EFFEECT OF WELDING CURRENT ON MECHANICAL PROPERTIES OF GALVANIZED CHROMIDED STEEL SHEET IN RESISTANCE SPOT WELDING

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering (Design and Innovation) with Honours.

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2012

SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation)"

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Date : 27 JUNE 2012.

Study on the Effect of Welding Current On Mechanical Properties of Galvanized Chromided Steel Sheet In Resistance Spot Welding

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This report is submitted as
fulfillment of the requirements for the
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DECLARATION

"I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged."

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Date	:	27 JUNE 2012

DEDICATION

This report is dedicated for my beloved parent, brother and best friend who always are my pillars of light during my darker times.

I also want to send this message to my supervisor who always gives me the best guide to me. The way of his life will be my path for my future.

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ABSTRACT

In this study, the effect of welding current on mechanical properties of galvanized chromided steel sheet with thickness 0.5mm and 1mm spot welded by resistance spot welding were investigated. Two levels, four factor and half-fractional factorial design applied for conducting the experiments. The welding current, electrode force, weld time and sheet thickness were chosen as welding parameters. The maximum stress on the nugget was measure by using tensile shear stress machine and the nugget area were measure by using AUTOCAD software. For each set of parameters, the data were processed by using statistical method of regression. The mathematical models that obtain form the analysis of data was tested on the accuracy of the models. The value obtain through the manual calculation base on the model were compared with the observe value in a graph. The most influent parameter on tensile shear stress were found is welding current whereas the most influent parameter on nugget area were found is weld time.

ABSTRAK

Dalam kajian ini, kesan terhapat pengaruh arus kimpalan terhadap sifat mekanikal pada "galvanized chromided kepingan besi" dengan ketebalan 0.5mm dan 1mm dikimpal dengan menggunakan kimpalan "spot". Dua peringkat, empat pemboleh-ubah dan setengah pembahagian eksperimen digunakan. Arus kimpalan, daya elektrod, masa kimpalan dan ketebalan kepingan besi dipilih sebagai pemboleh-ubah. Maksimum tegasan pada "nugget" diuji menggunakan mesin "tensile" dan luas "nugget" dikira dengan menggunakan "autocad". Setiap eksperimen, datanya akan diproses dengan mengguanakan kaedah "statical by regression". Matematic fomula yang terhasil dari analisis data akan diuji ketapatannya. Nilai yang dapat daripada pengiraan akan dibandingkan dengan nilai yang dapat dari eksperimen. Didapati arus memainkan peranan yang paling penting dalam tegasan manakala untuk luas "nugget", masa kipalan memainkan peranan yang paling penting.

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LIST OF ABBREVIATION

RSW	-	Resistance spot welding
Eq	-	Equation
MF-DC	-	Medium frequency to direct current
AC	-	Alternative current

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO RESISTANCE WELDING

Resistance welding is a process that uses heat generated from the current flow to the parts being welded. Fundamentally, there are three types of resistance welding which are spot welding, seam welding and projection welding. It is a widely used technique for joining metal sheets and components in automotive and manufacturing industries. Different sheet metal requires different welding current, welding time and welding force. For automobile industry, galvanized steel is the most widely used sheet metal to increase the corrosion protection. Essentially, the galvanized sheet metal needs higher welding force and welding current than uncoated sheet metal.

1.2 PROBLEM STATEMENT

Resistance spot welding is used widely in the automotive industry. For automobile, the strength of the joint is vital and it's the manufacture's responsibility to certify that the strength at the joint is always in the optimum range. Besides that, the appearance of automobile is significant in manufacturing industry. There are several important parameters for spot welding that affect the strength and quality of

the product. Too low or too high the current will not only affect the strength of the joint but also causes the expulsion of molten metal which can affect the joint strength and surface quality of work piece.

1.3 OBJECTIVES

1. To study, investigate and compare the effects of welding current on mechanical properties of galvanized chromided steel sheet in resistance spot welding.
2. To use mathematical modelling for obtaining the best current range so as to optimize the strength of the weld joint to use it for automation of the processing technology.

1.4 SCOPE

To study, understand and investigate the effect of welding parameters such as welding current, weld time and electrode force and electrode selection applied on mechanical properties of galvanized chromided steel sheet in resistance spot welding by using statistical method by regression.

