

# Main Roads Technical Standard

## **MRTS78** **Fabrication of Structural Steelwork**

**January 12**

 **Queensland** Government

### **TRADEMARKS ACKNOWLEDGEMENT**

Terms mentioned in this document that are known or understood to be trademarks, whether registered or not, have been identified. Where trademarks have been confirmed as registered in Australia, this has been indicated by the addition of the ® symbol, otherwise the ™ symbol is used. While all care has been taken to identify trademarks, users should rely on their own inquiries to determine trademark ownership. Use of a term in this document as a trademark should not be regarded as affecting the validity of any trademark.

### **IMPORTANT INFORMATION**

The requirements of this document represent Technical Policy of the department and contain Technical Standards. Compliance with the department's Technical Standards is mandatory for all applications for the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

This document will be reviewed from time to time as the need arises and in response to improvement suggestions by users. Please send your comments and suggestions to the feedback email given below.

### **FEEDBACK**

Your feedback is welcomed. Please send to [mr.techdocs@tmr.qld.gov.au](mailto:mr.techdocs@tmr.qld.gov.au).

### **DISCLAIMER**

This publication has been created for use in the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

Where the publication is used in other than the department's infrastructure projects, the State of Queensland and the department gives no warranties as to the completeness, accuracy or adequacy of the publication or any parts of it and accepts no responsibility or liability upon any basis whatever for anything contained in or omitted from the publication or for the consequences of the use or misuse of the publication or any parts of it.

If the publication or any part of it forms part of a written contract between the State of Queensland and a contractor, this disclaimer applies subject to the express terms of that contract.

### **COPYRIGHT**

Copyright protects this publication. Except for the purposes permitted by and subject to the conditions prescribed under the Copyright Act, reproduction by any means (including electronic, mechanical, photocopying, microcopying or otherwise) is prohibited without the prior written permission of the department. Enquiries regarding such permission should be directed to the Contracts and Technical Capability Branch, Queensland Department of Transport and Main Roads.

© State of Queensland (Department of Transport and Main Roads) 2012



<http://creativecommons.org/licences/by-nc-nd/2.5/au>

## Table of Contents

	Page
1 INTRODUCTION .....	1
2 DEFINITION OF TERMS .....	1
3 REFERENCED DOCUMENTS .....	1
4 QUALITY SYSTEM REQUIREMENTS.....	2
4.1 Hold Points, Witness Points and Milestones.....	2
4.2 Construction Procedures.....	3
4.3 Conformance Requirements .....	3
5 REGISTERED FABRICATOR .....	3
5.1 Registered Fabricator.....	3
5.1.1 Registered Fabricator for Major Bridge Infrastructure – In Australia .....	3
5.1.2 Registered Fabricator for Minor Bridge Infrastructure – In Australia .....	3
5.1.3 Registered Fabricator – Outside Australia.....	4
6 WELDING PROCEDURE SHEETS.....	4
7 MATERIALS.....	4
7.1 Steel Plate and Sections .....	4
7.2 Welding Consumables .....	5
7.3 Bolts, Nuts and Washers.....	5
7.3.1 Standard Bolts, Nuts and Washers – Class 4.6 .....	5
7.3.2 High Strength Bolts, Nuts and Washers – Class 8.8 .....	5
7.3.3 Number of Test Specimens .....	6
8 FABRICATION.....	7
8.1 General.....	7
8.2 Cutting and Edge Preparation of Steel Sections .....	7
8.2.1 Cutting of Sections.....	7
8.2.2 Edge Preparation of Steel Sections.....	7
8.3 Holes .....	7
8.4 Bending of Plate.....	8
8.5 Welding .....	8
8.5.1 General .....	8
8.5.2 Welding Supervisor.....	8
8.5.3 Welding Personnel.....	8
8.5.4 Welding .....	8
8.5.5 Weld Maps.....	8
8.5.6 Inspection of Completed Product.....	9
8.6 Welding Undertaken Outside Australia .....	9
8.6.1 General – Outside Australia.....	9
8.6.2 Supervision of the Overseas Fabrication.....	9
8.6.3 Welding Supervisor - Outside Australia.....	9
8.6.4 Welding Personnel - Outside Australia .....	9
8.6.5 Welding – Outside Australia .....	9
8.6.6 Weld Maps – Outside Australia .....	9
8.6.7 Inspection of Completed Product Manufactured Outside Australia.....	10
9 QUALITY OF WELDS.....	10
9.1 General.....	10
9.2 Shear Connectors .....	10
9.3 Threaded Holes.....	10
9.4 Member to be Straight.....	10
9.4.1 All Fabrication .....	10
9.4.2 Elements Except Bridge Barrier.....	10
10 TOLERANCES.....	10
10.1 General.....	10

