Poka – Yoke in Welding

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ABSTRACT

Integral Coach Factory is the Premier Coach (ICF) building Industry in Indian Railways. This factory has so far produced more than 30000 coaches in about 170 designs. It was the first among the Indian Railway production units to get ISO 9001 certification. Quality of the coach is being ensured from the raw material to end product. In ICF. fabrication of coaches are being carried out by welding process. Though welding is a reliable metal joining process, the soundness of the weldment largely depends on Men, Machine, Material and Method. The quality of the weldment is ensured by implementation of various quality tools. Even then it is quite difficult to achieve 100% defect free product in manufacturing. Even if 100% inspection is resorted to at every stage of manufacturing defects are inevitable since the inspection is being carried out by human and human errors are inadvertent and inevitable. **Poka-Yoke** is a tool which achieves 100% defect free product at low cost with the aid of low cost equipments. These low cost equipments aids the employee to manufacture defect free product. The aim of this study is to develop Poka-Yoke methods in a welding application. Few parameters which affect the quality of the weld are identified, and various methods are developed to control these parameters and eliminate defects. The parameters identified are shielding gas flow rate, pre and post heat temperature, welding sequence and electricity. These parameters are recorded in a standard format. Poka-Yoke Techniques were applied to control the above said parameters and ensure error free welding in ICF.

INTRODUCTION

Integral Coach Factory has been involved in fabrication of coaches over the past 50 years. The joining of various parts are being carried out by various welding process, such as Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Resistance Welding (RW) and Robotic Welding.

POKA-YOKE

In ICF. Several Statistical Quality Control (SQC) tools are used to ensure the quality of the rolling stock. These tools are used to minimize defects. Use of SQC tools alone will not ensure a defect free product. Poke-Yoke is one of the quality tool conceived by Shiego Shingo, Japanese manufacturing Engineer, which aids in achieving 100% defect free product at low cost. In conventional methods inspection is being carried out by human. Inadvertent errors are frequent even in 100% inspection technique. In Poka-Yoke low cost equipments such as sensors, limit switches, alarms, guide pins etc. are used to eliminate defects. Poka-Yoke is a method by which defects are anticipated and possible steps are taken to prevent their occurrence. In addition, this method can be used to identity and fix the defect as soon as it occurs, before the defects multiplies.

OBJECTIVES

To test the efficacy of Poka-Yoke in welding applications with the following parameters chosen for monitoring.

i. Shielding gas.
ii. Pre heat temperature
iii. Welding sequence.
iv. Electricity

Statement of the problem identified

Problem 1

It was observed that most of the welders are not setting CO_2 flow rate as per specification. They are setting higher CO_2 flow rate. It is a significant problem which increases the weld cost due to wastage of CO_2 shielding gas.

Problem 2

Pre heat temperature is not being maintained properly, which in turn leads to failure of the welded parts.

Problem 3

Distortion in the welded parts due to non adherence of planned weld sequence.

Problem 4

During the non – welding periods the welder forgets to switch off the welding

equipment, which leads to no load energy loss.

METHODOLOGY

A standard format has been devised to identify the problems, Results obtained, Comparison between past and present status (Table 1-4). **Application of poka-yoke in solving the problem.**

CONCLUSION

The above said modifications were implemented in Technical Training Center on trail basis and were found to be effective in controlling the defects.

REFERENCE

Achieving zero defect manufacturing through Poka Yoke", (2005), ABK Aots Dosokai, Tamil Nadu Centre.

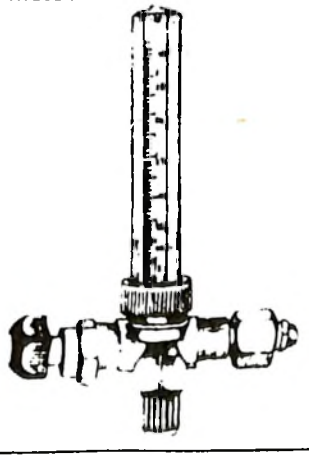
Unit	Welding
Process	Gas Metal Arc Welding (GMAW)
Problem : 1 Excessive CO_2 flow rate.	
Solution Usage of preset flow meters	
Improvement CO_2 gas wastage is minimized and weld cost is reduced.	
Before Improvement Flow meter is used to Control the flow of the shielding gas. The welder normally do not set the flow rate to the exact requirement since it needs a careful observation of the flow indication while turning the knob of the flow meter. 	**After Improvement** By using preset flow meters, the welder has to either open or close the gas flow meter. flow rate of the shielding gas is controlled within the nominal flow rate of 15L/min.

