



IEC 60974-13

Edition 2.0 2021-04  
REDLINE VERSION

# INTERNATIONAL STANDARD



Arc welding equipment –  
Part 13: Welding current return clamp

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ARC WELDING EQUIPMENT –

## Part 13: Welding current return clamp

## FOREWORD

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International Standard IEC 60974-13 has been prepared by IEC technical committee 26: Electric welding.

This second edition cancels and replaces the first edition, published in 2011, and constitutes a technical revision.

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

- Modified the title from "Welding clamp" to "Welding current return clamp" and updated the term through the document.
- Updated all values of test current in Table 1 corrected to 40 °C.
- Updated the reference to EN 50565-1:2014, *Electric cables – Guide to use for cables with a rated voltage not exceeding 450/750 V (U0/U) – Part 1: General guidance*

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## ARC WELDING EQUIPMENT –

### Part 13: Welding current return clamp

#### 1 Scope

This part of IEC 60974 is applicable to WELDING CURRENT RETURN CLAMPS for arc welding processes, designed to make an electrical connection to the workpiece without using tools.

This document is not applicable to WELDING CURRENT RETURN CLAMPS for underwater welding and plasma cutting.

This document specifies safety and performance requirements of WELDING CURRENT RETURN CLAMPS.

This document does not specify requirements for welding cables.

#### 2 Normative references

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IEC 60050-151:2001/AMD1:2013

IEC 60050-151:2001/AMD2:2014

IEC 60050-151:2001/AMD3:2019

IEC 60050-151:2001/AMD4:2020

IEC 60974-1:2017, *Arc welding equipment – Part 1: Welding power sources*

IEC 60974-1:2017/AMD1:2019

#### 3 Terms and definitions

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- IEC Electropedia: available at <http://www.electropedia.org/>
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##### 3.1

**WELDING CURRENT RETURN CLAMP**

**WORK CLAMP, US**

**RETURN CURRENT CLAMP, UK**

~~device-connecting~~ clamp that is attached to, or in contact with, the workpiece, to connect the welding return cable to the workpiece

[SOURCE: IEC 60050-851:2008, 851-14-36]

### 3.2

#### RATED CURRENT

current assigned by the manufacturer that the WELDING CURRENT RETURN CLAMP can accept at 60 % duty cycle without exceeding the permitted temperature rise

### 3.3

#### RETAINING MEANS

mechanical arrangement that holds the WELDING CURRENT RETURN CLAMP in position and prevents an unintentional withdrawal, when properly attached to the workpiece

## 4 Environmental conditions

The WELDING CURRENT RETURN CLAMP shall be capable of operation when the following environmental conditions prevail:

- a) range of ambient air temperature:
  - during operation:  $-10\text{ °C}$  to  $+40\text{ °C}$ ;
- b) relative humidity of the air: up to 50 % at  $40\text{ °C}$ ;  
up to 90 % at  $20\text{ °C}$ .

The WELDING CURRENT RETURN CLAMP shall withstand storage and transport at an ambient air temperature of

- $20\text{ °C}$  to  $+55\text{ °C}$  without any damage to function and performance.

## 5 Type Tests

### 5.1 Test conditions

All type tests shall be carried out on the same new and completely assembled WELDING CURRENT RETURN CLAMP.

All type tests shall be carried out at an ambient air temperature between  $10\text{ °C}$  and  $40\text{ °C}$ .

### 5.2 Measuring instruments

~~The accuracy of measuring instruments shall be:~~

- ~~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:  $\pm 2\text{ K}$ .~~

As specified in 5.2 of IEC 60974-1:2017.

### 5.3 Test sequence

The type tests given below shall be carried out in the following sequence:

- a) general visual inspection;
- b) temperature rise, see 8.1;
- c) RETAINING MEANS, see 9.1;
- d) drop withstand, see 9.4;
- e) voltage drop, see Clause 7.4;
- f) general visual inspection.

The other type tests in this document not mentioned above may be carried out in any convenient sequence.

## 6 Designation

The WELDING CURRENT RETURN CLAMP shall be designated by the range of cross-section area of the welding cable intended to be connected. The test current is given in Table 1 based on maximum cross-section area. The WELDING CURRENT RETURN CLAMP shall accept the minimum cross-sectional area as given in Table 1. Minimum cross-sectional area may be reduced to extend the WELDING CURRENT RETURN CLAMP fitting range.