10.2	Bridge Barrier .....	11
10.3	Girders Fabricated from Rolled Steel Sections .....	11
10.4	Girders Fabricated from Steel Plate .....	12
10.5	Expansion Bearings for Rolled Steel Girders .....	12
10.5.1	Stainless Steel Plate .....	12
10.5.2	Steel Base Plate .....	12
10.5.3	Polytetrafluoroethylene .....	12
10.6	Structures other than Bridge Barrier, Girders and Expansion Bearings .....	12
11	COATINGS .....	12
11.1	Hot-dipped Galvanising .....	12
11.2	Coating on Bolts .....	12
11.3	Finishing After Galvanising .....	13
11.3.1	Inspection and Repairs at Galvanising Works .....	13
11.3.2	Dressing .....	13
11.3.3	Subsequent Repairs to Coatings .....	13
11.3.4	Strapping of Galvanised Items .....	13
11.3.5	Additional Requirements for Bridge Barrier .....	13
12	ASSEMBLY .....	13
12.1	General .....	13
12.2	Bolts, Nuts and Washers .....	13
12.3	Bolt Tensioning .....	13

# Fabrication of Structural Steelwork

## 1 INTRODUCTION

This Standard applies to the fabrication of structural steelwork for bridges, other structures, roadside furniture and poles.

This Standard shall be read in conjunction with MRTS01 *Introduction to Technical Standards*, MRTS50 *Specific Quality System Requirements* and other Technical Standards as appropriate.

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

Structural steelwork shall be fabricated only by a fabricator that is registered by Transport and Main Roads.

For the requirements for registration and information regarding registered fabricators refer to –

Department of Transport and Main Roads  
Director (Structural Materials)  
GPO Box 1412  
Brisbane Qld 4001

## 2 DEFINITION OF TERMS

The terms used in this Standard shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Standard*.

## 3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this Technical Standard.

**Table 3 – Referenced Documents**

Reference	Title
AS 1100.101	Technical drawing – General principles
AS 1100.201	Technical drawing – Mechanical engineering drawing
AS 1110	ISO metric hexagon bolts and screws – Product grades A and B
AS 1111	ISO metric hexagon bolts and screws – Product grade C
AS 1112	ISO metric hexagon nuts
AS/NZS 1163	Structural steel hollow sections
AS 1195	Polytetrafluoroethylene (PTFE) skived tape
AS 1196	Polytetrafluoroethylene (PTFE) moulded sheet
AS 1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237	Plain washers for metric bolts, screws and nuts for general purposes
AS/NZS 1252	High strength steel bolts with associated nuts and washers for structural engineering
AS 1275	Metric screw threads for fasteners
AS/NZS 1554	Structural steel welding Set
AS/NZS 1554.1	Structural steel welding – Welding of steel structures
AS/NZS 1554.2	Structural steel welding – Stud welding (steel studs to steel)
AS/NZS 1594	Hot-rolled steel flat products
AS 1858	Electrodes and fluxes for submerged-arc welding – Carbon steels and carbon-manganese steels
AS 2203	Cored electrodes for arc-welding – Ferritic steel electrodes

Reference	Title
AS/NZS 2717.1	Welding – Electrodes – Gas metal arc – Ferritic steel electrodes
AS/NZS 3678	Structural steel – Hot-rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural steel – Hot-rolled bars and sections
AS 4100	Steel structures
AS/NZS 4291.1	Mechanical properties of fasteners made of carbon steel and alloy steel – Bolts, screws and studs
AS/NZS 4291.2	Mechanical properties of fasteners – Nuts with specified proof load values – Coarse thread
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 9001	Quality management systems – Requirements
ASTM A 240M	Standard specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure vessels and for General Applications
ASTM A 480M	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, sheet, and Strip
CTP – SM01	Procedures Manual: Register for Approved Fabricators of Steelwork, Aluminium and Stainless Steel Components
MRTS78 – Commentary	Fabrication of Structural Steelwork - Commentary

## 4 QUALITY SYSTEM REQUIREMENTS

### 4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Standards*.

The Hold Points and Witness Points applicable to this Standard are summarised in Table 4.1. There are no Milestones defined in the table.

