Hot Dip Galvanizing Data Sheet GA

2.10 Welding After Galvanizing

1. General

From time to time it may be necessary to weld hot dip galvanized components on site or to produce steel fabrications from semi-manufactures which have already been galvanized. Also, it is not always possible or practical to fully assemble components before they are galvanized and in some cases the complete welded assembly may be too large to galvanize or too difficult to handle and transport. In these cases too, it will be necessary to weld after galvanizing.

The essentials of welding galvanized steel are the same as those of welding ungalvanized steel. Tests on the most commonly used steels have shown that mechanical properties are not significantly changed by hot dip galvanizing whether or not the steel has been welded.

Hand held electric arc welding is common and has advantages which are described later in this data sheet. Gas welding is most suitable for hot dip galvanized steel up to 3 mm thick, but it has the disadvantage that the heat affected area around the weld is greater than it is in hand held arc welding and so the effect on the galvanized coating is also more extensive.

Resistance welding methods are most often used where it is necessary to weld hot dip galvanized sheet metal.

2. Welding practice

Because the welding operation uses high temperatures, the zinc coating immediately adjacent to the weld and on both sides of the component is either completely vaporised or otherwise heat affected. Welding operations must take account of this and the welder must be prepared to disperse the greyish-white fumes of zinc oxide which are evolved. The resulting reduced visibility of the weld pool can sometimes lead to unsatisfactory and porous welds. However, if sensible precautions are taken to maintain visibility, welds on galvanized steel will have the same mechanical properties as those on uncoated steel.

Guidance for welding galvanized steel is given in Figure 1.

Figure 1a shows *butt welding*. In butt welding galvanized steel the distance between the steel plates should be slightly greater than for butt welding ungalvanized steel. This allows the vaporised zinc oxide to escape more readily from the weld pool, avoiding pores. The same guidance can be used for V profiled welds.

Figure 1b shows that the *speed of welding* is important in producing a good quality weld in galvanized steel. A slower than usual welding rate will allow zinc oxide vapour to escape from the weld pool. Rapid welding will result in zinc oxide vapour becoming trapped in the weld, leading to the formation of pores.

Figure 1c illustrates the fact that the existence of *vaporised zinc oxide in the arc* affects the arc's stability. A slight increase in the welding current is recommended to improve arc stability and to encourage ready vaporisation of zinc oxide from the weld pool.

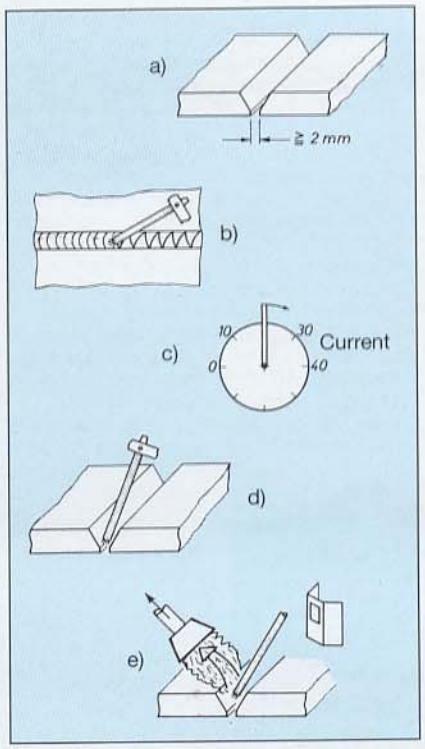

Fig. 1: Essential information for welding hot dip galvanized steel.

Figure 1d shows that the *correct choice of electrode* is essential. Electrodes which produce a slag with a long solidification time are preferred for welding galvanized steel as the lower freezing rate of the slag gives zinc oxide vapour more time to escape from the weld metal. The recommended rods for welding mild and structural steels in which the welds will not be subjected to exceptional stress are rutile or rutile-cellulose coated and of normal diameter. The correct selection is particularly important for avoiding the inclusion of zinc at the weld root. Once the weld root has been established the choice of electrode becomes less important because the steel faces to be welded will be largely free of zinc as a result of the initial operation to establish the weld root.

