IEC 60974-9

Edition 2.0 2018-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Arc welding equipment –
Part 9: Installation and use

Matériel de soudage à l'arc –
Partie 9: Installation et utilisation

IEC 60974-9:2018-04(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60974-9 has been prepared by IEC technical committee 26: Electric welding.

This standard cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

a) addition of a new Clause 8;
b) addition of interpolation details in Table 1.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
26/648/FDIS	26/649/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

In this standard, the following print types are used:

– terms defined in Clause 3: in **bold** type.

A list of all the parts of the IEC 60974 series can be found, under the general title *Arc welding equipment*, on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ARC WELDING EQUIPMENT –

Part 9: Installation and use

1 Scope

This document is applicable to requirements for installation and instructions for use of equipment for arc welding and allied processes designed in accordance with safety requirements of IEC 60974-1, IEC 60974-6 or equivalent.

This document is applicable for the guidance of instructors, operators, welders, managers, and supervisors in the safe installation and use of equipment for arc welding and allied processes and the safe performance of welding and cutting operations.

National and local regulations take precedence over this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60245-6, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 6: Arc welding electrode cables*

IEC 60755, *General requirements for residual current operated protective devices*

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

IEC 60974-4, *Arc welding equipment – Part 4: Periodic inspection and testing*

IEC 60974-11, *Arc welding equipment – Part 11: Electrode holders*

IEC 60974-12, *Arc welding equipment – Part 12: Coupling devices for welding cables*

IEC 60974-13, *Arc welding equipment – Part 13: Welding clamp*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
welding circuit
conductive material through which the welding current is intended to flow

Note 1 to entry: In arc welding, the arc is a part of the **welding circuit**.

Note 2 to entry: In certain arc welding processes, the arc can be established between two electrodes. In such a case, the **workpiece** is not necessarily a part of the **welding circuit**.

[SOURCE: IEC 60050-851:2008, 851-14-10]

3.2
extraneous conductive part
conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the earth potential

Note 1 to entry: Electrical installation includes the **welding circuit**.

[SOURCE: IEC 60050-851:2008, 851-14-57]

3.3
workpiece
metal piece or pieces on which welding or allied processes are performed

[SOURCE: IEC 60050-851:2008, 851-11-19]

3.4
protective clothing
protective accessories
protective clothing and accessories (e.g. gloves, hand shields, head masks and filter lenses) used in order to diminish electric shock risks and the effects of fume and spatter and to protect the skin and eyes against arc radiation

[SOURCE: IEC 60050-851:2008, 851-11-18]

3.5
environment with increased risk of electric shock
environment where the hazard of electric shock by arc welding is increased in relation to normal arc welding conditions

Note 1 to entry: Such environments are found for example

a) locations in which freedom of movement is restricted, so that the operator is forced to perform the welding in a cramped (for example kneeling, sitting, lying) position with physical contact with conductive parts;

b) in locations which are fully or partially limited by conductive elements and in which there is a high risk of unavoidable or accidental contact by the operator;

c) in wet, damp or hot locations where humidity or perspiration considerably reduces the skin resistance of the human body and the insulating properties of **protective accessories**.

Note 2 to entry: **Environments with increased risk of electric shock** are not meant to include places where electrically conductive parts in the near vicinity of the operator which can cause increased hazard have been insulated.

[SOURCE: IEC 60050-851:2008, 851-15-09]

3.6
expert
competent person
skilled person
person who can judge the work assigned and recognize possible hazards on the basis of professional training, knowledge, experience and knowledge of the relevant equipment

Note 1 to entry: Several years of practice in the relevant technical field can be taken into consideration in assessment of professional training.

[SOURCE: IEC 60050-851:2008, 851-11-10]

3.7
wire feeder
equipment that delivers filler wire to the arc or weld zone which includes means to apply motion to the filler wire

Note 1 to entry: The **wire feeder** may also include the wire-feed control, the filler wire supply, devices for gas control, indicators and remote connectors.

[SOURCE: IEC 60050-851:2008, 851-14-39]

4 Installation

4.1 General

Welding equipment used in arc welding installations shall be intended for the purpose as given on the rating plate.

Electromagnetic compatibility (EMC) requirements shall be taken into consideration during installation, see Clause 5.

The requirements of national and local regulations shall be taken into consideration during installation, including grounding or protective earth connections, fuses, supply disconnecting device, type of supply circuit, etc.

Read the manufacturer's instruction manual before installing the equipment. Full use shall be made of the technical information relevant to the welding equipment.

Specific advice may be obtained from the welding equipment manufacturer, if necessary.

4.2 Supply circuit

4.2.1 Selection of supply cables

Supply cables for welding equipment and their overload protection, if not provided by the manufacturer, shall be selected in accordance with the information given in the manufacturer's instruction manual.