**Table 4.1 – Hold Points and Witness Points**

Clause	Hold Point	Witness Point
6	1. Verification of welding procedure sheets for all welded components	
7.1	2. Approval of Test certificates for steelwork	Test of steel where test certificates are not available
7.3.1.1	3. Selection of Class 4.6 bolts, nuts and washers for testing	
7.3.1.1	4. Approval of the Class 4.6 bolts, nuts and washers	
7.3.2.1	5. Selection of high strength bolts, nuts and washers	
7.3.2.1	6. Approval of the Class 8.8 bolts, nuts and washers	
8.5.4	7. Verification of butt weld preparations	
8.5.5	8. Supply of weld maps	
8.5.6	9. Inspection of completed product	
8.6.5	10. Verification of butt weld preparations for product manufactured outside Australia	

Clause	Hold Point	Witness Point
8.6.6	11. Supply of weld maps for product manufactured outside Australia	
8.6.7	12. Verification of completed product manufactured outside Australia	
11.3.1		Inspection of galvanising
12.3	13. Bolt tensioning procedure and demonstration of capability	

#### 4.2 Construction Procedures

Construction procedures which are required to be submitted by the Contractor to the Administrator in accordance with the quality system requirements of the Contract are listed in Table 4.2.

**Table 4.2 - Construction Procedures**

Clause	Conformance Requirement
6	Weld procedure specification sheet
7.1	Test certificates for steelwork
7.3.1.1	Test certificates for Class 4.6 bolts, nuts and washers
7.3.2.1	Test certificates for high strength bolts, nuts and washers

#### 4.3 Conformance Requirements

The conformance requirements which apply to lots of work covered by this Standard are summarised in Table 4.3.

**Table 4.3 - Conformance Requirements**

Clause	Conformance Requirement
10	Tolerances

## 5 REGISTERED FABRICATOR

### 5.1 Registered Fabricator

Steelwork shall only be fabricated by an approved fabricator. Registration as an approved fabricator will be reviewed periodically or earlier if unsatisfactory performance is reported. Information regarding approval status can be obtained from: –

Department of Transport and Main Roads  
Director (Structural Materials)  
GPO Box 1412  
Brisbane QLD 4001

#### 5.1.1 Registered Fabricator for Major Bridge Infrastructure – In Australia

To be registered as an Approved Fabricator of Steelwork for Bridge Structures and Gantry Structures which span over road carriageways, a fabricator shall –

- a) Operate a quality system certified to AS/NZS ISO 9001 or ISO 3834. The system will be audited by Transport and Main Roads to ensure that fabricators are working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts.
- b) Demonstrate technical conformance to MRTS78.

#### 5.1.2 Registered Fabricator for Minor Bridge Infrastructure – In Australia

To be registered as an Approved Fabricator of Steelwork other than Bridge Structures and Sign Gantries which span over road carriageways, a fabricator shall –

- a) Operate a quality system certified to AS/NZS ISO 9001 or ISO 3834. The system will be audited by Transport and Main Roads to ensure that fabricators are working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts.
- b) Demonstrate technical conformance to MRTS78.

### **5.1.3 Registered Fabricator – Outside Australia**

To be registered as an Approved Fabricator of Steelwork, a fabricator shall –

- a) Operate a quality system certified to AS/NZS ISO 9001 and ISO 3834. The system will be audited by an Auditor acceptable to Transport and Main Roads. The Auditor shall ensure that the fabricators are working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts.
- b) Demonstrate technical conformance to MRTS78. The technical capability shall be audited by an Auditor acceptable to Transport and Main Roads. The Auditor shall ensure that the fabricators are able to comply with the requirements of MRTS78.

## **6 WELDING PROCEDURE SHEETS**

The Contractor shall supply the Welding Procedure Specification Sheets for the welding to be undertaken, in accordance with AS/NZS 1554.1 and a copy submitted to the Administrator.

Welding shall not be carried out until the appropriate Welding Procedure Specification Sheet has been approved. **Hold Point 1**

## **7 MATERIALS**

### **7.1 Steel Plate and Sections**

Steel shall comply with the requirements of the following standards –

- Rolled plate AS 1594;
- Hollow sections AS/NZS 1163 Grade L0;
- Hot-rolled steel plates AS 3678; and
- Hot-rolled steel sections AS 3679.1.

For each shipment of steel to be used in the fabrication of –

- a) bridge girders, bridge traffic barrier, safety barrier and pedestrian balustrade,
- b) other load bearing structures with a design life of 100 years or more, and
- c) other steelwork structures.

The Contractor shall supply to the Administrator prior to the commencement of fabrication copies of the steel manufacturer's test certificates, showing the chemical properties and results of tensile and elongation tests and Charpy V-notch impact tests. The Charpy V-notch impact tests results are to be supplied for material where "LO" is specified.

Steel fabrication shall not commence until the Administrator has reviewed and approved the material test certificates. **Hold Point 2**

If test certificates are not available, then the Contactor shall submit to the Administrator for approval a proposal for selecting samples for testing of tensile strength and elongation, cold and temper bend tests, chemical analysis and Charpy V-notch impact test in accordance with the appropriate Australian Standard at no expense to the Principal. **Witness Point** Minimum testing requirements are 2 percent of each size and grade of product with a minimum sample size of one for each size and grade of the steel.

