AS/NZS 3752:2006
ISO 3690:2000

AS/NZS 3752:2006

Australian/New Zealand Standard™

Welding and allied processes—Determination of hydrogen content in ferritic steel arc weld metal

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AS/NZS 3752:2006

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee WD-002, Welding Consumables. It was approved on behalf of the Council of Standards Australia on 13 January 2006 and on behalf of the Council of Standards New Zealand on 20 January 2006.
This Standard was published on 23 February 2006.

The following are represented on Committee WD-002:

Australian Chamber of Commerce and Industry
Bureau of Steel Manufacturers of Australia
Business New Zealand
CSIRO Manufacturing and Infrastructure Technology
Welding Technology Institute of Australia

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This Standard was issued in draft form for comment as DR 05429.

Australian/New Zealand Standard™

Welding and allied processes—Determination of hydrogen content in ferritic steel arc weld metal

Originated in Australia as AS 3752—1990.
Jointly revised and designated AS/NZS 3752:1996.
Second edition 2006.

Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 7272 2

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WD-002, Welding Consumables, to supersede AS/NZS 3752:1996, *Welding—Methods for determination of the diffusible hydrogen content of ferritic weld metal produced by arc welding.*

The objective of this Standard is to provide sampling and analytical procedures for the determination of diffusible and residual hydrogen in ferritic weld metal arising from the welding of ferritic steel using arc welding processes with filler metal.

This Standard is identical to, and has been reproduced from, ISO 3690:2000, *Welding and allied processes —Determination of hydrogen content in ferritic steel arc weld metal.*

As this Standard is reproduced from an International Standard, the following applies:

(a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.

(b) In the source text 'ISO 3690 should read 'AS/NZS 3752'.

(c) A full point should be substituted for a comma when referring to a decimal marker.

(d) Any French text on figures should be ignored.

The terms 'normative' and 'informative' are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard		*Australian Standard*	
ISO		AS	
14175	Welding consumables—Shielding gases for arc welding and cutting	4882	Shielding gases for welding

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INTRODUCTION

During welding processes hydrogen is absorbed by the weld pool from the arc atmosphere. During cooling some of this hydrogen escapes from the solid bead by diffusion but some also diffuses into the HAZ and parent metal. The amount which does so depends on several factors such as original amount absorbed, the size of the weld and the time-temperature conditions of cooling. Other factors being equal, the more hydrogen present in the weld the greater the risk of cracking. The principal sources of hydrogen in welding are:

— moisture contained in and picked up by electrode coatings and fluxes;

— other hydrogenous materials which may break down in the heat of the arc;

— oil, dirt and grease on the plate surface or trapped in the surface layers of welding wires;

— atmospheric moisture during welding.

Measurements of weld hydrogen level therefore provide the means of deciding the degree to which a given welding consumable is introducing hydrogen to the weld pool. They may thus help to categorize the sources of hydrogen and classify different welding consumables. In addition, such measurements provide a starting point for calculating preheating temperatures and temperatures of heat treatment to remove hydrogen after welding.

Hydrogen is unlike other elements in ferritic weld metal in that it diffuses rapidly at normal room temperatures and some of it may be lost before an analysis can be made. This, coupled with the fact that the concentrations to be measured are usually at the parts per million level, means that special sampling and analysis procedures are needed. In order that results be comparable between different laboratories and can be used to develop hydrogen control procedures, some international standardization of these sampling and analysis methods is necessary.

It has become clear from work within the International Institute of Welding that the same sampling and analysis procedure can be used with minor modifications to deal with a number of fusion welding procedures and also for purposes other than the simple classification of consumables. The purpose of this document is therefore to define a standardized procedure of sampling and analysis of weld metal for the determination of hydrogen. The essential features of the International Standard provide for the production of a weld specimen in the form of a rapidly quenched single bead, and the procedure is described in 3.1; 3.2 of this International Standard gives details of the procedures to be used when different welding processes are under investigation. The specimen obtained in this way is then compatible with the recommended analytical techniques specified in 3.3.

There are two principal ways in which this International Standard is intended to be used:

a) To provide information on the levels of weld hydrogen arising from the use of consumables in specific states (e.g. wet or dry), or as a result of the use of specific welding parameters (e.g. different current levels). For such purposes the method can be applied with a variety of welding parameters and states of consumable, and these will be chosen on each occasion in order to provide the specific information sought. It is important however to state such conditions when results are reported so that misunderstandings can be avoided.

b) To enable consumables to be classified and to assist in quality control. In such cases consumables have to be treated in like manner — i.e. with fixed conditions of drying temperature and time, welding current and so on.

It is understood that mercury is a hazardous substance, and that its use may be restricted in some countries. It should be recognized that this International Standard provides a reference method against which all other methods are to be calibrated. Once a proper calibration of an alternate method against this reference method is established, normal testing can be conducted with the alternate method. Then the reference method need only be used in rare instances, such as for checking calibration or in cases of dispute.

AUSTRALIAN/NEW ZEALAND STANDARD

Welding and allied processes — Determination of hydrogen content in ferritic steel arc weld metal

1 Scope

This International Standard specifies the sampling and analytical procedure for the determination of diffusible and residual hydrogen in ferritic weld metal arising from the welding of ferritic steel using arc welding processes with filler metal. Collection of the hydrogen over mercury is the primary method. Provided that the weld specimen size is maintained within limits dictated by the size of the test block, variations in welding parameters are permissible in order to investigate the effect of such variables on the weld hydrogen content. The techniques described in this International Standard constitute a reference method which should be used in cases of dispute.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 14175, *Welding consumables — Shielding gases for arc welding and cutting*.

3 Test procedures

3.1 Production of weld specimens

3.1.1 Principle

The welding process to be tested is used to deposit a single weld bead which is rapidly quenched and subsequently stored at –78 °C or lower until required for preparation and analysis.

3.1.2 Welding fixture

A copper welding jig for heat inputs up to 2 kJ/mm, which may be water cooled, is shown in Figure 1. It is designed to promote the proper alignment and clamping of the test piece assembly by means of the single clamping unit which is used with a ring spanner or other suitable means. See 3.1.4 for evidence of proper alignment and clamping. A welding jig without water cooling may be used as long as the same dimensions are retained and as long as the temperature is controlled in the manner described in 3.1.4 below.

The welding jig shown in Figure 2 will allow the production of test welds with a heat input greater than 2 kJ/mm and up to about 3 kJ/mm.