1.5 BACKGROUND

Resistance welding is classified into three types which are spot welding, seam welding and projection welding. There are coalescence of the metal is produced at the faying interface by the heat generated by the contacting of resistance, (A. G. Thakur, et al.2010) .The use of resistance spot welding in the automotive manufactures has been increasing. There are so many engineering metals, even though they can be welded but the mechanical properties may be poor due to the weldability of the metals itself. Galvanized steel sheet is the most widely used material for automotive bodies because of its ability to prevent the corrosion. The galvanized steel sheets can be joined easily together by resistance spot welding. Generally there are approximately

3000 – 4000 of spot welds in every car (Kearns, 1982). It is one of the quickest and cleanest welding processes available but there are still some short comings and problems to be improved and modified. (R. S. Parmar, 2008). The purpose of this study is to examine the best current range that can produce the higher strength at the joint by using 0.5mm and 1mm sheet thickness. At the same time, the different sheet thickness is used to examine which sheet thickness can produce a better strength at the joint with what kind of current range. With the data obtained, it will enlighten the welding community to the weaknesses and the strengths that found from the experiment by using variable of parameter. In addition, this research will further improve the automotive industry through the good quality weld and optimize the strength at the joint.

CHAPTER 2

REVIEW OF LITERATURE

2.1 INTRODUCTION TO WELDING

Welding process has evolved and improved tremendously over the past few decades. It plays an important role in most manufacturing and structure fabrication industries. Principally, welding process can be classified into:

a) Fusion welding

b) Non-fusion welding or solid state welding

In fusion welding, it involves the actual melting of the metal in the formation of bond whereas in solid state welding, there is no melting process. (N. K.Srinivasan, 2008 & Beddoes & M. J. Bibby, 1999) Figure 2.1 shows the classification of the joining processes.

2.2 RESISTANCE WELDING

Resistance welding is refer to processes that use electrically generated heat and pressure to contact between two sheet metals such processes usually pertain to connecting the sheet metal but the term off resistance welding may also used plastic bonding. This type of welding is regarded as quick and efficient when done by properly but mistake during the process can result to problem such as cracking, cavities and deformed surface appearance.

