1. **SCOPE**
This Technical Guidance Note provides instruction on executing non-loadbearing welds for reinforcing steel (generally referred to as tack welds) used in concrete structures designed and constructed in accordance with AS 3600 and AS 5100.5. For more detailed welding related information, refer to AS/NZS 1554.3. The materials covered by this technical guidance note are reinforcement steel grades 250N, 500L and 500N conforming to AS/NZS 4671.

2. **REFERENCES**
AS 2205.5.1    Methods for destructive testing of welds in metals - Macro metallographic test for cross-section examination
AS 3600        Concrete structures
AS 5100.5      Bridge design – Concrete
AS/NZS 1554.3  Structural steel welding Part 3: Welding of reinforcing steels
AS/NZS 4671    Steel reinforcing materials
WTIA - TN7     Technical Note 7: Health & safety in welding
WTIA - TN22    Technical Note 22: Welding electrical safety


   **Non-loadbearing welded joints:**
   Welded joints for which the strength is not taken into account during the design of the reinforced concrete structure

   **Reinforcing steel:**
   Material complying with AS/NZS 4671

4. **SAFETY**
For guidance on welding safety refer to WTIA Technical Notes 7 and 22.

5. **JOINT TYPES**
Welding of reinforcing steel is widespread in the concrete construction industry. Non-load bearing welds are of two types, the lap joint and the cross joint. This Technical Guidance Note applies to these types of welds.

**Examples of non-loadbearing joints:**

<table>
<thead>
<tr>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Figure 1" /></td>
<td>Example of Lap Joint 12mm to 12mm</td>
</tr>
<tr>
<td><img src="image2.png" alt="Figure 2" /></td>
<td>Example of Cross Joint 12mm to 16mm</td>
</tr>
</tbody>
</table>

Figure 1. Example of Lap Joint Ø12mm to Ø12mm

Figure 2. Example of Cross Joint Ø12mm to Ø16mm

An Expert Technology Tool developed as part of the WTIA National Diffusion Networks Project and supported by:
Where welded reinforcing bar joints need to take loads other than those for which the structure has been designed, such as welds for prefabricated reinforcement cages, then these welds must be designed by a suitably qualified person with extensive experience in the design, welding and handling of prefabricated cages. Design weld details must be noted on the drawings or in attached documents. In some instances, the designed weld details may be the same as the specified minimum details for non-load bearing welds, but in other instances larger or longer welds may be required, such as those for large bars in cages transported over rough terrain.

6. DESIGN REQUIREMENTS FOR NON-LOADBEARING WELDS

Table 1 – Design requirements for non-loadbearing welds

<table>
<thead>
<tr>
<th>Dmin, smallest bar diameter (mm)</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>W, minimum weld width (mm)</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>L, minimum weld length (mm)</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>24</td>
<td>28</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>S, Minimum throat thickness (mm)</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

Note: It is the installers’ responsibility to ensure welds are sufficient to resist lifting loads.

Figure 3. Schematic representation of cross and lap joints

7. WELDING PROCESSES
MMAW, GMAW and FCAW processes are suitable for preparing non-loadbearing welds. Appendices 1 to 3 respectively give sample procedures.

8. WELDING PROCEDURE QUALIFICATION
It is a requirement for the fabricator to prepare a written weld procedure specification (WPS) listing all the welding parameters necessary to control the welding process. This WPS will form a record and be available for examination. However, it is not essential for the WPS to be qualified before commencing welding of non-loadbearing welds. Nevertheless, it is strongly recommended that a trial weld is prepared in a manner identical to that in production and during this trial all welding parameters should be recorded. On completion of the trial weld it should be visually examined, then cut to allow macro examination and assessment against the design requirements identified in the Table of Section 6 of this Guidance Note and the acceptance criteria given in AS/NZS 1554.3.

9. WELDER QUALIFICATION
The welder should prepare a test weld of the type shown in Figure 1 using the process and position required for production. This should be visually examined and subjected to a macro examination and assessment against AS/NZS 1554.3.
10. VISUAL EXAMINATION

All welds should be visually examined after completion to ensure that the welds meet the design requirements identified in the Table of Section 6 of this Guidance Note and the acceptance criteria of AS/NZS 1554 Part 3. Examples of acceptable and unacceptable welds are provided:

- **Figure 4. Example of Acceptable Tack Weld**
  - Uniform weld geometry

- **Figure 5. Example of Unacceptable Tack Weld**
  - Inadequate weld length

- **Figure 6. Example of Acceptable Tack Weld**
  - Acceptable weld length

- **Figure 7. Example of Unacceptable Tack Weld**
  - Insufficient weld length

- **Figure 8. Example of Unacceptable Tack Weld**
  - Evidence of porosity & unacceptable undercut

