

# Code of practice for validation of arc welding equipment

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This British Standard has been prepared by Technical Committee WEE/6, Arc welding equipment, upon which the following bodies were represented:

- Association of Welding Distributors
- British Cable Makers' Confederation
- British Cables Association
- Cranfield University
- Institute of Electrical Engineers
- National Association of Arc Welding Equipment
- Offshore Contractors' Association
- Welding Institute
- Welding Manufacturers' Association

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## Foreword

This British Standard is published under the authority of committee WEE/6, Arc welding equipment. It supersedes BS 7570:1992, which is withdrawn.

Welding is considered to be a special process because the final result may not always be capable of being verified by testing, hence it requires continuous control and/or adherence to documented procedures.

The standard series BS EN 729, *Quality requirements for welding — Fusion welding of metallic materials*, has been published to identify the controls and procedures required. BS EN 729 requires the use of calibrated welding equipment, then the quality/consistency of the weld depends upon accurate and repeatable setting of parameters such as current, voltage, speed, gas flow, etc.

This new edition of BS 7570 has been written based on the experience gained in using BS 7570:1992 over the last few years.

This edition has been simplified and concentrates on validating equipment built to the constructional standard BS EN 60974-1. The accuracy of this equipment is designated as standard grade. A higher level of accuracy (precision grade) was introduced in BS 7570:1992, but this has not gained wide acceptance so is now included in annex A for information.

Annexes A to F are all informative.

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

A British Standard does not purport to include all necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover, and a back cover.

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## Introduction

The quality and consistency of a weld depends on the welder, the materials and the welding equipment. Variability in the output of the welding equipment will affect the quality of the weld. In some arc welding processes, e.g. MMA, the welder controls the process through his experience, and measurement of run out length is used to monitor the heat input. However, in other arc welding processes, the quality of the weld depends upon accurate and repeatable setting of parameters such as current, voltage, speed, gas flow, pulse characteristics etc.

The relevant construction standard for arc welding equipment is BS EN 60974-1. This standard sets the reference level for the accuracy and consistency of the welding output. BS EN 60974-1 derives its specification for performance accuracy from the requirements of manual welding. In manual welding the welder plays a key role in adapting and adjusting the output of the equipment to meet the requirements of the weld. This adaptability allows equipment to be constructed with a relaxed specification for calibration of output.

Mechanized welding methods lack the skilled adaptability of the manual welder and require precise control of all aspects of the welding process. The control of the output of the welding equipment is of particular importance. Manufacturers have responded to this need by producing equipment with an accuracy of output control and calibration which far exceed the requirements of BS EN 60974-1.

In addition to the demands of mechanized welding, manual welding methods have become more refined and welding procedures often call for the precise control of power source outputs to limit the freedom of the manual welder in order to produce particular results.

The improvement in equipment construction, the adoption of mechanized welding, the introduction of quality assurance programmes and the increased understanding of the factors which control weld quality have led to the demand for more rigorous calibration and validation of welding equipment performance.

The term calibration has been used in the foregoing text to introduce the general subject of checking that the welding equipment output meets the manufacturer's specification and is fit for the purpose of making welds. This is a commonly accepted term for this checking operation but it does not meet the strict definition of the word calibration.

Clause 3 of this document gives the definition of calibration. The operation of calibration can be applied only to determining and adjusting the errors of a measuring instrument. An item of welding equipment is not a measuring instrument though the meters fitted to the welding equipment are and can be calibrated. The difficulty of terminology and the

checking task is further compounded as many pieces of welding equipment do not have calibrated outputs but are scaled in arbitrary units. Again this is a function of the manual welding usage in which the skill of the manual welder is used to adjust and set the welding variables. It is necessary to use an alternative term to describe the operation of verifying that the welding equipment is fit for the intended purpose. The term selected is validation.

Validation is the operation which verifies that the welding equipment conforms to the operating specification for that equipment. If the equipment fails to conform to the specification then the correction of the errors within the equipment is outside the scope of this standard. That operation is the province of the manufacturers or equipment specialists.