Material supplied in accordance with AS/NZS 1163, where the Silicon content is greater than 0.24% shall not be used when steelwork is to be hot dip galvanised in accordance with AS/NZS 4680.

## 7.2 *Welding Consumables*

Welding consumables shall be compatible with the parent metal and shall be classified and identified in accordance with the provisions of AS 1554.1, AS 1858, AS 2203, and/or AS 2717.1.

## 7.3 *Bolts, Nuts and Washers*

### 7.3.1 **Standard Bolts, Nuts and Washers – Class 4.6**

#### 7.3.1.1 **Properties**

Bolts, nuts and washers shall comply with the requirements of the following standards –

- Bolts AS 1110, AS 1111
- Nuts AS 1112
- Flat Washers AS 1237

Bolts shall be property Class 4.6 in accordance with either AS 1110 or AS 1111, as relevant. Bolt diameter, thread form and pitch shall be to ISO coarse pitch series in accordance with AS 1275 to 8 g tolerances.

Nuts shall be normal hexagonal nuts of property Class 5 in accordance with AS 1112. Diameter, thread form and pitch shall be to ISO coarse pitch series in accordance with AS 1275 to 8H tolerances.

A summary of the properties of Class 4.6 bolts is given in Appendix A.

All bolts, nuts and washers shall be hot-dipped galvanised in accordance with the requirements of AS 1214.

Each batch of bolts and nuts are to be supplied with the following –

- a) The bolt supplier shall supply the fabricator with a material test certificate stating the chemical composition, mechanical properties of all bolts supplied. The test certificate shall be able to be traced back to the batch of bolts; and
- b) A conforming test certificate from a NATA certified testing laboratory stating the bolt assembly test results and hardness. All bolts are tested as an assembly in the configuration that they will be used (that is, assembled bolt and nut). Samples for testing are to be selected in the presence of the Administrator. **Hold Point 3** The assembly test certificate shall be traceable back to the batch of bolts.

The material test certificates and assembly test reports for each batch of bolts shall be reviewed and approved by the Administrator prior to being used. **Hold Point 4**

#### 7.3.1.2 **Testing for Class 4.6 Bolts**

Class 4.6 bolts, nuts and washers shall be tested in accordance with Clause 7.3.3.

#### 7.3.1.3 **Acceptance of Bolts**

If one test bolt does not conform to the assembly testing requirements, then the batch of bolts shall be rejected.

In order to ensure that the non-conforming bolts are not re-supplied to the project, the Administrator shall be notified of the non-conforming bolt batch and supply numbers. New bolts shall be supplied with documentary evidence to show the bolts have been sourced from a different batch.

The new batch of bolts shall be tested as per this standard. That is, supplied with a conforming test certificate from a NATA certified testing laboratory outlining the material properties, the mechanical properties and the hardness.

### 7.3.2 **High Strength Bolts, Nuts and Washers – Class 8.8**

#### 7.3.2.1 **Properties**

High strength bolts, nuts and washers shall conform to the requirements of AS 1252.

High strength bolts shall be property Class 8.8 in accordance with AS 1252, with diameter, thread form and pitch to ISO coarse pitch series in accordance with AS 1275 to 6 g tolerances.

High strength nuts shall be property Class 8 in accordance with AS 1252, with diameter, thread form and pitch to ISO coarse pitch series in accordance with AS 1275 to 6H tolerances.

A summary of the properties of high strength bolts is given in Appendix A.

All bolts, nuts and washers shall be hot-dipped galvanised in accordance with the requirements of AS 1214.

Each batch of bolts and nuts are to be supplied with the following -

- a) The bolt supplier shall supply the fabricator with a material test certificate stating the chemical composition, mechanical properties of all bolts supplied. The test certificate shall be able to be traced back to the batch of bolts; and
- b) A conforming test certificate from a NATA certified testing laboratory stating the bolt assembly test results and hardness. All bolts are tested as an assembly in the configuration that they will be used (that is, assembled bolt and nut). Samples for testing are to be selected in the presence of the Administrator. **Hold Point 5** The assembly test certificate shall be traceable back to the batch of bolts.

The material test certificates and assembly test reports for each batch of bolts shall be reviewed and approved by the Administrator prior to being used. **Hold Point 6**

**7.3.2.2 Bolt Identification Marks**

All High-Strength bolts nuts and washers shall have the identification marks as outlined in Clause 1.5 - Markings of AS 1252.

