

**PART S30 FABRICATION STRUCTURAL STEELWORK CONTENTS**

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**1. GENERAL**

- .1 This Part specifies the requirements for the fabrication of structural steelwork.
- .2 The following documents are referenced in this Part:

**Nuts, Bolts and Washers:**

- |     |         |   |
|-----|---------|---|
| (a) | AS 1110 | ISO metric hexagon bolts and screws—Product grades A and B                            |
| (b) | AS 1111 | ISO metric hexagon bolts and screws—Product grade C                                   |
| (c) | AS 1112 | ISO Metric Hexagon Nuts   |
| (d) | AS 1214 | Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)   |
| (e) | AS 1237 | Plain washers for metric bolts, screws and nuts for general purposes                  |
| (f) | AS 1252 | High strength steel bolts with associated nuts and washers for structural engineering |
| (g) | AS 1275 | Metric Screw Threads for Fasteners  |
| (h) | AS 4680 | Hot-dip galvanized (zinc) coatings on fabricated ferrous articles                     |

**Steel:**

- |     |           |  |
|-----|-----------|--|
| (a) | AS 1163   | Structural Steel Hollow Sections                             |
| (b) | AS 1594   | Hot Rolled Steel Flat Products                               |
| (c) | AS 3678   | Structural Steel - Hot-rolled Plates, Floor Plates and Slabs |
| (d) | AS 3679.1 | Structural Steel - Hot-rolled bars and sections              |
| (e) | AS 3679.2 | Structural Steel - Welded I sections                         |

**Welding and Structural:**

- |     |           |   |
|-----|-----------|---|
| (a) | AS 1554.1 | Structural steel welding - Welding of Steel Structures  |
| (b) | AS 1554.2 | Structural steel welding - Arc Stud Welding, as modified by TP 580 "Welding of Steel Structures". |
| (c) | AS 1796   | Certification of Welders and Welding Supervisors  |
| (d) | AS 2214   | Certification of Welding Supervisors - Structural Steel Welding                                   |
| (e) | AS 4100   | Steel Structures  |
- Australian Steel Institute: Standardised Structural Connections  
Welding Technology Institute of Australia (WTIA) Technical Notes:  
TN01 The Weldability of Steels  
TN03 Care and Conditioning of Arc Welding Consumables  
TN05 Flame Cutting of Steels  
(available from <http://www.wtia.com.au/tgn.html>)

**Testing:**

- |     |           |   |
|-----|-----------|---|
| (a) | AS 1171   | Method for Magnetic Particle Testing  |
| (b) | AS 1710   | Non-destructive Testing of Carbon and Low Alloy Steel Plate and Classification of Quality |
| (c) | AS 2177.1 | Radiography of Welded Butt Joints in Metal  |
| (d) | AS 2205   | Methods of Destructive Testing of Welds in Metal  |
| (e) | AS 2207   | Methods for the Ultrasonic Testing of Fusion Welded Joints in Carbon and Low Alloy Steel  |

**Quality:**

- (a) AS 9001 Quality Management Systems – Requirements
- (b) AS 3834.2 Quality requirements for fusion welding of metallic materials - Comprehensive quality requirements

**2. QUALITY REQUIREMENTS****Certification**

- .1 The fabricating structural steelwork for SA Government projects shall be certified in the appropriate category under the [National Structural Steelwork Compliance Scheme \(NSSCS\)](#).
- .2 The supplier of materials shall hold a valid certificate of approval issued by the Australasian Certification Authority for Reinforcing and Structural Steels (ACRS). Refer to <http://www.acrs.net.au>.
- .3 Provision of the above certification shall constitute a **HOLD POINT**.

