

Superseded

Technical Specification

**Transport and Main Roads Specifications
MRTS71A Stainless Steel Reinforcing**

November 2018

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Contents

- 1 Introduction 1**
- 1.1 Registered products and suppliers 1
- 2 Definition of terms 1**
- 3 Referenced documents 1**
- 4 Standard test methods 2**
- 5 Quality system requirements 2**
- 5.1 Hold Points, Witness Points and Milestones 2
- 6 Materials 3**
- 6.1 Supply of stainless steel reinforcing 3
- 6.2 Stainless steel reinforcement..... 4
- 7 Handling and storage of stainless steel bar 4**
- 8 Cutting and bending 4**
- 8.1 Bending 5
- 8.2 Cutting 5
- 8.3 Tolerances 5
- 9 Surface condition of steel reinforcement 5**
- 10 Placing and fixing 6**
- 11 Splicing of reinforcement 6**
- 11.1 General 6
- 11.2 Splice welding 6
- 11.3 Mechanical reinforcing bar splices 7
 - 11.3.1 Mechanical reinforcing bar splice properties 7
 - 11.3.2 Installation and use 7
- 12 Tolerance on position of stainless steel reinforcing 7**
- 13 Substitutions 8**
- 14 Welding 8**
- 14.1 General 8
- 14.2 Welding procedure sheets 8
 - 14.2.1 Welding consumables and surface finish 9
- 14.3 Welding Supervisor 9
- 14.4 Locational tack welding of reinforcement 9
 - 14.4.1 Welding staff – tack welding 9
- 14.5 Splice welding 9
 - 14.5.1 Welding staff – Splice welding 9
- 15 Prefabrication of reinforcing cages 10**
- 15.1 Provision for lifting of cages 10
- 15.2 Labelling cages 10
- 15.3 Inspection of cages fabricated outside of Australia 10
- 16 Electrical conductivity 10**

1 Introduction

This specification applies to the supply, fabrication and placement of stainless steel reinforcing bar used in concrete road, marine and bridge structures, and all other incidental concrete construction.

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.

1.1 Registered products and suppliers

The requirements for the supply and placement of stainless steel reinforcement include the use of registered products and suppliers. For information regarding these products and suppliers refer to the department's website, www.tmr.qld.gov.au or email TMRStructuralMaterials@tmr.qld.gov.au.

Items requiring registration include:

- supply and processing of stainless steel reinforcement, and
- mechanical reinforcing bar splices.

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 |
|-------------|---|
| CARES | Certification Authority for Reinforcing Steels. A UK-based certification body. |
| Designer | RPEQ Certified Engineer responsible for the design of the reinforcement cage or structure. |
| Fabrication | The process of assembling reinforcement or a reinforcing cage, such work may include tying, bending, welding and cutting of reinforcement. |
| Processing | Any process which significantly changes the shape and properties of the reinforcing steel. Processing may include cold-rolling, cold-drawing, de-coiling and straightening (including assembly into spiral cages), and automatic electric-resistance welding (adapted from AS/NZS 4671 (2001) Clause 3.20). |
| Small Cages | A reinforcing cage smaller than the limits defining a large cage. |
| Large Cages | A reinforcing cage with either a mass exceeding 500 kg or a length in any direction exceeding 4 m. |

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

| Reference | Title |
|---------------|--|
| AS/NZS 1554.3 | <i>Structural steel welding - Welding of reinforcing steel</i> |

