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# AUSTROADS TECHNICAL SPECIFICATION ATS 5410
## Structural Steelwork – Fabrication and Erection

Austroads

## Contents



# 1. Scope

1.1 Austroads Technical Specification ATS 5410 sets out the requirements for the construction of steelwork for bridges and gantries which:

a) are designed in accordance with AS 5100.6;

b) use steel complying with one or more of the material standards listed in Table 5.3; and

c) use steel with a design yield stress of 690 MPa or less.

1.2 If specified in the Contract documents, it applies to other structures such as poles and roadside furniture.

1.3 ATS 5410 comprises wholly or partially the ‘construction specification’ referenced in AS/NZS 5131.

1.4 Steel fabrication, erection and modification must be carried out in accordance with:

a) this Specification;

b) any manufacturer’s instructions specifically applicable to the item concerned; and

c) AS/NZS 5131.

In the event of an ambiguity or inconsistency, the above order of precedence applies.

1.5 Clause 9 and Clause 10 of AS/NZS 5131 are excluded from the scope of this Specification.

1.6 The terms ‘should’ and ‘shall’ in AS/NZS 5131 mean a mandatory requirement.

1.7 The Contractor must ensure that the Fabricator complies with this Specification. The Contractor may be the same entity as the Fabricator.

## 2. Referenced Documents

2.1 The following documents are referenced in this specification:

**Australian / New Zealand Standards**

| | |
|---|---|
| AS 1101.3 | Graphical symbols for general engineering - Welding and non-destructive examination |
| AS/NZS 1163 | Cold formed structural steel hollow sections |
| AS 1171 | Non-destructive testing - Magnetic particle testing of ferromagnetic products, components and structures |
| AS/NZS 1554.1 | Welding of steel structures |
| AS/NZS 1554.2 | Stud welding (steel studs to steel) |
| AS/NZS 1554.3 | Welding of reinforcing steel |
| AS/NZS 1554.4 | Structural steel welding – Part 4: Welding of high strength quenched and tempered steels |
| AS/NZS 1554.5 | Welding of steel structures subject to high levels of fatigue loading |
| AS/NZS 1554.6 | Structural steel welding – Part 6: Welding stainless steels for structural purposes |
| AS/NZS 1594 | Hot rolled steel flat products |
| AS 1710 | Non-destructive testing - Ultrasonic testing of carbon and low alloy steel plate and universal sections - Test methods and quality classification |
| AS 2177 | Non-destructive testing - Radiography of welded butt joints in metal |
| AS 2205 | Methods for destructive testing of welds in metal |
| AS 2205.3.1 | Transverse guided bend test |
| AS 2205.4.1 | Nick-break test |
| AS 2205.5.1 | Macro metallographic test for cross-section examination |
| AS 2205.7.1 | Charpy V-notch impact fracture toughness test |
| AS 2207 | Non-destructive testing - Ultrasonic testing of fusion welded joints in carbon and low alloy steel |
| AS/NZS 2980 | Qualification of welders for fusion welding of steels |
| AS 3597 | Structural and pressure vessel steel – Quenched and tempered plate |
| AS/NZS 3678 | Structural steel – Hot-rolled plates, floorplates and slabs |
| AS/NZS 3679 | Structural steel |
| AS/NZS 3679.1 | Hot-rolled bars and sections |
| AS/NZS 3679.2 | Welded I sections |
| AS/NZS ISO 3834 | Quality requirements for fusion welding of metallic materials |
| AS/NZS ISO 3834.2 | Comprehensive quality requirements |
| AS/NZS ISO 3834.3 | Standard quality requirements |
| AS 4100 | Steel structures |

| | |
|---|---|
| AS/NZS 5100.1 | Bridge design – Part 1: Scope and general principles |
| AS/NZS 5100.6 | Bridge design – Part 6: Steel and composite construction |
| AS/NZS 5131 | Structural steelwork – Fabrication and erection |
| AS/NZS ISO 9001 | Quality management systems – Requirements |
| AS/NZS ISO 9606.1 | Qualification testing of welders - Fusion welding Steels |
| AS ISO 9712 | Non-destructive testing - Qualification and certification of NDT |
| AS/NZS ISO 14731 | Welding coordination - Tasks and responsibilities |
| AS/NZS ISO/IEC 17024 | Conformity assessment—General requirements for bodies operating certification of persons |
| AS ISO/IEC 17025 | General requirements for the competence of testing and calibration laboratories |
| AS ISO/IEC 17050.1 | Conformity assessment - Supplier's declaration of conformity - General requirements |
| AS/NZS ISO/IEC 17065 | Conformity assessment - Requirements for bodies certifying products, processes and services |
| SA TS 102 | Structural steel - Limits on elements added |
| SA TS 103 | Structural steel welding – Limits on boron in parent materials. |

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|---|---|
| ATS 5316 | Cementitious Mortar and Grout |
| ATS 5420 | Supply of Bolts, Nuts & Washers |

**International / European Standards**

| | |
|---|---|
| EN1090-2 | Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures. |
| ISO 10893-2 | Non-destructive testing of steel tubes — Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections |
| ISO 10893-3 | Non-destructive testing of steel tubes — Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections |
| ISO 10893-11 | Non-destructive testing of steel tubes — Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections ISO 13588 Non-destructive testing of welds - Ultrasonic testing - Use of automated phased array technology |
| IIW MCS ISO 3834IIW | Manufacturer Certification Scheme for the Management of Quality in Welding - Interpretation and Implementation of ISO 3834 requirements |
| ISO 15590-1 | Petroleum and natural gas industries – Induction bends, fittings, and flanges for pipeline transportation system – Part 1: Induction bends |

**ASTM International**

| | |
|---|---|
| ASTM E 488 | Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |
| ASTM E 1512 | Standard Test Methods for Testing Bond Performance of Adhesive-Bonded Anchors |

**Australian Technical Infrastructure Committee**

ATIC Scheme 10 Edition 2 (2019) Structural Steel Products - Conformity Assessment.

# 3. Definitions

3.1 In addition to the definitions in AS/NZS 5131, the following definitions apply to this Specification:

| | |
|---|---|
| Principal's Registration Scheme: | Any scheme for the prequalification, registration or approval of products, manufacturers, suppliers and/or Professional Engineers in operation in the jurisdiction where the steelwork is to be erected. |
| Professional Engineer: | A person who:<br>a) has at least 5 years of relevant experience in the design or fabrication of steel structures;<br>b) is registered on any scheme of registration of engineers prescribed by legislation in the applicable jurisdiction;<br>c) is appropriately registered or prequalified if the Principal has implemented an applicable registration or prequalification scheme; and<br>i) satisfies at least one of the following requirements:<br>ii) is a Chartered Professional Engineer; or<br>iii) holds a 4 year civil engineering degree from a university that is accredited under the Washington Accord and is registered in a relevant area of practice on the National Engineering Register (in Australia) or the Register of Chartered Professional Engineers (in New Zealand). |
| Welding Coordinator: | Person, or group of people performing defined welding coordination tasks, as set out in AS/NZS ISO 14731 Annex-B. [1] |
| Welding Supervisor: | The person who is responsible for the daily operations of fabrication and meets the requirements of Clause 7.16 a). |
| Welding Inspector: | Refer Clause 13.4. |

The following abbreviations apply to this Specification:

| | |
|---|---|
| ACRS | Australasian Certification Authority for Reinforcing and Structural Steels |
| ATIC | Australian Technical Infrastructure Committee |
| FDR | Fabricator's Data Report |
| HAZ | Heat affected zone |
| ICNDT MRA | International Committee for Non-Destructive Testing Mutual Recognition Agreement |
| IAF | International Accreditation Forum |
| JAS-ANZ | Joint Accreditation System of Australia and New Zealand |
| IIW | International Institute of Welding |
| ITP | Inspection and Test Plan |
| MCS | Manufacturer's Certificate Scheme |
| NDE | Non-Destructive Examination |
| NDT | Non-Destructive Testing |
| RT | Radiographic Examination |
| UT | Ultrasonic Examination |

[1] *Note: previously referred to as the Responsible Welding Coordinator*

# 4. Design, Specification, Documentation and Traceability

## Prequalification or Registration of Fabricators

4.1 Where a Principal's Registration Scheme is in place for fabricators, the Fabricator must comply with that scheme for steelwork erected in that jurisdiction. In addition, the Fabricator must be prequalified or registered to the level specified in the tender documents (if any).

| HOLD POINT 1. | |
|---|---|
| Process Held | Commencement of steel procurement or the fabrication of steelwork. |
| Submission Details | The Contractor must submit evidence of compliance with Clause 4.1 to the Principal at least 10 working days prior to the commencement of steel procurement or the fabrication of steelwork. |

## Quality System Accreditation

4.2 The Fabricator must have in place a quality management system conforming to Appendix D of AS/NZS 5131 for the specified Construction Category. Unless specified otherwise in the Contract documents, the quality management system must also conform to AS/NZS ISO 9001.