**Quality Plan**

- .4 The Contractor shall prepare and implement a Quality Plan that includes, at a minimum, the following documents, procedures and/or instructions:
  - (a) Evidence of certification;
  - (b) Names and qualifications of all personnel to be associated in the planning, production and inspection of all welds (except the names of welders to be qualified by testing, vide Clause 6.1 of this Part);
  - (c) Process to verify of the origin and quality of materials and suitability of welding consumables;
  - (d) Assembly, including dimensional control and details of manufacturing jigs;
  - (e) Cambering (where applicable) and method of determination of the beam profile which allows for deformation during fabrication;
  - (f) Repairs and corrections allowed under this Specification;
  - (g) Shop assembly;
  - (h) End finishing for field joints (where applicable);
  - (i) Proposed sequence of operations and the proposed time required for all members and/or parts;
  - (j) System of identification of members and/or parts and components, and erection marks; and
  - (k) Welding procedures.
- .5 If not provided beforehand, this documentation shall be submitted at least 28 days prior to the commencement of the fabrication work.

**Safety**

- .6 The Contractor shall prepare and implement Safe Work Method Statements that address, at a minimum:
  - (a) handling and transportation of materials (also refer to Part S26 "Transportation and Erection of Structural Members" if the members exceed 4.2 m in length);
  - (b) the safety requirements of AS 1554 Part 1;
  - (c) precautions to protect all persons working or present near welding operations, including the control of exposure to arc radiation, hot metal and welding fumes as well as the prevention of electric shock and fire; and
  - (d) where non-destructive tests employing industrial x-ray plant or radioactive isotopes are used, precautions to ensure that people in the vicinity are not be subjected to direct or scattered radiation.
- .7 Provision of the documentation listed in this Clause shall constitute a **HOLD POINT**.

**3. MATERIALS**

- .1 Fasteners and steel shall comply with the following:
 

Class 4.6 bolts nuts:	AS 1110, AS 1111, AS 1275 to Tolerance Grade 8
Class 4.6 nuts	AS 1112, AS 1275 to Tolerance Grade 8

Class 4.6 washers:	AS 1237
Class 8.8 bolts, nuts and washers:	AS 1252, AS 1275 to Tolerance Grade 6
Hollow steel sections	AS 1163, Grade L0
Rolled plate	AS 1594
Hot-rolled steel plates	AS 3678
Hot rolled steel sections	AS 3679.1
Welded steel I sections	AS 3679.2

- .2 All fasteners shall be hot dip galvanized in accordance with AS 1214 (nuts and bolts) and AS 4680 (washers)
- .3 All structural steel, associated components and welding consumables shall be manufactured by companies accredited to AS 9001 and shall hold a valid certificate of approval issued by the Australian Certification Authority for Reinforcing and Structural Steels (ACRS). Refer to <http://www.acrs.net.au>.
- .4 Unidentified materials shall not be used in structural members. The Contractor shall provide Test Certificates and Certificates of Compliance showing that all materials conform to the tests required by the above Australian Standards. At a minimum, the Test Certificates shall show the following:
  - (a) applicable Australian Standard;
  - (b) batch no. / identification;
  - (c) results of mechanical tests (including Charpy V-notch impact tests results where "L0" steel is specified);
  - (d) results of ultrasonic tests; and
  - (e) chemical analysis, including carbon equivalent (where applicable).
- .5 Welding consumables shall be compatible with the parent metal and shall be classified and identified in accordance with the provisions of AS 1554.1. The Contractor shall provide the manufacturer's certification that the welding consumables comply with the applicable Australian Standard.
- .6 Provision of the Test Certificates and Certificates of Compliance listed in this Clause shall constitute a **HOLD POINT**.

**4. NOTICE OF WORK COMMENCEMENT AND PROGRAM**

- .1 At least 2 weeks prior to the commencement of any work associated with fabrication, the Contractor shall submit a complete program of work showing all activities involved in the fabrication process, including cutting, welding, shear stud connectors (where applicable) and application of protective treatment. The Contractor shall also provide advice of any alteration to the program.
- .2 Provision of the program and any amended program shall constitute a **HOLD POINT**.

