BS EN 60974-4:2016

BSI Standards Publication

Arc welding equipment

Part 4: Periodic inspection and testing

bsi.

National foreword

This British Standard is the UK implementation of EN 60974-4:2016. It is identical to IEC 60974-4:2016. It supersedes BS EN 60974-4:2011 which is withdrawn.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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EUROPEAN STANDARD

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English Version

Arc welding equipment - Part 4: Periodic inspection and testing (IEC 60974-4:2016)

Matériel de soudage à l'arc - Partie 4: Inspection et essais périodiques
(IEC 60974-4:2016)

Lichtbogenschweißeinrichtungen - Teil 4: Wiederkehrende Inspektion und Prüfung
(IEC 60974-4:2016)

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Comité Européen de Normalisation Electrotechnique
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European foreword

The text of document 26/597/FDIS, future edition 3 of IEC 60974-4, prepared by IEC/TC 26 "Electric welding" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60974-4:2016.

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)	2017-05-25
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-08-25

This document supersedes EN 60974-4:2011.

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The text of the International Standard IEC 60974-4:2016 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

Publication	Year	Title	EN/HD	Year
IEC 60050-151	-	International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices	-	-
IEC 60050-195	-	International Electrotechnical Vocabulary (IEV) - Chapter 195: Earthing and protection against electric shock	-	-
IEC 60050-851	-	International Electrotechnical Vocabulary (IEV) - Part 851: Electric welding	-	-
IEC 60974-1	2012	Arc welding equipment - Part 1: Welding power sources	EN 60974-1	2012
IEC 60974-6	-	Arc welding equipment - Part 6: Limited duty equipment	EN 60974-6	-
IEC 61140	-	Protection against electric shock - Common aspects for installation and equipment	EN 61140	-
IEC 61557-4	-	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 4: Resistance of earth connection and equipotential bonding	EN 61557-4	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ARC WELDING EQUIPMENT –

Part 4: Periodic inspection and testing

FOREWORD

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International Standard IEC 60974-4 has been prepared by IEC technical committee 26: Electric welding.

This third edition cancels and replaces the second edition published in 2010. It constitutes a technical revision.

The main significant technical changes with respect to the previous edition are the following:

- With regard to basic standards the term "leakage current" has been replaced by "touch current" and "protective conductor current".
- Measurements of circuits connected in a non-galvanic way shall be tested according to the information of the manufacturer.
- The order of the chapters dealing with measurements to be carried out has been changed.
- The example test report in Annex B has been adapted.

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

FDIS	Report on voting
26/597/FDIS	26/603/RVD

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

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

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

In this standard, the following term types are used:

- *conformity statements: in italic type*.

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

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

ARC WELDING EQUIPMENT –

Part 4: Periodic inspection and testing

1 Scope

This part of IEC 60974 specifies test procedures for periodic inspection and, after repair, to ensure electrical safety. These test procedures are also applicable for maintenance.

This standard is applicable to power sources for arc welding and allied processes designed in accordance with IEC 60974-1 or IEC 60974-6. Stand-alone ancillary equipment designed in accordance with other parts of IEC 60974 may be tested in accordance with relevant requirements of this part of IEC 60974.

NOTE 1 The welding power source can be tested with any ancillary equipment fitted that can affect the test results.

This standard is not applicable to testing of new power sources or engine-driven power sources.

NOTE 2 For a power source not built in accordance with IEC 60974-1, see Annex C.

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 60050-151, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-195, *International Electrotechnical Vocabulary – Part 195: Earthing and protection against electric shock*

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

IEC 60974-1:2012, *Arc welding equipment – Part 1: Welding power sources*

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

IEC 61557-4, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the IEC 60050-151, the IEC 60050-195, the IEC 60050-851, the IEC 60974-1, as well as the following, apply.

3.1
expert
competent person
skilled person
a 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 may be taken into consideration in assessment of professional training.

[SOURCE: IEC 60974-1:2012, 3.3]

3.2
instructed person
person informed about the tasks assigned and about the possible hazards involved in neglectful behaviour

Note 1 to entry: If necessary, the person has undergone some training

[SOURCE: IEC 60974-1:2012, 3.4]

3.3
periodic inspection and test
examination carried out at specified intervals to reduce the risk of hazard

3.4
maintenance
service carried out at specified intervals to reduce the risk of hazard and failure

3.5
repair
restore to a safe and intended operating condition

3.6
test personnel
instructed person or expert that has been trained and authorized to perform periodic inspection and testing

4 General requirements

4.1 Qualification of test personnel

Tests of welding equipment can be hazardous and shall be carried out by an instructed person or expert in the field of electrical repair, preferably also familiar with welding, cutting and allied processes. Instructed persons should be considered qualified for simple periodic testing and maintenance provided the equipment enclosure does not have to be opened.

