INTERNATIONAL STANDARD

IEC 60974-2

First edition
2002-06

Arc welding equipment –

Part 2:
Liquid cooling systems

Matériel de soudage à l'arc –

Partie 2:
Systèmes de refroidissement par liquide

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60974-2 has been prepared by IEC technical committee 26: Electric welding.

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

FDIS	Report on voting
26/236/FDIS	26/238/RVD

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

This standard shall be used in conjunction with IEC 60974-1 (1998).

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

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

ARC WELDING EQUIPMENT –

Part 2: Liquid cooling systems

1 Scope

This part of IEC 60974 specifies safety and construction requirements for liquid cooling systems intended to cool torches. These liquid cooling systems can be internal or external to power sources for arc welding and allied processes (see annex A).

This standard is not applicable to refrigerated cooling systems.

2 Normative references

The following referenced documents are indispensable for the application 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 60974-1:1998, *Arc-welding equipment – Part 1: Welding power sources*
Amendment 1 (2000)

IEC 60974-7:2000, *Arc-welding equipment – Part 7: Torches*

3 Terms and definitions

For the purposes of this part of IEC 60974 the definitions of IEC 60974-1, IEC 60974-7 and following apply.

3.1
liquid cooling system
system that circulates and cools liquid used for decreasing the temperature of equipment of arc welding and allied processes

3.2
internal cooling system
cooling system incorporated in a welding power source

3.3
external cooling system
cooling system not incorporated in a welding power source

3.4
cooling power (*P*)
cooling energy related to the mass flow rate

4 Environmental conditions

As specified in IEC 60974-1, clause 4.

5 Test conditions

As specified in IEC 60974-1, clause 5.

External cooling systems may be tested without a welding power source.

Internal cooling systems shall be tested with the welding power source.

5.1 Type tests

All type tests shall be carried out on the same cooling system except as specified otherwise.

As a condition of conformity the type tests given below shall be carried out in the following sequence:

a) general visual inspection, as defined in IEC 60974-1, 3.7;
b) protection provided by the enclosure, as specified in IEC 60974-1, 6.2.1;
c) mechanical requirements, see clause 7;
d) insulation resistance, see 6.1.3;
e) dielectric strength, see 6.1.4.

The other tests included in this standard and not listed here may be carried out in any convenient sequence.

5.2 Routine tests

All routine tests given below shall be carried out on each cooling system in the following sequence:

a) general visual inspection, as defined in IEC 60974-1, 3.7;
b) continuity of the protective circuit, as specified in IEC 60974-1, 10.4.2;
c) dielectric strength, see 6.1.4;
d) functional test as specified by the manufacturer, for example leaks of fluid or gas, flow sensor operation.

6 Protection against electric shock

6.1 Insulation

As specified in IEC 60974-1, 6.1.

6.1.1 Clearances

As specified in IEC 60974-1, 6.1.1.

6.1.2 Creepage distances

As specified in IEC 60974-1, 6.1.2.

6.1.3 Insulation resistance

Without cooling liquid, see IEC 60974-1, 6.1.3

6.1.4 Dielectric strength

Without cooling liquid, see IEC 60974-1, 6.1.4.

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

As specified in IEC 60974-1, 6.2.

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

As specified in IEC 60974-1, 6.3.

6.4 Connection to the input supply

As specified in IEC 60974-1, clause 10.

6.5 Leakage current between welding circuit and protective earth

With the cooling system, filled with coolant as specified by the manufacturer, the current from the contact tip of the torch to the protective earth connection of the cooling system shall not exceed 10 mA d.c.

Conformity shall be checked without interference suppression or protection capacitors (see 6.3.1 of IEC 60974-1) by application of a d.c. voltage of 500 V at room temperature. When tested, the coolant shall be flowing with at least a 3 m torch attached to the cooling system in a typical fashion. Hoses used for external connection to the torch shall be with a maximum length of 0,5 m.

7 Mechanical requirements

As specified in IEC 60974-1, clause 14.

