DECLARATION

I hereby, declared this report entitled "**Effect of Spot Weld Tip to the Welding Characteristic of Dissimilar Resistance Spot Welding**" is the results of my own research except as cited in references.

Signature :

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Date : 15/12/2017

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirement for the Degree of Engineering Technology (Maintenance Technology) with Honour. The member of the supervisor is as follow:

……

(Project Supervisor)

EN. MOHD HARRIS FADHILAH BIN ZAINUDIN

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ABSTRACT

In automotive industry, crashworthiness refers to the capabilities of a car structure to provide an adequate protection to passengers against injuries when crash happen. Mostly, car structure depends on the spot weld quality and mechanical characteristic behaviour. The result of spot welds significantly affects the safety of the vehicles. Therefore, the effect of spot weld tip to the welding characteristic of two dissimilar SPCC and AHSS metal sheet has been studied. The welding characteristics such as heat affected zone, fusion zone, size of nugget and type of failure of spot weld is important for good quality of welding. This study used different electrode welding tip which are dome type and the flat type. The experimental processes that has been used is hardness testing machine and tensile test (Universal Testing Machine). Besides that, in checking the microstructure of the specimen, the scanning electron microscopy was used.

Abstrak

Dalam industri automotif, kemalangan berlaku merujuk kepada keupayaan struktur kereta untuk memberikan perlindungan yang mencukupi kepada penumpang terhadap kecederaan apabila berlaku kemalangan. Kebanyakannya, struktur kereta bergantung kepada kualiti kimpalan tempat dan kelakuan ciri mekanik. Hasil kimpalan tempat memberi kesan yang ketara terhadap keselamatan kenderaan. Oleh itu, kesan titik kimpalan pada kimpalan ciri dua helaian SPCC dan AHSS logam yang berbeza telah dipelajari. Ciri-ciri kimpalan seperti zon terjejas haba, zon gabungan, saiz nugget dan jenis kegagalan kimpalan tempat penting untuk kualiti kimpalan yang baik. Kajian ini menggunakan tip kimpalan elektrod yang berbeza iaitu jenis kubah dan jenis rata. Proses eksperimen yang digunakan ialah mesin ujian kekerasan dan ujian tegangan (Universal Testing Machine). Di samping itu, dalam memeriksa struktur mikro spesimen, mikroskop elektron pengimbasan digunakan.

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RSW	Resistance Spot Welding
FZ	Fusion Zone
HAZ	Heat Affected Zone
M	Martensite
B	Bainite

CHAPTER 1

INTRODUCTION

This chapter explains about the background of this study, problem statements, objective, scope, and project significant one as well as the limitations in completing this research. The structure of the report of the review is quickly disclosed also to guarantee representation of the succession of the whole review.

1.0 Background Project

Resistance spot welding (RSW) is a popular welding process due to its high speed and low cost combination. It also provides excellent reproducibility. In electronics, biomedical and automotive industries, Resistance Spot Welding is one of the metal joining techniques for high volume production. It is one of the efficient and cleanest welding for fabrication sheet metal.

Resistance spot welding is a welding process where the assembly of work part is produced by electrode pressure and heat obtain from resistance with the flow of electric current. The shape and size of weld formed depends on the shape and size of the electrodes (Sahota et al. 2013). Resistance spot welding work by applying an electric current through two contact point with at least two layer of metal sheet welded together. This procedure might be performed by automated, physically or by devoted spot welding machine.

Resistance spot welding process are widely used in automotive industry and commonly used for joining steel sheet for automotive production line. It is a very effective method, easy and flexible for set. Parameters such as welding time, welding power and welding current is fixed. The process of spot welding is shown in the Figure 1.0 below.

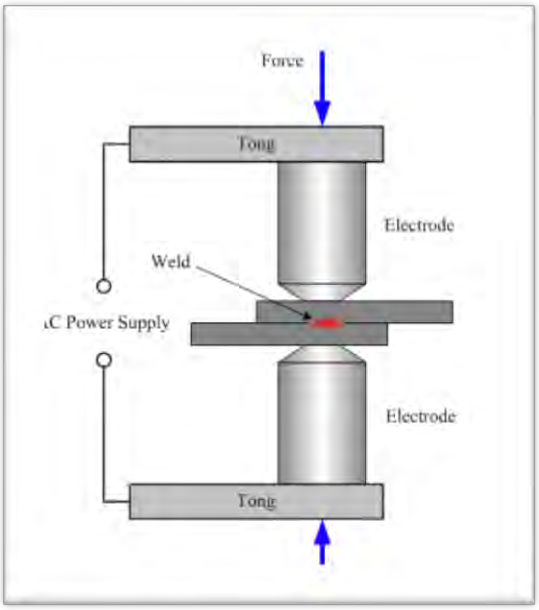

Figure 1.1: Process Resistance Spot Welding (Gabriel, 2008)