**Table 1 – Relation between WELDING CURRENT RETURN CLAMP test current and welding cables cross-sectional area**

Range of cross-sectional area mm <sup>2</sup>	Welding clamp test current at 60 % duty cycle A	Welding clamp test current at 100 % duty cycle A
up to 6	80	70
6 to 10	125	87
10 to 16	150	117
16 to 25	200	157
25 to 35	250	196
35 to 50	300	248
50 to 70	400	309
70 to 95	500	374

NOTE – 100 % duty cycle test current values are based on cable current capacity given in Table 10 of HD 516 S2.

Range of cross-sectional area mm <sup>2</sup>	WELDING CURRENT RETURN CLAMP test current at 60 % duty cycle A	WELDING CURRENT RETURN CLAMP test current at 100 % duty cycle A
6 to 10	88	87
10 to 16	121	117
16 to 25	165	157
25 to 35	211	196
35 to 50	275	248
50 to 70	351	309
70 to 95	433	374
95 to 120	511	435
120 to 150	599	505
150 to 185	693	579
185 to 240	824	679

NOTE 60 % and 100 % duty cycle test current values are based on cable current capacity given in Table D.4 of EN 50565-1:2014 corrected for an ambient temperature of 40 °C.

Conformity shall be checked by measurement.

## 7 Protection against electric shock – Voltage drop

### 7.1 ~~Voltage drop~~

The WELDING CURRENT RETURN CLAMPS in the new condition shall be capable of satisfactorily passing the voltage test.

Conformity shall be checked by the following test:

Two WELDING CURRENT RETURN CLAMPS are required for this test. Connect each clamp to a cable of maximum cross-sectional area as indicated in Table 1, by using the method of attachment for which the clamps are designed. Attach one clamp to each end of a clean mild steel plate 300 mm × 75 mm × 12 mm. The two clamps shall be positioned so that the centers of the contact points are 260 mm ±20 mm apart. Connect the other end of the cables to a power source to form a circuit. Pass the test current through both clamps and the plate. The voltage is measured on the two cables, at a distance of 10 mm ~~away~~ from the ~~clamps~~ cable connections. The voltage drop shall not exceed 0,08 V per 100 A of the test current.

### 7.2 ~~Protection of live parts~~

~~The welding clamp can be either protected against unintentional contact with the workpiece or not protected.~~

~~Conformity shall be checked by visual inspection.~~

## 8 Thermal rating

### 8.1 Temperature rise

The temperature rise caused by the current passing through a WELDING CURRENT RETURN CLAMP normally coupled and fitted with an untinned copper welding cable of maximum cross-sectional area as indicated in Table 1 shall not exceed:

- at the hottest spot of the external surface normally gripped by the operator: ~~30~~ 40 K;
- at the connection of the welding cable to the WELDING CURRENT RETURN CLAMP: 45 K.

NOTE These values are temperature rises in relation to the ambient air temperature (maximum 40 °C).

Conformity shall be checked by the following test:

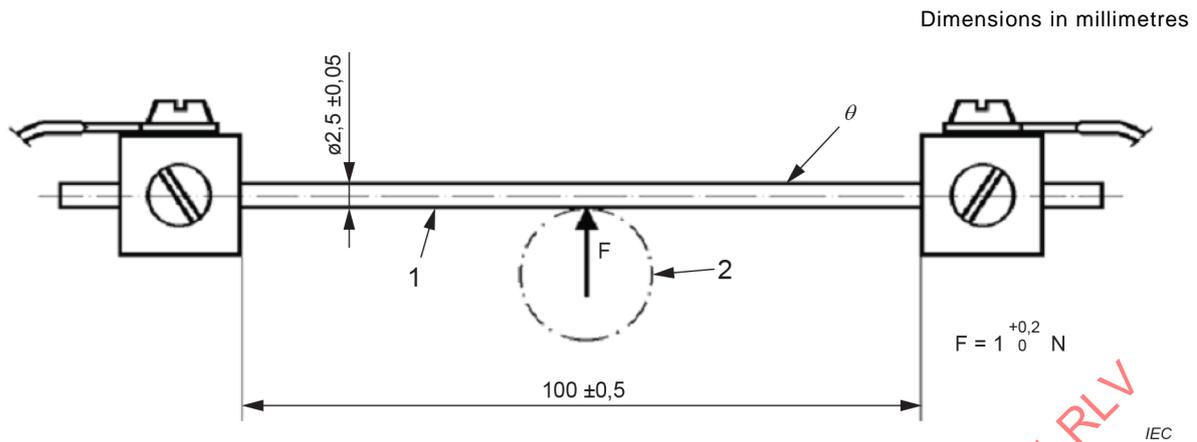
Voltage drop set-up given in Clause 7 is used for this test. Before beginning the test, pass the test current through the WELDING CURRENT RETURN CLAMP for a period of 1 h. Allow the WELDING CURRENT RETURN CLAMP to cool to ambient temperature.

