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Title:
IEC 60974-6 Ed.2: Arc welding equipment - Part 6: Limited duty manual metal arc welding power sources

(Titre) :
CEI 60974-6 Ed.2: Matériel de soudage à l'arc - Partie 6: Sources de courant de soudage manuel à l'arc métallique à service limité

Introductory note

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60974-6 has been prepared by IEC technical committee 26: Electric welding.

This second edition cancels and replaces the first edition published in 2003 and constitutes a technical revision.

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

— Extension of the scope;

— Induced changes due to publication of IEC 60974-1 edition 3.

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

FDIS	Report on voting
26/XX/FDIS	26/XX/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.

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 the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn;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

ARC WELDING EQUIPMENT –

Part 6: Limited duty power sources

1 Scope

This part of IEC 60974 specifies safety and performance requirements applicable to limited duty arc welding and cutting power sources, wire feeders, torches and electrode holders designed for use by laymen.

NOTE 1 These power sources are typically used by laymen in a non-industrial, non-professional setting.

This part of IEC 60974 is not applicable to arc welding and cutting power sources that require for operation:

- arc striking and stabilizing devices;
- liquid cooling systems;
- gas consoles;
- three-phase input supply;
- auxiliary output.

These power sources are intended for industrial and professional use only.

This part of IEC 60974 is not applicable to arc welding and cutting power sources and ancillary equipment used in:

- mechanised applications;
- submerged arc welding process;
- plasma gouging process;

that are covered by other parts of IEC 60974.

NOTE 2 Power sources, wire feeders, torches and electrode holders designed for industrial and professional use only are respectively covered by IEC 60974—1, IEC 60974—5, IEC 60974—7 and IEC 60974—11.

NOTE 3 This part of IEC 60974 does not specify electromagnetic compatibility (EMC) requirements.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60974. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60974 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60974-1:2005, *Arc welding equipment – Part 1: Power sources*

IEC 60974-5, *Arc welding equipment – Part 7: Wire feeders*

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

IEC 60974-11, *Arc welding equipment – Part 11: Electrode holders*

IEC 61032, *Protection of persons and equipment by enclosure - Probes for verification*

ISO 17846, *Welding and allied processes – Health and safety – Wordless precautionary labels for equipment and consumables used in arc welding and cutting*

ISO 2503, *Gas welding equipment - Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar*

ISO 7000, *Graphical symbols for use on equipment – Index and synopsis*

3 Definitions

For the purpose of this part of IEC 60974, the following definitions apply, with those in IEC 60974-1:

3.1
touch current
electric current passing through a human body or through an animal body when it touches one or more accessible parts of an installation or equipment [IEV 195-05-21]

3.2
limited duty welding power source
power source intended for use by a layman

3.3
layman
operator who does not weld in the performance of his profession and may have little or no formal instruction in arc welding

3.4
effective supply current (I_{1eff})
value of the effective input current, calculated from the rated maximum supply current (I_{1max} in A), the supply current at no-load (I_0 in A) and the rated maximum welding time in intermittent mode ($\sum t_{ON}$ in s) at the rated maximum welding current during an uninterrupted time of one hour by the formula:

$$I_{1\text{eff}} = \sqrt{I_{1\text{max}}^2 \times \frac{\sum t_{on}}{3600\text{s}} + I_0^2 \times \left(1 - \frac{\sum t_{on}}{3600\text{s}}\right)}$$

4 Environmental conditions

Welding power sources shall be capable of operating when the following environmental conditions prevail:

a) range of the temperature of the ambient air:

during operation: –10 °C to +40 °C;

after transport and storage at: –20 °C to +55 °C;

b) relative humidity of the air:

up to 50 % at 40 °C;

up to 90 % at 20 °C;

c) ambient air, free from abnormal amounts of dust, acids, corrosive gases or substances etc. other than those generated by the welding process;

d) altitude above sea level up to 1 000 m;

e) base of the welding power source inclined up to 10°.

Welding power sources shall be capable of delivering their rated output from 0 °C to +20 °C.

5 Tests

5.1 Test condition

The tests shall be carried out on new, dry and completely assembled welding power sources at an ambient air temperature between 10 °C and 40 °C.

The thermal tests shall be carried out at ambient temperature of 20 °C, see tolerances in 7.1.2 (e).

When placing the measuring devices, the only access permitted shall be through openings with cover plates, inspection doors or easily removable panels provided by the manufacturer. The ventilation in the test area and the measuring devices used shall not interfere with the normal ventilation of the welding power source or cause abnormal transfer of heat to or from it.

5.2 Measuring instruments

See 5.2 of IEC 60974-1.

5.3 Conformity of components

See 5.3 of IEC 60974-1.

5.4 Type tests

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

The welding power source shall be tested with any ancillary equipment fitted that could affect the test results.

All type tests shall be carried out on the same welding power source except where it is specified that a test may be carried out on another welding power source.

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

a) general visual inspection, see 3.7 of IEC 60974-1;

b) insulation resistance, see 6.1.4 (preliminary check);

c) enclosure, see 14.2;

d) handling means, see 14.3;

e) drop withstand, see 14.4;

f) protection provided by the enclosure, see 6.2.1;

g) insulation resistance, see 6.1.4;

h) dielectric strength, see 6.1.5;

i) general visual inspection, see 3.7 of IEC 60974-1.

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

5.5 Routine tests

All routine tests shall be carried out on each welding power source. The following sequence is recommended:

a) general visual inspection, see 3.7 of IEC 60974-1;

b) continuity of the protective circuit, see 10.4.2 of IEC 60974-1;

c) dielectric strength, see 6.1.5;

d) no-load voltage

   1. rated no-load voltage, see 11.1; or
   2. if applicable, rated reduced no-load voltage, see 13.2 of IEC 60974-1; or
   3. if applicable, rated switched no-load voltage, see 13.3 of IEC 60974-1;

e) test to ensure rated minimum and maximum output values in accordance with 15.3 b) and 15.3 c) of IEC 60974-1. The manufacturer may select conventional load, short circuit load or other test conditions;

f) general visual inspection, see 3.7 of IEC 60974-1.