**7.3.2.3 Testing for Class 8.8 Bolts**

High-Strength bolts nuts and washers shall be tested in accordance with Clause 7.3.3.

**7.3.2.4 Acceptance of Bolts**

If one test bolt does not conform to the assembly testing requirements, then the batch of bolts shall be rejected.

In order to ensure that the non-conforming bolts are not re-supplied to the project, the Administrator shall be notified of the non-conforming bolt batch and supply numbers. The new bolts shall be supplied with documentary evidence to show the bolts have been sourced from a different batch.

The new batch of bolts shall be tested as per this standard. That is, supplied with a conforming test certificate from a NATA certified testing laboratory outlining the material properties, the mechanical properties and the hardness.

**7.3.3 Number of Test Specimens**

The number of bolts and nuts to be tested is based on the number of bolts and nuts of each size purchased in an individual order. Appendix A Table A1 AS/NZS 1252 - Number of Test Specimens shall be deleted and replaced by Table 7.3.3.

**Table 7.3.3 - Replacement for Table A1 in AS/NZS 1252**

**NUMBER OF TEST SPECIMENS FOR BOLTS AND NUTS**

<b>Number of pieces in lot</b>	<b>Minimum number of samples</b>
Up to 50	3
51 - 500	4
501 – 35 000	8
35 001 and above	16

The Test Methods for bolts are described in AS/NZS 4291. 1.

The proof load test for nuts shall be in accordance with Clause 8.1 of AS/NZS 4291.2.

Hardness shall be tested in accordance with Clause 8.2 of AS/NZS 4291.2 using a Vickers harness test.

## 8 FABRICATION

### 8.1 General

All structural steel components shall be fabricated in accordance with AS 1554.1 and AS 4100.

### 8.2 Cutting and Edge Preparation of Steel Sections

#### 8.2.1 Cutting of Sections

All members shall be cut to the required length using either of the following processes;

- a) Saw Cut;
- b) Laser Cut;
- c) Profile Cut; or
- d) Oxy-acetylene cut.

The cropping/shearing of the following steel sections is not permitted;

- a) Hot Rolled Sections;
- b) Hollow section material to the requirements of AS/NZS 1163; and
- c) Flat bars with a thickness greater than 12mm.

No rough edges shall be allowed to remain and uneven outer edges shall be dressed off to a true line to the approval of the Administrator.

#### 8.2.2 Edge Preparation of Steel Sections

Where welding is to be carried out along the edge of any of the following materials –

- a) sheared edges of material 12 mm or thicker;
- b) rolled edges of plates or flats thicker than 16 mm; and
- c) toes of angles or rolled shapes thicker than 16 mm.

then these edges shall be trimmed back by 12 mm in the case of plates and 6 mm in the case of all other sections, to prepare the edge for welding.

Edge preparation shall be performed by either planing or oxy-acetylene cutting. Edges to be welded shall not be sheared.

Preparation of edges by oxy-acetylene cutting shall, wherever possible, be carried out by machine. Machine oxy-acetylene cutting shall be generally as smooth and regular as that produced by edge planing and the edge shall be left free of slag.

Manual oxy-acetylene cutting shall be permitted only where machine oxy-acetylene cutting is not practicable, and only with the approval of the Administrator. The edges resulting from manual oxy-acetylene cutting shall be smoothed by grinding.

Where nominated on the Drawings, all re-entrant corners shall be filleted to a radius of 12 mm by drilling a 25 mm diameter hole at each such corner before cutting. The cut lines shall not extend beyond the fillet, and all cutting shall follow closely the lines prescribed.

No rough edges shall be allowed to remain and uneven outer edges shall be dressed off to a true line to the approval of the Administrator.

### 8.3 Holes

All holes shall finish accurately to size and in the position shown on the Drawings and shall be cleaned of all burrs and rough edges.

The axis of the holes shall be at right angles to the surface through which they pass, except where otherwise shown on the Drawings.

All holes shall be drilled except for stiffener bar holes through girder webs which may be oxy-acetylene cut. If oxy-acetylene cutting is used, a suitable compass or profile shall be employed to obtain a hole generally as smooth and accurate as a drilled hole.

Punching of holes in material having a thickness greater than 10 mm will not be permitted.

#### **8.4 Bending of Plate**

Bending of steel plate shall be carried out in a press to produce clean straight bends with no distortion in the adjacent flat surfaces.

Prior to bending, any rags present on sheared edges shall be removed by grinding or filing to prevent the possibility of plate splitting on the outside corner.

#### **8.5 Welding**

##### **8.5.1 General**

Welding shall be carried out in accordance with the provisions of AS/NZS 1554.1 except as amended by Clauses 8.5.2, 8.5.3, 8.5.4, 8.5.5 and 8.5.6.