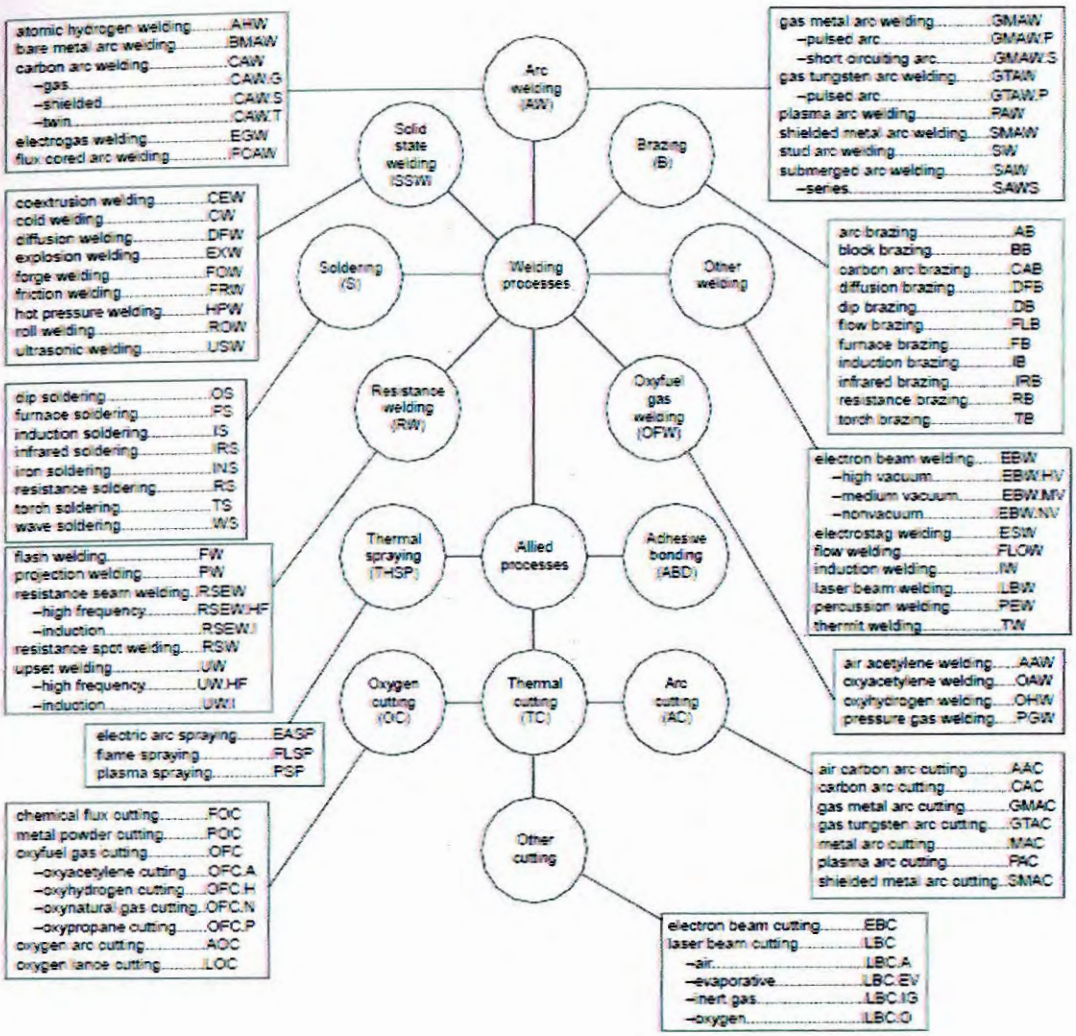


Figure 2.1: Master chart of welding and allied process

2.2.1 Seam Welding

Seam welding is used for producing continuous leak proof joints. The application of seam welding mostly applied to container tanks or vessel. The electrode type in seam welding is either copper wheels or rollers. Welding current was supplied through the bearing of the electrode while the pressure was applied in the same way of press type spot welding as shown in figure 2.2.. (R. S. Parmar, 2008)

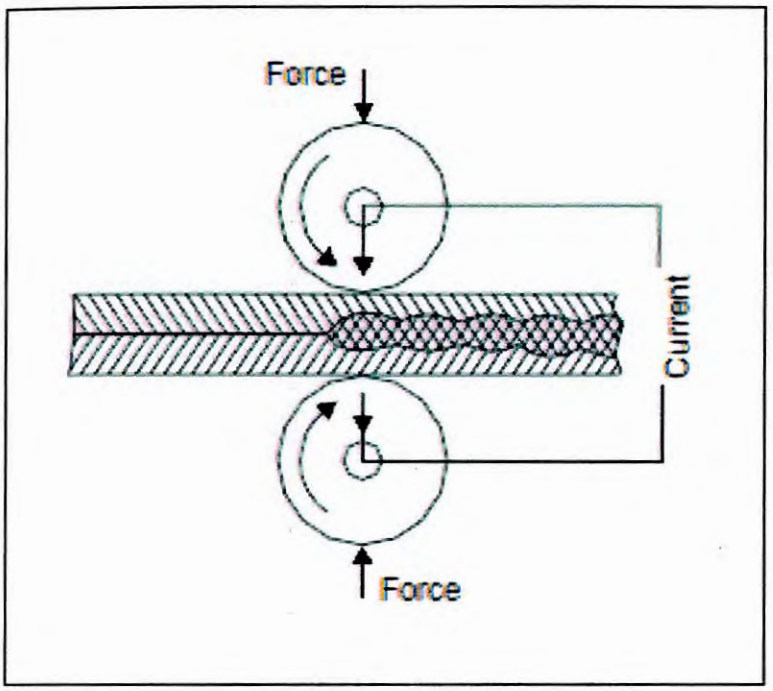


Figure 2.2: Seam welding circuit.

