Contents

1. Scope .................................................................................................................................................. 2
2. Definitions ........................................................................................................................................... 2
3. Referenced Documents ...................................................................................................................... 3
4. Quality System Requirements .......................................................................................................... 4
5. Materials ........................................................................................................................................... 5
   Carbon Reinforcing Steel ..................................................................................................................... 5
   Stainless Reinforcing Steel .................................................................................................................. 5
   Bar Chairs and Spacers ........................................................................................................................ 5
   Mechanical Splices .............................................................................................................................. 6
6. Handling, Storage and Surface Condition .......................................................................................... 7
   Handling and Storage .......................................................................................................................... 7
   Surface Condition ............................................................................................................................... 7
7. Placing and Fixing .............................................................................................................................. 7
   General ................................................................................................................................................ 7
   Prefabrication of Reinforcing Cages .................................................................................................... 8
   Cages Fabricated Outside Australia .................................................................................................... 8
   Electrical Conductivity ....................................................................................................................... 9
8. Bending ............................................................................................................................................. 9
   General ................................................................................................................................................ 9
   Hot Bending ....................................................................................................................................... 9
9. Splicing of Reinforcement .................................................................................................................. 10
   General .............................................................................................................................................. 10
   Lap Splicing of Bars ............................................................................................................................. 10
   Mechanical Splices ............................................................................................................................ 11
   Welded Splices ................................................................................................................................. 11
10. Welding of Carbon Steel Reinforcement ......................................................................................... 11
    General .......................................................................................................................................... 11
    Welders ......................................................................................................................................... 12
    Locational Welding of Reinforcement ............................................................................................. 12
    Splice Welding ................................................................................................................................. 12
11. Welding Stainless Steel Reinforcement .......................................................................................... 13
    General .......................................................................................................................................... 13
    Welding Procedure Qualification .................................................................................................... 13
    Inspection and Quality of Welds ....................................................................................................... 13
    Cleaning of Welds ............................................................................................................................ 13
    Corrosion Resistance of Welds ......................................................................................................... 14
12. Tolerances ....................................................................................................................................... 14
    Fabrication ..................................................................................................................................... 14
    Position .......................................................................................................................................... 14

Annexure A: Summary of Hold Points, Witness Points and Records .................................................... 16
1. Scope

1.1 This Austroads Technical Specification ATS 5310 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 Specification.

2. Definitions

2.1 In addition to the definitions set out in AS/NZS 4671 and AS 5100.5, the following definitions apply to this Specification:

ACRS: Australasian Certification Authority for Reinforcing and Structural Steels.

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.

Professional Engineer: A Chartered Professional Engineer who:
   a) is registered on the National Engineering Register (NER);
   b) is registered on any scheme of registration of engineers prescribed by legislation in the applicable jurisdiction;
   c) has at least 5 years experience in design of concrete structures; and
   d) is appropriately registered in any applicable Principal’s Registration Scheme.

For Works constructed in Queensland, the following additional requirement applies:
The Professional Engineer must be a RPEQ Certified Engineer.

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.

Small cage: A reinforcing cage which meets the following requirements: an overall length of not more than 4.0 m in any direction, or an overall weight not greater than 500 kg.
3. Referenced Documents

3.1 The following documents are referenced in this Specification:

**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/NZS 2425 Bar Chairs in Reinforced Concrete – Product Requirements and Test Methods.
- AS 2832.5 Cathodic protection of metals: Steel in concrete structures.
- 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.
- AS 5100.5 Bridge design: Concrete.
- AS/NZS 14341 Welding consumables – Wire electrodes and weld deposits for gas shielded metal arc welding of non-alloy and fine grain steels.
- AS/NZS 16834 Welding consumables – Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels – Classification.
- AS/NZS ISO 17632 Welding consumables – Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steels – Classification.
- AS/NZS ISO 18276 Welding consumables – Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of high strength steels – Classification.