1.1 Problem Statement

Welding in the automotive industry is important in ensuring the safety and well-being through the structure of a car. Low quality welding can bring a decline in the quality safety of a car. This may lead to higher costs in making a car (Mansourzadehi, 2009).

The ways to weld low carbon steel for the automotive industry sector generally use resistance spot welding technique. Resistance Spot Welding has many limitations such

as high wear rate of electrode, which limits the electrode life during welding of steels, high temperature and rapid cooling rate which leads to formation of brittle microstructure (Lakshminarayanan et al. 2015).

Resistance spot welding has advantages such as high speed and appropriateness for mechanization and incorporation in high-generation mechanical production systems with other creating operations. Control of current, timing and cathode powers, sound spot welds can be made dependably at high rates and low work costs by incompetent administrator (Tumuluru et al. 2011)

Vehicle crashworthiness is characterized as the capacity to provide auto insurance to customers to satisfy their safety in the event of accidents. It relies on the mechanical execution of spot welding. Resistance spot weld joint failure has been recognized as one of the imperative failure when vehicle crashes. The quality execution and the mistake properties of resistance spot welds are important for affirmation of quality and security plan of the vehicles.

Material play an important role in an automotive body in white. It has been observed as a result of increasing requirements of passenger safety, vehicle performance and fuel economy. The response of steel industry of the new challenges is a rapid development of higher steels named Advanced High Strength Steels (AHSS) (Keeler et al. 2014).

AHSS selection also plays the important role in determine the safety of the car. It also utilized as a part of the automobile industry for assembling a few body-in-white parts of vehicles. AHSS are multiphase steels that contain different concentration of ferrite, bainite, martensite and austenite stages (Shome & Tumuluru, 2014). The splendid properties of AHSS offer the potential for improvement in vehicle crash execution without extra weight increment. These days, approximately 85% of AHSS have been utilized for various basic parts of a vehicle that could lead a weight decrease up to 25% contrasted and a typical model (Liu et al. 2016)

. Nevertheless, properties of the joint using different welding tips are still questionable. It is because failure of the joint is possible to occur to the joint of the material. Futhermore, testing the properties on the joint that using different welding tip is the technique to determine and compare the properties between the joint (Pouranvari & Marashi 2013)

Besides that, difference electrode welding tip can give imprints of welding electrodes left on the surface after welding. It also can affect a negative effect on the strength of a welding and weld surface appearance (Mazur et al. 2016)

1.2 Objective

1. To investigate weld characteristic of the welded joint of two different metal sheets using different electrode welding tip.
2. To investigate the mechanical properties of sample after undergo joining using different electrode welding tip.

1.3 Scope

1. Investigating the effect of spot weld tip to the spot weld characteristics of SPCC and AHSS metal sheets.
2. Comparing the weld characteristics which are weld nugget and type of failure of the welded joint of SPCC and AHSS metal sheets using dome and flat electrode welding tip.
3. Comparing the mechanical properties which are hardness, tensile and microstructure of sample after undergo joining using different type of electrode in resistance spot welding.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss the literature review the background, principle, parameter of resistance spot welding and welding tip. Besides that, material used in automotive body such as SPCC and AHSS are also being discussed in this chapter.

2.1 Resistance Welding

Resistance welding is a technology that used in various industries for joining metal sheets together. Resistance welding is a thermo-electric process in which heat is generated at the interface of the parts to be joined by passing an electrical current through the parts for a precisely controlled time and under a controlled force (Amada Miyachi America, 2013). The weld is made by generating heat through current at the metal sheets. Resistance Welding Machine can also classified into four type such as:

- Resistance Butt Welding
- Resistance Spot Welding
- Resistance Seam Welding
- Resistance Projection Welding

2.1.1 Resistance Butt welding

This method is similar to resistance spot welding. In this procedure, the two finishes are arranged up close and personal in the jaws of the machine so they can touch together with great contact. The two electrode push them near one another end to end and they are mechanically joined after most extreme heat is produced at the purpose of contact. The two finishes are heated in a white heat of the metal to a plastic state. The metal faces are applicable flat and parallel when clamped. This process is applicable to join round rods and bars up to 25 mm diameter. The clamping dies of copper alloy which carry the current to the components and hold them during touched with each other under high pressure (Weman 2012).