For the compliance tests the cooling system shall be filled with cooling liquid.

7.1 Cooling liquid overflow

When filling the cooling system according to the manufacturer's instructions, overflow or spillage shall not result in electric shock.

Conformity shall be checked by the following treatment and test. The liquid container is completely filled. A further quantity of liquid equal to 15 % of the capacity of the container or 0,25 l, whichever is the greater, is then poured in steadily over a period of 60 s. Immediately after this treatment, the equipment shall pass the dielectric strength test of 6.1.4 between input circuits and exposed conductive parts.

7.2 Hose coupling devices and hose connections

If hose coupling devices or hose connections, which often have to be undone, are placed above or near to live parts, these live parts shall be protected from cooling liquid by splash proof enclosures, with drains or other appropriate measures. An exception is made for live parts of the welding circuit.

8 Cooling system

8.1 Rated maximum pressure

The manufacturer shall determine the maximum pressure attainable by the cooling system, see 10.2 c), box 13.

Conformity shall be checked by measuring the pressure when the outlet is blocked.

8.2 Pressure and temperature

Liquid cooling systems shall be capable of operating without leakage at the rated maximum pressure with a coolant temperature of 70 °C.

Conformity shall be checked by visual inspection during 30 s operation at a pressure of 1,5 times the rated maximum pressure. All cooling passages which are normally pressurized are subjected to the 1,5 times pressure test.

8.3 Cooling liquid

In general, water with or without antifreezing agents and corrosion inhibitors is used as cooling liquid.

The cooling system shall be visibly marked with a specification on the type of cooling liquid and its antifreezing characteristics.

NOTE Antifreezing agents will affect the electrical conductivity.

8.4 Thermal requirements

8.4.1 Heating test

Liquid cooling systems shall be capable of operating at rated cooling power without causing any component to exceed its rated temperature.

Conformity shall be checked in accordance with clause 9.

8.4.2 Tolerances of test parameters

a) p pressure: 10 %/–2 %

b) q_V volume flow: 10 %/–2 %

c) T temperature: ±2 K

8.4.3 Duration of test

As specified in IEC 60974-1, 7.1.2.

8.5 Abnormal operation

Fan and/or pump motors in the stalled condition shall comply with clause 8 (without 8.2 and 8.3) of IEC 60974-1.

9 Cooling power

9.1 Test procedure

Cooling power data shall be given in kW for 100 % duty cycle (duty factor), with the cooling liquid as recommended by the manufacturer and at an ambient air temperature between 20 °C and 25 °C. For these values the volume flow shall be 1 l/min.

This test may be carried out on a separate cooling system.

An internal cooling system may additionally be heated by the welding power source. Therefore, the test shall be performed together with the welding power source, set for maximum heating.

Conformity shall be checked by the following test and calculation:

a) the liquid cooling system is filled with the amount and type of cooling liquid recommended in the manufacturer's instructions;

b) the liquid cooling system is connected to a measuring circuit according to figure 1;

c) the valve is adjusted to obtain a flow of 1 l/min ± 0,1 l/min;

d) the electric heater is adjusted to give a stable condition at a temperature 40 K ± 2 K over ambient air temperature at the inlet of the liquid cooling system;

e) the inlet and outlet temperature is measured directly at the liquid cooling system. Heat losses of the measuring device should be as low as possible;

f) the test is carried out for a period of not less than 60 min and continued until the rate of temperature rise does not exceed 2 K/h.

The cooling power is calculated by the following formulae:

$$P = (T_1 - T_2)\ q_m\ c \qquad q_m = q_v\ \rho$$

where

P is the cooling power (kW);

T_1 is the temperature of inlet flow (K);

T_2 is the temperature of outlet flow (K);

$T_1 - T_2$ is the temperature difference (K);

q_m is the mass flow (kg/s);

q_v is the volume flow (l/s);

c is the specific heat capacity of the cooling liquid, see table 1 (kJ/(kg×K));

ρ is the density of the cooling liquid, see table 1 (kg/l).