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आर्क वेल्डिंग उपकरण  
भाग 7 मशालें

**Arc Welding Equipment**  
Part 7 Torches

ICS 25.160.30

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## NATIONAL FOREWORD

This Indian Standard (Part 7) which is identical with IEC 60974-7 : 2019 'Arc welding equipment — Part 7: Torches' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on recommendation of the Electric Welding Equipment Sectional Committee and approval of the Electrotechnical Division Council.

This Indian Standard is published in several parts. The other parts in this series are:

- Part 1 Welding power sources
- Part 2 Liquid cooling systems
- Part 3 Arc striking and stabilizing devices
- Part 4 Periodic inspection and testing
- Part 5 Wire feeders
- Part 6 Limited duty equipment
- Part 8 Gas consoles for welding and plasma cutting systems
- Part 10 Electromagnetic compatibility (EMC) requirements
- Part 12 Coupling devices for welding cables

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 60529 Degrees of protection provided by enclosures (IP Code)	IS/IEC 60529 : 2001 Degrees of protection provided by enclosures (IP Code)	Identical with IEC 60529 : 2001
IEC 60695-11-10 Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods	IS/IEC 60695-11-10 : 2013 Fire hazard testing: Part 11 Test flames, Section 10 50 W Horizontal and vertical flame test methods	Identical with IEC 60695-11-10 : 2013

The technical committee has reviewed the provisions of the following international standard referred in this adopted standard and decided that they are acceptable for use in conjunction with this standard.

<i>International Standard</i>	<i>Title</i>
IEC 60974-1 : 2017	Arc welding equipment — Part 1: Welding power sources
ISO 21904-3 : 2018	Health and safety in welding and allied processes — Requirements, testing and marking of equipment for air filtration — Part 3: Determination of the capture efficiency of on-torch welding fume extraction devices

(Continued on third cover)

*Indian Standard*  
**ARC WELDING EQUIPMENT**  
**PART 7 TORCHES**

## **1 Scope**

This part of IEC 60974 specifies safety and construction requirements for TORCHES used for arc welding and allied processes. This document is applicable to MANUAL, MECHANICALLY GUIDED, AIR-COOLED, LIQUID-COOLED, MOTORIZED, SPOOL-ON and FUME EXTRACTION TORCHES.

In this document, a TORCH consists of the TORCH BODY, the CABLE-HOSE ASSEMBLY and other components.

This document is also applicable to a CABLE-HOSE ASSEMBLY connected between a power source and ancillary equipment.

This document is not applicable to electrode holders for manual metal arc welding or air-arc cutting/gouging.

NOTE 1 Typical allied processes are electric arc cutting and arc spraying.

NOTE 2 Other components are listed in Table A.1.

NOTE 3 In this document, all procedures and requirements are the same for "TORCHES" and "GUNS". For convenience, the term "TORCH" is used in the following text.

## **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 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

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

ISO 21904-3:2018, *Health and safety in welding and allied processes – Requirements, testing and marking of equipment for air filtration – Part 3: Determination of the capture efficiency of on-torch welding fume extraction devices*

## **3 Terms and definitions**

For the purposes of this document, the terms and definitions given in IEC 60974-1, as well as the following 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>

NOTE Additional terminology is given in Annex A.

### **3.1**

#### **torch**

device that conveys all services necessary to the arc for welding, cutting or allied processes (for example, current, gas, coolant, ELECTRODE WIRE)

[SOURCE: IEC 60050-851:2008, 851-14-21]

### **3.2**

#### **gun**

TORCH with a HANDLE substantially perpendicular to the TORCH BODY

[SOURCE: IEC 60050-851:2008, 851-14-22]

### **3.3**

#### **torch body**

main component to which the CABLE-HOSE ASSEMBLY and other components are connected

[SOURCE: IEC 60050-851:2008, 851-14-29]

### **3.4**

#### **handle**

part designed to be held in the operator's hand

[SOURCE: IEC 60050-851:2008, 851-14-28, modified – The statement “of a TORCH or an electrode holder” after the term is deleted.]

### **3.5**

#### **gas nozzle**

component at the exit end of the TORCH directing the shielding gas around the arc and over the weld pool

[SOURCE: IEC 60050-851:2008, 851-14-56]

### **3.6**

#### **wire electrode**

solid or tubular FILLER WIRE which conducts welding current

[SOURCE: IEC 60050-851:2008, 851-14-02]

### **3.7**

#### **contact tip**

replaceable metal component fixed at the front end of the TORCH, which transfers the welding current to, and guides, the WIRE ELECTRODE

[SOURCE: IEC 60050-851:2008, 851-14-17]

### **3.8**

#### **cable-hose assembly**

flexible assembly of cables and hoses, and their connecting elements, that delivers supplies to the TORCH BODY or ancillary equipment

[SOURCE: IEC 60050-851:2008, 851-14-34, modified – The definition is expanded to include ancillary equipment and the word “supplies” is used instead of “all necessary services”.

**3.9**  
**manual torch**

TORCH held and guided by the operator's hand during its operation

[SOURCE: IEC 60050-851:2008, 851-14-24]

**3.10**  
**mechanically guided torch**

TORCH fixed to, and guided by, a mechanical device during its operation

[SOURCE: IEC 60050-851:2008, 851-14-25]

**3.11**  
**air-cooled torch**

TORCH cooled by the ambient air and, where appropriate, by gas flow

**3.12**  
**liquid-cooled torch**

TORCH cooled by the circulation of a cooling liquid

**3.13**  
**motorized torch**

TORCH incorporating means to supply motion to the WIRE ELECTRODE

[SOURCE: IEC 60050-851:2008, 851-14-26]

**3.14**  
**spool-on torch**

MOTORIZED TORCH incorporating a FILLER WIRE supply

[SOURCE: IEC 60050-851:2008, 851-14-27]

**3.15**  
**arc striking and stabilizing voltage**

voltage superimposed on the welding circuit to initiate or maintain the arc or both

**3.16**  
**filler metal**

metal added during welding or allied processes

[SOURCE: IEC 60050-851:2008, 851-14-43]

**3.17**  
**filler wire**

FILLER METAL, in solid or tubular wire form, which may or may not be part of the welding circuit

[SOURCE: IEC 60050-851:2008, 851-14-44]

**3.18**  
**plasma tip**

component that provides the constricting orifice through which the plasma arc passes

[SOURCE: IEC 60050-851:2008, 851-14-18]

### 3.19

#### **visual inspection**

inspection by eye to verify that there are no apparent discrepancies with respect to the provisions of the standard concerned

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

### 3.20

#### **plasma cutting system**

combination of power source, TORCH, and associated devices for plasma cutting/gouging

[SOURCE: IEC 60050-851:2008, 851-13-03, modified – The word “safety” is deleted between the words “associated” and “devices”.]