**Other Standards**

- BS 6744 Stainless steel bars for the reinforcement of and use in concrete. Requirements and test method.
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 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
| 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
  • evidence of producer certification and steel processor certification to a conformity assessment scheme. |

For Works constructed in Queensland, the following additional requirements apply:

4.3 Suppliers and products for the items listed below must be registered by the Queensland
    Department of Transport and Main Roads.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 and 5.5</td>
<td>Supply and processing of reinforcing steel</td>
</tr>
<tr>
<td>5.7</td>
<td>Bar chairs</td>
</tr>
<tr>
<td>5.17</td>
<td>Mechanical reinforcing bar splices</td>
</tr>
</tbody>
</table>

For information regarding approved suppliers and products for the above items, refer to:

For Works constructed in New South Wales, the following additional requirement applies:

4.4 Mechanical splices must be Transport for NSW approved types. Details of Transport for
    NSW approved mechanical splices can be found at: https://www.rms.nsw.gov.au/business-industry/partners-suppliers/disciplines/bridge.html

For Works constructed in Victoria, the following additional requirement applies:

4.5 Mechanical splices must comply with the requirements of VicRoads Bridge Technical Note
    BTN 025 AS 5100 Part 5. The tests must be conducted in accordance with ISO 15835-2.
5. Materials

Carbon Reinforcing Steel

5.1 Carbon steel used for reinforcing concrete must comply with AS/NZS 4671. Unless shown otherwise on the drawings, the grade of the reinforcing steel must comply with Table 5.1.

Table 5.1: Carbon reinforcing steel strength grades

<table>
<thead>
<tr>
<th>Reinforcement</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deformed reinforcing steel bars:</td>
<td>Grade D500N (Grade D600N or D750N may only be used if shown on the drawings)</td>
</tr>
<tr>
<td>Plain reinforcing bars:</td>
<td>Grade R250N</td>
</tr>
<tr>
<td>Mesh:</td>
<td>Grade D500L</td>
</tr>
</tbody>
</table>

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 and passivated in a 0.15% sodium dichromate solution.

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 All bar chairs and spacers must:
   a) comply with AS/NZS 2425 and this Specification;
   b) comply with the strength grade specified in Table 1 of AS/NZS 2425 appropriate to the mass of reinforcement being supported and any other loads;
   c) not be made from site-cast concrete; and
   d) be shaped so the formation of the homogenous concrete both within and around the bar chair or spacer is obstructed as little as possible.

For Works constructed in Queensland, the following additional requirements apply:

5.8 Bar chairs and spacers must be made from concrete, with the exception that plastic tipped wire chairs may be used where cover is required from existing structural, but not blinding, concrete at a construction joint.

5.9 Bar chairs for cast-in-place pile reinforcement cages must comply with the requirements of MRTS63, MRTS63A and MRTS64.
For Works constructed in New South Wales, the following additional requirement applies:

5.10 Any type of wire bar chairs, including those made of stainless steel, must not be used.

5.11 The maximum length of any one support must not exceed 330 mm.

5.12 If a bar chair is only suitable for soffit use, it must not be used against side forms.

5.13 Only fibre reinforced concrete chairs and spacers must be used in concrete members located in exposure classifications C1 and C2.

5.14 Individual plastic bar chairs may be used only for precast and cast-in-place concrete members located in exposure classifications A, B1 or B2 and for enclosed internal surfaces not exposed to view.

5.15 Concrete supports must:
   a) be extruded fibre concrete or conventional concrete manufactured under factory-controlled conditions;
   b) not be less durable than the surrounding concrete and have a characteristic compressive strength which is not less than the higher of 60 MPa and the characteristic compressive strength of the surrounding concrete;
   c) have a chloride permeability class of “very low” in accordance with Table 2 of AS 2425 (ie maximum Rapid Chloride Penetration Test value of less than 1000 coulombs at 56 days); and
   d) if made of fibre concrete, only contain non-metallic, synthetic fibres and not contain asbestos or similar fibres based on naturally occurring silicate minerals.

5.16 Where stainless steel nibs are permitted, the nibs must be manufactured from a material compliant with this Specification and welded to the reinforcing steel in compliance with the locational weld requirements of this Specification.

**Mechanical Splices**

5.17 If mechanical splices are specified on the drawings, the splices must be approved in accordance with any applicable Principal’s Registration Scheme for mechanical splices.

<table>
<thead>
<tr>
<th>HOLD POINT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held</td>
</tr>
<tr>
<td>Submission Details</td>
</tr>
</tbody>
</table>

5.18 Notwithstanding the requirements of Clause 5.17, 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.

5.19 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.

5.20 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.
5.21 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.

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 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.

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

6.4 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**

6.5 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. The presence of mill scale or surface rust is not cause for rejection of reinforcement under this Clause unless present on stainless steel reinforcement (refer AS 5100.5 Clause 17.4.4.).

