

Main Roads Technical Standard

MRTS71A

Stainless Steel Reinforcing

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Stainless Steel Reinforcing

1 INTRODUCTION

This Standard applies to the supply, fabrication and placing of stainless steel reinforcing bar used in concrete road and bridge structures.

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

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

The requirements for the supply, fabrication and placing of stainless steel reinforcing bar used in concrete road and bridge structures shall include the use of suppliers and products for the items listed in Table 1 that are registered by Transport and Main Roads.

Table 1 – Items Requiring Use of Registered Suppliers and Products

Clauses	Category of Work
5.1	Stainless Steel reinforcing.
8	Bar Chairs and Spacers

For information regarding registered suppliers and products for the above items refer to –

Queensland Department of Transport and Main Roads
Structures Division
GPO Box 1412
Brisbane Qld 4001

2 DEFINITION OF TERMS

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

3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this Technical Standard

Table 3 – Referenced Documents

Reference	Title
AS/NZS 1554.3	Structural steel welding - Welding of reinforcing steel
AS/NZS 1554.6	Structural steel welding - Welding stainless steels for structural purposes
BS 5499 Part 4	Splicing
BS 6744	Stainless steel bars for the reinforcement of and use in concrete. Requirements and test methods
BS 8666	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete.

4 QUALITY SYSTEM REQUIREMENTS

4.1 Hold Points, Witness Points and Milestones

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

The Hold Points, Witness Points and Milestones applicable to this Standard are summarised in Table 4.1.

Table 4.1 - Hold Points and Milestones

Clause	Hold Point	Milestone
5.1	1. Acceptance of supplier.	Submission of proposed supplier of stainless steel reinforcing (7 days).
5.2	2. Stainless steel reinforcing compliance.	
8	3. Approval of reinforcement placement	
11.2.2	4. Welding of test pieces for qualification of welders.	
11.3	5. Approval of welding process and consumables. 6. Approval of welding.	
12	7. Substitution of stainless steel reinforcing.	Proposal to substitute alternative reinforcement (4 weeks).

5 MATERIALS

5.1 Supply of Stainless Steel Reinforcing

Stainless steel reinforcing shall be manufactured, processed and supplied only by a registered steel reinforcing supplier (refer Clause 1) who is also a member of the Australian Stainless Steel Development Association.

To be eligible to be registered, a supplier shall –

- a) operate a quality system certified to a minimum of AS 9001; and
- b) have an inspection and test plan acceptable to the department for supply of stainless steel reinforcing which demonstrates compliance with this Standard.

At least 7 days before steel reinforcing is supplied, the Contractor shall submit to the Administrator the identity and address of the proposed supplier and evidence of conformance with this Clause. **Milestone**

Stainless steel reinforcing shall not be delivered to the Site until written acceptance of the proposed supplier has been obtained from the Administrator. **Hold Point 1**

5.2 Stainless Steel Reinforcing

Stainless steel reinforcement shall be solid ribbed bars conforming to –

- a) duplex grade 2205, and
- b) austenitic grades 304/304LN and 316/316LN.

The Contractor shall supply, to the Administrator, certified copies of the manufacture's test certificates identifiable with the reinforcement or provide documentary evidence that all products meet the requirements of BS 6744 and that the manufacturer has a system in place to prevent non conforming material from being supplied. **Hold Point 2** Where such certificates cannot be supplied, the Contractor shall arrange testing of reinforcement for tension, bending and ductility to BS 6744.

The number of bars to be tested shall be determined on the basis of one bar length for each 5 tonnes of reinforcement, or part thereof, for each size and grade of reinforcing bar used, with a minimum of 2 bar lengths per size and grade.

Test results shall be made available to the Administrator. The cost of this testing shall be borne by the Contractor.

6 HANDLING AND STORAGE OF STAINLESS STEEL BAR

- a) Stainless steel reinforcing bars shall be bundled and tied with stainless steel wire. Bundles shall be wrapped in polyethylene sheeting to avoid contamination from contact with carbon steel and other contaminants during transportation and storage; and

- b) On site, bundles shall be stored separately from carbon steel and shall be opened only as needed. Webbing slings shall be used for lifting and not chains. Grinding, cutting and welding shall not be carried out over open bundles of stainless steel. Additionally, tools and machinery used to process stainless steel reinforcing shall be made of hardened stainless steel or at least hard chromed tool steel. Hand tools, once used on carbon steel, shall not be used on stainless steel.

