Department of Transport and Main Roads

Technical Specification

Transport and Main Roads Specifications MRTS71 Reinforcing Steel

July 2025

(ATS 5310 Supply and Placement of Steel for the Reinforcement of Concrete, Ed 1.0 June 2020)

Queensland Government

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About this document

The document adopts and modifies Austroads Technical Specification ATS 5310 *Supply and Placement of Steel for the Reinforcement of Concrete* as part of national harmonisation. It sets out the requirements for the supply and placement of reinforcing steel.

How to use this document

This document includes the national guidance and Queensland-specific advice while following the structure established in Austroads Technical Specifications.

Queensland-specific advice includes practices which vary from national practice because of local environmental conditions (such as geography, soil types, climate); different funding practices; local research; local legislation requirements; and to expand instruction on particular issues.

This document:

- sets out how the Austroads Technical Specification ATS 5310 *Supply and Placement of Steel for the Reinforcement of Concrete* applies in Queensland
- has precedence over the Austroads Technical Specification ATS 5310 *Supply and Placement of Steel for the Reinforcement of Concrete* when applied in Queensland
- has the same clause numbering and headings as the Austroads Technical Specification ATS 5310 *Supply and Placement of Steel for the Reinforcement of Concrete*.

Transport and Mains Roads provides an ancillary document which outlines adopted national and modified Queensland-specific content with tracked changes. To access a copy click on the below link: Ancillary documents for harmonised Technical Specifications.

Terminology

The following general amended definitions apply when reading this document.

Reference to…	Means
Shall	Denotes mandatory requirements.
Must	Denotes mandatory requirements.
Principal	The State of Queensland acting through the Department of Transport and Main Roads.
Administrator	The Administrator will be responsible for the overall administration of this Contract.

Contents

1 Scope

1.1 This Technical Specification sets out the requirements for the supply, fabrication, handling and placement of steel used for the reinforcement of concrete ('reinforcing steel'). Two types of reinforcing steel are covered:

a) carbon reinforcing steel, as described in AS/NZS 4671, and

b) stainless reinforcing steel, as described in BS 6744.

1.2 The reinforcing steel must be supplied and installed in accordance with the drawings, AS 5100.5 and this Technical Specification.

1.3 This Technical Specification applies to the supply, fabrication and placement of steel (including stainless steel) reinforcement used in concrete road, marine and bridge structures, and all other incidental concrete construction.

1.4 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.

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

Glass fibre Reinforced Polymer (GFRP) reinforcement is covered by MRTS271 *Glass Fibre Reinforced Polymer (GFRP) Reinforcement*.

2 Definitions

2.1 In addition to the definitions set out in AS/NZS 4671, AS 5100.5 and in Clause 2 of MRTS01 *Introduction to Technical Specifications*, Table 2.1 definitions apply to this Technical Specification.

Table 2.1 – Definition of terms

Term	Definition
ACRS	Australasian Certification Authority for Reinforcing and Structural Steels.
Cage	Two or more reinforcing bars joined together (welded or tied)
Fabrication	The process of fabricating and assembling reinforcement or a reinforcing cage. Such work may include tying, bending, welding and cutting of reinforcing steel.
Large cage	Any reinforcing cage not meeting the requirements of a small cage.
Pre-fabricated cage	Reinforcing cage fabricated off-site at a separate location to the construction site for on-site works, or at a location separate to the precast yard for precast works. Includes cages for piles to MRTS63 *Cast-In-Place-Piles*, MRTS63A *Piles for Ancillary Structures*, or MRTS64 *Driven Tubular Steel Piles (with reinforced concrete pile shaft)*.
Principal's Registration Scheme	Any scheme for the prequalification, registration or approval of products, manufacturers, suppliers and/or Professional Engineers which is in operation in the jurisdiction where the reinforcing steel is to be placed.

Term	Definition
Processing	Any process which significantly changes the shape and properties of the reinforcing steel. Processing includes cold-rolling, cold-drawing, de-coiling and straightening including manufacture of circular cages (including pile cages), and automatic electric-resistance welding (adapted from AS/NZS 4671:2019 *Steel for the reinforcement of concrete* Clause 3.19).
Professional Engineer	A Chartered Professional Engineer who: a) has at least 5 years experience in design of concrete structures, and b) for works constructed in Queensland, the Professional Engineer must be a RPEQ Certified Engineer.
Registered	Pre-qualified product or supplier in accordance with departmental registration schemes: • Supplier Registration Scheme: Bridges and Other Structures • Product Index for Bridges and Other Structures, and • Construction Materials Testing (CMT) Supplier Registration Scheme. Registration for certain products and suppliers is a pre-requisite for Administrator approval, not a substitute.
Small cage	A reinforcing cage with an overall length of not more than 4.0 m in any direction, and an overall weight not greater than 500 kg.