### 3.21

#### **plasma cutting power source**

equipment for supplying current and voltage and having the required characteristics suitable for plasma cutting/gouging and which may supply gas and cooling liquid

Note 1 to entry: A PLASMA CUTTING POWER SOURCE may also supply services to other equipment and auxiliaries, for example auxiliary power, cooling liquid, and gas.

[SOURCE: IEC 60050-851:2008, 851-13-04, modified – The word “electric” is deleted before the word “current”.]

### 3.22

#### **torch coupling device**

part of TORCH connecting the CABLE-HOSE ASSEMBLY to the welding equipment

Note 1 to entry: A TORCH COUPLING DEVICE may include several connecting parts.

### 3.23

#### **fume extraction torch**

TORCH that incorporates means to capture the welding fumes

## 4 Environmental conditions

TORCHES 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  $20\text{ °C}$ .

TORCHES 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.

NOTE Different environmental conditions can be agreed upon between the manufacturer and the purchaser. Examples of these conditions are: high humidity, unusually corrosive fumes, steam, excessive oil vapour, abnormal vibration or shock, excessive dust, severe weather conditions, unusual coastal or shipboard conditions, vermin infestation and atmospheres conducive to the growth of mould.

## 5 Classification

### 5.1 General

TORCHES shall be classified in accordance with:

- a) the process for which they are designed, see 5.2;
- b) the method by which they are guided, see 5.3;
- c) the type of cooling, see 5.4;
- d) the method of striking the main arc for plasma processes, see 5.5.

### 5.2 Process

TORCHES can be designed for:

- a) MIG/MAG welding;
- b) self-shielded flux-cored arc welding;
- c) TIG welding;
- d) plasma welding;
- e) submerged arc welding;
- f) plasma cutting/gouging.

### 5.3 Guidance

Methods of TORCH guidance:

- a) manual;
- b) mechanical.

### 5.4 Cooling

Type of TORCH cooling method:

- a) ambient air or shielding gas, see 3.11;
- b) liquid, see 3.12.

### 5.5 Main arc striking for plasma processes

Methods for striking the main arc:

- a) by an arc striking voltage;
- b) by a pilot arc;
- c) by contact.

## 6 Test conditions

### 6.1 General

Tests shall be carried out on new and completely assembled TORCHES, fitted with the CABLE-HOSE ASSEMBLY normally supplied.

All tests shall be carried out at any ambient air temperature given in Clause 4, item a).

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) temperature measuring device:  $\pm 2$  K.

## **6.2 Type tests**

Unless otherwise specified, the tests in this document are type tests.

The type tests given below shall be carried out on the same sample and in the following sequence:

- a) general VISUAL INSPECTION;
- b) insulation resistance (preliminary check), see 7.2 without humidity treatment;
- c) impact resistance, see 11.1;
- d) resistance to hot objects, see Clause 10;
- e) protection against direct contact, see 7.4;
- f) insulation resistance, see 7.2;
- g) dielectric strength, see 7.3;
- h) requirements for ARC STRIKING AND STABILIZING VOLTAGE rating, see 7.5;
- i) general VISUAL INSPECTION.

The heating test in accordance with 8.3 may be carried out on a separate sample and shall be followed by the coolant leakage test in accordance with Clause 9. The other tests included in this document and not listed here may be carried out in any convenient sequence.

## **6.3 Routine tests**

The following routine tests shall be carried out on each TORCH in the following sequence:

- a) general VISUAL INSPECTION;
- b) functional test as specified by the manufacturer, for example, leaks of fluid or gas, trigger operation.

## **7 Protection against electric shock**

### **7.1 Voltage rating**

TORCHES shall be rated according to the classification and use as given in Table 1.



**Table 1 – Voltage rating of TORCHES**

Classification	Voltage rating $V_{peak}$	Insulation resistance M $\Omega$	Dielectric strength V RMS	Degree of protection in accordance with IEC 60529			
				NOZZLE orifice	HANDLE	TORCH COUPLING DEVICE <sup>a</sup>	Other parts <sup>b, c</sup>
Manually guided TORCHES except for plasma cutting	113	1	1 000	IP0X	IP3X	IP2X	IP3X
MECHANICALLY GUIDED TORCHES except for plasma cutting and submerged arc welding	141	1	1 000	IP0X	Not applicable	IPXX	IP2X
MECHANICALLY GUIDED submerged arc welding TORCHES	141	1	1 000	IP0X	Not applicable	IPXX	IPXX
Manually guided plasma cutting TORCHES	500	2,5	2 100	PLASMA TIP, see 7.4.2	IP4X	IP3X	IP3X
MECHANICALLY GUIDED plasma cutting TORCHES	500	2,5	2 100	IP0X	Not applicable	IP2X	IP2X
<sup>a</sup> Degree of protection for TORCH COUPLING DEVICE is tested while coupled. <sup>b</sup> Other parts are, for example, GAS NOZZLE, neck. <sup>c</sup> Wire drive systems of MOTORIZED TORCHES that are accessible to touch are not considered as other parts: IPXX.							

## 7.2 Insulation resistance

The insulation resistance of a new TORCH shall, after the humidity treatment, be not less than the values given in Table 1.

*Conformity shall be checked by the following test:*

### a) Humidity treatment

A humidity cabinet is maintained at a temperature  $t$  between 20 °C and 30 °C and a relative humidity between 91 % and 95 %.

The TORCH fitted with the CABLE-HOSE ASSEMBLY (LIQUID-COOLED TORCHES without cooling liquid) is brought to a temperature between  $t$  and  $(t + 4)$  °C and is then placed for 48 h in the humidity cabinet.

### b) Insulation resistance measurement

Immediately after the humidity treatment, the TORCH HANDLE and 1 m at each end of the CABLE-HOSE ASSEMBLY are wiped clean and tightly wrapped in a metal foil covering the external surface of the insulation.

The insulation resistance is measured by the application of a DC voltage of 500 V between

– all circuits and the metal foil,

and

– all wires and circuits intended to be isolated from each other within the TORCH.

The reading is made after stabilization of the measurement.

### 7.3 Dielectric strength

#### 7.3.1 General requirement

The insulation shall withstand the test voltages of Table 1 without any flashover or breakdown.

The AC test voltage shall be of an approximate sine waveform with a peak value not exceeding 1,45 times the voltage of Table 1, having a frequency of approximately 50 Hz or 60 Hz. Alternatively, a DC test voltage of 1,4 times the RMS test voltage may be used.

*Conformity shall be checked by the following test:*

LIQUID-COOLED TORCHES are tested without cooling liquid.

