

**Technical Specification**

**Transport and Main Roads  
MRTS78 Fabrication of Structural Steelwork**

**November 2020**

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## 1 Introduction

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

For stainless steel fabrication refer to MRTS78A *Fabrication of Structural Stainless Steelwork*.

For aluminium fabrication refer to MRTS79 *Fabrication of Aluminium Components*.

For the supply of structural fasteners refer to MRTS278 *Supply of Structural Fasteners*.

The aim of this Technical Specification is to produce fabricated steelwork which conforms to the specified drawings and to ensure the required durability. It describes the materials, supply, welding finishing and assembly of steel components and structures.

This Technical Specification is meant for the management of steelwork which is fabricated within a designated workshop using the following processes:

- Gas Metal Arc Welding (GMAW)
- Flux Cored Arc Welding (FCAW), and
- Submerged Arc Welding (SAW).

The Manual Metal Arc Welding (MMAW) welding process is permitted in limited cases which are outlined in this Technical Specification.

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

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

The use of commentary text, such as this, is covered by Clause 16 of MRTS01 *Introduction to Technical Specifications*.

### 1.1 Registered suppliers

The requirement for the fabrication of steel components and structures includes the use of registered suppliers.

For information regarding these suppliers refer to the Transport and Main Roads website, <https://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers> or email [TMRStructuralMaterials@tmr.qld.gov.au](mailto:TMRStructuralMaterials@tmr.qld.gov.au).

Note the differing submission requirements throughout this Technical Specification. Some approvals (for example, suitability of the welding supervisor) are wholly dealt with through the registration process, some submissions (for example, welding procedures) can be assessed by Structures Construction Materials but signed by the Administrator after receipt of a report or similar, and others (for example, niche project-specific requirements) are assessed by the Administrator.

## 2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*. In addition, terms listed in Table 2 are applicable to this Technical Specification.

**Table 2 – Definition of terms**

Term	Definition
Approved	Approved by the Administrator (this may be on the advice from Structures Construction Materials unit).
ATIC	Australian Technical Infrastructure Committee
Construction Categories (CC) – AS/NZS 5131	CC2 is equivalent to a Transport and Main Roads Registered Supplier of Minor Infrastructure. CC3 is equivalent to a Transport and Main Roads Registered Supplier of Major Infrastructure.
Designer	The Registered Professional Engineer of Queensland (RPEQ) responsible for the design of the component.
Design criteria	Departmental requirements for design details and methodology, found in different documents depending on application. In this Technical Specification, this refers to <i>Design Criteria for Bridges and Other Structures</i> .
Engineering Drawings	RPEQ certified drawings as detailed in the Project / Contract Drawings.
Fabricator	The supplier of the welded steel components.
fasteners	Bolts, nuts and washers. These may be as an assembly or as individual components. Refer to MRTS278 <i>Supply of Structural Fasteners</i> for more information.
FP welding	Fatigue purpose welding
GP welding	General purpose welding
NDE	Non-destructive examination
NDT	Non-destructive testing
PQR	Procedure qualification record
Registration Scheme	The process through which Fabricators are assessed as competent to carry out stainless steel fabrication.
registered supplier	Prequalified supplier in accordance with departmental registration schemes. In this document, this refers to: <i>Registration Scheme: Suppliers and Products for Bridges and Other Structures</i> . Registration for certain suppliers is a prerequisite for Administrator approval, not a substitute.
robot welder	The welding process that uses both a robot welding machine and a qualified operator.
SCM	Structures Construction Materials unit
SP welding	Structural purpose welding
WPS	Welding Procedure Specification
WTIA	Welding Technology Institute of Australia, now known as Weld Australia (WA).

### 3 Referenced documents

All products in this Technical Specification shall comply with the relevant standards including the variations to the standards as outlined in Table 3. The latest revision of these documents shall be used, unless noted otherwise in the table.

**Table 3 – Referenced documents**

<b>Reference</b>	<b>Title</b>
AS 1544.2	<i>Method for impact tests on metals, Part 2: Charpy V-notch</i>
AS 1627.4	<i>Metal finishing – Preparation and pretreatment of surfaces, Part 4: Abrasive blast cleaning of steel</i>
AS/NZS 1163	<i>Cold-formed structural steel hollow sections</i>
AS/NZS 1554.1	<i>Structural steel welding, Part 1: Welding of steel structures</i>
AS/NZS 1554.2	<i>Structural steel welding – Stud welding (steel studs to steel)</i>
AS/NZS 1554.5	<i>Structural steel welding, Part 5: Welding of steel structures subject to high levels of fatigue loading</i>
AS/NZS 1594	<i>Hot-rolled steel flat products</i>
AS/NZS 2717.1	<i>Welding – Electrodes – Gas metal arc Part 1: Ferritic steel electrodes (Superseded)</i>
AS/NZS 3678	<i>Structural steel – Hot-rolled plates, floorplates and slabs</i>
AS/NZS 3679.1	<i>Structural steel, Part 1 – Hot-rolled bars and sections</i>
AS/NZS 3679.2	<i>Structural steel, Part 2 – Welded I sections</i>
AS/NZS 4680	<i>Hot-dip galvanized (zinc) coatings on fabricated ferrous articles</i>
AS/NZS 4855	<i>Welding consumables – Covered electrodes for manual metal arc welding of non-alloy and fine grain steels – Classification</i>
AS/NZS 5131	<i>Structural steelwork – Fabrication and erection</i>
AS/NZS 14341	<i>Welding consumables – Wire electrodes and weld deposits for gas shielded metal arc welding of non-alloy and fine grain steels – Classification</i>
AS/NZS ISO 9606.1	<i>Qualification testing of welders – Fusion welding, Part 1: Steels</i>
AS/NZS ISO 14171	<i>Welding consumables – Solid wire electrodes, tubular cored electrodes and electrode / flux combinations for submerged arc welding of non-alloy and fine grain steels – Classification</i>
AS/NZS ISO 14174	<i>Welding consumables – Fluxes for submerged arc welding and electroslag welding – Classification</i>
AS/NZS ISO 17632	<i>Welding consumables – Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels – Classification</i>
Design Criteria	<i>Design Criteria for Bridges and Other Structures</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS63	<i>Cast-In-Place Piles</i>
MRTS63A	<i>Piles for Ancillary Structures</i>
MRTS64	<i>Driven Tubular Steel Piles (with reinforced concrete pile shaft)</i>

Reference	Title
MRTS78A	<i>Fabrication of Structural Stainless Steelwork</i>
MRTS79	<i>Fabrication of Aluminium Components</i>
MRTS88	<i>Protective Coating for New Work</i>
MRTS97	<i>Mounting Structures for Roadside Equipment</i>
MRTS278	<i>Supply of Structural Fasteners</i>
SA TS 102	<i>Structural steel – Limits on elements added</i>
SA TS 103	<i>Structural steel welding – Limits on boron in parent material</i>
SD1365	<i>Traffic Sign – Traffic Sign Support Breakaway Post Details (Two or more Supports)</i>
TN61	<i>Use and storage of hydrogen-controlled electrodes</i>
TN62	<i>Assembly and tensioning of high strength bolts and nuts</i>
-	<i>Registration Scheme: Suppliers and Products for Bridges and Other Structures</i>

#### 4 Standard test methods

The standard test methods referenced in the applicable material standards shall be used in this Technical Specification.

