

BS EN 60974-3:2014



BSI Standards Publication

# Arc welding equipment

Part 3: Arc striking and stabilizing devices

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### National foreword

This British Standard is the UK implementation of EN 60974-3:2014. It is identical to IEC 60974-3:2013. It supersedes BS EN 60974-3:2007 which is withdrawn.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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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

# EN 60974-3

February 2014

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Supersedes EN 60974-3:2007

English version

Arc welding equipment -  
Part 3: Arc striking and stabilizing devices  
(IEC 60974-3:2013)

Matériel de soudage à l'arc -  
Partie 3: Dispositifs d'amorçage et de  
stabilisation de l'arc  
(CEI 60974-3:2013)

Lichtbogenschweißeinrichtungen -  
Teil 3: Lichtbogenzünd- und -  
stabilisierungseinrichtungen  
(IEC 60974-3:2013)

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

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

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

## Foreword

The text of document 26/518/FDIS, future edition 3 of IEC 60974-3, prepared by IEC/TC 26 "Electric welding" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60974-3:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-09-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-12-31

This document supersedes EN 60974-3:2007.

EN 60974-3:2014 includes the following significant technical changes with respect to EN 60974-3:2007:

- changes induced by the publication of IEC 60974-1:2012.

This standard is to be read in conjunction with EN 60974-1:2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

## Endorsement notice

The text of the International Standard IEC 60974-3:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated :

IEC 60974	NOTE	Harmonized in EN 60974 series (not modified).
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## 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 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 60974-1	2012	Arc welding equipment Part 1: Welding power sources	EN 60974-1	2012
IEC 60974-7	-	Arc welding equipment Part 7: Torches	EN 60974-7	-
IEC 61140	-	Protection against electric shock - Common aspects for installation and equipment	EN 61140	-

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## ARC WELDING EQUIPMENT –

### Part 3: Arc striking and stabilizing devices

#### 1 Scope

This part of IEC 60974 specifies safety requirements for industrial and professional arc striking and arc stabilizing devices used in arc welding and allied processes.

This part of IEC 60974 is applicable to stand-alone units which may be connected to a separate welding power source or one where the welding power source and the arc striking and arc stabilizing devices are housed in a single enclosure.

NOTE 1 Typical allied processes are for example plasma arc cutting and arc spraying.

NOTE 2 This standard does not include electromagnetic compatibility (EMC) requirements.

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

IEC 60974-7, *Arc welding equipment – Part 7: Torches*

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 IEC 60974-1 and IEC 60974-7, as well as the following, apply.

##### 3.1

##### **arc striking device**

device which superimposes a voltage on the welding circuit to ignite an arc

##### 3.2

##### **arc stabilizing device**

device which superimposes a voltage on the welding circuit to maintain an arc

##### 3.3

##### **arc striking voltage**

voltage superimposed on the no-load voltage to ignite an arc

##### 3.4

##### **arc stabilizing voltage**

voltage superimposed on the arc voltage to maintain the arc



### 3.5

#### **arc striking period**

period during which the arc striking voltage is superimposed on the no-load voltage

## 4 Environmental conditions

As specified in IEC 60974-1:2012, Clause 4.

## 5 Tests

### 5.1 Test conditions

As specified in 5.1 of IEC 60974-1:2012.

### 5.2 Measuring instruments

The accuracy of measuring instruments shall be as follows:

- a) electrical measuring instruments: class 1 ( $\pm 1$  % of full-scale reading), except for the measurement of insulation resistance and dielectric strength where the accuracy of the instruments is not specified, but shall be taken into account for the measurement;
- b) thermometer:  $\pm 2$  K;
- c) high-voltage probe:  $\pm 5$  %.

### 5.3 Conformity of components

As specified in 5.3 of IEC 60974-1:2012.