3 Referenced documents

3.1 The requirements of the referenced documents listed in Table 3.1 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced documents, the requirements in this Technical Specification shall take precedence.

Table 3.1 – Reference documents

Reference	Title
Australian / New Zealand Standards	
AS 1391	*Methods for tensile testing of metals*
AS 2062	*Non-destructive testing - Penetrant testing of products and components*
AS 2205.5.1	*Methods for destructive testing of welds in metal - Macro metallographic test for cross-section examination*
AS 2832.5	*Cathodic protection of metals: Steel in concrete structures*
AS 5100.5	*Bridge design: Concrete*
AS/NZS 1554.3	*Structural steel welding. Part 3: Welding of reinforcing steel*
AS/NZS 1554.6	*Structural steel welding. Part 6: Welding stainless steels for structural purposes*
AS/NZS 2425	*Bar Chairs in Reinforced Concrete – Product Requirements and Test Methods*
AS/NZS 4671	*Steel for the reinforcement of concrete*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS 4855	*Welding consumables – Covered electrodes for manual metal arc welding of non-alloy and fine grain steels – Classification*

Reference	Title
AS/NZS ISO 9001	*Quality management systems – Requirements*
Other Standards	
BS 6744	*Stainless steel bars for the reinforcement of and use in concrete. Requirements and test method*
ISO 15620	*Welding – Friction welding of metallic materials*
ISO 15835-1	*Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 1: Requirements*
ISO 15835-2	*Steels for the reinforcement of concrete – Reinforcement couplers for mechanical splices of bars – Part 2: Test Methods*
Transport and Main Roads Technical Documents	
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS63	*Cast-In-Place-Piles*
MRTS63A	*Piles for Ancillary Structures*
MRTS70	*Concrete*
MRTS271	*Glass Fibre Reinforced Polymer (GRFP) Reinforcement*
MRTS278	*Supply of Structural Fasteners*
PIBOS	*Product Index for Bridges and Other Structures*
SCM-P-015	*Registration Scheme: Suppliers and Products for Bridges and Other Structures*
SD1043	*Reinforcing Steel – Standard Bar Shapes, Typical Details and Notes*
SD1044	*Reinforcing Steel – Lap Lengths*
-	*Construction Materials Testing (CMT) Supplier Registration Scheme*

4 Quality system requirements

4.1 The Contractor must prepare and implement a Quality Plan that includes:

a) detailed procedures for verifying that the reinforcing steel has been fabricated and placed within the specified tolerances, and providing documentary evidence of conformance

b) procedures for welding

c) the procedure for re-bending or straightening bars on site

d) details of suppliers, and

e) details of the reinforcing steel, bar chairs, spacers and mechanical splices; where required by this Technical Specification, details of approvals, certification and/or test results must also be included.

4.2 The producer and the processor of reinforcing steel must be certified to a product conformity assessment scheme which is acceptable to the Principal. The Australasian Certification Authority for Reinforcing and Structural Steels (ACRS - refer to http://www.acrs.net.au) is acceptable to the Principal. **Hold Point 1** **Record**

HOLD POINT 1	
Process Held	Delivery of reinforcing steel to the Site.
Submission Details	The following must be provided at least 14 days prior to the delivery of the reinforcing steel to the Site: • Quality Plan • details of the suppliers of reinforcing steel, bar chairs, spacers and mechanical splices, and • Supplier registration certificates.

4.3 'Suppliers of reinforcing steel and manufacturers of pre-fabricated cages' shall be registered suppliers, and the Department's registration certificate shall be submitted as part of Hold Point 1.

4.4 Registration of reinforcing steel suppliers and fabricators is governed by the Supplier Registration Scheme: Bridges and Other Structures. Producers and processors are to be third-party certified for their respective activities, all other suppliers shall be third-party product certified for traceability. Registration of bar chairs and mechanical reinforcing bar splices is governed by the *Product Index for Bridges and Other Structures*.

4.5 Registered suppliers of precast concrete may have processing of reinforcement included in their scope of registration, under the limitations listed in the Registration Scheme, in lieu of third-party certification. Third-party certification is required for processing not covered by the exemptions in the Registration Scheme.