**5. FABRICATION**

**General**

- .1 Fabrication shall be in accordance with the drawings and with the requirements of AS 4100, Section 14.

**Dimensional Tolerances**

- .2 The Contractor shall take all measurements necessary to demonstrate compliance with the requirements of this Clause. Measurements of lengths shall be checked with a standard steel measuring tape or band and corrected to a temperature of 20°C. Unless noted otherwise, after fabrication the tolerances on any cross-section or deviations from the specified dimensions shall be in accordance with AS 4100.
- .3 Unless specified otherwise on the drawings, all dimensions shall comply with the tolerances specified in Table 5.3 "Dimensional Tolerance".

<b><u>TABLE 5.3 DIMENSIONAL TOLERANCES</u></b>	
<b>Property</b>	<b>Tolerance</b>
Member dimensions	Members up to and including 5 m shall not exceed ± 2 mm. An additional allowance of ± 2 mm shall be made to the above for each additional 10 m or part thereof.

<b><u>TABLE 5.3 DIMENSIONAL TOLERANCES</u></b>	
<b>Property</b>	<b>Tolerance</b>
Sweep (variation from straightness)	Not exceed 1 mm per 1 000 mm of the member. The sweep shall be measured between the ends of the member and shall be even throughout the length of the member.
Flatness of Bearing Seats and Plates	Out of flatness of the surfaces shall not exceed 0.2 mm.
Twist	The angular rotation of any cross-section relative to an end cross-section shall not exceed 10 mm per 1 000 mm depth of beam or unit.
Flatness of Surfaces	Deviation from flatness shall not exceed 2 mm per 1 000 mm of measuring length over any portion of the surface.
Curvature Tolerance	Deviation from specified profile shall not exceed $\pm 5$ mm.

**Bridge Beams**

- .4 If the work under the Contract includes bridge beams, the curvature of completed beams shall be planar and without sectional twist or buckling, or local buckling of the web or flanges outside of the tolerances specified in Table 5.3 "Dimensional Tolerance". The beam profile shown on the drawings is the completed profile of the beam, on its side, after all welding.

**Repair of Surface Flaws and Defects**

- .5 Surface flaws and defects on plates are deemed to be detrimental to their engineering use and shall be removed in accordance with AS 3678 and AS 3679. However, weld metal shall not be deposited to remove deep surface defects (refer AS 3678, Clause 9.3 and AS 3679, Clause 15.2.2) unless prior approval of the welding and repair procedure has been obtained.

**6. WELDED FABRICATION****General**

- .1 All welding shall be carried out in accordance with AS 1554.1 and follow the recommendations and procedures of the Welding Technology Institute of Australia (refer to WTIA Technical Notes). All welds shall be:
- (a) SP category in accordance with AS 1554.1;
  - (b) prequalified in accordance with Clause 4.3 and 4.12 of AS 1554.1; and
  - (c) subject to visual inspection in accordance with Clause 6.2 of AS 1554.1.
- .2 All butt welds shall be complete penetration butt welds.

**Straightening of Material and Components**

- .3 Material and components shall be straightened and made free from twist so that on assembly, mismatching and misalignment will not occur outside of specified tolerances. The methods adopted for the above shall be such as not to damage or alter mechanical properties, nor to impair the design or function of the material or component.

**Weld Profiles**

- .4 The finished surface and the profile of all welding shall be smooth and free from sharp edges or crevices that would be detrimental to the performance of the structure or to the protective treatment. Where a satisfactory finish has not been achieved, the weld shall be replaced or repaired or the surface shall be ground until a satisfactory finish has been achieved.

**Field Splice Welding**

- .5 Field splice welding shall not be carried out and components shall be fabricated in total with all protective treatment applied prior to transport to site. Where site-splicing of the beams is permitted, the splice welding procedure shall be subject to a full-size trial weld using a mock-up of plates of the same size as in the completed beam.