4.3 If specified in the Contract documents, the Fabricator must be certified as conforming to the Construction Category CC2, CC3 or CC4 of AS/NZS 5131, as applicable to the works or to parts of the works. The certification of Construction Category applies to those Sections of AS/NZS 5131 that are applicable to the work carried out by the Fabricator.

4.4 The certifying body must be accredited by an organisation that is accredited for that purpose to AS/NZS ISO/IEC 17065 either by JAS-ANZ or a member of the International Accreditation Forum.

4.5 If specified in the Contract documents, the Fabricator must be certified as conforming to:

a) AS/NZS ISO 3834.2 for CC3;

b) AS/NZS ISO 3834.3 for CC2.

## Construction Specification (Refer AS/NZS 5131 Clause 4.1)

### Construction Category

4.6 This Specification sets out the requirements for both construction categories CC2 and CC3.

4.7 Unless specified otherwise in the Contract documents, the steelwork must be fabricated in accordance with the requirements for Construction Category CC3.

4.8 Where the Designer allocates a Construction Category other than CC3 to a fabricated component or structural element, this must be noted on the drawings.

4.9 If Construction Category CC4 is specified, requirements in addition to those for CC3 will be included in the Contract documents.

### Geometrical Tolerances

4.10 Unless specified otherwise in the Contract documents, the Essential and Functional Tolerances (refer Section 12 of AS/NZS 5131) specified in Table 4.11 apply.

**Table 4.11: Geometrical Tolerances**

| Tolerance | Construction category | |
|---|---|---|
| | CC2 | CC3 |
| Essential Tolerances | Class 1 | Class 2 |
| Functional Tolerances | Class 1 | Class 2 |

## Use of Building Information Modelling (Refer AS/NZS 5131 Clause 4.3)

4.11 Digital Building Information Models will be provided when so stated in the Contract documents.

## Shop Detailing Documentation (Refer AS/NZS 5131 Clause 4.4)

### Production of Shop Detailing Documentation

4.12 The Fabricator is responsible for the production of shop detail documentation (if required).

### Scope of Documentation

4.13 In addition to the requirements of AS/NZS 5131 Clause 4.4.2, the details shown on the shop drawings must:

a) conform to and identify the Design Drawings, together with the revision number, on which they are based;

b) clearly identify that part on the shop drawings (if any), where the shop drawings depict a part of the Design Drawings;

c) clearly distinguish between shop welds and field welds;

d) clearly indicate those joints where no welding is permitted; and

e) show details of all holes, including the method of sealing the holes.

### Approval of Shop Detailing Documentation

4.14 The Contractor must submit a copy of the shop detail documentation to the Principal.

4.15 Unless specified otherwise in the Contract documents, the Contractor must certify that the shop drawings conform to this Specification and submit the certification to the Principal.

4.16 Unless specified otherwise in the Contract documents, the Designer is responsible for the review and approval of shop detail documentation, including any changes.

### Documentation Required (Refer AS/NZS 5131 Clause 4.5)

4.17 Where applicable, the Contractor must submit evidence of the certification required under Clause 4.3 and / or Clause 4.5 to the Principal.

4.18 The Contractor must prepare and implement the following documentation:

a) the Quality Documentation listed in Clause 4.5.1 of AS/NZS 5131;

i) a Quality Plan which addresses each element listed in AS/NZS 5131 Appendix E;

i) an ITP for welding (if required under Clause 13.11); and

b) Shop Detailing Documentation and Work Method Statements.

4.19 The Contractor must submit the documentation listed in Clause 4.19 to the Principal. The Principal may waive the requirement to submit the documentation listed in Clause 4.19 a) if this documentation has been previously provided under a registration or certification scheme.

| HOLD POINT 2 | |
|---|---|
| Process Held | Commencement of fabrication. |
| Submission Details | The documentation listed in Clause 4.19 must be provided to the Principal at least 15 working days prior to the commencement of fabrication. |

### Surveillance and Audit

4.20 Unless approved otherwise by the Principal, where welded product audits are carried out, at least one auditor in the audit team assessment must:

a) hold a valid International Welding Technologist (IWT) qualification, or higher;

b) have at least seven years of experience in welding and steel fabrication,

c) have lead auditor training; and

d) be authorised by the Principal to conduct audits.

### As-Built Documentation

4.21 Within 4 weeks of the completion of the fabrication and erection of the steel members, drawings (including shop drawings and site drawings) showing the Works as actually constructed must be submitted to the Principal. These drawings must be in an electronic format acceptable to the Principal and if requested, A1 size prints must also be submitted. These drawings must clearly mark departures from the original drawings.

## Purchasing - Components and Subcontracted Services (Refer AS/NZS 5131 Clause 4.6)

### Steel

4.22 Suppliers of materials and components must have in place quality management systems independently certified as fully complying with AS/NZS ISO 9001, by an organisation accredited by JAS-ANZ or an affiliated international accreditation organisation, and must provide documentation to this effect with each consignment of materials or components supplied under this Specification.

## Product Conformity Assessment

4.23 All steel must be produced by steel manufacturers certified by a product conformity assessment scheme acceptable to the Principal. ATIC Scheme 10 or the ACRS Product Certification Scheme are acceptable to the Principal. Third-party conformity assessment bodies must be accredited to AS/NZS ISO/IEC 17065 either by JAS-ANZ or by a member of the IAF.

4.24 Any alternative product conformity assessment scheme to ATIC Scheme 10 or the ACRS Product Certification Scheme must be submitted for review and accepted by the Principal prior to the commencement of the procurement of the steel.

4.25 In addition to a manufacturer's material and inspection certificate, all parties to the steel procurement must provide a Suppliers Declaration of Conformity (SDoC) conforming to AS ISO/IEC 17050.1.

4.26 Any testing of materials or components must be in accordance with Clause 13.1 of this Specification.

4.27 The manufacturer's material and inspection certificates proving that all materials and consumables to be used for the Works conform to this Specification must be provided to the Principal.

| HOLD POINT 3. | |
|---|---|
| Process Held | Procurement of the steel |
| Submission Details | The steel manufacturer's certification under Clause 4.24, the material / inspection certificates and the SDoC must be provided to the Principal at least 5 working days prior to the commencement of the fabrication |

## Traceability (Refer AS/NZS 5131 Clause 4.7)

### General

4.28 Unless specified otherwise in the Contract documents, piece traceability in conformity to AS/NZS 5131 is required for the Works. Records and evidence of traceability must be included in the Fabricator's Data Report (refer Clause 15).

### Steel

4.29 Steel that is not identified or not traceable to test certificates must not be incorporated into the Works.

4.30 Low stress steel stamps to mark each fabricated component with a unique identifier must be used. The identifier must remain recognisable after protective treatment but be located in an inconspicuous position after erection.

### Welds

4.31 Traceability of welders must be available through the use of weld maps and by marking their identification symbol adjacent to each weld.

4.32 Traceability of welding procedures must be available through the use of weld maps.

### Bolts, Nuts, Screws and Washers

4.33 Traceability for bolts, nuts, screws and washers must conform to ATS 5420 Supply of Bolts, Nuts & Washers.

# 5. Materials

## General (Refer AS/NZS 5131 Clause 5.1)

### Proprietary Products

5.1 Where a Principal's Registration Scheme is in place for a class of proprietary products or systems which are to be used in the Works, any products or systems within the scope of that scheme must be registered / approved by the Principal.

### Structural Steel Standards

5.2 All materials supplied must conform to the standards and specifications shown on the Design Drawings unless specified otherwise in the Contract documents.

5.3 All structural steel must conform to the applicable product standards listed in Table 5.3

**Table 5.3: Steel product standards applicable to this specification**

| Number | Description |
|---|---|
| AS/NZS 1163 | Cold formed structural steel hollow sections |
| AS/NZS 1594 | Hot rolled steel flat products |
| AS 3597 | Structural and pressure vessel steel – Quenched and tempered plate |
| AS/NZS 3678 | Structural steel – Hot-rolled plates, floorplates and slabs |
| AS/NZS 3679.1 | Structural steel – Hot-rolled bars and sections |
| AS/NZS 3679.2 | Structural steel – Welded I sections |
| SA TS 102 | Structural steel – Limits on elements added |
| SA TS 103 | Structural steel welding – Limits on boron in parent materials. |

5.4 The Fabricator must purchase steel of the specified grade, as detailed on the drawings, that conforms to the applicable product standard listed in Table 5.3, including where applicable, impact properties and through thickness properties.

5.5 Test and inspection certificates that demonstrate conformity to the relevant standard listed in Table 5.3 must be submitted to the Principal prior to the commencement of steel fabrication. The certificates must be issued by the manufacturer and be in English alphanumeric characters.