7 CUTTING AND BENDING

Bending and forming of stainless steel reinforcement shall be in accordance with BS 8666. Bending radii, shapes and lap lengths are all specified in BS8666.

Stainless steel reinforcing bar shall be fabricated to the shape and dimensions shown in the Drawings and within the following tolerances –

- a) On any overall dimension for bars except where used as a fitment –
- i) Length up to 600 mm - 25 mm, + 0;
 - ii) Length over 600 mm - 40 mm, + 0;
- b) On any overall dimension of bars or mesh used as a fitment –
- i) For deformed bars and mesh –
 - for deck and kerb units and girders ± 5 mm;
 - for other areas - 15 mm, + 0;
 - ii) For plain round bars –
 - for deck and kerb units ± 5 mm
 - for other areas - 10 mm, + 0;
- c) On the overall offset dimension of a cranked column bar - 0, + 10 mm.

If a reinforcing bar has been bent and subsequently bent in the reverse direction or straightened, it shall not be bent again within 20 bar diameters of the previous bend.

After cutting and bending, bars shall be bundled or stored in a manner which permits clear identification of their bending schedule mark.

8 PLACING AND FIXING

Stainless steel reinforcing shall be placed in position as shown in the Drawings. In the case of stainless steel reinforcing bar, the bars shall be tied together by wiring each intersection, using 1.6 mm diameter soft annealed Grade 316 stainless steel. Where the bar spacing is 300 mm or less, alternate intersections only need to be tied.

Clearance from forms shall be maintained by use of registered bar chairs (refer Clause 1). The shape of the chair shall be such that minimum obstruction is offered to the formation of the homogeneous concrete both within and around the chair. Tubular or cylindrical types shall not be used. Some bar chairs are suitable for soffit use only and shall not be used against side forms. Bar chairs shall have sufficient structural strength to support the weight of stainless steel reinforcing bars and workmen at temperatures experienced on the Site.

Use of plastic tipped metal chairs is banned for all locations other than those where there is no possibility of the tips of the feet of the chairs becoming exposed.

Precast mortar blocks shall not be used unless approved by the Administrator. Blocks manufactured from vibrated concrete of strength equivalent to that of the main concrete, and to a size and shape approved by the Administrator may be used. Such blocks shall have suitable fixing wires cast in.

Layers of bars shall be separated by means of registered bar spacers (refer Clause 1). Stirrups and ligatures shall pass around the main reinforcement and shall be securely tied to it.

The system of fixing shall be such as to form a rigid cage which maintains dimensional tolerances under loads experienced during handling and transport of cages and placement of concrete. Welding of stainless steel reinforcing to form a rigid cage shall comply with the following requirements –

- a) Welding shall be in accordance with the requirements of AS/NZS 1554.6. In particular, tack welds shall not substantially reduce the cross-section of the stainless steel reinforcing bar nor adversely affect its strength. Tack welding on bent portions of bars is permitted subject to the requirements of AS/NZS 1554.3 Clauses 3.3.

Tack welds shall –

- i) have a throat thickness not less than 4 mm;
 - ii) have a length not less than the diameter of the smaller bar; and
 - iii) be made using controlled hydrogen consumables,
- b) Splice welding shall not be carried out within a distance equal to two bar diameters of any portion of a bar which has been or shall be bent; and
- c) Not more than one-third of the main stainless steel reinforcing bars at any cross-section shall be so welded.

All stainless steel reinforcing in position shall be inspected and approved by the Administrator before placement of concrete is commenced. **Hold Point 3**

9 TOLERANCE ON POSITION OF STAINLESS STEEL REINFORCING

The deviation from the specified position of stainless steel reinforcing shall not exceed the following –

- a) For positions controlled by cover –
- | | |
|---|-------------------|
| i) in girders, beams, slabs and deck and kerb units | - 5 mm, + 10 mm; |
| ii) in slabs, columns and walls | - 5 mm, + 10 mm; |
| iii) in slabs-on-ground including footings of walls and culverts | - 10 mm, + 20 mm; |
| iv) in footings cast in the ground where the depth of the footing is 500 mm or more | - 20 mm, + 40 mm, |

where a positive value indicates the amount the cover increases and a negative value indicates the amount the cover decreases; and

- b) For positions not controlled by cover –
- | | |
|---|--------|
| i) the location of stainless steel reinforcing on a profile | 10 mm; |
| ii) the position of the ends of stainless steel reinforcing along the line of the bar | 50 mm; |
| iii) the spacing of bars in walls and slabs and of fitments in beams and columns – | |
| • 10% of the specified spacing; or | |
| • 15 mm, | |
| whichever is greater. | |

10 WELDING PROCEDURE SHEETS

No welding shall be carried out until a Welding Procedure Specification Sheet, in accordance with Appendix C of AS/NZS 1554.6 has been completed and a copy submitted to the Administrator. Welding shall not be carried out until the appropriate Welding Procedure Specification Sheet has been verified by the Administrator [**Refer Hold Point 5**].