### 5.4 Type tests

As a condition of conformity, the type tests given below shall be carried out on stand-alone units in the following sequence with no drying time between f), g) and h):

- a) general visual inspection, as defined in 3.7 of IEC 60974-1:2012;
- b) insulation resistance, as specified in 6.1.4 of IEC 60974-1:2012 (preliminary check);
- c) enclosure, as specified in 14.2 of IEC 60974-1:2012;
- d) handling means, as specified in 14.3 of IEC 60974-1:2012;
- e) drop withstand, as specified in 14.4 of IEC 60974-1:2012;
- f) protection provided by the enclosure, as specified in 6.2.1 of IEC 60974-1:2012;
- g) insulation resistance, as specified in 6.1.4 of IEC 60974-1:2012;
- h) dielectric strength, as specified in 6.1.5 of IEC 60974-1:2012;
- i) general visual inspection, as defined in 3.7 of IEC 60974-1:2012.

Rated arc striking and stabilizing peak voltage shall be measured in accordance with 11.1 in any convenient sequence of type tests but before verifying mechanical provisions.

The other type tests included in this document and not listed here shall be carried out in any convenient sequence.

### 5.5 Routine tests

#### 5.5.1 Stand-alone unit

All routine tests shall be carried out on each stand-alone unit in the following sequence:

- a) general visual inspection (as defined in 3.7 of IEC 60974-1:2012);
- b) continuity of the protective circuit (as specified in Clause 10 and, if applicable, 10.5.1 of IEC 60974-1:2012);
- c) dielectric strength (as specified in 6.1.5 of IEC 60974-1:2012);
- d) high-voltage circuit test: working voltage shall be applied to high-voltage circuits to establish insulation integrity as specified by the manufacturer;

NOTE No-load voltage and connection of the return cable, either to the ground circuit or isolated, affects working voltage.

- e) general visual inspection (as defined in 3.7 of IEC 60974-1:2012).

### 5.5.2 Built-in unit

The following routine test shall be carried out on each built-in unit in any convenient sequence for the power source (as specified in 5.5 of IEC 60974-1:2012):

High-voltage circuit test: working voltage shall be applied to high-voltage circuits to establish insulation integrity as specified by the manufacturer.

NOTE No-load voltage and connection of the return cable, either to the ground circuit or isolated, affects working voltage.

## 6 Protection against electric shock

### 6.1 Insulation

#### 6.1.1 General

As specified in 6.1.1 of IEC 60974-1:2012.

#### 6.1.2 Clearances

The minimum clearances for high-voltage components shall be in accordance with Table 1. The minimum clearance for other components shall be in accordance with 6.1.2 of IEC 60974-1:2012.

*Conformity shall be checked by measurement and visual inspection.*

#### 6.1.3 Creepage distances

The minimum creepage distances for arc striking and stabilizing circuits shall be in accordance with Table 1. The minimum creepage distances for other components shall be in accordance with 6.1.3 of IEC 60974-1:2012.

*Conformity shall be checked by measurement and visual inspection.*

**Table 1 – Minimum clearances and creepage distances  
for arc striking and stabilizing circuits**

Rated peak voltage <sup>a</sup> kV	Clearance <sup>b</sup> mm	Creepage distance <sup>b</sup> mm
3	3	6,3
6	5,5	10
8	8	12,5
10	11	16
12	14	20
15	18	25
18	25	30
20	30	35
NOTE These values apply to circuits which are designed in accordance with 11.3.		
<sup>a</sup> Rated peak voltage shall be measured in accordance with 11.1.		
<sup>b</sup> Interpolation is allowed.		

#### 6.1.4 Insulation resistance

As specified in 6.1.4 of IEC 60974-1:2012.

#### 6.1.5 Dielectric strength

The output circuit of arc striking and stabilizing devices and the insulation of coupling components (for example, coupling transformers or coupling capacitors) shall withstand an arc striking test voltage 20 % higher than the rated peak arc striking voltage at the maximum pulse repetition rate of the device.

Alternatively, an a.c. test voltage with the same peak value of approximately sine waveform at 50 Hz or 60 Hz may be used for coupling components only. The maximum permissible setting of the tripping current shall be 100 mA. The high voltage transformer shall deliver the prescribed voltage up to the tripping current. Tripping is regarded as a flashover or a breakdown.

NOTE 1 For the operator's safety, the lowest setting of the tripping current (less than or equal to 10 mA) is typical.

*Conformity shall be checked by the following test.*

Coupling components intended for use with arc striking and stabilizing voltages shall be subjected to the arc striking test voltage or the a.c. test voltage for 60 s.