It is implicit in the introduction of a more rigorous standard for accuracy of control of output for welding equipment that the scope of application of that standard should be defined. This standard defines two levels of accuracy. One is derived directly from BS EN 60974-1 and is called standard grade. A higher level of accuracy for more exacting welding applications is defined, called precision grade, and this is given in annex A for information. The use of precision grade is dependent upon the welding application.

The welding equipment covered by this standard will be fitted with controls intended to regulate the output of the welding equipment. The controls may be scaled in absolute units (amperes, volts, metres per minute) or in arbitrary units (numbers, letters, geometrical marks). Controls scaled in absolute units may be validated and the consistency of those controls scaled in arbitrary units may be assessed.

The welding equipment may be fitted with meters that measure the output of the equipment and these meters should normally be validated against the appropriate standard, unless a different method is used to control the welding process.

The use of meters and measuring instrument packages with welding equipment that is required to produce welds of integrity and reliability is strongly recommended.

This code of practice recommends the use of resistive loads to validate the power source and associated meters. Alternatively, independent instrumentation may be used to monitor the welding process, rather than validating the power source itself. The method of control and type of instrumentation should be detailed on the welding procedure sheet.

## 1 Scope

This British Standard gives recommendations for validation methods for welding equipment constructed and used to the accuracy specified in BS EN 60974-1 or other equivalent standards. The accuracy of this equipment is designated as standard grade.

The welding equipment covered by this standard includes:

- 1) welding power sources;
- 2) wire feeders;
- 3) welding instrumentation.

Guidance is also given on the calibration and validation of ancillary equipment which may affect the quality of the weld, e.g. flow gauges, thermocouples, robots and manipulators.

## 2 Normative references

The following normative documents contain provisions which, through reference to this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 89-2:1990, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 2: Specification for special requirements for ammeters and voltmeters.*

BS 90:1975, *Specification for direct-acting electrical recording instruments and their accessories.*

BS 499-1:1991, *Welding terms and symbols — Glossary for welding, brazing and thermal cutting.*

BS 638-4:1996, *Arc welding power sources, equipment and accessories — Part 4: Specification for welding cables.*

BS 638-7:1984, *Arc welding power sources, equipment and accessories — Part 7: Specification for safety requirements for installation and use.*

BS 638-10:1990, *Arc welding power sources, equipment and accessories — Part 10: Specification for safety requirements for arc welding equipment: welding power sources (withdrawn, see clause 4).*

BS EN 729:1995 (all parts), *Quality requirements for welding — Fusion welding of metallic materials.*

BS EN 60051-1:1999, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 1: Definitions and general requirements common to all parts.*

BS EN 60974-1:1998, *Arc welding equipment — Part 1: Welding power sources.*

## 3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 499-1 and the following apply.

### 3.1

#### calibration

operations for the purpose of determining the magnitude of the errors of a measuring instrument and if necessary to determine other metrological properties

### 3.2

#### validation

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

### 3.3

#### accuracy

closeness of an observed quantity to the defined or true value

### 3.4

#### consistency test

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

NOTE The results obtained from the present validation are compared to the results of the previous validation. The repeatability/consistency is the difference between these readings.

### 3.5

#### class

designation according to the accuracy of a measuring instrument conforming to BS EN 60051-1:1999, BS 89-2:1990 or BS 90:1975

NOTE For example, class 2.5 refers to  $\pm 2.5$  % full scale deflection.

### 3.6

#### portable welding monitor (brief case monitor)

assembly of measuring instruments packaged in a portable case used to measure, record and/or analyse the welding equipment output

### 3.7

#### expert (competent, skilled person)

person who can judge the work assigned to him and recognize possible dangers on the basis of his professional training, knowledge and experience and his knowledge of the relevant requirements

### 3.8

#### standard grade

grade of validating equipment built to the constructional standard BS EN 60974-1 or BS EN 638-10:1990

NOTE BS 638-10:1990 was withdrawn in 1998 and superseded by BS EN 60941-1:1998.