NOTE In short circuit and other test condition, the output values may differ from conventional load values.

6 Protection against electric shock

6.1 Insulation

6.1.1 General

See 6.1.1 of IEC 60974-1.

6.1.2 Clearances

See 6.1.2 of IEC 60974-1.

6.1.3 Creepage distances

See 6.1.3 of IEC 60974-1.

6.1.4 Insulation resistance

See 6.1.4 of IEC 60974-1.

6.1.5 Dielectric strength

See 6.1.5 of IEC 60974-1.

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

6.2.1 Protection provided by the enclosure

6.2.1.1 General

Welding power sources shall have a minimum degree of protection of IP21S using IEC 60529 test procedures and conditions.

Remote controls for welding power sources shall have a minimum degree of protection of IP2X using IEC 60529 test procedures and conditions.

6.2.1.2 Protection against ingress of water

Adequate drainage shall be provided by the enclosure. Retained water shall not interfere with the correct operation of the equipment or impair safety.

Conformity shall be checked as follows:

A welding power source shall be subjected to the appropriate water test without being energized. Immediately after the test, the welding power source shall be moved to a safe environment and subjected to the insulation resistance and dielectric strength tests.

Adequate drainage of the enclosure shall be checked by visual inspection.

6.2.1.3 Side and top enclosure openings

The enclosure shall be such that a 50 mm long test pin cannot be inserted from all sides except the underside to touch:

a) live parts of the input circuit or
b) in the case of Class II welding power sources, any metal part which is separated from live parts of the input circuit by basic insulation.

Conformity shall be checked with test probe 12 of IEC 61032, see Figure 6.1.

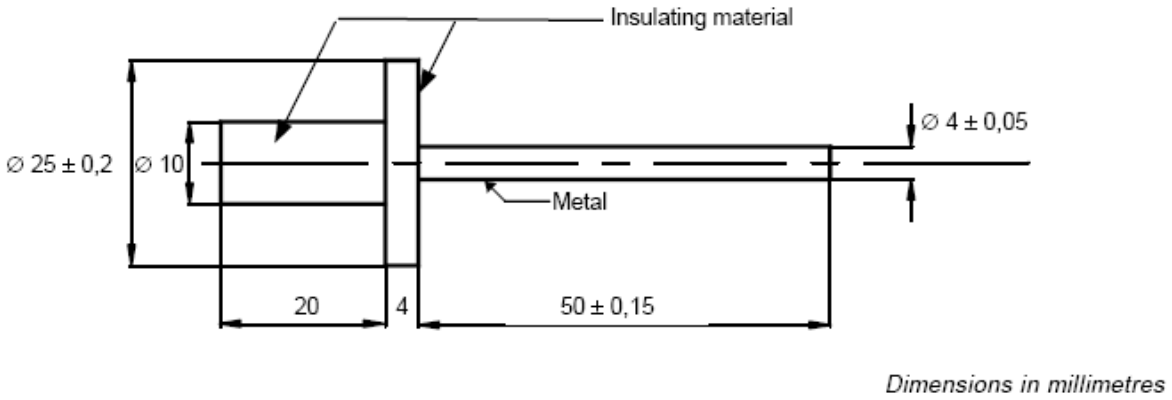


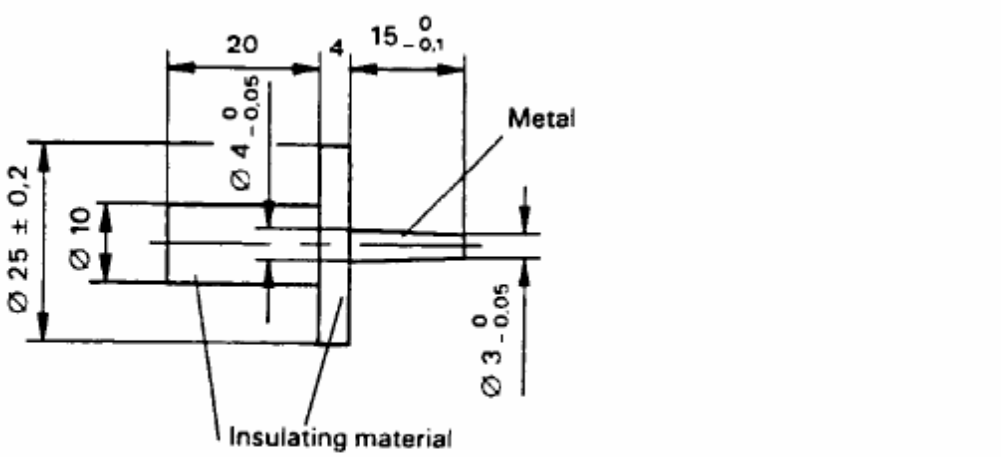
Figure 6.1 – Test probe 12 of IEC 61032

6.2.1.4 Bottom enclosure openings

The enclosure shall be such that a 15 mm long test pin cannot be inserted from the underside to touch:

a) live parts of the input circuit or
b) in the case of Class II welding power sources, any metal part which is separated from live parts of the input circuit by basic insulation.

Conformity shall be checked with test probe 13 of IEC 61032, see Figure 6.2.



Dimensions in millimetres

Figure 6.2 – Test probe 13 of IEC 61032

6.2.2 Capacitors

See 6.2.2 of IEC 60974-1.

6.2.3 Automatic discharge of input capacitors

See 6.2.2 of IEC 60974-1.

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

6.3.1 Protective provisions

See 6.3.1 of IEC 60974-1.

6.3.2 Isolation of the supply circuit and the welding circuit

See 6.3.2 of IEC 60974-1.

6.3.3 Insulation between windings of the supply circuit and the welding circuit

See 6.3.3 of IEC 60974-1.

