# REVIEW ON: EFFECT OF WELDING PARAMETERS AND INTERLAYER ON CHARACTERISTICS OF DISSIMILAR METAL SPOT WELD

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**ABSTRACT**

*In automobile, rail and aircraft industries Resistance Spot Welding (RSW) is an extensively used welding process for joining thin metal sheets. With the increasing usage of various types of dissimilar metals joints in automobile and aircraft industries, research on resistance spot weld-ability of dissimilar metal attracts more and more attention. In past few years researchers are concentrating on areas like process modelling and finite element analysis, dissimilar metal welding, failure mode analysis, parametric optimization and characterization of resistance spot welds (RSW). This paper reviews research works done on resistance spot welding of various dissimilar metal. The welding parameters are highly influences the mechanical, chemical properties of spot weld.*

***Keywords: RSW, Dissimilar metal welding, weld parameters***

## I. INTRODUCTION

Resistance spot welding is the process of joining two metal plates where heat is generated by the resistance of parts being welded to the flow of current. There are about 2000–5000 spot welds in a modern vehicle. Simplicity, low cost, high speed (low process time) and automation possibility are among the advantages of this process. There are three welding parameters welding current, welding time and electrode force which are considered while this process is carried out. In resistance spot welding process the quality of weld strength affects the entire welding structure quality. In sheet metal fabrication Resistance spot welding is widely used as an important metal joining process. It has got lot of applications in the field of automobile industries, rail coach manufacturing, aerospace and nuclear sectors, electric and electronic industries. In 1877 E. Thomson invented Resistance spot welding. Two or more metal parts can be joined by fusion at discreet spots at the interface of work pieces. It can be used on a variety of materials such as magnesium, nickel, aluminum, copper, low carbon steel and austenitic stainless steel. The maximum thickness of workpieces by using resistance welding when producing lap joints is approximately 6 mm for uncoated steels and 4 mm for coated steels.The joining of two or more different metals or alloys are involves in Dissimilar metal welding. Dissimilar metal welding have several types but most common type is welding of stainless steel with other metal. Dissimilar metals are widely used in sheet metal fabrication, especially in automotive and aircraft, mainly due to corrosive resistivity and it is economical as compared to the one made by stainless steel only. When welding dissimilar metals there are several problems arise. These are mainly related to the different physical, chemical and mechanical properties of welded material.

## II. DIFFERENT CASE STUDIES

Since dissimilar metal joints find lot of applications in industries hence Resistance spot welding of dissimilar metals attracted the attention of many researchers. Many study reports have been presented on this area with different combinations with one of the material as stainless steel **M. Alenius et al**. in 2006 study discovered mechanical properties of spot welded dissimilar joints for stainless and galvanized steels. To determine the spot welding parameters for the dissimilar metal joints and to characterize their mechanical properties numerous tests were performed. Investigation of Spot weld ability of dissimilar metal joints between stainless steels and non stainless steels was carried out in this work. In dissimilar metal joint between stainless steel and non stainless steel it is found that the failure load of cross tension specimen was 72-78 % of the lap shear specimen.[1]**R.K Rajkumar et al**., analyzes the spot weld growth on 302 austenitic stainless steel and low carbon steel of 1mm of thickness and investigated the Dissimilar Weld Joints of AISI 302 Austenitic Stainless Steel and Low Carbon Steel in a research. For this study he varies the basic controlling parameters of resistance spot welding i.e. welding current and welding time but the electrode force kept constant. This paper reports that the parametric changes (current and time) have resulted proportional changes in tensile strength regardless of base materials. The fusion zones of stainless steel are longer than the carbon steel but heat affected zones are shorter than the carbon steel.[3] **P. Penner et al.,** investigated mechanical and micro-structural properties of Al/Mg dissimilar welds produced by RSW with Zn foil and Zn-coated steel inter layers. He studied with reference to resistance spot welding of AZ31B Mg alloy to Al Alloy 5754 was studied using Zn foil and Zn-coated steel interlayer. Poor strength joints were produced with a Zn foil interlayer due to formation of brittle inter-metallic phases. To prevent mixing of the Al and Mg alloys, resulting in much higher strength of the welds a Zn-coated steel interlayer was used. Failure load reached 74% of the same size similar AZ31B joints.[8] **P. Penner et al** investigated microstructure and mechanical properties of the dissimilar aluminium–magnesium resistance spot welds made with gold coated and bare nickel inter-layers. Different welding currents in a range from 16 to 24 kA and fixed welding time of five cycles were used for Welds. In order to improve metallurgical bonding, experiments with gold coated nickel interlayer were conducted and this produced much higher strength aluminium–magnesium resistance spot welds. The welds produced with welding current of 24 kA had average peak load of 4.69 kN, which was as high as 90% of the optimised similar AZ-31B welds. No joint were made by using bare nickel. The promising approach represents in dissimilar resistance spot welding by employing an interlayer with good brazing material. **[7] A. Gopichand et al**. utilized peel test to know the strength of the spot weld experimentally and also using finite element analysis for different combination of dissimilar materials to evaluate the stresses. To know temperature distribution thermal analysis is also carried out. for different combination of dissimilar materials Finite element analysis is done such as copper-aluminum, stainless steel-aluminum, stainless steel-copper, stainless steel-mild steel and stress values are obtained .then he find that stainless steel-aluminum have low stress value and stainless steel-mild steel have low temperature which is analyzed from the thermal analysis. [9] **A.K. Biradar et al**. in the year 2009 studied resistance spot welding of dissimilar metal between mild steel and AISI 304 austenitic stainless steel, having medium range thickness.