### Alloying Elements

5.6 Steels with alloying elements exceeding the values given in Table 1 of SA TS 102 must not be used.

5.7 Steels must be assessed for boron content prior to the establishment of welding procedures.

## Non-Destructive Testing of Steel Plate and Tube

5.8 Ultrasonic testing conforming to quality grade level 1 of AS 1710 in conformity to Clause A3 of AS/NZS 3678 must be carried out for steel plates requiring through thickness ductility (Z category), and where specified in Contract documents or design drawings, for other steel plates.

5.9 If specified in the Contract documents or design drawings, the weld seams of any hollow sections must be tested for conformance with acceptance level L4 of ISO 10893-2 or either of ISO 10893-3 or ISO 10893-11, with the exception that the acceptance level must be based on, as a minimum, the use of N 15 internal / external notches.

5.10 For the application of ISO 10893-3, the notch must not be greater than twice the depth of the reference notch, with a maximum of 1.0 mm, in conformity to Clause 8.2.2 of AS/NZS 1163.

## Structural Steels (Refer AS/NZS 5131 Clause 5.3)

### Verification Testing

5.11 If compliance with any of Clauses 4.24, 4.26 or 4.29 cannot be demonstrated, or if specified in the Contract documents, prior to steel fabrication, testing in conformity to the applicable product standard on at least two samples must be carried out for each heat of the steel.

| **WITNESS POINT 1.** | |
|---|---|
| Process Witnessed | Steel verification testing. |
| Notice Period | At least 10 working days prior notice of the commencement of steel verification testing must be provided to the Principal |

### Work After Leaving Steel Mill

5.12 The Contractor must ensure that any cutting or shaping of steel plates and sections after the steel has left the steel manufacturing mill is carried out in conformity to AS/NZS 5131.

5.13 The Fabricator must verify whether precautions to avoid lamellar tearing in tee, cruciform and corner joints have been specified by the Designer (refer to Section 5.3.5 of AS/NZS 5131).

5.14 Steelwork will be deemed to be nonconforming if defects in the parent steel due to the manufacture of the steel become evident at any stage of fabrication.

5.15 Any defects in the steel must be assessed against the freedom from defects clause in AS/NZS 1163, AS/NZS 1594, AS 3597, AS/NZS 3678, AS/NZS 3679.1 or AS/NZS 3679.2, as applicable, and where permitted by the Principal.

## Mechanical Fasteners (Refer AS/NZS 5131 Clause 5.5)

5.16 The supply of bolts, nuts, screws and washers and their assemblies must conform to ATS 5420.

## Studs and Shear Connectors (Refer AS/NZS 5131 Clause 5.6)

5.17 Studs and shear connectors must conform to AS/NZS 1554.2 and this Specification.

5.18 Certification from the stud supplier verifying that the materials of the studs and their bases conform to the appropriate specification as specified by Clause 2.2.3, Paragraph C10 and Appendix C of AS/NZS 1554.2 must be provided to the Principal.

## Grouting Materials (Refer AS/NZS 5131 Clause 5.8)

5.19 Any proprietary grouts must be registered or approved under any applicable Principal's registration Scheme and comply with ATS 5316.

## Steel Components Supplied by the Principal

5.20 If it is specified in the Contract documents that the Principal will supply steel components, the Contractor must:

a) issue a signed receipt for each steel component at the time of delivery or pick up;

b) comprehensively inspect the steel components;

c) if any damage / defects are identified, immediately provide the Principal with details of the damage / defects, including photographs and provide reasonable opportunity for the Principal to arrange for the damage / defects to be rectified; and

d) store and handle the Principal-supplied steel components such that they remain undamaged.

# 6. Preparation, Assembly and Fabrication

## Handling and Storage (Refer AS/NZS 5131 Clause 6.3)

6.1 The Fabricator must have available cranes with safe working load capacity that is at least equal to the maximum mass or tonnage of a single fabricated component made during the Works for safely lifting and turning individual steelwork components at each workstation or work area.

6.2 Handling during fabrication involving lifts over 5 tonnes must have a documented safe operation procedure, associated lift studies, lifting maps and sequencing diagrams for such lifts.

6.3 In addition to the provisions of Clause 5.9 and 6.3 of AS/NZS 5131, all steel must be stored at least 200 mm above the ground on platforms, slabs, or other supports under cover unless alternative arrangements are included in the approved Quality Plan.

## Cutting (Refer AS/NZS 5131 Clause 6.5)

6.4 In addition to the requirements of AS/NZS5131 Clause. 6.5, the following applies:

a) hand cutting may only be used where machine cutting is not possible, as approved by the Principal;

b) edges to be welded must not be cropped or sheared.

c) shearing must not be used for main plates, reinforcing plates, main gussets, splice plates and diaphragms except in a direction perpendicular to the direction of their main stresses; and

d) distortions caused by shearing must be removed.

6.5 Steel must not be cut when under stress or loading.

## Holing (Refer AS/NZS 5131 Clause 6.7)

6.6 The Fabricator is responsible for the accuracy of all holes regardless of variations in dimensions of rolled sections or tolerances allowed in fabrication.

## Shop Assembly (Refer AS/NZS 5131 Clause 6.9)

6.7 Temporary connections are not permitted unless shown otherwise on the Design Drawings.

6.8 In addition to the requirements of AS/NZS5131 Clause 6.9, a shop assembly of the structural steelwork must be performed:

a) for all splices in main girders; and

b) when required by the design.

6.9 The shop assembly must check the alignment, level and fit of the components and to verify the suitability of the templates, if any, used during fabrication to prove or obtain conformity to the Design Drawings. Components must be match marked before being dismantled.

6.10 Surveyed datum lines must be used to ensure the correct horizontal and vertical alignment of the girder segment end while positioned as required for the completed structure.

6.11 Unless specified otherwise in the Contract documents, shop assembly is not required for girders for simply supported girder spans less than 25 m in length.

6.12 For spans 25 m or greater in length with steel cross girders or cross frames, the first two lines of girders (i.e. Abutment A to Abutment B) fabricated must be shop assembled to check the fabrication procedures, the fit of the components and to verify the suitability of the templates used in fabrication.

6.13 All shop assembled joints must be match marked before the assembly is dismantled.

6.14 A certificate, signed by a person authorised to represent the Contractor, confirming satisfactory shop assembly must be submitted to the Principal.

## Fabrication

### Plate Alignment (Rolling Direction)

6.15 If specified on the Design Drawings, the plates and flats must be aligned so that the main stresses will be in the direction of rolling.

### Repairs

6.16 Any defects or score marks found during fabrication must be ground out in conformity to Clause 6 of AS/NZS 5131 and Clause 5.8.3 of AS/NZS 1554.1 or AS/NZS 1554.5.

6.17 Grinding marks must be parallel to the direction of the main stresses.

### Splices

6.18 Where splice locations are not shown on the Design Drawings or where splices at locations other than those shown on the Design Drawings are proposed, the details of the design and position of the proposed splices must be submitted to the Principal. After approval for use and after welding, these splice weld must be non-destructively inspected as detailed in Table 13.14. Splices at locations not shown on the Design Drawings that are not approved by the Principal are not permitted.

6.19 Unless specified otherwise in the Contract documents, all splice welds must be full strength butt welds.

| **HOLD POINT 4.** | |
|---|---|
| Process Held | Commencement of fabrication of members with splice locations nominated by the Contractor. |
| Submission Details | Details of design and locations of proposed splices to be used in the steelwork, at least 15 working days prior to the proposed commencement of fabrication. |

### Field Welded Splices

6.20 Where field welded splices are required, the finish of the ends of all girder segments must be true, as shown on the Design Drawings, to a tolerance of ± 1 mm over the depth and width of the girder.

## Cambering

6.21 Cambering of rolled sections, adjustment of camber in built-up sections and measurement of camber must be carried in accordance with the method statements / procedures included in the Quality Plan.

6.22 Unless specified otherwise, the camber in built-up sections must be prepared by cutting webs to the shapes detailed on the Design Drawings.

6.23 When measuring camber, deflections due to self-weight must be accounted for in conformity to the results of calculations carried out by a Professional Engineer.

## Correction of Distortion

6.24 Any distortion must be corrected by mechanical or thermal means, provided that the process used complies with Clause 6.6 of AS/NZS 5131, does not damage the components and does not impair their intended use.

6.25 Any weld located in a zone where unacceptable distortion has been corrected must be inspected after the corrective work has been completed.

## Ancillary Steel Items

### General

6.26 Except where shown on the Design Drawings, splices are not permitted for ancillary steel items (such as barrier railings, fingerplate expansion joints, welded anchors and bearing attachment plates).

6.27 Where items are to be hot-dip galvanized, adequate measures must be taken during fabrication to ensure that the items will not be distorted or otherwise damaged during the galvanizing process.