A DC current equal to the 100 % duty cycle test current given in Table 1 is passed through the WELDING CURRENT RETURN CLAMP until the rate of the temperature rise does not exceed 2 K/h. During the total test time, the DC current shall be kept constant with a tolerance of ± 2 %.

### 8.2 Resistance to hot objects

In the case of insulated WELDING CURRENT RETURN CLAMP, the insulation shall be capable of withstanding hot objects and the effects of a normal amount of weld spatter without being ignited.

Conformity shall be checked with a device in accordance with Figure 1.



### Key

- 1 18/8 chrome-nickel steel
- 2 WELDING CURRENT RETURN CLAMP
- $\theta$  test temperature

**Figure 1 – Device for testing the resistance to hot objects**

An electric current (of approximately 25 A) is passed through the rod until a steady-state temperature  $\theta$  of  $\geq 300 \text{ }_0^{+5} \text{ }^\circ\text{C}$  is reached. During the test, the temperature of the heated rod shall be maintained. This temperature will be measured by a contact thermometer or thermocouple.

The heated rod in a horizontal position is then applied for 2 min to the insulation. The heated rod shall not penetrate through the insulation and contact live parts.

An attempt is made to ignite any gases which may be emitted in the region of the contact point by means of an electric spark or small flame. If the gases are flammable, the burning shall stop as soon as the heated rod is removed.

## 9 Mechanical requirements

### 9.1 RETAINING MEANS

A WELDING CURRENT RETURN CLAMP shall be designed to maintain ~~efficient~~ sufficient electrical contact in normal service and to prevent the unintentional separation of the WELDING CURRENT RETURN CLAMP as a result of a longitudinal pull.

Where springs are incorporated in the WELDING CURRENT RETURN CLAMP, they shall not constitute part of the current path unless they are permanently by-passed by a fixed conductor capable of carrying the test current given in Table 1.

*Conformity shall be checked by visual inspection and the following test:*

A WELDING CURRENT RETURN CLAMP is fitted in accordance with the manufacturer's instructions, with a welding cable of maximum cross-sectional area 5 m length and its coupling device. The welding cable is folded to form a bundle not exceeding 0,4 m in length. The ~~welding~~ clamp is attached to a clean mild steel plate 3 mm thick. The steel plate is ~~hanged in order~~ positioned such that the cable bundle applies a vertical longitudinal ~~strength~~ force on the ~~welding~~ clamp ~~during~~ for 1 min.

Test is passed if the WELDING CURRENT RETURN CLAMP remains attached to the steel plate.

## 9.2 Welding cable entry

The cable entries of the WELDING CURRENT RETURN CLAMP shall be designed so as to prevent damage to the cable due to flexing.

*Conformity shall be checked by visual inspection.*

## 9.3 Welding cable connection

The design of the WELDING CURRENT RETURN CLAMP shall be such that welding cables with a cross-sectional area within the range as specified by the manufacturer can be replaced. The connection shall withstand the mechanical stress of the following tensile test without separation. A ~~welding~~ clamp may be provided with adaptor to enlarge the fitting range.

*Conformity shall be checked by visual inspection and by the following test:*

A WELDING CURRENT RETURN CLAMP is fitted in accordance with the manufacturer's instructions, with a welding cable of maximum cross-sectional area. The connection is subjected to 10 pulls with a force of 40 N per mm<sup>2</sup> of the cross-sectional area with a maximum of 2 000 N applied to the welding cable. The force of each pull is gradually increased from zero to the specified value in 1 s and maintained for 1 s.

After the test, the conductor shall not have been ~~noticeably~~ displaced by more than 2 mm.

This test shall be repeated with a welding cable having the minimum permissible cross-sectional area as specified by the manufacturer.

If more than one method of cable fixing is provided, all methods shall be tested.

## 9.4 Drop withstand

The WELDING CURRENT RETURN CLAMP shall be capable of withstanding a drop test without impairing the mechanical functioning.

*Conformity shall be checked by the following test, manual operation and visual inspection.*

Lift the WELDING CURRENT RETURN CLAMP without any cable fitted to a height of 5 m above a 10 mm thick steel plate, release without initial velocity and allow to fall on the steel plate. ~~With the clamp in various initial attitudes, carry out this procedure 10 times.~~ Repeat this procedure 10 times with the clamp in various initial orientations to ensure each side and edge is tested.

## 10 Marking

The following information shall be legibly and indelibly marked on a WELDING CURRENT RETURN CLAMP:

- a) name of the manufacturer, distributor, importer or the registered trademark;
- b) RATED CURRENT;
- c) maximum permissible cross-sectional area of the welding cable;
- d) minimum permissible cross-sectional area of the welding cable;
- e) reference to this document, confirming that the WELDING CURRENT RETURN CLAMP complies with the requirements.