NOTE Examples of local regulations are given in the Bibliography, e.g. EN 50525-2-21, Electrical code NFPA 70 (SE, SO, ST, STO or other extra hard usage cable) or CSA C22.1. PVC insulation has been proven not suitable for the application.

Supply cables shall be placed so that they cannot be damaged in use. If that cannot be achieved, a residual current device (RCD), capable of operating at a leakage current not exceeding 30 mA in accordance with IEC 60755, shall be used to reduce the risk of electric shock.

4.2.2 Supply disconnecting device

The installer shall ensure that a supply disconnecting device is fitted at the point of supply.

NOTE A plug can be used as supply disconnecting device in accordance with national or local regulation.

4.2.3 Emergency stopping device

When an emergency stopping device is required by a national regulation (e.g. automatic welding equipment), it shall conform to the relevant IEC standard.

For welding in an **environment with increased risk of electric shock**, see 7.10.

4.3 Welding circuit

4.3.1 Isolation from the input supply

The **welding circuit** and circuits electrically connected to the **welding circuit** shall be electrically isolated from the mains supply.

Verification shall be carried out by an **expert**.

4.3.2 Summation of no-load voltages

If more than one welding power source is in use at the same time, their no-load voltages can be cumulative and could create an increased hazard of electric shock. Welding power sources shall be installed so as to minimize this risk. Guidance is given in 7.9.

NOTE In the case of two welding transformers connected to the same lines, the resulting output voltage can be the sum of both no-load voltages. This can be avoided by using a suitable input or output connection (see 7.9).

Where more than one welding power source is installed, individual welding power sources with their separate controls and connections should be clearly identified to show which items belong to any one **welding circuit**.

4.3.3 Welding cables

Welding cables shall comply with IEC 60245-6. Copper conductor welding cables shall be selected in accordance with the duty cycle and national regulations or, when inexistant, the current rating given in Table 1. Where long cable runs are involved, it can be necessary to choose the cable size on the basis of voltage drop, see Annex B.

Table 1 – Current ratings for copper welding cables

Nominal cross-sectional area[b]	Current ratings for specified duty cycle at an ambient temperature of 25 °C[a]						
	100 %	85 %	80 %	60 %	35 %	20 %	8 %
mm^2	A	A	A	A	A	A	A
10	100	100	100	101	106	118	158
16	135	136	136	139	150	174	243
25	180	182	183	190	213	254	366
35	225	229	231	243	279	338	497
50	285	293	296	316	371	457	681
70	355	367	373	403	482	602	908
95	430	448	456	498	606	765	1 164
120	500	524	534	587	721	917	1 404
150	580	610	622	689	853	1 090	1 676
185	665	702	717	797	995	1 277	1 971

[a] For higher ambient temperatures, a correction factor shall be applied:
0,96 (30 °C); 0,91 (35 °C); 0,87 (40 °C); 0,82 (45 °C). No interpolation is allowed for duty cycle values.

[b] For intermediate values of nominal cross-section areas, interpolation is allowed.

NOTE Table originates from EN 50565-1:2014.

4.3.4 Connection between the welding power source and the workpiece

When the welding current does not flow entirely in the **welding circuit**, stray currents, which are components of the welding current, occur. These can cause damage to electrical systems of buildings and to other sensitive systems in buildings and can be minimized by the following means:

a) the electrical connection between the welding power source and the **workpieces** shall be made as direct as practicable by means of an insulated return cable having an adequate current-carrying capacity;

b) **extraneous conductive parts**, such as metal rails, pipes and frames shall not be used as part of the **welding circuit**, unless they constitute the **workpiece** itself;

c) the welding clamp shall be as near as practicable to the welding arc;

d) the welding clamp disconnected from the **workpiece** shall be electrically isolated from parts connected to earth, e.g. metallic enclosures with protective earth connection (class I), metal floors, building services;

NOTE 1 The welding clamp can cause an electrical shock when welding current is flowing or when the electrode circuit is in contact with the electrical ground circuit or work piece.

e) the **welding circuit** shall not be earthed unless required by national or local regulations (see 4.3.5);

f) connection of the return cable to the **workpiece** shall be ensured by the use of devices having suitable means for cable connection, a fastening system not liable to come loose accidentally, and good electrical contact. Magnetic devices only present a good electrical contact if the contact surfaces of the magnetic device and the contact area of the **workpiece** are sufficiently large, even, conductive and clean (e.g. free from rust and primer) and if the contact area of the **workpiece** is magnetic;

NOTE 2 If **workpieces** are on a welding bench or a work-handling device, the return cable can be connected to the bench or the device.

g) connection devices for non-stationary flexible welding cables in the **welding circuit** shall:

1) have an adequate covering of insulating material to prevent inadvertent contact with live parts, when connected, with the exception of the welding clamp at the **workpiece** itself;
2) be suitable for the sizes of cables used and the welding current;
3) be effectively connected to the welding cables and in good electrical contact with them.

h) Welding, control and mains cables shall be protected from spatter and heat to prohibit unintentional damage to the insulation.

