

Australian/New Zealand Standard™

Structural steel welding

Part 1: Welding of steel structures



AS/NZS 1554.1:2014

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee WD-003, Welding of Structures. It was approved on behalf of the Council of Standards Australia on 24 September 2014 and on behalf of the Council of Standards New Zealand on 12 September 2014.
This Standard was published on 25 November 2014.

The following are represented on Committee WD-003:

Australasian Corrosion Association
Australian Chamber of Commerce and Industry
Australian Industry Group
Australian Steel Institute
Austroads
Bureau of Steel Manufacturers of Australia
Energy Networks Association
Engineers Australia
New Zealand Heavy Engineering Research Association
New Zealand Non-Destructive Testing Association
Steel Reinforcement Institute of Australia
University of Sydney
Welding Technology Institute of Australia

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Australia Web Site at www.standards.org.au or Standards New Zealand web site at www.standards.govt.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of Standards Australia or the New Zealand Standards Executive at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS 1554.1.

Australian/New Zealand Standard™

Structural steel welding

Part 1: Welding of steel structures

Originated in Australia as AS CA8—1933.
Originated in New Zealand, in part, as NZS 4701:1981.
Previous edition AS/NZS 1554.1:2011.
Ninth edition 2014.
Reissued incorporating Amendment No. 1 (September 2015).
Reissued incorporating Amendment No. 2 (September 2017).

COPYRIGHT

© Standards Australia Limited

© The Crown in right of New Zealand, administered by the New Zealand Standards Executive

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WD-003, Welding of Structures, to supersede AS/NZS 1554.1:2011.

This Standard incorporates Amendment No. 1 (September 2015) and Amendment No. 2 (September 2017). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide rules for the welding of a wide range of steel constructions, and while it is expected that its main use will be for statically loaded welds, it applies also to some welds subject to fatigue. Although this Standard has been specifically prepared for steel structures, it may be usefully applied to machine frames and other types of steel constructions.

This edition incorporates the following major changes to the 2011 edition:

(a) *Revision of the following Clauses:*

1.1 (new Note), 2.3.1, 2.3.3, 3.1.2.2 (new), 4.1.1 (Note 2 revised), 4.1.4, 4.2(b) and Note 1, 4.2 (d) (correction), 4.3, 4.5.5.1, 4.5.5.3, 4.6.1.1(c) (G1), 4.6.1.2 (new Note), 4.7.1, 4.7.7, 4.8, 4.12.1, 4.12.2.3, 5.2.4, 5.3.4, 5.3.5 (title), 6.2.2, 6.3.3 (Note added), 6.4.3 (Note added), 6.7 (Note 2 revised), 6.8 (new Note), 7.2(e) (new), F2.2, F4, Appendix H (new).

(b) *Revision of the following Tables:*

4.1.3, 4.6.1(A), 4.6.1(B), 4.6.1(C), 4.6.2, 4.7.1 (Notes 1, 3 and 4 revised), 4.11(A) (item deleted and Item (i) revised), 4.12.2 B) (Note 1), 5.2.4 (new), 5.3.4, 6.2.2, E4 (items renumbered, root gap revised), G1.

(c) *Revision of the following Figures:*

4.5.5.1 (Note 2 and the title revised), 4.5.5.3 (Note 2 revised), 4.5.5.4 (title revised).

This Standard requires that weld preparations, welding consumables and welding procedures be qualified before commencement of welding. Prequalified joint preparations, welding consumables and welding procedures are also given in the Standard.

This Standard, in catering for structures subject to fatigue conditions as well as statically loaded structures, provides two categories of welds with two differing levels of weld quality assurance associated with the different types of service to which the welds are subjected. The intention is that the designer select the category suited to the severity of the service and nominate this on the drawings. Where a structure contains both categories, this nomination of appropriate categories will ensure that appropriate levels of supervision and inspection will be applied to the relevant parts of the structure.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	5
1.2 EXCLUSIONS.....	6
1.3 INNOVATION	6
1.4 NORMATIVE REFERENCES	6
1.5 DEFINITIONS AND SYMBOLS	6
1.6 WELD CATEGORIES	7
1.7 MANAGEMENT OF QUALITY.....	7
1.8 SAFETY	8
SECTION 2 MATERIALS OF CONSTRUCTION	
2.1 PARENT MATERIAL.....	9
2.2 BACKING MATERIAL	9
2.3 WELDING CONSUMABLES.....	9
SECTION 3 DETAILS OF WELDED CONNECTIONS	
3.1 GENERAL.....	11
3.2 BUTT WELDS	11
3.3 FILLET WELDS	12
3.4 COMPOUND WELDS	17
3.5 SEAL WELDS.....	18
3.6 PLUG WELDS	19
3.7 SLOT WELDS.....	19
3.8 COMBINING STEEL SECTIONS	19
SECTION 4 QUALIFICATION OF PROCEDURES AND PERSONNEL	
4.1 QUALIFICATION OF WELDING PROCEDURE.....	21
4.2 METHODS FOR QUALIFYING A WELDING PROCEDURE.....	23
4.3 PREQUALIFIED WELDING PROCEDURES.....	24
4.4 PORTABILITY OF QUALIFIED WELDING PROCEDURES	24
4.5 PREQUALIFIED JOINT PREPARATIONS	24
4.6 QUALIFICATION OF WELDING CONSUMABLES.....	32
4.7 QUALIFICATION OF WELDING PROCEDURE BY TESTING	40
4.8 EXTENSION OF QUALIFICATION	45
4.9 COMBINATION OF PROCESSES	45
4.10 RECORDS OF TESTS	45
4.11 REQUALIFICATION OF WELDING PROCEDURES	45
4.12 QUALIFICATION OF WELDING PERSONNEL	49