### Welded Anchors

6.28 Anchors for protection angles and expansion joints, other than stud anchors, must be welded to base plates with SP category welds conforming to AS/NZS 1554.1 or AS/NZS 1554.3 (as applicable). Where required for the qualification of the welding procedure, a special test piece must be tested by applying a tensile force to the anchor to verify that the welded attachment is stronger than the anchor.

## Transport to Site (Refer AS/NZS 5131 Clause 6.11)

6.29 The Fabricator must complete the inspection of the fabricated steelwork not less than 3 working days prior to any products being dispatched for protective coating or delivery to site.

6.30 The Fabricator must notify the Principal that the fabricated steelwork is available for inspection.

| **HOLD POINT 5.** | |
|---|---|
| Process Held | Transport of fabricated steelwork to other workshops or to site. |
| Submission Details | The relevant documents from the Fabricator's Data Report (refer Clause 15) must be submitted to the Principal at least 3 working days prior to the transportation of the steel. |

## Hot Induction Bends

6.31 Notwithstanding AS/NZS 5131, any hot induction bends must comply with ISO 15590-1 PSL2.

# 7. Welding

## General (Refer AS/NZS 5131 Clause 7.1)

7.1 Unless specified otherwise on the Design Drawings or in this Specification, all welding must conform to AS/NZS 1554.1 Category SP, AS/NZS 1554.4 Category SP or FP or AS/NZS 1554.5 Category FP.

7.2 AS/NZS 1554.1, AS/NZS 1554.4 and AS/NZS 1554.5 must be read in conjunction with the complementary technical specifications SA TS 102 and SA TS 103.

## Welding Plan (Refer AS/NZS 5131 Clause 7.2)

7.3 A Welding Plan must be submitted to the Principal in conformance to the requirements of AS/NZS 5131 Clause 7.2.

| **HOLD POINT 6.** | |
|---|---|
| Process Held | Commencement of welding. |
| Submission Details | If not included in the Quality Plan, the Welding Plan must be submitted to the Principal at least 15 working days prior to transport. |

## Qualification of Welding Procedures and Welding Personnel (Refer AS/NZS 5131 Clause 7.4)

### Qualification of Welding Procedures

7.4 The Welding Procedure Specification for each welded joint must be qualified and approved by the Welding Coordinator and submitted to the Welding Inspector.

7.5 Requalification of previously qualified welding procedures is not necessary. However, all the Fabrication Documents for the Works (such as Welding Procedures, Repair Welding Procedures, Welder Qualifications, Distortion Control, Flame Straightening etc.) must be signed as approved for construction by both the Welding Coordinator and the Welding Inspector.

| **WITNESS POINT 2.** | |
|---|---|
| Process Witnessed | Manufacture of weld procedure qualification test piece |
| Notice Period | At least 3 working days prior notice of the time and place where the welding and testing of test pieces and/or assemblies will be carried out. |

7.6 Weld procedures for repair work must be qualified and approved by the Welding Coordinator.

7.7 For qualification by testing of a steel type that is not specifically provided for by AS/NZS 1554.1 AS/NZS 1554.4 and / or AS/NZS 1554.5, the welding consumables are deemed to be non-prequalified.

7.8 Where the weld arc energy exceeds the limits specified for prequalified consumables in Clause 4.6 of AS/NZS 1554.1 and AS/NZS 1554.5, impact tests on the heat affected zone (HAZ) of the parent steel to must be carried out to verify that the impact properties of the HAZ continue to meet the minimum requirement for that steel specified in AS/NZS 1554 or as specified on the Design Drawings.

7.9 Where specified in the Contract documents, special test pieces to verify the suitability of the welding procedure (such as Annexure B and Clause 4.7.2 of AS/NZS 1554.1) and the welder qualification must be prepared.

7.10 The qualification and approval of the weld procedure must be documented in a Welding Procedure Qualification Record and a Welding Procedure Specification in accordance with AS/NZS 1554.1, AS/NZS 1554.4 or AS/NZS 1554.5 Clause 4.10 and submitted to the Principal.

| **HOLD POINT 7** | |
|---|---|
| Process Held | Commencement of welding. |
| Submission Details | The Welding Procedure Qualification Record, Welding Procedure Specification(s) and Welder Qualification certificates (refer Clause 7.12) must be submitted to the Principal at least 15 working days prior to commencement of welding. |

7.11 Welding procedure traceability is required irrespective of the designated Construction Category.

## Qualification of Welders

7.12 All welders must be qualified to ISO 9606.1 or alternatively to AS/NZS 2980, subject to acceptance by the Principal. Welders may also be qualified for a particular procedure through Clause 4.12.2.3 of AS/NZS 1554.1, AS/NZS 1554.4 or AS/NZS 1554.5, as appropriate.

7.13 In addition to the requirements of AS/NZS 5131, records from an industry-operated welder certification scheme acceptable to the Principal may be deemed to conform as a record of welder qualification.

7.14 Where a welder qualification test piece is made during the construction of the Works, it must be witnessed by the Welding Coordinator and Welding Inspector and may be witnessed by the Principal. The Welding Procedure Specification used for the production of the welder qualification test piece must be previously qualified in conformity to Clause 7.4.

| **WITNESS POINT 3**. | |
|---|---|
| Process Witnessed | Welder qualification test, including manufacture of a welder qualification test piece. |
| Notice Period | At least 3 working days prior notice of the time and place where the welding and testing of test pieces and/or assemblies will be carried out must be provided to the Principal. |

7.15 Identification and traceability of welders is required, irrespective of the designated Construction Category.

## Welding Coordination

7.16 In accordance with AS/NZS ISO 3834.2 and ISO 14731, the Fabricator must appoint both:

a) a Welding Supervisor who satisfies at least one of the requirements of Clause 4.12.1 (a) to (d) or Clause 7.2 (a) to (d) of AS/NZS 1554.1, AS/NZS 1554.4 or AS/NZS 1554.5; and

b) a Welding Coordinator to coordinate the execution of the welding.

7.17 The Responsible Welding Coordinator and the Welding Supervisor may be the same person.

7.18 The Welding Coordinator must have technical knowledge of the applicable Australian standards, welding processes and equipment, materials and their behaviour during welding and be competent in all welding-related tasks relevant to the Works.

## Preparation and Execution of Welding (Refer AS/NZS 5131 Clause 7.5)

### Joint Preparation

7.19 Welding through protective coatings is not permitted.

### Welding Consumables

7.20 Hydrogen-controlled welding is required. The hydrogen content of deposited weld metal must not exceed 10 ml $H_2$ per 100 g of weld metal. Hydrogen controlled (low hydrogen) consumables and / or processes must be used (i.e. H10 classification or better).

### Butt Welds

7.21 The Fabricator must provide prior notice to the Principal of the commencement butt weld preparation.

| **WITNESS POINT 4.** | |
|---|---|
| Process Witnessed | Butt weld preparation. |
| Notice Period | At least 3 working days prior notice of commencement of fabrication of butt welded joints. |

7.22 Permanent steel backing must not be used unless shown on the Design Drawings or approved by the Designer in advance of fabrication.

7.23 A 20% sample of back gouged preparations must be examined and reported by the Welding Inspector.

7.24 Run-on / Run-off tabs with a minimum length of 50mm and the same thickness and preparation as joint must be used for all welds in accordance with AS/NZS 5131 Cl. 7.5.9.1. Run-on / Run-off tabs must be removed without damage to parent material after the joint has cooled. The ends of the weld must be finished smooth and flush with the faces of the abutting parts.

### Welds on Weathering Steel

7.25 Procedures for the welding of weather-resistant steel must include the use of consumables that provides weld metal with the characteristics of resistance to atmospheric corrosion and of colouring similar to those of the parent material. For the steel grades listed in AS/NZS 1554.1 or AS/NZS 1554.5 Table 4.6.1(C), welding consumables for all the welding passes must be selected in accordance with Table 7.25. This information must be included in the appropriate Welding Procedure Specification(s).

**Table 7.25: Weathering Steel Welding Consumables**

| Welding Process | Option 1 | Option 2 |
|---|---|---|
| Manual Metal Arc Welding | 2.5% Ni | 1% Ni, 0.5% Mo |
| Metal Active Gas Welding | 2.5% Ni | 1% Ni, 0.5% Mo |
| Submerged arc welding – solid wire or strip | 2% Ni | 1% Ni, 0.5% Mo |
| Flux cored arc welding | 2% Ni | 1% Ni, 0.5% Mo |

## Welding of Steel Structures Subject to High Levels of Fatigue Loading

7.26 For the welding of steel structures or component subject to high levels of fatigue loading, specified on the Design Documentation drawings as Category FP, the minimum extent of inspection or testing must be as provided in accordance with Table 13.14 or, when welds are not specified in Clause 13, the maximum recommendations of Table 7.4 of AS/NZS 1554.5 for Category FP.