2.2.2 Projection Welding

Projection welding defined the joining of two sheets or even a sheet and a thick component or a small component like a nut to a body by making raised portions or projections on one of the components where weld nugget is required to be made. The raised portions or projections act to localised the heat of welding circuit. Normally the projection was made by forging, embossing or by the intersection and may be dome type, ring type, cross wire welding and radius projection. Figure 2.3 show the projection welding circuit. (R. S. Parmar, 2008)

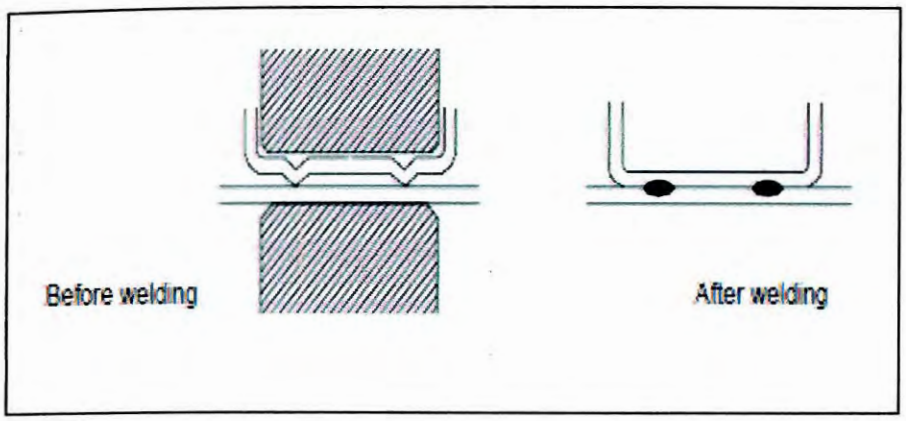


Figure 2.3: Projection welding circuit.

2.2.3 Resistance Spot Welding (RSW)

Resistance spot welding is differing from other welding process because of no usage of filler metal and the joints are often in lap type (R. S. Parmar, 2008). Spot weld is made by two sheets over lap and the sheet is grapping by the electrode when the force is applied. During the gripping of electrode, the current will flow to the work-piece and the localised heating will be occurs. The metal melted due to the heat generated by the current. After the current has been switched off, the molten metal solidifies and leaving a nugget. Figure 2.5 show typical single phase spot welding circuit and figure 2.6 show the difference types of arm in spot welding (Amaresh Banerjee, 2007).

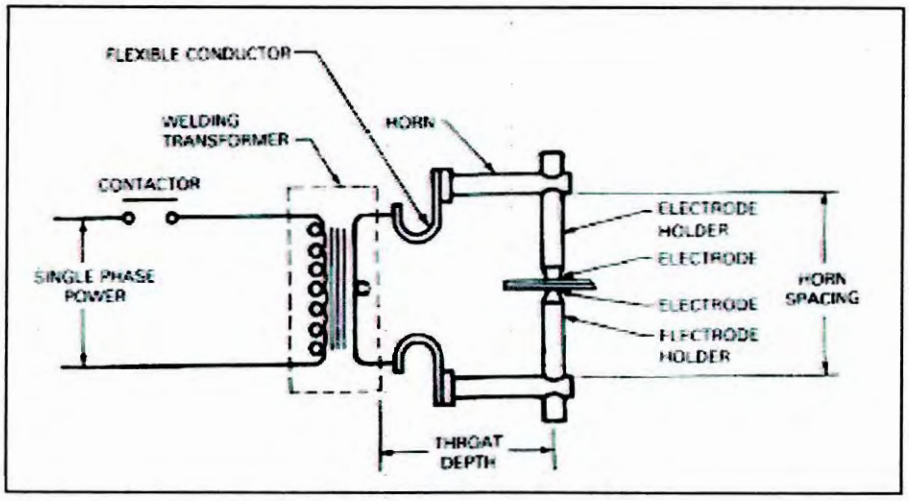


Figure 2.4 : Typical single phase spot welding circuit.(Robert W. Messler, et al. 1999)