Both the welding cable and the connection device shall be used within their specified current rating. The connection device shall not be fitted with a cable smaller in diameter than specified by the manufacturer of the connection device.

When coupling devices or welding clamps are used, they shall comply with IEC 60974-12 or IEC 60974-13, respectively.

4.3.5 Earthing of the workpiece

The **welding circuit** should not be earthed, since it can increase the risk of stray welding currents (see 4.3.3). Earthing of the **welding circuit** can also increase the area of metal through which a person in contact with the **welding circuit** (e.g. the welding electrode) could receive an electric shock.

NOTE 1 There are **workpieces** that have an inherent connection to earth, e.g. steel structures, ships, pipelines. When these are welded, the possibility of stray currents is increased.

NOTE 2 In some cases, the **workpiece** can be in permanent contact with earth, e.g. with protection class I equipment which itself has protective conductors connected to earth. Such a **workpiece** is considered to be inherently connected to earth.

An assessment of the **welding circuit** and the welding area shall be made to ensure that a stray welding current will not flow through any object connected to earth that is not intended or capable of carrying the welding current (e.g. protective earth connection).

If electrical hand tools are used that could come into contact with the **workpiece**, then those tools shall be class II equipment (i.e. with double or reinforced insulation without protective earth connection).

If earthing is required by national or local regulations, the earth connection shall be made by a separate dedicated cable or conductor with a rating of at least that of the return cable and connected directly to the **workpiece**.

Precautions shall be taken to insulate the operator from earth as well as from the **workpiece** (see 7.7.2).

Where external radio frequency noise suppression networks are connected to the **welding circuit**, an **expert** shall assess whether the **welding circuit** can still be regarded as insulated from earth.

NOTE 3 External radio frequency noise suppression networks could consist of a number of different components, for example, LCR filters (inductance/capacitance/resistance).

4.3.6 Location of gas cylinders

Care shall be taken to prevent gas cylinders in the vicinity of the **workpiece** from becoming part of the **welding circuit**.

5 Electromagnetic compatibility (EMC)

5.1 General

The user is responsible for installing and using the arc welding equipment in accordance with 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.

5.2 Assessment of area

Before installing arc welding equipment, the user shall make an assessment of potential electromagnetic interferences 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 wearable medical devices and implants;

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 can 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 can extend beyond the boundaries of the premises.

5.3 Methods of reducing emissions

5.3.1 Public supply system

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

5.3.2 Maintenance of arc-welding equipment

The arc-welding equipment shall be routinely maintained in accordance with IEC 60974-4 and the manufacturer's instructions. All access and service doors and covers shall be closed and properly fastened when the arc-welding equipment is in operation. The arc-welding equipment shall 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 shall be adjusted and maintained in accordance with the manufacturer's instructions.

5.3.3 Welding cables

The welding cables shall be kept as short as possible and shall be positioned as close as possible to each other, running at or close to the floor level. The welding cables shall never be coiled during welding.

5.3.4 Equipotential bonding

Bonding of all metallic objects in the surrounding area should be considered for the purpose of reducing emissions. However, metallic objects bonded to the **workpiece** 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 shall be insulated from all such bonded metallic objects.

5.3.5 Earthing of the workpiece

Where the **workpiece** is not bonded to earth for electrical safety, a connection bonding the **workpiece** to earth can 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 in accordance with national and local regulations.

5.3.6 Screening and shielding

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

6 Electromagnetic fields (EMF)

6.1 General

Electric current flowing through any conductor causes localized electric and magnetic fields (EMF). All welders should use the following procedures in order to minimize the risk associated with exposure to EMFs from the **welding circuit**:

– route the welding cables together – secure them with tape when possible;

– place your body as far away as possible from the **welding circuit**;

– never coil welding cables around your body;

– do not place your body between welding cables. Keep both welding cables on the same side of your body;

– connect the return cable to the **workpiece** as close as possible to the area being welded;

– do not work next to, sit or lean on the welding power source;

– do not weld whilst carrying the welding power source or **wire feeder**.

EMFs can also interfere with wearable medical devices and implants. Protective measures for persons with wearable medical devices and implants shall be taken. For example, access restrictions for passers-by or individual risk-evaluations for welders. Risk assessment and recommendation for users of wearable medical devices and implants shall be made by a medical expert.