

# Arc welding equipment —

Part 10: Electromagnetic compatibility  
(EMC) requirements

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ICS 25.160.30

## National foreword

This British Standard is the UK implementation of EN 60974-10:2007. It is identical to IEC 60974-10:2007. It supersedes BS EN 60974-10:2003 which is withdrawn.

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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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2008

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ISBN 978 0 580 54474 3

### Amendments/corrigenda issued since publication

Date	Comments

English version

**Arc welding equipment**  
**Part 10: Electromagnetic compatibility (EMC) requirements**  
(IEC 60974-10:2007)

Matériel de soudage à l'arc  
Partie 10: Exigences relatives à la  
compatibilité électromagnétique (CEM)  
(CEI 60974-10:2007)

Lichtbogenschweißeinrichtungen -  
Teil 10: Anforderungen an die  
elektromagnetische Verträglichkeit (EMV)  
(IEC 60974-10:2007)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 26/341/CDV, future edition 2 of IEC 60974-10, prepared by IEC TC 26, Electric welding, was submitted to the IEC-CENELEC parallel Unique Acceptance Procedure and was approved by CENELEC as EN 60974-10 on 2007-12-01.

This European Standard supersedes EN 60974-10:2003.

Significant technical changes with respect to EN 60974-10:2003 are:

- application of more stringent r.f. emission limits for inside mode;
- 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.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2008-09-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2010-12-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2004/108/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 60974-10:2007 was approved by CENELEC as a European Standard without any modification.

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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  $\leq 16$  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  $\leq 16$  A per phase and not subject to conditional connection<sup>1</sup>*

Amendment 1 (2001)

Amendment 2 (2005)

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<sup>1</sup> There exists a consolidated edition 1.2 (2005) that includes edition 1 and its amendments 1 and 2.

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  $\leq 75$  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  $\leq 75$  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



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 mode in which the power is switched on, but the welding circuit is not energized

## 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  $\Omega$ /50  $\mu$ H 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  $\Omega$ . 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.

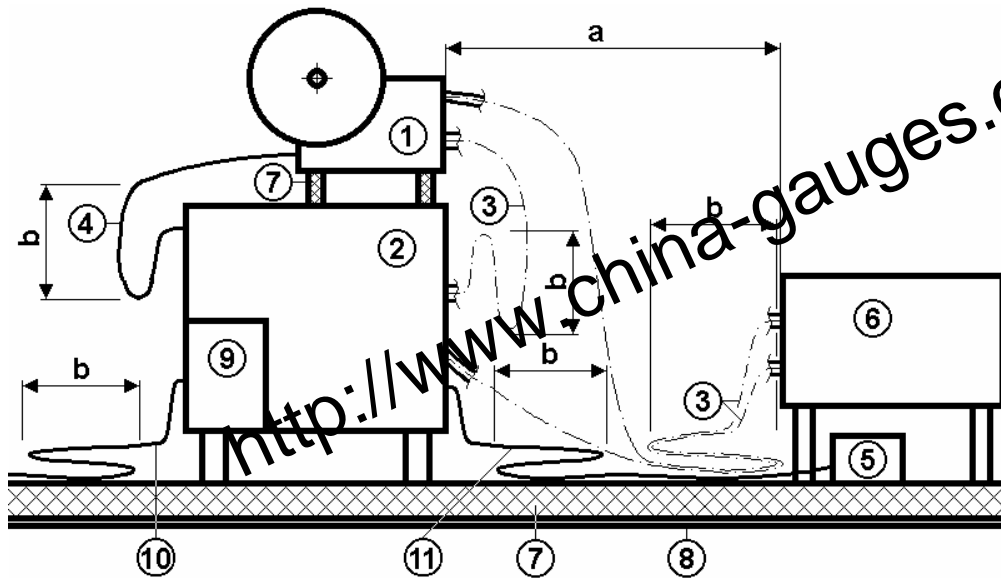
## 5 Test set-up for emission and immunity

### 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.

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

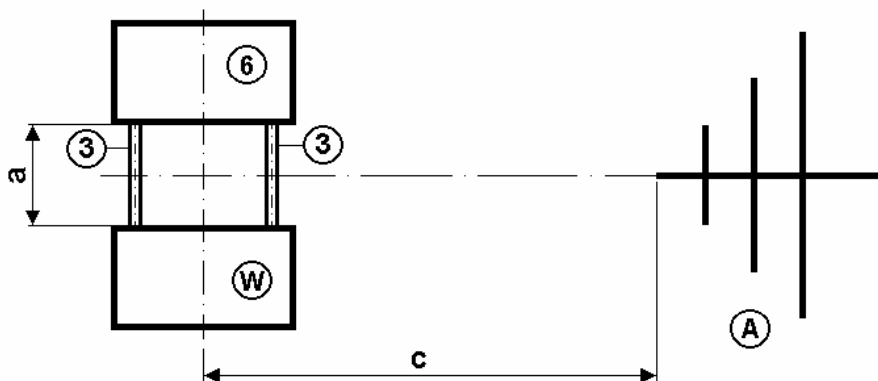


**Key**

- |   |                                 |    |                                |
|---|---------------------------------|----|--------------------------------|
| 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**

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 and 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.