6.3.4 Internal conductors and connections

See 6.3.4 of IEC 60974-1.

6.3.5 Additional requirements for plasma cutting systems

See 6.3.5 of IEC 60974-1.

6.3.6 Movable coils and cores

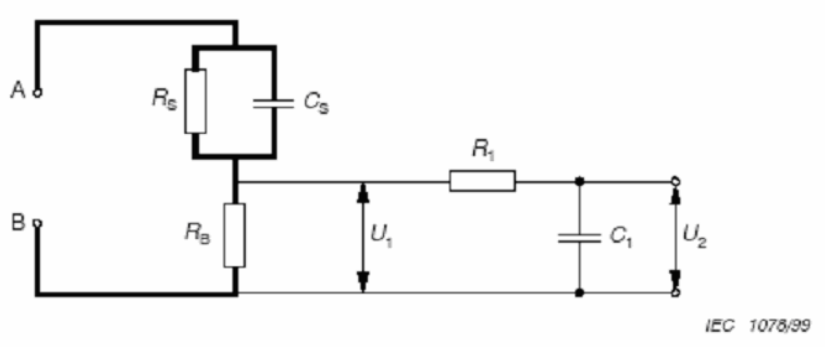
See 6.3.6 of IEC 60974-1.

6.3.7 Touch current

The touch current shall not exceed 5 mA in the case of protective conductor failure or disconnection.

Conformity shall be checked using the measuring circuit as shown in Figure 6.3 under the following conditions:

a) the welding power source is:
   – isolated from the ground plane;
   – supplied by the highest rated supply voltage;
   – not connected to the protective earth except through measurement components;
b) the output circuit is in the no-load condition;
c) interference suppression capacitors shall not be disconnected.



Key

A, B	Test terminals	C_S	0,22 µF
R_S	1 500 Ω	R_1	10 000 Ω
R_B	500 Ω	C_1	0,022 µF
	Weighted touch current (perception/reaction)		$= \frac{U_2}{500}$ (peak value)

Figure 6.3 - Measuring network for touch current

NOTE Caution! A qualified person must perform this test. The protective conductor is disabled for this test.

7 Thermal requirements

7.1 Heating test

7.1.1 Test conditions

The welding power source shall be operated at the rated maximum welding current $I_{2\max}$ and conventional load voltage given in 11.2, starting from the cold state.

If it is known that $I_{2\max}$ does not give the maximum heating, then a test shall additionally be made at the setting within the rated range which gives the maximum heating.

NOTE 1 The maximum temperature of components may be reached at the no-load condition.

NOTE 2 The maximum welding current test and the relevant worst case test may follow each other without waiting for the welding power source to return to the ambient air temperature.

7.1.2 Tolerances of the test parameters

During the heating test in accordance with 7.1.3, the following tolerances shall be met:

a) load voltage: ±5 % of the appropriate conventional load voltage;
b) welding current: ±5 % of the appropriate conventional welding current;
c) supply voltage: ±10 % of the appropriate rated supply voltage;

d) engine speed: ±5 % of the appropriate rated speed;

e) temperature: $^{+10}_{-0}$ K of the ambient temperature.

7.1.3 Rated maximum welding current

The test sequence for the rated maximum welding current $I_{2\max}$ shall be as follows:

a) Ensure that the welding power source is at thermal equilibrium with the ambient temperature of 20 °C, see tolerances in 7.1.2 (e).
b) Operate the power source at the rated maximum welding current until operation of thermal protection.
c) Start the test immediately after the thermal protection resets.
d) Record ON time for each cycle $t_{ON}(i)$ during 60 min.

7.1.4 Calculation

The following rated values shall be calculated:

— rated maximum welding time $t_{ON}(\max)$ in continuous mode at the rated maximum welding current, see 7.1.3 (b);
— rated maximum welding time $\sum t_{ON}(i)$ in intermittent mode at the rated maximum welding current during an uninterrupted time of 60 minutes see 7.1.3 (d);

where $t_{ON}(i)$ is the ON time for each cycle.

Values of $t_{ON}(i)$ less than 60 s shall not be taken into account for calculation of $\sum t_{ON}(i)$.

The minimum values of $t_{ON}(\max)$ and $\sum t_{ON}(i)$shall be 60 s.

7.2 Temperature measurement

7.2.1 Measurement condition

For each cycle, the peak and the minimum temperature shall be determined as follows:

a) For windings, by measurement of the resistance, or by surface or embedded temperature sensor;
b) For other parts, by surface temperature sensor.

7.2.2 Surface temperature sensor

See 7.2.2 of IEC 60974-1.

7.2.3 Resistance

See 7.2.3 of IEC 60974-1.

7.2.4 Embedded temperature sensor

See 7.2.4 of IEC 60974-1.

7.2.5 Determination of the ambient air temperature

See 7.2.5 of IEC 60974-1.

7.2.6 Recording of temperatures

See 7.2.6 of IEC 60974-1.

7.3 Limits of temperature rise

7.3.1 Windings, commutators and slip-rings

The temperature rise for windings, commutators and slip-rings shall not exceed the values given in table 6 of IEC 60974-1, regardless of the method of temperature measurement used, except that the resistance measurement or an embedded temperature sensor shall be used for coils and windings wherever possible.

No part shall be allowed to reach any temperature that will damage another part even though that part might conform to the requirements in table 6 of IEC 60974-1.

Conformity shall be checked by measurement in accordance with 7.2.

7.3.2 External surfaces

See 7.3.2 of IEC 60974-1.

7.3.3 Other components

The maximum temperature of other components shall not exceed their rated maximum temperature, in accordance with the relevant standard.

7.4 Loading test

See 7.4 of IEC 60974-1.

7.5 Commutators and slip-rings

Commutators, slip-rings and their brushes shall show no evidence of injurious sparking or damage throughout the range of the rotating welding power source.

Conformity shall be checked by visual inspection during

a) the heating test in accordance with 7.1
   and
b) the loading test in accordance with item 1) or 2) of 7.4.

