AS/NZS 1554.5:2011

Australian/New Zealand Standard™

Structural steel welding

Part 5: Welding of steel structures subject to high levels of fatigue loading

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 18 May 2011 and on behalf of the Council of Standards New Zealand on 1 June 2011.
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The following are represented on Committee WD-003:

Australian Chamber of Commerce and Industry
Australian Industry Group
Australian Steel Institute
AUSTROADS
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Engineers Australia
New Zealand Heavy Engineering Research Association
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Australian/New Zealand Standard™

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Part 5: Welding of steel structures subject to high levels of fatigue loading

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PREFACE

This Standard was prepared by the Joint Australian/New Zealand Committee WD-003, Welding of Structures, to supersede AS/NZS 1554.5:2004.

The objective of this Standard is to provide rules for the welding of steel structures subject to high levels of fatigue loading.

The objective of this edition is to update the Standard and bring it in line with the latest edition of AS/NZS 1554.1, *Structural steel welding*, Part 1: *Welding of steel structures*.

This edition incorporates the following major changes to the 2004 edition:

(a) *Amendments to the following Clauses*:

1.2, 1.6 (new title), 1.6.1 (new), 2.1(c), 2.3.1, 3.2.5 (new paragraph), 4.1.2(d)(f)(h)(j)(k)(iii) (new sub clauses), 4.6.1.2 (d), 4.2 (b), 4.10 (new note), 4.12.2, 5.1.1 (new note), 5.1.2 (note added), 5.3.3 (second paragraph), 5.3.5 (new), 5.7.1 (note added), 6.3.3 (noted added), 7.2(a) (new), 7.3 (first paragraph – new), Appendix F (new).

(b) *Amendments to the following Tables*:

4.6.1(A), 4.6.1(B), 4.6.1(C), 4.6.2, 4.7.1 (new notes, notes 1 and 3 amended), 4.11(D) (new), 4.11(A) (items b, e, o, u), 4.11(C) item (d) (note added), 4.12.2.3(A), 4.12.2.3(B) (new), 5.3.4(A), B1 (new steel types added).

(c) *Amendments to the following Figure*:

3.2.5(c) (new).

This Standard specifically applies to welds subject to fatigue loading in excess of the range covered by AS/NZS 1554.1, *Structural steel welding*, Part 1: *Welding of steel structures* and hence, it should not be specified where AS/NZS 1554.1 is acceptable.

It is expected that welds covered by this Standard will not normally occur with structures such as buildings, tanks or silos, but only in certain classes of machinery and transport equipment.

The 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.

Statements expressed in mandatory terms in notes to Tables and Figures are deemed to be requirements to 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.

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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).

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

The Standard applies specifically to the welding of steelwork in structures complying with AS 3990, AS 4100 or NZS 3404.1. Where welded joints in these structures are governed by dynamic loading conditions, the Standard applies only to those welded joints that comply with the fatigue provisions of AS 3990, where the stress range in the welded joint is greater than 80% of the permissible stress range for Category B of AS 3990, or exceeds the stress range permitted for detail Category 112 of AS 4100 or NZS 3404.1, but does not exceed the maximum stress ranges permitted for these categories.

NOTE: Fillet welds and incomplete penetration butt welds may be used in AS 4100 or NZS 3404.1 detail Category 125, and in Category B fatigue applications of AS 3990 when the direction of the weld is parallel to the direction of the applied stress.

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

NOTES:

1 Further information on this Standard is given in WTIA Technical Note 11.

2 The Standard is basically in line with AS/NZS 1554.1; however, it specifically applies to welds subject to fatigue loading in excess of the range covered by AS/NZS 1554.1 and hence it should not be specified where AS/NZS 1554.1 is acceptable.

3 It is expected that welds covered by this Standard will not normally occur with structures such as buildings, tanks or silos, but only in certain classes of machinery and transport equipment.

4 The Standard requires that weld preparation, 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.

1.2 EXCLUSIONS

The Standard does not apply to the welding of structures by the following processes:

(a) Oxyacetylene welding (OAW).

(b) Friction welding (FW).

(c) Thermit welding (TW).

(d) Resistance welding (RW).

The Standard does not apply to the welding of pressure vessels and pressure piping.

The Standard does not cover the design of welded connections or permissible stresses in welds, nor the production, rectification or repair of castings.

This Standard does not apply to underwater welding.

NOTE: For guidance on underwater welding the user should refer to ISO 15614-10, ISO 15618-1 and ISO 15618-2 as appropriate.

1.3 INNOVATION

Any alternative materials, welding processes, consumables, methods of construction or tests that give equivalent results to those specified, but do not comply with the specific requirements of this Standard or are not mentioned in it, are not necessarily prohibited.

The Joint Standards Australia/Standards New Zealand Committee on welding of structures can act in an advisory capacity concerning equivalent suitability, but specific approval remains the prerogative of the inspecting authority.