Table 1 : Shielding Gas Flow Rate

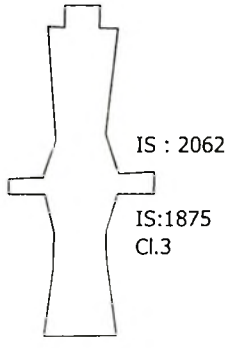
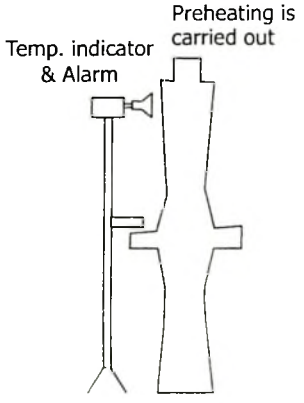
Unit	Welding
Process	Gas Metal Arc Welding (GMAW)
Problem : 2 Difficult to maintain preheat temp. Resulting in overheating or less heating of center pivot pin assembly	
Solution To devise a Mechanism for sensing the temperature by provision of temperature indicator with alarm.	
Improvement Preheat temp maintained	
Before Improvement Difficult to maintain Correct preheat temp. Preheating temp 225° 250°C  	**After Improvement** Easy to notice preheat temp using sensor and alarm. 

Table 2 : Pre Heat Temperature

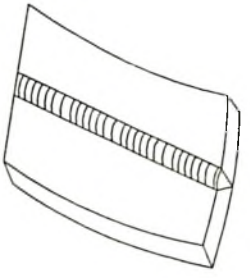
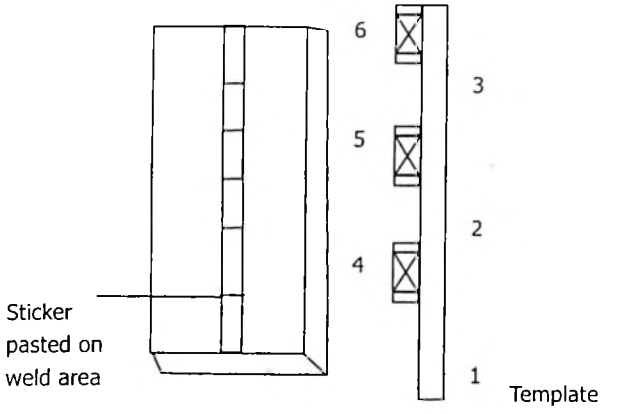
Unit	Welding
Problem : 3 Distortion due to continuous welding	
Solution Devise a template to sequence the weld.	
Improvement Distortion controlled.	
Before Improvement If welding is done continuously, the welded part will distort. Distorted Structure 	**After Improvement** (i) A template is made of light weight non-metal, with pre calculated alternative openings and closings for the specified length. Welding will be carried out sequentially. (ii) A tape is pasted on the area to be welded. The tape is numbered like 1, 2, 3 etc. and the direction of welding is also indicated. The welder peels the tape and then carryout the welding. 

Table 3 : Distortion

Unit	Welding
Process	Gas Metal Arc Welding (GMAW)
Problem : 4 Wastage of current due to non switching of Welding equipment during non working periods.	
Solution : By incorporating variable speed drive (VSD) the speed of the motor in the welding equipment is reduced and in turn conserves energy	
Improvement : Saving of current	
Before Improvement The welder may go for break or may involve in non welding activities without switching off the machine.	**After Improvement** When the welder removes his finger from torch switch the VSD will become active and power consumption is minimized.

Table 4 : Electricity