Further details of test numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Specifications*.

All tests for the purpose of compliance are to be performed and reported by a NATA-accredited (or ILAC registered equivalent) laboratory, whose scope of accreditation encompasses the test method used.

#### 5 Quality system requirements

##### 5.1 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 Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1. A checklist is also available on the department's website for assistance in managing these quality points.

**Table 5.1 – Hold Points, Witness Points and Milestones**

Clause	Hold Point	Witness Point	Milestone
7	1. Approval of fabricator and design approval (where applicable)		Submission of fabricator's registration certificate and design approval (10 business days)
8.2	2. Approval of welding documentation		Submission of welding documentation (5 business days)



Clause	Hold Point	Witness Point	Milestone
9.1.1	3. Approval of material test certificates		Submission of welding documentation (5 business days)
10.4.4.1, 10.4.4.3		1. Approval of butt weld preparation	Inspection notification – butt weld preparation (3 business days)
10.4.4.2, 10.4.4.4	4. Approval of butt weld preparation		Inspection notification – butt weld preparation (3 business days)
10.4.7.2, 10.4.8	5. Visual scan of completed welding		Inspection notification – completed weld (3 business days)
10.4.7.3	6. Submission and review of non-destructive testing reports		
10.4.8	7. Inspection of completed welding in Australia		Inspection notification – completed weld for overseas fabrication (3 business days)
10.4.9	8. Submission and review of weld maps		
11.1		2. Submission of abrasive blasting report	
11.2.3	9. Galvanising inspection		Inspection notification – galvanising coating (3 business days)
12.4	10. Approval of tensioning procedure and trial installation		Inspection notification – trial installation (5 business days)

## 5.2 Conformance requirements

The conformance requirements which apply to lots of work covered by this Technical Specification are summarised in Table 5.2.

**Table 5.2 – Conformance requirements**

Clause	Conformance Requirement
10.3	Tolerances
10.4	Welding
11	Coatings
12.4	Bolt tensioning

## 6 Conditions for fabrication of steel components

### 6.1 General

All steel components shall be fabricated in accordance with the details shown on the Engineering Drawings and in accordance with this Technical Specification.

## **6.2 Manufacture by registered Fabricator**

Steel components shall be manufactured only by a registered supplier. Registered suppliers shall comply with the *Registration Scheme: Suppliers and Products for Bridges and Other Structures*.

This document, accompanying information and a list of registered Fabricators can be found on the department website <https://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers>.

Enquiries regarding registration can be forwarded to [TMRStructuralMaterials@tmr.qld.gov.au](mailto:TMRStructuralMaterials@tmr.qld.gov.au).

The Registration Scheme also covers Fabricators who are located outside Australia. Other requirements are specified within this Technical Specification.

## **6.3 New steel products**

Alternate or innovative product designs which do not comply with the department's Standard Drawings or the Engineering Drawings shall not be submitted without prior approval from the department's Engineering and Technology Branch. Alternative product designs shall comply with the Design Criteria, this Technical Specification and other relevant Technical Specifications. Supply of product to alternative designs shall not occur without prior approval of the Administrator.

Alternative product designs for products covered by Standard Drawings or other innovative products shall be submitted to the relevant section of the department's Engineering and Technology Branch for consideration and approval by the relevant Deputy Chief Engineer. All product details, including welding details, shall be provided.

Where innovative products are proposed, it should be noted that the department has a strategy document on engineering innovation.

Note that approval of an alternate or proprietary design by Engineering and Technology Branch, and the approval to supply an alternative product by the Administrator are separate processes. The former is, however, a prerequisite of the latter.

With respect to intellectual property, the department respects manufacturers' intellectual property however, it is considered necessary for all details of the product purchased by the department to be provided. These details shall not be provided to any third party.

Note: Any confidentiality document or formal agreement required would need to be negotiated between the departments' Legal Services unit and the manufacturer.

## **6.4 Construction categories**

Fabrication of steel components shall fall into the following categories as outlined in AS/NZS 5131, unless noted differently on the Engineering Drawings:

- a) Construction Category 2 (CC2) – minor infrastructure, or
- b) Construction Category 3 (CC3) – major infrastructure.

## 7 Prior to commencing fabrication

No fewer than ten business days **Milestone** prior to the start of fabrication, the Contractor shall supply to the Administrator a copy of the nominated Fabricator's registration certificate and any design approvals for proprietary products where applicable. **Hold Point 1**

## 8 Welding

### 8.1 General

Welding carried out under this Technical Specification applies to GP and SP welding to AS/NZS 1554.1 and FP welding to AS/NZS 1554.5.

Submerged arc welding shall be carried out in accordance to AS/NZS 1554.1.

Stud welding shall be carried out in accordance to AS/NZS 1554.2 and Clause 10.4.3 of this Technical Specification.

### 8.2 Welding documentation

No fewer than five business days **Milestone** prior to the start of fabrication, the Contractor shall supply the following to the Administrator.

- a) a copy of the Welding Procedure Specification (WPS)
- b) the corresponding Procedure Qualification Record (PQR)
- c) macro test results for the welding staff for each submitted WPS, refer to Clause 10.4.3
- d) welding wire batch certificate, and
- e) a draft weld map, refer to Clause 10.4.9, to show where the WPS will be used.

The qualification of the PQR shall comply with Table 4.7.1 of AS/NZS 1554.1.

The WPS shall be in accordance with AS/NZS 1554.1 or AS/NZS 1554.5 as required.

The WPS shall reflect the connection to be welded shown on the Engineering Drawings and any proposed joint changes shall be approved by the Designer prior to the WPS documentation submission. Any approval to joint changes shall be included with **[Hold Point 2]**.

The submission of two WPS shall not be approved to cover the welding of a compound weld.

Welding shall not be carried out until the above documentation has been Approved by the Administrator. **Hold Point 2**

AS/NZS 1554.1, Appendix C shows a typical form for a welding procedure specification. The WPS outlines the way the welded joint needs to be prepared, the welding parameters and the run sequence for the placement of the welds.

Transport and Main Roads' Structures Construction Materials unit can assist with the review of this documentation if the Administrator is unsure of the technical requirements. A copy of the Engineering Drawings is required to undertake this review.

### 8.3 Welding consumables

Welding consumables shall be compatible with the parent material and shall be classified and identified in accordance with the provisions of the following standards apart from the variation stated below:

AS/NZS ISO 14171	<i>Welding Consumables – Solid wire electrodes, tubular cored electrodes and electrode / flux combinations for submerged arc welding of non-alloy and fine grain steels – Classification</i>
AS/NZS ISO 14174	<i>Welding consumables – Fluxes for submerged arc welding and electroslag welding – Classification</i>
AS/NZS 14341	<i>Welding consumables – Wire electrodes and weld deposits for gas shielded metal arc welding of non-alloy and fine grain steels – Classification</i>
AS/NZS ISO 17632	<i>Welding consumables – Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels – Classification</i>

The welding consumables standard AS/NZS 2717.1 is now obsolete, any WPS referencing this Standard will need to be amended.

Welding with Manual Metal Arc Welding (MMAW) shall only be undertaken where noted on the department's Standard Drawings or where previously approved by Transport and Main Roads – Structures Unit.

Welding consumables for MMAW shall comply with AS/NZS 4855.