NOTE Hazardous voltages and currents inside the equipment enclosure can cause shock, burn or death. Only expert test personnel can open the equipment.

4.2 Test conditions

Tests shall be carried out at an ambient air temperature between 10 °C and 40 °C on dry and cleaned welding equipment.

4.3 Measuring instruments

The accuracy of measuring instruments shall be class 2.5 as a minimum, except for the measurement of insulation resistance, where the accuracy of the instruments is not specified but shall be taken into account for the measurement.

4.4 Periodic inspection and test

The periodic inspection and test specified in Table 1 shall be carried out.

Tests shall be documented in a test report in accordance with 7.1.

During the tests, complementary instructions from the manufacturer shall be followed.

4.5 Maintenance

The manufacturer's maintenance schedule and instructions shall be followed.

Tests shall be documented in a test report in accordance with 7.1.

4.6 Repair

After repair or replacement of a component which restores a welding or cutting function, an expert shall select appropriate tests to be carried out, as specified in Table 1.

NOTE After a minor repair such as replacement of a lamp, wheel or under carriage, the tests given in Table 1 may not be necessary.

Tests shall be documented in a test report in accordance with 7.1.

During the tests, complementary instructions from the manufacturer shall be observed (for example, circuit diagrams, spare part list, functional test of power source and ancillary equipment, etc.).

4.7 Test sequence

The test sequence is given in Table 1.

Table 1 – Test sequence on used arc welding equipment

Periodic inspection and test	After repair
a) Visual inspection in accordance with 5.1	a) Visual inspection in accordance with 5.1
b) Electrical test: – protective conductor resistance in accordance with 5.2 – insulation resistance in accordance with 5.3 (Optional: welding circuit touch current in accordance with 5.4, touch current in normal condition[b] in accordance with 5.5 and protective conductor current in accordance with 5.6)[a] – no-load voltage in accordance with 5.7	b) Electrical test: – protective conductor resistance in accordance with 5.2 – insulation resistance in accordance with 5.3 (Optional: welding circuit touch current in accordance with 5.4, touch current in normal condition[b] in accordance with 5.5 and protective conductor current in accordance with 5.6)[a] – no-load voltage in accordance with 5.7
c) Functional test: – no requirement	c) Functional test: – function in accordance with 6.1 – supply-circuit on/off switching device in accordance with 6.2 – voltage-reducing device in accordance with 6.3 – magnetic gas valve in accordance with 6.4 – signal and control lamps in accordance with 6.5
d) Documentation in accordance with Clause 7	d) Documentation in accordance with Clause 7

[a] If the insulation resistance test cannot be carried out for without disconnection of any component of the equipment to be tested (e.g. interference suppression networks, protection capacitors or surge protection component), the insulation resistance test may be replaced by the optional tests specified in item b).

[b] Only if there are accessible conductive surfaces not connected to the protective circuit.

5 Protection against electrical shock

5.1 Visual inspection

Visual inspection shall be carried out in accordance with the conditions of use of welding equipment and the manufacturer's instructions.

An example of items for a visual inspection is given in Annex A.

5.2 Continuity of the protective circuit

For mains-powered welding equipment of protection class I, including ancillary equipment (for example, cooling system) having mains connecting cables up to a length of 5,0 m, the maximum measured protective conductor resistance shall not exceed 0,3 Ω.

For cables longer than 5,0 m, the permissible value of the protective conductor resistance is increased by 0,1 Ω per additional 7,5 m cable. The maximum permissible value of the protective conductor resistance is 1 Ω.

Conformity shall be checked by measuring the resistance between the protective conductor contact at the plug and exposed conductive parts with testing equipment according to IEC 61557-4.

During the measurement, the cables shall be bent, flexed or twisted along the whole length, especially in the vicinity of cable entries into the enclosure, in order to detect interruptions in the protective conductor.

5.3 Insulation resistance

The insulation resistance shall not be less than the values given in Table 2.