- **Figure 9. Example of Unacceptable Tack Weld**
  - Unacceptable weld width and undercut
## Appendix 1 – Sample Weld Procedure Specification for Manual Metal Arc Welding

### WELDING PROCEDURE SPECIFICATION (AS/NZS 1554.3-2002)*

<table>
<thead>
<tr>
<th>Material Spec/Grade</th>
<th>AS4671 Gr 250N, 500L &amp; N</th>
<th>WPS No: WTIA-Reobar-MMAW Rev. 0</th>
<th>Date: 6/6/05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of weld (App B Figure B1 d)</td>
<td>Joining Crossed Bars</td>
<td>Revision: 0</td>
<td>Revision Date: N-A</td>
</tr>
<tr>
<td>Weld Category (3.3)</td>
<td>Non Load Bearing Tack Welds</td>
<td>PQR No: Not Required (see Clause 3.1)</td>
<td></td>
</tr>
<tr>
<td>Bar Diameter range qualified:</td>
<td>12mm to 36mm</td>
<td>Welding Positions: ALL</td>
<td></td>
</tr>
<tr>
<td>Preheat temperature (Table 4.11.6(a))</td>
<td>20°C min when metal temperature &lt; 0°C</td>
<td>Edge preparation: Not Required</td>
<td></td>
</tr>
<tr>
<td>Heating method (AS ISO 13916):</td>
<td>Oxy fuel</td>
<td>Inter-run temperature (max): 250°C</td>
<td></td>
</tr>
<tr>
<td>Checking method:</td>
<td>Temperature crayon</td>
<td>PWHT: Not Required</td>
<td></td>
</tr>
</tbody>
</table>

### Weld Preparations & Tolerances (AS/NZS 1554.3 Page 40, Fig B1)

- Recommended Weld Preparation: As per Fig B1(d)
- **Throat Thickness** (Clause 3.3.2a) “S” shall be > 0.3 “Dmin”
- **Weld Length** (Clause 3.3.2b) “L” > Bar Diameter “Dmin”
  
  \[ D_{min} = \text{smallest bar diameter} \]

### Weld Run Details

<table>
<thead>
<tr>
<th>Pass No</th>
<th>Filler Class</th>
<th>Filler Spec</th>
<th>Dia mm</th>
<th>Trade-name</th>
<th>Amperage range, A</th>
<th>Voltage range, V</th>
<th>Current &amp; polarity</th>
<th>Speed mm/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AS/NZS1553.3</td>
<td>E4816</td>
<td>3.2</td>
<td>Enter name</td>
<td>100 - 150</td>
<td>22 - 26</td>
<td>AC or DC +</td>
<td>100 - 120</td>
</tr>
<tr>
<td>Next</td>
<td>As above</td>
<td>As above</td>
<td>&quot;</td>
<td>Enter name</td>
<td>100 - 150</td>
<td>22 - 26</td>
<td>AC or DC +</td>
<td>100 - 120</td>
</tr>
</tbody>
</table>

### Welding Parameters

- Welding Technique: Start & Finish Welding out of weld groove
- Backgouge method: None
- Initial cleaning: Wire Brush, chipping, grinding
- Inter-run clean: Wire Brush, chipping, grinding

### PROJECT APPLICATION DATA (3.3): NON-LOADBEARING LOCATIONAL TACK WELDS

Welds do not have any quantifiable structural performance. It is the installers’ responsibility to ensure welds are sufficient to resist lifting loads.

- **Project Title:** Tack Welding of Reinforcement Bar
- **Client:**
- **Drawing No:**
- **Acceptance Criteria:** AS/NZS 1554.3-2002 i.e.

### Notes:
- Where ventilated air ovens or hot boxes are not available for conditioning of electrodes prior to use, then it is recommended to have electrodes delivered in hermetically sealed containers that preserve the condition of the electrodes for a fixed time.

