

SUPERSEDED

Technical Specification

**Transport and Main Roads Specifications
MRTS78A Fabrication of Structural Stainless Steelwork**

July 2017

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SUPERSEDED

1 Introduction

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

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.

Structural stainless steelwork shall be fabricated only by a fabricator which is registered by the Department of Transport and Main Roads.

For the requirements and information regarding registration of fabricators refer to the departmental website, www.tmr.qld.gov.au

2 Definition of terms

The terms defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* and used in this Technical Specification shall have the meaning as stated.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Reference documents

Reference	Title
AS/NZS 1167.2	<i>Welding and Brazing – Filler Metals – Filler Metal for Welding</i>
AS/NZS 1554.6	<i>Structural Steel Welding – Welding Stainless Steels for Structural Purposes</i>
AS/NZS 4854	<i>Welding Consumables – Covered Electrodes for Manual Metal Arc Welding of Stainless and Heat-Resisting Steels - Classification</i>
AS/NZS ISO 9001	<i>Quality Management Systems – Requirements</i>
ASTM A240	<i>Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications</i>
ASTM A276	<i>Standard Specification for Stainless Steel Bars and Shapes</i>
ASTM A312	<i>Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes</i>
ASTM A380	<i>Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems</i>
ASTM A554	<i>Standard Specification for Welded Stainless Steel Mechanical Tubing</i>
ASTM A789	<i>Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service</i>
BCM-P-011	<i>Registration Procedure: Approved Suppliers of Steel Fabricated Products</i>
ISO 3506	<i>Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners</i>
ISO 3834	<i>Quality requirements for fusion welding of metallic materials - Comprehensive quality requirements</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>

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 Specifications*.

The Hold Points and Witness Points applicable to this Technical Specification are summarised in Table 4.1. There are no Milestones defined.

An Administrators Checklist is available to aid administrators (Refer Appendix B) to ensure they are supplied with the correct information during the fabrication of steel structures.

Table 4.1 – Hold Points and Witness Points

Clause	Hold Point	Witness Point	Milestone
6	1. Verification of Welding Procedure Specification for all welded components		
7.1	2. Approval of Material test certificates	1. Testing of Steel	
7.3	3. Material test certificate for bolts		
8.7.4	4. Verification of butt weld preparation		
8.7.5	5. Supply of weld map		
8.7.6	6. Inspection of completed product		
8.8.5	7. Verification of butt weld preparation for welding outside Australia		
8.8.6	8. Supply of weld map for welding outside Australia		
8.8.7	9. Verification of completed product manufactured outside Australia		

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 Requirements
6	Welding Procedure Specification

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

Table 4.3 – Conformance requirements

Clause	Conformance requirements
10	Tolerances

These procedures are critical. Note the receipt of these procedures is often seen as a defacto approval. In every case a response should be made to the Contractor acknowledging receipt of the procedures.

5 Registered fabricator

5.1 Registered fabricator

Stainless steelwork shall only be fabricated by a registered fabricator. Registration will be reviewed periodically or earlier if unsatisfactory performance is reported. Information regarding approval status can be obtained from the departmental website, www.tmr.qld.gov.au

This section states all stainless steel fabrication shall be undertaken by a Transport and Main Roads Registered Fabricator. Bridge Construction, Maintenance and Asset Management unit is responsible for the approval of the fabricators on the Transport and Main Roads Registered Supplier List. It is recommended that before a Contract commences the Administrator obtains the current list of registered fabricators from the Transport and Main Roads website 'Approved Products and Registered Suppliers'.

5.1.1 Registered fabricator – in Australia

To be registered as a Fabricator of Stainless Steelwork for bridges and other structures, roadside furniture and poles, a fabricator in Australia 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 the fabricator is working as stated in their system, and
- b) Demonstrate technical conformance to MRTS78A.

5.1.2 Registered fabricator – outside Australia

To be registered as a Fabricator of Stainless Steelwork, a fabricator not in Australia 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 the fabricator is working as stated in their system and the system conforms to the requirements of the Transport and Main Roads contracts.
- b) Demonstrate technical conformance to MRTS78A. The technical capabilities shall be audited by an Auditor acceptable to the department. The Auditor shall ensure the fabricator is able to comply with the requirements of MRTS78A.