| Reference | Title |
|--------------------|--|
| AS/NZS 1554.6 | <i>Structural steel welding - Welding stainless steels for structural purposes</i> |
| AS/NZS 4671 | <i>Steel reinforcing materials</i> |
| AS/NZS ISO 9001 | <i>Quality management systems - Requirements</i> |
| BS 6744 | <i>Stainless steel bars for the reinforcement of and use in concrete. Requirements and test methods.</i> |
| BS EN 10088-1 | <i>Stainless steels - List of stainless steels</i> |
| ISO 15835-1 (2009) | <i>Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 1: Requirements</i> |
| ISO 15835-2 (2009) | <i>Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 2: Test Methods</i> |
| MRTS01 | <i>Introduction to Technical Specifications</i> |
| MRTS50 | <i>Specific Quality System Requirements</i> |
| MRTS63 | <i>Cast-In-Place Piles</i> |
| MRTS70 | <i>Concrete</i> |
| SCM-P-015 | <i>Registration Scheme: Suppliers and Products for Bridges and Other Structures</i> |
| SD1043 | <i>Reinforcing steel – Standard bar shapes typical details and notes – Drawings 1 of 4 to 4 of 4</i> |
| SD1044 | <i>Reinforcing steel – Lap lengths</i> |

4 Standard test methods

The standard test methods stated in Table 4 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.

Table 4 – Standard test methods

| Property to be Tested | Test No. |
|---|------------------------|
| Tensile strength of mechanical bar couplers | ISO 15835-2 Clause 5.3 |
| Slip in mechanical bar couplers | ISO 15835-2 Clause 5.4 |

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.

For Transport and Main Roads registered precasters only, Hold Point 3 shall be a mandatory Hold Point in the supplier's Quality Management System and a Witness Point for the Administrator.

Table 5.1 – Hold Points, Witness Points and Milestones

| Clause | Hold Point | Witness Point | Milestone |
|--------|---|-------------------------------------|---|
| 6.1 | 1. Acceptance of supplier | | Submission of proposed supplier of stainless steel reinforcing (7 days) |
| 6.2 | 2. Stainless steel reinforcing compliance | | |
| 10 | 3. Approval of reinforcement placement | 1. As per Hold Point (precast only) | |
| 11.3 | 4. Approval of mechanical reinforcing bar splices | | |
| 11.3.2 | | 2. Assembly of mechanical splices | |
| 13 | 5. Substitution of stainless steel reinforcing | | Proposal to substitute alternative reinforcement (3 weeks) |
| 14.2 | 6. Approval of welding process and consumables | | |
| 14.5 | 7. Approval of splice welds | | |
| 15.1 | 8. Certification of lifting design | | |
| 15.3 | 9. Inspection of prefabricated cages | | |
| 16 | 10. Submission of conductivity results | | |

6 Materials

Stainless steel reinforcement shall be sourced from a supplier registered in accordance with Registration Scheme: Suppliers and Products for Bridges and Other Structures. Reinforcing materials, and associated test certificates shall comply with Clause 6.2.

6.1 Supply of stainless steel reinforcing

Stainless steel reinforcement shall be manufactured, processed and bent only by a registered supplier.

At least seven 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 reinforcement shall not be delivered to the Site until written acceptance of the proposed supplier and processor has been obtained from the Administrator. **Hold Point 1**

Distributors who do not bend or process the reinforcement do not need to be registered provided the steel is sourced from a registered supplier and full traceability is maintained.

6.2 Stainless steel reinforcement

Reinforcement shall comply with BS 6744 and be supplied as solid ribbed bars of the following designations:

- a) duplex grade 2205
- b) duplex grade 2304, or
- c) austenitic grade 316/316L.

BS 6744 uses different steel designations from BS EN 10088-1. Equivalence is not 1:1, but for ease of use:

- Duplex 2205 ≡ (is equivalent to) 1.4462
- 316/316L ≡ 1.4436
- Duplex 2304 ≡ 1.4362

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. **Hold Point 2**

"Documentary evidence" may include third party certification, such as that from CARES.

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 five tonnes of reinforcement, or part thereof, for each size and grade of reinforcing bar used, with a minimum of two 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.

7 Handling and storage of stainless steel bar

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. The stacking method shall ensure that the reinforcement is not bent, kinked or damaged.

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. Tools, once used on carbon steel, shall not be used on stainless steel.

8 Cutting and bending

Stainless steel reinforcing bar shall only be bent by a registered supplier.