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 (see items b) and c)) according to the process as given in 6.2.2 under each of the following output conditions:

- a) idle state;
- b) at rated minimum welding current;
- c) at rated welding current at 100 % duty cycle.

If applicable, the idle state test is made with the configuration shown in Figure 1, but with an open circuit at the load.

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.

## 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 mode

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  $I_{1\max}$  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.

### 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 mode

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<sub>2</sub>-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.

### 7.1.3 Category 2

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.

*Compliance shall be checked* by measuring the no-load voltage and the mean value of the welding current.

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, the pressure should be 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.

NOTE This may require the equipment to be switched 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 process 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
Electrostatic discharge	Contact discharge	kV (charge voltage)	±4 <sup>a</sup>	IEC 61000-4-2	See basic standard for applicability of contact and/or air discharge test.	B
	Air discharge	kV (charge voltage)	±8 <sup>a</sup>			B
<sup>a</sup> 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 (1kHz)	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	% reduction periods	30 0,5	IEC 61000-4-11	-	B
	% reduction periods	60 5			C
NOTE The test level can also be defined as the equivalent current into a 150 Ω load.					

**Table 3 – Immunity levels – Ports for process measurement and control lines**

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 (1kHz)	0,15 to 80 10 80	IEC 61000-4-6	See note The test level specified is prior to modulation	A
Applicable to process 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 and after the purchase shall clearly indicate the equipment class.

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 wording or its equivalent shall be included in the instruction manual:

**WARNING:** 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 may be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.

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

**WARNING:** 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 if necessary, that the equipment may be connected.

- d) Information on any special measures that have to be taken to achieve compliance, for example the use of shielded cables.
- e) Recommendations on the assessment of the surrounding area, to identify necessary precautions required for the installation and use, to minimize disturbances; see Clause A.2.
- f) Recommendations on methods to minimize disturbances; see Clause A.3;
- g) 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 welding circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel welding current return paths, which may damage the earth circuits of other equipment. Further guidance is given in IEC/TS 62081<sup>2</sup>.

#### 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 Methods of reducing emissions

##### A.3.1 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.

<sup>2</sup> IEC/TS 62081: Arc welding equipment – Installation and use.

### **A.3.2 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 stalling devices should be adjusted and maintained according to the manufacturer's recommendations.

### **A.3.3 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.3.4 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.3.5 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.3.6 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 this annex 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 11:2003

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

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

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

Frequency band MHz	Class B dB $\mu$ V		Class A dB $\mu$ V		Class A > 100 A <sup>a</sup> dB $\mu$ V	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15-0,50	66 Decreasing linearly with logarithm of frequency to 56	56 46	100	90	130	120
0,50-5	56	46	86	76	125	115
5-30	60	50	90 Decreasing linearly with logarithm of frequency to 70	80 60	115	105

<sup>a</sup> Applicable to equipment with mains supply currents  $I_{1max}$  in excess of 100 A per phase.

### B.3 Electromagnetic radiation disturbance limits

Source: CISPR 11:2003

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

Frequency band MHz	Class B (at 10 m measuring distance) dB $\mu$ V/m	Class A (at 10 m measuring distance) dB $\mu$ V/m
30-230	30	40
230-1 000	37	47

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

Frequency band MHz	Class B (at 10 m measuring distance) dB $\mu$ V/m	Class A (at 10 m measuring distance) dB $\mu$ V/m
30-80,872	30	80
80,872-81,848	50	Decreasing linearly with logarithm of frequency to
81,848-134,786	30	
134,786-136,414	50	
136,414-230	30	
230-1 000	37	

### B.4 Harmonic current limits

Sources: IEC 61000-3-2:2005 and IEC 61000-3-12:2004

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

Harmonic order n	Harmonic current A
<b>Odd harmonics</b>	
3	3,45
5	1,71
7	1,16
9	0,60
11	0,50
13	0,32
$15 \leq n \leq 39$	$0,23 \times 15/n$
<b>Even harmonics</b>	
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 professional equipment with  $I_{1max} \leq 75$  A other than balanced three-phase equipment**

Minimal $R_{sce}$	Admissible individual harmonic current $I_n/I_1^a$						Admissible harmonic current distortion factors	
	%						%	
	$I_3$	$I_5$	$I_7$	$I_9$	$I_{11}$	$I_{13}$	<i>THD</i>	<i>PWHD</i>
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
$\geq 350$	41	24	15	10	8	8	47	47

NOTE 1 The relative values of even harmonics up to order 12 must not exceed  $16/n$  %. Even harmonics above order 12 are taken into account in *THD* and *PWHD* in the same way as odd order harmonics.

NOTE 2 Linear interpolation between successive  $R_{sce}$  values are permitted.

<sup>a</sup>  $I_1$  = reference fundamental current;  $I_n$  = harmonic current component.

