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Arc Welding Equipment—
Part 12: Coupling Devices for Welding Cables

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FOREWORD FOR U.S. ADOPTION

This American National Standard is an adoption of IEC 60974-12, edition 2, *Arc welding equipment – Part 12: Coupling devices for welding cables*, and was developed and approved in accordance with procedures set forth by the American National Standards Institute. Any reference in this standard to an IEC 60974 part is understood to mean a reference to the equivalent ANSI/NEMA/IEC 60974 part, where it exists.

ANSI/NEMA/IEC 60974-12-2009 (R2020) is a reaffirmation of ANSI/NEMA/IEC 60974-12-2009. No substantive changes were made to the document during this reaffirmation.

This standard contains all the original text from IEC 60974-12, edition 2, in addition to a number of U.S. Differences to the IEC standard that were identified by Accredited Standards Committee W1, *Requirements for Apparatus Designed for Use in Arc Welding, Plasma Arc Cutting, and Allied Processes.* Each U.S. Difference is found both in a compilation of U.S. Differences following this foreword, and inserted in the appropriate place(s) in the standard relating to the difference. Each insertion is in red text and is marked by three lines on its left (two thin, one thick). Each difference is identified with the following format:

[Clause/Subclause Number]DV[Number of Difference for the Given Clause/Subclause]

Following this format, the example 17.1DV.3 signifies that it is the third U.S. Difference to subclause 17.1.

Suggestions for the improvement of this standard are welcome and should be submitted to the Secretariat of Accredited Standards Committee W1 as follows:

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This standard was processed and approved by the Accredited Standards Committee W1. Committee approval does not necessarily imply that all Committee members voted for its approval. At the time this standard was approved, Accredited Standards Committee W1 consisted of the following members:

Greg Corban, Chair
Mike Madsen, Vice-Chair
Khaled Masri, Secretary

Name		Organization	Voting Status	Interest Category
Andrew	Davis	American Welding Society	Alt. Voting	ANSI - GEN INTEREST
David	Werba	American Welding Society	Voting	ANSI - GEN INTEREST
David	Beneteau	CenterLine (Windsor) Limited	Voting	ANSI - GEN INTEREST
Jean-Pierre	Boivin	CSA Group - Certification	Voting	ANSI - USER
Ramana	Tangirala	CSA Group - Standards	Alt. Voting	ANSI - USER
Sam	Zaffino	CSA Group - Certification	Alt. Voting	ANSI - USER
Lorenzo	Tiracchia	CSA Group - Standards	Voting	ANSI - GEN INTEREST
Carlos	De Lima	ESAB Welding & Cutting Products	Voting	ANSI - PRODUCER
Gregory	Corban	Hypertherm Incorporated	Voting	ANSI - PRODUCER

Patrick	Salas	Hypertherm Incorporated	Alt. Voting	ANSI - PRODUCER
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Michael	Madsen	Miller Electric Mfg. LLC An ITW Welding Company	Voting	ANSI - PRODUCER
John	Freudenberg	Northeast Product Safety Society	Voting	ANSI - GEN INTEREST
Christopher	Doty	UL LLC	Voting	ANSI - USER

COMPILATION OF U.S. DIFFERENCES

NOTE This section is an integral part of American National Standard ANSI/NEMA/IEC 60974-12. See the section "Foreword for U.S. Adoption" for an explanation of the format used to identify U.S. Differences.

ForewordDV.1 Modify the foreword by adding the following:

The numbering system in this standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

GlobalDV.1 Throughout this document, replace the phrase "this part of IEC 60974" with "this part of ANSI/NEMA/IEC 60974"

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

ARC WELDING EQUIPMENT –

Part 12: Coupling devices for welding cables

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). 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. 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 60974-12 has been prepared by IEC technical committee 26: Electric welding.

This second edition cancels and replaces the first edition published in 1992. This edition constitutes a technical revision.