6 Welding procedure specification

The Contractor shall supply to the Administrator a copy of the Welding Procedure Specification (WPS) for the welding to be undertaken, in accordance with AS/NZS 1554.6 and a copy submitted to the Administrator.

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

Appendix A, Attachment 1 shows a typical WPS. The WPS outlines the way the welded joint needs to be prepared and the welding parameters for the placement of the welds.

The Administrator is required to ensure the WPS supplied by the fabricator reflects the welding the designer has specified on the engineering drawings. Bridge Construction, Maintenance and Asset Management unit can review the WPS if the Administrator is unsure of the technical requirements.

The Administrator is also responsible for the release of the Hold Point before fabrication commences.

7 Materials

7.1 Stainless steel plate and sections

Stainless steel shall comply with the requirements of the following standards:

- Flat Bar ASTM A276
- Round Bar ASTM A276
- Round Tube ASTM A312
- Square Tube ASTM A554
- Plate, Sheet & Coil ASTM A240
- Duplex Tube ASTM A789.

All stainless steel shall be Grade 316 (UNS S31600) or Grade 316L (UNS S31603). When specified on the engineering drawings, duplex stainless steel shall be Grade 2205. Material manufactured to other standards will be accepted provided the material comply with the appropriate ASTM standards.

For each shipment of stainless steel to be used in the fabrication of:

- a) bridge traffic barriers, safety barriers and pedestrian balustrades
- 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 stainless steel material test certificates, showing the chemical properties and results of all mechanical testing.

If material test certificates are not available then the Contractor shall submit to the Administrator for approval a proposal for selecting samples for testing of tensile strength and elongation, cold and temper bend tests and chemical analysis in accordance with the appropriate standard at no expense to the Principal. **Witness Point 1** Minimum testing requirements are 2% of each size and grade of product with a minimum sample size of one for each size and grade of the stainless steel. Stainless steel fabrication shall not commence until the Administrator has reviewed and approved the material test certificates or material testing as appropriate. **Hold Point 2**

All stainless steelwork used in the manufacture of structural stainless steelwork is required to comply with the American Society for Testing and Materials (ASTM) Standards. This section outlines the most commonly used ASTM standards used for the supply of stainless steel sections. If other ASTM Standards are used in the fabrication of a component, these standards will be outlined on the certified RPEQ engineering drawings.

This section also requires the Fabricator to supply the Administrator with the material test certificates for all material used in the fabrication of the stainless steelwork. This requirement was introduced as the Transport and Main Roads' Structures section found some stainless steel merchants were sourcing materials which did not comply with the requirements of the relevant standards.

The Administrator is required to verify the materials supplied to the fabricator match the material test certificates supplied for approval. To make verification of materials easier and ensure the correct materials have been supplied, the stainless steel manufactures are ink printing the material heat number on the member, which can be traced back to the material test certificates.

Figure 7.1(a) and Figure 7.1(b) show the heat number on a stainless steel plate which can be traced back to the material test certificate. The material test certificate shown in Appendix A, Attachment 2 and Attachment 3 matches the material supplied to the fabricator (shown in Figure 7.1(a) and Figure 7.1(b)).

This cross check is important, as on a number of occasions the material supplied to the fabricator has not matched the material test certificates submitted for approval. If there is no traceability between the material test certificates and the material supplied, we recommend the material is tested, as stated in Clause 7.1, by a NATA accredited test laboratory or is rejected.

Figure 7.1(a) – View of the heat number on the stainless steel plate



Figure 7.1(b) – View of the heat number on the stainless steel plate



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/NZS 1167.2 and / or AS/NZS 4854.

7.3 Stainless steel bolts, nuts and washers

Stainless steel bolts shall be Grade 316 (UNS S31600), nuts shall be Grade 304 (UNS S30400) A2-70 and washers shall be Grade 316 (UNS S31600) unless noted otherwise on the engineering drawings. All stainless steel bolts and nuts shall conform to the requirements of ISO 3506. Materials manufactured to other standards will be accepted provided the material comply with the appropriate ISO standard.

The bolt supplier shall supply the fabricator with a certified material test certificate outlining the chemical composition and mechanical properties of all bolts supplied. The test certificate shall be able to be traced back to the batch of bolts.

The material test certificates for each batch of bolts shall be reviewed and approved by the Administrator prior to being used. **Hold Point 3**

All bolts, nuts and washers shall be either electro polished or passivated in accordance with ASTM A380. Nuts shall be lubricated with a nickel based, anti-seize lubricant subject to the approval of the Administrator.