Butt welding is utilized broadly to weld rail road lines into continuous lengths. The rail is clamped by two vertically and on a level plane acting barrels which adjust each rail to a typical datum such as an anti-twist device removes axial twist. Along these lines long rails can be weld by this machine. Butt welding machines must be made solid and intense as impressive weight is applied for welding overwhelming areas. The Figure 2.1 below show the process of Resistance Butt Welding.

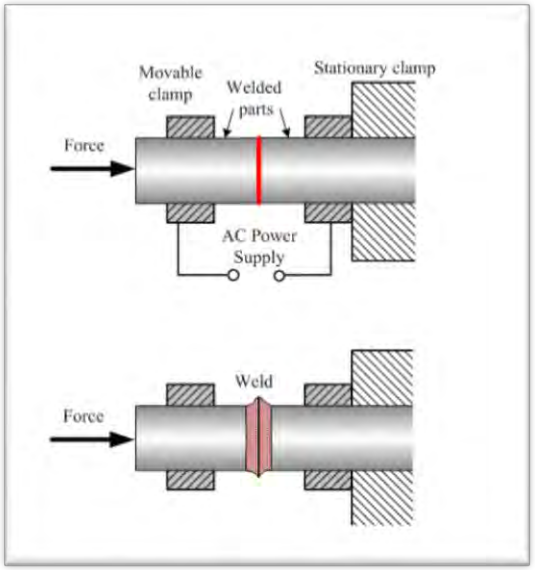

Figure 2.1: Resistance Butt Welding Process (Dmitri Kopeliovich, 2012)

2.1.2 Resistance Spot Welding

Resistance spot welding is a basic advancement in various endeavors for joining two or more than two metals. The spot welding process joins no less than two metal sheets together through mix at a certain point. It is a crucial procedure that utilization two copper anodes to press the work sheets together and drive high current to experience joining the metal sheets (a. Aravinthan & C. Nachimani, 2011)

The procedure is utilized for joining sheet material and utilizations molded copper compound terminals to apply pressure and pass on the electrical current through the work piece. Heat develop at the interface between two sheets, conveying on the material being welded to join, framing a liquid pool and the weld piece. Significantly, Resistance Spot Welding is a favored system for joining Advanced High Strength Steel (AHSS) (Banerjee, 2016). The Figure 2.2 below show the schematic diagram of Resistance Spot Welding process.

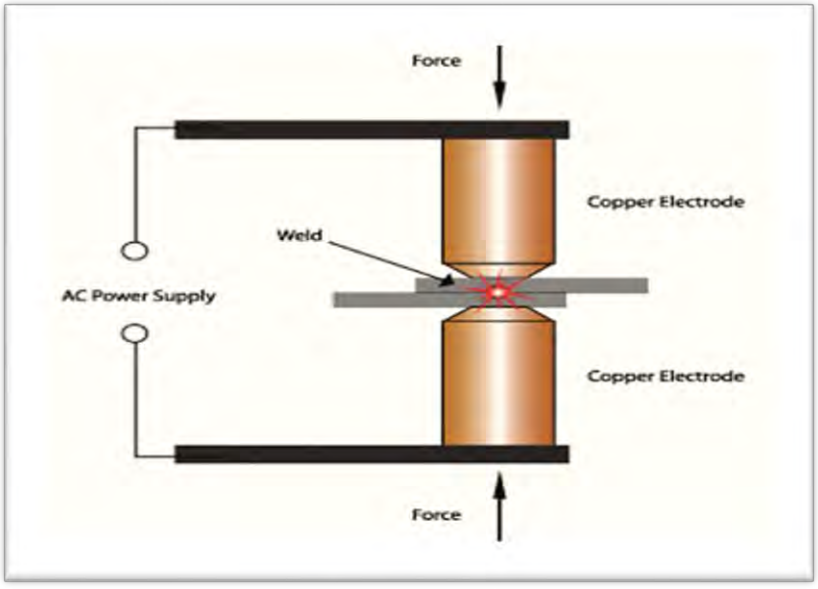

Figure 2.2: Spot Welding Process (Sahota et al. 2013)