Major changes with respect to the first edition are the following:

- An operation capability requirement has been added to item b) of Clause 4).
- Tables 1 and 6 have slightly changed values and consider only a 60 % duty cycle.
- Subclause 7.1 “Voltage rating” has been newly introduced.
- Under 7.3 “Dielectric strength”, the paragraphs 2 and 5 are newly introduced to consider arc striking and stabilizing devices.
- Examples and design recommendations have been removed from the normative part of the document and introduced in Annex A.

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

FDIS	Report on voting
26/303/FDIS	26/309/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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60974 consists of the following parts, under the general title *Arc welding equipment*:

Part 1: Welding power sources
Part 2: Liquid cooling systems
Part 3: Arc striking and stabilizing devices
Part 4: Safety, maintenance and inspection of arc welding equipment in use [1]
Part 5: Wire feeders
Part 6: Limited duty manual metal arc welding power sources
Part 7: Torches
Part 8: Gas consoles for welding and plasma cutting systems
Part 10: Electromagnetic compatibility (EMC) requirements
Part 11: Electrode holders
Part 12: Coupling devices for welding cables

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.

ForewordDV.1 Modify the foreword by adding the following:

The numbering system in this standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

[1] Under consideration.

ARC WELDING EQUIPMENT –

Part 12: Coupling devices for welding cables

GlobalDV.1 Throughout this document, replace the phrase "this part of IEC 60974" with "this part of ANSI/NEMA/IEC 60974"

1 Scope

This part of IEC 60974 is applicable to coupling devices for cables for welding and allied processes designed for connection and disconnection without using tools.

This part of IEC 60974 specifies safety and performance requirements of coupling devices.

This part of IEC 60974 is not applicable to coupling devices for underwater welding.

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 60050(151): *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-151, IEC 60974-1, as well as the following apply.

3.1
coupling device
device connecting two welding cables together or connecting a welding cable to welding equipment

3.2
rated current
current assigned by the manufacturer that the coupling device can accept at 60 % duty cycle without exceeding the permitted temperature rise

3.3
retaining means
mechanical arrangement that holds the coupling device in position and prevents an unintentional withdrawal, when properly connected

3.4
arc striking and stabilizing voltage
voltage superimposed on the welding circuit to initiate or maintain the arc

4 Environmental conditions

The coupling device shall be capable of operation when the following environmental conditions prevail:

a) ambient air temperature:
   – during operation: –10 °C to +40 °C;
   – after transport and storage: –25 °C to +55 °C;
b) relative humidity of the air: up to 90 % at 20 °C.

5 Type tests

5.1 Test conditions

All type tests shall be carried out on the same new and completely assembled coupling device.

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

The accuracy of measuring instruments shall be:

a) electrical measuring instruments: class 0,5 (±0,5 % 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 devices: ±2 K.

5.2 Test sequence

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

a) general visual inspection;
b) temperature rise, see 8.1;
c) crush strength, see 9.5;
d) insulation resistance, see 7.2;
e) dielectric strength, see 7.3.

The other type tests in this part of IEC 60974 not mentioned above may be carried out in any convenient sequence.

6 Designation

Coupling devices shall be designated by the value of the rated current at 60 % duty cycle. This value shall relate to the minimum fitting range for welding cables in accordance with Table 1.

Table 1 – Relation between coupling device rated current and welding cables

Coupling device rated current at 60 % duty cycle A	Minimum fitting range for welding cable cross-sectional area mm^2
125	up to 10
150	10 to 16
200	16 to 25
250	25 to 35
300	35 to 50
400	50 to 70
500	70 to 95
NOTE Welding cables, the coverings of which are not capable of withstanding a conductor temperature of 85 °C will be damaged if the coupling devices are used at the rated current given above in an ambient air temperature of 40 °C.	

Conformity shall be checked by measurement.

7 Protection against electric shock

7.1 Voltage rating

Coupling devices shall be rated in accordance with the process as given in Table 2 and the arc striking and stabilizing voltage if applicable.