Welded reinforcing mesh shipped in rolls shall be straightened into flat sheets before use.

8.1 Bending

Stainless steel reinforcing bar shall be free of kinks or other unwanted deformation, and shall be cut to length, and bent in accordance with the Drawings.

Reinforcing bar shall be cold bent by the application of a consistent force around a circular pin.

All bends shall be made in accordance with the shapes and dimensions shown on Standard Drawings 1043 and 1044, unless shown otherwise on the Drawings.

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

Hot bending is not permitted.

8.2 Cutting

After cutting, bars shall be bundled or stored in a manner which permits clear identification of the bar marks.

8.3 Tolerances

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 - 15 mm, + 0
- c) For all precast/prestressed concrete - 5 mm, + 5 mm
- d) On the overall offset dimension of a cranked column bar - 0, + 10 mm
- e) For the sawn or machined end of a straight bar intended for use as an end-bearing splice, the angular deviation from square measured in relation to the end 300 mm of the bar shall be within 2°.

For situations requiring tolerances tighter than those outlined above the contractor shall specify the required tolerance limits when sourcing the reinforcement.

In all cases the required cover to formwork and other surfaces shall be maintained.

9 Surface condition of steel reinforcement

The surface condition of stainless steel reinforcement shall comply with the following requirements:

- a) At the time concrete is placed, stainless steel reinforcement shall be free from mud, oil, grease, paint, and other coatings.
- b) Any stainless steel reinforcement projecting from a previous concreting operation shall be cleaned free of adhering concrete or slurry prior to any further embedment.

- c) Any stainless steel reinforcement placed within 1 km of the coastline shall be thoroughly washed with a high pressure potable water jet immediately prior to pouring concrete to remove any salts deposited during storage and placement.
- d) Stainless steel reinforcement which has been accidentally submerged by tidal or flood waters shall be cleaned with a high pressure potable water jet prior to pouring concrete.
- e) With the exception of cast-in-place piles (refer MRTS63), construction or placement of reinforcing cages in tidal water, or submerged in standing fresh or salt water shall not be permitted.

10 Placing and fixing

Stainless steel reinforcing shall be placed in position as shown in the Drawings. Bars shall be tied together by wiring each intersection. Where the bar spacing is 300 mm or less, only alternate intersections need to be tied. Wire shall be soft annealed Grade 316 or Duplex 2304 stainless steel with diameter no less than 1.55 mm.

Clearance from forms, and between layers of bars, shall be maintained by use of registered bar chairs or stainless steel nibs / spacers in accordance with MRTS70. Wire ties embedded in bar chairs and nibs shall be Grade 316 or Duplex 2304 stainless steel.

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. All stainless steel reinforcing in position shall be inspected and approved by the Administrator before placement of concrete is commenced. **Hold Point 3 Witness Point 1**

As per Clause 5 this Hold Point is a Witness Point in reference to precasters but must be considered as a Hold Point (for internal sign off) in the precasters inspection and test plan.

11 Splicing of reinforcement

11.1 General

Splicing of stainless steel reinforcing bar shall occur only in the locations shown in the Drawings, unless otherwise approved by the Administrator. Where practical, splices in steel reinforcing bar shall be staggered. Where splices cannot be staggered, the splices lap length shall be increased by 1.3 times the standard lap length.

Where an unscheduled splice occurs or where the length is not shown in the drawings, the length of the lap splice shall be as shown on Standard Drawing 1044. All stainless steel reinforcement shall be spliced in such a manner as to maintain specified clear cover to the surface of the concrete.

Welded reinforcing mesh shall be lap spliced only. Splicing of welded reinforcing mesh shall be achieved by the two outermost transverse bars of one sheet of mesh overlapping the two outermost transverse bars of the sheet being lapped.

Locational tack welding of spliced bar shall comply with Clause 14.4.

11.2 Splice welding

Splicing by welding shall be permitted using the procedures described in Clause 14.5.

