

BS EN 60974-10:2014+A1:2015



BSI Standards Publication

Arc welding equipment

Part 10: Electromagnetic compatibility
(EMC) requirements

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National foreword

This British Standard is the UK implementation of EN 60974-10:2014+A1:2015. It is identical to IEC 60974-10:2014 incorporating amendment 1:2015. It supersedes BS EN 60974-10:2014 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example text altered by IEC amendment 1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee WEE/6, Electric arc welding equipment.

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

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

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ICS 25.160

English Version

Arc welding equipment - Part 10: Electromagnetic compatibility
(EMC) requirements
(IEC 60974-10:2014)

Matériel de soudage à l'arc - Partie 10: Exigences de
compatibilité électromagnétique (CEM)
(CEI 60974-10:2014)

Lichtbogenschweißeinrichtungen - Teil 10: Anforderungen
an die elektromagnetische Verträglichkeit (EMV)
(IEC 60974-10:2014)

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 26/519/FDIS, future edition 3 of IEC 60974-10, prepared by IEC/TC 26 "Electric welding" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60974-10:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-02-28
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-03-13

This document supersedes EN 60974-10:2007.

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive.

For the relationship with EU Directive see informative Annex ZZ, which is an integral part of this document.

Endorsement notice

The text of the International Standard IEC 60974-10:2014 was approved by CENELEC as a European Standard without any modification.

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

IEC 60974-9	NOTE	Harmonized as EN 60974-9.
CISPR 14-1	NOTE	Harmonized as EN 55014-1.

Foreword to amendment A1

The text of document 26/549/CDV, future IEC 60974-10/A1, prepared by IEC/TC 26 "Electric welding" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60974-10:2014/A1:2015.

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standards conflicting with the
document have to be withdrawn

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For the relationship with EU Directive see informative Annex ZZ, included in EN 60974-10:2014.

Endorsement notice

The text of the International Standard IEC 60974-10:2014/AMD 1:2015 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	Series	International Electrotechnical Vocabulary	-	
IEC 60974-1	-	Arc welding equipment - Part 1: Welding power sources	EN 60974-1	-
IEC 60974-6	-	Arc welding equipment - Part 6: Limited duty equipment	EN 60974-6	-
IEC 61000-3-2 A1 A2	2005 ¹⁾ 2008 ¹⁾ 2009 ¹⁾	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2 A1 A2	2006 ²⁾ 2009 ²⁾ 2009 ²⁾
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	EN 61000-3-3	2013
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	EN 61000-3-11	2000
IEC 61000-3-12	2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase	EN 61000-3-12	2011
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	-

¹⁾ Superseded by IEC 61000-3-2:2014.

²⁾ Superseded by EN 61000-3-2:2014 (IEC 61000-3-2:2014).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-3	-	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	-
IEC 61000-4-4	-	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	-
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-
IEC 61000-4-6	-	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	-
IEC 61000-4-11	-	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	-
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	EN 61000-4-34	-
CISPR 11 (mod) A1	2009 2010	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011 A1	2009 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	EN 55016-1-1	-
CISPR 16-1-2	-	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Coupling devices for conducted disturbance measurements	EN 55016-1-2	-
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	EN 55016-1-4	-

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Annex ZZ
(informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only essential requirements as given in Article 5 of the EU Directive 2004/108/EC and in Articles 1 a) and 1 b) of Annex I.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements in other EU Directives may be applicable to the products falling within the scope of this standard.

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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 (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 μ H 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.

A1 For the measurement of the output current ripple, there are no specific requirements for the equipment configuration. **A1**

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.

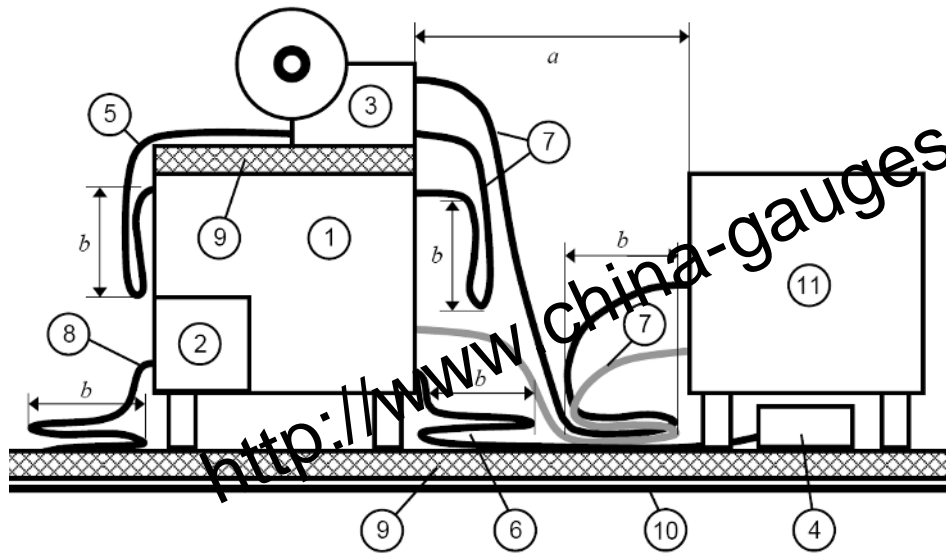
For RF emission, EM field immunity, common mode immunity, and fast transient immunity tests the following dimensions apply:

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.