4.6 All third-party product certification schemes for steel reinforcement production and processing must have both scheme and conformity assessment body accreditation by JAS-ANZ and be accepted by E&T Structures.

4.7 Where the reinforcing steel processor has third-party certification, the steel producer certificate is not required to be submitted.

4.8 Third-party product certification is not mandatory for the supply or processing of stainless steel reinforcement. Where third-party certification is not held, test reports shall be made available on request.

Third party certification for stainless steel is encouraged.

Note: The 'Supplier' may fall into different registration subcategories depending on the supply and processing chain used

5 Materials

Carbon reinforcing steel

5.1 Carbon steel used for reinforcing concrete must comply with AS/NZS 4671. The grade of reinforcing steel must comply with the Drawings and Table 5.1.

Table 5.1 – Carbon reinforcing steel strength grades

Reinforcement	Grade
Deformed reinforcing steel bars:	D500N, D600N, D750N
Plain reinforcing bars:	Grade R250N
Mesh:	Grade D500L

5.2 For Grade D600N and D750N, the bar markings must include an alphanumeric marking showing the strength grade and ductility class. For all other grades, the bar markings must be in accordance with AS/NZS 4671.

5.3 Galvanised reinforcing steel must not be used unless specified on the drawings or elsewhere in the Contract. If galvanised reinforcing steel is specified, it must be galvanised in accordance with AS/NZS 4680.

5.4 Reinforcement with other protective coatings, including epoxy coating, must not be used.

Stainless reinforcing steel

5.5 Where the use of stainless reinforcing steel is specified on the drawings or elsewhere in the Contract, the stainless reinforcing steel must comply with BS 6744 Grade 500 and AS 5100.5 Clause 17.4.1.2.

5.6 Stainless reinforcing steel must be supplied, handled and stored separately from other steels. Tools used for cutting, bending and transport of stainless reinforcing steel must not have been used for other materials.

Bar chairs and spacers

5.7 Refer to the relevant information in MRTS70 *Concrete* which governs bar chairs and spaces.

Mechanical splices

5.8 Mechanical splices shall be a registered product. **Hold Point 2** **Record**

HOLD POINT 2	
Process Held	Installation of a mechanical reinforcing bar splice.
Submission Details	Evidence that the mechanical splice complies with this Technical Specification must be submitted at least 14 days prior to the installation of the splice.

5.9 For registration, mechanical splices must be tested in accordance with ISO 15835-2 in a NATA-accredited laboratory to demonstrate compliance with ISO 15835-1 as a Category B coupler. A coupler must comply with any fatigue or seismic requirements specified in the design.

5.10 When tested, the spliced connection shall possess an ultimate tensile strength exceeding 1.25 times the characteristic yield strength of the reinforcing bar.

To test compliance to Clause 5.10 (which arises from AS 5100.5), a higher strength bar may need to be used.

5.11 Couplers shall be re-tested for conformance to this Technical Specification every 3 years.

5.12 Mechanical reinforcing bar splices must connect two reinforcing bars on a single axis and must be of either of the following types:

a) mechanically gripped to the end of a reinforcing steel bar by swaging or clamping with screws, or

b) connected to a reinforcing steel bar with a thread, or

c) friction wielded to a steel reinforcing bar in accordance with ISO 15620, in a controlled factory environment.

Friction welded couplers will only be registered as a product when there is a corresponding registered supplier to weld them to a steel reinforcing bar (see Clause 9.13).

5.13 Each mechanical splice must be legibly and durably marked (for example, hard stamped) with the identity of the producer, the nominal bar size for which it is intended, and a batch mark for traceability purposes. Each coupler must be traceable back to its production data.

5.14 Mechanical splices for stainless reinforcing steel must be manufactured from stainless steel which conforms to the designations specified in AS 5100.5 Clause 17.4.1.2.

Substitutions

5.15 Substitution of different sizes, grades or ductility class of steel reinforcement to that shown on the Drawings shall not be made unless approved in writing by the Designer and the Administrator. The application shall be forwarded at least three weeks prior to the date on which the steel reinforcement is required to be placed.

5.16 Substitution shall be permitted only if the structure is not adversely affected by the change.

5.17 Substitution shall not proceed until the Administrator has approved the change. No additional payment shall be made on account of any approved substitution. **Hold Point 3** **Record**

HOLD POINT 3	
Process Held	Substitution of reinforcing steel.
Submission Details	Proposal for substitution.

6 Handling, storage and surface condition

Handling and storage

6.1 Reinforcing steel must be bundled and tagged with a label identifying the bar schedule shape and be traceable from the steel producer to its location within the structure.

