WELDING,FABRICATION AND REPAIRS

FABRICATION

Flat profiles and formed sections can be fabricated into larger items or finished structures using conventional welding procedures. Liners may be fixed to existing structures by bolting or by various welding techniques.

All structural welds must be applied to the substrate.

Methods of attachment - Fillet Welding

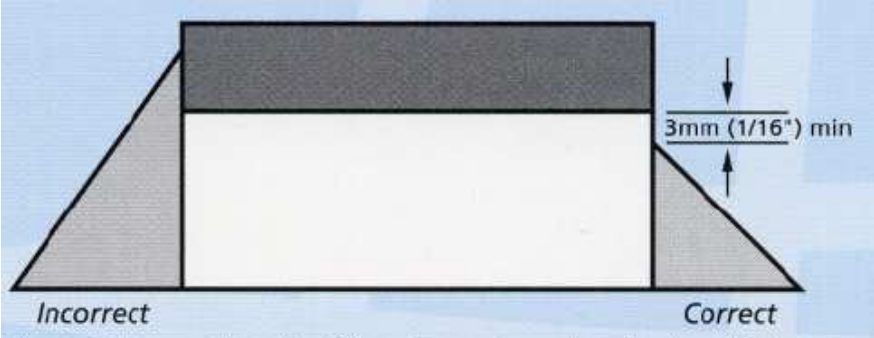


Figure 3 *Ensure that the fillet does not overlap the hardfacing by stopping it above 3mm (1/16") below the interface.*

The easiest method for attaching Triten overlay plate to an existing structure is by a fillet weld. Care should be taken to ensure that the weld is applied to the substrate only and does not overlap the hardfacing or its penetration, as this can lead to carbon contamination and embrittlement of the weld. This is best achieved by stopping the fillet approximately 3mm (1/8") below the alloy/base plate interface which should be clearly visible on a ground edge. See figure 3.

Any common welding process may be used including:

- Shielded metal arc welding (US - SMAW)
  Manual metal arc welding (UK - MMA)

- Gas metal arc welding (GMAW) using solid wire

- Flux cored arc welding (FCAW) using gas shielded or open arc wires.

Selection of welding rods/wires - Where the overlaid plate has a standard carbon steel substrate and the structure onto which the

plate is to be attached also comprises carbon steel or a steel which **does not** require preheat, the following types of consumables may be used:

• Coated rods:	AWS A5.1 -	E7016	EN499 E424 B12HS
	or	E7018	EN499 E463 B32HS
• Solid Wire for CO2 welding:	AWS A5.18 -	ER70S-3	EN440 G/W 2Si
	or	ER70S-6	EN440 G3Si1
• Flux cored wires:	AWS A5.20 -	E70T-1	EN758 T460 RC3H10
	or	E71T-1	EN758 T463 PM1HS

If the structural member requires preheat, either because of its chemical composition, yield strength or thickness, a grade of welding rod or wire should be selected compatible with normal practice for that base material:

For example: AWS A5.5 - E8018B2 (EN 1599 ECr.Mo1 B32HS)

If the Triten overlay has a stainless or alloy steel substrate and the structure to which it is to be welded is a high alloy manganese steel, through-hardened steel or a type AiSI-410 or 304 stainless alloy, then a suitable dissimilar metal alloy such as a AWS A5.4 - E309 (EN1600 E23.12 LR21) stainless type rod (electrode) or wire should be used.

Methods of attachment - Plug Welding

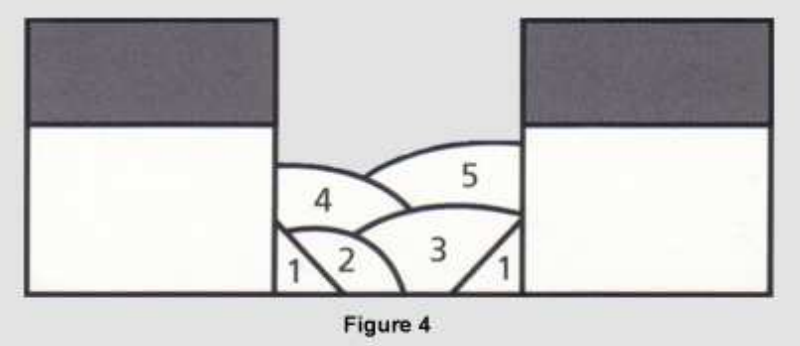


Figure 4

Triten overlay plate can be attached to another plate or structure by plug welding through a series of holes. Each hole should have a minimum 25mm (1 inch) diameter, typically set at between 300mm - 600mm (12 to 24") spacing.

Fixing holes should be cut by either carbon-arc gouging or plasma-arc cutting from the substrate side where possible to prevent chromium and carbon contaminating the carbon steel. When gouging plates thicker than 9.5mm (3/8") it is recommended that a hole is first drilled into the substrate to stop just short of the alloy interface before gouging is started.

