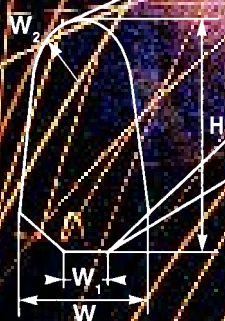


Welding of **BOROX 500**



BOROX
INTERNATIONAL



BOROX 500 has low carbon equivalent for its strength class

BOROX 500 has low contents of alloying elements and thus have low carbon equivalent. As a result, it can be easily welded to all ordinary structural plate using any conventional arc welding methods.

The low carbon equivalent reduces the risk of hydrogen cracking. The carbon equivalent increases with higher plate thickness.

Thickness range 5 – 80 mm

Carbon equivalent CE (IIW) 0,58 – 0,68 (typical values)

The carbon equivalent can be calculated from the following equation :

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

The risk of hydrogen cracking can be minimised by :

- preheating the parent material before welding.
- ensuring that the joint surfaces are perfectly clean and dry.
- minimising the shrinkage stresses. This can be achieved by a good fit between the workpieces and a well planned sequence of weld runs (balanced welding).
- selecting a filler material with low hydrogen content.

Preheating

Preheating is most important in tack welding and in welding of the root pass.

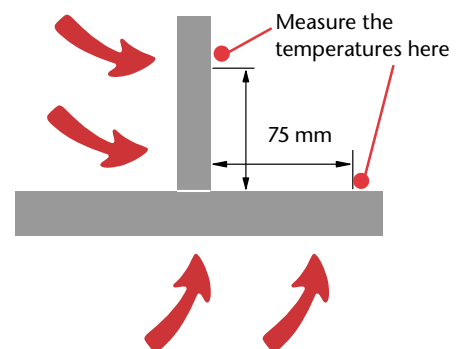
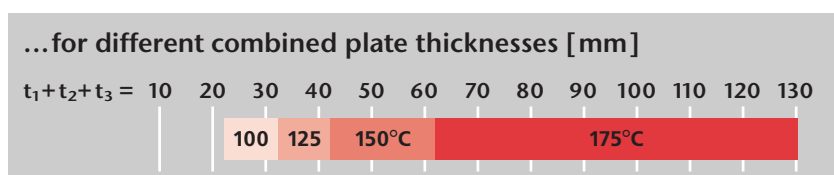
The higher the temperature during and after welding, the easier it will be for the hydrogen to escape from the steel.

The need for preheating increases with the plate thickness (see the table below).

If the ambient humidity is high and/or the temperature is below +5°C, the tabulated value should be increased by 25°C.

If different steel grades are welded together or if the electrodes used for welding have a higher CE than the parent material, the necessary preheating is determined by the steel (or electrode) with the highest carbon equivalent.

Recommended preheating temperatures for BOROX 500



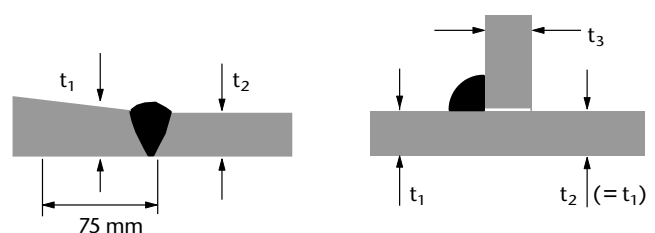
Recommended interpass temperature 150 – 175 °C

Note : CAUTION Post Weld Heat Treatment (PWHT)

BOROX 500 must not be subjected to PWHT as this would reduce the hardness.

Combined plate thicknesses, mm

t_1 = mean thickness within a distance of 75 mm from the weld metal.



