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NORME INTERNATIONALE

Arc welding equipment –
Part 14: Calibration, validation and consistency testing
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Matériel de soudage à l'arc –
Partie 14: Etalonnage, validation et essais de consistance
IEC 60974-14:2018
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ARC WELDING EQUIPMENT –

Part 14: CALIBRATION, VALIDATION and CONSISTENCY TESTING

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International Standard IEC 60974-14 has been prepared by IEC technical committee TC 26: Electric welding.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
26/661/FDIS	26/666/RVD

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

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

In this standard, the following print types are used:

- terms used throughout this standard which have been defined in clause 3: SMALL ROMAN CAPITALS.

A list of all parts of the IEC 60974 series can be found, under the general title *Arc welding equipment*, on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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INTRODUCTION

This document is the first international edition for CALIBRATION, VALIDATION and CONSISTENCY TESTING of arc welding equipment. It is based on the European Standard EN 50504:2008 and will replace it. A brief history helps to understand the origin and development of this document.

In Great Britain, BS 7570:1992, *Code of practice for the validation of arc welding equipment*, was published and it became the equivalent European pre-standard ENV 50184:1996 (withdrawn).

The revised second edition of BS 7570 was published in 2000 and was later replaced by the equivalent EN 50504:2008.

For quality management in the field of welding, this document should be used in conjunction with ISO 17662.

The significant changes in respect to EN 50504:2008 are the following:

- terms VERIFICATION and VALIDATION aligned to ISO/IEC Guide 99:2007;
- wire feed equipment moved from the annex to main part of the document;
- new preferred requirement for digital instrument CALIBRATION with fixed tolerance values;
- flow charts for determination of VERIFICATION methods and sample reports added;
- EN 50504:2008 Annex E *Validation of ancillary components in a welding system* and Annex F *Voltage drops in the welding circuit* deleted.

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ARC WELDING EQUIPMENT –

Part 14: CALIBRATION, VALIDATION and CONSISTENCY TESTING

1 Scope

This part of IEC 60974 specifies requirements for the VERIFICATION of arc welding and external monitoring equipment. This document also serves for practical implementation of the VERIFICATION procedure for arc welding equipment.

This document can be applied at the time of installation and any other times or intervals the user deems appropriate to ensure the equipment is capable of operating to the manufacturer's specification or other specifications deemed applicable by the user.

This document is not applicable to

- plasma systems used for cutting and gouging;
- arc striking and stabilizing devices;
- arc welding equipment designed in accordance with IEC 60974-6.

NOTE 1 Other components in welding systems such as for example robots, turning devices, gas consoles, etc. also have influence on the welding result and can be verified, if necessary. Additional information can be found in ISO 17662.

NOTE 2 Periodic inspection and testing for arc welding equipment is covered in IEC 60974-4.

This document is applicable for the user, service shop or manufacturer. It can be used

- stand alone;
- in conjunction with manufacturer's instructions; or
- as the basis for an equivalent VERIFICATION procedure written by the manufacturer for specific equipment.

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

3.1 displayed value

<at equipment> measured value by internal instrument and shown at the equipment

Note 1 to entry: In some cases, the same display can be used for both SET VALUES and measured values. In such cases the DISPLAYED VALUE is usually visible during welding.

3.2 set value

value chosen and set by the operator or by an automatic system

[SOURCE: IEC 60050-811:2017, 811-11-34, modified – Reference to motor vehicle and driver removed.]

3.3 reference value

measurement value obtained by the reference instrument and used as a basis for comparison with values of the same kind

3.4 expert competent person skilled person

person who can judge the work assigned and recognize possible hazards on the basis of professional training, knowledge, experience and knowledge of the relevant equipment

Note 1 to entry: Several years of practice in the relevant technical field can be taken into consideration in assessment of professional training.

[SOURCE: IEC 60050-851:2008, 851-11-10]

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3.5 verification

operations for the purpose of demonstrating that an item of welding equipment or a welding system conforms to the operating parameters for that welding equipment or system

3.6 calibration

set of operations which establishes, by reference to standards, the relationship which exists, under specified conditions, between a DISPLAYED VALUE and a REFERENCE VALUE

[SOURCE: IEC 60050-311:2001, 311-01-09, modified – Notes removed and terms "DISPLAYED VALUE" and "REFERENCE VALUE" used.]