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

6.7 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 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 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 the 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.

<table>
<thead>
<tr>
<th>HOLD POINT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held</td>
</tr>
<tr>
<td>Submission Details</td>
</tr>
</tbody>
</table>

Cages Fabricated Outside Australia

7.10 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 Principal at a location suitable to the Principal prior to placing the steel cage reinforcement in position.
### WITNESS POINT 1

<table>
<thead>
<tr>
<th>Process</th>
<th>Delivery of steel cages fabricated outside Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification</td>
<td>Notification of opportunity for inspection and location must be provided at least 7 days prior to the placement of the steel cage.</td>
</tr>
</tbody>
</table>

### Electrical Conductivity

7.11 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 Principal.

### HOLD POINT 4

<table>
<thead>
<tr>
<th>Process Held</th>
<th>Concrete placement where electrical conductivity is specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details</td>
<td>Test results demonstrating that electrical conductivity has been achieved must be submitted at least 24 hours prior to the commencement of the concrete placement.</td>
</tr>
</tbody>
</table>

### 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 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.
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.

For Works constructed in Victoria, the following additional requirement applies:

8.12 Bending or re-bending of reinforcing steel must be done in accordance with the requirements of AS 5100.5, Clause 17.4.3, and be read in conjunction with VicRoads Bridge Technical Note BTN 025 AS 5100 Part 5, Clause 2.2.

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.

9.5 The lap length must be as shown on the drawings or 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.
Mechanical Splices

9.6 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.

9.7 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.

<table>
<thead>
<tr>
<th>WITNESS POINT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process</strong></td>
</tr>
<tr>
<td><strong>Notification</strong></td>
</tr>
</tbody>
</table>

9.8 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.

9.9 “As constructed” drawings must be marked to show the type used and the location of the mechanical reinforcing bar splice.

Welded Splices

9.10 Splicing by welding must comply with Clause 10.

10. Welding of Carbon Steel Reinforcement

For Works constructed in New South Wales the following additional requirement applies:

10.1 Welding must comply with RMS Specification B203 Welding of Reinforcing Steel

General

10.2 Welding (including locational welding):
   a) must comply with AS/NZS 1554.3 and this Specification; and
   b) is subject to the Principal’s prior approval of the welding procedures included in the Quality Plan.

10.3 Non-locational welding of reinforcement is only permitted where indicated on the drawings.

10.4 This Clause 10 does not apply to fabrication of mesh certified under a product conformity assessment scheme which is acceptable to the Principal.

10.5 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.

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

10.7 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 AS1554.3.

### HOLD POINT 6

<table>
<thead>
<tr>
<th>Process Held</th>
<th>Welding of reinforcing steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details</td>
<td>The information listed in Clause 10.7 must be submitted at least 7 days prior to the commencement of the welding.</td>
</tr>
</tbody>
</table>

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

### Locational Welding of Reinforcement

10.10 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.

10.11 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

10.12 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.

10.13 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.

10.14 Splice welding is not permitted for Class L reinforcement.

10.15 Placement of the reinforcement within the concrete formwork must not proceed until all splice welds have been inspected.

### WITNESS POINT 3

<table>
<thead>
<tr>
<th>Process</th>
<th>Inspection of splice welds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification</td>
<td>Notification must be provided at least 24 hours prior to the placement of the reinforcement within the concrete formwork.</td>
</tr>
</tbody>
</table>

10.16 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.

10.17 Welded splices must be tested and must meet the specified tensile strength of the parent metal. Testing must be carried out by a laboratory with appropriate NATA accreditation.
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.

<table>
<thead>
<tr>
<th>HOLD POINT 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held</td>
</tr>
<tr>
<td>Submission Details</td>
</tr>
</tbody>
</table>

**Welding Procedure Qualification**

11.4 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.

11.5 The qualification process must be in accordance with AS/NZS 1554.3 and AS/NZS 1554.6.

<table>
<thead>
<tr>
<th>HOLD POINT 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held</td>
</tr>
<tr>
<td>Submission Details</td>
</tr>
</tbody>
</table>

**Inspection and Quality of Welds**

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

11.7 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 1554.6, Table 6.3.2.

11.8 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 1554.6, Table 6.3.2.