All slag should be removed from the fixing holes by grinding or chipping/ hammering.

The plate is then attached to the structure by welding the outside diameter of the hole through 360 degrees and then filling the remaining space using the pattern shown in figure 4.

The thickness of the weld should be determined using the same criteria as for fillet welding and should stop 3mm (1/8") short of the overlay alloy layer. When the weld has been filled to the desired level, it can be protected from abrasion by 'capping' with a suitable wear resistant alloy using Triten Armalloy tubular hardfacing rods (electrodes).

Methods of attachment - Stud Welding

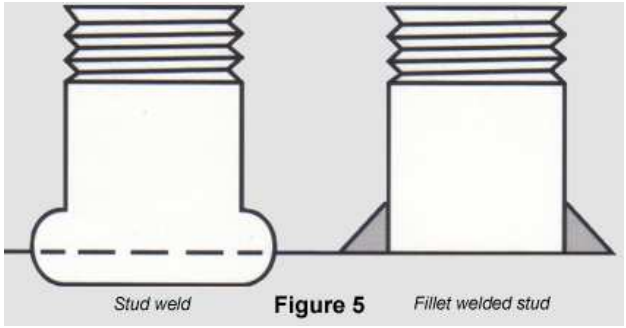


Figure 5

A standard carbon steel stud can be easily welded to the back of the Triten overlay plate using most types of stud welding equipment. The minimum recommended stud size is 19mm (3/4") and the number and spacing of the studs will depend on the size and shape of the plate being attached.

Studs with a diameter greater than 12.5mm (1/2") may be hand welded with the SMAW (manual metal arc process) using an E7018 rod (electrode). Since only a fillet weld is employed rather than a full penetration weld, a greater number of studs will be needed to secure the plate. See figure 5.

Method of attachment - Countersunk Bolts

Cross section of fixing hole with countersunk machined insert. Suitable holes for countersunk bolts may be produced by direct plasma arc cutting using an orbital tool post, by piercing or gouging a straight hole and welding a pre-machined insert in place, or by a combination of direct drilling and gouging.

The minimum recommended bolt size is 9.5mm (3/8") diameter and the number and spacing required will depend upon the size and shape of the plate.

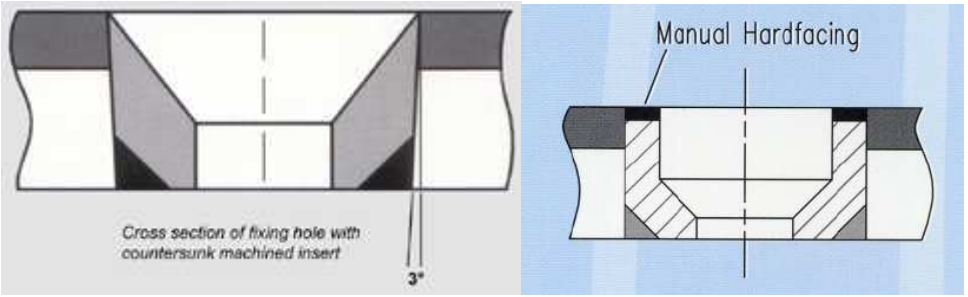
The finished counter sunk hole should allow the flat headed bolt to sit approximately 4mm below the surface of the plate. It can be protected from abrasion by 'capping' with a suitable Triten Armalloy tubular hardfacing electrode.

Direct plasma arc piercing - produces an acceptable countersunk hole. Working from the hardfaced side, the straight clearance hole should be cut first and then the plasma torch tilted to cut the countersunk section at an angle to match the fixing bolt.

Pre-machined inserts - Accurate pre-machined inserts may be used to fix overlay plates by cutting a straight hole in the plate and welding the insert in place from the carbon steel side.

Plasma arc cutting from the hardfaced side of the plate is recommended because it creates a naturally tapered hole which provides additional support for the insert.

The insert should be machined with a taper of around 3 degrees to match the hole and a chamfered weld preparation cut into the base. It is then welded into place from the carbon steel side using a low hydrogen electrode (AWS 5.1 - E7018 or 7016 type).



Gouging - this process is generally used on-site when plasma-arc cutting in not available. If a large number of holes is required, welded inserts are recommended and gouging should be used purely to cut the clearance hole.

An alternative method for one or two holes involves gouging a straight hole from the carbon steel side (see also cutting). The countersunk section is then created by gouging a taper from the hardfaced side. The holes may be cleaned with abrasive cone/plug shaped grinding stones.

STRUCTURAL CALCULATIONS

In load bearing applications, the surfacing must be taken as having no structural strength due to the cracking within the hardfacing. There must be an allowance made to accommodate the penetration into the base material during surfacing. It is recommended that calculations should be based upon the starting base plate thickness minus 2mm.

E.g. A 4 on 10mm plate (4mm hardfacing on a 10mm base plate) must be based on the strength of an 8mm plate, but the weight of a 14 mm plate. The standard backing plate is BS EN 10025 – S275.