##### **8.5.2 Welding Supervisor**

All work shall be carried out under the supervision of a welding supervisor who shall, in the opinion of the Administrator, conform to at least one the requirements of Clause 4.12.1 (a) to (f) of AS/NZS 1554.1.

##### **8.5.3 Welding Personnel**

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 on Transport and Main Roads projects.

All SP welding is undertaken by one of the following welding personnel:

- a) Trade qualified welding personnel, or by welding personnel with a demonstrated competency equivalent to a trade qualified welder subject to approval by Director (Structural Materials);
- b) 4th year apprentices subject to approval by Director (Structural Materials);

2nd year and 3rd year apprentices are permitted to undertake only fillet welds subject to approval by Director (Structural Materials);

Transport and Main Roads reserves the right to withdraw welder qualification if welding is below Transport and Main Roads requirements.

##### **8.5.4 Welding**

Not less than 3 working days prior to any welding commencing on any butt weld joints, the Fabricator shall notify the Administrator that the butt weld preparations are available for inspection. The Administrator shall ensure that the butt weld preparations are prepared in accordance with the weld procedure sheets.

##### **Hold Point 7**

##### **8.5.5 Weld Maps**

The fabricator shall provide a weld map outlining the welding undertaken in the manufacture of the steel components. The weld map shall outline the following:

- Weld procedure number used for the welding undertaken;
- Welder's initials or welding number for each weld undertaken; and
- Welding supervisor's initials or welding number for each weld inspected.

The weld map shall be submitted to the Administrator for approval before the steel product is dispatched for protective coating. **Hold Point 8**

### 8.5.6 Inspection of Completed Product

Not less than 3 working days prior to any products being dispatched for protective coating. The fabricator shall notify the Administrator that product is available for inspection. All steel fabricated product the Administrator shall ensure the following inspections are undertaken. **Hold Point 9**

- a) 100% of all products shall be visually examined;
- b) A minimum of 50% all gantry structure and bridge structure butt welds shall be Non Destructively tested. If any welds are found to be defective then 100% of the welds shall be Non Destructively Tested.

Transport and Main Roads reserves the right to increase the minimum level of Non Destructive Testing.

Any welding defects found during the inspection shall be repaired prior to the application of the protective coating.

## 8.6 Welding Undertaken Outside Australia

### 8.6.1 General – Outside Australia

Welding shall be carried out in accordance with the provisions of AS/NZS 1554 except as amended by Clauses 8.6.2, 8.6.3, 8.6.4, 8.6.5, 8.6.6 and 8.6.7.

### 8.6.2 Supervision of the Overseas Fabrication

All steel fabrication work undertaken overseas, the functions of the Administrator may be undertaken by a person nominated by the Administrator who, in the opinion of Director (Structural Materials), conforms to the following requirements;

- a) Clause 4.12.1 (a) of AS/NZS 1554.1;
- b) Is from a culturally different back ground to the country undertaking the fabrication.

### 8.6.3 Welding Supervisor - Outside Australia

All work shall be carried out under the supervision of a welding supervisor who shall, in the opinion of the Administrator, conform to at least one of the requirements of Clause 4.12.1 (a) to (c) of AS/NZS 1554.1.

### 8.6.4 Welding Personnel - Outside Australia

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 on Transport and Main Roads projects.

For SP welding, have a trade qualification, or demonstrate competence equivalent to a trade qualification subject to approval by Director (Structural Materials).

Transport and Main Roads reserves the right to withdraw welder qualification if welding is below Transport and Main Roads requirements.

### 8.6.5 Welding – Outside Australia

Prior to any welding commencing on any butt weld joints, the Fabricator shall notify the Administrator that the butt weld preparations are available for inspection. The Administrator shall ensure that the butt weld preparations are prepared in accordance with the weld procedure sheets. **Hold Point 10**

### 8.6.6 Weld Maps – Outside Australia

The fabricator shall provide a weld map outlining the welding undertaken in the manufacture of the steel components. The weld map shall outline the following:

- Weld procedure number used for the welding undertaken;
- Welder's initials or welding number for each weld undertaken; and
- Welding supervisor's initials or welding number for each weld inspected.

The weld map shall be submitted to the Administrator for approval before the steel product is dispatched for protective coating. **Hold Point 11**

### 8.6.7 Inspection of Completed Product Manufactured Outside Australia

All product supplied from an overseas fabricator shall be inspected by the Administrator in Australia at a location suitable to Transport and Main Roads prior to the application of the protective coating. **Hold Point 12**

The Contractor shall be responsible for covering all costs associated with carrying out the following inspections of the completed product.