8 Abnormal operation

8.1 General requirements

A welding power source shall not suffer hazardous electrical breakdown or cause a risk of fire under the conditions of operation of 8.2 and 8.3. These tests are conducted without regard to temperature attained on any part, or the continued proper functioning of the welding power source. The only criterion is that the welding power source does not become unsafe. These tests may be conducted on other welding power sources.

Welding power sources, protected internally by, for example, circuit-breaker or thermal protection, meet this requirement if the protection device operates before an unsafe condition occurs.

Conformity shall be checked by the following tests.

a) A layer of dry absorbent surgical type cotton is placed under the welding power source, extending beyond each side for a distance of 150 mm.

b) Starting from the cold state, the welding power source is operated in accordance with 8.2 to 8.3.

c) During the test, the welding power source shall not emit flames, molten metal or other materials that ignite the cotton indicator.

d) Following the test and within 5 min, the welding power source shall be capable of withstanding a dielectric test in accordance with 6.1.5 (b) of IEC 60974-1.

8.2 Stalled fan test

A welding power source, which relies on motor-driven fan(s) for conformity with the tests of Clause 7, is operated at rated supply voltage or rated load speed for a period of 4 h while the fan motor(s) is(are) mechanically stalled and disabled at the output condition of 7.1.

NOTE The intention of these tests is to run the power source with the fan stationary and the safe operation of the fan.

8.3 Short circuit test

See 8.3 of IEC 60974-1.

9 Thermal protection

9.1 General requirements

Welding power sources with limited duty shall be fitted with a thermal protection.

9.2 Construction

The thermal protection shall be so constructed that it is not possible:

a) to change its temperature setting, or

b) to alter its operation without inflicting obvious physical damage.

Conformity shall be checked by visual inspection.

9.3 Location

See 9.3 of IEC 60974-1.

9.4 Operation

The thermal protection shall prevent the welding power source windings from exceeding the peak temperature limits as specified in IEC 60974-1, Table 6 and without causing any over component to exceed its rated temperature.

Conformity shall be checked during operation with the setting within the rated range which gives the maximum heating.

9.5 Resetting

The thermal protection shall not reset until the temperature has dropped below that of the insulation class as specified in IEC 60974-1, Table 6.

Conformity shall be checked by operation and temperature measurement.

9.6 Operating capacity

The thermal protection shall be capable of breaking either the input current or the welding current 200 times consecutively without failure whilst the welding power source delivers the rated maximum welding current.

Conformity shall be checked by a suitable overload producing the required number of consecutive interruptions of a circuit having the same electrical characteristics, especially current and reactance, as the circuit in which the thermal protection is used.

After this test, the requirements of 9.4and 9.5shall be met.

9.7 Indication

See 9.7 of IEC 60974-1.

10 Connection to the input supply network

10.1 Input supply

10.1.1 Supply voltage

Welding power sources shall be capable of operating at the rated supply voltage ±10 %. This may give deviations from the rated values.

Conformity shall be checked by operation.

10.1.2 Supply current

Supply current shall be measured by a true r.m.s. meter with a minimum crest factor of 3 and calculation.

Conformity shall be checked by operation.

NOTE The measurement can be affected by the impedance of the supply circuit (see annex G of IEC 60974-1).

10.1.3 Engine driven welding power source

In the case of engine powered rotating welding power source, the engine shall be capable of tolerating load variations between maximum load and no-load without adversely affecting the welding performance of the generator.

Conformity shall be checked by operation.

10.2 Multi supply voltage

Welding power sources which are designed to operate from different supply voltages shall be fitted with:

a) two supply cables, each fitted with a different plug, and a selector switch which ensures that the pins of the plug not in use cannot become live;
b) a system to automatically configure the welding power source in accordance with the supply voltage.

Conformity shall be checked by operation.

In the case a), a selector switch is additionally tested in accordance with 10.7.

10.3 Means of connection to the supply circuit

Acceptable means of connection to the supply circuit are one of the following:

a) a flexible input supply cable attached to the welding power source;
b) appliance inlets fitted to the welding power source and a flexible input supply cable.

The flexible input supply cable shall be in accordance with 10.8 and fitted with a plug in accordance with 10.9.

Conformity shall be checked by visual inspection.

10.4 Supply circuit terminals

See 10.4 of IEC 60974-1.

10.5 Cable anchorage

See 10.5 of IEC 60974-1.

10.6 Inlet openings

See 10.6 of IEC 60974-1.

10.7 Supply circuit on/off switching device

Welding power sources shall be fitted with a supply circuit on/off switching device. The supply circuit on/off switching device shall be in accordance with 10.7 of IEC 60974-1.

10.8 Supply cables

Supply cables shall:

a) be suitable for the application and meet national and local regulations;
b) be dimensioned in accordance with the maximum effective supply current I_{1eff} and
c) have a length of at least 2 m as measured from the exit point of the enclosure.

Conformity shall be checked by visual inspection and measurement.

10.9 Supply coupling device (attachment plug)

The current rating of a supply coupling device shall be not less than:

a) the current rating of the fuse required to comply with the tests specified in 8.3;
b) the maximum effective supply current I_{1eff};

For 125 V input supply networks, the current rating shall, additionally, not be less than 70 % of the rated maximum supply current for equipment.

Conformity shall be checked by visual inspection, measurement and calculation.

11 Output

11.1 Rated no-load voltage

11.1.1 Rated no-load voltage for arc welding power source

The rated no-load voltage shall not exceed:

a) d.c. 113 V peak;

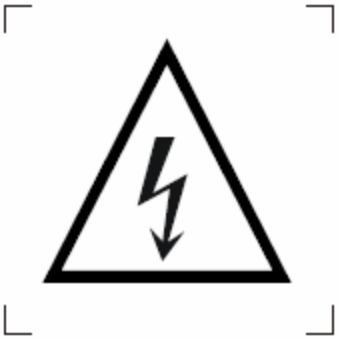
b) a.c. 68 V peak and 48 V r.m.s.

