

## 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   |

## 3. DEFINITIONS (TAKEN FROM AS/NZS 1554.3:2002)

*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:

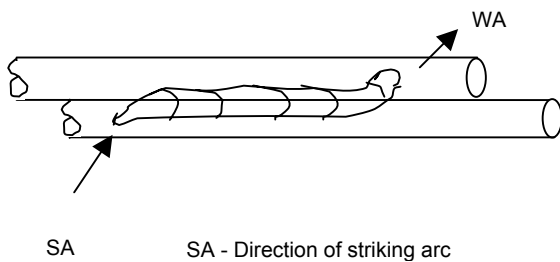


Figure 1. Example of Lap Joint  
Ø12mm to Ø 12mm

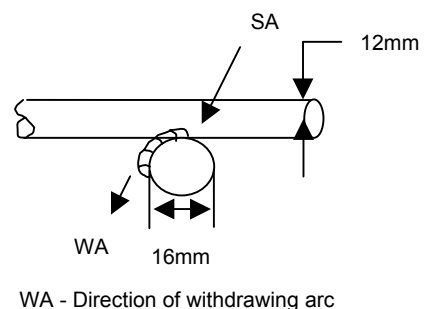


Figure 2. Example of Cross Joint  
Ø12mm to Ø 16mm

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

|                                  | Dmin, smallest bar diameter (mm) |    |    |    |    |    |    |
|----------------------------------|----------------------------------|----|----|----|----|----|----|
|                                  | 12                               | 16 | 20 | 24 | 28 | 32 | 36 |
| W, minimum weld width (mm)       | 6                                | 8  | 9  | 11 | 13 | 15 | 17 |
| L, minimum weld length (mm)      | 12                               | 16 | 20 | 24 | 28 | 32 | 36 |
| S, Minimum throat thickness (mm) | 4                                | 5  | 6  | 8  | 9  | 10 | 11 |

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

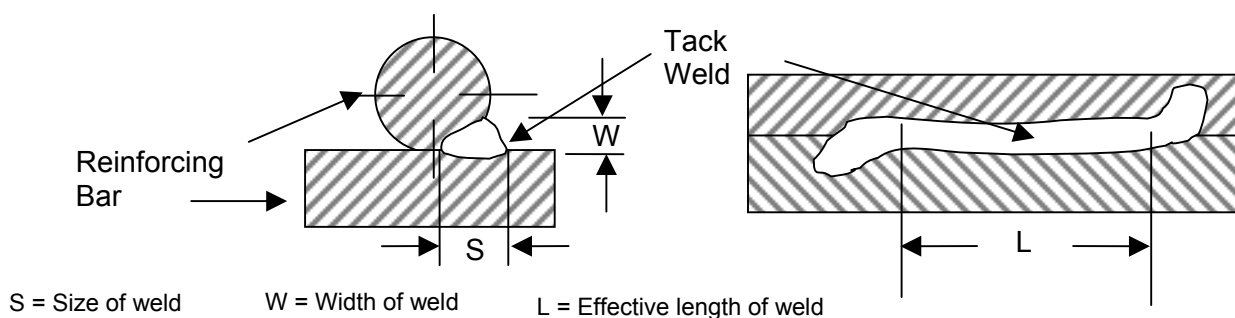


Figure 3. Schematic representation of cross and lap joints

## 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



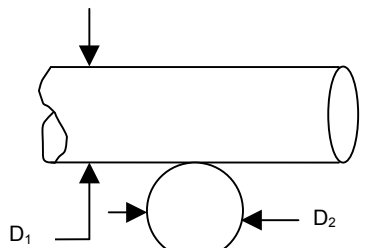
Figure 9. Example of Unacceptable Tack Weld  
Unacceptable weld width and undercut