6.2 Traceability shall include records of the steel producer's or steel processor's (as applicable) batch or bunder numbers. Where steel is supplied by a steel processor, the steel processor is responsible for maintaining traceability to the steel producer's records.

6.3 Steel reinforcement must be protected from damage and surface contamination. During storage, it must be stacked in racks, or on timber or other suitable material above ground and kept clean of any contamination. The stacking method must ensure that the reinforcement is not bent, kinked, or damaged.

6.4 Steel reinforcement that has been damaged in any way must not be incorporated into or used in the works.

6.5 Stainless reinforcing steel must be supplied, handled and stored separately from other steels. It must be stored so it is not contaminated by debris from processing operations, grease, oil, iron or other steels.

Surface condition

6.6 At the time concrete is placed, the surface condition of reinforcement must not impair its bond to the concrete or its performance in the member. Mud, oil, grease, non-metallic coatings and loose (flaky) rust shall be removed. The presence of mill scale or surface rust is not cause for rejection of reinforcement under this Clause unless present on stainless steel reinforcement or unless the geometry of the bar once brushed no longer conforms to AS/NZS 4671 (refer AS 5100.5 Clause 17.4.4.).

6.7 Spray paint marking of cages for lifting points and cage identification for traceability is accepted subject to the following requirements:

a) The length of the paint mark on the bar is no more than 100 mm.

b) The paint markings are kept to a minimum to mark lifting points and for cage identification or traceability.

c) The paint mark is located no closer than 200 mm from the end of any bar.

d) The paint thickness is as thin as practical and does not alter the effective rib height on a deformed or ribbed bar.

e) Paint markings are only applied to deformed or ribbed bar, and not round bar.

f) Any paint marking of prestressing strands on the section of strand located within the concrete element is not accepted.

6.8 Any reinforcing steel projecting from a previous concreting operation must be cleaned free of adhering concrete or slurry prior to any further embedment.

6.9 Any reinforcing steel which is installed within 1 km of the coastline or has been submerged by water must be thoroughly washed with a high-pressure potable water jet immediately prior to placing in concrete.

7 Placing and fixing

General

7.1 The system of fixing must form a rigid cage which maintains the tolerances required by this Technical Specification under all loads applied before and during the placement of concrete, without the need for further adjustment.

7.2 Where the bars will be tied together, the reinforcement must be tied by wiring at each intersection, using annealed wire not less than 1.6 mm in diameter. Where the bar spacing is 300 mm or less, alternate intersections only need to be tied. Stainless steel wire must be used for stainless reinforcing steel.

7.3 Plastic ties or clips are not permitted.

7.4 Supports used to provide cover to the soffit formwork must either be attached to the reinforcement or shaped to positively interlock into the concrete.

7.5 Bar chairs / supports must be placed sufficiently close together to ensure that the specified cover is maintained before and during concrete placement and to prevent any potential crushing of the bar chairs / supports or penetration into the formwork. Long continuous linear runs of supports must be avoided; each individual length of support must be laterally offset from its adjacent support by at least 200 mm to avoid the potential to induce linear cracking in the concrete.

7.6 Where supports are required to be attached to the reinforcing steel, such attachment may be via clips or steel wires provided that no part of the wire or clip is located within three quarters of the required cover depth from the surface of the concrete. If stainless steel or galvanised wire or clips are used, they must be located at a depth of no less than half the specified cover from the concrete surface. Steel spacers can be used for internal spacing of individual reinforcing mats where the spacer does not intrude on the cover zone in any way.

7.7 Any screeding guide rails and height pins must be independent of the underlying reinforcement. Attachments to forms must either be of durable sacrificial non-corrosive materials compatible with concrete or be capable of being completely removed from the deck after final screeding.

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

a) the fabricator’s name

b) date of manufacture

c) drawing reference

d) traceability of reinforcement as required by this Technical Specification

e) the mass of the cage, and

f) the colour and location of dedicated lifting points.

Prefabrication of reinforcing cages

7.9 Reinforcing cages fabricated or assembled out of position and subsequently lifted into position must comply with following additional requirements:

a) The reinforcing cage must have dedicated lifting points incorporated into the cage to permit such lifting. Lifting points must be clearly identifiable on all cages.

b) For large cages, a drawing certified by a Professional Engineer 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 prior to the lifting of the reinforcing cage. This Drawing must be specific or traceable to the cage element on the project. **Hold Point 4** **Record**

For example, generic lifting designs for pile cages are not sufficient without reference to project, specific details indicating which lifting arrangement is to be used for which cage component.