A welding power source that does not comply within 200 ms with the reduced no-load voltage limits:

a) d.c. 60 V peak;

b) a.c. 50 V peak and 35 V r.m.s;

shall be clearly and indelibly marked on or near the front panel or near the ON/OFF switching device with the following combination of symbols to signify "Caution!: Risk of Electric shock":



NOTE If the arc welding power source is fitted with a voltage reducing device, manufacturer should take into consideration lower additional no-load limit value as far as applicable for the welding process.

A rectifier type d.c. welding power source shall be so constructed that in case of a rectifier failure (e.g., open circuit, short circuit or a phase failure), the allowable values cannot be exceeded.

Conformity shall be checked by measurement in accordance with 11.1.3 and by simulation of a failure.

11.1.2 Rated no-load voltage for plasma cutting power source

The rated no-load voltage shall not exceed 350 V peak d.c.

Conformity shall be checked by measurement in accordance with 11.1.3, by operation and by visual inspection, except that the series combination of the 200 Ω fixed and 5 kΩ variable resistors may be replaced by a fixed resistance of 5 kΩ.

A rated no-load voltage exceeding 113 V peak d.c. may only be used if the following requirements are fulfilled.

a) The arc striking sequence shall only start when the tip of the torch is in contact with the workpiece.

b) These power sources with their corresponding torches shall prevent the output of no-load voltage if the torch is disassembled or disconnected from the power source.

c) The voltage between the electrode of the torch and the workpiece shall be less than 68 V peak not later than 2 s after the control circuit (e.g. trigger) or the cutting circuit is opened.

d) The voltage between the tip of the torch and the work piece shall not exceed 68 V peak not later than 0,3 s after the arc current is interrupted..

Conformity shall be checked by measurement by meter or oscilloscope in parallel with 5 kΩ minimum resistance.

11.1.3 Measurement

The rated no-load voltage at all possible settings shall not exceed the values given in 11.1.1 to 11.1.2, summarized in Table 1.

Table 1 – Summary of rated no-load voltages

Subclause	Power source	Rated no-load voltage
11.1.1	Arc welding	With risk of electric shock symbol: d.c. 113 V peak a.c. 68 V peak and 48 V r.m.s. Without risk of electric shock symbol: Reduced within 200 ms to d.c. 60 V peak a.c. 50 V peak and a.c. 35 V r.m.s
11.1.2	Plasma cutting	With risk of electric shock symbol: d.c. 350 V peak

Welding power sources, which are electronically controlled, shall be

a) designed to ensure that the output voltages given in Table 1 cannot be exceeded should any fault occur in an electronic circuit

or

b) fitted with a protection system, which switches off the voltage at the output terminals within 0,3 s and shall not be reset automatically.

If the no-load voltage is higher than these values, the welding power source shall be fitted with a hazard reducing device in accordance with clause 13.

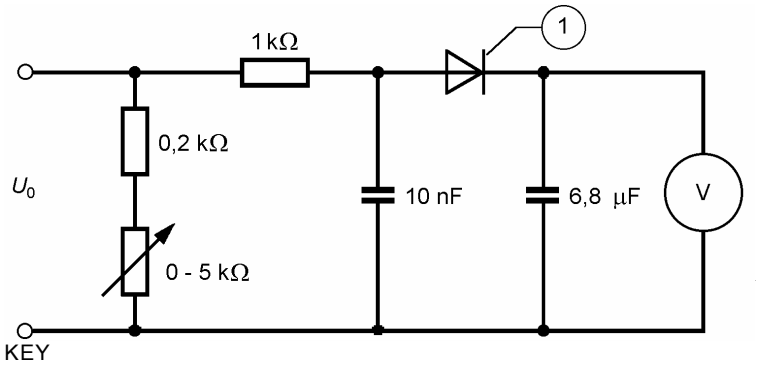
Conformity shall be checked by measurement and by analysis of the circuit and/or by failure simulation

a) **RMS values**

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

b) **Peak values**

To obtain reproducible measurements of peak values, omitting impulses which are not dangerous, a circuit is used as shown in Figure 11.1.



1 Diode 1N4007 or similar

Figure 11.1 – Measurement of peak values

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

The tolerance of the component values in the measurement circuit shall not exceed ±5 %.

For the type test, the rheostat is varied from 0 Ω to 5 kΩ in order to obtain the highest peak value of the voltage measured with these loads of 200 Ω to 5,2 kΩ. This measurement is repeated with the two connections to the measuring apparatus reversed.

The rheostat resistance and connection that produces the highest value of the voltage may be determined during the type test. This resistance and lead polarity may be used for the routine test.

11.2 Type test values of the conventional load voltage

11.2.1 Manual metal arc welding with covered electrodes

$U_2 = (18 + 0{,}04\ I_2)$ V

11.2.2 Tungsten inert gas

$U_2 = (10 + 0{,}04\ I_2)$ V

11.2.3 Metal inert/active gas and flux cored arc welding

$U_2 = (14 + 0{,}05\ I_2)$ V

11.2.4 Plasma cutting

$U_2 = (80 + 0{,}4\ I_2)$ V

For plasma cutting using air, the manufacturer may specify the load voltage as determined under typical cutting conditions.

11.2.5 Plasma welding

$U_2 = (25 + 0{,}04\ I_2)$ V

11.2.6 Measurement

Throughout its range of adjustment, the welding power sources shall be capable of supplying conventional welding currents (I_2) at conventional load voltages (U_2) in accordance with 11.2.1 to 11.2.5.

Conformity shall be checked by sufficient measurements (see annex H of IEC 60974-1).

11.3 Mechanical switching devices used to adjust output

A switch, contactor, circuit-breaker or other control device used to adjust or control the level of output from the welding power source shall have endurance suitable for the application.