**Repair of Failed Welds**

- .6 In the event that any welds fail to meet the requirements of this Specification and the Contractor proposes to repair the work, the Contractor shall prepare a detailed procedure for the repair. If the Contractor

cannot demonstrate that the repair will not induce excessive distortion or residual stresses in the fabricated members, the Contractor shall fabricate a replacement member.

- .7 Approval of the proposal to repair the weld and the repair procedure shall constitute a **HOLD POINT**.

#### **Inspection and Testing of Work**

- .8 The Contractor shall ensure the fabricated steelwork is available in a position and orientation suitable for inspection and testing and shall provide all assistance to the testing officer to perform the inspection and testing. Not less than 3 working days prior to any steelwork being dispatched for protective coating, the Contractor shall provide notification that the work is available for inspection.
- .9 Non-destructive testing (including visual inspection, ultrasonic, magnetic particle, and/or radiographic examination) shall be performed as necessary to qualify welding procedures and to ensure that those procedures are maintained throughout the works. At a minimum, non-destructive testing shall comply with Table 6.9:

<b><u>TABLE 6.9 WELD INSPECTION AND TESTING</u></b>		
	<b>Test Requirements</b>	<b>Minimum Test Frequency</b>
Fillet welds for bridge girders: <ul style="list-style-type: none"> <li>• Flange to web</li> <li>• Flange to stiffeners</li> <li>• Web to stiffeners</li> </ul>	Radiographic tested in accordance with AS 2177.	All welds
Other fillet welds	Magnetic particle testing in accordance with AS 1171.	15% of welds
Complete penetration butt welds	Ultrasonically testing in accordance with AS 2207.	All welds
Flange butt welds	Radiographic tested in accordance with AS 2177.	All welds

- .10 Provision of inspection and test results demonstrating compliance with the requirements of this Clause shall constitute a **HOLD POINT**.

#### **Additional Requirements for Overseas Fabrication**

- .11 If the fabrication takes place outside of Australia, the following additional requirements apply:
- (a) All work shall be carried out under the supervision of a welding supervisor who meets at least one of the requirements of Clause 4.12.1 (a) to (c) of AS 1554.1;
  - (b) All welders shall satisfy the conditions of Clause 4.12.2 of AS 1554.1. All welding personnel require macro re-qualification on a 12 monthly basis for each weld procedure undertaken the Contract; and
  - (c) the fabricated steelwork is made available for inspection in Australia prior to assembly / erection.

### **7. STEEL CUTTING**

- .1 Surfaces produced by cutting shall be finished true and smooth to the required dimensions. All burrs and sharp edges on cut surfaces shall be removed.
- .2 Where flame cutting is to be employed, the standard of surface condition of edges of cut plates shall not be inferior to WTIA Flame Cut Surface Roughness Class 2 (refer to WTIA TN05).
- .3 Gouges having a depth greater than 3 mm are deemed to be "damaged" vide this Clause 12 "Damage". All edges of flange plates shall be ground to produce a 2 mm radius.

### **8. STUD SHEAR CONNECTORS**

#### **General**

- .1 This clause only applies where shear stud connectors are specified on the drawings.

#### **Qualification**

- .2 The stud material, the stud base, the stud welding procedure and the welding operator shall be qualified in accordance with AS 1554.2, before production welding of studs commences. The Contractor shall

provide one week prior notice of qualification of stud welding, welding of stud connectors and testing of studs.

- .3 Notification of qualification shall constitute a **HOLD POINT**.
- .4 In addition to these requirements, a further Procedure Test shall be carried out to assess the process and operator. This test consists of welding an additional 4 studs of the size and type to be used on to a test plate of similar thickness, width and condition (i.e. rust) of the actual flange to which the studs will be welded.
- .5 The reinforcement formed within the ceramic ferrule shall be formed over 100% of the circumference.
  - (a) Two studs shall be tested to withstand a load representing a minimum tensile stress of 415 MPa.
  - (b) The remaining 2 studs shall be tested to AS 2205.5.1 "Macro Test". The 2 studs shall indicate complete fusion to the parent material.
- .6 All test studs shall pass the above tests. If any stud fails, the procedure test is deemed to be deemed a failure, and further complete procedure tests shall be undertaken until all studs pass.
- .7 Successful completion of the Procedure Test shall constitute a **HOLD POINT**.