The anti-seize compound shall be serviceable up to 80°C and UV stable. Anti-seize compounds containing graphite or other elemental carbon shall not be used. (Note: some anti-seize compounds sold as marine grade contain graphite and are not suitable for use with stainless steel).

Bolts and nuts shall be tightened to the manufacturer's recommended torque using a torque wrench.

Stainless steel bolts and nuts shall have ISO coarse pitch metric rolled threads.

8 Fabrication

8.1 General

All structural stainless steel components shall be fabricated in accordance with AS/NZS 1554.6.

8.2 Handling and storage of stainless steel components

All stainless steelwork shall be undertaken in a separate building to carbon steel unless approved by the Administrator.

Stainless steel material shall not be stored in contact with carbon steel.

Tools used to fabricate or assemble stainless steel components shall be dedicated tools for stainless steelwork. Tools previously used on carbon steel shall not be used for stainless steelwork.

Stainless steel material shall be wrapped or otherwise protected during transport to avoid contamination. If an adhesive plastic film is used all traces of adhesive shall be removed from the steel with a suitable solvent.

Webbing slings shall be used in lifting stainless steel components and not chains. Grinding, cutting and welding shall not be carried out over open bundles of stainless steel components.

8.3 Cutting and edge preparation of stainless 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.

These edges then shall be trimmed back by 6 mm, to prepare the edge for welding.

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

Preparation of edges by oxy-acetylene cutting shall, wherever possible, be carried out by machine. All butt weld preparation shall be prepared by machining, grinding or plasma 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.

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 40 mm by drilling an 80 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.

8.4 Holes

All holes shall be finished accurately to size and in the position shown on the drawings. All holes 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 in material with a thickness greater than 10 mm shall be drilled.

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

8.5 Bending of plate

Bending of stainless 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.

8.6 Stainless steel cover plates

Stainless steel cover plates made from material of thickness 9 mm and below shall be fabricated from stainless steel with a Class 2B mill finish.

Stainless steel cover plates made from material of thickness 10 mm and above shall be fabricated from stainless steel with a HRAP (Hot Rolled, Annealed and Pickled) finish.

8.7 Welding

8.7.1 General

Welding shall be carried out in accordance with the provisions of AS/NZS 1554.6 except as amended by Clauses 8.7.2, 8.7.3 and 8.7.4.

8.7.2 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 of the requirements of Clause 4.12.1 of AS/NZS 1554.6.

All fabricators are required to have a welding supervisor who is responsible for the daily supervision of fabrication. In order for a fabricator to gain approval as a registered fabricator Transport and Main Roads' Structures section ensures all welding supervisors are competent to supervise the fabrication of works.

Therefore the Administrator's role is to ensure the welding supervisor is performing their role within the fabricator's organisation with the inspection of product.

8.7.3 Welding personnel

All welders shall satisfy conditions A and B of Clause 4.12.2 of AS/NZS 1554.6. All welding personnel require macro re-certification on a 12 monthly basis for each welding procedure specification undertaken on Transport and Main Roads projects.

All welding shall be undertaken by one of the following personnel:

- a) trade qualified welding personnel, or by welding personnel with a demonstrated competency equivalent to a trade qualified welder subject to approval by the Director (Bridge Construction, Maintenance and Asset Management), or

- b) fourth year apprentices subject to approval by the Director (Bridge Construction, Maintenance and Asset Management).

Second and third year apprentices may undertake fillet welds only subject to the approval by the Director (Bridge Construction, Maintenance and Asset Management).

Transport and Main Roads reserves the right to withdraw welder approval if welding is below the department's requirements.

8.7.4 Welding

Not less than three working days prior to any welding commencing on any butt weld joint, the Fabricator shall notify the Administrator the butt weld preparations are available for inspection. Welding shall not start until the Administrator has reviewed the butt weld preparations are prepared in accordance with the WPS and has released the hold point. **Hold Point 4**

This clause was added to the Technical Specification as some fabricators in the past were not preparing the butt weld in accordance with the WPS or drawing requirements. Some fabricators also did not understand the welding symbols or felt the joint did not require the weld specified. This problem has been greatly reduced with the implementation of the Registered Suppliers List.