## Welding Quenched and Tempered Steel

7.27 For the welding of quenched and tempered steels, the following requirements apply:

a) where thermal methods are used to correct distortion, the temperature of the steelwork must not exceed the tempering temperature of the steel less 20°C; and

b) for Category SP welds, the minimum extent and type of inspection or testing must be in accordance with:

i) Clause 13; or

ii) if the welds are not specified in Clause 13, on the Design Documentation or in the Contract documents, the maximum recommendations of Table 7.4 of AS/NZS 1554.4 for Category SP apply;

c) for welds specified on the Design Documentation drawings as Category FP, the minimum extent of inspection or testing must be as provided for Category SP in Clause 13 or as given in Table 7.4 of AS/NZS 1554.4 for Category FP, whichever is the greater.

## Welding of Dissimilar Steels

7.28 In the case of welding dissimilar steels, the welding technique process must be reviewed for the issues associated with contamination and galvanic corrosion and documented by the Welding Coordinator. Welding of dissimilar metals must comply with any applicable requirements included in Appendix H of AS/NZS 1554.6.

## Stud Welding

7.29 Documentation for stud material properties and certification of the stud base welding must be submitted prior to the commencement of welding of studs.

7.30 Qualification of the stud welding operator must be carried in conformity to Clause 4.3.3 of AS/NZS 1554.2 using at least 6 studs prior to carrying out any stud welding of members by that operator.

| **HOLD POINT 8** | |
|---|---|
| Process Held | Commencement of stud welding. |
| Submission Details | All details required for stud certification and the qualification of the stud welding procedure and the stud welding operator, at least 5 working days prior to commencement of any stud welding of members |

7.31 Testing of welded stud shear connectors must be carried out in accordance with Clause 13.

| **WITNESS POINT 5.** | |
|---|---|
| Process Witnessed | Testing of welded studs using ring and bend tests |
| Notice Period | At least 3 working days prior notice of testing must be provided to the Principal |

### Execution of Welding

7.32 Where the work includes the fabrication of similar items, the first one welded (referred to as the prototype) must be inspected and required documents submitted to the Principal prior to any welding of subsequent items.

7.33 The prototype must be inspected by the Welding Inspector to check that the welding processes used are satisfactory, dimensional tolerances are not exceeded and that welding of further items will result in completed components which are within tolerance.

7.34 In addition to the non-destructive examinations specified in Clause 13, the extent of inspection on the prototype for all categories must comprise 100% testing of all butt welds using either ultrasonic or radiographic test methods, with 100% magnetic particle testing of all fillet welds.

7.35 All such tests on the prototype welds must be carried out in accordance with Clause 13.6.2 of AS/NZS 5131 in terms of minimum hold time.

7.36 Weld inspections must be carried out after all heat treatment is completed.

| **HOLD POINT 9.** | |
|---|---|
| Process Held | Commencement of welding of subsequent similar items. |
| Submission Details | Documents demonstrating conformity of the prototype at least 5 days prior to the continuation of the welding |

## Acceptance Criteria (Refer AS/NZS 5131 Clause 7.6)

### Routine Requirements and Corrections to Welds

7.37 Where a nonconforming weld is detected and less than 100% of the weld length is required to be inspected, the remainder of the weld must be inspected.

7.38 Where another nonconforming weld is detected, the same cycle of inspection must be repeated until no more nonconforming welds are found.

7.39 The Principal must be notified of any weld nonconformity, together with the extent of the nonconformity, the proposed repair procedure, the results of re-inspection after repair and the outcome of the welding procedure review.

| **HOLD POINT 10.** | |
|---|---|
| Process Held | Further welding or repairs to welds. |
| Submission Details | Results of the inspection and examination of all completed welds, including any nonconforming welds, together with the extent of the nonconformity, the proposed repair procedure and the outcome of the welding procedure review, must be submitted to the Principal prior to the commencement of repair work |

7.40 After repair welding has been completed, the full length of the repaired weld must then be re-inspected with 100% visual inspection and 100% NDE. The re-inspection must include the 300 mm of weld on each side of the repaired weld, unless the end of weld occurs at a shorter distance.

7.41 This Specification does not require the use of the fracture mechanics method of assessment of weld imperfections that exceed the levels given in the application Standard.

# 8. Mechanical Fastening

## General (Refer AS/NZS 5131 Clause 8.1)

8.1 Work method statements, procedures, personnel qualifications and experience, equipment details and other evidence of conformity of bolting operations to AS/NZS 5131 and ATS 5420 must be submitted to the Principal.

| **HOLD POINT 11.** | |
|---|---|
| Process Held | Commencement of bolting operations |
| Submission Details | Evidence of conformity of bolting operations to AS/NZS 5131 and ATS 5420 must be submitted to the Principal at least 15 working days prior to the commencement of delivery of fasteners to the Site. |

8.2 Fasteners used for tensioned applications (8.8/TB and 8.8/TF categories in AS 5100.6) must be supplied in accordance with ATS 5420.

## Bolts, Nuts and Washers (Refer AS/NZS 5131 Clause 8.2)

8.3 Bolts must not be welded.

## Preparation of Contact Surfaces on Plies (Refer AS/NZS 5131 Clause 8.4)

8.4 The minimum thickness of material within the grip of the fastener for friction-type connections must not be less than the diameter of the bolt.

8.5 For friction-type connections, all burrs must be removed from the contact surfaces.

8.6 For a surface or coating not covered by Clause 12.5.4.1 of AS 5100.6, the friction coefficient (slip factor) of an applied coating system must be determined in accordance with AS 4100, Appendix J.

## Inspection of Mechanical Fastening (Refer AS/NZS 5131 Clause 13.7)

8.7 Traceability records of the specific fasteners used at each bolted connection must be kept.

8.8 At the completion of bolting, test reports, bolting records and other evidence of conformity of bolting operations to AS/NZS 5131 must be submitted to the Principal.

| **HOLD POINT 12.** | |
|---|---|
| Process Held | Completion of bolting operations |
| Submission Details | Test reports, bolting records and other evidence of conformity of bolting operations to AS/NZS 5131 must be submitted to the Principal before proceeding with subsequent work. |

# 9. Surface Treatment and Corrosion Protection

9.1 Clause 9 of AS/NZS 5131 is excluded from this Specification.

# 10. Architecturally Exposed Structural Steelwork

10.1 Clause 10 of AS/NZS 5131 is excluded from this Specification.

# 11. Erection

## Erection Process (Refer AS/NZS 5131 Clause 11)

11.1 The Contractor must submit an erection plan, work method statements and, when applicable, safe operation procedures for lifts, to the Principal.

| HOLD POINT 13. | |
|---|---|
| Process Held | Erection of structural steelwork. |
| Submission Details | The erection plan, work method statements and when applicable the safe operation procedure for lifts certified by the Designer, at least 15 working days prior to planned commencement of erection work. |

11.2 The Contractor must provide at least 7 days of notice of its intention to commence assembly of members at the construction worksite.

| WITNESS POINT 6. | |
|---|---|
| Process Witnessed | Commencement of assembly of members. |
| Notice Period | At least 7 working days prior notice of testing must be provided to the Principal |

11.3 The steelwork must be handled so that individual parts will not be bent, twisted or damaged in any way.

## Supports (Refer AS/NZS 5131 Clause 11.6)

### Bearings, Anchor Bolts and Anchoring Devices

11.4 To allow for the change in length of the members under dead load and temperature variations, the bearings must be positioned so that the horizontal distance between the centres of base plates will be as shown on the drawings at the specified temperature.

### Field Welded Joints

11.5 For field welded joints, the ends of the members and/or segments must be held in position during welding using suitable temporary devices. If tack welding is used, on completion of the joints, the steel surface must be restored by grinding smooth and flush in accordance with AS/NZS 5131 and demonstrated to be free of cracking by non-destructive inspection.

### Field Bolted Connections

11.6 Those surfaces of steelwork which will be in contact after bolting must:

a) be free of oil, dirt, burrs or any other coating or defects that would prevent satisfactory seating of parts or interfere with the development of friction between them; and

b) have the coating specified by the Designer, or as demonstrated by testing, to achieve the required slip factor.

11.7 Hot-dip galvanized coatings and approved zinc-silicate primers do not need to be removed from contact surfaces.

### Tensioning Method

11.8 Unless specified otherwise, nuts for TB and TF category bolts must be tensioned using the part-turn method.

11.9 For joints containing more than eight bolts, the “snug-tight” condition must be checked by a second run over the bolts, in the order of the design sequence.

11.10 Nuts must be marked after snug tightening and prior to final tensioning to allow measurement of the true amount of turn of the nut.

11.11 Re-tensioning of bolts, which have been fully tensioned, is not permitted except as set out in AS/NZS 5131.

### Certification of Bolting

11.12 The Contractor must submit a certificate by a Professional Engineer verifying that bolting has been carried out in conformity to this Specification.

### Removal of Falsework

11.13 Equipment for pulling piles or for removing falsework must not be supported or attached to any portion of the new structure.