### **Fabrication**

- .8 After welding, 5% of the studs on each beam shall be bend tested by hammering through 15 degrees and all studs shall be ring tested. If any stud fails, all studs on the beam shall be bend tested.

## **9. BOLTED CONNECTIONS**

- .1 Where high strength bolts are specified, the bolts shall be installed snug tight as defined in AS 4100. All fasteners shall be coated with suitable lubricant to facilitate the initial tightening.
- .2 All holes for bolts shall be drilled full size or, where permitted by AS 4100, punched full size. Burnt holes will not be permitted under any circumstances. After assembly of the parts to be joined, all holes shall be true throughout, perpendicular to the face of the member and aligned so as to permit the bolts to be positioned without damage to the threaded portion. The surfaces in contact of parts joined shall be free from distortion and all burrs or ridges shall be removed.
- .3 The length of each bolt shall be such that the threaded portion will project through the nut for at least one complete thread and such that the nut will be at least one thread apart from the thread runout. The shanks of bolts shall be of sufficient length so that the thread shall not project through the shear plane.
- .4 At least one washer, but no more than 2 washers shall be placed under the part being rotated in tightening. Taper washers shall be used where the part under the bolt head is not perpendicular to the axis of the bolt. Bolts shall be positioned so that the taper washers, if required, shall be fitted under the non-rotating part.

## **10. HOLDING DOWN BOLTS**

- .1 Where high strength bolts or rods are cast into concrete, the bolts or rods shall be firmly held in position by a jig and the rods or bolts shall not be welded. Where a structure is subjected to fatigue loading (including light poles, traffic gantries, major cantilever signs and tall utility poles), the following applies:
  - (a) base plates shall be supported on a levelling layer of high strength grout;
  - (b) wedges or pads shall be used to support the plate during the grouting process; and
  - (c) thin levelling nuts shall not be used to support the plate.

## **11. MOCK SET UP**

- .1 Where the work under the Contract includes beams / structural elements for bridges, the beams / structural elements shall be assembled in the form of a mock set-up in the fabrication workshop to the lines and relative levels and with the support conditions that will apply in the completed structure.
- .2 On completion of the mock set-up, a **HOLD POINT** shall apply.

## **12. DAMAGE**

- .1 Any damage to steel work that occurs prior, during or after fabrication is deemed to be a non-conformance.

**13. HOLD POINTS**

.1 The following is a summary of Hold Points referenced in this Part:

<b>CLAUSE REF.</b>	<b>HOLD POINT</b>	<b>RESPONSE TIME</b>
2.3	Provision of certification	Refer to the Principal
2.7	Submission of Quality Documentation	7 days
3.6	Materials Test Certificates and Certificates of Compliance	7 days
4.2	Provision of the program of work and any amended program	2 days
6.7	Submission of repair procedures for failed welds	2 days
6.10	Provision of test results	2 days
8.3	Notification of stud welding qualification (where part of the Contract)	2 days
8.7	Completion of the Shear Stud Procedure Test (where part of the Contract)	1 day
11.2	Mock set up in workshop of bridge beams and structural elements (where part of the Contract)	2 days

**14. VERIFICATION REQUIREMENTS AND RECORDS**

.1 The following is a summary of records to be supplied by the Contractor to demonstrate compliance with this Part (in addition to records provided with Hold Points):

<b>CLAUSE REF</b>	<b>RECORD</b>
5.2	Evidence of compliance with dimensional tolerances