11 SPLICING

11.1 General

Splicing of stainless steel reinforcing shall occur only in the locations shown in the Drawings, unless otherwise approved by the Administrator. Where practical, splices in stainless steel reinforcing bar shall be staggered.

Stainless steel reinforcing bar shall be anchored or lapped as for carbon steel reinforcement. The allowable bond stress may be determined using the guidance in BS 5499 Part 4 Type 2 deformed bars. Duplex Grades 2101, 2205, and austenitic grade 316LN only shall be used specified as ribbed bars.

11.2 Qualification of Welders

11.2.1 General

Welding personnel shall be qualified by one of the methods given below –

- a) The provisions of AS/NZS 1554.6 Clause 4.10.2; or
- b) Qualification by the Contractor.

11.2.2 Qualification by the Contractor

The Contractor shall arrange for testing of two test pieces for each welder proposed to be employed on the work. Each test piece shall be 300 mm long with a joint of the type proposed to be used at the centre.

Test pieces shall be prepared from the same size and grade of stainless steel reinforcing as that to be welded on the job. Welding of test pieces shall be carried out on the job, using the equipment and consumables to be used on the job, and using the least advantageous welding position likely to be experienced in the works. The Contractor shall provide all information regarding the welding of test pieces requested by the Administrator.

The welding of all test pieces shall be carried out in the presence of the Administrator. **Hold Point 4**

One test piece shall be tested in tension. The tensile test piece when ruptured under tensile load shall have an ultimate strength at least equal to that of the parent metal. The other test piece shall be tested in bending as described in AS/NZS 1554.6 and shall pass the requirements of this test.

Testing shall be conducted by a laboratory registered by NATA for the test.

In the event of failure of any of the test pieces to meet the above requirements, four further test pieces shall be made and tested. Two of the test pieces shall be tested in tension and the remaining two in bending. Should any of the re-tests fail, the welder shall be deemed to have failed the test and shall not be eligible for Qualification under this clause.

11.3 Splicing by Welding

Welding adjacent to or above any prestressing bar or strand (stressed or unstressed) shall not be permitted without special precautions to protect all prestressing from welding splatter. Protection arrangements shall be verified by the Administrator **[Refer Hold Point 5]**.

Welding of stainless steel reinforcing shall conform to the requirements of Australian Standard AS/NZS 1554.6. Electrode and filler metal selection is defined in Section 2 of AS/NZS 1554.6.

Splicing of steel reinforcing bar by welding shall be permitted only where specified or where approved by the Administrator. The process and consumables shall be approved by the Administrator. **Hold Point 5**

Surface finishing after welding of stainless steel reinforcement shall conform to Table 11.3.

The Administrator will approve the welding.

Placement of the reinforcement within the concrete formwork shall not proceed until the Administrator has approved all splice welds. **Hold Point 6**

Table 11.3 – Summary of Welding Requirements for Stainless Steel Reinforcing Bars

Grade of Material to be Welded	Electrode Grade	Surface Finish #
Gr. 304/304LN	E308L	Acid pickling and passivation or finishing. Grade 2 [a] and [c]
Gr. 316/316LN	E316L E309 – stainless to carbon welds	As above
UNS S31803	2209	As above. Refer Note A

Refer AS/NZS 1554.6: Section 6. Table 6.2.1 Grade finish (a) & (c).

NOTE A: The welding of duplex steels is more complex than for the 304/316 austenitic Grades. Special 2205 type consumables (type 2209) shall be used with controlled energy input and interpass temperatures to maintain the strength and corrosion resistance of the parent material.

12 SUBSTITUTION OF REINFORCEMENT

Substitution of different sizes of stainless steel reinforcing shall not be made unless approved in writing by the Administrator. The application shall be forwarded at least 4 weeks prior to the date on which the stainless steel reinforcing is required to be placed **Milestone**. Substitution shall be permitted only if the structure is not adversely affected by the change. **Hold Point 7** No additional payment shall be made on account of any approved substitution.