The HANDLES are tightly wrapped with a metal foil. The CABLE-HOSE ASSEMBLY is placed in contact with a conductive surface throughout its entire length, for example wrapped around a metal cylinder or coiled on a flat metal surface. The metal foil and the conductive surface are electrically connected.

The full value of the test voltage is applied for 60 s between:

- a) the conductive surface and each isolated circuit;
- b) all circuits intended to be isolated from each other (e.g. trigger or other remote control circuits).

At the discretion of the manufacturer, the test voltage may be slowly raised to the full value.

The maximum permissible setting of the overload release 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 breakdown.

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

#### 7.3.2 Additional requirements for plasma cutting TORCHES

In addition for manual plasma cutting TORCHES the insulation between the HANDLE and the cutting circuit shall withstand a test voltage of 3 750 V RMS. During the dielectric strength test of plasma cutting TORCHES, the electrode and PLASMA TIP connections shall be electrically connected together.

*Conformity shall be checked by the test given in 7.3.1.*

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

#### 7.4.1 Degree of protection requirements

TORCHES shall meet the degree of protection requirements of Table 1. In addition CABLE-HOSE ASSEMBLY shall meet the degree of protection IP 3X. TORCHES are not intended for operation during rain or snow or equivalent conditions.

*Conformity shall be checked in accordance with IEC 60529.*

#### 7.4.2 Additional requirements for plasma cutting TORCHES

The plasma cutting TORCH, parts (e.g. parts typically replaced due to wear) and PLASMA CUTTING POWER SOURCE, recommended by the manufacturer, shall form a safe system.

Additional requirements for plasma cutting TORCHES are given in 6.3.4 of IEC 60974-1:2017.

## 7.5 Requirements for ARC STRIKING AND STABILIZING VOLTAGE rating

### 7.5.1 General requirement

TORCHES intended for use with arc striking and stabilizing devices shall have an ARC STRIKING AND STABILIZING VOLTAGE rating.

For tungsten inert gas (TIG) and plasma arc welding TORCHES the rated ARC STRIKING and/or STABILIZING VOLTAGE shall be determined by the manufacturer.

For plasma cutting TORCHES, the rated ARC STRIKING and/or STABILIZING VOLTAGE shall be determined as follows:

- a) operate each power source expected to form a safe system (see item p) of Clause 13) according to manufacturer's recommendation, for example with proper consumables and gasses, and under single fault condition;
- b) measure the ARC STRIKING and/or STABILIZING VOLTAGE at each end of the TORCH;
- c) the highest value measured, from all power sources operated in item a), will be the rated ARC STRIKING and/or STABILIZING VOLTAGE.

### 7.5.2 ARC STRIKING AND STABILIZING VOLTAGE test

The TORCH insulation shall withstand a test voltage without flashover or breakdown. Corona discharges are permitted.

LIQUID-COOLED TORCHES may be tested without cooling liquid.

*Conformity shall be checked by the following test:*

The TORCH HANDLE is tightly wrapped with a metal foil. The cable and hose assembly is placed in contact with a conductive surface throughout its entire length, for example wrapped around a metal cylinder or coiled on a flat metal surface. The metal foil and the conductive surface are electrically connected.

A test voltage with a peak voltage 20 % higher than the rated ARC STRIKING AND STABILIZING VOLTAGE is applied for 2 s between the TORCH electrode and the conductive surface. Other isolated circuits may be connected to the TORCH electrode, the conductive surface or left isolated as specified by the manufacturer. The equipment manufacturer shall conduct a risk assessment of the other isolated circuitry and respective external parts.

Circuits other than the cutting circuit that leave the plasma cutting TORCH may be electrically connected to the electrode or isolated during this test, provided that the external parts of the other circuit have reinforced insulation to protect the operator. Additionally, the equipment manufacturer shall conduct an appropriate risk assessment and establish a set of measures which give sufficient protection against electric shock under single-fault conditions.

This test voltage is either:

- a) high-frequency voltage of pulse width between 0,2  $\mu$ s and 8  $\mu$ s, with a repetition frequency between 50 Hz and 300 Hz; or
- b) an AC test voltage with the same peak value of approximately sine waveform at 50 Hz or 60 Hz. 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 For the operator's safety, the lowest setting of the tripping current (less than or equal to 10 mA) is typical.

## 8 Thermal rating

### 8.1 General

MANUAL TORCHES shall be rated at a minimum of 100 % or 60 % or 35 % duty cycle.

MECHANICALLY GUIDED TORCHES shall be rated at a minimum of 100 % duty cycle.

FUME EXTRACTION TORCHES shall be rated at the extraction flow rate defined by the manufacturer.

### 8.2 Temperature rise

The temperature rise of MANUAL TORCHES, at any point on the outer surface of the part of the HANDLE gripped by the operator, shall not exceed 30 K.

The temperature rise of CABLE-HOSE ASSEMBLY, at any point on the outer surface, shall not exceed 40 K.

After completion of the tests, the safety and operability of the TORCH shall not be impaired.

*Conformity shall be checked by the heating test according to 8.3.*

### 8.3 Heating test

#### 8.3.1 General

The TORCHES shall be loaded with all rated currents at their corresponding rated duty cycles, see 8.1.

The mean value of the DC current shall be taken and the electrode polarity shall be chosen in accordance with 8.3.2 and 8.3.3.

The temperature shall be measured at the hottest spot on the area of the HANDLE, normally gripped by the operator for MANUAL TORCHES.

The temperature shall be measured at the hottest spot of CABLE-HOSE ASSEMBLY.

The temperature measuring device(s), HANDLE and CABLE-HOSE ASSEMBLY shall be protected from draughts and radiant heat.

The TORCH clamping device used shall not significantly affect the test result, for example by heat loss.

LIQUID-COOLED TORCHES shall be continuously cooled with the minimum flow rate and minimum cooling power as specified by the manufacturer (see item h) of Clause 13).

NOTE Cooling power is defined in IEC 60974-2.

Each heating test shall be carried out for a period of not less than 30 min and continued until the rate of temperature rise does not exceed 2 K/h.

The cycle time for test purposes shall be 10 min.

The ambient and TORCH temperature shall be measured simultaneously during the last 10 min in the case of continuous load (100 % duty cycle). For lower duty cycles, it shall be measured in the middle of the load period during the last cycle.

The ambient air temperature is measured by a device, located at a distance of 2 m, at the same height as the TORCH and shall be protected from draughts and radiant heat.

### 8.3.2 Metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding TORCH

A metal tube of a diameter and length appropriate to the welding process, for example 400 mm in diameter and 500 mm long, is horizontally clamped into a rotating device. The inside of the tube is cooled by some means, for example by water or air.

The TORCH shall be positioned in a plane perpendicular to the tube axis in such a way that the WIRE ELECTRODE is  $15_{-15}^0$ ° to the vertical (see Figure B.1). In addition, for manually guided TORCHES, the HANDLE shall be positioned on the cooler side.