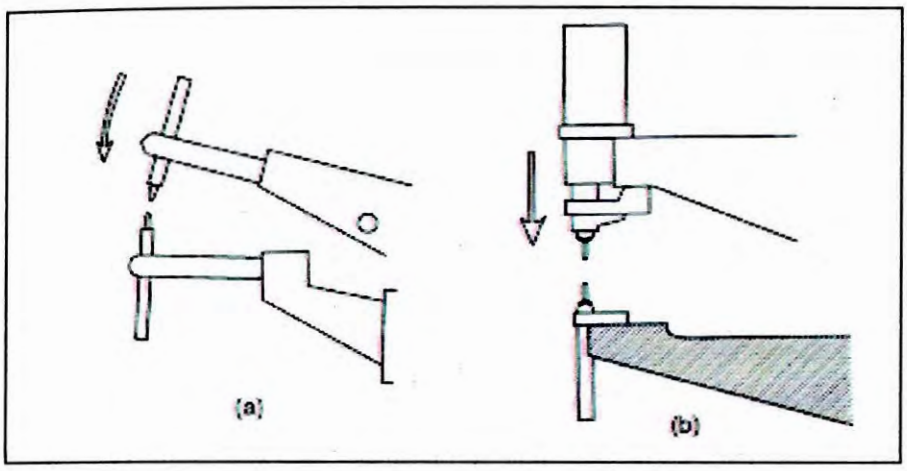


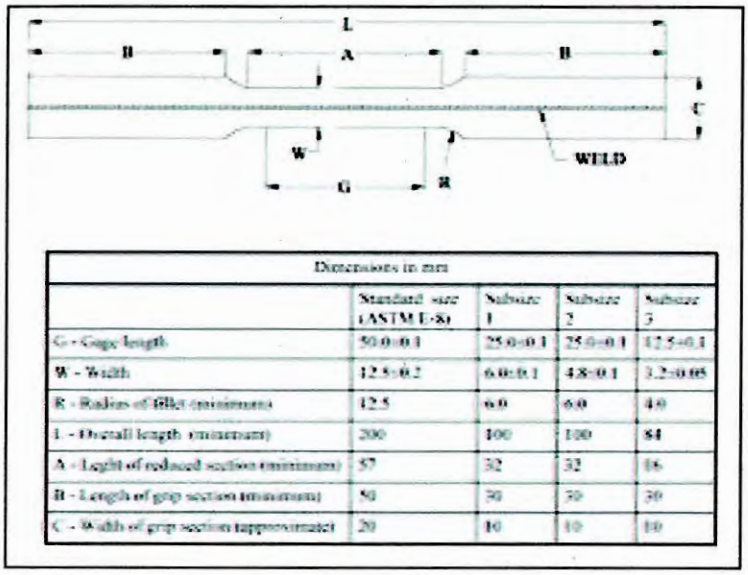
Figure 2.5 : Difference types of arm in spot welding- a)pivoting arm, b) vertical travel (Amaresh Banerjee, 2007)

2.3 WELD QUALITY AND TESTING METHOD

Destructive and non-destructive testing must be done in order to implement the quality control. A destructive test is used to determine the limit at which point of material is destroyed. The limit is called as fracture limit. The destructive test method includes the peel test, tension shear, U-tensile and cruciform tensile which are required for production quality control based on define norms. The non-destructive testing is used to determine the properties of materials by testing on the internal or surface of a material without damaging them. Non-destructive tests are for the flaw detection and inspection. For non-destructive testing methods, there are LPI, MPI, ultrasonic and radiography which is not applicable to check the quality of joints in spot welding. (Baldev, et al. 2008).

2.3.1 Tensile Test

Tensile test machine is used to apply uniaxial tensile or compressive load to the specimen. Besides that, this machine also provisions for accurately registering value or the load and the amount of deformation that occurred at specimen. The tensile test provides tensile properties of strength, ductility, rigidity and even given information regarding the stress-strain behaviour of the joint. Strength is a property of a material that measures the ability material to withstand stress or the load carrying. Stress is a condition of a material due to applied load. If no load is applied on a part, then there are no stresses in it. Figure 2.6 is tensile test specimen size and figure 2.8 is tensile test machine. (Joseph Datsko, 1997



Dimensions in mm				
	Standard size (ASTM E-8)	Subsize 1	Subsize 2	Subsize 3
G - Gage length	50.0±0.1	25.0±0.1	25.0±0.1	12.5±0.1
W - Width	12.5±0.2	6.0±0.1	4.8±0.1	3.2±0.05
R - Radius of fillet (minimum)	12.5	6.0	6.0	4.0
L - Overall length (minimum)	200	100	100	64
A - Length of reduced section (minimum)	57	32	32	16
B - Length of grip section (minimum)	50	30	30	20
C - Width of grip section (approximate)	20	10	10	10

Figure 2.6: Standard size of specimen for tensile test.