When fabrication commences, the WPS are used to ensure the welded joint is prepared correctly and the welder is following the weld settings nominated on the WPS. Figure 8.7.4 shows the butt weld preparation for the attached WPS has been undertaken correctly.

Figure 8.7.4 – View of the butt weld preparation



Butt weld bevel angle needs to be inspected to ensure it is prepared in accordance with the WPS.

If the joint is not prepared in accordance with the procedure, then the Administrator has the right to reject the butt weld preparation and the fabricator will need to prepare the welded joint in accordance with the WPS.

When the welding is being undertaken and the welder operates outside the parameters outlined on the WPS, then the Administrator shall do one of the following:

- the welder shall change back to the welding settings outlined on the WPS, or
- all work shall cease and the welder shall undertake a macro test using the revised welding parameters.

If the Administrator is unsure of the requirements, it is recommended they contact Transport and Main Roads' Structures section.

8.7.5 Weld maps

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

- WPS 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 after all welding has been completed. **Hold Point 5**

It is critical all fabricated stainless steelwork is documented correctly. It is important to record which staff member welded a joint and which staff member checked a particular joint. This section outlines the requirements for the supply of the conformance documentation. This section is used to track product after the project is completed. This weld map will be used to validate which welding staff were used for the fabrication of product in the event of a structural failure.

8.7.6 Inspection of completed product

Not less than three working days after the completion of the fabrication of the stainless steel component, notify the Administrator the product is available for inspection.

The Administrator shall ensure, for all stainless steel fabricated product, the following inspections are undertaken: **Hold Point 6**

- a) 100% of all products shall be visually examined, and
- b) a minimum of 50% of all gantry structure and bridge structure butt welds shall be non destructively examined. If any welds are found to be defective then 100% of butt welds shall be non destructively examined.

Transport and Main Roads reserves the right to increase the minimum level of non destructive examination.

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

Once all the welding is completed it is recommended the welding is inspected to ensure the welds are the correct size and are free of weld defects. Figure 8.7.6(a) shows the way to inspect a fillet weld leg length. Figure 8.7.6(b) shows the way to inspect a fillet weld throat thickness.

Figure 8.7.6(a) – Fillet weld leg length



Method of inspecting the fillet weld leg length. This weld is the correct size as the weld fills the area of the gauge.

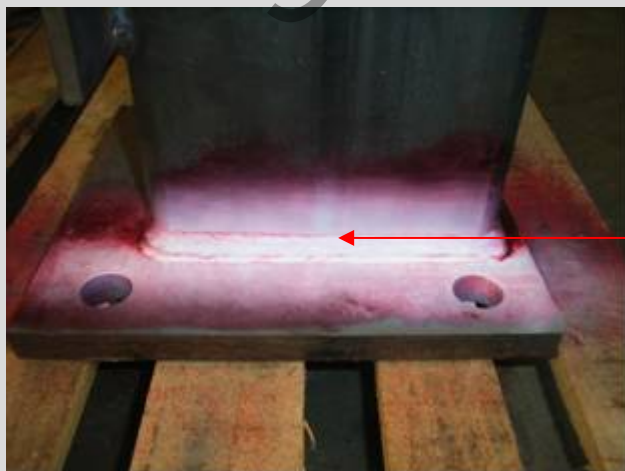
Figure 8.7.6(b) – Fillet weld throat thickness



Method of inspecting the fillet weld throat thickness. The weld should be in contact with the point shown.

If there is a concern the welding has a lack of fusion weld defect, it is recommended the weld is inspected using dye penetrant testing. The dye penetrant highlights any weld defects. Refer to Figure 8.7.6(c).

Figure 8.7.6(c) – View of the dye penetrant testing



Dye penetrant identifies the areas where the weld is not correctly fused to the member.

8.8 Welding undertaken outside Australia

8.8.1 General – outside Australia

All work shall be carried out in accordance with the provisions of AS/NZS 1554 except as amended by Clauses 8.8.2, 8.8.3 and 8.8.4.

8.8.2 Supervision of the overseas fabrication

For all stainless steel fabrication undertaken overseas, the functions of the Administrator may be carried out by a person nominated by the Administrator who, in the opinion of the Director (Bridge Construction, Maintenance and Asset Management), conforms to the following requirements:

- a) Clause 4.12.1 (a) of AS/NZS 1554.6, and
- b) has a culturally different background to the country undertaking the fabrication.