- a) 100% of all products shall be visually examined;
- b) A minimum of 50% of all welds shall be Non Destructively Tested. If any welds are found to be defective then 100% of the welds shall be Non Destructively Tested.

Transport and Main Roads reserves the right to increase the minimum level of Non Destructive Testing.

Any welding defects found during the inspection shall be repaired by an Approved Transport and Main Roads fabricator prior to the application of the protective coating.

## 9 QUALITY OF WELDS

### 9.1 General

Permissible levels of imperfection in butt welds shall conform to AS 1554.1 Category SP.

Fillet welds shall conform to weld category SP unless detailed as GP on the Drawings.

### 9.2 Shear Connectors

Shear connectors shall be attached to girders in the locations and to the details shown on the Drawings.

Stud shear connectors shall be attached to girders by welding in accordance with AS 1554.2.

Stud welding operators shall be qualified in accordance with AS 1554.2 Clause 4.3.

Channel shear connectors shall be attached to girders by welding in accordance with AS 1554.1.

### 9.3 Threaded Holes

Where fabricated steel is to be hot-dipped galvanised, threaded holes shall be fabricated oversize to allow for the resulting reduction in size.

### 9.4 Member to be Straight

#### 9.4.1 All Fabrication

All structural steel shall be straight before being drilled, welded or worked. Straightening of either fabricated or as-manufactured steel, if necessary, shall be carried out by means of a steady pressure applied by rollers or presses.

#### 9.4.2 Elements Except Bridge Barrier

Straightening shall not be carried out by means of hammering or by heating unless the Administrator's prior approval has been obtained in writing. **Nonconformance** If straightening by heating is permitted, the steel shall not be heated to a higher temperature than that producing a dark cherry red colour. After heating, the metal shall be cooled slowly in air without any additional means of cooling. Straightening by heating shall not be used on any item manufactured from steel of grade in excess of 300 MPa.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

## 10 TOLERANCES

### 10.1 General

Tolerances shall comply with the requirements of Clauses 10.2, 10.3, 10.4, 10.5 or 10.6, as applicable.

### 10.2 Bridge Barrier

Bridge barrier shall be constructed to the tolerances detailed in Table 10.2.

**Table 10.2 - Tolerances for Bridge Barrier**

Location	Tolerance (mm)
Length of member	± 2
Height of post/balustrade	± 2
Centre of holes	± 2
Line of barrier from plan dimension	± 3

### 10.3 Girders Fabricated from Rolled Steel Sections

Bridge girders fabricated from rolled steel sections shall be constructed to the tolerances detailed in Table 10.3.

**Table 10.3 - Tolerances for Steel Girders**

Location	Tolerance
Length of girder	± 3 mm
Squareness of ends	± 3 mm in full depth of girder
Lateral bow <ul style="list-style-type: none"> <li>• if gradual</li> <li>• if localised</li> </ul>	12 mm over length of girder 6 mm over length of girder
Lateral kink <ul style="list-style-type: none"> <li>• within middle half of span</li> <li>• outside middle half of span</li> </ul>	6 mm over length of girder 3 mm over length of girder
Hog	+ 6 mm, - 0 over length of girder
Position of bearing holes in flange	± 1 mm
Position of holes in web	± 2 mm
Width of bottom flange at expansion bearings	± 1 mm
Surface of bearing area of bottom flange where bearing is attached	The underside of the girder where the bearing is attached shall be machined so that the face has a tolerance on flatness of 0.5 mm and the machined face is perpendicular to the web. The edge of the flange shall have a tolerance of +/- 1 mm from the perpendicular. No more than 2 mm shall be removed by grinding to achieve this standard of flatness
Warping or tilt of flanges of welded plate girders from a line perpendicular to the plan of the web	$\frac{1}{1000}$ of depth of web
Deviation from flatness of girder webs within a distance equal to the depth of the girder	$\frac{1}{250}$ of width of flange
Deviation between centre lines of web and flange of a built up girder	3 mm maximum
Full Contact Splice Joints	The maximum clearance between the abutting surfaces shall not exceed 1mm, and shall also not exceed 0.5mm over at least 67% of the contact area

#### **10.4 Girders Fabricated from Steel Plate**

Bridge girders fabricated from steel plate shall be constructed to the tolerances specified in Clause 14.4 of AS 4100.

#### **10.5 Expansion Bearings for Rolled Steel Girders**

##### **10.5.1 Stainless Steel Plate**

Stainless steel plate shall be supplied with a flatness tolerance across the width of the stainless steel plate of 0.5 mm and a straightness of 0.05 mm over 25 mm in any direction. The terms flatness and straightness are defined in AS 1100.101.