At the time of publication SD1365 is the only Standard Drawing which references this welding process. This drawing nominates MMAW based on crash testing data.

It was found that Fabricators had not been storing MMAW electrodes as per the manufacturer's specifications. This nonconformance can lead to weld defects, refer to TN61 *Use and storage of hydrogen-controlled electrodes* for more information.

## 9 Materials

### 9.1 Steel sections

#### 9.1.1 Approval of material test certificates

No fewer than five business days **Milestone** prior to the start of fabrication, the Contractor shall supply a copy of the material test certificates for the materials to be used in the fabrication.

Steel fabrication shall not commence until the Administrator has reviewed and approved: **Hold Point 3**

- a location map showing where the material can be found on the Engineering Drawings, and
- a conforming material test certificate, and
- the third-party certification, or
- material testing as appropriate.

Third-party certification can be undertaken by an independent party for product conformity assessment. The certifying body shall be acceptable to the department. The certification will be carried out on the manufacturer of the raw material.

Material test or testing certificates are still required to prove traceability and to determine if there will be any issues during galvanising.

The submission of the material test certificates was introduced as it was found that some merchants were sourcing material which did not comply with the relevant Australian Standards.

The following are examples of the documents which could be submitted:

Option 1	Option 2
Third-party certificate	Material testing results
Conforming material test certificate	A location map showing material location
A location map showing material location	

Transport and Main Roads' Structures Construction Materials unit can assist with the review of this documentation if the Administrator is unsure of the technical requirements. A copy of the Engineering Drawings is required to undertake this review.

If material test certificates are not available, the sample testing shall comply with the requirements of Clause 9.1.1.1.

If the material which is specified on an Engineering Drawing is not available, it must be raised with the Designer or their nominated RPEQ representative to be resolved prior to the commencement of fabrication.

#### 9.1.1.1 Sample testing

If testing is needed, then the sampling conditions must be completed:

- a minimum of one test per size and grade, or
- 2% of the material of the same size and grade.

The sample tests shall be in accordance with the appropriate Australian Standard, stating the full chemical composition and mechanical test results, including yield, tensile, elongation and, where applicable, Charpy impact tests. The results shall be NATA-endorsed. The sample tests shall be at no expense to the Principal.

#### 9.1.2 Relevant Australian Standards

Structural steel shall comply with the requirements of the following Standards and Technical Specification apart from the variations stated below:

- AS/NZS 1163 *Cold-formed structural steel hollow sections*
- AS/NZS 1594 *Hot-rolled steel flat products*
- AS/NZS 3678 *Structural steel – Hot-rolled plates, floorplates and slabs*
- AS/NZS 3679.1 *Structural steel, Part 1 – Hot-rolled bars and sections*

- AS/NZS 3679.2                    *Structural steel, Part 2 – Welded I sections*
- SA TS 102                        *Structural steel – Limits on elements added*
- SA TS 103                        *Structural steel welding – Limits on boron in parent materials*

Material which has not been manufactured to Australian Standards but manufactured to a different Standard, for example JIS (Japanese Industrial Standards), will be deemed non-conforming.

As a minimum, structural steel purchased to AS/NZS 1163, where the size is deemed suitable, shall be supplied with impact test results at a temperature of 0°C in accordance with AS 1544.2. The results of the testing shall be reported by a NATA (or ILAC-registered equivalent) endorsed laboratory.

Engineering Drawings which specify impact-rated steel shall be supplied with impact test results at the design service temperature in accordance with AS 1544.2. The results of the testing shall be reported by a NATA (or ILAC-registered equivalent) endorsed laboratory. The acceptance of the material shall be in accordance with the relevant mechanical properties table in the nominated Australian Standard.

### **9.1.3 Variations to the Australian Standards**

#### **9.1.3.1 Material to AS/NZS 1594**

Steel supplied to AS/NZS 1594 shall have a material test certificate which complies with the requirement of Clause 11 of AS/NZS 3678.

These conditions align with the requirements those of:

- AS/NZS 1163
- AS/NZS 3678, and
- AS/NZS 3679.

The material test certificate shall state the full chemical composition and mechanical properties in accordance with AS/NZS 1594 and, in addition, the total boron content in accordance with Clause 9.1.3.3 in this Technical Specification.

#### **9.1.3.2 Silicon content**

Steel supplied to AS/NZS 1163 and hot dip galvanised to AS/NZS 4680, the silicon content shall not exceed 0.25% unless approved by Transport and Main Roads – SCM.

All material with a silicon content less than 0.01% shall be abrasive blasted to Sa2.5, refer to Clause 10.2.6.

Cold-formed structural steel hollow sections with a silicon content of greater than 0.25% will develop an excessively high galvanising coating thickness which may result in the delamination of the galvanising and affecting the durability of the product.

Cold-formed structural steel hollow sections and hot-rolled sections with a silicon content of less than 0.01% may result in insufficient galvanising coating thickness; that is, less than 55 µm for material thickness of 6 mm and less than 70 µm for material thickness greater than 6 mm.

### 9.1.3.3 Boron content

All steel supplied to Transport and Main Roads shall have a total boron content of less than 0.0008%.

Reporting of the boron content shall comply with Clause 7 of SA TS 103.

Material with a boron content of equal to or greater than 0.0008%:

- can have an impact on the material in the weld heat-affected zone
- are deemed non-prequalified for welding to AS/NZS 1554.1, and
- will require the relevant WPS to be requalified in accordance with SA TS 103.

### 9.1.4 Traceability of material

The Fabricator shall prove traceability of materials. The Administrator shall be satisfied with the traceability provided by the Contractor.

If there is no traceability between the material test certificates and the material supplied, the material shall be tested by a NATA laboratory accredited for the appropriate testing in accordance with Clause 9.1.1.1.

Most materials supplied to Australian Standards have ink-line marking. The markings are traceable to the Material Test Certificate. There are certain sizes and sections which do not have these markings. These are smaller sections covered by AS/NZS 3679.1.

Traceability can be demonstrated by:

- photographic evidence (as shown below), and
- testing of each section as per Clause 9.1.1.1.

Figure 9.1.4(a) following shows the heat number on a Circular Hollow Section (CHS). This number can also be found on the corresponding material test certificate, refer to Figure 9.1.4(b).

The cross check between the Material Test Certificate and the material is important to ensure the material being fabricated complies with the relevant Australian Standards above and the clauses of this Technical Specification.


The person undertaking any Hold Point inspections may carry out random checks on traceability.