Table 2 – Insulation resistance

Measurement [a]			Resistance	Insulation
Supply circuit	to	welding circuit	5,0 MΩ	Double or reinforced
Welding circuit	to	protective circuit	2,5 MΩ	Basic
Supply circuit	to	protective circuit	2,5 MΩ	Basic
Supply circuit of Class II equipment	to	accessible surfaces [b]	5,0 MΩ	Double or reinforced

[a] Control circuits are tested together with this circuit to which they are galvanically connected. Accessible control circuits separated from all other circuits are tested according to the manufacturer's specification.

[b] For measurement to accessible non-conductive surfaces, such surfaces shall be considered to be covered by metal foil.

Conformity shall be checked by the stabilized measurement of the insulation resistance by application of a d.c. voltage of 500 V at room temperature.

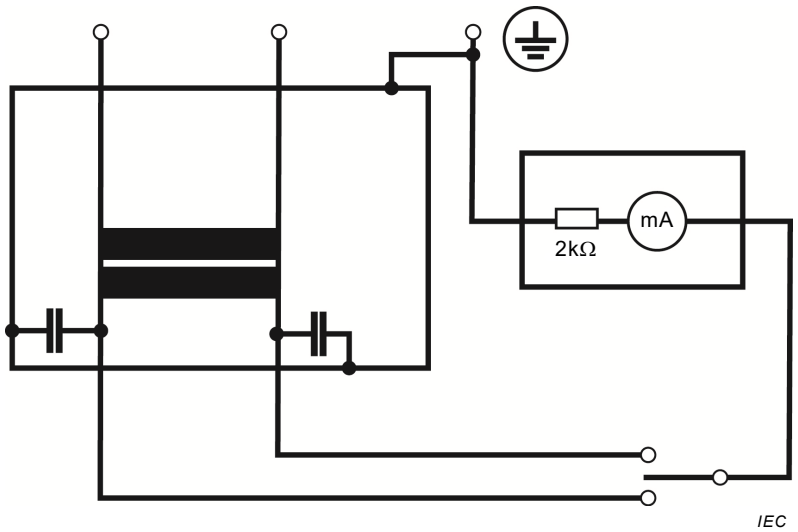
During the measurement, torches shall be disconnected, solid-state electronic components and their protective devices may be short-circuited, and liquid cooling units shall be tested without liquid.

5.4 Welding circuit touch current

The touch current between the welding circuit connections and the protective conductor terminal shall not exceed 10 mA r.m.s.

Conformity shall be checked by visual inspection and measurement of the touch current with a circuit as shown in Figure 1 at the rated supply voltage(s) and no-load condition.

The measuring network shall be connected as shown in Figure 1.



NOTE For class II equipment, use the PE-terminal of earthed supply network.

Figure 1 – Measurement of welding circuit touch current

5.5 Touch current in normal condition

The touch current for accessible conductive surfaces, not connected to the protective circuit, shall not exceed 0,5 mA r.m.s under normal conditions.

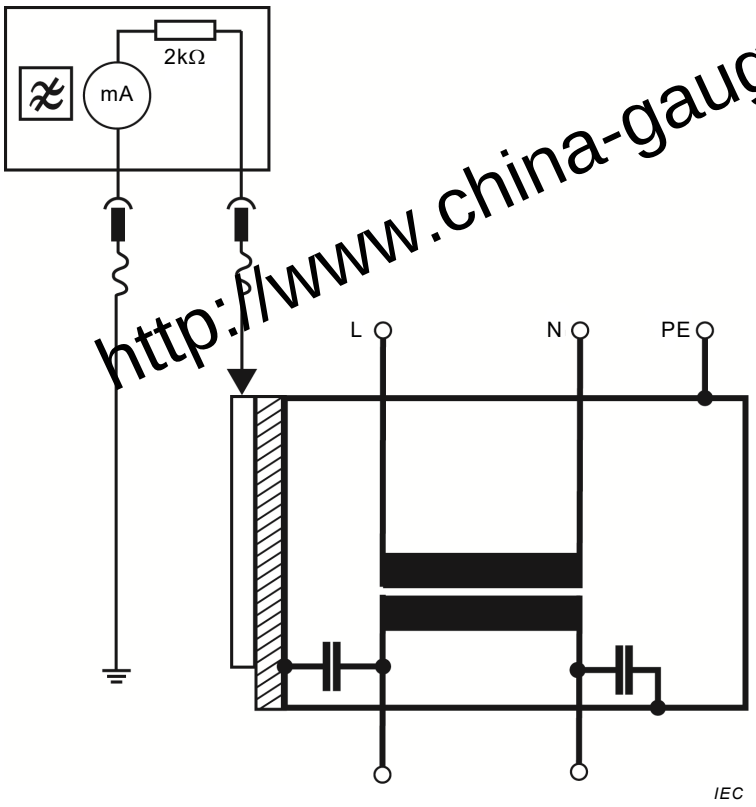


Figure 2 – Measurement of touch current in normal condition

Conformity shall be checked as shown in Figure 2.