The TORCH shall be moved parallel to the centre line of the tube in order to form a weld bead.

a) Test conditions for metal inert gas arc welding (MIG) of aluminium alloys are given below and in Table 2:

- WIRE ELECTRODE: aluminium, 3 % to 5 % magnesium;
- type of current: DC;
- electrode polarity: positive;
- shielding gas: argon;
- tube material: aluminium alloy;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

**Table 2 – Test values for metal inert gas arc welding (MIG) of aluminium alloys**

Welding current A	Nominal diameter of the WIRE ELECTRODE mm	Distance between CONTACT TIP and metal tube $\pm 20$ % mm	Maximum gas flow l/min
Up to 150	0,8	10	10
151 to 200	1	15	12
201 to 300	1,2	18	15
301 to 350	1,6	22	18
351 to 500	2	26	20
Above 500	2,4	28	20

b) Test conditions for metal active gas arc welding (MAG) of mild steel are given below and in Table 3:

- WIRE ELECTRODE: copper-coated mild (low carbon) steel;
- type of current: DC;
- electrode polarity: positive;
- shielding gas: argon/CO<sub>2</sub> mixed gas (15 % to 25 % CO<sub>2</sub>);
- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

If additional values for the shielding gas CO<sub>2</sub> are specified in the instructions for use, an additional test with this gas shall be carried out according to the test conditions given in Table 3.

**Table 3 – Test values for metal active gas arc welding (MAG) of mild steel**

Welding current	Nominal diameter of the WIRE ELECTRODE	Distance between CONTACT TIP and metal tube $\pm 20\%$	Maximum gas flow
A	mm	mm	l/min
Up to 150	0,8	10	10
151 to 250	1	15	13
251 to 350	1,2	18	15
351 to 500	1,6	22	20
Above 500	2	26	25

c) Test conditions for metal active gas arc welding (MAG) with flux-cored wire are given below and in Table 4:

- WIRE ELECTRODE: rutile type;
- type of current: DC;
- electrode polarity: positive;
- shielding gas: argon/CO<sub>2</sub> mixed gas (15 % to 25 % CO<sub>2</sub>);
- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

**Table 4 – Test values for metal active gas arc welding (MAG) with flux-cored wire**

Welding current	Nominal diameter of the WIRE ELECTRODE	Distance between CONTACT TIP and metal tube $\pm 20\%$	Maximum gas flow
A	mm	mm	l/min
251 to 350	1,2 to 1,4	25	15
351 to 500	1,6 to 2	30	18
Above 500	2,4	35	20

d) Test conditions for self-shielded flux-cored arc welding of mild steel are given below and in Table 5:

- WIRE ELECTRODE: type 1: a wire designed with a fast freezing slag for all-positional welding;  
type 2: a wire designed for high deposition rates in flat and horizontal vertical position welding;
- type of current: DC;
- electrode polarity: WIRE ELECTRODE type 1: negative;  
WIRE ELECTRODE type 2: positive;
- tube material: mild (low carbon) steel;
- load voltage and welding speed: adjusted to give a stable arc and a continuous weld pool.

**Table 5 – Test values for self-shielded flux-cored arc welding of mild steel**

Welding current A	Type of WIRE ELECTRODE	Nominal diameter of the electrode mm	Distance between CONTACT TIP and metal tube $\pm 20\%$ mm
Up to 250	1	Up to 1,2	20
251 to 350	2	1,6 to 2,0	50
351 to 500	2	2,4 to 3,0	50
Above 500	2	3,2 and more	60

### 8.3.3 Tungsten inert gas (TIG) and plasma arc welding TORCH

A copper block, with or without water cooling (see for example, Annex C), shall be used and the TORCH shall be positioned perpendicular to the upper horizontal face of the copper block (see Figures B.2 and B.3).

For plasma welding TORCHES, the shielding gas and the gas flow shall be as specified by the manufacturer in the instructions for use.

The testing installation shall be equipped with the instruments as shown in Figure A.6.

The nominal AC welding currents of a TORCH are defined as 70 % of the nominal DC value.

- a) Test conditions for tungsten inert gas arc welding (TIG) are given below and in Table 6:
- electrode type: tungsten alloy;
  - electrode diameter: maximum for the test current as recommended by the manufacturer;
  - type of current: DC;
  - electrode polarity: negative;
  - shielding gas: argon;
  - load voltage: adjusted to give a stable arc and a continuous weld pool.

**Table 6 – Test values for tungsten inert gas arc welding (TIG)**

Welding current A	Maximum gas flow l/min	Distance between nozzle and copper block $\pm 1\text{ mm}$ mm	Distance between electrode and copper block $\pm 1\text{ mm}$ mm
Up to 150	7	8	3
151 to 250	9	10	5
251 to 350	11	10	5
351 to 500	13	10	5
Above 500	15	10	5

- b) Test conditions for plasma welding are given below and in Table 7:

- type of current: DC;
- electrode polarity: negative;
- gases and gas flow: as specified by the manufacturer.

**Table 7 – Test values for plasma arc welding**

Welding current A	Distance between PLASMA TIP and copper block $\pm 1$ mm mm
Up to 30	3
31 to 50	3
51 to 100	3
101 to 150	4
151 to 200	6
201 to 250	8
251 to 280	8
Above 280	10

#### 8.3.4 Plasma cutting TORCH

The TORCH shall be tested:

- a) at the rated current with the corresponding rated duty cycle, see 8.1;
- b) with the type of gas and flow rate specified by the manufacturer;

and

- c) at the distance between PLASMA TIP and workpiece specified by the manufacturer with one of the following test arrangements:

- 1) copper block with a hole, according to Annex D or similar (suitable for use up to 75 A): the TORCH shall be positioned perpendicularly to the upper horizontal face of the copper block and centred to the hole;
- 2) copper bars with a slot, according to Annex E or similar (suitable for use up to 200 A): the TORCH shall be positioned perpendicularly to the upper horizontal face of the copper bars, centred between them and moved about 500 mm backwards and forwards;
- 3) cutting (suitable for all currents): the TORCH shall be positioned perpendicularly to a mild steel sheet or tube with the maximum thickness specified by the manufacturer for the rated current. The cutting speed shall be sufficient to cut through the material. In order to reduce scrap, it is permitted to arrange the cutting so that the arc indexes approximately one kerf width per pass.

For a duty cycle lower than 100 % there shall be a new start after each stop. All cuts shall start at the edge of the steel sheet;

- 4) other means that are shown to be equivalent to 1), 2) or 3) above.

#### 8.3.5 Submerged arc welding TORCH

A metal tube of a diameter and length appropriate to the welding process, for example 400 mm in diameter and 500 mm long, is horizontally clamped into a rotating device. The inside of the tube is cooled by some means, for example by water or air.