2.1.3 Resistance Seam Welding

Seam welding machines are same as that of Spot welding and the rule of this welding is likewise comparable. Both Spot and Seam welding machines contain of a bed-frame, a transformer and a weight system with an interlocked switch. In this procedure, the parts to be joined are clipped between two copper roller or wheel terminal drive frameworks which push on the "work" to be welded. It is possible that one or both are driven and the current is taken to the wheels through the rotary bearing. The more common shaft drive enables different sorts of wheel to be easily fitted. By the utilization of more complex electro-mechanical bearing gatherings, longitudinal and circumferential welds can be made. Moreover, steam welding gun are to a great helpful for manufacturing a wide range of tanks, fumes frameworks, barrels, dribble moldings on auto body sheets (Weman 2012). The Figure 2.3 below show the process of Seam Welding.

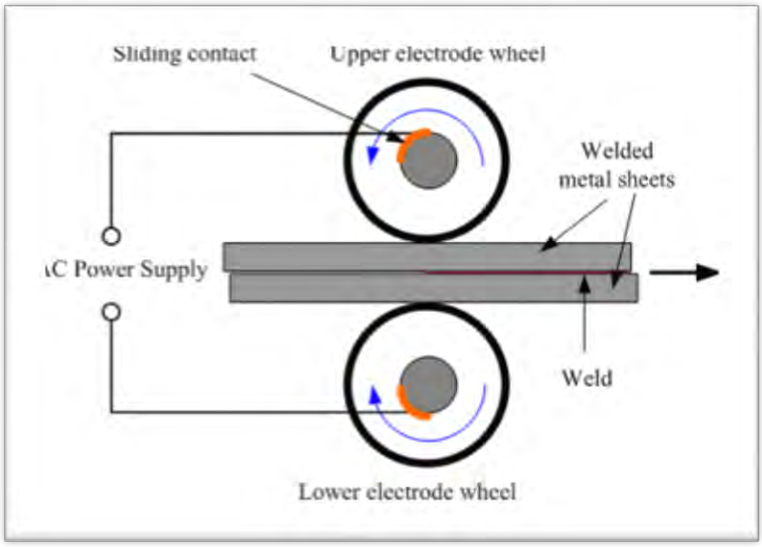

Figure 2.3: Seam Welding Process (Dmitri Kopeliovich, 2012)

2.1.4 Resistance Projection Welding

The projection machines are essentially presses, the tipped electrode of the spot welder being change by flat plates with "T" openings for the connection of special instruments. Projection welding is used to produce a variety of components such as steel radiator coupling components, brake shoes, tin-plate tank handles and spout. The work pieces are loaded into a projection welding press in which the electrode is a substantial slab. At the point when the current is exchanged on, an exceedingly limited heat is made at every projection, and the metal at the projections rises rapidly to a plastic temperature. In addition, the projection welding is especially relevant to large scale manufacturing work. Low carbon mild steel, copper-covered mellow steel, metal, stainless steel, mellow steel and stirred steel wire all can be welded by this procedure. For the most part, low carbon steel, stainless steel and copper-covered mellow steel as used for milk bottle holders, cages, cookers, icebox lattices, and a few joints. The Figure 2.4 below show the process of Projection Welding.