Figure 9.1.4(a) – Heat number on CHS



Material traceability

Figure 9.1.4(b) – Corresponding material test certificate



Certificate No: Q180829-0011  
 LOT NO: Q180829  
 Version: 1  
 Page 1 of 2  
 Date Printed: 18/06/2018

**TEST CERTIFICATE**

**SUPPLIER:** Austube Mills Pty Ltd  
 146 Ingram Road  
 Acacia Ridge, QLD4109  
 ABN 21 123 668 679

**PRODUCT DESCRIPTION**  
**SPECIFICATION:** AS1074:1989 AS/NZS 1163:2016 C250L0  
**MATERIAL:** ERW Steel Tube with no subsequent overall heat treatment on the finished product  
**STEELMAKING:** Basic Oxygen, Fully Killed, Continuous Cast, Fine Grained  
**STEEL FEED:** Coil from Hot Strip Mill. Coil that has been subjected to a cold rolling reduction of more than 15%, following the reduction has been subjected to a subcritical annealing cycle that has recrystallized the structure and formed new ferrite grains

**ITEMS COVERED BY THIS CERTIFICATE**

GTIN	DESCRIPTION	Date Range
92317889856414	50NB MED CLR PE 6.5 M AS 1074+AS/NZS 1163-C250L0	30/05/18 - 30/05/18 18150 - 18150
92317889765341	50NB MED NOP PE 6.5 M AS 1074+AS/NZS 1163-C250L0	
92317889971391	50NB MED PTD RED PE 6.5 M AS 1074+AS/NZS 1163-C250L0	
92317889971414	50NB MED PTD RED SOE 6.5 M AS 1074+AS/NZS 1163-C250L0	

NOTE: - Item:  
 (1) The Date Range indicates the mill manufactured date range. Line marking on further processed product may be after these dates.

**CHEMICAL ANALYSIS**

Test No	Heat No	Test Lab	Analysis Category	Percentage of Elements by Mass									
				C	P	Mn	Si	S	Ni	Cr	Mo	Cu	
A44109	8597799	632	L	0.080	0.014	0.190	<0.005	0.011	0.018	0.023	0.003	0.039	
A43995	8597789	632	L	0.056	0.014	0.190	0.005	0.012	0.014	0.021	0.003	0.037	
A43789	8588409	632	L	0.051	0.014	0.180	<0.005	0.011	0.012	0.024	0.003	0.035	
SPEC LIMITS				L/P	0.120	0.030	0.500	0.050	0.030	0.250	0.150	0.100	0.250


Test No	Heat No	Test Lab	Analysis Category	Percentage of Elements by Mass								
				Al-t	Ti	Nb	V	B	CE	CF2	CF3	
A44109	8597799	632	L	0.038	<0.002	0.001	<0.003	<=0.0008	0.10	0.006	0.040	
A43995	8597789	632	L	0.031	<0.002	0.001	<0.003	<=0.0008	0.10	0.006	0.040	
A43789	8588409	632	L	0.028	<0.002	0.001	<0.003	<=0.0008	0.09	0.006	0.040	
SPEC LIMITS				L/P	0.020-0.100	0.040	0.010	0.030	0.0008	0.25	0.030	0.090

NOTE: - Chemical Analysis:  
 (1) The Test No. represents the test report reference for this analysis.  
 (2) For details on Test Lab - see Laboratories section below.  
 (3) L/P: L=Load or Cast analysis; P=Product analysis.  
 (4) Spec Limits represent maximum values. For Al the spec limits are minimum and maximum values (Min/Total, Al=Soluble).  
 (5) For products less than 6 mm thick with Al below the min. limit, finished product Ferrite Grain Size is greater than or equal to 5 as required by Clause 5.4.2.3(b) of AS/NZS 1163:2016 (separate report available on request).  
 (6) CE = Cr+Mn/5+Si+Ni/10; CF2 = Nb+V; CF3 = Si+2.S.P.  
 (7) Analysis results are taken from supplier laboratory accredited Test Certificates and are not rounded.

**MECHANICAL PROPERTIES**

**Tensile Test**

Test No	Heat No	Test Lab	Test Cat	Test Type	Yield Strength (MPa)	Tensile Strength (MPa)	Elong (%)	Gauge Length Method	Comments	
23368	8597799	17051	B	LSA	365	400	30.00	2		
23381	8597789	17051	B	LSA	380	410	31.25	2		
23383	8588409	17051	B	LSA	390	420	25.75	2		
SPECIFICATION 15 < d0/t <= 30					LSA	250	320	20	—	Minimum Values

 Accredited for compliance with ISO/IEC 17025.

## 9.2 Fasteners

### 9.2.1 General

Fasteners shall conform to the requirements of MRTS278 *Supply of Structural Fasteners*.



## 10 Fabrication

### 10.1 General

All steelwork shall be fabricated in accordance with the following Standards or as specified in this Technical Specification:

- AS/NZS 1554.1                    *Structural steel welding, Part 1: Welding of steel structures*
- AS 1627.4                        *Metal finishing – Preparation and pretreatment of surfaces, Part 4: Abrasive blast cleaning of steel*
- AS/NZS 5131                      *Structural steelwork – Fabrication and erection*

Any clause referenced in AS/NZS 5131 with the text '*should*' shall be replaced with '*shall*'. Any clause referenced in AS/NZS 5131 with the text '*review*' shall be replaced with '*approval*'.

### 10.2 Material processing

#### 10.2.1 General

All steel shall be straight before drilling, processing or welding.

Straightening of manufactured steel, if necessary, shall be carried out by means of steady pressure applied by rollers or press brake.

##### 10.2.1.1 Sections except bridge traffic barriers

Straightening shall not be carried out by means of hammering or by heating unless prior approval in writing has been given by the Administrator.

Where heat straightening is used the temperature in the heated areas shall not exceed 600°C. After straightening with heat, the material shall be air cooled in a controlled manner without any assistance.

Straightening by heating shall not be used on any section with a steel grade greater than 300 MPa.

#### 10.2.2 Cutting and edge preparation of steel

All material shall be cut to the required length as outlined by Clause 6.5.1 of AS/NZS 5131, except for the following.

The cropping and/or shearing of the following steel sections is not permitted:

- hot rolled sections to AS/NZS 3679.1 and AS/NZS 3679.2
- hollow sections to AS/NZS 1163
- flat and round bars to AS/NZS 3679.1 with a thickness equal to and greater than 12 mm, and
- plate to AS/NZS 3678 with a thickness equal to and greater than 12 mm.

No rough edges shall remain, and uneven outer edges shall be dressed off to a true line.

Cropping or shearing of these sections may cause distortion. Figure 10.2.2 shows an I beam which was cropped for a Transport and Main Roads project.

**Figure 10.2.2 – Distortion of an I beam due to cropping**



All re-entrant corners shall have 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 tangent points of the predrilled hole, and all cutting shall follow closely the lines prescribed.

#### **10.2.2.1 Edge preparation for welding**

Edge preparation on material to be welded shall comply with the requirements of Clause 5.1.1 of AS/NZS 1554.1.

Edges to be welded shall not be sheared.

All butt weld preparation shall be prepared by machining, grinding or thermal cutting, followed by grinding. All cutting shall be generally as smooth and regular as that produced by edge planing and the edge shall be left free of slag and ground back to bright steel.

#### **10.2.2.2 Edge preparation for galvanising**

Any edge which has been cut by a thermal cutting process shall be ground. The ground edge surface shall be free of slag and ground back to bright steel.

The surface preparation on a thermally cut edge is important to ensure the galvanising coating thickness is achieved. Undressed edges on a gantry baseplate have been known to only reach 60 µm whereas the main surface of the plate may reach up to 300 µm.

### **10.2.3 Holes**

Circular holes for bolts shall be drilled. Circular holes for other purposes shall be cut using a CNC machine or drilled with the allowable processes outlined in Clause 6.5.1 of AS/NZS 5131.

Punching of holes in material having a thickness greater than 12 mm will not be permitted.

