WELDING OF AUSTENITIC MANGANESE STEEL

Austenitic Manganese steel, called "SLL" by M.C.S.D. or Hadfield Manganese Steel by the materials community is an extremely tough non-magnetic alloy in which the usual hardening transformation that occurs in low alloy steel has been suppressed by the high manganese content. It is characterized by high strength, high ductility and good wear resistance.

The welding of "SLL" requires considerable care. Though it is very tough, it is sensitive to reheating, so caution is necessary to avoid embrittlement. Arc welding is entirely practical and many tons of austenitic manganese steel electrodes are used annually. Experience and research have shown that the following procedures are helpful:

1. Welds in which both parts are "SLL" should be made with covered manganese steel electrodes that meet the requirements of AWS Spec. A5.13 Classification EFeMn-A.

2. Welds in which one part is "SLL" and the other part is carbon or low alloy steel should be made with covered stainless steel electrodes that meet the requirements of AWS Spec. A5.4 - Classification E309.

3. Never weld "SLL" with carbon or low alloy steel electrodes.

4. In manual welding, the electrode is always inclined in the direction of the weld bead travel. Pushing the arc might give gassy, unsound deposits.

5. Oxy-acetylene welding of "SLL" should be avoided since it is likely to cause marked embrittlement of the base metal.

6. The energy input per inch should be kept to minimum values consistent with sound welds.

7. The maximum suggested heat input for "SLL" is 65,000 joules. Heat input can be calculated as follows:

$$\text{Heat Input (Joules/Inch of Weld)} = \frac{\text{Amps} \times \text{Volts} \times 60}{\text{Travel Speed (in./min.)}}$$

8. Temperature adjacent to welds should never exceed 600° F one minute after bead is deposited. It may easily be determined by using temperature indicating crayons such as "Tempilstiks".

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WELDING OF AUSTENITIC MANGANESE STEEL

9. Factors that will help reduce energy input and heat buildup include the following:
   a.) Maintain a short arc; a long arc increases volts.
   b.) Minimize puddling; it lowers travel speed.
   c.) Do not preheat "SLL" unless the temperature is below 20° F; then only enough to take the chill out.
   d.) Use skip welding of beads in various locations or on different parts to distribute heat.
   e.) Allow time for cooling. The judicious use of water quenching is helpful in some applications.

10. Welding electrodes should be stored in a dry place.

11. Manufacturers' instructions accompanying welding electrodes should be followed regarding polarity and handling.

12. Rust, grease and other foreign matter should be removed from work pieces before welding.

13. Wherever possible, work-hardened "SLL" should be removed before welding because of its greater susceptibility to embrittlement than in the soft condition. Areas that cannot easily be indented with a center punch should be ground or air-carbon arced out.

14. Any defective areas such as those containing sand inclusions, shrinkage porosity, slag, cracks, etc., should be removed before welding.

15. Immediate peening of hot beads will assist in reducing warpage and internal stresses from contraction during cooling.

16. In multiple layer weld deposits or groove welds the slag should be completely removed before applying additional layers.

17. Do not peen the last pass.

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-19-78

AUSTENITIC MANGANESE STEEL ("SLL") WELDING ELECTRODES
PER A.W.S. SPECIFICATION A5.13 - CLASSIFICATION EFeMn-A

MANUFACTURER	TRADE NAME
Airco Welding Products	Nickel Mang "C"
AGA de Mexico, S. A.	AGA B-81
American Manganese Steel Co.	Wear-Arc Nickel Manganese
Champion Hobart, S. A. de D. V.	Champion Duron Mn
Ford Steel Company	Coated Mangalloy
Hobart Brothers Company	Chro-Nimang
McKay	Hardalloy 118
Murex	Hardex 110
National Cylinder Gas	Wear-Arc Nickel Manganese
Rex Arc	S3
Stoody Company	Twin-Cote Ni-Mn
Stulz-Sickles Company	Manganal Flo-Kote

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12/20/78