NOTE 2 Interference suppression capacitors are not coupling devices.

The output circuit shall be subjected to the arc striking test voltage for 60 s applied between the point of connection to the welding electrode and

- a) exposed conductive parts;
- b) other isolated circuits.

Flashover or breakdown shall not occur. Any discharges unaccompanied by a voltage drop (corona) are disregarded.

NOTE 2 Interference suppression capacitors are subjected to the test of the output circuit.

## 6.2 Protection against electric shock in normal service (direct contact)

As specified in 6.2 of IEC 60974-1:2012.

## 6.3 Protection against electric shock in case of a fault condition (indirect contact)

Stand-alone arc striking and stabilizing device shall be class I or class II equipment in accordance with IEC 61140, with the exception of the welding circuit.

The output circuit of the arc striking and stabilizing device shall be electrically isolated from the public supply system by double or reinforced insulation in accordance with the maximum rated input voltage. Figure A.1 shows examples of coupling systems for arc striking and stabilizing devices.

Internal conductors and connections shall be secured or positioned as specified in 6.3.3 of IEC 60974-1:2012.

For Class I stand-alone arc striking and stabilizing device, weighted touch current in the case of an external protective conductor failure or disconnection shall not exceed the value specified in 6.3.6 of IEC 60974-1:2012 when energized and not providing the arc striking and stabilizing voltage.

*Conformity shall be checked by visual inspection and by measurement.*

## 6.4 Protective provision

Connection of exposed conductive parts to the protective conductor is not required if the rated supply voltage is supplied by the welding circuit or SELV.

## 7 Thermal requirements

Current-carrying components, incorporated in the arc striking and stabilizing device, shall be capable of carrying the rated welding current as specified by the manufacturer without

- a) exceeding the temperature rating of the current-carrying components;
- b) causing the surface temperatures, specified in Table 7 of IEC 60974-1:2012, to be exceeded.

For liquid-cooled apparatus, the test shall be carried out with the minimum flow and the maximum temperature of the coolant, as recommended by the manufacturer.

*Conformity shall be checked by measurement in accordance with 7.2 of IEC 60974-1:2012.*

## 8 Thermal protection

If the arc striking and stabilizing device is designed for use with or built-in a specific welding power source, the thermal protection tests shall be carried out with the welding power source.

## 9 Abnormal operation

In the case of a stand-alone arc striking and stabilizing device the abnormal operation tests defined in Clause 9 of IEC 60974-1:2012 shall be carried out as applicable.

If the arc striking and stabilizing device is designed for use with a specific welding power source, the abnormal operation tests shall be conducted with the arc striking and stabilizing device connected to that welding power source.

The arc stabilizing device shall be short circuited at the output, with neither a torch nor a return cable connected, until equilibrium is achieved.

Arc striking and stabilizing devices protected internally, for example by automatic shut-off, meet this requirement if the protection device operates before an unsafe condition occurs.

## 10 Connection to the supply network

As specified in Clause 10 of IEC 60974-1:2012.

## 11 Output

### 11.1 Rated peak voltage

The rated peak voltage ( $U_p$ ) is obtained by subtraction of the no-load voltage ( $U_0$ ) from the measured peak voltage (see Figure 1). To determine the peak, the voltage shall be measured across a 220 pF capacitor with neither a torch nor a return cable connected.

When reported on the rating plate of arc striking and stabilizing devices, the rated peak voltage ( $U_p$ ) shall be equal to or greater than the measured peak voltage, but shall not exceed the maximum values given in Table 2.