HOLD POINT 4	
Process Held	Placement of large reinforcing cage.
Submission Details	A Professional Engineer certified drawing must be submitted at least 24 hours prior to the placement of a large reinforcing cage.

7.10 Suppliers of pre-fabricated reinforcing cages (fabricated either within or outside of Australia) shall be registered suppliers, in accordance with the Supplier Registration Scheme: Bridges and Other Structures.

7.11 Pre-fabricated reinforcing cages shall comply with all other requirements of this Technical Specification.

7.12 Reinforcing bar threaded for installation of nuts (e.g. SD1404) shall be tested as a bolt assembly in accordance with MRTS278 *Supply of Structural Fasteners*.

7.13 Hold Point 4 does not apply to cages manufactured and place in precast yards.

Cages fabricated outside Australia

7.14 If a steel cage is fabricated outside Australia, the Contractor must:

a) ensure that the cage is protected against salt attack and corrosion during shipping to Australia, and

b) provide an opportunity for the cage to be visually inspected in Australia by the Administrator at a location suitable to the Administrator prior to placing the steel cage reinforcement in position. **Witness Point 1**

WITNESS POINT 1	
Process	Delivery of steel cages fabricated outside Australia.
Notification	Notification of opportunity for inspection and location must be provided at least 7 days prior to the placement of the steel cage.

Electrical conductivity

7.15 If electrical conductivity is specified, prior to the placement of concrete, the Contractor must demonstrate that electrical conductivity has been achieved by means of testing in accordance with AS 2832.5 Clause 5.2 and submit the results to the Administrator. **Hold Point 5** **Record**

HOLD POINT 5	
Process Held	Concrete placement where electrical conductivity is specified.
Submission Details	Test results demonstrating that electrical conductivity has been achieved must be submitted at least 24 hours prior to the commencement of the concrete placement.

Adjustments to placement

7.16 Reinforcing bars may be adjusted laterally by a maximum of 50 mm to avoid conflict with cast-in items or voids, unless noted otherwise on the Drawings. Cover to reinforcement shall not lessened by this adjustment. The clear distance between parallel bars, other than bars lapped together shall not be less than 40 mm.

7.17 Cover to voids that will subsequently be filled with grout (e.g. transverse stressing bar ducts) shall be no less than the specified cover minus 10 mm.

This reduced cover to grouted void allowance is equivalent to increasing the tolerance on cover from 5 to 10 mm.

Fixing of reinforcement (pile cages)

7.18 Lengths of reinforcing cage for piles may be secured together with clamps for the purpose of lifting and installation of the cage only, with bar lap lengths for structural continuity to remain as per the Drawings. The number, placement and detail of these clamps shall be included in the lifting design certification of the cage. Clamps shall not intrude into the concrete cover zone.

8 Bending

General

8.1 Bending of reinforcing steel must comply with AS 5100.5.

8.2 The steel reinforcing bar must be free of kinks or other unwanted deformations, and must be cut to length, and bent in accordance with the Drawings. Welded reinforcing mesh shipped in rolls must be straightened into flat sheets before use.

8.3 The steel reinforcing bar must be cold bent by the application of a consistent force around a circular pin. Steel reinforcement must not be bent or straightened in a manner that will cause damage to the steel.

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

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

8.6 Reinforcement partially embedded in concrete may be field bent, provided that the bending conforms with the requirements of this Technical Specification. The bond of the embedded portion must not be impaired as a result of the bending.

8.7 Tools used for bending stainless reinforcing steel must not have been used for fabricating other materials. Pins used in the bending of stainless steel must be made from stainless steel.

Hot bending

8.8 If the Contractor proposes to hot bend carbon steel reinforcing bars, it must submit a proposal for undertaking the hot bending under controlled workshop conditions. **Hold Point 6** **Record**

HOLD POINT 6	
Process Held	Hot bending of bars.
Submission Details	Procedures or other evidence which demonstrate that hot bending will not be detrimental to reinforcement properties must be submitted at least 24 hours prior to the commencement of the hot bending of bars.

8.9 If approved, hot bending of bars must comply with the following:

a) the Producer's recommendations

b) the steel must be heated uniformly through and beyond the portion to be bent (5 bar diameters is suitable for a 90° bend)

c) the temperature must not exceed 450°C

d) suitable temperature indicating crayons or equivalent must be used to determine the temperature, and

e) the bar must not be cooled by quenching, compressed air blast or any other accelerated method. If the temperature of the bar exceeds 450°C, the bar must be rejected.