Conformity shall be checked by the following test:

The device is installed in a test welding power source and subjected to 600 cycles of operation over the complete range of mechanical movement with the output at the no-load condition. If the device is in the supply circuit, the welding power source is operated at the highest rated supply voltage. Check that no electrical or mechanical failure of the device or damage to the welding power source occurs.

NOTE A component having demonstrated that it passes these tests may be used in other similar applications, if the other requirements are equal or less.

11.4 Welding circuit connections

11.4.1 Protection against unintentional contact

See 11.4.1 of IEC 60974-1.

11.4.2 Location of coupling devices

See 11.4.2 of IEC 60974-1.

11.4.3 Outlet openings

See 11.4.3 of IEC 60974-1.

11.4.4 Marking

See 11.4.5 of IEC 60974-1.

11.4.5 Connections for plasma cutting torches

See 11.4.6 of IEC 60974-1.

11.5 Power supply to external devices

See 11.5 of IEC 60974-1.

11.6 Auxiliary power output

See 11.6 of IEC 60974-1.

11.7 Welding cables

See 11.7 of IEC 60974-1.

12 Control circuits

Control circuits not connected to the welding circuit shall meet the following requirements.

a) The supply voltage of control circuits shall not exceed 277 V.
b) The working voltage of control circuits that leave the enclosure of the welding power source shall be SELV.
c) A transformer with separate windings shall be used for supplying the control circuits.
d) Overcurrent protection shall be provided.
e) Single-fault conditions that may impair safety shall be evaluated.
f) Transformer secondary, except for SELV, circuits shall be grounded.
g) Insulation of bundled conductors shall be rated to the highest voltage of any of the conductors.
h) Software and logic circuits shall not affect safety negatively.
i) Control circuits that leave the enclosure shall be isolated from the primary circuit by double or reinforced insulation.

Conformity shall be checked by measurement or analysis, as appropriate.

NOTE Types of control circuits:

a) control circuits that are internal to the welding/cutting equipment enclosure;

b) control circuits intended for interface between the power source and peripheral equipment designed by the manufacturer;

c) control circuits intended for interfacing between the power source and other types of ancillary equipment;

d) control circuits intended for inside the gas console.

13 Hazard reducing device

13.1 General

Hazard reducing devices are only applicable to plasma cutting power source with a rated no-load voltage exceeding 113 V.

Conformity of hazard reducing device shall be checked in accordance with 13.1 of IEC 60974-1.

13.2 Voltage reducing device

A voltage reducing device shall have automatically reduced the rated no-load voltage to the reduced level given in 11.1.1 at the moment the resistance of the external welding circuit exceeds 200 Ω.

NOTE It is recommended that the reduced rated no-load voltage should be as low as practicable.

Conformity shall be checked by connecting a variable load resistor across the welding output connections of the welding power source. Voltage measurements and operating time are taken while the resistance is being increased.

14 Mechanical provisions

14.1 General requirements

See 14.1 of IEC 60974-1.

14.2 Enclosure

14.2.1 Enclosure materials

See 14.2.1 of IEC 60974-1.

14.2.2 Enclosure strength

See 14.2.2 of IEC 60974-1.

14.3 Handling means

See 14.3 of IEC 60974-1.

14.4 Drop withstand

See 14.4 of IEC 60974-1.

14.5 Tilting stability

See 14.5 of IEC 60974-1.

15 Ancillary Equipment

15.1 General

Ancillary equipments used with power sources designed for use by layman shall fulfil the requirement of this part of IEC 60974.

15.2 Wire feeder

15.2.1 General

Wire feeder shall be mechanically attached or built into the power source and comply with the requirement of IEC 60974-5 with the exemption of the following.

15.2.2 Test conditions

Test conditions shall be in accordance with this part of IEC 60974.

15.2.3 Thermal requirements

Thermal requirement shall be in accordance with this part of IEC 60974.

15.3 Torch

15.3.1 General

Torch shall comply with the requirement of IEC 60974-7 with the exemption of the following.

15.3.2 Test conditions

Test conditions shall be in accordance with this part of IEC 60974.

15.3.3 Thermal requirements

Thermal requirement shall be in accordance with this part of IEC 60974.

15.4 Electrode holder

Only type A electrode holder in accordance with IEC 60974-11 shall be delivered with the welding power source designed in accordance with this part of IEC 60974.

15.5 Pressure regulator

Pressure regulator delivered with the welding power source shall be designed in accordance with ISO 2503.

16 Rating plate

16.1 General requirements

See 15.1 of IEC 60974-1.

16.2 Description

The rating plate shall be divided into sections containing information and data for the

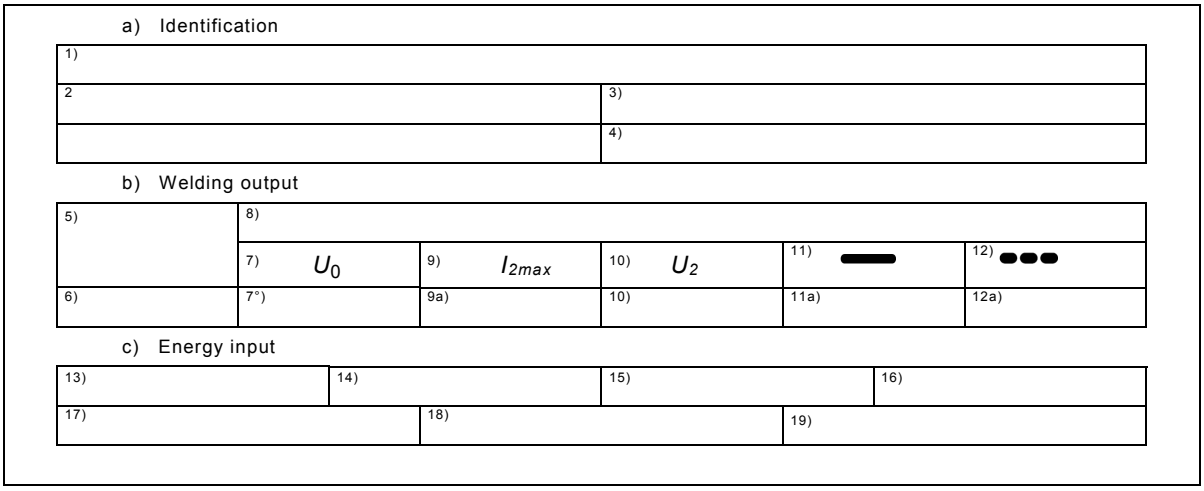
a) identification;
b) welding output;
c) energy input.