## Appendix 1 – Sample Weld Procedure Specification for Manual Metal Arc Welding

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

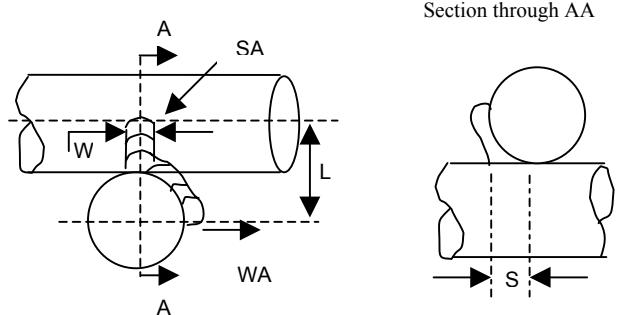
|  |   |
|--|---|
| Material Spec/Grade <b>AS4671 Gr 250N, 500L &amp; N</b>                                    | WPS No: WTIA-Reobar-MMAW Rev. 0 Date: <b>6/6/05</b> |
| Type of weld (App B Figure B1 d) <b>Joining Crossed Bars</b>                               | Revision: <b>0</b> Revision Date: <b>N-A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

**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

| 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/NZS1553.3 | E4816       | 3.2    | Enter name | 100 - 150          | 22 - 26          | AC or DC +         | 100 - 120    |
| Next If required | As above     | As above    | "      | Enter name | 100 - 150          | 22 - 26          | AC or DC +         | 100 - 120    |
|                  |              |             |        |            |                    |                  |                    |              |

|   |                               |
|---|-------------------------------|
| Welding Technique: <b>Start &amp; Finish Welding out of weld groove</b> | Backgouge method: <b>None</b> |
| Initial cleaning: <b>Wire Brush, chipping, grinding</b>                 | Backgouge check: <b>None</b>  |
| Inter-run clean: <b>Wire Brush, chipping, grinding</b>                  |                               |

**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.  
 Weld throat, **S**: > 0.3 x Bar Diameter, **Dmin** Weld Length, **L** > One Bar Diameter, **Dmin**  
**Note:** 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.

|                           |  |
|---------------------------|--|
| Prepared by : <b>WTIA</b> | Recommended by: <b>C Smallbone, Executive Director, WTIA</b> |
| Approved by Fabricator:   | Accepted by Client:  |

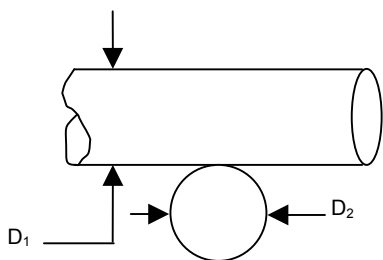
\* Disclaimer applies – WTIA  
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## Appendix 2 – Sample Weld Procedure Specification for Gas Metal Arc Welding

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

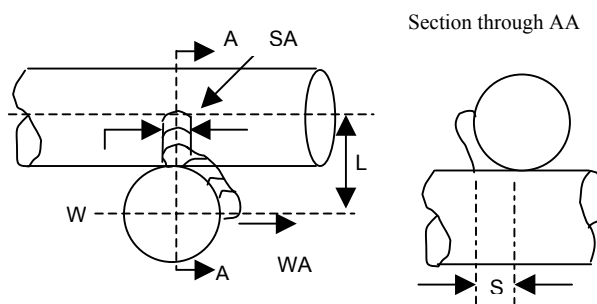
|   |  |
|---|--|
| Material Spec/Grade <b>AS4671 Gr 250N, 500L &amp; N</b>                                   | WPS No: WTIA-Reobar-GMAW Rev. 0      Date: <b>6/6/05</b> |
| Type of weld (App B Figure B1 d) <b>Joining Crossed Bars</b>                              | Revision: <b>0</b> Revision Date: <b>N-A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

**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

#### WELDING CONSUMABLES

|   |                               |
|---|-------------------------------|
| Flux: N/A                                 | Usage rate: N/A               |
| Shielding gas: Argon + 8% CO <sub>2</sub> | Flow rate: 16 – 20 litres/min |

#### WELD RUN DETAILS

#### WELDING PARAMETERS

| Pass No          | 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: <b>Start &amp; Finish Welding out of weld groove</b> | Backgouge method: <b>None</b> |
| Initial cleaning: <b>Wire Brush</b>                                     | Backgouge check: <b>None</b>  |
| Inter-run clean: <b>Wire Brush</b>                                      |                               |

#### 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**

Client:

Drawing No \_\_\_\_\_ 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

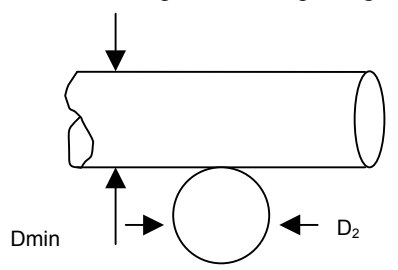
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Email: info@wtia.com.au    URL: <http://www.wtia.com.au>