8.10 Class L reinforcement or mesh must not be heated or hot bent.

8.11 On-site heating of reinforcing steel is not permitted.

Bending details

8.12 If bending details are not shown on the Drawings, bends shall be made in accordance with Standard Drawings SD1043 and SD1044.

9 Splicing of reinforcement

General

9.1 Splicing of reinforcing steel must comply with AS 5100.5, Clause 13.2 and not compromise the concrete cover.

9.2 Reinforcing steel must be supplied in the lengths shown on the Drawings. Splicing of reinforcing steel is only permitted at the locations shown on the drawings.

9.3 Mesh must be lap spliced only. Splicing of mesh must be achieved so that the two outermost transverse bars of one sheet of mesh overlap the two outermost transverse bars of the sheet being lapped. Loose small pieces of fabric may only be used where they are essential for fitting into small confined parts of the Works.

Lap splicing of bars

9.4 Unless shown otherwise on the Drawings, if a non-contact splice is used, the clear distance between bars of the lapped splice must not exceed $3d_b$, where d_b is the nominal diameter of the reinforcing. In the case of unequal bars d_b is of the smaller bar.

9.5 The lap length must be as shown on the Drawings and be long enough to develop the full strength of the reinforcement and not be less than the appropriate tensile or compressive development length determined in accordance with AS 5100.5, Clause 13.1. Where splices cannot be staggered, the splices lap length must be increased by 1.3 times the standard lap length.

9.6 For unscheduled laps, or where the lap length is not shown on the Drawing, laps lengths shall be as per SD1044.

Mechanical splices

9.7 Mechanical reinforcing bar splices must:

a) only be installed where shown on the Drawings, and

b) be installed in accordance with the manufacturer's instructions.

9.8 Mechanical bar splices shall be as details on the Drawings. The Contractor may propose an alternative registered bar splice for approval by the Administrator.

9.9 Prior to attaching bars with a mechanical reinforcing bar splice, all bar ends must be thoroughly cleaned. Bars must be completely engaged and the joint assembled and tightened or locked. **Witness Point 2**

WITNESS POINT 2	
Process	Installation of a mechanical reinforcing bar splice.
Notification	Notification must be provided at least 24 hours prior to the installation of a mechanical reinforcing bar splice.

9.10 The exposed internal threads of a mechanical splice must be protected from contamination by concrete or dirt by means of a plastic plug until the second reinforcing bar is installed.

9.11 ‘As constructed’ drawings must be marked to show the type used and the location of the mechanical reinforcing bar splice.

Welded splices

9.12 Splicing by welding must comply with Clause 10.

Friction-welded couplers

9.13 Friction welded couplers shall only be fitted to steel reinforcing bar by a Transport and Main Roads registered supplier.

For the purposes of the Supplier Registration Scheme: Bridges and Other Structures this process falls under 'fabrication of reinforcing cages' until specified otherwise in that document.

10 Welding of carbon steel reinforcement

General

10.1 Welding (including locational welding):

a) must comply with AS/NZS 1554.3 and this Technical Specification, and

b) is subject to the Administrator's prior approval of the welding procedures included in the Quality Plan.

10.2 Loadbearing welding of reinforcement is only permitted where indicated on the drawings.

10.3 This Clause 10 does not apply to fabrication of mesh certified under a product conformity assessment scheme.

10.4 Welding adjacent to or above any prestressing bar or strand (stressed or unstressed) is not permitted without special precautions to protect all prestressing from welding spatter.

10.5 With the exception of locational welding on small reinforcing cages, reinforcing mesh must not be welded.

10.6 Welding must not be carried out until the following has been submitted and approved:

a) welding personnel names, roles, qualifications and experience

b) welding procedure specifications (WPS) for the required welding in accordance with Section 4 of AS/NZS 1554.3

c) welding procedure qualification records (PQR or WPQR) for the applicable WPS

d) if applicable, a description of precautions to protect all prestressing from welding spatter, and

e) evidence that the proposed welding consumables comply with AS/NZS 1554.3.
Hold Point 7 **Record**

HOLD POINT 7	
Process Held	Welding of reinforcing steel.
Submission Details	The information listed in Clause 10.7 must be submitted at least 7 days prior to the commencement of the welding.