The arrangement and sequence of the data shall comply with the principle shown in Figure 16.1 (for examples, see Annex A).

The dimensions of the rating plate are not specified and may be chosen freely.

It is permissible to separate the above sections from each other and affix them at locations more accessible or convenient for the user.

NOTE Additional information may be given. Further useful information, for example class of insulation, pollution degree or power factor, may be given in technical literature supplied by the manufacturer, (see Clause 18).



Key See 16.3.

Figure 16.1 – Principle of the rating plate

16.3 Contents

The following explanations refer to the numbered boxes shown in Figure 16.1.

a) Identification

Box 1 Name and address of the manufacturer or distributor or importer and, optionally, a trade mark and the country of origin, if required.

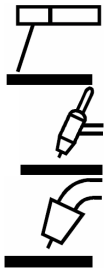
Box 2 Type (identification) as given by the manufacturer.

Box 3 Traceability of design and manufacturing data, for example serial number.

Box 4 Reference to the standards confirming that the welding power source complies with their requirements.

b) Welding output

Box 5 Welding process symbol e.g.:



Manual metal arc welding with covered electrodes

Tungsten inert-gas welding

Metal inert and active gas welding including the use of flux cored wire

Selfshielded flux cored arc welding

Plasma cutting

Plasma welding

Box 6 Welding current symbol e.g.:

Direct current
Alternating current, and additionally the rated frequency in Hertz e.g.: ~50Hz

Direct or alternating current at the same output, and additionally the rated frequency in Hertz

Rated value at an ambient temperature of 20 °C.

Box 7a) U_0..V Rated no-load voltage

a) Arithmetic mean value in case of direct current;

b) R.M.S. value in case of alternating current.

Box 8 .. A/..V The maximum welding current and the corresponding conventional load voltage shall be given.

Box 9a) I_{2max}..A rated maximum welding current;

Box 10a) U_2..V Values of the conventional load voltage.

Box 11a) ▬ rated maximum welding time $t_{ON}(\max)$ in continuous mode at the rated maximum welding current, see 7.1.3 (b), expressed in minutes and seconds;

Box 12a) ▬▬▬ rated maximum welding time $\sum t_{ON}(i)$ in intermittent mode at the rated maximum welding current during an uninterrupted time of 60 minutes see 7.1.3 (d), expressed in minutes and seconds;

c) Energy input

Box 13 Energy input symbol e.g.:

Supply circuit, number of phase (1) symbol for alternating current and the rated frequency (e.g. 50 Hz or 60 Hz)

Engine

Box 14 U_1... V Rated supply voltage;

Box 15 I_{1max}. A Rated maximum supply current;

Box 16 I_{1eff}... A Maximum effective supply current;

Box 17  IS0 7000-626 “keep away from rain”.

Box 18 IP.. Degree of protection, for example IP21 or IP23.

Box 19  Symbol for class II equipment, if applicable.

16.4 Tolerances

Manufacturers shall meet rating plate values within the following tolerances by controlling component and manufacturing tolerances:

a) U_0 rated no-load voltage in V ± 5 % measured in accordance with 11.1, but in no case shall the values summarized in Table 1 be exceeded;

b) I_{2min} rated minimum welding current in A;
U_{2min} minimum conventional load voltage in V;
The values of b) shall not be greater than those stated on the rating plate.

c) I_{2max} rated maximum welding current in A;
U_{2max} maximum conventional load voltage in V;
The values of c) shall not be less than those stated on the rating plate.

d) n_0 rated no-load speed of rotation in min^{-1} ±5 %;

e) P_{1max} maximum power consumption in kW $^{+10}_{0}$ %;

f) I_{1max} rated maximum supply current in A ±10 %.

Conformity shall be checked by measuring under conventional welding conditions (see 3.17 of IEC 60974-1).

17 Adjustment of the output

See 16 of IEC 60974-1.

18 Instructions and markings

18.1 Instructions

18.1.1 General

Each welding power source shall be delivered with an instruction manual and safety instructions.

18.1.2 Instruction manual

The instruction manual shall include the following (as applicable):

a) general description;

b) precautions to be taken with gas cylinders and pressure regulator;

c) the meaning of indications, markings and graphical symbols;

d) information on connection to the supply network, fuse and/or circuit-breaker rating;

e) correct operational use relating to the welding power sources (for example cooling requirements, location, control device, indicators, fuel type);

f) welding capability, limitations and explanation of thermal protection;

g) limitations of use relating to the degree of protection provided, for example welding power sources are not suitable for use in rain or snow;

h) how to maintain the welding power source (for example cleaning);

i) warning against the use of a welding power source for pipe thawing;

j) pressure, flow rate and type of shielding gas;

18.1.3 Safety instructions

The safety instructions shall include the following basic guidelines or equivalent regarding protection against personal hazards for persons in the area.

a) Risk of electric shock:
Electric shock from welding electrode can kill. Wear dry insulating gloves. Do not touch electrode with bare hands. Do not wear wet or damaged gloves. Protect yourself from electric shock by insulating yourself from workpiece. Do not open the equipment enclosure.

b) Risk induced by the welding fumes:
Breathing welding fumes can be hazardous to your health. Keep your head out of the fumes. Use equipment in an open area. Use ventilating fan to remove fumes.

c) Risk induced by the welding sparks:
Welding sparks can cause explosion or fire. Keep flammables away from welding. Don’t weld near flammables. Welding sparks can cause fires. Have a fire extinguisher nearby and have a watchperson ready to use it. Do not weld on drums or any closed containers.

d) Risk induced by arc rays:
Arc rays can burn eyes and injure skin. Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.

e) Risk induced by electromagnetic field:
Welding current produces electromagnetic field. Do not use with medical implants. Never coil welding cables around your body. Route the welding cables together.