Table 2 – Voltage rating of coupling devices

Process	Voltage rating V peak	Insulation resistance MΩ	Dielectric strength V r.m.s.	Degree of protection in accordance with IEC 60529
All processes except plasma cutting	113	2,5	1 000	IP 3X
Plasma cutting	500	2,5	2 100	IP 3X

7.2 Insulation resistance

The insulation resistance of a new coupling device shall, after the humidity treatment, be not less than 2,5 MΩ.

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 within ± 1 K and a relative humidity between 91 % and 95 %.

The coupling device without cables fitted 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 coupling device is wiped clean and tightly wrapped in a metal foil covering the external surface of the insulation.

The insulation resistance is measured by application of a d.c. voltage of 500 V between the live parts and the metal foil, the reading being made after stabilization of the measurement.

7.3 Dielectric strength

The insulation shall withstand an a.c. test voltage of 1 000 V r.m.s. without flashover or breakdown. Any discharges unaccompanied by a voltage drop are disregarded.

In addition, for couplers for use with arc striking and stabilizing voltage, the insulation shall withstand the rated peak arc striking and stabilizing voltage as rated by the manufacturer. The insulation shall withstand a high frequency voltage of pulse width 0,2 µs to 8 µs, a repetition frequency of 50 Hz to 300 Hz and shall be 20 % higher than the rated peak arc striking and stabilizing voltage as determined by the manufacturer.

Conformity shall be checked by the following test.

The coupling device is wiped clean and tightly wrapped in a metal foil covering the external surface of the insulation.

The a.c. test voltage shall be of an approximate sine waveform with a peak value not exceeding 1,45 times the r.m.s. value, having a frequency of 50 Hz or 60 Hz, applied for 1 min between the live parts and the metal foil.

For couplers intended for use with arc striking and stabilizing voltage, the couplers shall be subjected to the high-frequency test voltage. The full value of the high-frequency voltage is applied for 2 s between the electrode circuit and

a) conductive surfaces;

b) other isolated circuits.

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

Alternatively, for couplers intended for use with arc striking and stabilizing voltage, an a.c. test voltage of approximately sine waveform at 50 Hz or 60 Hz may be used.

7.4 Protection of live parts against unintentional contact

Parts designed to carry welding current and likely to be live after disconnection shall be recessed to a depth of at least 10 % of the internal diameter of the insulation with a minimum depth of 2 mm with respect to the insulating body.

As a consequence, insulation has to be able to withstand normal service conditions so that the protecting length is maintained during the life of the coupling device.

Conformity shall be checked by linear measurement and visual inspection.

8 Thermal rating

8.1 Temperature rise

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

a) at the hottest spot of the external surface: 40 K;

b) at the connection of the welding cable to the coupling device: 45 K.

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

Conformity shall be checked by the following test.

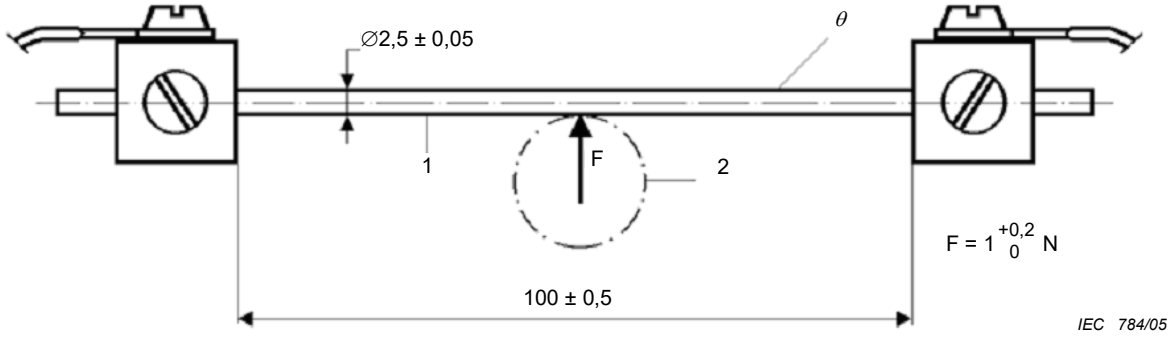
The coupling device is normally coupled and fitted with at least 2 m long welding cables. The coupling device is suspended by its welding cables from two wooden laths 1 m apart, hanging between the two laths in the horizontal plane about 200 mm above the ground in a draught-free area.