# 12. Geometrical Tolerances

12.1 Measurement to determine conformity must be undertaken when all fabrication and heating operations are completed, the member has cooled to a uniform temperature and prior to protective treatment.

# 13. Inspection, Testing and Correction

## General (Refer AS/NZS 5131 Clause 13.1)

13.1 All testing required under this Specification (including materials testing, testing of welding procedure test coupons and non-destructive inspections) must be performed by laboratories with third-party accreditation to AS ISO/IEC 17025 by a signatory to the International Laboratories Accreditation Cooperation (ILAC) through their Mutual Recognition Agreement (MRA) in the specific field and class of testing for the purpose of establishing conformity to the requirements.

13.2 The appropriate logo or further details of the ILAC MRA signatory must be noted on the document or test report. Note that the National Association of Testing Authorities (NATA) and International Accreditation New Zealand (IANZ) are signatories to ILAC MRA.

13.3 All inspections throughout the fabrication process must be documented and signed by qualified personnel as required by this Specification.

## Competency of the inspection personnel (refer AS/NZS 5131 Clause 13)

13.4 Unless specified otherwise in the Contract documents, the Contractor must appoint a Welding Inspector to undertake the inspection required by AS/NZS 5131 Clause 13.6. The Welding Inspector must:

a) not undertake any other role (including carrying out welding or supervising welding) in respect of the fabrication of the Works;

b) not be an employee of the Fabricator (unless approved otherwise by the Principal); and

c) be qualified as a Welding Inspector in accordance with AS/NZS 1554.1 Clause 7.2 (a) to (d).

13.5 The Principal and Contractor must not interfere with or attempt to improperly influence the Welding Inspector in the performance of any of their functions pursuant to this Specification.

13.6 All non-destructive examinations (e.g. ultrasonic examination, radiography, etc) must be carried out by technicians suitably qualified and certified for carrying out the examination method employed (see Section 7.4 of AS/NZS 1554.1, AS/NZS 1554.4 or AS/NZS 1554.5). Non-destructive testing technicians must be certified by an organisation accredited to certify personnel in accordance with AS ISO 9712, to at least Level 2 for the relevant method. Suitable organisations include:

a) Australian Institute for Non Destructive Testing (AINDT); or

b) A certification body for persons accredited to ISO 17024 and ISO 9712 by a signatory member of the ICNDT MRA.

13.7 Non-destructive testing technicians certified by Certification Board of Inspection Personnel, New Zealand (CBIP NZ) are deemed to hold an equivalent qualification.

13.8 The currency of the above qualifications and certifications must conform to the requirements of the issuing institution. Lapsed qualifications and certifications are not acceptable.

## Test and Inspection Reports

13.9 Material and NDE test certificates and other test and inspection certificates must be in the English language. A certificate must include, as applicable, the specific chemical composition and materials properties required by a particular materials standard and the specific content required by a particular materials standard (including SA TS 102) or test method.

13.10 All non-destructive examination reports must be prepared as required by the relevant test method in accordance with Clauses 13.1 and 13.2. The report must identify both the technician responsible for carrying out the test and the technician ~~r~~esponsible for the test report.

### Inspection and Test Plan for Welding

13.11 Further to Clause 4.18, for CC2 and above, an ITP covering the inspection of Items (i) to (xxviii) of Clause 13.6.1.2 of AS/NZS 5131 must be prepared where relevant.

### Inspection After Welding

13.12 Visual scanning and visual examination must be undertaken in accordance with AS/NZS 5131, Table 13.6.2.2(A).

13.13 Magnetic particle examination must be undertaken in accordance with Clause 6.5 of AS/NZS 1554.1, AS/NZS 1554.4 or AS/NZS 1554.5. The extent of testing for Category SP Welds must conform to Table 13.14. For Category FP Welds, the extent of examination of each weld length is 100% unless specified otherwise in Table 13.14.

13.14 The extent of non-destructive examination (radiographic or ultrasonic) must conform to Table 13.14 and be undertaken using either:

a) the radiography method (conforming to Clause 6.3 of AS/NZS 1554.1 or AS/NZS 1554.4 for SP and Clause 6.2 of AS/NZS 1554.5 for FP); or

b) the ultrasonics method (conforming to Clause 6.4 of AS/NZS 1554.1 or AS/NZS 1554.4 for SP and Clause 6.3 of AS/NZS 1554.5 for FP).

**Table 13.14: Minimum extent of Visual, Magnetic Particle and Ultrasonic (or Radiographic) Examination of Welds.**

| Sr. No. | Weld Location or Component (as Appropriate to Design) | Minimum Extent of Inspection for Each Weld Length (The figure in brackets is the minimum extent of inspection for FP category) |
|---|---|---|
| 1 | Visual examination of all welds prior to any NDE (In accordance with AS/NZS 1554.1 or AS/NZS 1554.5 Cl. 7.3) | 100% (100%) |
| 2 | Tension Flange: Butt Weld (e.g. flange to flange splice)<br>Tension Flange: T Weld (e.g. longitudinal weld between tension flange and web, welds between tension flange and end plates, diaphragm, stiffeners) | 100% (100%) |
| 3 | Compression Flange - Butt Weld | 100% for the flange width <= 750mm<br>50% for the flange width >750mm<br>(100%) |
| 4 | T welds such as:<br>1. Compression flange or web to Stiffeners, diaphragms or end plate.<br>2. Diaphragm stiffeners to diaphragm. | 20% (50%) |
| 5 | Web butt welds | For the depth <=1600mm: 300 mm minimum at each end of each joint.<br>For the depth >1600mm: As above and additional 300mm in the centre of each joint. (Same for FP) |
| 6 | Web to compression flange T-welds (longitudinal welds) | 20% (50%) of each weld length, including all the following:<br>• 500 mm each side of all diaphragms; (Same for FP)<br>• 1000 mm at all weld ends (Same for FP);<br>• Plus intermediate portions to make up inspected length (Same for FP) |
| 7 | Web to flange coping/splice<br>(refer Clause 13.15 a) | 50% (50% if NDT of prototype is acceptable without repairs; otherwise 100%) of the total weld length for affected welds, including 1000 mm at:<br>• All ends of welds (Same for FP);<br>• Locations below or adjacent to lifting lugs (Same for FP);<br>• Diaphragm locations (Same for FP);<br>• Plus intermediate portions to make up inspected length (Same for FP) |
| 8 | Butt welds (incl. V, X, U butt) in:<br>- Hollow sections (except pile casings),<br>- Rolled open sections,<br>- Plates (except web and flange). | 50% (50% if Prototype is acceptable, otherwise 100%). |

| Sr. No. | Weld Location or Component (as Appropriate to Design) | Minimum Extent of Inspection for Each Weld Length (The figure in brackets is the minimum extent of inspection for FP category) |
|---|---|---|
| 9 | Piles, Pile casings, Wharf piling splice welds (refer Clause 13.15 b) | 1. Testing of the first splice weld; and<br>2. 10% of remaining number of splices; and<br>3. 100% of the selected weld; and<br>4. 150mm on all sides of T-intersection between longitudinal seam weld and circular seam weld.<br>(Same for FP) |
| 10 | Any other welds except for the prototype (for example traffic barriers, joints in CC2 structure other than the joint in base plate) | 10% unless specified otherwise (100%) |
| 11 | Sign structures - Welds between horizontal arms and flange connection plates. | 100% (100%) |
| 12 | Base plate welds in sign structures, mast, gantries, columns, towers, traffic barriers etc. | 100% (100%) |
| 13 | Cruciform welds (including stffeners at cruciform locations) | 100% (100%) |
| 14 | Joints to make-up member length | 100% (100%) |
| 15 | Repairs to weld (incl. repair welding, gouging, grinding, cutting) | 100% (100%) |
| 16 | Lifting Lug | 100% (100%). Include the far side of the lifting lug weld. |
| 17 | Field Welded Joints | 100% (100%) |
| 18 | All welds in Prototype | 100% (100%) NDT to commence 48hours after the weld cools down to ambient temperature. |

*The following notes apply for all weld locations or components:*

1. *Ultrasonic (or Radiographic) examination of fillet welds is not required unless specified otherwise.*
2. *Magnetic Particle Examination and Ultrasonic (or Radiographic) Examination must be carried out at the same location.*
3. *Visual and NDT inspections must include ends of all welds after removal of run-in and run-out plates.*
4. *%NDT must be shown in weld maps against the selected joints.*