SECTION 5 WORKMANSHIP

5.1	PREPARATION OF EDGES FOR WELDING	54
5.2	ASSEMBLY	54
5.3	PREHEATING AND INTER-RUN CONTROL	56
5.4	WELDING UNDER ADVERSE WEATHER CONDITIONS	62
5.5	TACK WELDS	62
5.6	WELD DEPTH-TO-WIDTH RATIO	62
5.7	CONTROL OF DISTORTION AND RESIDUAL STRESS	63
5.8	BACKGOUGING AND REPAIR OF DEFECTS IN WELDS	64
5.9	TEMPORARY ATTACHMENTS	65
5.10	ARC STRIKES	65
5.11	CLEANING OF FINISHED WELDS	65
5.12	DRESSING OF BUTT WELDS	65

SECTION 6 QUALITY OF WELDS

6.1	CATEGORIES OF WELDS	66
6.2	METHODS OF INSPECTION AND PERMISSIBLE LEVELS OF IMPERFECTIONS	66
6.3	RADIOGRAPHY	71
6.4	ULTRASONIC EXAMINATION	72
6.5	MAGNETIC PARTICLE EXAMINATION	73
6.6	LIQUID PENETRANT EXAMINATION	73
6.7	WELD DEFECTS	73
6.8	REPORTING	73

SECTION 7 INSPECTION

7.1	GENERAL	74
7.2	QUALIFICATIONS OF INSPECTORS	74
7.3	VISUAL INSPECTION OF WORK	74
7.4	NON-DESTRUCTIVE EXAMINATION OTHER THAN VISUAL	75

APPENDICES

A	NORMATIVE REFERENCED DOCUMENTS	76
B	BRITTLE FRACTURE	79
C	TYPICAL FORMS FOR WELDING PROCEDURES	84
D	MATTERS FOR RESOLUTION	87
E	WELDED JOINT AND PROCESS IDENTIFICATION	88
F	WELD PROCEDURE REQUIREMENTS ASSOCIATED WITH CHANGES TO THE WELDING CONSUMABLE CLASSIFICATION SYSTEM	107
G	TYPICAL MATERIAL GROUPS FOR COMMON STEELS	111
H	SELECTION OF MATERIALS FOR THE AVOIDANCE OF LAMELLAR TEARING	113

BIBLIOGRAPHY	116
--------------------	-----

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Structural steel welding

Part 1: Welding of steel structures

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the welding of steel structures made up of combinations of steel plate, sheet or sections, including hollow sections and built-up sections, or castings and forgings, by the following processes:

- (a) Manual metal-arc welding (MMAW).
- (b) Submerged arc welding (SAW).
- (c) Gas metal-arc welding (GMAW or MIG), including pulsed mode.
- (d) Gas tungsten-arc welding (GTAW or TIG).
- (e) Flux-cored arc welding (FCAW).
- (f) Electroslag (including consumable guide) welding (ESW).
- (g) Electrogas welding (EGW).

This Standard is limited to the welding of steel parent material with a specified minimum yield strength not exceeding 500 MPa.

This Standard applies to the welding of steelwork in structures complying with AS 3990, AS 4100, AS/NZS 4600 or NZS 3404.1. Where welded joints in these structures are governed by dynamic loading conditions, this Standard applies only to those welded joints that comply with the fatigue provisions of AS 3990, AS 4100 or NZS 3404.1, as limited by Item (ii) below, or the directly equivalent fatigue provisions of other application Standards.

Welded joints complying with the above Standards are the following:

- (i) Those that are not subject to fatigue conditions.
- (ii) Those that are subject to fatigue conditions, where—
 - (A) the stress range in the welded joint complies with the permissible stress range of stress categories C, D, E or F of AS 3990, or weld categories lower than or equal to detail category 112 of AS 4100 or NZS 3404.1; or
 - (B) the stress range in the welded joint is not greater than 80% of the permissible stress range of stress category B of AS 3990.

In addition to the abovementioned structures, the Standard applies to the welding of cranes, hoists and other dynamically loaded structures, the welding of road and pedestrian bridges and the welding of steelwork in applications other than structural.

NOTES:

- 1 Further information on this Standard, is given in WTIA Technical Note 11.
- 2 GMAW includes waveform controlled welding such as 'synergic', 'programmable', and 'microprocessor controlled' processes (e.g. pulsed spray transfer or controlled short circuit transfer).