Technical Data

Bulletin

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WELDABILITY OF ALUMINUM SPRAY COATED STRUCTURAL STEEL

Note: Standards referenced in this bulletin are from British Standards BS 1719.

Conclusions:

1. Although there are difficulties associated with the welding of aluminum coated steel, for specific steels with coating thickness up to 0.18 mm (0.007"), they can be overcome by the judicious selection of welding process, welding consumables and joint geometry.

2. Provided the coating thickness does not exceed 0.1 mm (0.004"), Grade 43A* (mild) steel can be welded satisfactorily in terms of mechanical properties, weld soundness and range of weld details, by the metal-arc process with electrodes of classes 3, 6 and 9, the submerged arc process, and possibly the CO_2 process under spray conditions (under dip transfer conditions aluminum adversely affects the operating characteristics).

3. With a coating thickness of 0.18 mm (0.007"), the satisfactory welding of Grade 43A* is much more restricted, but good open square butt welds can be made either with the metal-arc process using electrodes from classes 1, 3 and 6 (low carbon .06-0.08%), with the submerged arc process, and possibly also by the CO_2 process under spray transfer conditions.

4. With Grade 50B* steel and irrespective of the coating thickness, only with the "spray-transfer" CO_2 process can welds having satisfactory mechanical properties be produced.

*Both the grades of steel are weldable structural steels; the full data is given in BS.4360: Part 2: 1969. Basically grade 43A has a maximum carbon content of .30% and a UTS of 43-51 h bars. Grade 50B has a UTS of 50-62 h bars with the following composition:

C .24 max., Si .55 max., MN 1.6 max., Ni .1 max., S and P .06 max.

5. Not unexpectedly, the amount of aluminum that is absorbed into the weld metal is dependent not only on the coating thickness but also on the weld geometry. The major effects of the presence of aluminum in the weld metal are threefold, namely:

   a. Increased recovery of carbon, manganese, silicon and niobium. Of these silicon and carbon have a pronounced influence on ductility and on impact properties.

   b. An unfortunate tendency to cause a change from a ductile to an intergranular mode of fracture.

   c. A tendency to promote hydrogen porosity with welding processes that are not of the low-hydrogen type.

Recommendations for Further Work:

1. Further work is required to develop welding consumables for aluminum coated steel designed specifically to avoid an excessively high level of carbon, silicon and manganese in the weld metal. This would be useful from two points of view:

   a. It would improve the ductility and notch toughness of the joints.

   b. It would reduce the carbon equivalent of the weld metal.

2. A detailed examination of the fracture surface of welds that fail in intergranular manner is also required so that the reason for the mode of fracture can be established and in turn the appropriate remedial measures can be taken.

3. Investigate the possibility of welding steel with an aluminum sprayed coating sealed with sealants other than a vinyl copolymer.