The TORCH shall be positioned in a plane perpendicular to the tube axis in such a way that the WIRE ELECTRODE is  $15_{-15}^0$ ° to the vertical (see Figure B.1). In addition, for manually guided TORCHES, the HANDLE shall be positioned on the cooler side.

The TORCH shall be moved parallel to the centre line of the tube in order to form a weld bead.



The TORCH shall be tested:

- a) at the rated current with the corresponding rated duty cycle, see 8.1;
  - b) with the type of wire and flux specified by the manufacturer;
- and
- c) with the type of current and the electrode polarity specified by the manufacturer.

## 9 Pressure of the liquid cooling system

The liquid cooling system of LIQUID-COOLED TORCHES shall withstand a minimum pressure of 0,5 MPa (5 bar) at a minimum temperature of 70 °C without leakage.

*Conformity shall be checked by measurement and VISUAL INSPECTION immediately following the heating test in accordance with 8.3.*

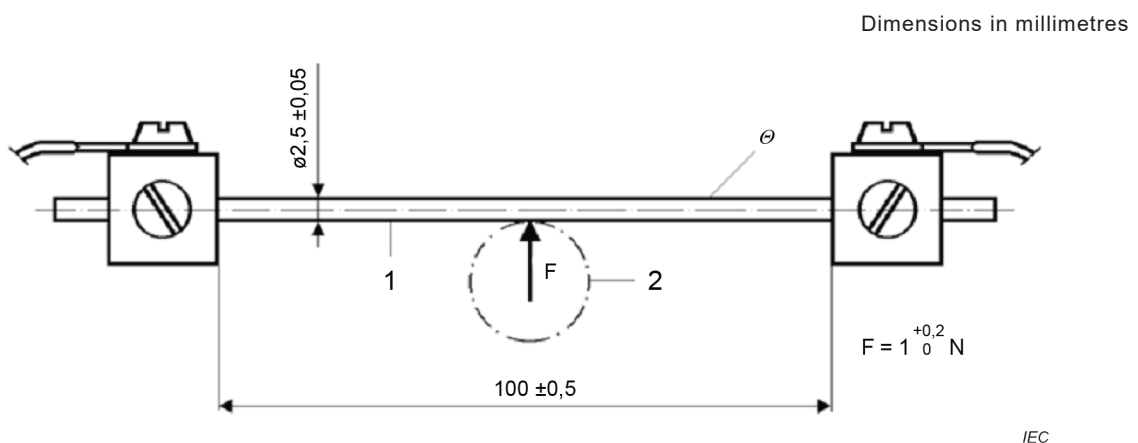
## 10 Resistance to hot objects

The insulation of the HANDLE and the CABLE-HOSE ASSEMBLY shall be capable of withstanding hot objects and the effects of a normal amount of weld spatter without being ignited or becoming unsafe.

This requirement is not applicable for:

- a) TORCH COUPLING DEVICE;
- b) coupling device of CABLE-HOSE ASSEMBLY connected between a power source and ancillary equipment;
- c) MECHANICALLY GUIDED TORCHES intended to be protected in their final installation;
- d) CABLE-HOSE ASSEMBLY connected between a power source and ancillary equipment when incorporated welding cable is compliant with this test;
- e) CABLE-HOSE ASSEMBLY that is not a part of the welding circuit.

*Conformity shall be checked with a device according to Figure 1.*



### Key

- 1 18/8 chrome-nickel steel       $\theta$  Test temperature
- 2 HANDLE of the TORCH

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

An electric current (of approximately 23 A) is passed through the rod until a steady-state test temperature of  $250^{+5}_0$  °C is reached. During the test, the temperature of the heated rod shall be maintained. This temperature shall be measured by a contact thermometer or a thermocouple. The heated rod in a horizontal position is then applied for 2 min to the insulation at the weakest points (for example, minimum insulation thickness and closest distance to live parts). The heated rod shall not penetrate through the insulation and contact live parts. The heated rod shall be applied at the portion with the minimum wall thickness and where internal live parts are closest to the surface. 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.

Following the test, the HANDLE and the CABLE-HOSE ASSEMBLY shall meet the requirements of Clause 7.

## 11 Mechanical provisions

### 11.1 Impact resistance

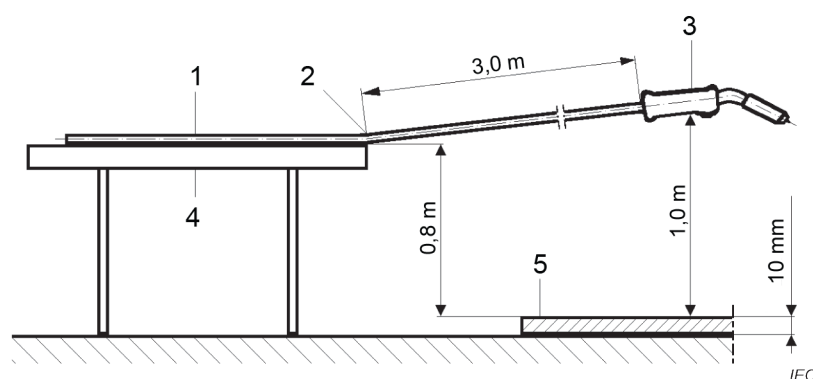
MANUAL TORCHES shall have sufficient mechanical strength to ensure that, when used in accordance with the requirements, no damage occurs which will impair the safety or operability.

Fragile parts such as ceramic nozzles, etc. which, if damaged, impair the operability but not the safety may be replaced after the test.

Clause 11 does not apply to SPOOL-ON TORCHES, MECHANICALLY GUIDED and MOTORIZED TORCHES.

*Conformity shall be checked by the following impact test and VISUAL INSPECTION.*

The TORCH at its full 3 m extension of its CABLE-HOSE ASSEMBLY, is lifted to a height of 1 m, measured at the HANDLE, i.e. 0,2 m above the level of the point where the cable-hose is fixed as shown in Figure 2.



#### Key

- |   |                     |   |             |
|---|---------------------|---|-------------|
| 1 | CABLE-HOSE ASSEMBLY | 4 | Table       |
| 2 | Fixing point        | 5 | Steel plate |
| 3 | TORCH HANDLE        |   |             |

**Figure 2 – Device for the impact test**

The TORCH HANDLE is released without initial velocity and allowed to fall onto a hard and rigid surface, for example a steel plate. This procedure shall be repeated 10 times and arranged so that the TORCH falls on different parts.

Following the test, the TORCH shall meet the requirements of Clause 7 and be operable.

### 11.2 Accessible parts

Accessible parts shall have no sharp edges, rough surfaces or protruding parts likely to cause injury.

