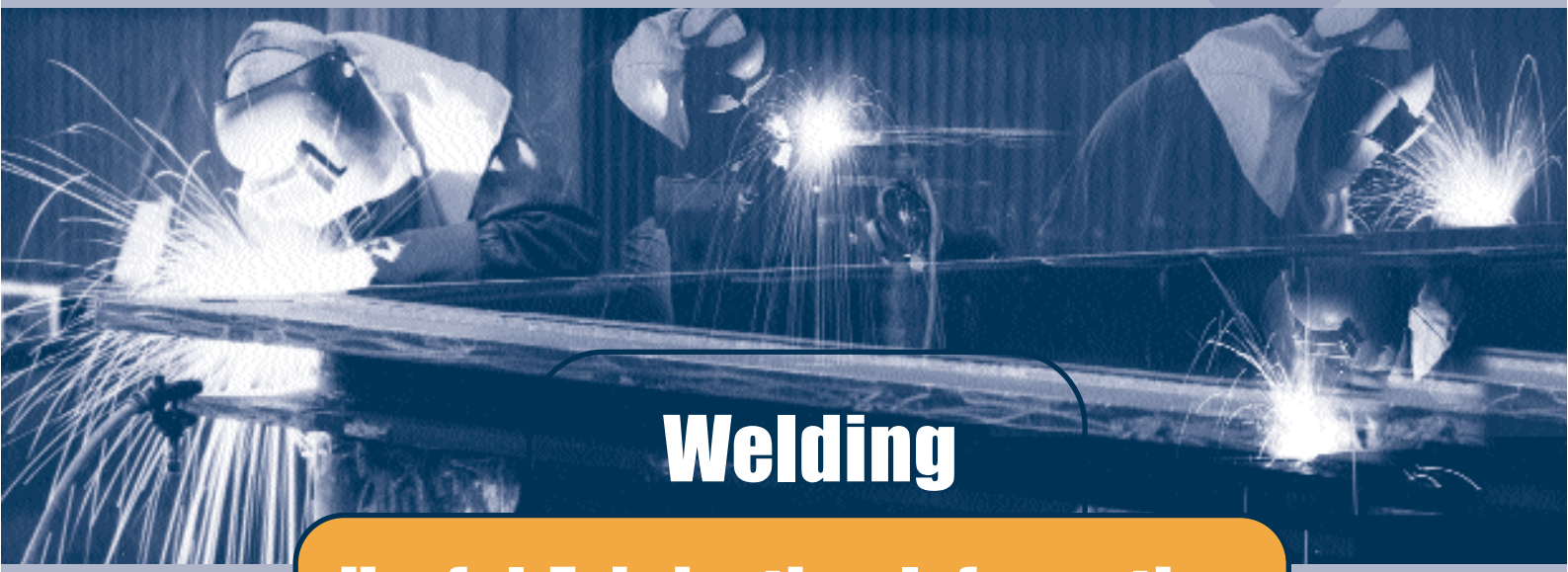
Welding



Welding

Useful Fabrication Information

Weldability Guide

The following data provides information on the weldability of a range of BlueScope Steel plate grades. Although most of the steels listed are readily weldable, an incorrect choice of welding conditions may lead to unnecessary difficulty. The data gives recommendations for the control of heat affected zone hardness and thus provides a measure of protection against heat affected zone cracking, through the correct combination of welding energy (heat) input and preheat for the welding process concerned.

The use of controlled heat inputs for reasons other than the avoidance of heat affected zone cracking, eg. specifically for control of notch toughness, joint strength, weld metal cracking, or avoidance of hot cracking, is outside the scope of this brochure.

The basis of the Weldability Guide is a Group Number based on the steel grade composition. Grades having a low Group Number (low carbon equivalent) are readily welded, whilst high Group Numbers (high carbon equivalent) indicate need for care in the selection of welding conditions.

Reference should be made to Welding Technology Institute of Australia (W.T.I.A) Technical Note 1 for additional guidance regarding practical welding variables.