## Appendix 3 – Sample Weld Procedure Specification for Flux Cored Arc Welding

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

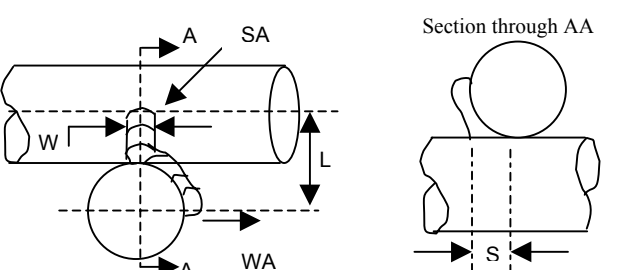
|   |   |
|---|---|
| Material Spec/Grade <b>AS4671 Gr 250N, 500L &amp; N</b>                                   | WPS No: WTIA-Reobar-FCAW Rev. 0 Date: <b>6/6/05</b> |
| Type of weld (App B Figure B1 d) <b>Joining Crossed Bars</b>                              | Revision: <b>0</b> Revision Date: <b>N-A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

**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

#### WELDING CONSUMABLES

|   |                                      |
|---|--------------------------------------|
| Shielding gas: <b>100% CO<sub>2</sub></b> | Flow rate: <b>16 – 20 litres/min</b> |
|---|--------------------------------------|

| 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 2203.1 | W502A.M1 H10 | 1.6    | Optional   | 250 - 350          | 27 - 31          | DC +               | 200 - 350    |
| Next If required | As above      | As above     | “      | As above   | 250 - 350          | 27 - 31          | DC +               | 200 - 350    |

|   |                               |
|---|-------------------------------|
| Welding Technique: <b>Start &amp; Finish Welding out of weld groove</b> | Backgouge method: <b>None</b> |
| Initial cleaning: <b>Wire Brush, chipping, grinding</b>                 | Backgouge check: <b>None</b>  |
| Inter-run clean: <b>Wire Brush, chipping, grinding</b>                  |                               |

**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**  
 Client:  
 Drawing No \_\_\_\_\_ 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:

**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.

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|--|--|--|
| <b>NDNP<br/>TECHNOLOGY<br/>DIFFUSION<br/>ACTIVITY # 27</b> | <br>Welding Technology Institute of Australia<br>ABN 69 003 696 526           | <b>Document No:</b><br>9.4.5QR-0002            |
|  | <b>NATIONAL DIFFUSION NETWORKS PROJECT<br/>TECHNOLOGY QUESTIONNAIRE<br/>Building &amp; Construction Industry Group<br/>“Tack Welding of Reinforcement Bar”</b> | <b>Revision No:</b> Rev 0                      |
|  |  | <b>Page 1 of 2</b><br><b>Date:</b> 21 Nov 2005 |

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? \_\_\_\_\_

|  |   |  |   |
|--|---|--|---|
| <b>NDNP<br/>TECHNOLOGY<br/>DIFFUSION<br/>ACTIVITY # 27</b> | <br><small>Welding Technology Institute of Australia</small><br>ABN 69 003 696 526<br><b>NATIONAL DIFFUSION NETWORKS PROJECT<br/>TECHNOLOGY QUESTIONNAIRE<br/>Building &amp; Construction Industry Group<br/>"Tack Welding of Reinforcement Bar"</b> | <b>Document No:</b><br>9.4.5QR-0002            | 2 |
|  |   | <b>Revision No:</b> Rev 0                      |   |
|  |   | <b>Page 2 of 2</b><br><b>Date:</b> 21 Nov 2005 |   |

**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.

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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.**

The WTIA has joined forces with industry and government to create a 3.5 million dollar Technology Support Centres Network. This network will assist industry to identify and exploit world's best technology and manufacturing methods to establish a vibrant Australian industry beyond 2006. Together we will be implementing a step by step process which will lead to ongoing viability and greater profitability for all concerned:



- (1) Determine your technological and manufacturing needs;
- (2) Identify world's best practice;
- (3) Draw upon the network to implement world's best practice at your site