18.2 Markings

Each welding power source shall be clearly, visibly and indelibly marked with the following combination of symbols or equivalent:

Caution! Read instruction manual

Electric shock from welding electrode can kill

Breathing welding fumes can be hazardous to your health

Welding sparks can cause explosion or fire

Arc rays can burn eyes and injure skin

Electromagnetic field can cause pacemaker malfunction

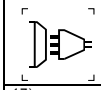
Each welding power source shall be clearly, visibly and indelibly marked with precautionary labels that contain the safety instructions. Precautionary labels may consist of text only, text and symbols, or symbols only. Where symbols-only precautionary labels are used, it is recommended that these labels follow ISO 17846. An example of symbols-only precautionary label is given in Annex B.

Conformity shall be checked by visual inspection and by testing in accordance with the durability test in 16.1.

Annex A
(informative)
Examples of rating plates

1) Manufacturer Address	Trademark
2) Type	3) Serial number
	4) IEC 60974-6

5) 	8) 15 A / 18,6 V to 140 A / 23,6 V				
	7) U_0	9) I_{2max}	10) U_2	11)	12)
6) 	7a) 48 V	9a) 140 A	10) 23,6 V	11a) 2’30’’	12a) 7’36’’

13)  1 ~ 50 Hz	14) U_1 = 230 V	15) I_{1max} = 27 A	16) I_{1eff} = 8 A
17) 	18) IP21S	19) 	

Annex B
(informative)
Symbols-only precautionary label

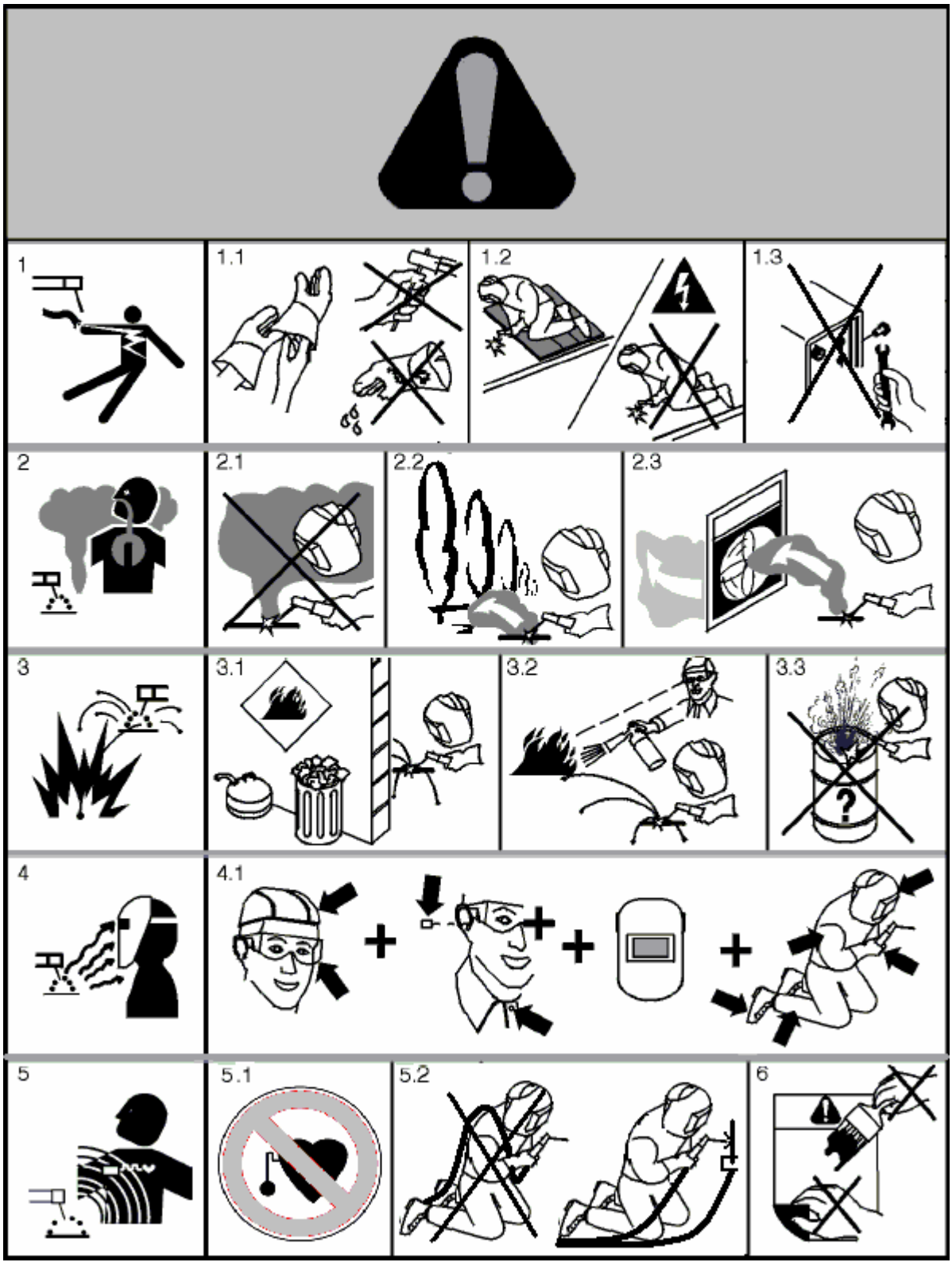


Figure B.1 – Manual metal arc welding equipment with reduced no-load voltage in accordance 11.1.1