Slotted holes shall be CNC machine cut or formed by drilling two adjacent holes and completed by hand cutting between the holes and ensuring the hole surface is smooth and free from 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 finished accurately to size and in the position shown on the drawings. All holes shall be cleaned, and the edges deburred.

#### **10.2.3.1 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.

### **10.2.4 Bending of material**

Bending of steel materials shall be carried out in a press which produces clean straight bends with no distortion in the adjacent flat surfaces.

Prior to bending, any rough edges shall be smoothed by grinding and free from burrs to reduce the chance of the material cracking or splitting.

Bending shall comply with the tolerances outlined in Table F1.4 of AS/NZS 5131.

### **10.2.5 Rolling of material**

Prior to processing, all rolling equipment shall be cleaned of any potential contamination.

Prior to rolling, any rough edges shall be smoothed by grinding and free from burrs to reduce the chance of the material cracking or splitting.

The surfaces of the rollers shall be clean so the material will not be scratched or pick up contaminants.

### **10.2.6 Abrasive blasting**

For information regarding abrasive blasting requirements, refer to Clause 11.1 of this Technical Specification.

## **10.3 Tolerances**

### **10.3.1 General**

Tolerances shall comply with the requirements of the essential tolerances outline in AS/NZS 5131 or in Clause 10.3.2, as applicable.

### **10.3.2 Bridge traffic barriers and balustrade**

The tolerances listed in Table 10.3.2 shall apply to bridge traffic barriers and balustrades.

**Table 10.3.2 – Tolerances for bridge traffic barriers**

Location	Tolerances
Length of rails and balustrade	± 2 mm
Height of posts	± 2 mm
Centre of holes	± 2 mm
Finished height of balustrade	± 2 mm
Plan dimensions	± 3 mm
Bow in rail and balustrade	1 mm / m

## **10.4 Welding**

### **10.4.1 General**

Welding shall be carried out in accordance with AS/NZS 1554.1 except as amended by this Clause.

Where welding is undertaken outside Australia, all the Clauses shall be complied with unless modified with the relevant additional Clauses in this Technical Specification.

Surface treatment in accordance with AS/NZS 5131 shall be Treatment Grade P3.

#### **10.4.1.1 Administrator supervision for fabrication outside Australia**

All fabrication shall be overseen by the Administrator or their representative who conforms to the following requirements:

- Clause 4.12.1 (a) to (d) of AS/NZS 1554.1, and
- has a culturally different background to the country where the fabrication is being undertaken.

All costs associated with this supervision shall be at the Contractor's expense.

#### **10.4.2 Welding supervisor**

All work shall be carried out under the supervision of a welding supervisor who conforms to at least one of the requirements of Clause 4.12.1 (a) to (e) of AS/NZS 1554.1 or as specified in the Registration Scheme.

The nominated welding supervisor shall be available to the welding personnel in the workshop or factory office during all welding processes, including tack welding.

The welding supervisor's qualifications and competency shall be assessed through the Registration Scheme.

The welding supervisor is responsible for the daily supervision of fabrication.

The inspections undertaken by the Administrator does not mitigate the responsibility of the welding supervisor.

#### **10.4.2.1 Welding supervisor for fabrication outside Australia**

All work shall be carried out under the supervision of a welding supervisor who conforms to one of the requirements of Clause 4.12.1 (a) of AS/NZS 1554.1.

### **10.4.3 Welding personnel**

All welding personnel shall comply with the initial welder qualification requirements of Clause 4.12.2.3 of AS/NZS 1554.1.

After the initial qualification, all welding personnel shall undertake a macro test on a 12 monthly basis. The macros shall be for each welding procedure specification used on Transport and Main Roads projects. The macro tests shall be undertaken with the grade of material specified on the Welding Procedure Specification.

Welder qualification to AS/NZS ISO 9606.1 is not acceptable.

Welding personnel nominated to carry out welding for Transport and Main Roads shall be assessed and approved under the Registration Scheme.

Transport and Main Roads reserves the right to withdraw a welder's approval if the welding is below the minimum requirements outlined in AS/NZS 1554.1.

#### **10.4.3.1 Welding personnel (robot welder)**

All welding undertaken by a robot welder and the associated operator shall comply with the initial welder qualification requirements of Clause 4.12.2.3 of AS/NZS 1554.1.

After initial qualification the robot welder shall undertake a macro test on a 12-monthly basis. The macros shall be for each welding procedure specification used on Transport and Main Roads projects. The macro tests shall be undertaken with the grade of material specified on the welding procedure specification.

Individual operators of the robot welder shall undertake the qualifications detailed above.

Transport and Main Roads reserves the right to withdraw approval of the robot operator if the welding is below the minimum requirements outlined in AS/NZS 1554.1.

#### **10.4.3.2 Welding personnel (sub-arc welding)**

All welding undertaken by a sub-arc welder and the associated operator shall comply with the initial welder qualification requirements of Clause 4.12.2.3 of AS/NZS 1554.1.

After initial qualification the sub-arc welder shall undertake a macro test on a 12-monthly basis. The macros shall be for joint identification B-C3 shown in Table E1 of Appendix E of AS/NZS 1554.1. The macro tests shall be undertaken with the grade of material specified on the welding procedure specification.

Individual operators of the sub-arc welder shall undertake the qualifications detailed above.

Transport and Main Roads reserves the right to withdraw approval of the sub-arc operator if the welding is below the minimum requirements outlined in AS/NZS 1554.1.

#### **10.4.3.3 Non-trade qualified welding personnel**

The welding of products which have been evaluated as acceptable, through the Registration Scheme process, may be undertaken by non-trade qualified welding personnel.

If deemed acceptable the non-trade qualified welding personnel shall comply with the initial welder qualification requirements of Clause 4.12.2.3 of AS/NZS 1554.1.

After the initial qualification, all welding personnel shall undertake a macro test on a six-monthly basis. The macros shall be for each welding procedure specification used on Transport and Main Roads

projects. The macro tests shall be undertaken with the grade of material specified on the welding procedure specification.

Welder qualification to AS/NZS ISO 9606.1 is not acceptable.

Welding personnel nominated to carry out welding for Transport and Main Roads shall be assessed and approved under the Registration Scheme.

Transport and Main Roads reserves the right to withdraw a welder's approval if the welding is below the minimum requirements outlined in AS/NZS 1554.1.

#### **10.4.4 Butt weld preparation**

##### **10.4.4.1 Pile liners (MRTS63 *Cast-In-Place Piles* and MRTS63A *Piles for Ancillary Structures*)**

No fewer than three business days **Milestone** prior to welding commencing on the first longitudinal seam weld, the Contractor shall notify the Administrator the butt weld preparation is ready for inspection. The Administrator shall ensure the preparation has been assembled in accordance with the approved WPS, including bevel angle and root gap. **Witness Point 1**

If the joint does not comply with the details on the WPS, the Fabricator shall either:

- a) modify the steel so the joint complies with the WPS, or
- b) develop and test a PQR with the new joint details, then qualify the necessary welding staff to the subsequent WPS in accordance with Clause 10.4.3.

Any subsequent butt weld preparation inspections may be arranged during this time.