11.3 Mechanical reinforcing bar splices

Mechanical reinforcing bar splices shall be registered proprietary products used for splicing stainless steel reinforcing bar and be manufactured from stainless steel.

Mechanical reinforcing bar splices shall be of either of the following types:

- a) mechanically gripped to the end of a stainless steel reinforcing bar by swaging or clamping with screws, or
- b) connected to a stainless steel reinforcing bar with a thread.

Mechanical reinforcing bar splices shall connect two reinforcing bars on a single axis.

Substitution of couplers listed on the Drawings shall not be made without prior approval of the Administrator. **Hold Point 4**

Each coupler shall be legibly and durably marked (e.g. hard stamped) with the identification of the manufacturer, the nominal bar size for which it is intended, and a batch mark for traceability purposes. Each coupler shall be traceable back to its production data.

The reinforcing coupler types listed further restrict the definition in ISO 15835 to exclude, for example, the use of adhesives to bond the joint together.

11.3.1 Mechanical reinforcing bar splice properties

The mechanical reinforcing bar splice shall be tested in accordance with ISO 15835-2, or approved equivalent, and exhibit:

- a) a tensile strength of not less than 1.08 times the nominal specified yield stress of the weaker bar at the splice, and
- b) a total slip of no more than 0.10 mm.

The ductility of the spliced bars shall conform to the requirements of ISO 15835-1 Clause 5.2.3.

Testing for compliance shall be undertaken at a NATA accredited laboratory.

11.3.2 Installation and use

Mechanical reinforcing bar splices shall be installed where shown on the Drawings. Prior to attaching bars with a mechanical reinforcing bar splice, all bar ends shall be thoroughly cleaned. Bars shall be completely engaged and the joint assembled and tightened or locked in accordance with the manufacturer's instructions. **Witness Point 2**

Unless supplied with a threaded coupling bar installed, the mechanical reinforcing bar splice shall be fitted with a plastic plug to protect the thread.

As constructed drawings shall be marked up to show the type used and the location of the mechanical reinforcing bar splice.

12 Tolerance on position of stainless steel reinforcing

The deviation from the specified position of steel reinforcement shall not exceed the following stated tolerances. A positive value indicates the amount of cover increases, and a negative value indicates the amount the cover decreases.

- a) For positions controlled by cover:
- in girders, beams, slabs, and deck and kerb units - 5 mm, + 10 mm
 - in slabs, columns and walls - 5 mm, + 10 mm
 - in slabs-on-ground including footings of walls and culverts - 10 mm, + 20 mm
 - in footings cast in the ground where the depth of the footing is 500 mm or more
- 10 mm, + 40 mm.
- b) For positions not controlled by cover:
- the location of steel reinforcement on a profile ± 10 mm
 - the position of the ends of steel reinforcement along the line of the bar ± 50 mm
 - the spacing of bars in walls and slabs, and of fitments, the greater of:
 - i. 10% of the specified spacing, and
 - ii. 15 mm.

13 Substitutions

Substitution of different sizes or steel designation of stainless steel reinforcing shall not be made unless approved in writing by the Administrator. The application shall be forwarded at least 3 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. Substitution shall not proceed until the Administrator has approved the change. **Hold Point 5**

No additional payment shall be made on account of any approved substitution.

14 Welding

14.1 General

Where stainless steel reinforcement is to be welded, the welding shall be conducted in accordance with the provisions of AS/NZS 1554.3, AS/NZS 1554.6 and the following requirements.

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 spatter. Protection arrangements shall be approved by the Administrator.

With the exception of locational tack welding on small reinforcing cages reinforcing mesh shall not be welded.

Where AS/NZS 1554.3 and AS/NZS 1554.6 refer to "principal" this shall be understood as the Administrator.