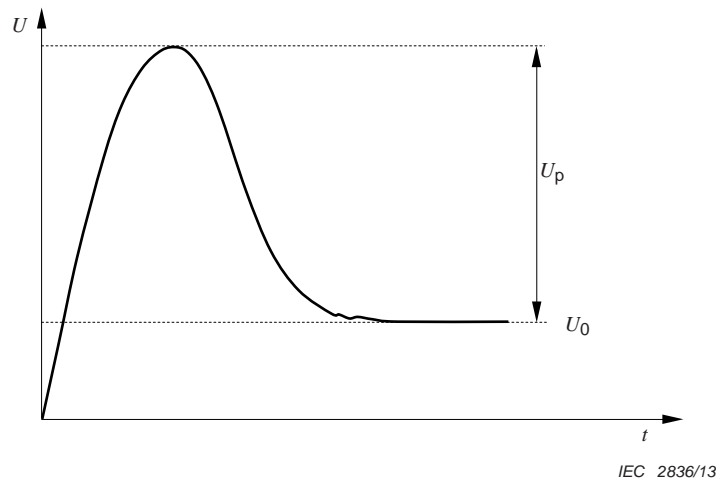


Figure 1 – Rated peak voltage

Table 2 – Maximum peak voltages

Type of torch	Peak voltage
Manually guided	15 kV
Mechanically guided or plasma cutting	20 kV

Conformity shall be checked by measurement with an oscilloscope and a high-voltage probe with sufficient bandwidth.

## 11.2 Impulse current

### 11.2.1 Risk of electric shock

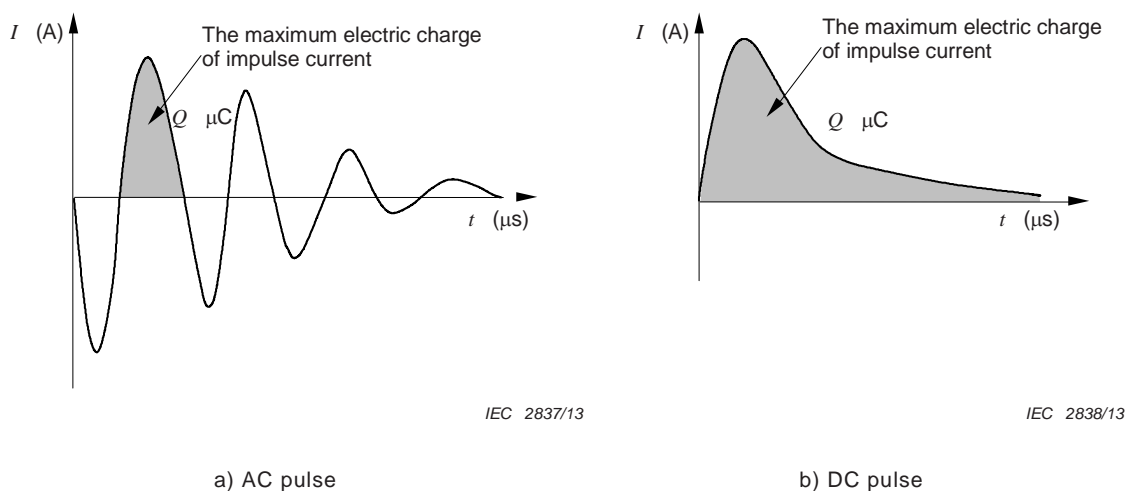
Depending on the design of an arc striking and stabilizing device, a risk of electric shock due to an impulse current can occur under the following situations:

- the human body is in direct contact with the output of the arc striking and stabilizing device (as specified in 11.2.3);
- the human body is in series with the arc gap as part of the welding circuit (as specified in 11.2.4).

### 11.2.2 Electric charge

The maximum electric charge in one half cycle of impulse current, regardless of polarity, shall not exceed (see Figure 2):

- 8  $\mu\text{C}$  for equipment intended to be used with manually guided torches;  
and
- 15  $\mu\text{C}$  for equipment intended to be used with mechanically guided torches and plasma cutting torches.



**Figure 2 – Measurement of electric charge of impulse current**

*Conformity shall be checked by measurement with an oscilloscope and a high-voltage probe with sufficient bandwidth.*

### 11.2.3 Direct contact

To simulate the torch capacitance, the value for  $C_T$  shall be

- 220 pF for equipment intended to be used with torches or return cables up to 10 m length;  
or
- 1 000 pF for equipment intended to be used with torches or return cables above 10 m length.