3.7 validation

operations for the purpose of demonstrating that a SET VALUE meets the REFERENCE VALUE (within specified limits)

3.8 consistency test

test to determine the repeatability of the equipment output over a period of time

3.9 standard grade

equipment verified to meet the accuracy for indication and meters required by IEC 60974-1 or IEC 60974-5

3.10

precision grade

equipment verified to a higher level of accuracy for indication and meters than required by IEC 60974-1 or IEC 60974-5

4 Safety precautions

VERIFICATION requirements and procedures for power sources depend on the type of welding power source, i.e. whether these are power sources with "drooping characteristic" or with "flat characteristic".

NOTE Drooping characteristic is related to MMA/TIG welding (typically constant current) and flat characteristic is related to MIG/MAG/FCAW welding (typically constant voltage).

The output of a power source with flat characteristic should not be short-circuited, because a very high current can result. A load resistance shall be used.

Care should be taken that testing instruments are not damaged. See Annex D.

For tungsten inert gas (TIG) equipment, the arc striking and stabilizing device shall be switched off or be deactivated by other means. See Annex D.

If verifying with an arc, follow all local and national safety regulation and safety precautions specified by the manufacturer.

5 Testing personnel

Welding equipment shall be tested by an EXPERT with suitable qualifications, corresponding experience and sufficient training in welding and measurement technology, with knowledge of electrical hazards that may occur and the required protective measures.

6 VERIFICATION accuracies – permitted deviations

For welding equipment that measures and displays current, voltage and/or wire feed speed (DISPLAYED VALUE), the CALIBRATION accuracies given in Table 1 shall be used for the tests. Current and voltage CALIBRATION are performed according to 7.3.2. For wire feed speed, instructions in 8.3 apply.

Table 1 – CALIBRATION accuracies of DISPLAYED VALUES

Measurement	Type of measuring instrument	STANDARD GRADE	PRECISION GRADE	Reference
Current	Analog	± 2,5 %	± 1 %	from upper range value of instrument
	Digital	± 2,5 %	± 1 %	of highest rated value for welding current according to rating plate
Voltage	Analog	± 2,5 %	± 1 %	from upper range value of instrument
	Digital	± 1,5 V or ± 2,5 %	± 0,6 V or ± 1 %	preferred method or of rated no-load voltage (U_0) or according to manufacturer's specifications
Wire feed speed	Analog or Digital	± 2,5 %		of maximum setting below 25 % of maximum setting
		± 10 %		of REFERENCE VALUE between 25 % and 100 % of maximum setting
	Analog or Digital		± 2,5 %	of maximum setting below 40 % of maximum setting
			± 6,25 %	of REFERENCE VALUE between 40 % and 100 % of maximum setting

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For welding equipment that uses SET VALUES for current, voltage and/or wire feed speed classified in physical units (e.g. V, A) VALIDATION accuracies given in Table 2 shall be used for the tests. Current and voltage VALIDATION are performed according to 7.3.3. For wire feed speed instructions in 8.3 apply.

NOTE For example a manual metal arc (MMA) typically has only a current SET VALUE.

Table 2 – VALIDATION accuracies of SET VALUES

SET VALUE	Grade	Accuracy	Reference	VALIDATION range
Current	Standard	± 2,5 %	of highest SET VALUE	below 25 % of highest SET VALUE
		± 10 %	of REFERENCE VALUE	25 % to 100 % of highest SET VALUE
	Precision	± 1 %	of highest SET VALUE	below 40 % of highest SET VALUE
		± 2,5 %	of REFERENCE VALUE	40 % to 100 % of highest SET VALUE
Voltage	Standard	± 2,5 %	of highest SET VALUE	below 25 % of highest SET VALUE
		± 10 %	of REFERENCE VALUE	25 % to 100 % of highest SET VALUE
	Precision	± 2 %	of highest SET VALUE	below 40 % of highest SET VALUE
		± 5 %	of REFERENCE VALUE	40 % to 100 % of highest SET VALUE
Wire feed speed	Standard	± 2,5 %	of highest setting	below 25 % of highest setting
		± 10 %	of REFERENCE VALUE	between 25 % and 100 % of highest setting
	Precision	± 2,5 %	of highest setting	below 40 % of highest setting
		± 6,25 %	of REFERENCE VALUE	between 40 % and 100 % of highest setting

See Annex A for diagrams of VERIFICATION accuracies established in Table 1 and Table 2.

7 Arc welding power sources

7.1 Selection related to CALIBRATION, VALIDATION or CONSISTENCY TESTING of process-relevant parameters

7.1.1 VERIFICATION method

Key parameters shall be verified. In general, these include current, voltage and wire feed speed.

The current wave shape shall be considered (see C.1). VERIFICATION is preferred in DC mode. Consult manufacturer for further specifications.