##### **10.4.4.2 Pile tubes (MRTS64 *Driven Tubular Steel Piles (with reinforced concrete pile shaft)*)**

No fewer than three business days **Milestone** prior to welding commencing on the first longitudinal seam weld, the Contractor shall notify the Administrator the butt weld preparation is ready for inspection. The Administrator shall ensure the preparation has been assembled in accordance with the approved WPS, including bevel angle and root gap. **Hold Point 4**

If the joint does not comply with the details on the WPS, the Fabricator shall either:

- a) modify the steel so the joint complies with the WPS, or
- b) develop and test a PQR with the new joint details, then qualify the necessary welding staff to the subsequent WPS in accordance with Clause 10.4.3.

Any subsequent butt weld preparation inspections may be arranged during this time.

##### **10.4.4.3 Traffic mast arm and road lighting to noise barriers and MRTS97 *Mounting Structures for Roadside Equipment***

No fewer than three business days **Milestone** prior to welding commencing on the first longitudinal seam weld, the Contractor shall notify the Administrator the butt weld preparation is ready for inspection. The Administrator shall ensure the preparation has been assembled in accordance with the approved WPS, including bevel angle and root gap. **Witness Point 1**

If the joint does not comply with the details on the WPS, the Fabricator shall either:

- a) modify the steel so the joint complies with the WPS, or
- b) develop and test a PQR with the new joint details, then qualify the necessary welding staff to the subsequent WPS in accordance with Clause 10.4.3.

Any subsequent butt weld preparation inspections may be arranged during this time.

#### 10.4.4.4 All other steel fabrication

No fewer than three business days **Milestone** prior to welding commencing on any butt welded connection, the Contractor shall notify the Administrator that the joint is ready for inspection. The Administrator shall ensure the butt weld preparation has been assembled in accordance with the approved WPS, including bevel angle and root gap. **Hold Point 4**

If the joint does not comply with the details on the WPS, the Fabricator shall either:

- a) modify the steel so the joint complies with the WPS, or
- b) develop and test a PQR with the new joint details, then qualify the necessary welding staff to the subsequent WPS in accordance with Clause 10.4.3.

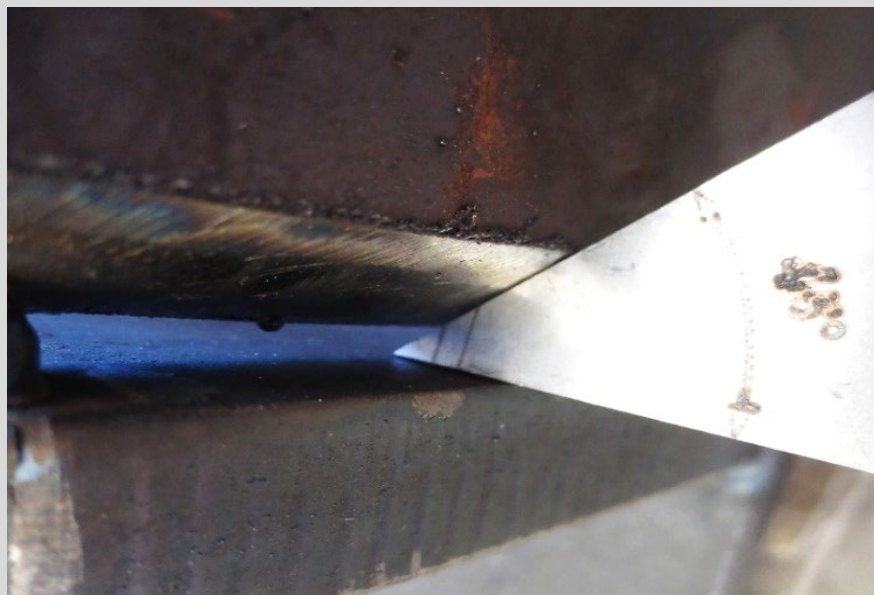
Clause 10.4.4.4 was added to this Technical Specification as some Fabricators had not prepared the butt weld joint in accordance with the drawings and WPS requirements. Some Fabricators did not understand the welding symbols or thought the joint was over-designed and did not require the weld type specified. This problem has been reduced with the inclusion of this Hold Point and the implementation of the Registered Suppliers List (see Clause 1.1).

The preparation of this type of joint is critical in guaranteeing the weld has its intended purpose. This may be due to the strength of the connection or to prevent crevice corrosion. Both the bevel angle (Figure 10.4.4.4(a)) and the root gap (Figure 10.4.4.4(b)) are important to getting the correct weld. The WPS should specify both factors.

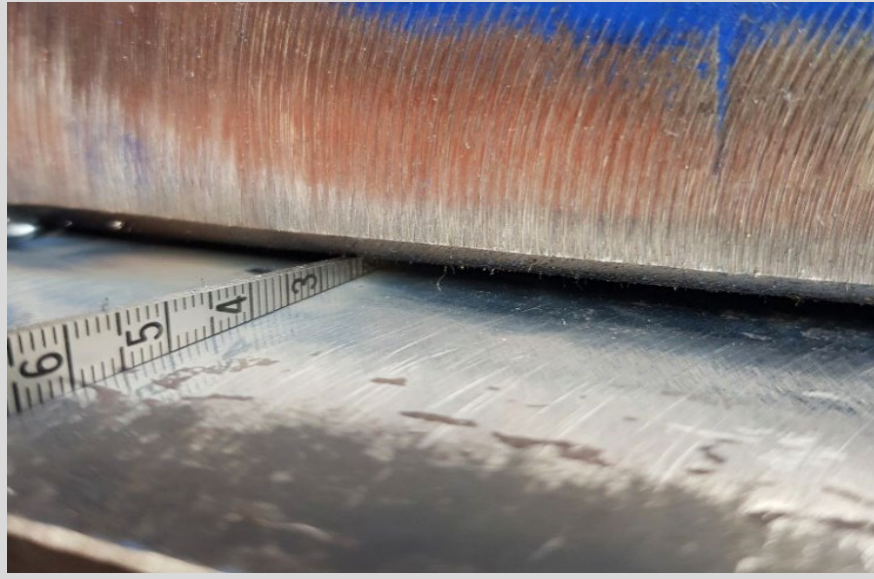
This Hold Point may take place at several stages during the fabrication process.

Transport and Main Roads – SCM unit can assist with this inspection if the Administrator is unsure of the technical requirements. A copy of the Engineering Drawings and the WPS are required to undertake this inspection.

**Figure 10.4.4.4(a) – Bevel angle on a butt weld preparation**



**Figure 10.4.4.4(b) – Root gap on a butt weld preparation**



#### **10.4.5 Stud welding**

Stud welding shall comply with the requirements of AS/NZS 1554.2.

Welded studs shall be bent to an angle of 30° with a strike of a hammer or with a pipe extension at the following intervals. Care shall be taken to ensure the bent angle does not interfere with any possible reinforcement.

- The first stud welded at the start of a shift.
- The first stud welded after a break of more than 20 minutes.
- 1 in 50 welded studs thereafter.

If a test fails, then the Fabricator shall make set up changes in accordance with AS/NZS 1554.2.

#### **10.4.6 Tack welding**

All tack welds shall comply with Clause 7.5.7 of AS/NZS 5131.

All tack welds shall have a suitable WPS which shall be made available to the Administrator if requested.

Any tack welding not incorporated into a finished weld shall be ground smooth.

#### **10.4.7 Completed welds**

##### **10.4.7.1 Quality of welds**

Permissible levels of imperfections for weld category SP and GP shall conform to AS/NZS 1554.1.