a) The welding power source is:
   – isolated from the ground plane;
   – supplied by the highest rated supply voltage;
b) the welding circuit is in the no-load condition;
c) interference suppression capacitors are not disconnected.

5.6 Protective conductor current

For class 1 equipment, the protective conductor current shall not exceed 10 mA r.m.s except for equipment with permanent connection by a reinforced protective conductor in accordance with IEC 61140.

Equipment for permanent connection with a reinforced protective conductor may have a leakage current up to 5 % of the rated supply current per phase.

Conformity shall be checked using the measuring circuit as shown in Figure 3 under the following conditions:

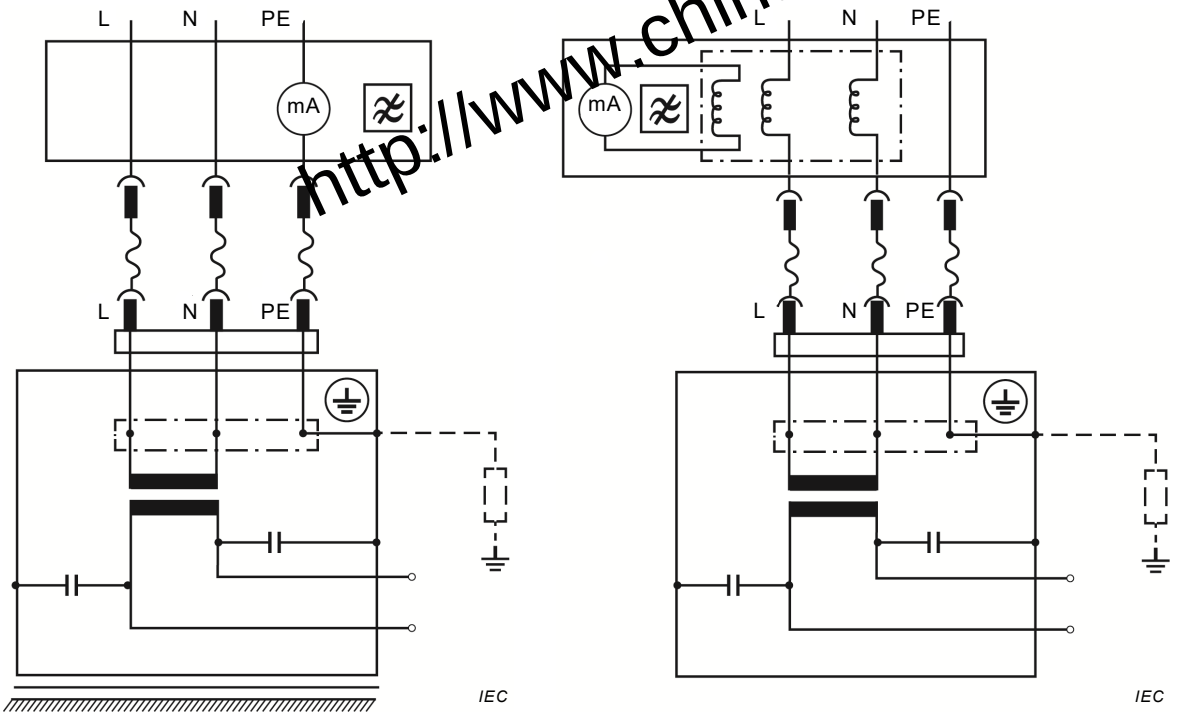
1) the welding power source is:
   – isolated from the ground plane;
   – supplied by the highest rated supply voltage;
   – not connected to the protective earth except through measurement components;

2) the welding circuit is in the no-load condition;

3) interference suppression capacitors shall not be disconnected.

The measurement of the protective conductor current may be performed directly or in the form of a difference current measurement (see Figure 3). The tolerance of the component values in the measurement circuit shall not exceed ±5 %.