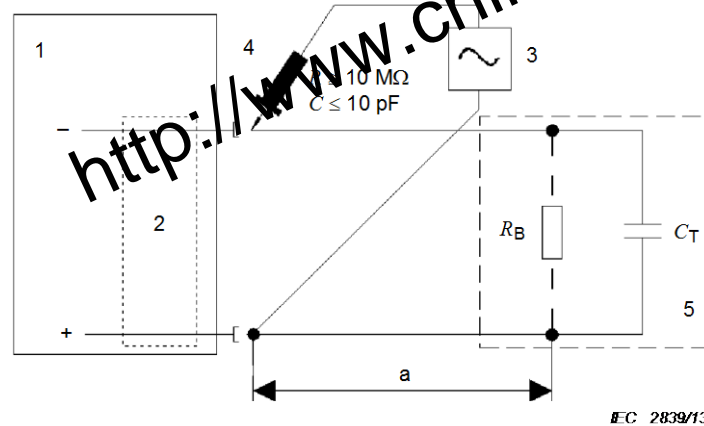
To simulate the body resistance, the value of a non-inductive resistor  $R_B$  shall be

- 1 k $\Omega$  for equipment intended to be used in environments without increased hazard of electric shock or with a mechanically guided torch;  
or

- 500  $\Omega$  for equipment intended to be used in environments with increased hazard of electric shock.

The value of the impulse current is obtained by dividing the value of the measured voltage by the value of the resistor  $R_B$ .

Conformity shall be checked by voltage measurement with an oscilloscope and a high-voltage probe with sufficient bandwidth, in a circuit as given in Figure 3, with neither a torch nor a return cable connected.



**Key**

- |   |                                     |   |                                      |
|---|-------------------------------------|---|--------------------------------------|
| 1 | Welding or cutting power source     | 4 | High-voltage probe                   |
| 2 | Arc striking and stabilizing device | 5 | Load as compact as possible          |
| 3 | Oscilloscope                        | a | Connection lead as short as possible |

**Figure 3 – Measuring circuit for direct contact**

#### 11.2.4 Series contact

The arc gap (6) (see Figure 4) shall be adjusted to the maximum distance at which flashover consistently occurs.

To simulate the torch capacitance, the value for  $C_T$  shall be

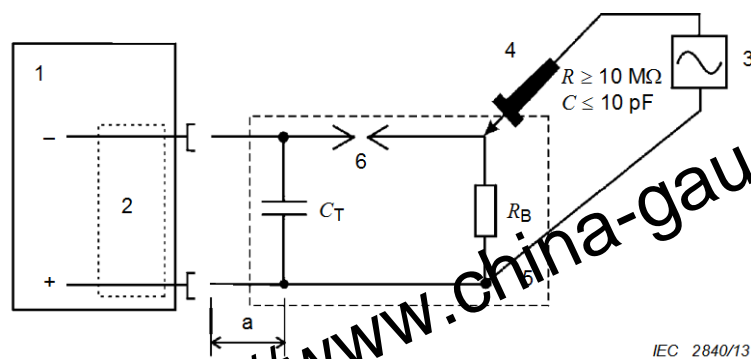
- 220 pF for equipment intended to be used with torches or return cables up to 10 m in length;
- or
- 1 000 pF for equipment intended to be used with torches or return cables above 10 m in length.

To simulate the body resistance, the value of a non-inductive resistor  $R_B$  shall be

- 1 k $\Omega$  for equipment intended to be used in environments without increased hazard of electric shock or with a mechanically guided torch;
- or
- 500  $\Omega$  for equipment intended to be used in environments with increased hazard of electric shock.

The value of the impulse current is obtained by dividing the value of the measured voltage by the value of the resistor  $R_B$ .

Conformity shall be checked by voltage measurement with an oscilloscope and a high-voltage probe with sufficient bandwidth, in a circuit as given in Figure 4, with neither a torch nor a return cable connected.

**Key**

- |   |                                     |   |                                      |
|---|-------------------------------------|---|--------------------------------------|
| 1 | Welding or cutting power source     | 5 | Load as compact as possible          |
| 2 | Arc striking and stabilizing device | 6 | Arc gap                              |
| 3 | Oscilloscope                        | a | Connection lead as short as possible |
| 4 | High-voltage probe                  |   |                                      |