A d.c. current equal to 75 % of the rated current (equivalent to approximately 60 % duty cycle (duty factor)) is passed through the coupling device until the rate of the temperature rise does not exceed 2 K/h. During the total test time, the d.c. rated current shall be kept constant with a tolerance of ±2 %.

8.2 Resistance to hot objects

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

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



Key *Dimensions in millimetres*

1 18/8 chrome-nickel steel

2 coupling device

θ test temperature

Figure 1 – Device for testing the resistance to hot objects

An electric current (of approximately 25 A) is passed through the rod until a steady-state temperature θ of 300 $^{+5}_{0}$ °C is reached. During the test, the temperature of the heated rod shall be maintained. This temperature will be measured by a contact thermometer or thermocouple.

The heated rod in a horizontal position is then applied for 2 min to the insulation at the weakest point (for example, minimum insulation thickness and closest distance to live parts). The heated rod shall not penetrate through the insulation and contact live parts.

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

9 Mechanical requirements

9.1 Retaining means

A retaining means shall be provided to prevent the unintentional separation of the coupling device as a result of a longitudinal pull.

NOTE If possible, indicating marks, for example two lines opposite each other, should show by visual inspection that the retaining means has functioned.

Conformity shall be checked by manual operation and visual inspection.

9.2 Welding cable entry

The cable entries of cable couplers shall be designed so as to prevent damage to the cable due to flexing.

Conformity shall be checked by visual inspection.

9.3 Penetration of the welding cable insulation

The design of cable couplers shall be such that the insulation of the cables can enter to a depth of at least twice the outer diameter of the welding cable with a minimum of 30 mm.

Conformity shall be checked by measurement with a welding cable of the maximum cross-sectional area as specified by the manufacturer.

9.4 Welding cable connection

The design of the coupling device shall be such that welding cables with a cross-sectional area within the range as specified by the manufacturer can be replaced. The connection shall withstand the mechanical stress of the tensile test without separation.

Conformity shall be checked by visual inspection and by the following test.

A plug, a connector or a plug connector is fitted in accordance with the manufacturer's instructions, with a welding cable of maximum cross-sectional area. The connection is subjected to 10 pulls with a force of 40 N/mm² of the cross-sectional area with a maximum of 2 000 N applied to the welding cable. The force of each pull is gradually increased from zero to the specified value in 1 s and maintained for a further 1 s.

After the test, the conductor shall not have been noticeably displaced.

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

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

9.5 Crush strength

Coupling devices shall withstand the mechanical stress of the crush test without the insulation being destroyed or the mechanical functioning being impaired.

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

A cable coupler connected and fitted, in accordance with the manufacturer's instructions, with welding cables of maximum cross-sectional area is placed between the parallel plates of a press, the axis of the cable coupler being at a right angle to the direction of the crush force.

The crush force is applied and gradually increased up to the values given in Table 3.

Table 3 – Crush force

Cross-sectional area of welding cable mm^2	Crush force N
up to 25	1 200
25 to 50	1 500
above 50	2 000

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

9.6 Dimensions

An example of dimensions for coupling devices is given in Annex A.

10 Marking

The following information shall be legibly and indelibly marked on each part of a coupling device:

a) name of the manufacturer, distributor, importer or the registered trademark;
b) maximum permissible cross-sectional area of the welding cable;
c) minimum permissible cross-sectional area of the welding cable;
d) rated peak arc striking and stabilizing voltage if applicable;
e) reference to this part of IEC 60974, confirming that the coupling device complies with the requirements.