14.2 Welding procedure sheets

No welding shall be carried out until a Welding Procedure Specification, 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 has been approved by the Administrator. **Hold Point 6**

14.2.1 Welding consumables and surface finish

Welding consumables shall be compatible with the parent metal and shall be classified and identified in accordance with the provisions of AS/NZS 1554.6 Table 4.6.1. When welding consumables are specified on the Certified Engineering Drawings, the welding consumables on the Drawings take precedent.

14.3 Welding Supervisor

All work shall be carried out under the supervision of a welding supervisor who shall conform to Clause 4.12.1 of AS/NZS 1554.6.

14.4 Locational tack welding of reinforcement

Locational tack welding shall comply with AS/NZS 1554.3 Clause 3.3 and shall:

- a) not substantially reduce the cross-section of the stainless steel reinforcing bar nor adversely affect its strength
- b) have a throat thickness not less than 4 mm, and
- c) have a length not less than the diameter of the smaller bar.

Non-hydrogen controlled consumables may be used provided yearly qualification tests in accordance with AS/NZS 1554.3 have been completed and their use is not excluded by the drawing notes or other specification requirements.

Not more than one third of the main steel reinforcing bars at any cross section shall be tack welded.

14.4.1 Welding staff – tack welding

All welders shall satisfy Clause 4.12.2.1 of AS/NZS 1554.3.

The remainder of Clause 4.12.2 of AS/NZS 1554.3 does not apply to the qualification of welders for location tack welding.

14.5 Splice welding

Splicing of steel reinforcing bar by welding shall comply with AS/NZS 1554.3 and AS/NZS 1554.6 and be permitted only where shown in the RPEQ certified “for construction” drawings or where approved by the Administrator.

Splices shall be made by direct butt or double-lap welds. Butt welds shall be qualified complete penetration butt joints in accordance with AS/NZS 1554.6.

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 will be bent.

Placement of the reinforcement within the concrete formwork shall not proceed until the Administrator has inspected and approved all splice welds. **Hold Point 7**

14.5.1 Welding staff – Splice welding

All welders shall satisfy Clause 4.12.2 of AS/NZS 1554.6 and be requalified on a twelve monthly basis.

All qualification testing shall be conducted by a laboratory accredited by NATA for the tests.

Clause 4.12.2.1 of AS/NZS 1554.6 sets down requirements for evidence and particulars to be submitted and the consequences for non-conforming welding.

15 Prefabrication of reinforcing cages

Reinforcing cages fabricated or assembled out of position and subsequently lifted into position shall comply with the requirements of this technical specification and the following additional requirements.

15.1 Provision for lifting of cages

All reinforcing cages which are required to be lifted or transported into position, shall have dedicated lifting points incorporated into the cage to permit such lifting. Lifting points shall be clearly identifiable on all cages.

Lifting points not subject to design stresses shall be welded in accordance with AS/NZS 1554.3 Clause 3.3.

For large cages, an RPEQ engineer certified drawing which clearly shows the location and capacity of all lifting points and the location of all welding to ensure the reinforcing cage remains rigid during lifting and handling must be submitted to the Administrator prior to the lifting of the reinforcing cage.

Hold Point 8

All components of lifting forces should be considered.

15.2 Labelling cages

All reinforcing cages shall be identified with the following information, either by tagging or a combination of labels, schedules and drawings:

- a) fabricator's name
- b) date of manufacture
- c) drawing reference
- d) mass of cage, and
- e) for large cages, colour and location of dedicated lifting points.

For cages fabricated on site this information need not be written out on every cage. A visual inspection, with accompanying documentation, should be able to discern the above information.

15.3 Inspection of cages fabricated outside of Australia

All cages fabricated outside of Australia shall be visually inspected by the Administrator in Australia at a location acceptable to the department prior to placing all steel reinforcement in position.

Hold Point 9

The supplier shall be responsible for covering all costs involved.

16 Electrical conductivity

If electrical conductivity is specified in the Drawings, it shall be demonstrated to the satisfaction of the Administrator by means of test results prior to placement of concrete. **Hold Point 10**

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