1 Classification for r.f. emission tests

6.1.1 Class A equipment

Class A equipment is intended for use in locations other than residential locations where the electrical power is provided by the public low-voltage supply system.

Class A equipment shall meet Class A limits in accordance with 6.3.

6.1.2 Class B equipment

Class B equipment is suitable for use in all locations, including residential locations where the electrical power is provided by the public low-voltage supply system.

Class B equipment shall meet Class B limits in accordance with 6.3.

6.2 Test conditions

6.2.1 Welding power source

6.2.1.1 Test conditions for r.f. emission tests

The welding power source shall be tested at the conventional load voltages referenced in 6.2.2 under the following output conditions:

a) at rated minimum welding current;

b) at rated welding current at 100 % duty cycle.

Additionally, if there is an idle state, the welding power source shall be tested in this condition with the configuration shown in Figure 1, with the load disconnected.

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If the primary current is greater than 25 A at any of the output conditions given above, the output may be reduced to give a primary current of 25 A. However, if a primary current of 25 A or less cannot be achieved, the voltage probe, as specified in 4.4, may be used in 6.3.2 as an alternative to an artificial mains network.

Welding power sources capable of operating in both a.c. and d.c. modes shall be tested in both modes.

Multi-process welding power sources shall be tested with the conventional load which gives the highest load voltage for the set current. If a welding power source contains more than one output circuit (for example, plasma cutting and manual arc welding), each circuit shall be tested separately.

For power sources with an external wire feeder, only the MIG configuration shall be tested with the MIG conventional load voltage.

6.2.1.2 Test conditions for harmonics

Welding power sources within the scope of IEC 60974-1 shall be tested at the conventional load voltage according to the process as given in 6.2.2 at maximum rated welding current at the rated duty cycle. The observation period shall be 10 min.

Welding power sources capable of operating in both a.c. and d.c. modes shall be tested in both modes.

Multi-process welding power sources shall be tested with the conventional load which gives the highest conventional load voltage for the set current.

Test conditions for welding power sources within the scope of IEC 60974-6 are given in IEC 61000-3-2.

6.2.1.3 Test conditions for voltage fluctuations and flicker

Test conditions for welding power sources are given in IEC 61000-3-3.

6.2.2 Load

Conventional load voltages are given in IEC 60974-1 or IEC 60974-6.

6.2.3 Wire feeders

Wire feeders shall be tested at 50 % of the maximum wire feed speed setting, where possible. Pre-programmed and synergic wire feeders shall be tested according to the output setting of the welding power source.

During this test, pressure shall be removed from the drive rolls of the wire feeder and the welding power source shall be loaded as given in 6.2.1.1.

6.2.4 Ancillary equipment

Other ancillary equipment shall be tested according to the manufacturer's recommendations.

Arc striking and stabilizing devices and arc stud welding equipment shall be classified as Class A equipment. For arc striking and stabilizing devices which are energy limited in accordance with IEC 60974-3, no additional r.f. emission tests are required.

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6.3 Emission limits

6.3.1 General

Emission limits are designed to reduce the probability of interference but will not in all cases eliminate interference, for example, when the receiving apparatus is in close proximity or has a high degree of sensitivity.

The ability of arc welding equipment to work in a compatible manner with other radio and electronic systems is greatly influenced by the manner in which it is installed and used. For this reason a code of practice is appended to this standard (see Annex A), and it is important that the arc welding equipment be installed and used in accordance with this code of practice if electromagnetic compatibility is to be achieved.

Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. A statement shall be included in the documentation for the user, drawing attention to the fact that there may be potential difficulties in ensuring electromagnetic compatibility in those locations.

6.3.2 Mains terminal disturbance voltage

6.3.2.1 Idle state

The mains terminal disturbance voltage limits for Class A arc welding equipment are the Group 1 limits given in Table 2a of CISPR 11.

The mains terminal disturbance voltage limits for Class B arc welding equipment are the Group 1 limits given in Table 2b of CISPR 11.

The EUT shall meet either both the average and the quasi-peak limits using corresponding detectors or the average limit when using a quasi-peak detector.

6.3.2.2 Loaded

The mains terminal disturbance voltage limits for Class A arc welding equipment are the Group 2 limits given in Table 2a of CISPR 11. The applicable limit shall be selected based on the rated maximum supply current I_{1max} value.

The mains terminal disturbance voltage limits for Class B arc welding equipment are the Group 2 limits given in Table 2b of CISPR 11.

The EUT shall meet either both the average and the quasi-peak limits using corresponding detectors or the average limit when using a quasi-peak detector.

For Class A equipment impulse noise (clicks) which occurs less than 5 times per minute is not considered.

For Class B equipment impulse noise (clicks) which occurs less than 0,2 times per minute a relaxation of the limits of 44 dB is allowed.

For clicks appearing between 0,2 and 30 times per minute, a relaxation of the limits of 20 log (30/N) dB is allowed (where N is the number of clicks per minute). Criteria for separated clicks may be found in CISPR 14-1.

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6.3.3 Electromagnetic radiation disturbance

6.3.3.1 General

For radiated emission tests the separation between the antenna and the equipment under test shall be as specified in Clause 5 of CISPR 11.

6.3.3.2 Idle state

The electromagnetic radiation disturbance limits for Class A arc welding equipment are the Group 1 limits given in Table 3 of CISPR 11.

The electromagnetic radiation disturbance limits for Class B arc welding equipment are the Group 1 limits given in Table 3 of CISPR 11.

6.3.3.3 Loaded

The electromagnetic radiation disturbance limits for Class A arc welding equipment are the limits given in Table 5b of CISPR 11.

The electromagnetic radiation disturbance limits for Class B arc welding equipment in the frequency band 30 MHz to 1 000 MHz are the Group 2 limits given in Table 4 of CISPR 11.

6.3.4 Harmonics, voltage fluctuations and flicker

The limits for

a) harmonic current emissions are given in IEC 61000-3-2 and IEC 61000-3-12;

b) voltage fluctuations and flicker are given in IEC 61000-3-3 and IEC 61000-3-11;

and are applicable to arc welding equipment, as far as covered by the scope of these standards.

NOTE IEC/TS 61000-3-4 may be used to guide the parties concerned by the installation of arc welding equipment with an input current above 75 A in a low-voltage network.

7 Immunity tests

7.1 Classification

7.1.1 Applicability of tests

Arc welding equipment covered by this standard is sub-divided into categories for the purpose of immunity requirements as given below. Category 1 arc welding equipment is considered to meet the necessary immunity requirements without testing. Category 2 arc welding equipment shall fulfil the requirements of 7.4.

7.1.2 Category 1

Arc welding equipment containing no electronic control circuitry, for example, transformers, transformer rectifiers, passive remote controls, liquid cooling systems, CO_2-heaters and non-electronic wire feeders.

Electric circuits consisting of passive components such as inductors, r.f. suppression networks, mains frequency transformers, rectifiers, diodes and resistors are not considered to be electronic control circuitry.

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