IEC 0233/14

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.

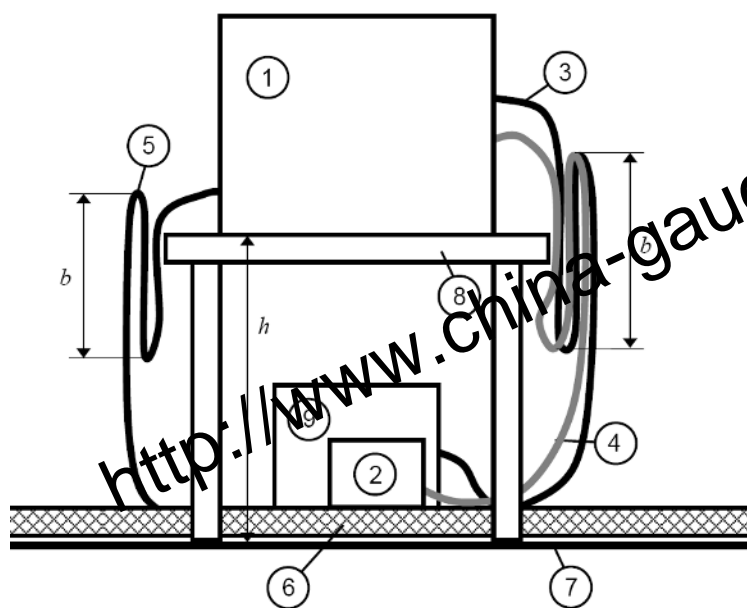
NOTE 2 Insulation (item 9) is placed between items 1 and 3 if specified by the manufacturer.

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.



IEC 0234/14

Key

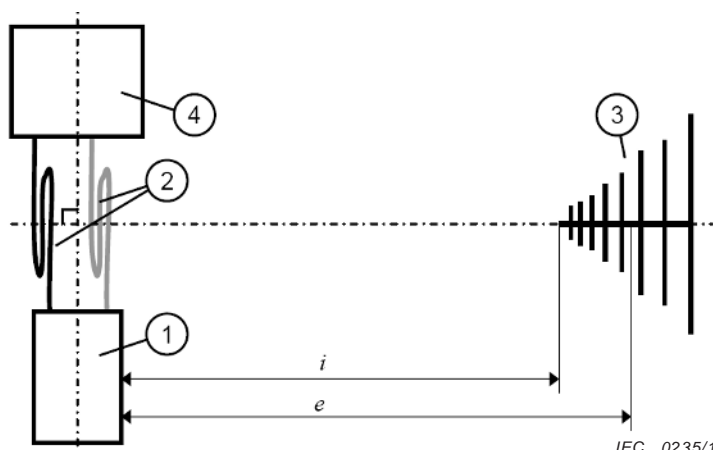
- | | |
|------------------------------------|------------------------------------------------------------------|
| 1 Arc welding equipment | 6 Insulation |
| 2 Remote control (under the table) | 7 Reference ground plane |
| 3 Welding cable (bundled) | 8 Non-conductive table |
| 4 Remote control cable (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



IEC 0235/14

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 surge 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.

A1 For the measurement of the output current ripple, the inductance of the load including welding cables at the fundamental frequency shall be less than 10 μH per 100 $\text{m}\Omega$ total resistance. **A1**

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.

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

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 create 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 RF 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 length shall be folded to form a bundle not exceeding 0,4 m in length, as far as practicable.

Complex controls that can be used independently from a dedicated power source may be tested in conjunction with the power source or as a stand-alone unit, as specified by the manufacturer.

5.3.4 Arc striking and stabilizing devices

Arc striking and stabilizing devices shall be disabled during all tests other than RF emission tests to protect test equipment. For RF emission tests, measurements shall be started 5 s after the equipment is in operation.

5.3.5 Liquid cooling systems

Liquid cooling systems shall be positioned on/by a welding power source as designed. Liquid cooling systems, which can be located both inside or outside the welding power source enclosure, shall be placed outside. For RF emission tests, liquid cooling systems 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 inlet and outlet may be connected by a hose, as recommended by the manufacturer, to allow the flow of cooling liquid.