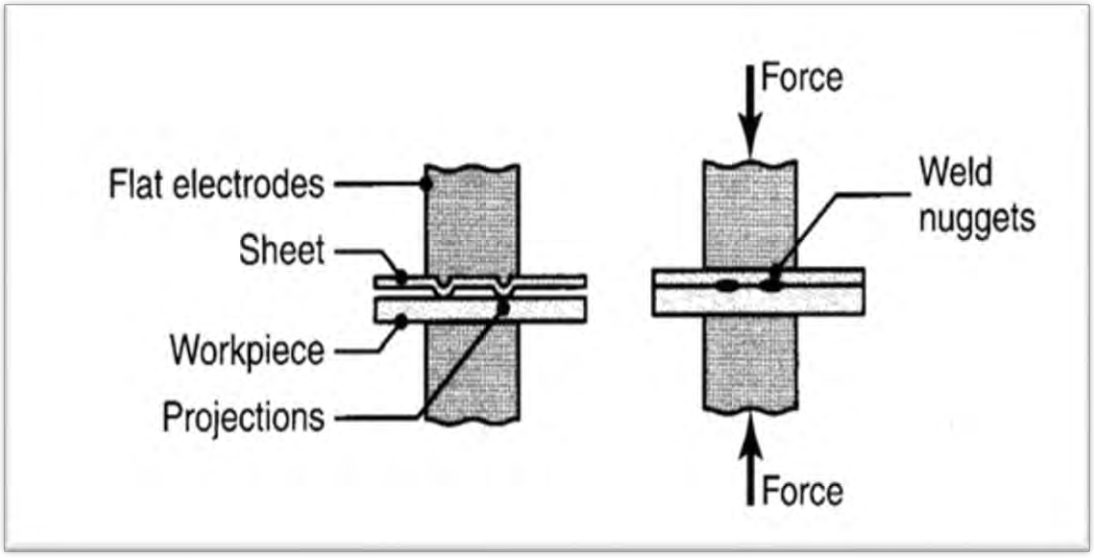

Figure 2.4: Projection Welding Process (Rajasekaran, 2015)

2.2 Principle of the Operation Resistance Spot Welding

Resistance spot welding is performed when a current is passed through the anode tips and bits of metal to be connected separately. Therefore, combining the use of a welding operation is set at a level most suited to traverse the appropriate time. This current must undergo a closed circuit. Base metal resistance to the flow of electric current warming then, led to a joint of the welding. Resistance spot welding piece surrounded between the joint surfaces is warmed because of welding, due to the joint surface resistance to the flow of electric current.

Since the filler metal or flux is not required, the filler metal or flux is added to the weld zone in the middle of the welding procedure. In addition, in the middle of the welding procedure is a spill the size of an electric current from the terminal to the workpiece. Figure 2.5 shown the resistance welding machine with workpiece.

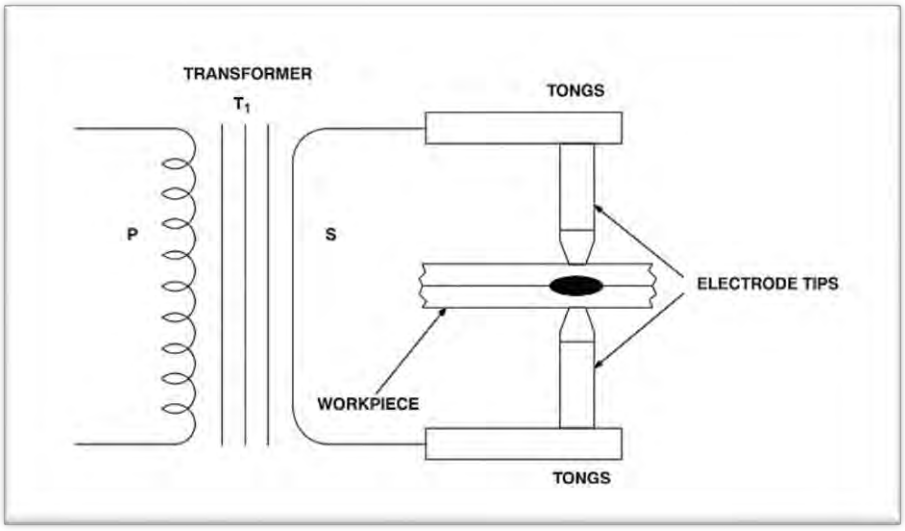

Figure 2.5: Resistance Welding Machine with Workpiece (Miller Welds Handbook, 2012)

In addition, the amount of heat produce according to Joule's law is expressed by the Equation 2.1:

$$H = I^2 Rt \qquad \text{(Eq. 2.1)}$$

Where H = Heat is generated in joules I = Current (in amperes), R = Resistance,

t = time

2.3 Parameter of Spot Welding

2.3.1 Electrode Force

The electrode force is an important process parameter because of its effect on contact resistance and hence heat generation. The function of electrodes is to control the amount of the force or pressure and also a welding current to the desired location, which it located at the interface of workpieces. Besides, its effect on the contact between both of workpieces makes region formation of welds occur. Moreover, if the force or pressure applied on the worksheet is lower it will cause the sparkling, splashing, and internal porosity or crack at the nugget formation after welding completion.

2.3.2 Squeeze Time

Squeeze Time is the time between the use of forced labor and the use of the anode in the main current. Squeeze time is important to put the current welding electrodes until power has met the desired level and set (Anon, 2014).