*Conformity shall be checked by VISUAL INSPECTION.*

### 11.3 HANDLE material

TORCH HANDLES for manually guided plasma cutting TORCHES shall have a flammability classification of HB or better in accordance with IEC 60695-11-10.

*Conformity is checked by inspection of non-metallic materials specification.*

## 12 Marking

The TORCH shall be clearly and indelibly marked as follows:

- a) name of the manufacturer, distributor, importer or the registered trademark;
- b) type (identification) as given by the manufacturer;
- c) reference to this standard.

EXAMPLE:

Manufacturer – type – Standard  
XXX – YYY – IEC 60974-7

*Conformity shall be checked by VISUAL INSPECTION and the test given in 15.1 of IEC 60974-1:2017.*

## 13 Instructions for use

Each TORCH shall be delivered with an instruction sheet. This instruction sheet shall include, as a minimum, the following information, if applicable:

- a) process, see 5.2;
- b) method of guidance, see 5.3;
- c) ARC STRIKING AND STABILIZING VOLTAGE rating, see 7.5;
- d) rated current and corresponding duty cycle, see 8.1;
- e) type of shielding gas (for example argon, CO<sub>2</sub> or mixed gases with their percentage)  
or,  
for plasma cutting TORCHES, type of gas, flow rate and/or operating pressure;
- f) length of the CABLE-HOSE ASSEMBLY;
- g) type and diameter range of the electrode  
or,  
for plasma cutting TORCHES, proper combinations of PLASMA TIP, NOZZLE and electrode types;

- h) type of cooling, see 5.4;  
and for LIQUID-COOLED TORCHES:
  - 1) minimum flow rate in l/min;
  - 2) minimum and maximum inlet pressure in MPa (bar);
  - 3) minimum cooling power in kW;
- i) for FUME EXTRACTION TORCHES:
  - 1) minimum extraction flow rate in m<sup>3</sup>/h and pressure difference in Pa;
  - 2) capture efficiency in accordance with ISO 21904-3;
- j) rating of electrical controls incorporated in the TORCH;
- k) requirements for the connection of the TORCH;
- l) essential information about the safe operation of the TORCH including environmental conditions;
- m) reference to this document confirming that the TORCH conforms with its requirements;
- n) conditions under which extra precautions are to be observed (for example environment with increased hazard of electric shock, flammable surroundings, flammable products, elevated working positions, ventilation, noise, closed containers, etc.).

For plasma cutting TORCHES, the following information shall also be provided:

- o) maximum and minimum gas pressure at the inlet;
- p) essential information about the safe operation of the plasma cutting TORCH and the functioning of interlocking and safety devices, for example a list of suitable PLASMA CUTTING SYSTEM components identified by the manufacturer, model, catalogue and/or serial number, which the manufacturer recommends for use with the system. Each component listed shall be such that it provides the level of protection to the operator (including compatibility of safety devices and/or protection circuits, no-load voltage, striking voltage and safe connection of the TORCH to the PLASMA CUTTING POWER SOURCE) as originally provided;
- q) type (identification) of PLASMA CUTTING POWER SOURCE or sources that can form a safe system with the plasma cutting TORCH.

*Conformity shall be checked by reading the instructions.*

**Annex A**  
(informative)

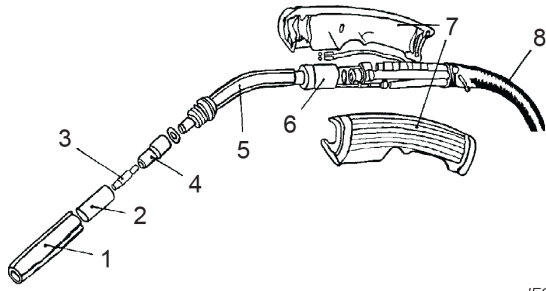
**Additional terminology**

The following terms (see Table A.1) and drawings (see Figures A.1 to A.7 and B.1 to B.3), although not used in the body of this document, are given as a useful aid to comprehend the construction and design of TORCHES.

**Table A.1 – List of terms**

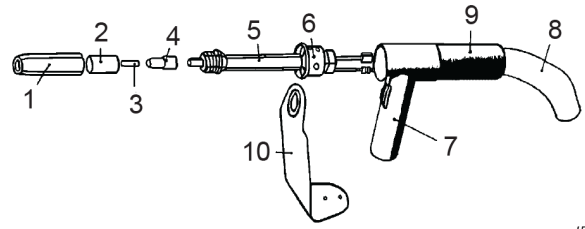
Reference in the figures of Annexes A and B	English term	French term
1	GAS NOZZLE	BUSE
2	insulator	canon isolant
3	CONTACT TIP	TUBE-CONTACT
4	tip adapter with or without gas diffuser	adapteur avec ou sans diffuseur de gaz
5	neck	lance
6	TORCH BODY	CORPS DE TORCHE
7	HANDLE	MANCHE
8	CABLE-HOSE ASSEMBLY	FAISCEAU
9	body housing	enveloppe de corps de torche
10	hand shield	protège-mains
11	gas lens filter	filtre de diffuseur
12	gas lens	diffuseur de gaz
13	collet body	porte-pince
14	heat shield	isolant thermique
15	collet	pince porte-électrode
16	electrode	électrode
17	back cap (short)	bouchon (court)
18	back cap (long)	bouchon (long)
19	PLASMA TIP	TUYERE
20	gas distributor	distributeur de gaz
21	gas diffuser	diffuseur de gaz
22	flow meter	débitmètre
23	thermometer	thermomètre
24	inlet pressure	pression d'entrée
25	cooling liquid	liquide de refroidissement
26	shielding gas	gaz de protection
27	plasma gas	gaz plasma
28	wire feeder	dévidoir
29	TORCH	TORCHE
30	adjustment unit	dispositif de positionnement
31	metal tube	tube métallique
32	copper block	bloc en cuivre

NOTE Items 29 to 32 are shown in Figures B.1 to B.3.