6 Emission tests

6.1 Classification for RF 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.

Arc striking and stabilizing devices and arc stud welding equipment shall be classified as Class A equipment.

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 RF emission tests

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

- A1) a) at rated minimum welding current;
- b) at rated welding current at 100 % duty cycle. If no rated current is specified for 100 % duty cycle, the test shall be carried out at 40 % of I_{2max} . A1

Additionally, if there is an idle state, the welding power source shall be tested with the cables disconnected at the load.

If the supply current is greater than 25 A at any of the output conditions given above, the output may be reduced to give a supply current of 25 A. However, if a supply current of 25 A or less cannot be achieved, the voltage probe, as specified in 4.4, may be used for tests in accordance with 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 arithmetic average value of 1,5 s smoothed r.m.s. supply current values (I_{ref} as per IEC 61000-3-12) shall be measured when the welding power source is delivering its maximum rated welding current I_{2max} .

For welding equipment within the scope of IEC 60974-1 with a rated maximum supply current below 16 A, the reference current I_{ref} for the definition of limits shall be 16 A.

The maximum and arithmetic average values of 1,5 s smoothed r.m.s. harmonic current values in each Discrete Fourier Transform (DFT) time window shall be determined over one full thermal cycle of 10 min including the idle state period.

NOTE An idle state period of more than 10 % is not a stand-by mode as defined in IEC 61000-3-12, but an operational mode of the welding equipment within its full thermal cycle.

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.

6.2.1.4 Test conditions for output current ripple

The welding power source shall be tested at the conventional load voltages referenced in 6.2.2 at rated welding current at 100 % duty cycle. If no rated current is specified for 100 % duty cycle, the test shall be carried out at 50 % of I_{2max} . The current ripple shall be recorded in the time domain.

6.2.2 Load voltages

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.

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 recommended that the arc welding equipment be installed and used in accordance with this code of practice if electromagnetic compatibility is to be achieved.

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 in idle state, regardless of the rated input power, are given in Table 2 of CISPR 11:2009 in the column for a rated input power less than or equal to 20 kVA.

The mains terminal disturbance voltage limits for Class B arc welding equipment in idle state are given in Table 3 of CISPR 11:2009.

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 6 of CISPR 11:2009. The appropriate set of limits shall be selected in accordance with the maximum rated input power of the equipment, calculated using the rated maximum supply current $I_{1\max}$.

The mains terminal disturbance voltage limits for Class B arc welding equipment are the Group 2 limits given in Table 7 of CISPR 11:2009.

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 can be found in CISPR 14-1.

6.3.3 Electromagnetic radiation disturbance

6.3.3.1 Idle state

The electromagnetic radiation disturbance limits for Class A arc welding equipment in idle state, regardless of the rated input power, are given in Table 4 of CISPR 11:2009 in the columns for a rated input power less than or equal to 20 kVA.

The electromagnetic radiation disturbance limits for Class B arc welding equipment are given in Table 5 of CISPR 11:2009.

6.3.3.2 Loaded

The electromagnetic radiation disturbance limits for Class A arc welding equipment are the limits given in Table 10 of CISPR 11:2009.

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 11 of CISPR 11:2009.

The 20 dB relaxations in the frequency ranges 80,872 MHz to 81,848 MHz and 134,786 MHz to 136,414 MHz are not applicable to arc welding equipment.

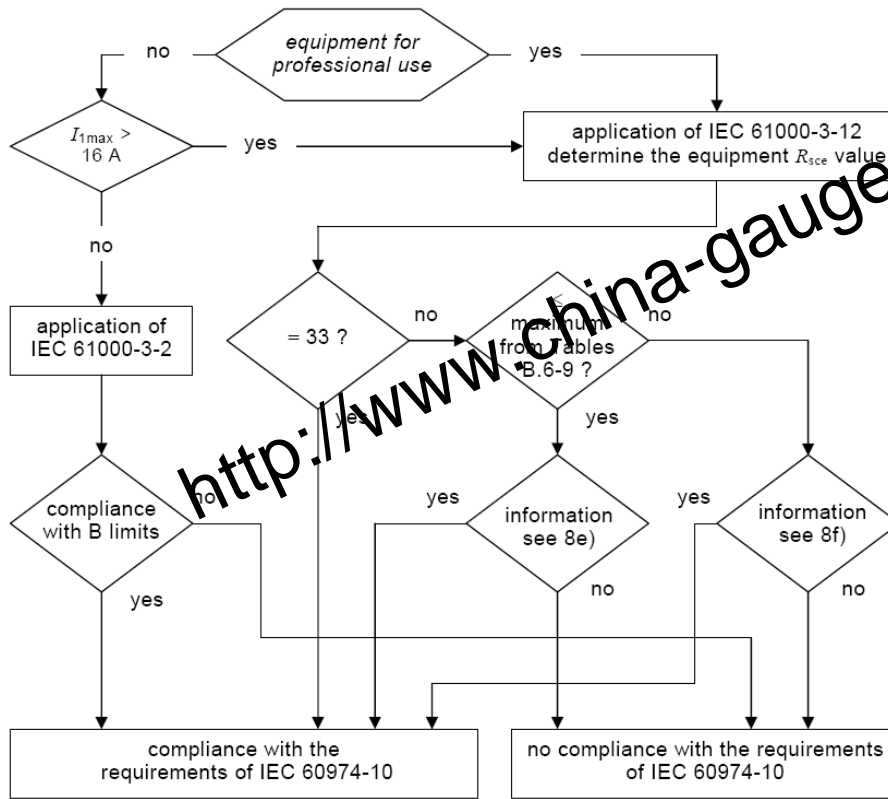
6.3.4 Harmonics, voltage fluctuations and flicker