10.7 For prefabricated cages and reinforcement welded in precast yards, the submission for Hold Point 7 shall be replaced by submission of an applicable Transport and Main Roads Registration Certificate covering these Works. Precast concrete and prefabricated cage suppliers shall have welding of reinforcement included in their supplementary scope of registration. Such registered suppliers are not required to requalify their welders every 12 months, but shall comply with AS/NZS 1554.3 in this regard, keeping adequate training and supervision records.

Sub-items (a) to (e) of Clause 10.6 will be assessed as part of supplier registration.

Welders

10.8 All welding must be carried out under the supervision of a welding supervisor who must conform to at least one of the requirements in AS/NZS 1554.3 Clause 4.12.1.

10.9 For locational tack welding only, the welding supervisor is not required to be on Site during all welding operations. The welding supervisor shall assess all welders for competence with adequate records kept; qualification to AS/NZS 1554.3 Clauses 4.12.2.2 or 4.12.2.3 is not required. A suitably qualified supervisor's delegate as per AS/NZS 1554.3 is to be on Site to monitor welding.

10.10 At a minimum, welders undertaking locational welding must satisfy AS/NZS 1554.3 Clause 4.12.2.1.

Locational (non-loadbearing) welding of reinforcement

10.11 Locational welding must comply with AS/NZS 1554.3 Clause 3.3, 5.6 and must:

a) not substantially reduce the cross-section of the reinforcing steel bar nor adversely affect its strength

b) have a throat thickness of not less than 4 mm, and

c) have a length not less than the diameter of the smaller bar.

10.12 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 Technical Specification requirements.

Splice welding

10.13 Splices must be made by direct butt or qualified double-lap welds. Butt welds must be qualified complete penetration butt joints in accordance with AS/NZS 1554.3.

10.14 Splice welds may also be single-lap splice welds (joint types L-d, L-e, L-f to AS/NZS 1554.3), noting the additional length required.

10.15 Splice welding must 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.

10.16 Splice welding is not permitted for Class L reinforcement.

10.17 Placement of the reinforcement within the concrete formwork must not proceed until all splice welds have been inspected. **Witness Point 3**

WITNESS POINT 3	
Process	Inspection of splice welds.
Notification	Notification must be provided at least 24 hours prior to the placement of the reinforcement within the concrete formwork.

10.18 All welders for splice welding must satisfy AS/NZS 1554.3 Clause 4.12.2 and be requalified on a twelve-monthly basis. All qualification testing must be conducted by a laboratory accredited by NATA for the tests.

10.19 Tensile testing of splices is only required when specified by AS/NZS 1554.3, with acceptance criteria as per that Standard.

11 Welding stainless steel reinforcement

General

11.1 Welding of stainless steel is only permitted if alternative methods of splicing or locating the steel are impractical.

11.2 Any welding of stainless reinforcing steel must be in accordance with AS/NZS 1554.3 and AS/NZS 1554.6.

11.3 Stainless reinforcing steel must be welded only in a welding workshop specifically set up for the purpose. The facility must maintain conditions that prevent any contamination of the stainless steel and welding consumables. All consumables must be stored, conditioned and handled in accordance with the manufacturer's recommendations.

11.4 The submission for Hold Points 8 and 9 shall include an applicable Transport and Main Roads Registration Certificate covering these Works. **Hold Point 8** **Record**

HOLD POINT 8	
Process Held	Welding of stainless reinforcing steel.
Submission Details	Supplier registration certificate for cage fabricator.

Welding procedure qualification

11.5 Welding of splices in stainless reinforcing steel, including to other steelwork and to continuity bar reinforcement, must not commence until the welding procedure has been qualified.

11.6 The qualification process must be in accordance with AS/NZS 1554.3 and AS/NZS 1554.6. **Hold Point 9** **Record**

HOLD POINT 9	
Process Held	Welding of stainless reinforcing steel.
Submission Details	Supplier registration certificate for cage fabricator.

Inspection and quality of welds

11.7 Except for locational welds, welds must be examined by liquid penetrant methods, to AS 2062, at a frequency of 5% of the welds manufactured.

11.8 Inspection of the welding of stainless reinforcing steel must be in accordance with AS/NZS 1554.6. The quality of welds must conform to Category 1B of AS/NZS 1554.6, Table 6.1, and any imperfections must be assessed in accordance with AS/NZS 1554.6, Table 6.3.2.

11.9 All arc strikes must be treated as welds, and inspected 100% by liquid penetrant methods, to AS 2062, and must be assessed in accordance with AS/NZS 1554.6, Table 6.3.2.