8.8.3 Welding supervisor – outside Australia

All work shall be carried out under the supervision of a welding supervisor who, in the opinion of the Administrator, shall conform to one of the requirements of Clause 4.12.1 (a) to (e) of AS/NZS 1554.6.

Only certain welding supervisors are permitted to undertake the supervision of welding.

8.8.4 Welding personnel – outside Australia

All welding personnel shall satisfy the conditions of Clause 4.12.2 of AS/NZS 1554.6. All welding personnel require macro re-qualification on a 12 monthly basis for each WPS undertaken on Transport and Main Roads projects.

All welding staff shall have a trade qualification, or demonstrate a competency equivalent to a trade qualification subject to the approval by the Director (Bridge Construction, Maintenance and Asset Management).

The department reserves the right to withdraw welder approval if welding is below the department's requirements.

To ensure the welding are personnel suitably qualified for the welding to be undertaken on Transport and Main Roads projects. Transport and Main Roads requires all Structural Purpose (SP) welding to be undertaken by a welder who has a trade qualification equivalent to an Australian trade qualification.

8.8.5 Welding – outside Australia

Prior to welding commencing on any butt weld joints the Fabricator shall notify the Administrator the butt weld preparations are available for inspection. Welding shall not start until the Administrator has reviewed the butt weld preparations are prepared in accordance with the WPS and released the hold point. **Hold Point 7**

Refer to Clause 8.7.4 Commentary

8.8.6 Weld maps – outside Australia

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

The weld map shall outline the following:

- WPS 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 prior to the inspection, stated in Clause 8.8.7, being carried out. **Hold Point 8**

Refer to Clause 8.7.5 Commentary

8.8.7 Inspection of completed product – outside Australia

All product supplied from an overseas fabricator shall be inspected by the Administrator in Australia at a location suitable to the department prior to the application of the protective coating. **Hold Point 9**

The Contractor shall be responsible for covering all the costs associated with carrying out the following inspection of the completed products:

- a) 100% of all products shall be visually examined, and
- b) a minimum of 50% of all welds shall be non destructively examined. If any welds are found to be defective then 100% of the welds shall be non destructively examined.

Transport and Main Roads reserves the right to increase the minimum level of non destructive examination.

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

9 Quality of welds

9.1 General

The heat input into the weld shall be limited. The weld shall not be preheated, post-heated or stress relieved.

The following conditions shall also apply:

- a) Grade 316L (Si) electrodes shall be used for Grade 316 and Grade 316L
- b) welds shall be Category 2B in accordance with AS/NZS 1554.6
- c) all welds shall be pickled and passivated after welding is completed except when pickling and passivating is excluded and where a specific coating treatment is included in the Contract, and
- d) the permissible levels of imperfections in all welds shall conform to AS/NZS 1554.6.

9.2 Member to be straight

9.2.1 All fabrication

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

9.2.2 Elements except bridge barrier

Straightening shall not be carried out by means of hammering or by heating unless the Administrator has given prior approval in writing. **Nonconformance** Following the straightening of a bend or buckle, the surface of the metal shall be visually inspected for evidence of any fracture.

10 Tolerance

10.1 General

Tolerances shall comply with the requirements of Clause 10.2 as applicable.

10.2 Fabricated Items

All stainless steel shall be constructed to the tolerances detailed in Table 10.2.

Table 10.2 – Tolerances for fabricated items

Location	Tolerance (mm)
Length of Member	± 2
Height of Post/Balustrade	± 2
Centre of Holes	± 2
Line of Plan Dimension	± 3

11 Coatings

Where a specific coating treatment is included in the Contract, that treatment shall be applied to the finished product.

Appendix A – Associated documents

Attachment 1 – Typical Welding Procedure Specification

WELDING PROCEDURE SPECIFICATION

Welding Code	AS.1554 - PT 6 - CAT 1B		WPS No.	SES - 37		Welding Processes	GMAW		Position	Horizontal	
Ref. PQR No.			Material Thickness (mm)	10 - 12		Joint Prep Qualified	✓		Base Material	ASTMA 310 GR 316L	
PreHeat Temp °C - Not required			PWHT	Not required		Join Material	ASTMA 310 GR 316L		Notes		
Minimum Temp °C	N/A		Hold Temp °C	N/A		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>• GAS FLOW SHIELD : 10-12 l/min</p> <p>• PRE GAS 1.2 SEC.</p> <p>• POST GAS 1.2 SEC.</p> </div> <div style="width: 45%;"> <p>• PULSE MIG SETTINGS N° 4</p> <p>• ARC LENGTH</p> <p>• WIRE SPEEDS</p> <p>• IMPEDANCE</p> </div> </div>					
Maximum Temp °C	150		Hold time (Hr)	N/A							
Interun											