*Conformity shall be checked by ~~reading the marking~~ visual inspection.*

## 11 Instructions for use

Each WELDING CURRENT RETURN CLAMP shall be delivered with an instruction sheet which includes the following information:

- a) correct coupling and uncoupling of the WELDING CURRENT RETURN CLAMP;
- b) correct connection of the welding cable;
- c) choice of welding cable, type and size;
- d) relation of permissible current and duty cycle.

Conformity shall be checked by ~~reading the instructions~~ visual inspection.

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## Bibliography

~~HD 516 S2:1997, Guide to use low voltage harmonized cables~~

IEC 60050-851:2008, *International Electrotechnical Vocabulary (IEV) – Part 851: Electric welding*

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**WELDING CURRENT RETURN CLAMP**

**WORK CLAMP, US**

**RETURN CURRENT CLAMP, UK**

clamp that is attached to, or in contact with, the workpiece, to connect the welding return cable to the workpiece

[SOURCE: IEC 60050-851:2008, 851-14-36]

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#### RATED CURRENT

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### 3.3

#### RETAINING MEANS

mechanical arrangement that holds the WELDING CURRENT RETURN CLAMP in position and prevents an unintentional withdrawal, when properly attached to the workpiece

## 4 Environmental conditions

The WELDING CURRENT RETURN CLAMP shall be capable of operation when the following environmental conditions prevail:

- a) range of ambient air temperature:
  - during operation: –10 °C to +40 °C;
- b) relative humidity of the air: up to 50 % at 40 °C;  
up to 90 % at 20 °C.

The WELDING CURRENT RETURN CLAMP shall withstand storage and transport at an ambient air temperature of

- 20 °C to + 55 °C without any damage to function and performance.

## 5 Tests

### 5.1 Test conditions

All type tests shall be carried out on the same new and completely assembled WELDING CURRENT RETURN CLAMP.

All type tests shall be carried out at an ambient air temperature between 10 °C and 40 °C.

### 5.2 Measuring instruments

As specified in 5.2 of IEC 60974-1:2017.

### 5.3 Test sequence

The type tests given below shall be carried out in the following sequence:

- a) general visual inspection;
- b) temperature rise, see 8.1;
- c) RETAINING MEANS, see 9.1;
- d) drop withstand, see 9.4;
- e) voltage drop, see Clause 7;
- f) general visual inspection.

The other type tests in this document not mentioned above may be carried out in any convenient sequence.

## 6 Designation

The WELDING CURRENT RETURN CLAMP shall be designated by the range of cross-section area of the welding cable intended to be connected. The test current is given in Table 1 based on maximum cross-section area. The WELDING CURRENT RETURN CLAMP shall accept the minimum cross-sectional area as given in Table 1. Minimum cross-sectional area may be reduced to extend the WELDING CURRENT RETURN CLAMP fitting range.

**Table 1 – Relation between WELDING CURRENT RETURN CLAMP test current and welding cables cross-sectional area**

Range of cross-sectional area mm <sup>2</sup>	WELDING CURRENT RETURN CLAMP test current at 60 % duty cycle A	WELDING CURRENT RETURN CLAMP test current at 100 % duty cycle A
6 to 10	88	87
10 to 16	121	117
16 to 25	165	157
25 to 35	211	196
35 to 50	275	248
50 to 70	351	309
70 to 95	433	374
95 to 120	511	435
120 to 150	599	505
150 to 185	693	579
185 to 240	824	679

NOTE 60 % and 100 % duty cycle test current values are based on cable current capacity given in Table D.4 of EN 50565-1:2014 corrected for an ambient temperature of 40 °C.

*Conformity shall be checked by measurement.*

## 7 Protection against electric shock – Voltage drop

The WELDING CURRENT RETURN CLAMPS in the new condition shall be capable of satisfactorily passing the voltage test.

*Conformity shall be checked by the following test:*

Two WELDING CURRENT RETURN CLAMPS are required for this test. Connect each clamp to a cable of maximum cross-sectional area as indicated in Table 1, by using the method of attachment for which the clamps are designed. Attach one clamp to each end of a clean mild steel plate 300 mm x 75 mm x 12 mm. The two clamps shall be positioned so that the centers of the contact points are 260 mm ±20 mm apart. Connect the other end of the cables to a power source to form a circuit. Pass the test current through both clamps and the plate. The voltage is measured on the two cables, at a distance of 10 mm from the cable connections. The voltage drop shall not exceed 0,08 V per 100 A of the test current.