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;

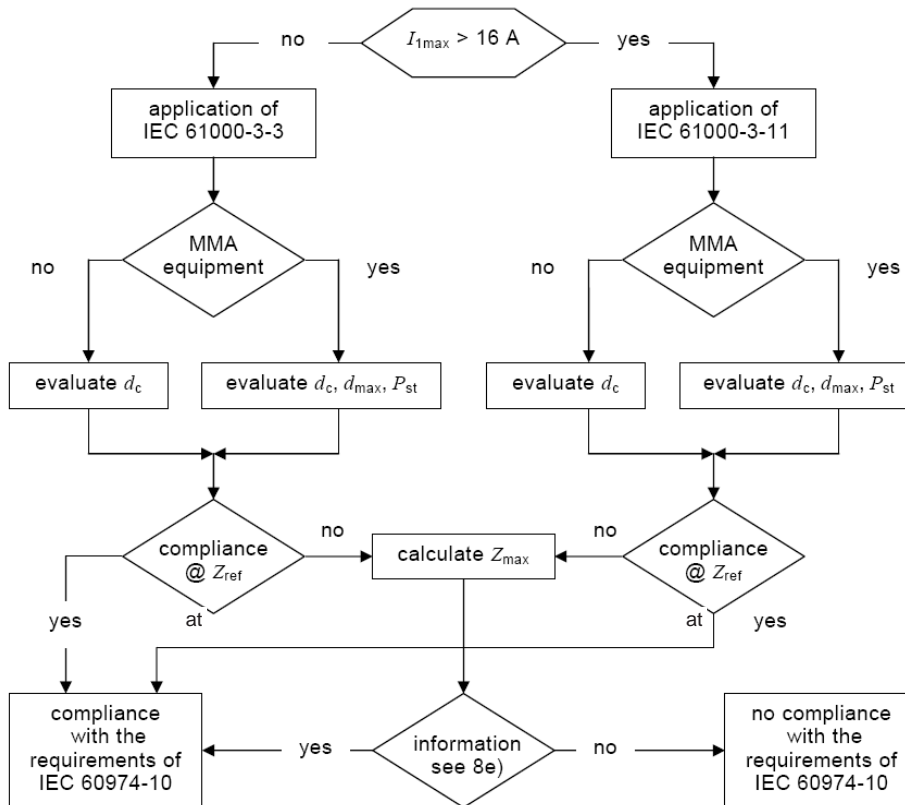
and are applicable to arc welding equipment with a supply current up to 75 A, as given in Figure 4 and Figure 5.

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



IEC 0236/14

Figure 4 – Overview of harmonic requirements for supply current up to 75 A



IEC 0237/14

Figure 5 – Overview of flicker requirements

A1 6.3.5 Output current ripple

The output current ripple of Class B arc welding power sources shall comply with the limits given in Table 4.

NOTE 1 Application of these limits to the peak-peak amplitude of the output current ripple ensures compliance with the limits for magnetic field emissions at a protection distance of 10 m from the welding system in the range from 150 kHz to 30 MHz as given in CISPR 11.

NOTE 2 The permissible peak-peak value is selected based on the fundamental frequency of the output current ripple. Compliance with this value at the fundamental frequency, which can be below the frequency range where limits for the magnetic field strength are defined, ensures compliance with all spectral components.

Table 4 – Output current ripple limits for Class B arc welding power sources

Frequency range MHz	Current ripple amplitude in time domain dBA ^a peak-peak
0,01 to 0,150	55,6 Decreasing linearly with logarithm of frequency to 8,6
0,150 to 30	8,6 Decreasing linearly with logarithm of frequency to -27,4
^a dBA is a logarithmic unit where 0 dBA represents a current of 1 A.	