NOTE 1 Key parameters can be listed in a welding procedure specification (WPS).

Depending on the design of the welding equipment to be tested, either CALIBRATION, VALIDATION or CONSISTENCY TESTING shall be carried out (see Figure 1).

The DISPLAYED VALUE and REFERENCE VALUE measurements shall be taken at the same time or in a steady state output condition.

NOTE 2 The selection of voltage or current control mode helps to achieve steady state output conditions. Some welding power sources have control functions that can influence the measurements. Consult relevant manual or manufacturer.

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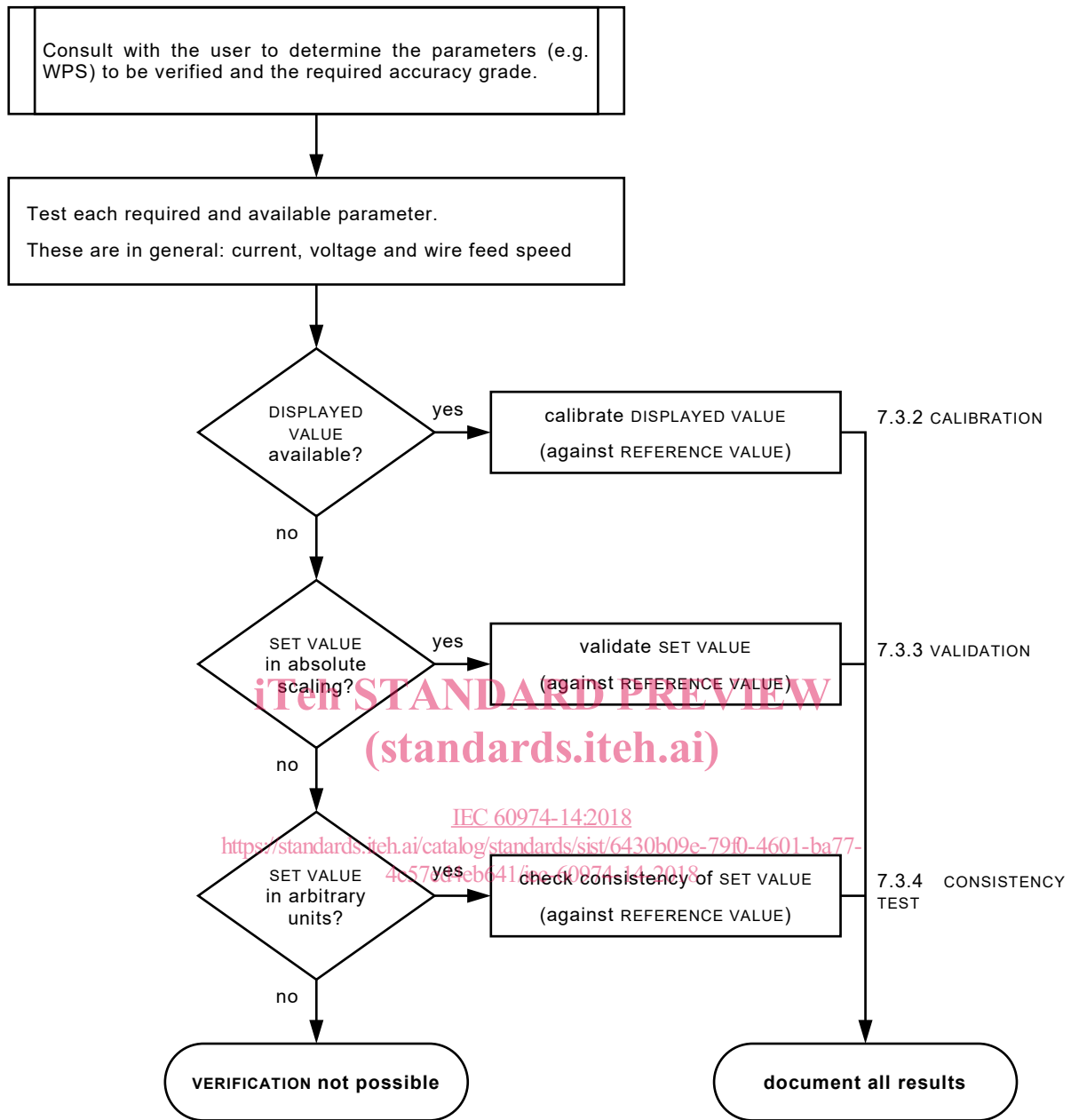


Figure 1 – Determination of VERIFICATION method

NOTE 3 Minimum requirements are shown. For equipment with a DISPLAYED VALUE, it is sufficient to perform CALIBRATION since the measured value is the most important VERIFICATION method. The user can perform additional VERIFICATION such as VALIDATION and CONSISTENCY TESTING.

