

SELECTION OF ELECTRODES FOR WELDING IN AUTOMOBILE INDUSTRIES

by

T. J. P. RAO and R. RAVI

The authors are with M/s. D&H Secheron Electrodes Ltd., Indore
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INTRODUCTION

As an industry, the automobile sector provides a very good scope for welding and related activities. Over the years, this industry has grown enormously and today in India we have a number of manufacturers, ancillary units and repair units which use welding extensively for their original equipment manufacturing and also for repair and reclamation activities. In the recent years this industry has been going through a boom period and also with the open Government policies, a number of new vehicles are being manufactured which has given a variety of opportunities for the welding industry.

While welding, as a joining method, is being used in the automobile industry extensively, the SMAW process has not increased its share. In fact, if one has to name an industry where SMAW share is eroding substantially, the automobile industry is the one. With the advances in welding technology, a number of processes have been developed, out of which the automatic and semi-automatic processes like CO₂ welding etc. together with

resistance welding processes are being increasingly used for welding in automobile industries today. However, there are a number of areas where SMAW is the preferred process and is being practiced by a number of industries. This paper highlights the selection of electrodes for various applications in automobile industries. While it will be too difficult to detail all the applications, for which electrodes can be used, in a paper of this nature, an attempt has been made to cover a variety of materials and applications in automobile industries.

WELDING OF SHEET METAL

Welding of sheet metal is one of the most common applications encountered in automobile industries. Since material remains mild steel, the selection of electrode in this case does not pose much of a problem. But, the ability of the electrode to operate at low currents with faster welding speeds, preferably in the vertical-down position gain importance. The welds should not have blow holes, produce punctures and distortion. The E-6013 electrode is normally used for this ap-

plication and apart from the original automobile manufacturers, the repair workshops use this electrode extensively for their body repair. Electrodes are available today in the market which can weld from top to bottom, operating at low currents and producing very low heat input levels to restrict the distortion to minimum.

WELDING CARBON STEEL

Carbon steel, mostly restricted to the common grade mild steel, is one of the widely used material in automobile industries. A number of components are being fabricated using this material. The welding of this material rarely poses any problem and the common electrodes like E 6013 are used for this fabrication. There are, however, larger section thicknesses in heavier vehicles and also critical components in smaller vehicles which require the use of low hydrogen electrodes like E-7018. The welding of these components has been standardised since long and rarely any difficulty is encountered in this fabrication. However, the use of low hydrogen electrodes call for

attention to the following aspects.

1. Specific attention to welders training for using low hydrogen electrodes since the operating characteristics of low hydrogen electrodes are not as good as rutile electrodes to which most of the welders are normally used to.
2. Use of adequate rebacking facilities for low Hydrogen electrodes together with appropriate storage conditions. It is in this respect the welding personnel require training as otherwise the very purpose of using low hydrogen electrode may be defeated.

Once a careful attention is given to these aspects, the weldmetal produced will have the desired properties to meet the service requirements.

USE OF ALLOY STEEL WELDMETALS

The use of alloy steel is restricted to a few components in the automobile industry. The choice of alloy steel weldmetal is mostly to achieve better mechanical properties particularly strength, hardness etc. Some of the typical examples are as given below :

- a) E 9018G electrode for welding of Rear Axle Beam of trucks.
- b) E 8018-B2 electrodes for welding of steering column of scooters.

These electrodes provide adequate strength to withstand the

requirements of the component during service.

WELDING OF CAST IRON

Cast Iron is another material which is used very widely in automobile industries. The welding of cast iron has always been a topic of great interest to the welding personnel since it poses typical problems in welding. In the automobile industry, a variety of cast irons are used. While they have different properties, their weldability, more or less remains the same barring the white cast iron. The cast irons are normally welded using 5 different types of electrodes which are as given below :

- i) A low hydrogen electrode conforming to E-7016
- ii) Cast Iron Electrode - ECI
- iii) A Ni electrode conforming to ENiCl
- iv) A ferro Nickel electrode conforming to ENiFeCl
- v) A Monel electrode conforming to ENiCuB

While the properties for welding different cast iron components, differ depending on the actual job, the electrode, more or less, falls into the above category. Each electrode has its own advantages as well as disadvantages and one has to decide the best choice depending on each job requirement. General guidelines for the features one can expect from these electrodes are listed in **Table I**. Apart from se-

lecting the correct electrode, the designing of good welding procedure is very essential to achieve success in cast iron welding. Some of the guidelines for welding of cast iron are indicated below :

1. Grind the area to be welded so that the casting skin is removed.
2. Clean the area free of all contaminants by degreasing, burning, brushing, grinding etc.
3. If a crack has to be repaired drill crack arrester holes at the end of the cracks. Remove the crack completely by gouging, grinding etc. and ensure complete removal by a dye penetrant test.
4. Deposit the welds in small lengths of 50mm at a time.
5. Peen the welds.
6. After welding allow the casting to cool slowly.
7. These are the general steps in cast iron welding. However, the procedures may have to be modified depending on the job.