A1

7 Immunity tests

7.1 Classification for immunity tests

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 equipment

Category 1 equipment includes arc welding equipment not containing electronic control circuitry, for example, transformers, transformer rectifiers, passive remote controls, liquid cooling systems, CO₂-heaters and non-electronic wire feeders.

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

7.1.3 Category 2 equipment

Category 2 equipment includes all arc welding equipment excluded from Category 1 above.

7.2 Test conditions

Welding power sources shall be tested during no-load and loaded operation at the welding current corresponding to a 100 % duty cycle, when delivering current into a conventional load in accordance with 6.2.2.

If the supply current is greater than 25 A at any of the output conditions given above, the output may be reduced to give a supply current of 25 A.

Compliance shall be checked by measuring the no-load voltage (for the no-load test) and the mean value of the welding current (for the loaded operation test).

Wire feeders shall be tested at 50 % of the maximum setting. The speed of the wire feeder shall be measured using a tachogenerator on a drive roll or by using other equivalent means.

NOTE To carry out this test, pressure is removed from the drive rolls.

7.3 Immunity performance criteria

7.3.1 Performance criterion A

The arc welding equipment shall continue to operate as intended. A variation in welding current, wire feed speed and travel speed of $\pm 10\%$ of the setting is permitted, unless the manufacturer states otherwise. All controls shall continue to function and, in particular, it shall be possible to terminate the welding current using the normal switch provided, for example, the switch on a metal inert/active gas welding torch or foot control. No loss of stored data is permitted. After the test the output shall return to the original setting. Under no circumstances shall the no-load voltage exceed those values given in IEC 60974-1.

7.3.2 Performance criterion B

A variation in welding current, wire feed speed and travel speed of $_{-100}^{+50}\%$ is permitted (in practice this may result in the arc extinguishing, in which case the arc may be reinitiated by the operator using the normal means). It shall be possible to terminate the welding current using the normal switch provided, for example the switch on a metal inert/active gas welding torch or foot control. No loss of stored data is permitted. After the test the output shall return to the original setting. Under no circumstances shall the no-load voltage exceed those values given in IEC 60974-1.

7.3.3 Performance criterion C

Temporary loss of function is permitted, requiring the arc welding equipment to be reset manually, for example by switching it off and on.

No loss of stored data is permitted unless it can be restored by the operation of the controls. Under no circumstances shall the no-load voltage exceed those values given in IEC 60974-1.

7.4 Immunity levels

Immunity requirements are given in Table 1 for the enclosure, Table 2 for the a.c. input power port and Table 3 for ports for measurement and control lines.

Table 1 – Immunity levels – Enclosure

Phenomena		Units	Test specification	Basic standard	Remarks	Performance criteria
Radiofrequency EM field, amplitude modulated		MHz V/m (unmod. r.m.s.) % AM (1 kHz)	80 to 1 000 10 80	IEC 61000-4-3	The test level specified is prior to modulation	A
		GHz V/m (unmod. r.m.s.) % AM (1 kHz)	1,4 to 2,0 3 80	IEC 61000-4-3	The test level specified is prior to modulation	A
		GHz V/m (unmod. r.m.s.) % AM (1 kHz)	2,0 to 2,7 1 80	IEC 61000-4-3	The test level specified is prior to modulation	A
Electrostatic discharge	Contact discharge	kV (charge voltage)	±4 ^a	IEC 61000-4-2	See basic standard for applicability of contact and/or air discharge test.	B
	Air discharge	kV (charge voltage)	±8 ^a			B

^a Testing is not required at lower levels than those specified.

Table 2 – Immunity levels – AC input power port

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) Repetition frequency kHz Tr/Th ns	±2 5 5/50	IEC 61000-4-4	Direct injection	B
Radio-frequency common mode	MHz V (unmod. r.m.s.) % AM (1 kHz)	0,15 to 80 10 80	IEC 61000-4-6	See note The test level specified is prior to modulation	A
Surges line-to-line line-to-earth	Tr/Th µs kV (open-circuit voltage) kV (open-circuit voltage)	1,2/50 (8/20) ±1 ±2	IEC 61000-4-5	This test is not required when normal functioning cannot be achieved because of the impact of the CDN on the EUT	B
Voltage dips	% residual voltage cycles at 50/60 Hz	70 25/30	IEC 61000-4-11	Voltage shift at zero crossing	B
	% residual voltage cycle	0 1	IEC 61000-4-34		C

NOTE The test level can also be defined as the equivalent current into a 150 Ω load.