1.4 NORMATIVE REFERENCES

Documents referenced for normative purposes are listed in Appendix A.

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

1.5 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 1101.3 and AS 2812 and those below apply.

1.5.1 Fabricator

The person or organization responsible for the welding of the structure during fabrication or erection.

1.5.2 Inspecting authority

The authority having statutory powers to control the design and erection of buildings or structures.

NOTE: Where the structure is not subject to statutory jurisdiction, the principal is deemed to be the inspecting authority.

1.5.3 Inspector

A person employed by, or acceptable to, the inspecting authority or principal for the purpose of inspecting welding in accordance with this Standard.

1.5.4 May

Indicates the existence of an option.

1.5.5 Principal

The purchaser or owner of the structure being fabricated or erected, or a nominated representative.

NOTE: The nominated representative should be suitably qualified to deal with the technical issues of this Standard.

1.5.6 Shall

Indicates that a statement is mandatory.

1.5.7 Should

Indicates a recommendation.

1.6 MANAGEMENT OF QUALITY

1.6.1 Quality management

Fabricators shall ensure that all welding and related activities prescribed within Clause 1.6.2 and this Standard are managed under a suitable quality management system.

Such a system should generally comply with the requirements of AS/NZS ISO 3834 and its parts particularly where fabrication activities require the approval of the principal or inspecting authority, or where the fabrication of large, complex or critical structures is being undertaken.

1.6.2 Basic welding requirements

The basis of this Standard is that a weld shall—

(a) be made in accordance with a qualified welding procedure;

(b) be carried out by a welder suitably qualified to carry out such a procedure;

(c) be carried out under the supervision of a welding supervisor who is employed by or contracted to the fabricator; and

(d) comply with the appropriate requirements of this Standard.

For certain conditions prescribed herein, the welding procedure is deemed to be prequalified and may not require full qualification testing (see Clause 4.3 and Table 4.7.1).

1.7 SAFETY

1.7.1 Safety equipment and procedures

Welding shall be carried out in accordance with the relevant requirements of AS 1470, AS 1674.1, AS 1674.2, AS/NZS 1336, AS/NZS 1337, AS/NZS 1338.1 and AS/NZS 2865.

1.7.2 Welding equipment

Welding plant and equipment shall comply with the relevant sections of appropriate regulations, and the relevant requirements of AS 60974.1, AS 2799, AS/NZS 1995.

1.7.3 Other hazards

The fabricator shall identify and manage any other risks and hazards from welding that are not covered by Clauses 1.7.1 and 1.7.2. In particular, due consideration shall be given to the control of emitted fumes, especially when welding through paints, primers and other surface coatings.

NOTES:

1 Guidance on the management of risk is given in AS/NZS ISO 31000.

2 Further guidance on safety precautions is given in WTIA Technical Notes 7 and 22.

SECTION 2 MATERIALS OF CONSTRUCTION

2.1 PARENT MATERIAL

The parent material to be welded shall—

(a) be of a grade with a specified minimum yield strength not exceeding 500 MPa;

(b) be selected in accordance with Appendix B; and

(c) comply with AS/NZS 1163, AS 1397, AS 1450, AS 1548, AS 2074, AS/NZS 1594, AS/NZS 1595, AS/NZS 3678, AS/NZS 3679.1 and AS/NZS 3679.2, as appropriate.

NOTE: Any steel type from any Standards may be welded to any other steel type from any Standard listed above, provided the requirements of this Standard are met for each of the steels.

With the exception of quenched and tempered steels, parent materials not identified to a Standard nominated in Item (c) above may be used provided one of the following requirements are met:

(i) Testing of the material, to determine compliance with any of the grade types in the Standards nominated in Item (c) above, has been carried out to the satisfaction of the principal.

(ii) A comparison of supplied test certificates with the requirements of any of the grade types in the Standards nominated in Item (c) above has been performed to the satisfaction of the principal.

NOTES:

1 For high-strength quenched and tempered steels, see AS/NZS 1554.4.

2 Impact tests, in addition to those prescribed by the Standards in Item (c) above may, be required to establish compliance with Paragraph B4.3.4, Appendix B.

2.2 BACKING MATERIAL

Permanently attached steel backing material shall have a weldability of not less than that of the parent material.

Temporary backing material of any type may be used for welds, provided the finished weld complies with the requirements of this Standard.

2.3 WELDING CONSUMABLES

2.3.1 Electrodes and filler wires

Electrodes for manual metal-arc welding shall comply with AS/NZS 4855 or AS/NZS 4857, as applicable (see Clause 4.6.1).

Electrodes or filler wires for processes other than manual metal-arc welding shall comply with AS 1858.1, AS/NZS 1167.2, AS/NZS 2717.1, AS/NZS ISO 17632, ISO 14341 or ISO 636, as applicable (see Clause 4.6.1).

Electrodes that do not comply with these Standards may be used, provided they are qualified in accordance with the requirements of Clause 4.6.2.