Whilst these recommendations can be used with a high level of confidence, they are a guide only, and as such, BlueScope Steel can not guarantee that cracking will never occur.

The preheat and weldability recommendations provided herein do not override the user's obligation to demonstrate suitability of the planned welding procedures through the use of procedure qualification tests as prescribed by AS/NZS 1554.1:2000 and other applicable fabrication standards. Additionally, it is assumed welding is performed by suitably qualified welders ie. capable of complying with the minimum requirements of AS/NZS 1554.1:2000 Section 4.12.2 Welder Qualifications.

The user should also be aware that good joint fit up under moderate levels of restraint are assumed, and that additional preheat beyond that recommended will be required where fit up is poor or where high levels of restraint are likely to be encountered.

Figure 1
Method of establishing Joint Weldability Index (A to L) from Grade Group Number and Joint Combined Thickness

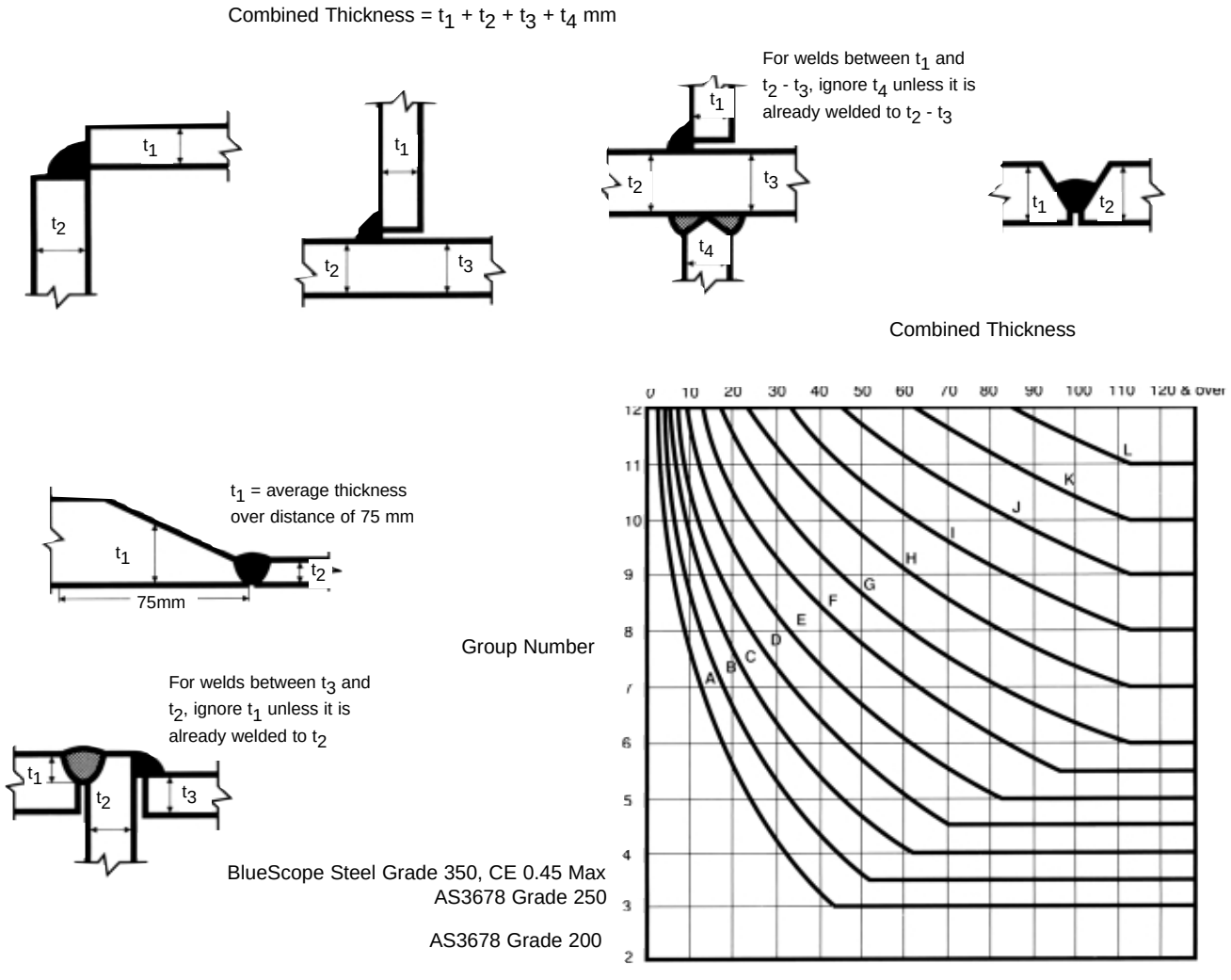
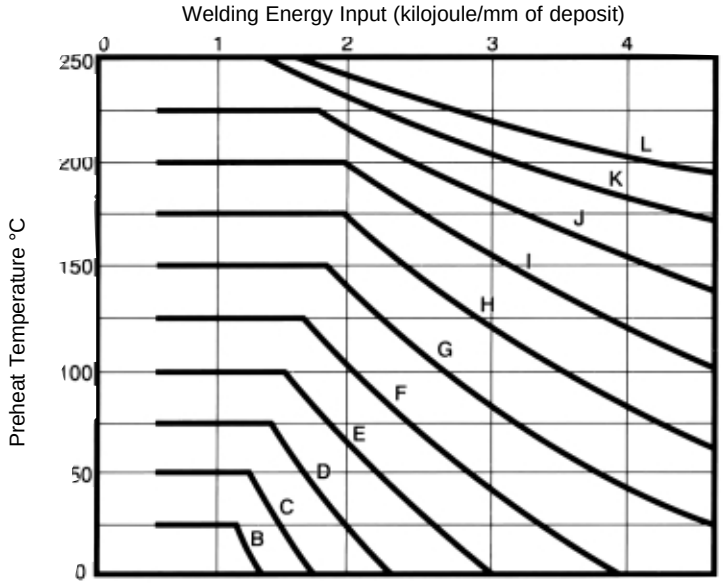
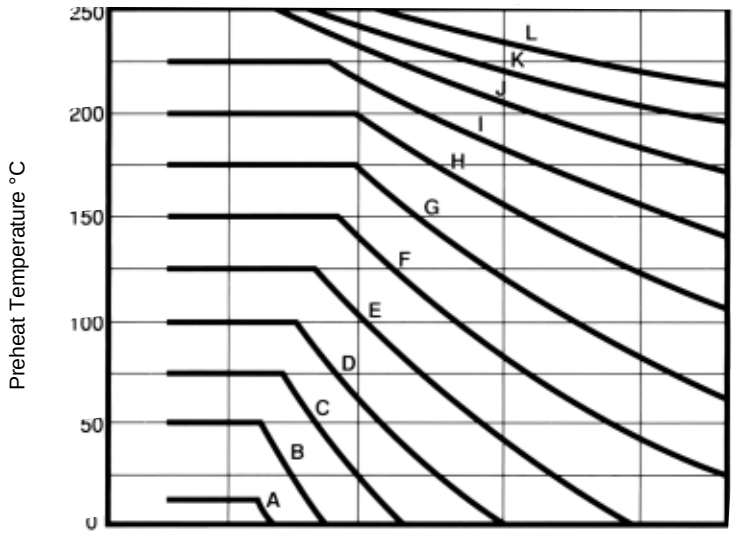


Figure 2
Method of establishing Pre-heat Temperature using Joint Weldability Index Letter and Welding Energy Input