13.15 The following examples show the extent of NDT

**Figure 13.15 a) Example - Extent of NDT at Web to Flange Splice**

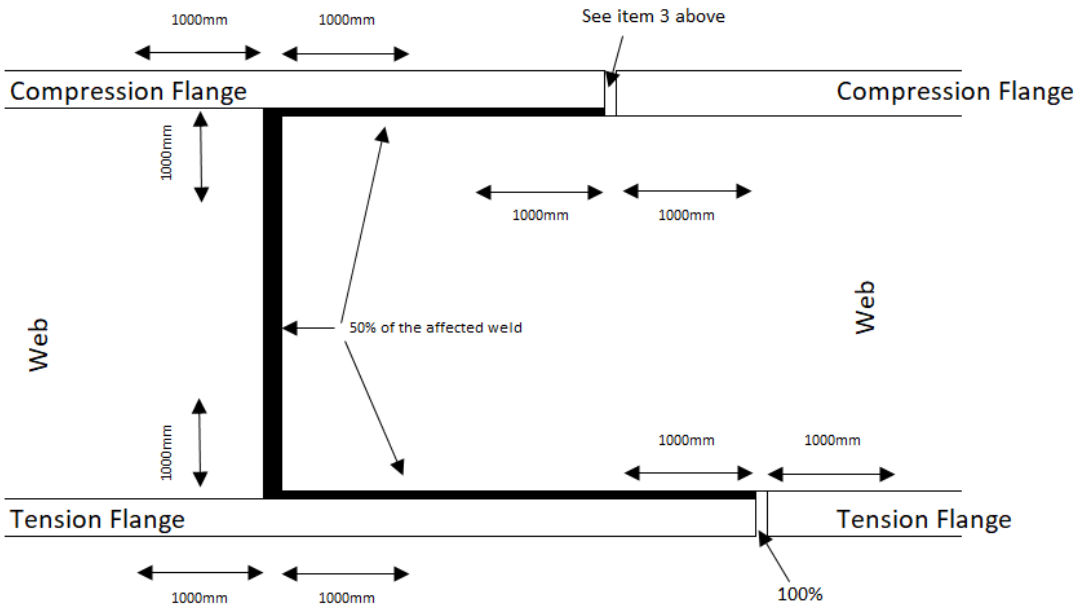



**Figure 13.14 b) Example - Extent of NDT in Pile Casings**


## Phased Array Ultrasonic Testing

13.16 In addition to the techniques covered under Clause 6 of AS/NZS 1554.1, phased array ultrasonic testing in conformity to ISO 13588 using appropriate test sensitivity to obtain defect dimensions, may be implemented, subject to approval by the Principal.

## Inspection and Testing of Welded Shear Studs for Composite Steel and Concrete Structures

13.17 Test welded stud shear connectors must be tested in accordance with Table 13.17.

**Table 13.17: Testing of welded stud shear connectors**

| Method | Location of studs | Percentage of total length or number |
|---|---|---|
| 30° hammer bend test in conformity to Clause 4.1.1 or Clause 4.1.2 of AS/NZS 1554.2 | First of each day's studs welded | First two studs welded, or more as required |
| Visual scanning | All studs welded | 100% |
| Stud weld ring test using a steel 1 kg hammer, swung freely to strike the stud in two opposite directions.<br>The tested stud must give a clear ring.<br>All studs which do not give a clear sound in the ring test must be subjected to the 10° bend test | All studs welded | 100% |
| Bend test in conformity to<br>Clause 6.1.1 or Clause 6.1.2 of AS/NZS 1554.2 | All members with stud welds | 5% of studs on each member (1 in each 20), and including studs with missing weld flash. Studs with less than 360° of weld flash must be bent 15° in a direction opposite to the missing portion of the flash.<br>If any stud fails, all studs on the member or element must be visually inspected and any stud with less than 360° of weld flash must be tested.<br>Do not bend back studs unless required for clearance |

# 14. Site Modifications during Erection and Modification and Repair of Existing Structures

## General (Refer AS/NZS 5131 Clause 14.1)

14.1 The Contractor must submit a proposal and the corresponding approval for any site modifications to the steelwork to the Principal. This applies to modifications made on-site to fabricated items during erection, and to modifications or repairs to existing structures or structural elements made on-site.

| HOLD POINT 14 | |
|---|---|
| Process Held | Modification of fabricated steelwork or existing structures. |
| Submission Details | Full details of any proposed site modification on fabricated steelwork or existing structures, including design calculations, detailed procedures and detailed drawings, at least 30 working days prior to commencing any such work. |

# 15. Certification of Completion of Fabrication

15.1 During the construction of the Works, the Fabricator must:

a) compile all technical details and records of activities into the Fabricator's Data Report ('FDR') [2];

b) keep the FDR up to date so that its submission on completion of the Works is not delayed;

c) ensure that all documents in the FDR are indexed to ATS 5410, in English, use SI units and are clearly legible.

15.2 At a minimum, the FDR must include all information under the following headings:

a) fabrication specific procedures included in the Quality Plan;

b) qualification of relevant fabrication personnel (Welding Coordinator, Welding Supervisor, Welding Inspector, NDT operator and welders);

c) inspection and test plans (ITPs) and documents detailed within the ITP;

d) any deviations from the Specification and the corresponding approval for the deviation;

e) piece traceability record (refer Clause 4.29), material test certificates, including for steel supplied to the Works, and for bolts, nuts and washers;

f) welding records, including weld maps, welding procedure specifications, welding procedure qualification records and relevant test certificates, welder qualification records, and welding consumable certificates;

g) Non-Destructive Examination reports;

h) As Constructed drawings of the fabricated members (refer Clause 4.22);

i) nonconformity reports and outcomes of corrective actions;

j) shop assembly records (refer Clause 4.22);

k) instrument calibration certificates;

l) inspection and testing records, including measurements of dimensions compared with relevant tolerances;

m) delivery/dispatch records.

15.3 The FDR must be submitted to the Principal in .pdf format. If requested by the Principal, the Contractor must also submit a hard copy, using A4-size binders with file separators clearly separating each section, with a detailed table of contents at the front of each binder.

# 16. Protection of the Patina in Weather Resistant Steel

16.1 Where weather resistant steel is used, the Contractor must implement the following processes and / or procedures:

a) blast cleaning on the construction site prior to erection to provide a uniform patina;

b) processes to identify the required uniformity of the patina;

c) procedure to assess the achievement of the required uniformity at the construction site; and

d) processes (including wrapping piers and abutments in protective sheeting or similar) to ensure that the weather resistant steel is not affected by staining during formation of the patina.

[2] Alternatively referred to as the Manufacturer's Data Report or MDR

16.2 The Contractor must ensure that the patina of the weather resistant steel is not damaged. Any damage to the patina is a nonconformity and the Contractor's proposed rectification of the nonconformity must include treatment in accordance with Clause 16.1 and be approved by the Principal.

16.3 If marking of weather resistant steel is required, water-based paint must be used. The marking must be removed after fabrication during blast cleaning. Any further marking following blast cleaning must be avoided unless necessary. If marking is necessary following blast cleaning, the marking must be removed with low pressure cleaning, taking care to protect the patina in accordance with this Clause 16.

# Annexure A: Summary of Hold Points, Witness Points and Records

The following is a summary of the Hold Points / Witness Points that apply to this Specification and the Records that the Contractor must submit to the Principal to demonstrate compliance with this Specification.

| Clause | Hold point | Witness point | Record |
|---|---|---|---|
| 4.1 | Commencement of steel procurement or fabrication of steelwork. | | Evidence of registration / prequalification |
| 4.19 | Commencement of fabrication. | | Quality plan |
| 4.27 | Commencement of steel procurement | | The steel manufacturer's material and inspection certificates and SDoC |
| 5.11 | | 1. Steel verification testing | |
| 5.18 | | | Certification of compliance from the stud supplier |
| 6.19 | Commencement of fabrication of members with splice locations nominated by the Contractor | | Design and locations of proposed splices |
| 6.30 | Transport of fabricated steelwork to other workshops or to site | | Relevant documents from the Fabricator's Data Report |
| 7.3 | Commencement of welding. | | Welding Plan |
| 7.5 | | 2. Manufacture of weld procedure qualification test piece | |
| 7.10 | Commencement of welding. | | Specifications, Records (PQR) and Welder Qualification certificates |
| 7.14 | | 3. Welder qualification test | |
| 7.21 | | 4. Butt weld preparation | |
| 7.30 | Commencement of stud welding | | Details required for stud certification |
| 7.31 | | 5. Testing of welded studs using ring and bend tests | |
| 7.36 | Commencement of welding of subsequent similar items | | |
| 7.39 | Further welding or repairs to welds | | Results of the inspection and examination of all completed welds |
| 8.1 | Commencement of bolting operations | | Procedures, personnel qualifications and experience, equipment details |

| Clause | Hold point | Witness point | Record |
|---|---|---|---|
| 8.8 | Completion of bolting operations | | Test reports, bolting records and other evidence of conformity of bolting operations to AS/NZS 5131 |
| 11.1 | Erection of structural steelwork | | Erection Plan and supporting documentation |
| 11.2 | | 6. Commencement of assembly of members. | |
| 14.1 | Modification of fabricated steelwork or existing structures | | Details of any proposed site modification |
| 15.3 | | | Fabricator's Data Report |

# Annexure B: Special Test Pieces

If specified in the Contract documents that Special Test Pieces must be prepared, the special test pieces must be representative of each type of weld within the limits of the essential variables of the welding procedure. The test pieces may be required for both shop welding and field welding.