STRUCTURAL WELDING

Triten overlay plate can be fabricated by welding the mild steel substrate using standard mild steel or low hydrogen electrodes. The following details are a general guide to welding Triten overlay plate.

Care must be taken to ensure that all structural welds stop short of the hardfacing alloy layer. The only welding carried out on the hardfaced side of the plate will involve the capping of joints, for wear protection, with a compatible Triten Armalloy tubular hardfacing electrode.

Fillet welds - Grind the edge of the plate to remove any slag and scale left from cutting. Care should be taken to ensure that the weld is applied to the substrate only and does not overlap the hardfacing or its penetration zone, as this can lead to carbon contamination and embrittlement of the weld and the adjacent area. This is best achieved by stopping the fillet approximately 3mm (1/8") below the overlay/base plate interface which should be clearly visible on a ground edge. (See figure below).

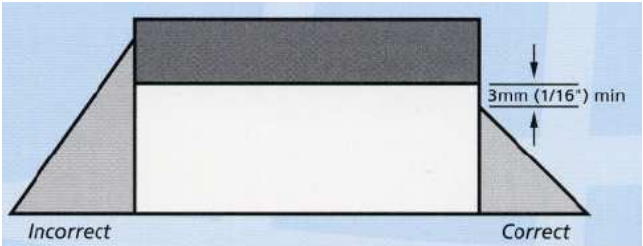


Figure 3 *Ensure that the fillet does not overlap the hardfacing by stopping it above 3mm (1/16") below the interface.*

Butt Welds - Partial penetration butt welds involve cutting a bevel into the carbon steel base by gouging or flame cutting (See figure 6). A 2mm to 3mm (1/16-1/8") 'land' should be left to prevent burn-through to the hardfaced layer when welding (See figure 7). Fit and tack the sections, then weld using the same technique as conventional joining.

Full penetration butt welds require the hardfacing (including alloy penetration zone see figure 8) to be completely removed from the joint area by grinding/ gouging back to at least 6mm (1/4") past the weld joint area.

Fit and tack the bevelled sections, then weld using the same technique as conventional joining.

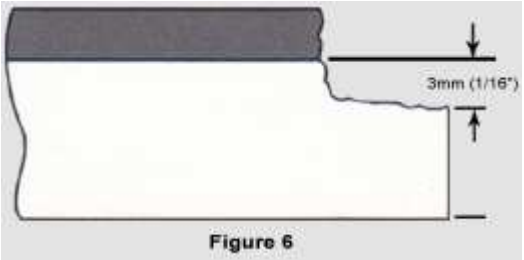


Figure 6

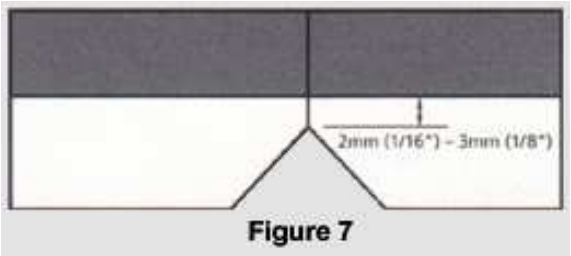


Figure 7

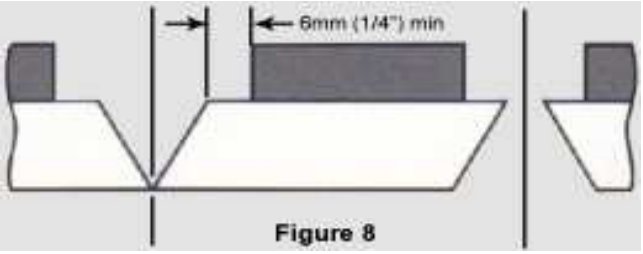


Figure 8

Welding Technique and Consumable Selection

The root pass must not melt through the 'land' into the hardfacing as this will lead to carbon contamination and embrittlement of the weld.

Welding consumables commonly used for structural welding of C-Mn steels should be employed and conventional welding procedures/techniques should be used.

For example:

AWS 5.1 - E7018 (SMAW)

AWS A5.18 - E70S-6 (GMAW) with 75% Argon 25% CO_2

AWS A5.20 - E70T-1 (FCAW)

Note: Where the fabrication proves difficult to align with sufficient accuracy to ensure that no contamination by the hardfacing is likely during welding, it is recommended that a 309 type stainless steel welding rod (electrode) be used.

SUMMARY OF PROCEDURES

• Always use a radiused top tool when forming with a press brake.

• Ensure that no hardfacing can contaminate the welds. If in doubt, use a AWS A5.4 - E309 stainless steel consumable during fabrication.

• Use conventional welding consumables and procedures for fabrication to match the substrate requirements.

• Cap joints on the facing side with a matching hardfacing electrode from the Triten Armalloy range.