7.1.2 Special features for AC determination of welding power source output mode for VERIFICATION

For power sources capable of AC and DC output modes, it is sufficient to verify them in DC mode (see Figure 2).

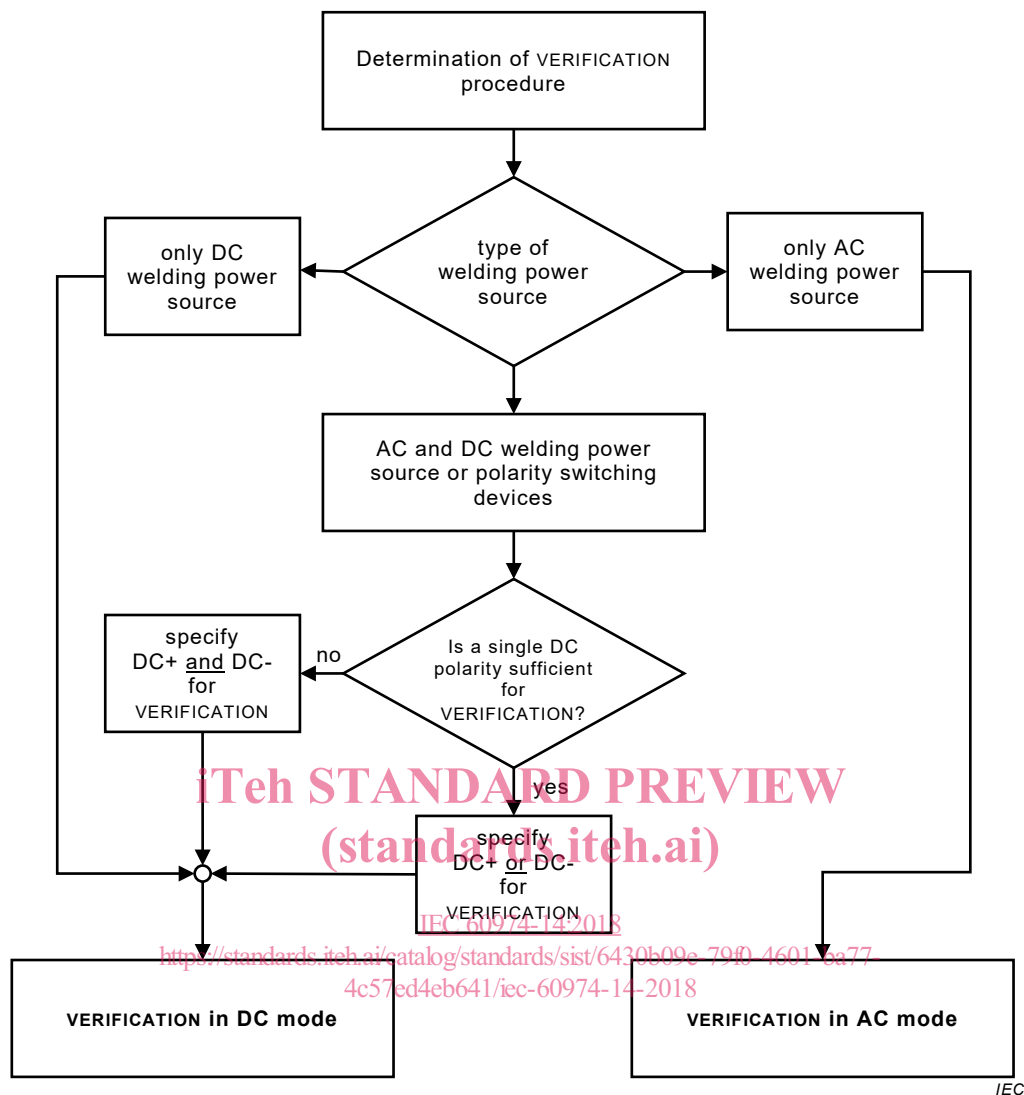


Figure 2 – Determination of VERIFICATION based on power source type

When verifying a pure AC power source, the aim is to identify the reproducibility of the output values of the AC power source under equal conditions (e.g. characteristic, voltage supply, load).

If it is determined for an AC and DC welding power source by the WPS requirements that VERIFICATION in AC mode is still necessary, refer to Annex B and Clause C.1 for additional information.