Table 3 – Immunity levels – Ports for measurement and control

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) Tr/Th ns Repetition frequency kHz	±2 5/50 5	IEC 61000-4-4	Capacitive clamp	B
Radio-frequency common mode	MHz V (unmod. r.m.s.) % AM (1 kHz)	0,15 to 80 10 80	IEC 61000-4-6	See notes. The test level specified is prior to modulation	A
Applicable to measurement and control ports interfacing to cables, unless the total length according to manufacturers' specifications does not exceed 3 m.					
NOTE The test level can also be defined as the equivalent current into a 150 Ω load.					

8 Documentation for the purchaser/user

The documentation made available to the purchaser/user prior to the purchase shall clearly indicate restrictions for use, due to:

- a) the RF equipment class (Class A or Class B);
- b) low-frequency (LF) requirements for the public low voltage supply network connection.

Symbol 1 given in Annex C is recommended to be used for Class A equipment to indicate the RF equipment class and restrictions for use.

Symbol 2 given in Annex C is recommended to be used to indicate restrictions for use due to LF requirements for the public low voltage supply network connection.

The user shall be made aware of the fact that proper installation and use of the arc welding equipment is necessary to minimize possible interfering emissions. The manufacturer or his authorized representative shall be responsible for including instructions and information with each welding power source as follows.

- a) For Class B equipment, a written statement that Class B equipment complies with electromagnetic compatibility requirements in industrial and residential environments, including residential locations where the electrical power is provided by the public low-voltage supply system.
- b) For Class A equipment the following warning or its equivalent shall be included in the instruction manual:

This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There can be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated radio-frequency disturbances.

- c) If the equipment with an input current below 75 A per phase is intended to be connected to public low voltage systems, and it does comply with IEC 61000-3-11 or IEC 61000-3-12 based on system impedance restrictions, the information given in the next paragraph or its equivalent shall be included in the instruction manual. The restriction shall be given as the lower value of the permissible system impedances (in mΩ) or the higher value of the required short circuit power (in MVA) resulting from tests in accordance with these standards. The impedance value may be calculated from the short circuit power value and vice versa.

Provided that the public low voltage system impedance at the point of common coupling is lower than XX mΩ (or the short circuit power is higher than XX MVA), this equipment is compliant with IEC 61000-3-11 and IEC 61000-3-12 and can be connected to public low

voltage systems. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the system impedance complies with the impedance restrictions.

- d) If the equipment with an input current below 75 A per phase is intended to be connected to public low voltage systems, and it does not comply with IEC 61000-3-12 the following information or its equivalent shall be included in the instruction manual:

This equipment does not comply with IEC 61000-3-12. If it is connected to a public low voltage system, it is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator, that the equipment may be connected.

- e) Information on any special measures that have to be taken to achieve compliance, for example the use of shielded cables.
- f) Recommendations on the assessment of the surrounding area, to identify necessary precautions required for the installation and use, to minimize disturbances; see A.2 and A.3.
- g) Recommendations on methods to minimize disturbances; see A.4;
- h) A statement drawing attention to the user's responsibility with respect to interference from welding.

Annex A (informative)

Installation and use

A.1 General

The user is responsible for installing and using the arc welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected, then it shall be the responsibility of the user of the arc welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the welding circuit (see note). In other cases, it could involve constructing an electromagnetic screen enclosing the welding power source and the work complete with associated input filters. In all cases electromagnetic disturbances shall be reduced to the point where they are no longer troublesome.

NOTE The practice for earthing the welding circuit is dependent on local safety regulations. Changing the earthing arrangements to improve EMC can affect the risk of injury or equipment damage. Further guidance is given in IEC 60974-9.

A.2 Assessment of area

Before installing arc welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- a) other supply cables, control cables, signalling and telephone cables, above, below and adjacent to the arc welding equipment;
- b) radio and television transmitters and receivers;
- c) computer and other control equipment;
- d) safety critical equipment, for example guarding of industrial equipment;
- e) the health of the people around, for example the use of pacemakers and hearing aids;
- f) equipment used for calibration or measurement;
- g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;
- h) the time of day that welding or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

A.3 Assessment of welding installation

In addition to the assessment of the area, the assessment of arc welding installations may be used to evaluate and resolve cases of interference. An emission assessment should include *in situ* measurements as specified in Clause 10 of CISPR 11:2009. *In situ* measurements may also be used to confirm the efficiency of mitigation measures.

A.4 Mitigation measures

A.4.1 Public supply system

Arc welding equipment should be connected to the public supply system according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the public supply system. Consideration should be given to shielding the supply cable of permanently installed arc welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

A.4.2 Maintenance of the arc welding equipment

The arc welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the arc welding equipment is in operation. The arc welding equipment should not be modified in any way, except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilising devices should be adjusted and maintained according to the manufacturer's recommendations.

