

Diffusible hydrogen —

Part 3: Primary method for the determination of diffusible hydrogen in manual metal-arc ferritic steel weld metal

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Welding Standards Committee (WEE/-) to Technical Committee WEE/39, upon which the following bodies were represented:

- British Association for Brazing and Soldering
- British Railways Board
- British Shipbuilders
- British Steel Industry
- British Steel Industry (Wire Section)
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Process Plant Association
- Society of Motor Manufacturers and Traders Limited
- Water-tube Boilermakers' Association
- Welding Institute
- Welding Manufacturers Association (BEAMA Ltd.)
- Coopted member

The following body was also represented in the drafting of the standard, through subcommittees and panels:

Aluminium Federation

This British Standard, having been prepared under the direction of the Welding Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 August 1988

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The following BSI references relate to the work on this standard:
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Foreword

BS 6693 has been prepared under the direction of the Welding Standards Committee and is being published in separate Parts covering different methods of determining diffusible hydrogen.

Parts 1 and 2 of this standard have been published as they were required by other standards. However they do not contain all the requirements of a primary method. This Part of BS 6693 is based on Part 2. It is anticipated that when Part 3 is fully established and called up in other standards, it will be possible to withdraw both Part 1 and Part 2, particularly as Part 3 makes provision for 72 h diffusible hydrogen measurement.

Because instrument methods are widely used for speed of application, an appendix has been included on relating instrument methods to the primary method given in this Part of BS 6693.

It has been assumed in the drafting of this Part of BS 6693 that the execution of its provisions is entrusted to appropriately qualified and experienced people.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

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.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 6693 describes a method for the determination of diffusible hydrogen in manual metal arc ferritic steel weld metal and where collection of hydrogen is continued until there is no increase in volume on successive days. Provision is made for the measurement of diffusible hydrogen after 72 h collection time. An upper limit of energy input of 2 kJ/mm is imposed by the sample size.

NOTE 1 This Part of BS 6693 is not a classification document, but the method may be used for classification purposes when required.

NOTE 2 The titles of the publications referred to in this Part of BS 6693 are listed on the inside back cover.

2 Principle

The electrode to be tested is used to deposit a single weld bead which is rapidly quenched. Both the welding and quenching procedures are carefully controlled. The specimen so produced is maintained at room temperature for a sufficient time to release its content of diffusible hydrogen, which is collected over mercury and measured volumetrically.

NOTE A video recording of the method entitled "Measurement of diffusible hydrogen in test welds" is available from the Welding Institute and is a useful training aid.

3 Reproducibility

Information on the reproducibility of the method is given in Appendix A.

4 Materials and apparatus

4.1 Test piece assembly

The test piece assembly shall be prepared from a plain carbon non-rimming steel containing not more than 0.20 % C and not more than 0.06 % S.

4.2 Electrodes

The covered electrode to be tested shall be used in one of the following ways.

- For the purposes of classification, when the electrode and the method of deposition of the weld shall be as specified in the standard with which the electrode complies.
- For the purposes of investigation, when the electrode and welding parameters shall be those given in the specific welding procedure.

When a predrying treatment is specified, then the time and temperature specified by the consumable manufacturer shall be used.

Electrodes with cracked or broken coatings shall not be used and electrodes to be tested in the as-received condition shall be taken from a freshly opened undamaged packet. During any drying treatment the electrodes shall not touch each other or the side of the oven. During any drying operation the electrodes shall spend the full specified time at the drying temperature as measured by a thermocouple in contact with an electrode. Only electrodes under test shall be placed in the oven during this time. When the drying operation is complete, the electrode shall be used immediately. Any electrodes removed from the drying oven and not then used shall not be redried and subsequently used for the test.

NOTE The arc energy for making the weld is restricted to a maximum of 2 kJ/mm.

4.3 Welding fixture

A copper fixture, as shown in Figure 1, shall be used for the alignment and clamping of the test piece assembly.

NOTE A faster through-put of samples can be achieved by incorporating water cooling channels in the copper fixture.

4.4 Copper foil

Annealed copper foil strips 1 mm thick shall be used as inserts between the test piece assembly and welding fixture (see Figure 1).

NOTE The foil may be annealed repeatedly at approximately 700 °C and quenched in water but should only be used once after each anneal. Oxide scale after annealing is removed by pickling with dilute nitric acid (10 %) followed by washing with distilled water and drying.