Permissible levels of imperfections for weld category FP shall conform to AS/NZS 1554.5

All surface finish of welds shall be prepared in accordance with Surface Treatment P3 of AS/NZS 5131.



### 10.4.7.2 Inspection of welding

No fewer than three business days **Milestone** prior to items being sent for protective coating, the Contractor shall notify the Administrator that the completed welds are ready for inspection.

The Fabricator shall ensure the welded items are positioned so they can be inspected; that is, stacking of items that restricts visibility of completed welds is not permitted. All welds shall pass a visual scan by the Administrator prior to coating. **Hold Point 5**

Additional testing, that is, non-destructive examination, shall be outlined on the Engineering Drawings, as required by Clause 10.4.7.3 or at the request of the Administrator.

Any minor welding defects identified shall be repaired prior to the application of the protective coating. Any suspected major welding defects shall be tested with a suitable non-destructive test.

The inspection in Clause 10.4.7.2 is to ensure the welds are the correct size and free from visible welding defects.

This Hold Point may take place at several stages during the fabrication process.

Transport and Main Roads – Structures Construction Materials unit can assist with this inspection if the Administrator is unsure of the technical requirements. A copy of the Engineering Drawings is required to undertake this inspection.

**Figure 10.4.7.2(a) – Fillet weld leg length**



The weld fillet gauge verifies the weld leg length is the correct size. Figure 10.4.7.2(a) shows the leg length on the vertical face is 8 mm (7.9 mm).

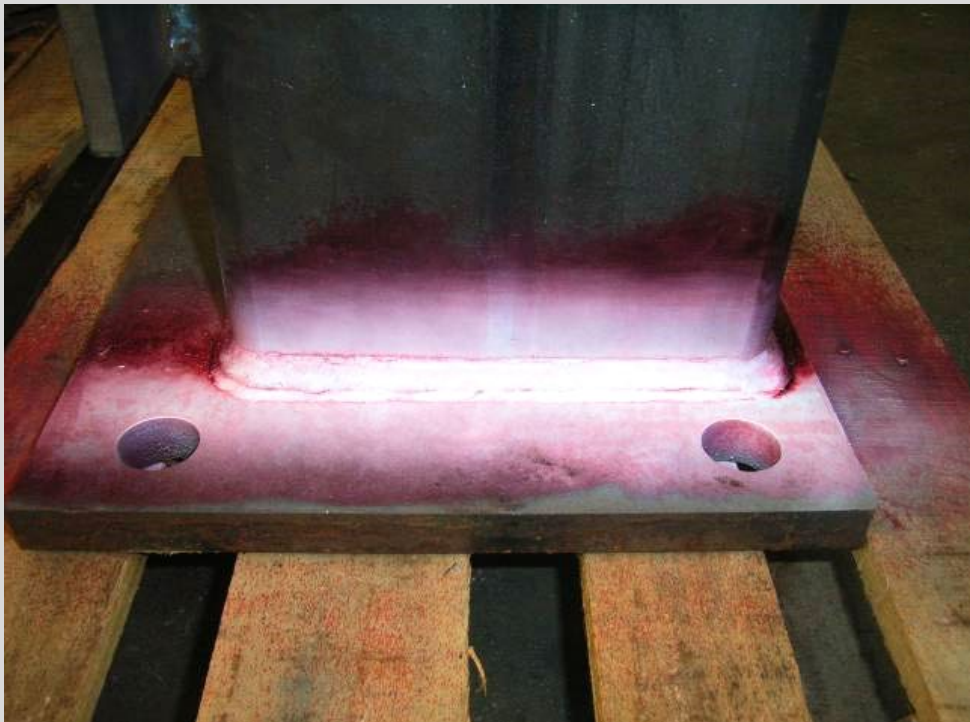
**Figure 10.4.7.2(b) – Fillet weld throat thickness**



The weld fillet gauge also verifies the weld throat thickness is the correct size. Figure 10.4.7.2(b) shows the throat thickness is compliant with the requirements of an 8 mm (7.9 mm) fillet weld.

A potential defect with stainless steel is lack of fusion. The use of dye penetrant testing can identify areas which have lack of fusion, refer to Figure 10.4.7.2(c).

**Figure 10.4.7.2(c) – Dye penetrant testing on a post**



**Figure 10.4.7.2(d) – Welding porosity**



Welding defects can include, but are not limited to, porosity and wormholes, Figure 10.4.7.2(d), and undercut, Figure 10.4.7.2(e).

**Figure 10.4.7.2(e) – Undercut in parent material**



### 10.4.7.3 Minimum non-destructive examination

In addition to the visual scanning, all fabricated steelwork shall comply with the non-destructive testing outlined in Table 10.4.7.3.

The minimum period of time required prior to any non-destructive testing being carried out shall be in accordance with Table 13.6.2.1 of AS/NZS 5131.

If the testing finds any defects found above those outlined in AS/NZS 1554.1, AS/NZS 1554.2, AS/NZS 1554.5 then 100% testing shall be carried out.

The amount of testing shall be taken as a percentage of the total fabricated steelwork and shall spread over all items being fabricated.

The Contractor shall submit the non-destructive testing reports for review. **Hold Point 6**

**Table 10.4.7.3 – Non-destructive testing requirements**

Product	Non-destructive testing	
	Ultrasonic testing	Magnetic particle testing
Truss bridges (including pedestrian and cycle)	50%	50%
Bridge girders to AS/NZS 3679 sections (with additional welded items)	50%	50%
Workshop fabricated girders	50%	50%
Over-road and cantilever gantries	50%	50%
Bus stations	50%	50%
Bridge traffic barriers	10% (base plate welds)	10% (base plate welds)
Anti-throw screen (or items of a similar type)	10% (base plate welds)	10% (base plate welds)
Pile liners (MRTS63 <i>Cast-In-Place Piles</i> and MRTS63A <i>Piles for Ancillary Structures</i> )	10%	
Pile tubes (MRTS64 <i>Driven Tubular Steel Piles (with reinforced concrete pile shaft)</i> )	50%	50%

### 10.4.8 Inspection of welding for fabrication outside Australia

No fewer than three business days, **Milestone** prior to items being transported to Australia, the Contractor shall notify the Administrator that the completed welds are ready for inspection.

The Fabricator shall ensure welded items are positioned so they can be inspected, that is, stacking of items that restricts the visibility of completed welds is not permitted. All welds shall pass a visual scan by the Administrator prior to coating. **Hold Point 5**

Any minor welding defects identified by the Inspector shall be repaired prior to the application of the protective coating. Any suspected major welding defects shall be tested with a suitable non-destructive test.

All fabricated products shall also be inspected by the Administrator in Queensland at a location nominated by the Administrator prior to the application of the protective coating. **Hold Point 7**

No fewer than three business days, **Milestone** notification by the Contractor shall be given to the Administrator once the products are available for inspection.

Any welding defects found either during the inspection or testing shall be repaired by a Transport and Main Roads registered fabricator prior to the application of the protective coating.

#### **10.4.8.1 Minimum non-destructive examination**

For the non-destructive testing requirements, refer to Clause 10.4.7.3 of this Technical Specification.

#### **10.4.9 Weld maps**

Once the welding has been completed, the Fabricator shall provide a weld map outlining the welding undertaken in the manufacture of the steel components.