The test pieces must be made from material of the same standard, grade and heat treatment as the material used in the structure. Each plate making up the test piece must be at least 150 mm x 300 mm. Example test pieces are shown in Figure B.1 and Figure B.2.

The test pieces must be examined using radiography or ultrasonics for butt welds and magnetic particle testing for fillet welds to assess conformity to this Specification.

Mechanical tests must be performed, including macro tests (to AS 2205.5.1) and as appropriate, transverse tensile tests (to AS 2205.4.1), bend tests (to AS 2205.3.1), fillet break tests (to AS 2205.7.1) and other tests as specified on the weld(s) of the test pieces, and assess for conformity to the applicable material and welding standards.

**Figure B.1: Example Test Pieces for Shop Welds**

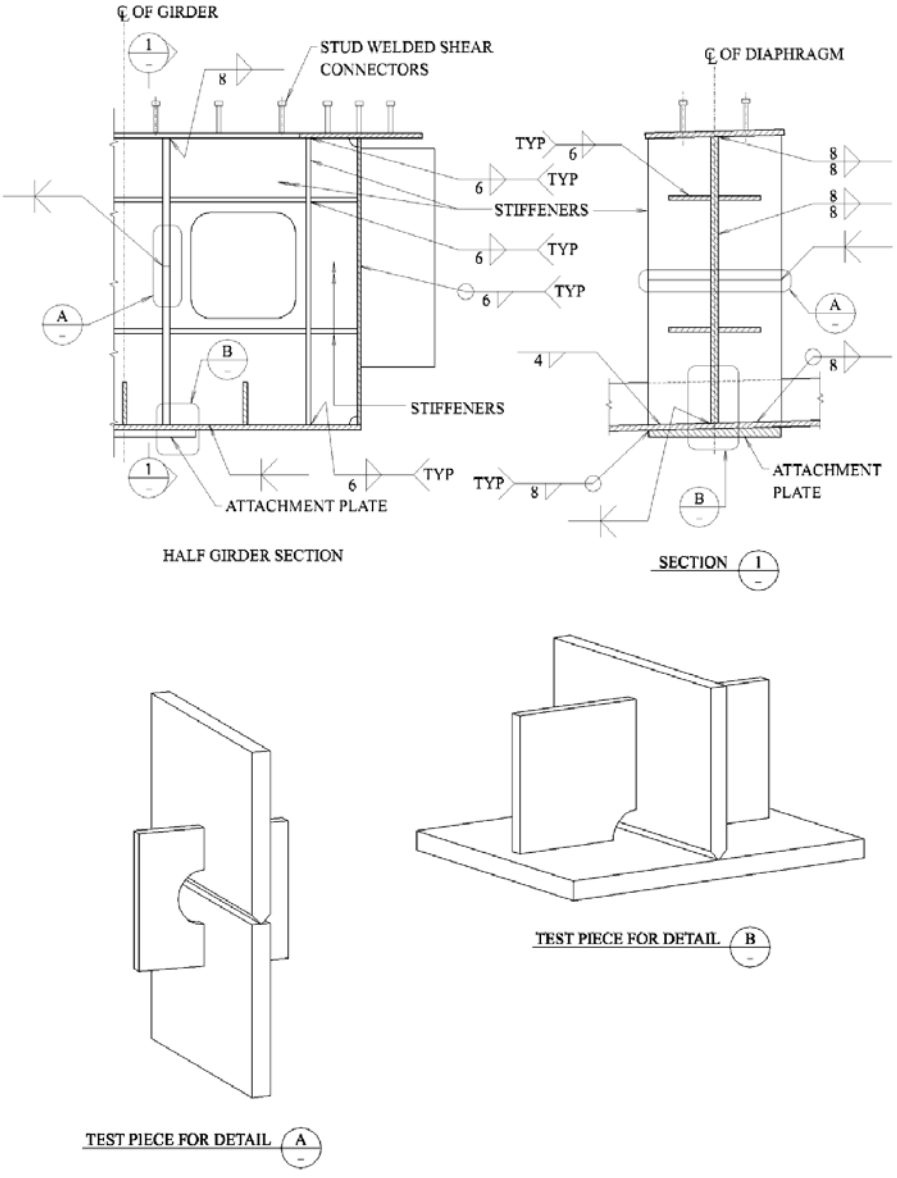
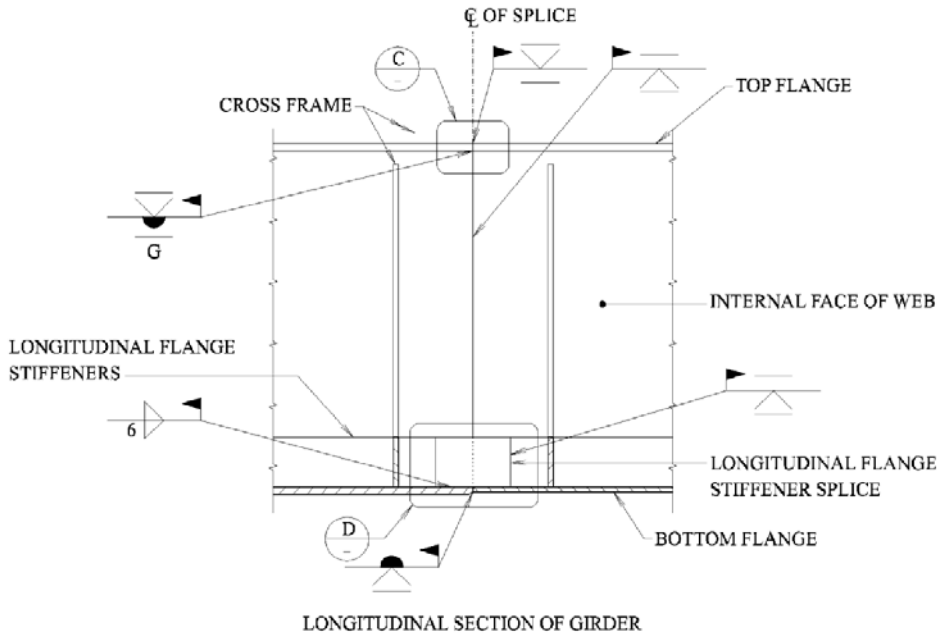
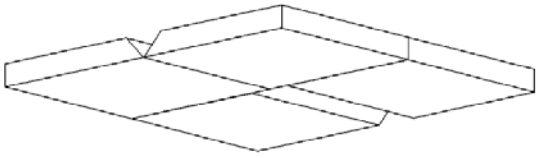
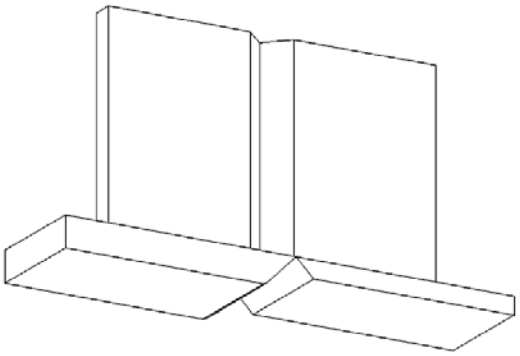


**Figure B.2: Example Test Pieces for Field Welds**



TEST PIECE FOR DETAIL C



TEST PIECE FOR DETAIL D

# Amendment Record

| Amendment no. | Clauses amended | Action | Date |
|---|---|---|---|
| - | New specification | New | October 2022 |
| 1 | 2.1 - list of referenced updated | Substitution | November 2023 |
| | 3.1 – definitions updated | Substitution | |
| | 4.1, 4.5 – clarification of requirements | Substitution | |
| | 4.6 – reference to IIW MCS ISO 3834 deleted | Removed | |
| | 4.15, 4.16, 4.28, 4.29 – clarification of requirements | Substitution | |
| | 5.1 – clarification of Principal's registration Scheme | Substitution | |
| | 5.8, 5.9, 5.11 – amendment to testing requirements | Substitution | |
| | 6.16, 6.18 - clarification of requirements | Substitution | |
| | 6.31 – compliance with ISO 15590-1 PSL2 added | New | |
| | 7.5, 7.9, 7.14, 7.16, 7.20, 7.24, 7.25, 7.26 – changes to inspection requirements | Substitution | |
| | 13.4, 13.13, 13.14, 13.15, 13.17 - changes to non-destructive testing requirements | Substitution | |
| | 15.2 – cross references added | Substitution | |
| | 16. – new clause on weather resistant steel | New | |

Key

| | |
|---|---|
| Format | Change in format |
| Substitution | Old clause removed and replaced with new clause |
| New | Insertion of new clause |
| Removed | Old clauses removed |