By varying the welding parameters such as welding time, welding current and welding force the spot welding of dissimilar metals of medium range thickness (0.8 mm to 1.2 mm M.S. and S.S. sheets) was carried. A polynomial equation of first order was developed to correlate weld strength with weld time, weld current and weld force.[2] **Mehdi Mansouri Hasan Abadi et al**. made a study about the correlation between mechanical properties and macro/micro structure of dissimilar resistance spot welds of AISI 304 austenitic stainless steel and AISI 1008 low carbon steel. Investigation of Structure-properties relationships in dissimilar resistance spot welding of AISI 304 austenitic stainless steel (SS) and AISI 1008 low carbon steel (CS) were carried out.[5] **Ladislav Kolarik et al.** analyzes the properties of between low carbon steel and austenitic CrNi stainless steel spot weld. For this study a Delta Spot welding gun with a process tape was used. The welding parameters influences the weld metal size is evaluated in this study. The size of weld metal proportionally increases with weld current. In fusion zone the hardness is increased. In the direction from weld metals towards DC 01 steel increase in iron content is observed while decrease in Cr, Mn and Ni from weld metal is also recorded.[11 **Nachimani Charde**, focused on the effect of parametric changes for dissimilar joints using medium carbon and stainless steels of 1mm sheets. The welding parameter current and welding time resulted proportional changes in tensile strength while inversely proportional with electrode force. The hardness of welded area is increased but its distribution along with the welded area is fluctuating. Carbon steel fusion zone is shorter than stainless steel while its heat affected zone is wider than the stainless steel.[6] **Dr. Sabah Khammass Hussein** analyze the effect of welding parameters on shear strength of weld of different metals using Taguchi technique for design of experiments. The shear, Microhardness and microstructure tests are carried out experimentally. Increasing the welding current and sample thickness increases the shear force, but increase in electrode force results reduction in shear force . In tests of Microhardness at the centre of nugget zone the maximum value of hardness is found. The nugget diameter is inversely proportional to the electrical and thermal coefficients and the Heat affected zone is decreased while the electrical and thermal coefficients increase.[10] **A. Aravinthan et al**., studied dissimilar metal spot joint between stainless steel and mild steel, focusing the nugget growth by varying current and weld time. Significant relationship between differing current increments and sufficient weld time to attain a proper weldment was done with the tensile tests. [4]

## III. CONCLUSION

1. These studies mostly focused on effect of welding parameters on RSW. The parametric change in current, welding time and electrode force resulted proportional change in strength of weld but the welding current is gives most significant contribution in this work.
2. Gold coated nickel interlayer in Mg and Al gives higher strength to the weld than bare nickel interlayer. Also the Zn coated steel interlayer prevents mixing of Al and Mg which results the higher strength of weld.
3. The bonding strength of weld pairs also increases with diameter of weld which affected by current and welding time.
4. Carbon steel fusion zone is shorter than stainless steel while its heat affected zone is wider than the stainless steel.
5. The nugget diameter is inversely proportional to the electrical and thermal coefficients and the Heat affected zone is decreased while the electrical and thermal coefficients increase.

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