Equipment for permanent connection with a reinforced protective conductor shall be tested according to the manufacturer's specification.



Principle of direct measurement

Principle of measurement according to the difference current procedure

Figure 3 – Principles of protective conductor current measurement for single phase equipment

NOTE Caution! This test is performed by a qualified person.

5.7 No-load voltage (U_0)

The peak values of the maximum no-load voltage at all possible settings of the power source should not be higher than ±15 % of no-load voltage U_0 and shall not exceed the values given in Table 13 of IEC 60974-1 when the power source is supplied at rated supply voltage and frequency.

Before testing, arc striking and stabilizing devices shall, if necessary, be removed or by-passed according to the manufacturer's instructions (see also instructions for use or manufacturer's testing instructions).

The no-load voltage is measured between welding output terminals. If this is not possible for safety or control reasons, the no-load voltage is measured between torch and welding return cable connection. This test is not required for plasma cutting power sources.

If rated reduced no-load voltage (U_R) or rated switched no-load voltage (U_S) are defined on the rating plate, U_R or U_S shall be measured instead of U_0.

Conformity shall be checked by measurement of

a) r.m.s. values

A true r.m.s. meter is used with a resistance of the external welding circuit of 5 kΩ.

b) peak values

To obtain reproducible measurements of peak values, omitting impulses which are not dangerous, a circuit as shown in Figure 4 is used.

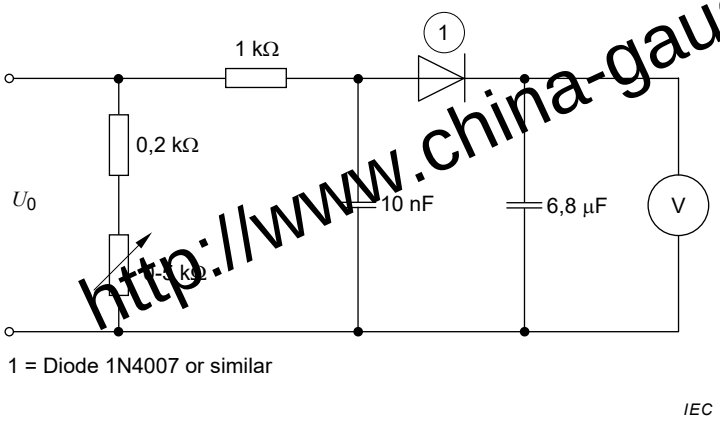


Figure 4 – Measurement of peak values

The voltmeter shall indicate mean values. The measurement range chosen shall be as near as possible to the actual value of the no-load voltage. The voltmeter shall have an internal resistance of at least 1 MΩ.

The tolerance of the component values in the measurement circuit shall not exceed ±5 %. The minimum power for the resistor of 0,2 kΩ is 65 W. The rheostat shall withstand a current value of 0,6 A. The capacitors shall have a minimum voltage rating of 200 V.

6 Functional test

6.1 Function

Each safety-related function judged as relevant by the test personnel shall be checked for correct operation.

Conformity shall be checked by operating the device and by checking whether the welding power source operates correctly.

6.2 Supply-circuit on/off switching device

Where an integral supply-circuit on/off switching device (for example, switch, contactor or circuit-breaker) is fitted, this shall:

a) open or close all ungrounded mains conductors;

b) clearly indicate whether the circuit is open or closed.

Conformity shall be checked by visual inspection and measurement.

6.3 Voltage-reducing device

Where a voltage-reducing device is fitted, it shall be checked for correct operation.

Conformity shall be checked by measurement of reduced no-load voltage (see 5.7) and visual inspection of indicator in load and no-load condition.

6.4 Magnetic gas valve

Each magnetic gas valve (for example, TIG, MIG/MAG, plasma power sources), shall be checked for correct operation.

Conformity shall be checked by visual inspection and the following operations or by a test specified by the manufacturer.

a) Function

Operate the trigger of the torch and check by means of the gas flow whether the magnetic gas valve operates.

b) Leakage

Pressurize the system and verify there is no leak, for example, there is no pressure drop.

NOTE Flexible gas tubes and their connections can be sources of leaks.

6.5 Signal and control lamps

Signal or control lamps shall be checked for correct operation if possible.

Conformity shall be checked by visual inspection.

7 Documentation

7.1 Test report

The test report shall include

a) identification of tested arc welding equipment;
b) date of testing;
c) supply voltage;
d) test results;
e) signature, identification of the test personnel and his organization;
f) identification of testing equipment.