Joint Detail Sketch

Run Number	Welding Process	Electrode Diameter	Electrode Class	Amps		Volts		Travel Speed (mm/min)	Current Type	Flux or Shield Gas	Arc Energy (kJ/mm)	
				Low	High	Low	High				Low	High
1	GMAW		316	240	26.3					LINDE		
2	GMAW		316	220	25.4		34 CM/MIN		DC-EN	CRACKON H20		
3	GMAW		316	222	25.4							

Notes:

Originator	Title	Manager	Date
LEIGH THORPE	Welding Procedure Specification		3-11-09

Attachment 3 – Material Test Certificate

INSPECTION CERTIFICATE 3.1		 COLUMBUS STAINLESS <small>Columbus Stainless (Pty) Ltd P.O. Box 111 Midburg, 5017 South Africa Branches: +27 (0) 31 911 111 Fax: +27 (0) 31 911 111 Website: www.columbusstainless.com A subsidiary of CERADORA, S.A.</small>		No. 1643559 - 1 / 1 Date: 09-Jul-2008 MANUFACTURER'S MARK  First of two lots HEATING PROCESS E/AOD Emission Purge																																																																																																																																																																																																																											
To: EN 10204		CUSTOMER (Name): MIDWAY METALS PTY LTD CNR ROM & BINARY STS YATALA, QUEENSLAND 4207 Australia		ORDER (Job) NO: EP07245 ORDER NO: 008 CUSTOMER ORDER No. (Customer's Ref): 2546 2347 MEDIA SPORTS (Reference)																																																																																																																																																																																																																											
PRODUCT (Designation): No 1 Finish		TREAT No. (Reference No.): 368834		INSPECTION No. 3688345/0																																																																																																																																																																																																																											
SPECIFICATION (Name): ASTM A240 / A140M-08 ASME SECT IIA, ED07 SA240		MATERIAL CODE (Name): 316L 316 316L 316		CLASS (Name): CCON51602																																																																																																																																																																																																																											
TOLERANCE: ASTM A480/A480M-08		Delivery Note Number: 799266		QUANTITY (Reference): 4 MASS (Gross): 2324 kg																																																																																																																																																																																																																											
DIMENSIONS (Reference): 16.000 mm x 1500 mm x 3000 mm		KEYNAME:		EVIDENCE:																																																																																																																																																																																																																											
CHEMICAL ANALYSIS (Certificate Reference) % ELEMENTS: C, S, P, Mn, Si, Ni, Cr, Mo, Ti, N, V, Co, Cu, Nb, Sn, Al, B			MECHANICAL PROPERTIES (Certificate Reference) Yield Strength (MPa), Tensile Strength (MPa), Elongation (%), Hardness (HRB), Impact (J), Grain Size, Heat Treatment																																																																																																																																																																																																																												
<table border="1"> <thead> <tr> <th rowspan="2">%</th> <th colspan="2">REQUIREMENT</th> <th rowspan="2">LAPSE (Normative)</th> <th rowspan="2">Test Direction</th> <th rowspan="2">Test No.</th> <th rowspan="2">Result (MPa)</th> <th rowspan="2">Elongation (%)</th> <th rowspan="2">Hardness (HRB)</th> <th rowspan="2">Impact (J)</th> <th rowspan="2">Grain Size</th> <th rowspan="2">Heat Treatment</th> </tr> <tr> <th>MIN</th> <th>MAX</th> </tr> </thead> <tbody> <tr> <td>C</td> <td></td> <td>0.030</td> <td>0.026</td> <td></td> <td></td> <td>206</td> <td></td> <td>581</td> <td>59.5</td> <td>77.2</td> <td></td> </tr> <tr> <td>S</td> <td></td> <td>0.030</td> <td>0.003</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>P</td> <td></td> <td>0.045</td> <td>0.025</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Mn</td> <td></td> <td>2.000</td> <td>1.420</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Si</td> <td></td> <td>0.750</td> <td>0.34</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Ni</td> <td>10.000</td> <td>14.000</td> <td>10.04</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cr</td> <td>16.000</td> <td>18.000</td> <td>16.74</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Mo</td> <td>2.000</td> <td>3.000</td> <td>2.037</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Ti</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>N</td> <td></td> <td>0.1000</td> <td>0.0432</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>V</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Co</td> <td></td> <td></td> <td>0.550</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Cu</td> <td></td> <td></td> <td>0.26</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Nb</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sn</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Al</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B</td> <td></td> <td></td> <td>0.0040</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			%	REQUIREMENT		LAPSE (Normative)	Test Direction	Test No.	Result (MPa)	Elongation (%)	Hardness (HRB)	Impact (J)	Grain Size	Heat Treatment	MIN	MAX	C		0.030	0.026			206		581	59.5	77.2		S		0.030	0.003									P		0.045	0.025									Mn		2.000	1.420									Si		0.750	0.34									Ni	10.000	14.000	10.04									Cr	16.000	18.000	16.74									Mo	2.000	3.000	2.037									Ti												N		0.1000	0.0432									V												Co			0.550									Cu			0.26									Nb												Sn												Al												B			0.0040									INTERANGULAR CORROSION (Certificate Reference) SPECIFICATION (Name): ASTM A162-91A-E RESULT (Reference): PASS		
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GRAIN SIZE: 1010 - 1100 HEAT TREATMENT (Certificate Reference): Anneal 1010 - 1100 AIR/SPRAY			The material is not to be used in applications where the maximum stress level for this material is not greater than the specified yield strength. The material is not to be used in applications where the maximum stress level is greater than the specified yield strength. The material is not to be used in applications where the maximum stress level is greater than the specified yield strength. The material is not to be used in applications where the maximum stress level is greater than the specified yield strength.																																																																																																																																																																																																																												
SCHEDULED STRUCTURES + FIXING PIPES TO CONCRETE - 58034			COLUMBUS STAINLESS (Pty) Ltd Hendrix Road, Midburg Mpumalanga, South Africa P.H. de Vos WORKS EXPERT																																																																																																																																																																																																																												