**Figure 4 – Measuring circuit for serial contact****11.3 Mean energy**

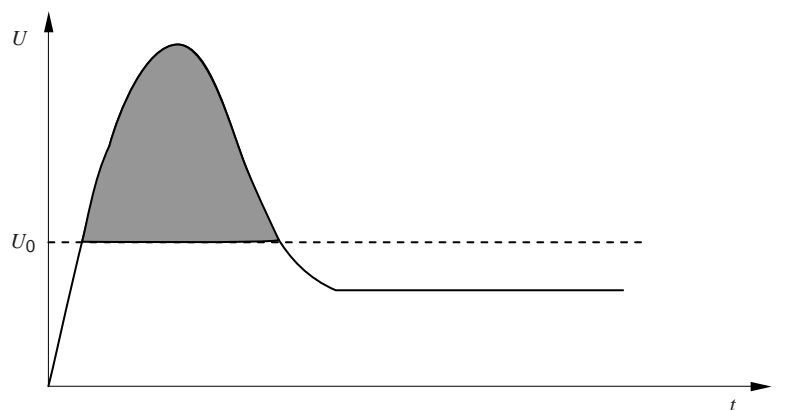
The mean energy generated by arc striking and stabilizing devices in a non-inductive resistor, simulating the body resistance shall not exceed during each period of 1 s

- 4 J for equipment intended to be used with manually guided welding torches;  
and
- 20 J for equipment intended to be used with mechanically guided and all plasma cutting torches.

*Conformity shall be checked by testing in accordance with 11.2.*

Arc striking and stabilizing devices with a mean energy below 4 J are considered as energy limited for all parts of IEC 60974.

The arc striking and stabilizing voltage is obtained by subtraction of the no-load voltage given in Table 13 of IEC 60974-1:2012 (see Figure 5).

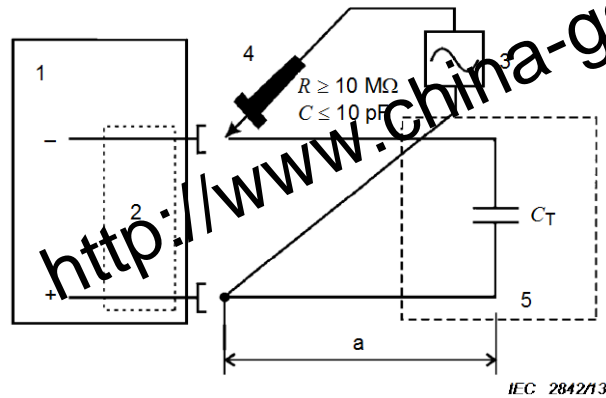
**Figure 5 – Measurement of mean energy**



#### 11.4 Output circuit capacitance discharging

One second after the arc striking and stabilizing device output is cut off or disabled, the output voltage shall not exceed 113 V d.c.

Conformity shall be checked by measurement of the voltage in a circuit as indicated in Figure 6 by an oscilloscope and a high-voltage probe.



#### Key

- |   |                                     |   |                                      |
|---|-------------------------------------|---|--------------------------------------|
| 1 | Welding or cutting power source     | 4 | High-voltage probe                   |
| 2 | Arc striking and stabilizing device | 5 | Load as compact as possible          |
| 3 | Oscilloscope                        | a | Connection lead as short as possible |

Figure 6 – Measuring circuit for capacitance discharging

To simulate the torch capacitance, the value for  $C_T$  shall be

- 220 pF for equipment intended to be used with torches or return cables up to 10 m in length;
- or
- 1 000 pF for equipment intended to be used with torches or return cables above 10 m in length.

## 12 Control circuits

As specified in Clause 12 of IEC 60974-1:2012.

## 13 Hazard reducing device

Not applicable.


## 14 Mechanical provisions

Only applicable for stand-alone unit as specified in Clause 14 of IEC 60974-1:2012.

## 15 Rating plate

A clearly and indelibly marked rating plate shall be fixed securely to, or printed on, each stand-alone arc striking and stabilizing device with the following minimum information (see Figure 7 and for examples see Figure B.1):

- 1) name and address of the manufacturer and, if required, distributor, importer, trade mark and country of origin;

- 2) type (identification) as given by the manufacturer;
- 3) traceability of design and manufacturing data, for example, serial number;
- 4) reference to IEC 60974-3, confirming that the arc striking and stabilizing device conforms with its requirements;
- 5)  $U_p$  rated peak voltage;
- 6)  $X\%$  duty cycle, if applicable;
- 7)  $I_2$  rated welding current, if applicable;
- 8)  $U_1$  rated input voltage(s) and frequency;
- 9)  $I_1$  rated input current(s) at maximum load;
- 10) IP.. degree of protection, for example IP21 or IP23;
- 11)  symbol for protection class M, if applicable.