The test report, after repair, shall include all the tests given in Table 1 and an indication shall be made if a particular test has not been carried out.

An example of a test report is given in Annex B.

7.2 Labelling

A label shall be attached to the equipment to indicate that it has passed the test.

The label shall state the date of testing or recommended date for next inspection depending on local regulation.

Annex A
(informative)

Check-list for the visual inspection

During visual inspection, the following listed items should be checked.

a) Torch/electrode holder, welding clamp
   - missing or defective insulation
   - defective connections
   - defective, damaged switches
   - other damage

b) Mains supply
   - defective, damaged cable
   - deformed, faulty plug
   - broken or thermally damaged plug pins
   - ineffective cable anchorage
   - cables and plugs unsuitable for the intended use and performance

c) Welding circuit
   - defective, damaged cable
   - deformed, faulty or thermally damaged coupler/sockets
   - ineffective cable anchorage
   - cables and couplers unsuitable for the intended use and performance

d) Enclosure
   - missing or damaged parts
   - unauthorized modifications
   - cooling openings blocked or missing air filters
   - signs of overload and improper use
   - missing or defective protective devices, for example, gas cylinder holder
   - missing or defective wheels, lifting means, holder, etc.
   - defective wire reel mounting means
   - conductive objects placed in the enclosure

e) Controls and indicators
   - defective switches, meters and lamps
   - defective pressure regulator or flowmeter
   - incorrect fuses accessible from outside the enclosure

f) General condition
   - excessive dust or pollution
   - cooling liquid circuit leaking or incorrect cooling liquid level
   - defective gas hoses and connections
   - poor legibility of markings and labelling
   - other damage or signs of improper use

Annex B
(informative)

Example of a test report after repair

Test report

Company: Sample Ltd.		Location: London Torchmarsh WH15 B4
Equipment: Arc welding power source	Type: Freefried	S/N: 123456
Manufacturer: Freefried Electric Ltd.		Protection class: I
Testing equipment: TESTDEVICE D6, Metaframe, measuring circuits as given in IEC 60974-4.		

Mains voltage		$U_{r.m.s}$	230				
Test point:		**Limit**	**Measured values**				
Visual inspection		---	OK				
Protective conductor resistance		---					
	R_{PE}	≤ 0,3 Ω	0,02 Ω				
Insulation resistance		---					
- Supply circuit/ Protective circuit (500 V)	R_{S-P}	≥ 2,5 MΩ	≥ 20 MΩ				
- Welding circuit, control circuit/ Protective circuit (500 V)	$R_{W,C-P}$	≥ 2,5 MΩ	≥ 20 MΩ				
- Supply circuit/ Welding circuit, control circuit (500 V)	$R_{S-W,C}$	≥ 5 MΩ	≥ 20 MΩ				
Protective conductor current[a]	I_{PE}	≤ 10 $mA_{r.m.s}$	2 mA				
Touch current in normal condition[a]	I_T	≤ 0,5 $mA_{r.m.s}$	0,04 mA				
- Equipment with reinforced protective conductor[a]	I_T	≤ 0,05 I_{1max} A	N/A				
Welding circuit touch current[a]							
	I_T	≤ 10 $mA_{r.m.s}$	0,056 mA				
No-load voltage		---					
With S mark	U_0	≤68 V_{peak}	N/A				
	U_0	≤113 V_{peak}	N/A				
Without S mark	U_0	≤113 V_{peak}	110 V				
	U_0	≤113 V_{peak}	N/A				
Functional test		---	ok				
Test passed			☒	☐	☐	☐	☐
Test personnel name		---	Myself				
Test personnel signature		---	Me				
Date		---	03-03-14				

Remarks (result of visual inspection or functional test): None

Testing company: Checkmates Limited

Address: London Weldshire WG3 A7

Repair: replacement of broken main switch

N/A: Not applicable to the repair according to the investigator

[a] optional measurements

Annex C
(informative)

Equipment not built in accordance with IEC 60974-1

Welding equipment not built in accordance with IEC 60974-1 (for example, built prior to the publication date of the first edition (1989)) may not meet all requirements of this standard.

In this case, the investigator should state in his report as follows:

- the requirements which have not been met;
- the extent to which the requirement has not been met;
- the assessment of the risk deriving there of;
- the corrective measures when necessary.

The report should enable the owner to make the appropriate decision regarding continued use of the equipment.

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