Cleaning of welds

11.10 Unless otherwise specified, any welds in stainless reinforcing steel covered by concrete must be acceptable as surface condition III, after removal of slag or wire brushing to AS/NZS 1554.6, Table 6.2.1. Any pickling compounds used must be chloride free.

Corrosion resistance of welds

11.11 Welds on stainless reinforcing steel must be tested for corrosion resistance against pitting and inter-granular corrosion in accordance with AS/NZS 1554.6, Appendix E. Corrosion resistance testing must be carried out on test specimens sampled from the weld procedure qualification tests and on three product samples, each prepared and tested at equally spaced quantity intervals during the works.

12 Tolerances

Fabrication

12.1 The shape and dimensions must be as shown in the Drawings and within the following tolerances in Table 12.1 (refer AS 5100.5 Clause 17.4.2).

Table 12.1 – Fabrication tolerance

Bar or mesh	Tolerance
On any overall dimension for bars and mesh except where used as a fitment:	
Length ≤ 600 mm	- 25 mm, + 0 mm
Length > 600 mm	- 40 mm, + 0 mm
On any overall dimension of bars or mesh used as a fitment:	
For deformed bars and mesh	- 15 mm, + 0 mm
For plain round bars and wire	- 10 mm, + 0 mm
On the overall offset dimension of a cranked column bar	- 0 mm, + 10 mm
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 must be within 2°

Bar or mesh	Tolerance
For all precast concrete	+ 0, - 10 mm
For prestressed concrete (deck units, winged plants, girders, piles) manufactured to MRTS73 XX	+ 0, - 5 mm

Position

12.2 Notwithstanding compliance with any other tolerance specified in this Contract, the deviation from the specified position of steel reinforcement must not exceed the tolerances in Table 12.2 (refer AS 5100.5 Clause 17.7.3).

Table 12.2 – Position tolerance

For positions controlled by cover:	
in beams, slabs, columns and walls	- 5 mm, + 10 mm
in slabs-on-ground	- 10 mm, + 20 mm
Formed surfaces and unformed finished surfaces	- 5 mm, + 10 mm
in footings cast in the ground	- 10 mm, + 40 mm
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 the spacing of fitments	The greater of 10% of the specified spacing and 15 mm.

Notes:

[1] A positive value indicates the amount of cover increases, and a negative value indicates the amount the cover decreases.

[2] Concrete cast against a blinding concrete layer is considered to be formed.

Note: For the purposes of Table 12.2 precast elements such as panels and culverts are considered walls/slabs for determining the tolerance for bar spacings.

13 Standard test methods

13.1 Test methods specified in the reference standards shall be used.

13.2 All testing for conformance required by this Technical Specification, shall be conducted in a laboratory holding National Association of Testing Authorities (NATA) accreditation, or equivalent mutual accreditation recognised by International Laboratory Accreditation Cooperation (ILAC) for that test. Test reports shall be in English.

Appendix A: Summary of Hold Points, Witness Points, Milestones and Records

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

The Hold Points, Witness Points, Milestones and Records that the Contractor must submit to the Administrator to demonstrate compliance with this Technical Specification, are summarised in Table A. There are no Milestones defined.

Table A – Hold Points, Witness Points, Milestones and Records

Clause	Hold Point	Witness Point	Milestone	Record
4.2	1. Delivery of reinforcing steel to the Site			Quality Plan, including details of approvals, certification and/or test results and Transport and Main Roads registration certificate(s)
5.8	2. Installation of a mechanical reinforcing bar splice (14 days)			Product Registration
5.19	3. Substitution of reinforcing steel			Proposal for substitution
7.12	4. Placement of large reinforcing cage (24 hours)			Certification of lifting design
7.14		1. Delivery of steel cages fabricated outside of Australia		
7.15	5. Concrete placement where electrical conductivity is specified (24 hours)			Test results demonstrating that electrical conductivity has been achieved must be submitted at least 24 hours prior to the commencement of the concrete placement
8.8	6. Hot bending of bars (24 hours)			Proposal for hot bending of bars
9.9		2. Installation of mechanical reinforcing bar splices (24 hours)		
10.6	7. Welding of reinforcing steel (7 days)			Welding details and procedures or Transport and Main Roads registration certificate
10.17		3. Inspection of splice welds (24 hours)		

Clause	Hold Point	Witness Point	Milestone	Record
11.4	8. Welding of stainless reinforcing steel (14 days)			Transport and Main Roads registration certificate
11.5	9. Welding of stainless reinforcing steel (14 days)			Transport and Main Roads registration certificate