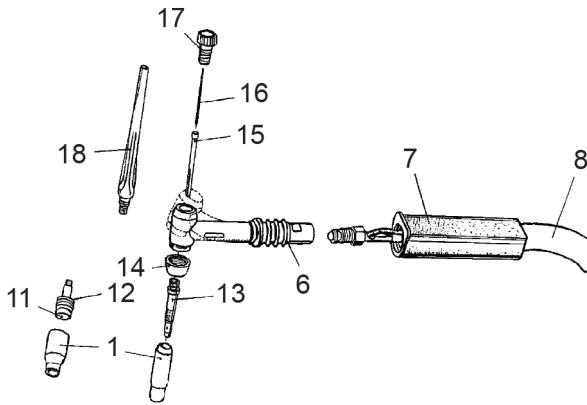
IEC

**Figure A.1 – TORCH for metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding**



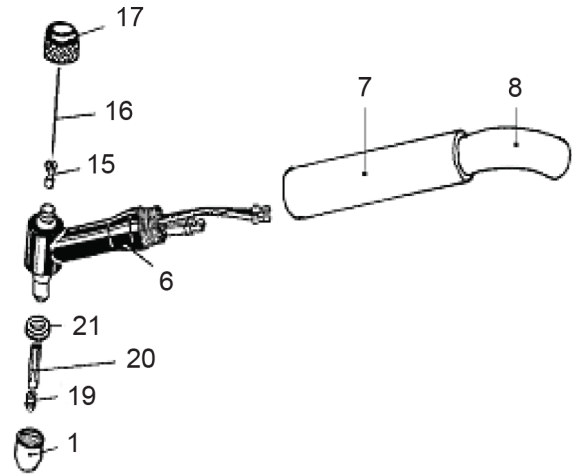
IEC

**Figure A.2 – GUN for metal inert/active gas (MIG/MAG) or self-shielded flux-cored arc welding**



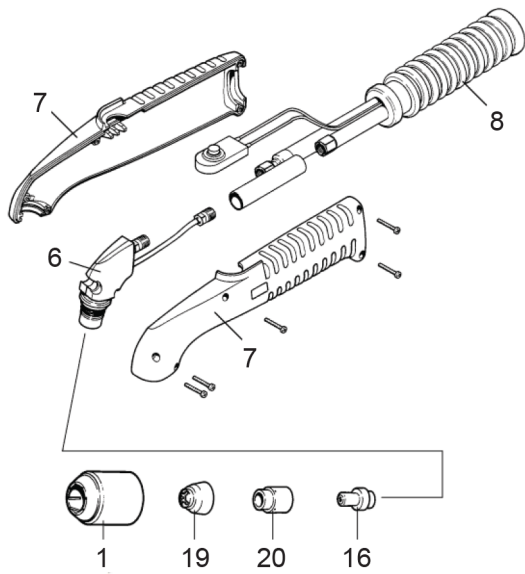
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**Figure A.3 – TORCH for tungsten inert gas arc welding**

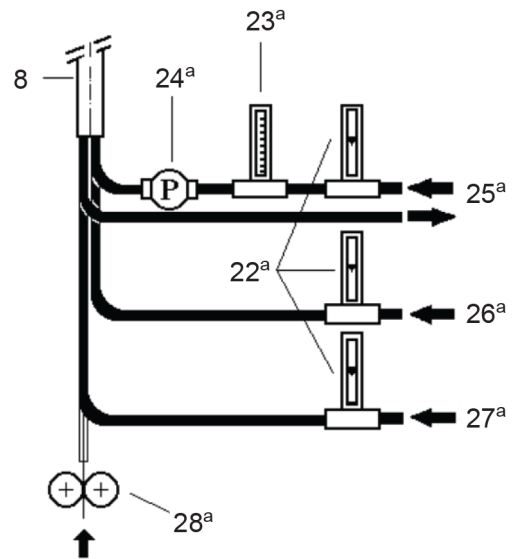


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**Figure A.4 – TORCH for plasma arc welding**



**Figure A.5 – TORCH for plasma cutting**



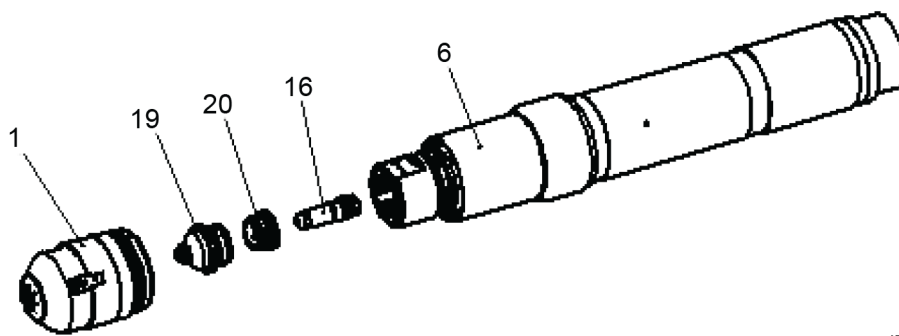
IEC

IEC

**Key**

<sup>a</sup> If necessary

**Figure A.6 – Supply unit**



IEC

**Figure A.7 – MECHANICALLY GUIDED plasma TORCH**

## Annex B (normative)

### Position of the welding TORCHES for the heating test

The position of the welding TORCHES for the heating test is given in Figures B.1 to B.3.

For explanation of numbered items, see Table A.1.