Selection of heat input

To calculate the heat input

$$Q = \frac{\eta \cdot U \cdot I \cdot 60}{v \cdot 1000}$$

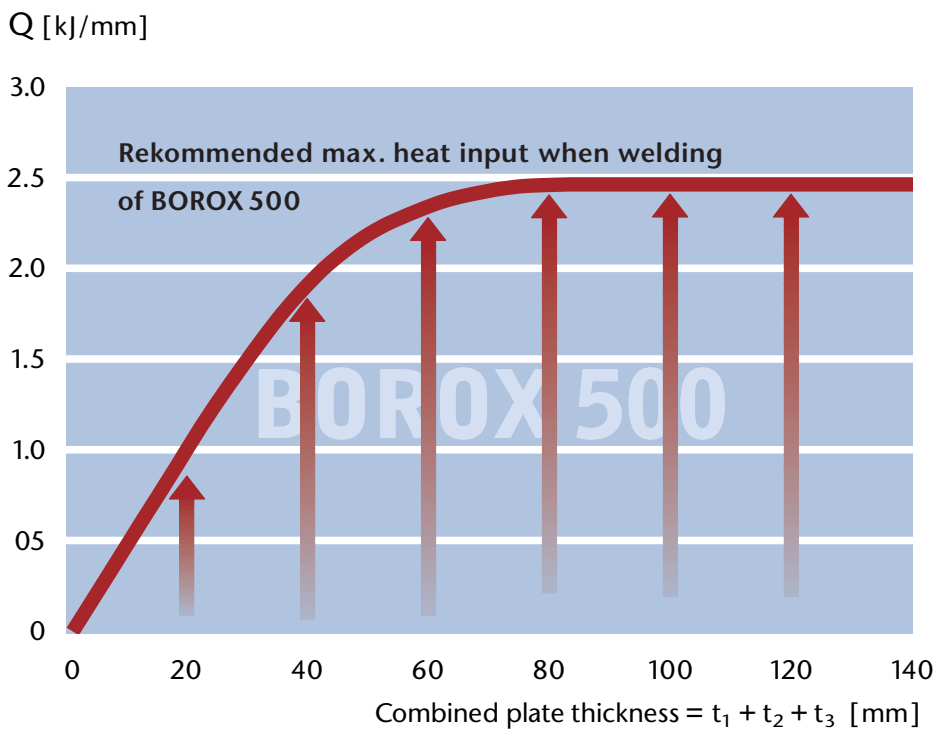
Q = Heat input [kJ/mm]

U = Voltage [V]

I = Current [A]

v = Welding speed [mm/min]

η = Arc efficiency factor



Arc efficiency factor	η
Manual metal arc (MMA)	0.8
Gas metal arc (MIG / MAG)	0.8–0.9
Flux cored arc (FCAW)	0.9
Submerged arc (SAW)	1.0
TIG (GTAW)	0.7

The higher the heat input the larger the HAZ.

Retain the hardness and wear resistance of the plate by welding with as low a heat input as possible.

Selection of filler material for welding BOROX 500™

BOROX 500 should be welded with soft basic electrodes. A soft electrode is a filler material with a yield strength below 500 N/mm². Such electrodes reduce the residual stress level in the joint and thus its sensitivity to cold cracking.

If the weld is located so that it is subjected to heavy wear, hard facing electrodes can be used for the cap beads.

BOROX 500 can very successfully be welded with austenitic stainless steel filler material in the following cases :

- if the workpiece is rigidly restrained
- if the workpiece cannot be preheated
- if the plate is thicker than 60 mm

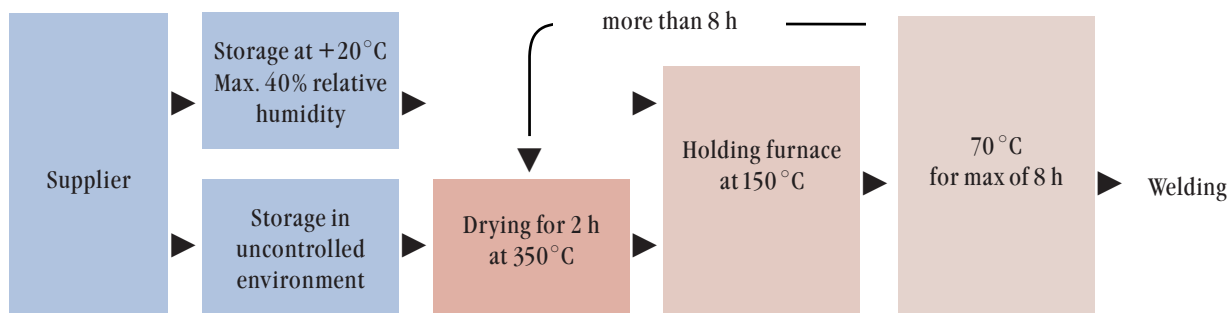
Filler material (AWS-classes)				Weld metal R _{p0.2} [N/mm ²]
MMA Manual metal arc	SAW Submerged arc	MIG / MAG Gas metal arc	FCAW Flux cored arc	
AWS A5.5 E 8018 AWS A5.5 E 8016	AWS A5.23 F 8AX-EX AWS A5.23 F 7AX-EX	AWS A5.28 ER 80S-X	AWS A5.29 E 8XT-X	500
AWS A5.5 E 7028 AWS A5.1 E 7018 AWS A5.1 E 7016	AWS A5.17 F 7AX-EX	AWS A5.18 ER 70S-X	AWS A5.20 E 7XT-X	400

Note: "X" stands for one or more characters.

General recommendations for the selection of filler material for welding BOROX500

- Basic flux should always be employed in FCAW, SAW and MMA welding.
- Always use a filler material with low hydrogen content (HD ≤ 5 ml / 100 g).

In order to prevent moisture absorption, the filler material should be stored in accordance with the manufacturer's recommendations. If there is risk of moisture having been absorbed, the filler material must be scrapped or re-dried in accordance with the manufacturer's instructions.



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