Conformity shall be checked by visual inspection.

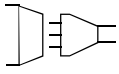
a) Identification			
1)		2)	
3)		4)	
b) Output			
5)			
6) $X$	6a)	6b)	6c)
7) $I_2$	7a)	7b)	7c)
c) Energy input			
	8)	9)	
10) Optional	11) If applicable		

Figure 7 – Rating plate

In the case of an internal arc striking and stabilizing device, box 5 shall be added to the rating plate of the power source (as specified in Clause 15 of IEC 60974-1:2012).

## 16 Adjustment of the output

As specified in Clause 16 of IEC 60974-1:2012.

## 17 Instructions and markings

### 17.1 Instructions

As specified in 17.1 of IEC 60974-1:2012, with the addition of the following requirement.

The manufacturer shall state in the instructions

- the rated peak voltage;
- if the arc striking and stabilizing device is designed for manual or mechanically guided operation.

If the use of longer torch or return cables increases the risk of electric shock (limits are specified in Clause 11) due to an impulse current, the manufacturer shall specify the maximum length (in m) and a torch type. The following warning shall be given:

**Warning:** Increasing the length of torch or return cables more than manufacturer maximum specified length will increase the risk of electric shock.

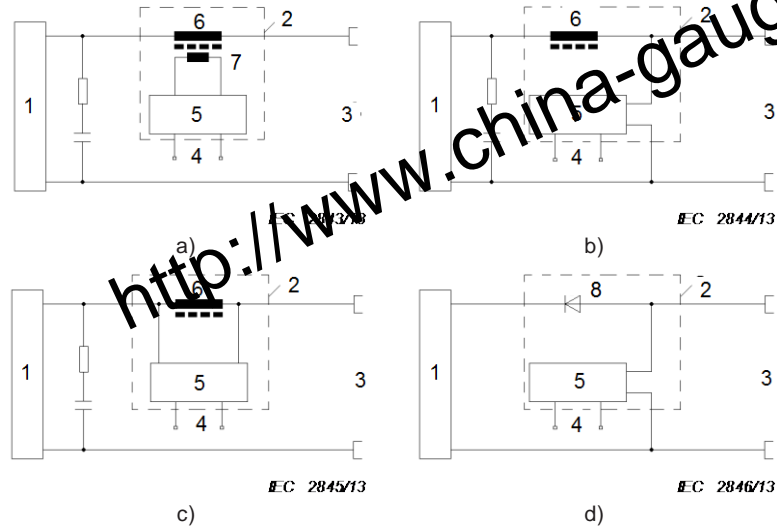
#### 17.2 Markings

Only applicable for stand-alone units, as specified in 17.2 of IEC 60974-1:2012.

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### Annex A (informative)

#### Examples of coupling systems for arc striking and stabilizing devices



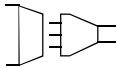
**Key**

- |   |                                     |   |                        |
|---|-------------------------------------|---|------------------------|
| 1 | Welding or cutting power source     | 5 | Voltage generator      |
| 2 | Arc striking and stabilizing device | 6 | Choke                  |
| 3 | Output                              | 7 | Input coupling winding |
| 4 | Voltage supply                      | 8 | Blocking diode         |

**Figure A.1 – Examples of coupling systems for arc striking and stabilizing devices**

**Annex B**  
(informative)

**Example of a rating plate**

a) Identification					
1) Manufacturer			2) Type		
3) Serial number			4) IEC 60974-3		
b) Output					
5) $U_p = 8,5 \text{ kV}$					
6) X		6a) 35 %	6b) 60 %		6c) 100 %
7) $I_2$		7a) 300 A	7b) 220 A		7c) 180 A
c) Energy input					
		8) $U_1 = 230 \text{ V}$		9) $I_1 = 0,5 \text{ A}$	
10) IP23		11)			

**Figure B.1 – Stand-alone unit**

## Bibliography

IEC 60974 (all parts), *Arc welding equipment*

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

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