After installation of the studs, the underside shall be polished to a surface roughness Ra with an arithmetic mean deviation of 0.2  $\mu\text{m}$  as defined in AS 1100.201. The plate shall have a flatness tolerance across the width of the stainless steel plate of 0.5 mm and a straightness of 0.05 mm over 25 mm in any direction after installation of the studs.

Stainless steel plate shall conform to the requirements of Grade 316 in accordance with ASTM A240M and ASTM A480M.

Stainless steel plate for bridge bearings shall have a Brinell hardness of not less than 125.

##### **10.5.2 Steel Base Plate**

The steel base plate shall be grade 250 to AS 3678.

The plate shall be supplied with a flatness tolerance across the width of the plate of 0.5 mm and straightness of 0.05 mm over 25 mm in any direction. The terms flatness and straightness are defined in AS 1100.101.

The top face shall be machined or polished to a surface roughness, Ra with an arithmetic mean deviation of 0.4  $\mu\text{m}$  as defined in AS 1100.201. The base plate shall then be hot-dipped galvanised in accordance with the requirements of Clause 10.6. The top surface shall be re-machined to a surface roughness Ra of 0.4  $\mu\text{m}$  in both directions.

##### **10.5.3 Polytetrafluoroethylene**

The resin used in the manufacture of polytetrafluoroethylene (PTFE) sheets shall be 100% virgin PTFE, complying with AS 1196, Grade A or AS 1195, Grade A, as appropriate.

#### **10.6 Structures other than Bridge Barrier, Girders and Expansion Bearings**

Structures other than bridge barrier and steel I girders shall be constructed to the tolerances specified in Clause 14.4 of AS 4100.

Full contact splice joints shall have a maximum clearance between the abutting surfaces not in excess of 1mm, and clearance shall also not exceed 0.5mm over at least 67% of the contact area.

### **11 COATINGS**

#### **11.1 Hot-dipped Galvanising**

All fabricated steelwork shall be hot-dipped galvanised after fabrication in accordance with the requirements of AS 4680.

#### **11.2 Coating on Bolts**

All bolts with a thread size greater than M10 shall be hot dip galvanised to the requirements of AS 1214.

All bolts with a thread less than M10 and all socket head bolts shall be mechanically plated to the requirements of AS 3566 Class 4.

All bolts with a thread less than M10 and all socket head bolts shall be mechanically plated to the requirements of Fe/Zn 25c2A - AS 1789.

### 11.3 *Finishing After Galvanising*

#### 11.3.1 Inspection and Repairs at Galvanising Works

Following galvanising and before leaving the galvanising works, the steelwork shall be inspected for coating defects **Witness Point**. Repairs to galvanised coatings, where necessary, shall be carried out strictly in accordance with the requirements of AS/NZS 4680.

#### 11.3.2 Dressing

All galvanised items shall be dressed free of all lumps, spikes and other zinc protrusions and ash and dross marks shall be removed. Threads on bolts shall be cleaned. Drilled holes shall be checked to ensure they are free of zinc build-up.

The use of power-operated sanding tools or grinders shall not be permitted.

#### 11.3.3 Subsequent Repairs to Coatings

Any damage which occurs to galvanised coatings during handling, transporting and/or storage shall be referred to the Administrator prior to repair. **Nonconformance** Repairs shall be made using an approved zinc-rich paint or zinc sticks. Under no circumstances shall aluminium paint be used.

#### 11.3.4 Strapping of Galvanised Items

All galvanised items shall be strapped with zinc rich primed steel strapping.

#### 11.3.5 Additional Requirements for Bridge Barrier

The internal surface of RHS rail components shall be dressed to ensure that the rail connectors can be readily assembled to the rails.

## 12 ASSEMBLY

### 12.1 *General*

Assembly of structural steelwork shall be in accordance with AS 4100.

### 12.2 *Bolts, Nuts and Washers*

Unless specifically shown otherwise on the Drawings, all bolts shall be supplied with one nut and one washer. The washer shall be placed under the nut when assembling or installing the steelwork. Where a washer is shown under the head of a bolt, a second washer shall be supplied and installed under the nut.

Bolt assemblies shall be installed with a minimum of 3mm of the bolt end projecting above the top of the nut after assembly.

### 12.3 *Bolt Tensioning*

All bolt assemblies with a T/B or T/F classification shall be fully tensioned. The bolt tension shall be verified with installation of load indicating washers.

7 days prior to the erection of any bolted members with a T/B or T/F classification, the Contactor shall provide a bolt tensioning procedure and demonstrate to the Administrator that they have the equipment and technical capability to tension the bolts as stated on the drawings. **Hold Point 13**