Appendix B – Administrators checklist

Table B1 – Administrator checklist

Hold Point Release	MRTS78A Clause Reference	Comment	Yes/No
Welding Procedure Specification (WPS)	Clause 6 Hold Point 1	The review of the Welding Procedure Specifications to ensure they correspond to the welding outlined on the drawings.	
Verification of Material Test Certificates	Clause 7.1 Hold Point 2	Ensure the material test certificates: <ul style="list-style-type: none"> • match the materials supplied • the grade of the materials match the grade specified on the drawings • the chemical composition is within the Specification of the ASTM standard • the Yield and Ultimate strength are within acceptable bounds as specified by the grade required • the elongation is above the minimum limit in the ASTM standard. 	
Verification of Standard Bolt Material Test Certificate	Clause 7.3 Hold Point 3	Ensure the material test certificate: <ul style="list-style-type: none"> • are traceable to the bolts supplied • the grade of the bolts match the grade specified on the drawings • the chemical composition is within the Specification of the ISO standard • the Yield and Ultimate strength are within acceptable bounds as specified by the grade required • the elongation is above the minimum limit in the ISO Standards. 	
Inspection of all butt weld preparations	Clause 8.7.4 Hold Point 4	The butt welds preparation is inspected prior to welding commencing.	
Weld Maps	Clause 8.7.5 Hold Point 5	The fabricator is responsible for providing a document which outlines the following: <ul style="list-style-type: none"> • which WPS was used • who welded each joint • who checked the welded joint. 	
Inspection of Completed Product	Clause 8.7.6 Hold Point 6	Product welded shall be inspected by the Administrator.	
Inspection of all butt weld preparations – Outside Australia	Clause 8.8.5 Hold Point 7	The butt welds are inspected prior to welding commencing.	
Weld Maps – Outside Australia	Clause 8.8.6 Hold Point 8	All documents have been supplied and approved by the Administrator and all Hold Points are released.	
Inspection of Completed Product – Outside Australia	Clause 8.8.7 Hold Point 9	Product welded outside Australia is inspected by the Administrator in Australia. All costs associated with the inspection are to be covered by the Contractor.	

SUPERSEDED