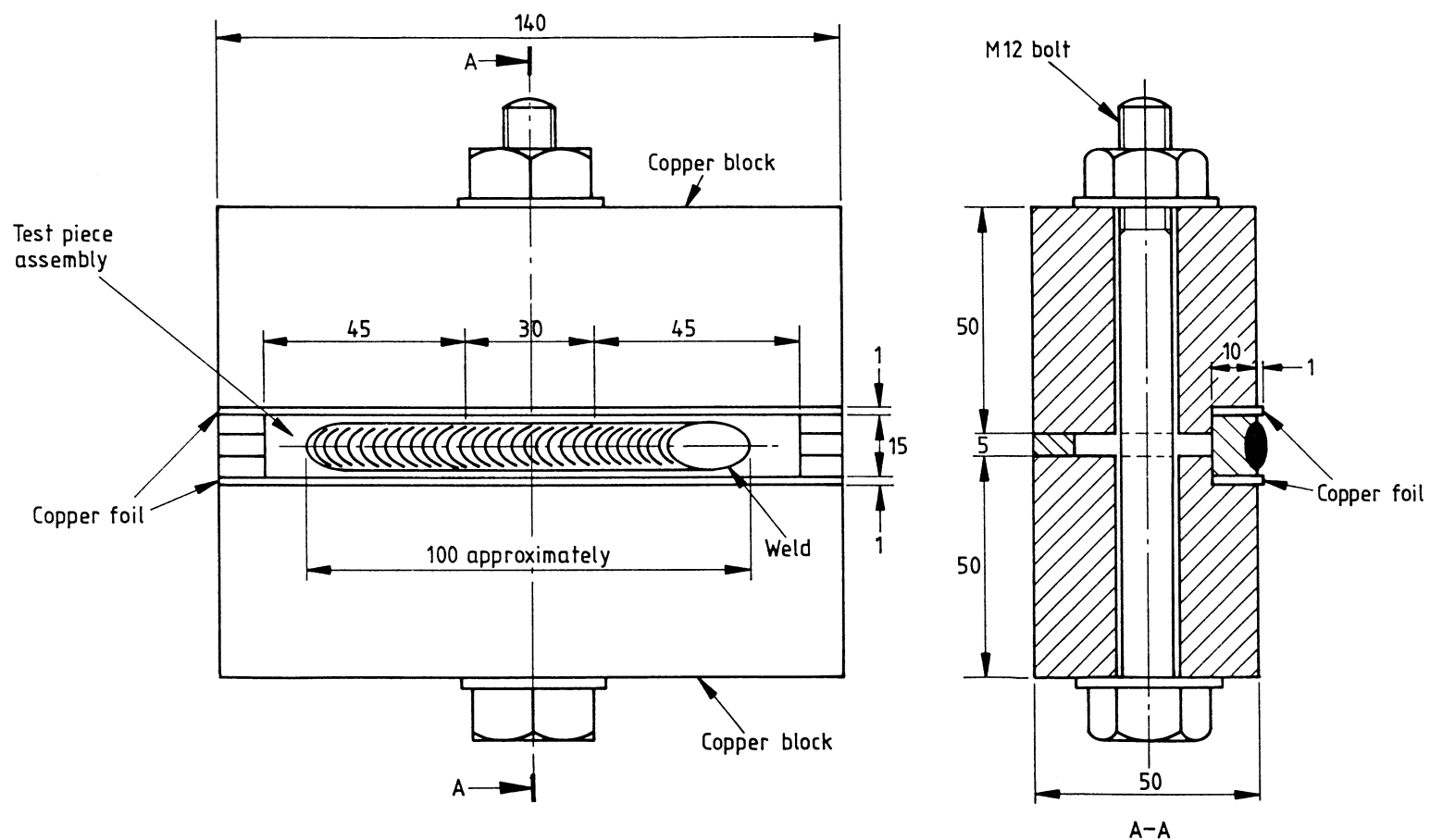
4.5 Apparatus for determination of diffusible hydrogen

An example of a gas burette for the measurement of extracted gas is shown in Figure 2. Burettes of other designs may be employed, provided that the following requirements are fulfilled.

- Clean mercury shall be used as the confining liquid.
- It shall be possible to maintain the sample under vacuum for a brief period, as specified in 5.3.2, to remove any trace of wash liquid or moisture trapped on the fractured surface of the sample.

NOTE This may be achieved in burettes consisting of a sealed limb, as shown in Figure 2, through manipulation of the mercury level and the stopcock, any contaminants released during the brief period of surface degassing being swept out of the burette before the measurements are taken.

- A cathetometer shall be used to measure to an accuracy of 0.02 mm the length of gas column in the precision bore limb.



All dimensions are in millimetres.

NOTE Water cooling channels may be used.

Figure 1 — Welding fixture and test piece assembly