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

Minimal $R_{sce}$	Admissible individual harmonic current $I_n/I_1^a$				Admissible harmonic current distortion factors	
	%				%	
	$I_5$	$I_7$	$I_{11}$	$I_{13}$	<i>THD</i>	<i>PWHD</i>
33	10,7	7,2	3,1	2	13	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
$\geq 350$	40	25	15	10	48	46

NOTE 1 The relative values of even harmonics up to order 12 must not exceed  $16/n$  %. Even harmonics above order 12 are taken into account in *THD* and *PWHD* in the same way as odd order harmonics.

NOTE 2 Linear interpolation between successive  $R_{sce}$  values are permitted.

<sup>a</sup>  $I_1$  = reference fundamental current;  $I_n$  = harmonic current component.

**Table B.8 – Current emission limits for professional balanced three-phase equipment with  $I_{1max} \leq 75$  A under specified conditions**

Minimal $R_{sce}$	Admissible individual harmonic current $I_n/I_1^a$				Admissible harmonic current distortion factors	
	%				%	
	$I_5$	$I_7$	$I_{11}$	$I_{13}$	<i>THD</i>	<i>PWHD</i>
33	10,7	7,2	3,1	2	13	22
$\geq 120$	40	25	15	10	48	46

NOTE 1 The relative values of even harmonics up to order 12 must not exceed  $16/n$  %. Even harmonics above order 12 are taken into account in *THD* and *PWHD* in the same way as odd order harmonics.

NOTE 2 Linear interpolation between successive  $R_{sce}$  values are permitted.

<sup>a</sup>  $I_1$  = reference fundamental current;  $I_n$  = harmonic current component.

Table B.8 may be used (with balanced three-phase equipments) 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 This condition is normally fulfilled by equipment with an uncontrolled rectifier 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 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 This condition is normally fulfilled by "12-pulse" equipment.

## B.5 Limits for voltage fluctuations and flicker

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

**Table B.9 – Limits for arc welding equipment with  $I_{1\max} \leq 75$  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
<sup>a</sup> $d_c$ 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.9 when tested or evaluated with the reference impedance given in IEC 61000-3-3 is subject to conditional connection, and the manufacturer may either

- 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, and declare  $Z_{\max}$  in the instruction manual, or
- test the equipment in accordance with 6.2 of IEC 61000-3-11, and declare in the instruction manual that the equipment is intended for use only in premises having a service current capacity  $\geq 100$  A per phase.



**Annex ZA**  
(normative)

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

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.

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-161	– <sup>1)</sup>	International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility	–	–
IEC 60050-851	– <sup>1)</sup>	International Electrotechnical Vocabulary (IEV) – Chapter 851: Electric welding	–	–
IEC 60974-1	– <sup>1)</sup>	Arc welding equipment – Part 1: Welding power sources	EN 60974-1	2005 <sup>2)</sup>
IEC 60974-3	– <sup>1)</sup>	Arc welding equipment – Part 3: Arc striking and stabilizing devices	EN 60974-3	2007 <sup>2)</sup>
IEC 60974-6	– <sup>1)</sup>	Arc welding equipment – Part 6: Limited duty manual metal arc welding power sources	EN 60974-6 + corr. May	2003 <sup>2)</sup> 2005
IEC 61000-3-2	2005	Electromagnetic compatibility (EMC) – Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	EN 61000-3-2	2006
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	EN 61000-3-3 + corr. July	1995 1997
A1	2001		A1	2001
A2	2005		A2	2005
IEC/TS 61000-3-4	– <sup>1)</sup>	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	–	–

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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 $\leq 75$ A and subject to conditional connection	EN 61000-3-11	2000
IEC 61000-3-12	2004	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 $\leq 75$ A per phase	EN 61000-3-12	2005
IEC 61000-4-2	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity	EN 61000-4-2	1995 <sup>2)</sup>
IEC 61000-4-3	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006 <sup>2)</sup>
IEC 61000-4-4	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2004 <sup>2)</sup>
IEC 61000-4-5	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006 <sup>2)</sup>
IEC 61000-4-6	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6 + corr. August	2007 <sup>2)</sup> 2007
IEC 61000-4-11	– <sup>1)</sup>	Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004 <sup>2)</sup>
CISPR 11 (mod)	2003	Industrial scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement	EN 55011 <sup>3)</sup>	2007
CISPR 14-1	– <sup>1)</sup>	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission	EN 55014-1	2006 <sup>2)</sup>

<sup>3)</sup> EN 55011 includes A1:2004 to CISPR 11 (mod).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 16-1-1	– <sup>1)</sup>	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	2007 <sup>2)</sup>
CISPR 16-1-2	– <sup>1)</sup>	Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances	EN 55016-1-2	2004 <sup>2)</sup>
CISPR 16-1-4	– <sup>1)</sup>	Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbances	EN 55016-1-4	2007 <sup>2)</sup>

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**Annex ZZ**  
(informative)

**Coverage of Essential Requirements of EC 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 all relevant essential requirements as given in Annex I of the EC Directive 2004/108/EC.

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

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

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