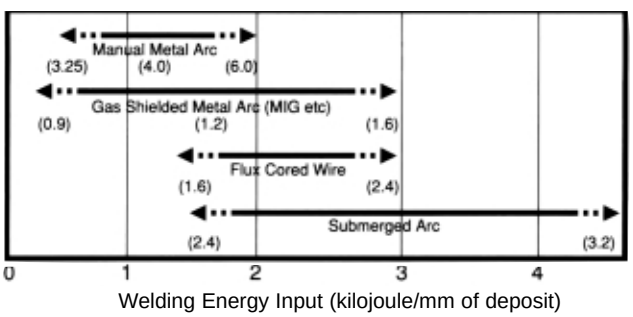
Pre-heat and Energy Input Requirements for Low Hydrogen Electrodes (EXX15, EXX16, EXX18, EXX28) Semi-automatic and Automatic Welding Processes



Pre-heat and Energy Input Requirements for Manual Metal Arc Welding with other than Low Hydrogen Electrodes



Typical Energy Input Requirements for Various Welding Processes. (Electrode wire sizes shown in brackets - mm)



Procedure for Determining Preheat and Welding Energy Input

To find the welding energy input and the preheat temperature required for use with a particular welding process and steel grade of known thickness, the steps given below should be followed:

Step 1: From Table 1 find the "Group Number" for the steel grade. For joints containing different steels use the higher Group Number.

Step 2: Using Figure 1 calculate the "Combined Thickness" of the joint.

Step 3: From Figure 1 find the closest curve to the intersection of Combined Thickness and Group Number. This curve designates the "Joint Weldability Index Letter".

Step 4: From Figure 2 and using the curve bearing the same Joint Weldability Index Letter found from Step 3, read off the preheat temperature for the welding energy input or vice versa.

Suggested Further Reading

1. Welding Technology Institute of Australia Technical Notes

Note 1 The Weldability of Steels

Note 2 Care of Manual Arc Welding Steel Electrodes

Note 5 Flame Cutting of Steels

Note 6 Control of Lamellar Tearing

Note 8 Design for Economic Welding

Note 11 Commentary on the Structural Steel Welding Standard AS/NZS 1554

Note 12 Minimisation of Corrosion in Welded Steel Structures

2. Steel Structures - A manual for use in the design and construction of structural steelwork. Prepared by the Australian Institute of Steel Construction and published by the Standards Association of Australia.

3. Economical Structural Steelwork- Published by the Australian Institute of Steel Construction, 4th Edition, 1997.

4. AS/NZS 1554.1 Structural Steel Welding Part 1: Welding of Steel Structures.

Table 1 - Weldability Guide - Steel Grades and Group Numbers

Qualifying Notes
O - Any electrode type or welding process is satisfactory,
H/O - Hydrogen controlled electrodes, or semi-automatic, or automatic processes are recommended; but rutile or other electrodes may be used.
H - Hydrogen controlled electrodes, or semi-automatic, or automatic processes are essential for good welding.
SC - Slow cooling from welding or preheat temperature is recommended.
SR - Postweld heat treatment (stress relief) is suggested for high quality work, particularly where severe service conditions apply to the component.

Grade Designation	Group Number	Qualifying Notes
BlueScope Steel Structural Grades – AS/NZS 3678		
- 200	1	O
- 250, 250L15, 300,300L15	4	O
- 350, 350L15, 400, 400L15	5	O
- 450, WR350, WR350LO	5	H/O
BlueScope Steel Analysis Grades – AS/NZS 3678		
A1006	1	O
K1042	8	H, SC, SR
BlueScope Steel Hot Rolled Strip Grades – AS/NZS 1594		
HA1, HA3	1	O
HA200	1	O
HA250, HU250	3	O
HU300, HU300/1	3	O
HA350	3	O
HW350	5	H/O
XF300	3	O
XF400	3	O
XF500	4	O
XK15B30	6	H, SC, SR
Shipbuilding Grades		
Lloyds, Norske Veritas		
Grade A	4	O
Grade D	4	O
Grade E	4	O
Boiler & Pressure Vessel Grades		
AS 1548 - 5 - 490	5	H/O
- 7 - 460	4	O
- 7 - 490	4	O

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