A.4.3 Welding cables

The welding cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

A.4.4 Equipotential bonding

Bonding of all metallic objects in the surrounding area should be considered. However, metallic objects bonded to the work piece will increase the risk that the operator could receive an electric shock by touching these metallic objects and the electrode at the same time. The operator should be insulated from all such bonded metallic objects.

A.4.5 Earthing of the workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

A.4.6 Screening and shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding area may be considered for special applications.

Annex B (informative)

Limits

B.1 General

The limits given in the standards referred to in the normative part of the present standard are summarized in Tables B.1 to B.10 for information. As some of the references refer to specific parts of tables of limits given in the referenced documents, only the applicable parts of those tables are duplicated.

B.2 Mains terminal disturbance voltage limits

Source: CISPR 11:2009, Amendment 1:2010

Table B.1 – Mains terminal disturbance voltage limits, idle state

Frequency range MHz	Class B dB μ V		Class A dB μ V	
	Quasi-peak	Average	Quasi-peak	Average
0,15-0,50	66	56	79	66
	Decreasing linearly with logarithm of frequency to			
	56	46		
0,50-30	56	46	73	60

Table B.2 – Mains terminal disturbance voltage limits, load conditions

Frequency range MHz	Class B dB μ V		Class A maximum rated input power ≤ 75 kVA ^a dB μ V		Class A maximum rated input power > 75 kVA ^a dB μ V	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15-0,50	66	56	100	90	130	120
	Decreasing linearly with logarithm of frequency to					
	56	46				
0,50-5	56	46	86	76	125	115
5-30	60	50	90	80	115	105
			Decreasing linearly with logarithm of frequency to			
			70	60		

^a The maximum rated input power is calculated using the rated maximum supply current I_{1max} .

B.3 Electromagnetic radiation disturbance limits

Source: CISPR 11:2009, Amendment 1:2010

Table B.3 – Electromagnetic radiation disturbance limits, idle state

Frequency range MHz	Class B dB μ V/m		Class A dB μ V/m	
	10 m measuring distance	3 m measuring distance ^a	10 m measuring distance	3 m measuring distance ^a
30-230	30	40	40	50
230-1 000	37	47	47	57

^a The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in B.6.

Table B.4 – Electromagnetic radiation disturbance limits, load conditions

Frequency range MHz	Class B dB μ V/m		Class A dB μ V/m	
	10 m measuring distance	3 m measuring distance ^a	10 m measuring distance	3 m measuring distance ^a
30	30	40	80	90
>30-80,872	30	40	Decreasing linearly with logarithm of frequency to	
80,872-81,848	30 ^b	40 ^b		
81,848-134,786	30	40		
134,786-136,414	30 ^b	40 ^b		
136,414- \leq 230	30	40	60	70
>230-1 000	37	47	60	70

^a The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in CISPR 11.

^b 20 dB relaxation has been removed based on 6.3.3.2.

B.4 Harmonic current limits

Sources: IEC 61000-3-2:2005 and IEC 61000-3-12:2011

Table B.5 – Maximum permissible harmonic current for equipment for non-professional use with input current $I_{1max} \leq 16$ A

Harmonic order n	Harmonic current
Odd harmonics	
3	3,45
5	1,71
7	1,16
9	0,60
11	0,50
13	0,32
$15 \leq n \leq 39$	$0,23 \times 15/n$
Even harmonics	
2	1,62
4	0,65
6	0,45
$8 \leq n \leq 40$	$0,35 \times 8/n$

Table B.6 – Current emission limits for equipment with $I_{1max} \leq 75$ A other than balanced three-phase equipment

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} ^a						Admissible harmonic parameters	
	%						%	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	21,6	10,7	7,2	3,8	3,1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
≥ 350	41	24	15	12	10	8	47	47

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.

Linear interpolation between successive R_{sce} values is permitted.

^a I_{ref} = reference current; I_h = harmonic current component.

Table B.7 – Current emission limits for balanced three-phase equipment with $I_{1max} \leq 75$ A

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} ^a				Admissible harmonic parameters	
	%				%	
	I_5	I_7	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	10,7	7,2	3,1	2	16	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	10	7	37	38
≥ 350	40	25	15	10	48	46

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.
Linear interpolation between successive R_{sce} values is permitted.

^a I_{ref} = reference current; I_h = harmonic current component.

Table B.8 – Current emission limits for balanced three-phase equipment with $I_{1max} \leq 75$ A under specified conditions (a, b, c)

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} ^a				Admissible harmonic parameters	
	%				%	
	I_5	I_7	I_{11}	I_{13}	THC/ I_{ref}	PWHC/ I_{ref}
33	10,7	7,2	3,1	2	13	22
≥ 120	40	25	15	10	48	46

The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and PWHC in the same way as odd order harmonics.
Linear interpolation between both R_{sce} values is permitted.