For coupling devices having a rated current of 125 A or 150 A, the dimensions of which are such that it is not possible to put on all the markings clearly, item c) can be omitted and shown on the packing or in the literature.

Conformity shall be checked by reading the marking.

11 Instructions for use

Each coupling device shall be delivered with an instruction sheet which includes the following information:

a) correct coupling and uncoupling of the coupling device;

b) correct connection of the welding cable;

c) choice of welding cable, type and size;

d) relation of permissible current and duty cycle.

Conformity shall be checked by reading the instructions.

Annex A
(informative)

Dimensions

Coupling devices in accordance with this part of IEC 60974 should have the dimensions specified in Figures A.1 and A.2 and in Table A.1.

NOTE The locking pin can be optionally cylindrical, conical or prismatic.

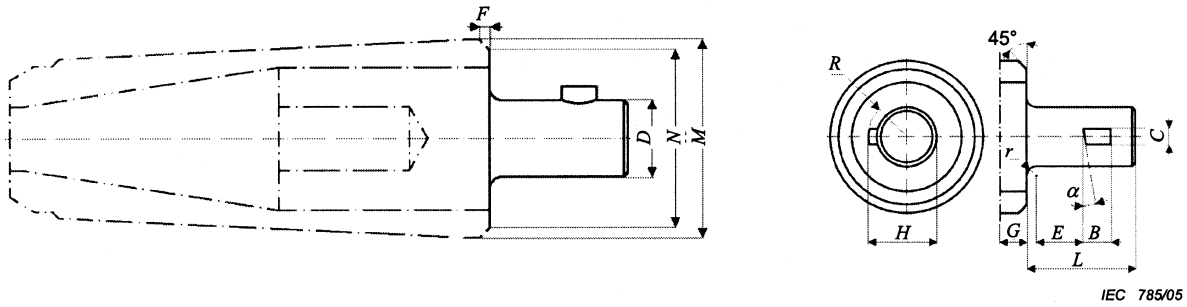


Figure A.1 – Male element

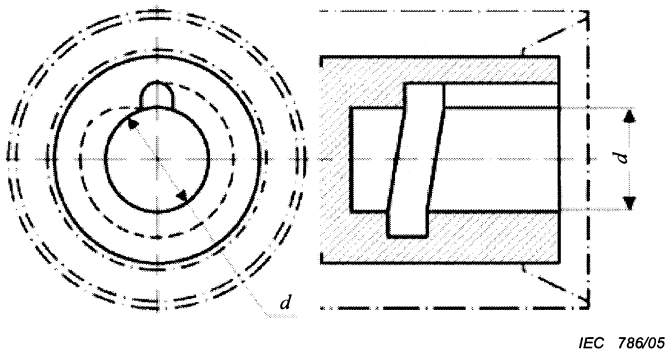


Figure A.2 – Female element

Dimensions and details not specified in Figures A.1 and A.2 and Table A.1 are left to the discretion of the manufacturer.

Table A.1 – Dimensions for Figures A.1 and A.2

Dimension		Dimension in millimetres or degrees		
		Type 1	Type 2	Type 3
α		4	5	1°40'
r		0,4	0,4	0,4
d		$9^{+0,08}_{+0,02}$	$13^{+0,08}_{+0,02}$	$15^{+0,08}_{+0,02}$
R	max.	6	8,7	10
N	max.	16	27	30
M	max.	26	40	45
H	max.	11	15,5	17,5
G	min.	6,5	7	7
F	min.	2	2,5	6
$E + r$		$4,65^{+0,1}_{0}$	$10,04^{+0,1}_{0}$	$15^{+0,1}_{0}$
D		$9^{-0,01}_{-0,1}$	$13^{-0,01}_{-0,1}$	$15^{-0,01}_{-0,1}$
C	max.	4,5	5,2	6
B	max.	4,5	5,2	6
L	max.	12	20	26

§