Figure 1e shows that *proper health and safety precautions* should be observed to avoid exposure of the welder to zinc fume which exceeds prescribed limits. Good ventilation must be established. Figure 2 shows a commercially available welding torch equipped with an integral fume exhaust.

Sometimes welding specifications call for the weld to be made on steel which is free of zinc although the component has already been galvanized. In this case the zinc coating should be removed over a distance of at least 10 mm from either side of the intended weld and on both sides of the workpiece. The most effective means of removing the galvanized

Fig. 2: Gas welding on a lorry cab constructed from hot dip galvanized steel plate.

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coating is by burning it off (remember to observe health and safety precautions about zinc oxide fume) at a temperature below the welding temperature. Grinding or other abrasive methods will probably leave traces of zinc. Burning should give a zinc free weld site without any further brushing or grinding.

3. Welding methods

Where automated *arc welding with open or shielded arcs* is used the usual problem is incorrect distance between the workpieces to be welded. Too small a separation results in a porous weld due to entrapment of vaporised zinc oxide. Best results are obtained if the separation is increased and the welding speed reduced. The larger weld pool gives vaporised zinc oxide a better opportunity to escape.
Metal Active Gas (MAG) welding is frequently employed. In many cases a mixture of 20% CO_2 and 80 % argon may be used as this offers a better result than pure argon shielding. The same guidance applies here. The welding speed for galvanized steel should be lower than for ungalvanized steel. An increase in separation of 1 – 2 mm reduces pore formation and a slight oscillating movement of the wire electrode improves weld annealing.
In *short arc CO_2 welding* of galvanized steel there is a tendency for increased weld spatter which readily adheres to the adjacent galvanized coating. The use of a suitable anti-spatter spray in the area local to the weld is recommended. On ungalvanized steel MAG butt and V welds will usually show a perfect structure when X-rayed. An equally good result can be achieved on galvanized steel by an appropriate reduction in welding speed.
Sprayed arc or pulsed arc welding gives good results so long as the advice given above is followed.

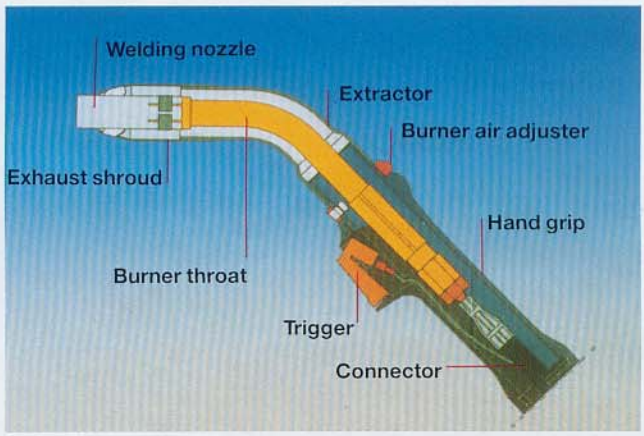

Fig. 3: MIG / MAG type gas welding torch.

Fig. 4: Making good with zinc-rich paint.

TIG welding is not recommended for galvanized steels as the zinc vapour has a detrimental effect on the arc and damages the tungsten electrode.
It should be stressed that good welds can be achieved on galvanized steel using most welding methods, but small changes in welding practice are required and operators will need to progress up a learning curve until they have established the correct parameters.

4. Restoring zinc coatings

All welds on galvanized steel destroy the zinc coating at the weld site and damage the coating adjacent to the weld. The protective coating must be restored when the welding operation is complete. Restoration should be carried according to BS 729-1971 (1986) and prEN 1029 (the preparatory document for EN 21461) using zinc rich paints or similar permitted products capable of building a zinc rich film to the thickness required by the standard.
In all cases welding slag must be removed and any zinc oxide or zinc-rich sublimate caused by burned off zinc must be thoroughly cleaned up before the zinc-rich paint is applied. If sweep blasting is used to clean up the weld site a surface roughness of Sa 2½ is the recommended target. If grinding is used it should be in accordance with repair medium manufacturers' recommendations.

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