The weld map shall outline, for each connection, the following:

- WPS number used
- welder's initials (or welder ID) and date welded, and
- nominated welding supervisor's initials (or welder ID) and date inspected.

The weld maps shall be submitted to the Administrator for approval prior to the steel product being released for protective coating. **Hold Point 8**

A table or legend shall be made available if requested to identify the welder's full name and corresponding initials or welder ID.

It is important to record which staff member welded a joint and which staff member checked that joint, as a part of the conformance documentation.

This **Hold Point** may take place at several stages during the fabrication process depending on the method the fabricator uses. The weld map template is reviewed during the supplier audit process.

Transport and Main Roads – SCM unit can assist with the review of this documentation if the Administrator is unsure of the technical requirements. A copy of the weld map, WPS and macro test results are required to undertake this review.

## **11 Protective coatings**

### **11.1 Abrasive blasting**

Abrasive blasting shall be carried out in accordance with Clauses 9.3 and 9.4 of AS/NZS 5131.

Either prior to tacking or prior to galvanising, all material with a silicon content less than 0.01% shall be abrasive blasted. Material traceability shall be established, where applicable, prior to abrasive blasting.

Abrasive blasting shall be carried out by a competent person. Blasting shall be dry abrasive cleaning. The material surface after blasting shall comply with Class Sa 2.5 as required by AS/NZS 4680.

The Contractor shall submit to the Administrator for review **Witness Point 2** an abrasive blasting report, stating:

- the original rust grade
- blast cleaning method used
- type and grade of abrasive used
- the class of preparation, and
- the surface profile.

## **11.2 Hot-dip galvanising**

All fabricated steelwork shall be hot-dip galvanised after fabrication.

Hot-dip galvanising is carried out on all departmental products to ensure the design life is met. Painting a product can only protect the outside of hollow section components.

### **11.2.1 Relevant Australian Standards**

Hot-dip galvanised structural steel shall comply with the requirements of AS/NZS 4680. Zinc coating thickness after galvanising shall comply with Table 1 and Table 2 of AS/NZS 4680.

### **11.2.2 Dressing of coating**

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.

### **11.2.3 Inspection of coating**

No fewer than three business days **Milestone** notice shall be given to the Administrator by the Contractor when a component is ready to be inspected for galvanising coating defects.

It is advisable for this inspection to be undertaken at the galvanising facility. If there are major concerns with the coating thickness readings or other galvanising defects, they may be repaired by the galvaniser. This may include stripping the coating off and re-dipping the items.

All steelwork shall be inspected for any defects and the coating thickness measured to ensure compliance with the tables above. **Hold Point 9**

Thickness measurements shall be carried out at positions not less than 10 mm away from edges, flame cut surfaces and corners.

In accordance with Note 7 in Clause 7 of AS/NZS 4680, items with wet storage stains (white rust) is not a cause for rejection.

An effective way of checking the coating thickness of a galvanised product is with a digital dry-film thickness gauge, refer to Figure 11.2.3(a) and Figure 11.2.3(b). The gauge uses an eddy current to determine the thickness of the galvanising.

**Figure 11.2.3(a) – Digital dry-film thickness gauge**



**Figure 11.2.3(b) – Digital dry-film thickness gauge**



Both material chemistry and the length of time an item is in the galvanising bath will affect the coating thickness. Refer to Clause 9.1.3.2 for information about silicon content.

Where possible it is important to check internal surfaces for adequate galvanising coating. Where there are insufficient vent and drainage holes often the internal services of hollow sections will not get coated, refer to Figure 11.2.3(c).

**Figure 11.2.3(c) – Insufficient venting and drainage**



#### **11.2.4 Repairs to hot-dip galvanising**

All repairs and damage to the galvanised coating shall be carried out in accordance with AS/NZS 4680.

Repairs shall be made using an approved inorganic zinc-rich paint or zinc stick. The use of zinc spray or silver spray is not permitted.

The internal surface of a hollow section, such as a bridge traffic barrier rail, shall be dressed to ensure the spigot or rail connector can be installed onsite.

It is important the appropriate repair methods are used, using a zinc spray coating or silver spray does not achieve the minimum coating thickness required by AS/NZS 4680.

In Figure 11.2.4, the coating reading taken on an area with zinc spray coating, shows a reading of 13  $\mu\text{m}$ , not the minimum of 75  $\mu\text{m}$  noted in AS/NZS 4680. One approved method is to apply two coats of Jotun Galvanite by brush.

**Figure 11.2.4 – Coating thickness reading on zinc spray**





### **11.3 Painting after hot-dip galvanising**

For paint systems which may be used after hot-dip galvanising, refer to *MRTS88 Protective Coating for New Work*.

Prior to painting, the galvanised surface shall be sweep blasted in accordance with Clause 9.11.2 of AS/NZS 5131.

## **12 Trial assembly, transportation and installation**

### **12.1 Trial assembly**

Where required by the Engineering Drawings, a trial assembly shall be carried out in the workshop. This is to:

- ensure the splice plates have no gaps
- ensure the camber is in accordance with the Engineering Drawings
- reduce site installation issues, or
- carry out the trial bolt tensioning procedure, refer to Clause 12.4.

### **12.2 Transportation**

All fabricated products shall be strapped during transportation using with an appropriate strapping material. The strapping shall not damage the coating surface during transportation.

Fabricated products which are transported on pallets shall use either galvanised strapping or plastic strapping. The use of black or painted strapping is not permitted.

### **12.3 Installation**

#### **12.3.1 Fasteners**

All fasteners shall be supplied in accordance with *MRTS278 Supply of Structural Fasteners*.

Unless otherwise shown on the Engineering Drawings, all fasteners shall be supplied with one bolt, one nut and one washer. The washer shall be placed under the nut prior to tightening. If the Engineering Drawings show a washer under the head of the bolt, then a second washer shall be supplied to ensure the nut also has a washer installed.

Fasteners shall be installed to ensure a minimum of three full threads are projecting above the top of the nut after assembly.

#### **12.4 Bolt tensioning**

Bolted connections which are classified as tension bearing (T/B) or tension friction (T/F) shall be torqued to achieve the appropriate tension for the bolt size. Where required by the bolt tensioning procedure, either a load indicating washer or direct tension indicating washer shall be included with the bolt assembly.

No fewer than five business days **Milestone** prior to the installation of the bolted members for a T/B or T/F connection, the Contractor shall supply the tensioning procedure to be used. Once the procedure has been Approved by the Administrator, the Contractor shall demonstrate the process using the equipment to be used during the installation. **Hold Point 10**

The trial installation shall demonstrate the equipment and the procedure is suitable to achieve the required tension in the bolts for the connection.

Technical Note TN62 *Assembly and tensioning of high strength bolts and nuts* can be used to develop the bolt tensioning procedure. It is important to have the correct equipment and a torque wrench with enough capacity to tension the bolts correctly.

It is recommended that all bolts are tightened with a calibrated torque wrench, an example is shown in Figure 12.4(a).

**Figure 12.4(a) – Pneumatic torque wrench**



The use of load indicating washers or direct tension indicating washers can assist in checking the bolt has been tightened enough. Feeler gauges are used to check the gaps left after the bolt is tensioned, refer to Figure 12.4(b).

**Figure 12.4(b) – Method of confirming correct torque applied**