MAINTENANCE WELDING APPLICATIONS IN AUTOMOBILE INDUSTRY AND ITS ALLIED INDUSTRIES

This area is one of the important areas where maintenance welding is being used very effectively for enhancing the life of the component. Apart from the automobile manufacturers, who use

**Table I : There are Basically four types of cast iron electrodes.
The characteristics of these types are given below**

Sl. No.	Property	Low Hydrogen deposit E St - CI	Nickel Deposit E Ni - CI	Ferro Nickel Deposit E Ni Fe - CI	Monel Deposit E Ni - Cu B
1.	Machinability	Non-machinable	Machinable	Machinable	Machinable
2.	Colour Matching	Good	No	Satisfactory	No
3.	Strength	Good	Not Good	Satisfactory	Not Good
4.	Tolerance for impurity elements	Good	Not Good	Satisfactory	Not Good
5.	Welding procedure	Normally requires preheat	Preheat may not be necessary	Preheat may not be necessary	Preheat may not be necessary
6.	Suitability	Ideal for buffer layer for sealing off the impurity elements and also for welds where machinability is not required.	For small Casting & filling up work	For all sizes of castings. filling up work, critical. sections. dissimilar joints etc.	For small jobs and for filling up work.

Table II : Application of electrodes in automobile industries

Sl. No.	Applications	Problem	Base Material	Electrodes (Nearest AWS Codification)
1.	Cylinder Block	Filling up, Burst	Cast Iron	E Ni CI
2.	Cylinder Head	Broken, Filling up	Cast Iron	E Ni CI
3.	Tie Rod End (Thread portion)	Broken	Forged Steel	E 309
4.	Fly Wheel Ring Gear	Wear	Forged Steel	E 310 Mo
5.	Gear Shift Lever	Broken	Cast Iron	E Ni CI
6.	Main Shaft	Broken	Steel	E 312
7.	Top Gear Shaft (Teeth)	Broken	Steel	E 312
8.	Gear Box Cover	Repair	Cast Iron	E Ni CI
9.	Crown Wheel (Teeth)	Chipped Teeth	Steel	E 312
10.	Stub Axle & Rear Axle (Bearing Area & Thread)	—	Steel	E 312
11.	Rear Axle	Elongated Bolt Hole	Steel	E 312
12.	Wheel Hub	Wear	Steel	E 7016
13.	Leaf Spring	Broken	Steel	E 312/E 7016
14.	Propellar Shaft	Damaged	Steel	E 7016
15.	Differential	Broken, Worn-out	Cast Iron	E Ni Fe-CI/E Ni-CI

these techniques for enhancing equipment life, this technique is being used by the transport corporations, original equipment manufacturers for automobile industries like forging units etc. A number of techniques are available today to reclaim the components and the list is shown in **Table II** should give some details of the components which can be reclaimed using welding electrodes and maintenance welding techniques.

The use of maintenance welding requires a good understanding of the base material characteristics, the service requirements based on which the electrode is selected. A knowledge of these aspect will help in deciding whether to use a single electrode or to use a combination of electrodes to achieve the desired service requirements like wear resistance, hardness etc. Welding technology has advanced today and techniques are available to exactly calculate the weldmetal composition requirements to suit a particular base material and service condition.

based on these knowledge, electrodes can be scientifically selected for various applications.

As indicated earlier, the original equipment manufacturers like forging units also use a number of maintenance welding techniques out of which reclamation of forging die is one of the important applications. These dies which are made of CrNiMoV material are reclaimed with a similar alloy weldmetal and this enhances die life substantially. Several tons of this electrode are being used for this application and they have served as an import substitute also for this application. These examples only go to show the extent to which the welding electrodes can be useful in the automobile industry not only in the fabrication of automobile but also in the allied industries.

CONCLUSION

Manual Metal Arc Welding, though a very popular process in India on the whole, has limited applications in automobile indus-

try owing to the increased use of automation and mechanisation. However, there are still a number of areas where the automobile manufacturers continue to use welding electrodes and SMAW process for their fabrication activities. A variety of materials can be welded today with SMAW electrodes in the automobile industry. Maintenance welding has been an area where welding electrodes are used extensively for various applications. The use of maintenance welding is not only restricted to the automobile manufacturers but also covers very important applications in the original equipment manufacturerd for automobile industries, transport corporations etc. This has resulted in the effective use of welding electrodes to enhance the service life of components.

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