^a I_{ref} = reference current; I_h = harmonic current component.

Table B.9 – Current emission limits for balanced three-phase equipment with $I_{1max} \leq 75$ A under specified conditions (d, e, f)

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} ^a												Admissible harmonic parameters	
	%												%	
	I_5	I_7	I_{11}	I_{13}	I_{17}	I_{19}	I_{23}	I_{25}	I_{29}	I_{31}	I_{35}	I_{37}	THC/ I_{ref}	PWHC/ I_{ref}
33	10,7	7,2	3,1	2	2	1,5	1,5	1,5	1	1	1	1	13	22
≥ 250	25	17,3	12,1	10,7	8,4	7,8	6,8	6,5	5,4	5,2	4,9	4,7	35	70

For R_{sce} equal to 33, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 1 % of I_{ref} .
For $R_{sce} \geq 250$, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 3 % of I_{ref} .
Linear interpolation between both R_{sce} values is permitted.

^a I_{ref} = reference current; I_h = harmonic current component.

Table B.6 is applied to equipment other than balanced three-phase equipment and Tables B.7, B.8 and B.9 are applied to balanced three-phase equipment.

Table B.7 may be used for any balanced three-phase piece of equipment.

Table B.8 may be used with balanced three-phase equipment if any one of the following conditions is met.

- a) The phase angle of the 5th harmonic current related to the fundamental phase voltage is in the range of 90° to 150°.

NOTE 1 This condition is normally fulfilled by equipment with an uncontrolled thyristor bridge and capacitive filter, including a 3 % a.c. or 4 % d.c. reactor.

- b) The design of the equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval (0°, 360°).

NOTE 2 This condition is normally fulfilled by converters with fully controlled thyristor bridges.

- c) The 5th and 7th harmonic currents are each less than 5 % of the reference fundamental current.

NOTE 3 This condition is normally fulfilled by "12-pulse" equipment.

Table B.9 may be used with balanced three-phase equipment if any one of these conditions is met:

- d) The 5th and 7th harmonic currents are each less than 3 % of the reference current during the whole test observation period.
- e) The design of the piece of equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval [0°, 360°].
- f) The phase angle of the 5th harmonic current related to the fundamental phase-to-neutral voltage is in the range of 150° to 210° during the whole test observation period.

NOTE 4 This condition is normally fulfilled by a 6 pulse converter with a small d.c. link capacitance, operating as a load.

B.5 Limits for voltage fluctuations and flicker

Sources: IEC 61000-3-3:2013 and IEC 61000-3-11:2000

Table B.10 – Limits for arc welding equipment with $I_{1max} \leq 75$ A

Maximum relative voltage change d_{max} %	Relative steady-state voltage change d_c ^a %	Short-term flicker indicator P_{st} ^a
7	3,3	1,0
^a d_c and P_{st} limits are only applicable to equipment designed to be used for the manual metal arc (MMA) process.		

The P_{st} requirement is not applicable to voltage changes caused by manual switching.

Equipment which does not meet the limits given in Table B.10 when tested or evaluated with the reference impedance given in IEC 61000-3-3 is subject to conditional connection, and the manufacturer may either


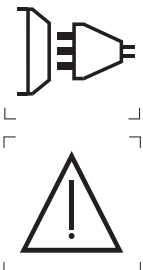
- a) determine the maximum permissible system impedance Z_{max} at the interface point of the users supply in accordance with 6.3 of IEC 61000-3-11:2000, and declare Z_{max} in the instruction manual, or
- b) test the equipment in accordance with 6.2 of IEC 61000-3-11:2000, and declare in the instruction manual that the equipment is intended for use only in premises having a service current capacity ≥ 100 A per phase.

Annex C
(informative)

Symbols

Table C.1 provides symbols for the indication of the RF equipment class and restrictions for use.

Table C.1 – Symbols to describe EMC properties

N°	SOURCE	SYMBOL	DEFINITION, KEYWORD OR PHRASE	APPLICATION
1.	IEC 60417-5109		Not to be used in residential locations where the electrical power is provided by the public low-voltage supply system.	To identify Class A equipment and restrictions for use NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase
2.	IEC 60417-5939 and ISO 7000- 0434A combined		Restrictions for the connection to public low voltage supply networks apply	To identify restrictions of use with regard to required supply network parameters NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase

Bibliography

IEC 60417-DB:2011², *Graphical symbols for use on equipment*

IEC 60974-9, *Arc welding equipment – Part 9: Installation and use*

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*

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

ISO 7000:2004, *Graphical symbols for use on equipment – Index and synopsis*

<http://www.china-gauges.com/>

² DB refers to IEC online database.

<http://www.china-gauges.com/>

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