**Cleaning of Welds**

11.9 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

11.10 When specified, 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>
<thead>
<tr>
<th>Bar or mesh</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>On any overall dimension for bars and mesh except where used as a fitment:</td>
<td></td>
</tr>
<tr>
<td>Length ≤ 600 mm:</td>
<td>- 25 mm, + 0 mm</td>
</tr>
<tr>
<td>Length &gt; 600 mm:</td>
<td>- 40 mm, + 0 mm</td>
</tr>
<tr>
<td>On any overall dimension of bars or mesh used as a fitment:</td>
<td></td>
</tr>
<tr>
<td>For deformed bars and mesh:</td>
<td>- 15 mm, + 0 mm</td>
</tr>
<tr>
<td>For plain round bars and wire:</td>
<td>- 10 mm, + 0 mm</td>
</tr>
<tr>
<td>On the overall offset dimension of a cranked column bar</td>
<td>- 0 mm, + 10 mm</td>
</tr>
<tr>
<td>For the sawn or machined end of a straight bar intended for use as an end-bearing splice</td>
<td>The angular deviation from square measured in relation to the end 300 mm of the bar must be within 2°</td>
</tr>
<tr>
<td>For all precast/prestressed concrete:</td>
<td>- 5 mm, + 0 mm</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>For positions controlled by cover:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>in beams, slabs, columns and walls</td>
<td>- 5 mm, + 10 mm</td>
</tr>
<tr>
<td>in slabs-on-ground</td>
<td>- 10 mm, + 20 mm</td>
</tr>
<tr>
<td>Formed surfaces and unformed finished surfaces</td>
<td>- 5 mm, + 10 mm</td>
</tr>
<tr>
<td>in footings cast in the ground</td>
<td>- 10 mm, + 40 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For positions not controlled by cover</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>the location of steel reinforcement on a profile</td>
<td>± 10 mm</td>
</tr>
<tr>
<td>the position of the ends of steel reinforcement along the line of the bar</td>
<td>± 50 mm</td>
</tr>
<tr>
<td>the spacing of bars in walls and slabs, and the spacing of fitments</td>
<td>The greater of 10% of the specified spacing and 15 mm.</td>
</tr>
</tbody>
</table>

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.
## Annexure A: Summary of Hold Points, Witness Points and Records

The following is a summary of the Witness Points/Hold Points that apply to this Specification and the Records that the Contractor must submit to the Principal to demonstrate compliance with this Specification.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Hold point</th>
<th>Witness point</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>1. Delivery of reinforcing steel to the Site</td>
<td></td>
<td>Quality Plan, including details of approvals, certification and/or test results</td>
</tr>
<tr>
<td>5.17</td>
<td>2. Installation of a mechanical reinforcing bar splice</td>
<td></td>
<td>Registration/certification/approval or test results demonstrating compliance with this Specification</td>
</tr>
<tr>
<td>7.9</td>
<td>3. Placement of large reinforcing cage</td>
<td></td>
<td>Certification of lifting design/drawing</td>
</tr>
<tr>
<td>7.10</td>
<td>1. Inspection of imported cages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.11</td>
<td>4. Concrete placement where electrical conductivity is specified</td>
<td></td>
<td>Evidence of electrical conductivity</td>
</tr>
<tr>
<td>8.8</td>
<td>5. Hot bending of bars</td>
<td></td>
<td>Proposal for hot bending of bars</td>
</tr>
<tr>
<td>9.7</td>
<td>2. Installation of mechanical reinforcing bar splices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.7</td>
<td>6. Welding of reinforcing steel</td>
<td></td>
<td>Welding details and procedures</td>
</tr>
<tr>
<td>10.15</td>
<td>3. Inspection of splice welds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.3</td>
<td>7. Welding of stainless reinforcing steel</td>
<td></td>
<td>Independent assessment of the specific welding shop</td>
</tr>
<tr>
<td>11.5</td>
<td>8. Welding of stainless reinforcing steel</td>
<td></td>
<td>Evidence of qualification of welding procedure</td>
</tr>
</tbody>
</table>
## Amendment Record

<table>
<thead>
<tr>
<th>Amendment no.</th>
<th>Clauses amended</th>
<th>Action</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>New specification</td>
<td>New</td>
<td>July 2020</td>
</tr>
</tbody>
</table>

### Key

- **Format**: Change in format
- **Substitution**: Old clause removed and replaced with new clause
- **New**: Insertion of new clause
- **Removed**: Old clauses removed