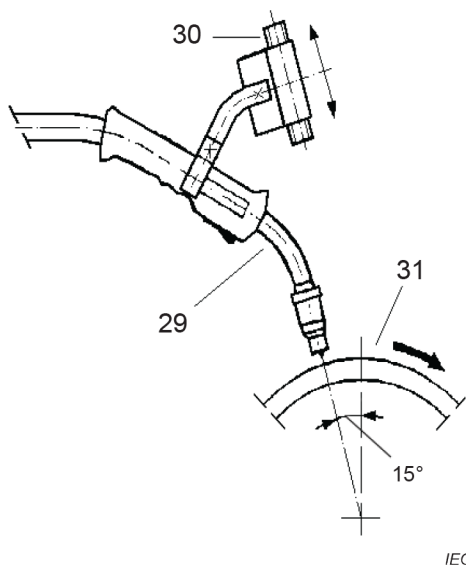


Figure B.1 – MIG/MAG TORCHES

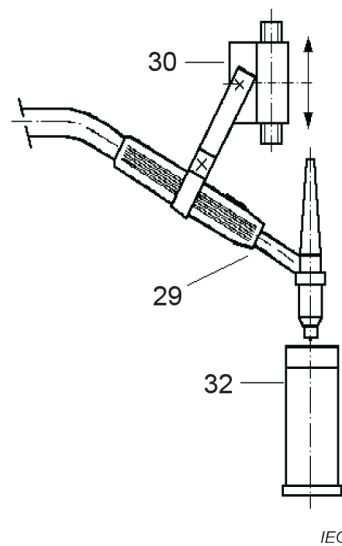


Figure B.2 – TIG  
TORCHES

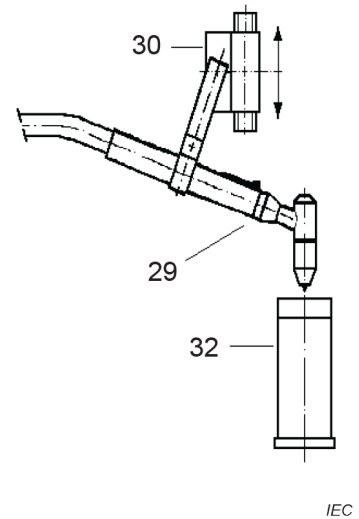


Figure B.3 – Plasma  
welding TORCHES

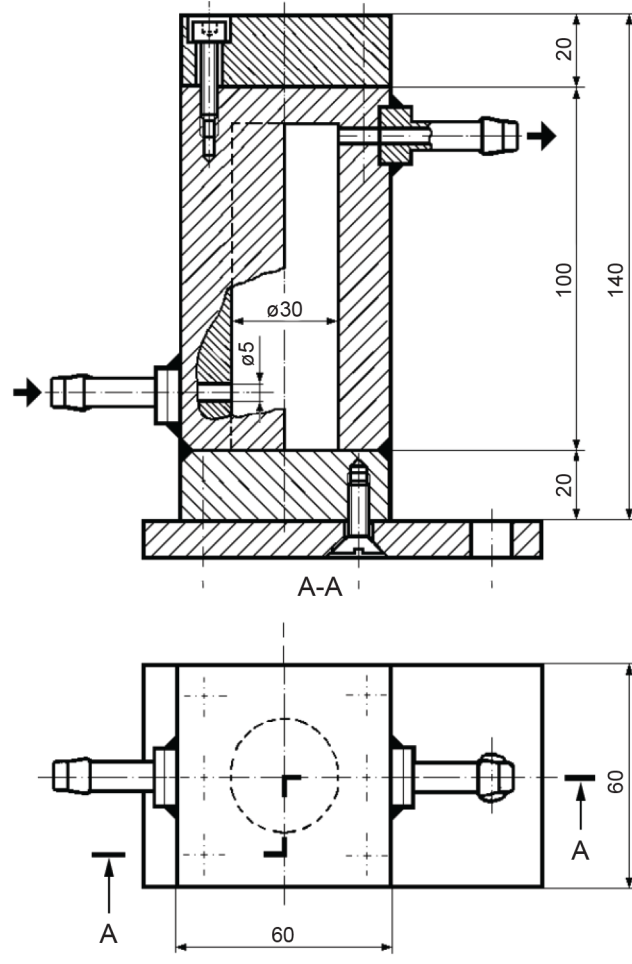


**Annex C**  
(informative)

**Cooled copper block**

An example of design of a water-cooled copper block is given in Figure C.1.

Dimensions in millimetres



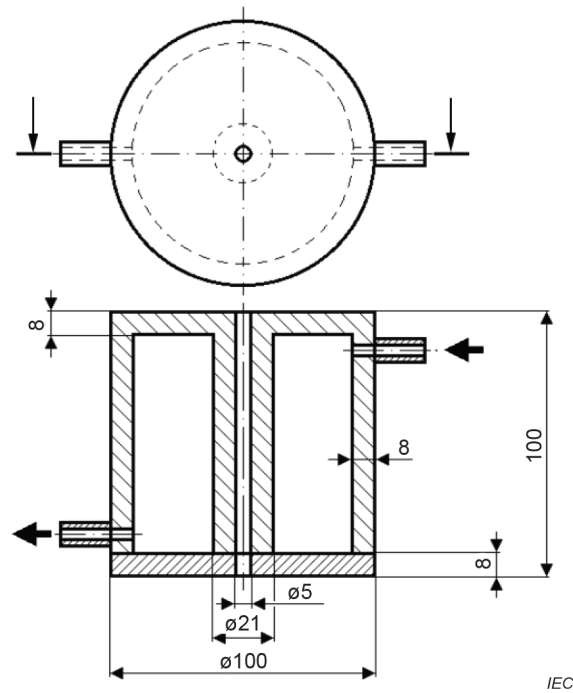
**Figure C.1 – Water-cooled copper block – Example**

**Annex D**  
(informative)

**Copper block with a hole**

An example of design of a water-cooled copper block with a hole is given in Figure D.1.

Dimensions in millimetres



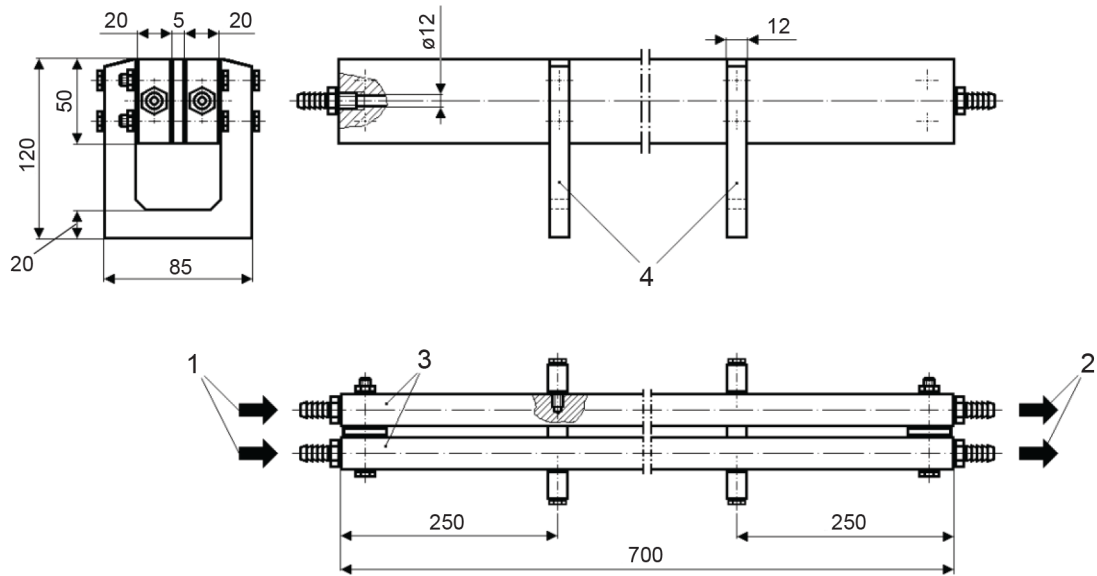
**Figure D.1 – Water-cooled copper block with a hole – Example**

**Annex E**  
(informative)

**Copper bars with a slot**

An example of design of a water-cooled copper bars with a slot is given in Figure E.1.

Dimensions in millimetres



IEC

**Key**

- 1 Water inlet
- 2 Water outlet
- 3 Copper bar
- 4 Support

**Figure E.1 – Water-cooled copper bars with a slot – Example**

## Bibliography

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

IEC 60974-2, *Arc welding equipment – Part 2: Liquid cooling systems*

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*(Continued from second cover)*

Only the English language text has been retained while adopting it in this Indian Standard, and as such, the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding of numerical values ( *revised* )'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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This Indian Standard has been developed from Doc No.: ETD 21 (12688).

### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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