*Disclaimer applies – WTIA

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Email: info@wtia.com.au  URL: http://www.wtia.com.au
WELDING PROCEDURE SPECIFICATION (AS/NZS 1554.3-2002)*

Material Spec/Grade: AS4671 Gr 250N, 500L & N

WPS No: WTIA-Reobar-GMAW Rev. 0       Date: 6/6/05

Type of weld (App B Figure B1 d) Joining Crossed Bars

Weld Category (3.3) Non Load Bearing Tack Welds

PQR No: Not Required (see Clause 3.1)

Bar Diameter range qualified: 12mm to 36mm

Preheat temperature (Table 4.11.6(a)): 200°C min when metal temperature < 0°C

Welding Positions: ALL

Weld Preparations & Tolerances (AS/NZS 1554.3 Page 40, Fig B1)

Recommended Weld Preparation: As per Fig B1(d)

Throat Thickness (Clause 3.3.2a) “S” shall be > 0.3 “Dmin”

Weld Length (Clause 3.3.2b) “L” > Bar Diameter “Dmin”

Dmin = smallest bar diameter

Run Sequence (See AS/NZS 1554.3 Page 40, Figure B1)

Note: The start of the weld and the end of the weld should be on different bars

SA = Direction for striking arc

WA = Direction for withdrawing arc

Flux: N/A

Shielding gas: Argon + 8% CO2

WELDING CONSUMABLES

Usage rate: N/A

Flow rate: 16 – 20 litres/min

WELD RUN DETAILS

WELDING PARAMETERS

PassNo .  Filler Class  Filler Spec  Dia mm  Trade-name  Amperage range, A  Voltage range, V  Current & polarity  Speed mm/min

1  AS/NZS 2717.1  W502AH  1.2  Optional  200 – 300  24 – 30  DC +  200 - 350

Next if required  As above  As above  "  As above  200 - 300  24 - 30  DC +  200 - 350

Welding Technique: Start & Finish Welding out of weld groove

Backgouge method: None

Initial cleaning: Wire Brush

Backgouge check: None

Inter-run clean: Wire Brush

PROJECT APPLICATION DATA (3.3): NON-LOADBEARING LOCATION TACK WELDS

Welds do not have any quantifiable structural performance. It is the installers’ responsibility to ensure welds are sufficient to resist lifting loads.

Project Title: Tack Welding of Reinforcement Bar

Acceptance Criteria: AS/NZS 1554.3-2002 ie

Weld throat, S > 0.3 x Bar Diameter, Dmin      Weld Length, L > One Bar Diameter, Dmin

Prepared by: WTIA

Recommended by: C Smallbone, Executive Director, WTIA

Approved by Fabricator:

Accepted by Client:

* Disclaimer applies – WTIA

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Email: info@wtia.com.au  URL: http://www.wtia.com.au
Appendix 3 – Sample Weld Procedure Specification for Flux Cored Arc Welding

**WELDING PROCEDURE SPECIFICATION (AS/NZS 1554.3-2002)**

<table>
<thead>
<tr>
<th>Material Spec/Grade</th>
<th>AS4671 Gr 250N, 500L &amp; N</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPS No</td>
<td>WTIA-Reobar-FCAW Rev. 0</td>
</tr>
<tr>
<td>Date</td>
<td>6/6/05</td>
</tr>
<tr>
<td>Type of weld</td>
<td>(App B Figure B1 d)</td>
</tr>
<tr>
<td>Joining Crossed Bars</td>
<td>Non Load Bearing Tack Welds</td>
</tr>
<tr>
<td>Bar Diameter range qualified:</td>
<td>12mm to 36mm</td>
</tr>
<tr>
<td>Preheat temperature (Table 4.11.6(a))</td>
<td>20°C min when metal temperature &lt; 0°C</td>
</tr>
<tr>
<td>Edge preparation</td>
<td>Not Required</td>
</tr>
<tr>
<td>Inter-run temperature (max)</td>
<td>250°C</td>
</tr>
<tr>
<td>Checking method</td>
<td>Temperature crayon</td>
</tr>
<tr>
<td>PWHT</td>
<td>Not Required</td>
</tr>
<tr>
<td>Recommended Weld Preparation:</td>
<td>As per Fig B1(d)</td>
</tr>
</tbody>
</table>

**Weld Preparations & Tolerances (AS/NZS 1554.3 Page 40, Fig B1)**

| Throat Thickness (Clause 3.3.2a) | “S” shall be > 0.3 “Dmin” |
| Weld Length (Clause 3.3.2b)      | “L” > Bar Diameter “Dmin” |
| Dmin = smallest bar diameter     |                           |

**WELDING CONSUMABLES**

| Shielding gas: | 100% CO₂ |
| Flow rate:     | 16 – 20 litres/min |

**WELD RUN DETAILS WELDING PARAMETERS**

<table>
<thead>
<tr>
<th>PassNo</th>
<th>Filler Class</th>
<th>Filler Spec</th>
<th>Dia mm</th>
<th>Trade-name</th>
<th>Amperage range, A</th>
<th>Voltage range, V</th>
<th>Current &amp; polarity</th>
<th>Speed mm/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AS/NZS 2203.1</td>
<td>W502A,M1 H10</td>
<td>1.6</td>
<td>Optional</td>
<td>250 - 350</td>
<td>27 - 31</td>
<td>DC +</td>
<td>200 - 350</td>
</tr>
<tr>
<td>Next</td>
<td>As above</td>
<td>As above</td>
<td>“</td>
<td>As above</td>
<td>250 - 350</td>
<td>27 - 31</td>
<td>DC +</td>
<td>200 - 350</td>
</tr>
</tbody>
</table>

**Welding Technique:** Start & Finish Welding out of weld groove

**Backgouge method:** None

**PROJECT APPLICATION DATA (3.3): NON-LOAD BEARING LOCATION TACK WELDS**

Welds do not have any quantifiable structural performance. It is the installers’ responsibility to ensure welds are sufficient to resist lifting loads.

**Project Title:** Tack Welding of Reinforcement Bar

<table>
<thead>
<tr>
<th>Client:</th>
<th>Drawing No</th>
<th>Acceptance Criteria: AS/NZS 1554.3-2002 ie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weld throat, S &gt; 0.3 x Bar Diameter, Dmin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weld Length, L &gt; One Bar Diameter, Dmin</td>
</tr>
<tr>
<td>Prepared by:</td>
<td>WTIA</td>
<td>Recommended by: C Smallbone, Executive Director, WTIA</td>
</tr>
<tr>
<td>Approved by Fabricator:</td>
<td>Accepted by Client:</td>
<td></td>
</tr>
</tbody>
</table>

Acknowledgment: WTIA wishes to acknowledge the contribution of the following Technology Expert Group and WTIA SMART Building & Construction Industry Sector Group members: Smorgon Steel, OneSteel, NSW Roads and Traffic Authority, Steel Reinforcement Institute of Australia, and Bureau of Steel Manufacturers Association of Australia.
As part of the WTIA National Diffusion Networks Project, the Building & Construction Industry Sector has identified the need for reliable and cost effective tack welding of reinforcement bar. The WTIA has prepared a Technical Guidance Note “Tack Welding of Reinforcement Bar” to explain the design requirements for tack welds, typical flaws found on visual examination and provide sample weld procedure specifications for effective tack welding. As a valued technology expert in this area we would like you to be part of the Technology Expert Group to review this note. Please complete this questionnaire so that we can gauge the success of meeting this need.

Objective 1: Identify the need to increase understanding of tack welding of reinforcement bar
There is an increasing need to carry out shop and site tack welds for the growing construction market. Traditionally the quality of tack welds has been the subject of debate between inspectors and suppliers. This guidance note is intended to provide the Building & Construction Industry with key knowledge to produce acceptable tack welds. How well does the document explain tack welding of reinforcement bar?

| poor | average | good | very good |

Comments: ______________________________________________________

Objective 2: Identify appropriate technology receptors in the Building & Construction Industry
This document was written for Welding Supervisors and welders in the Building & Construction Industry. Are these people the appropriate individuals we should be targeting?

| yes | no |

What other types of companies and/or personnel do you suggest we target? __________________________________________________________

Objective 3: Identify current best practice for tack welding of reinforcement bar
The document was written to reflect current best practice for tack welding of reinforcement bar. Do you envisage opportunities for the use of this technology in the industry?

| yes | no |

If yes, what and where, if no why not? ______________________________________________________

Objective 4: Is the information provided clear, concise and accurate?

| yes | no |

If not, why? ______________________________________________________

Objective 5: Broad dissemination of technology to the Building & Construction Industry
Please indicate how best to disseminate this Technical Guidance Note to the appropriate Building & Construction Industry Recipients

Free Website Download ☐ Poster ☐ Pocket Guide ☐ Pamphlet ☐

If poster, what size? A1 ☐ A2 ☐ A3 ☐ Laminated ☐ What selling price? $

If a pocket guide, what selling price? $

Other format? ______________________________________________________
Objective 6: Continuous Improvement
Please identify areas where the document can be improved or return the document with your recommended additions/amendments. Alternatively, please use the area below to provide any additional comments.

____________________________________________________

____________________________________________________

____________________________________________________

____________________________________________________

____________________________________________________

____________________________________________________

Respondents Name: __________________ Company: __________________ Phone: __________________
Fax: __________________ Email: __________________ Date: __________________

Please Fax (02 9748 2858) or E-mail (j.baker@wtia.com.au) your response.

Your prompt response is appreciated.