PARAMETER RANGE VALIDATION FOR RESISTANCE SPOT WELDING

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ABSTRACT

Resistance spot welding is widely used in automobile sector to build the vehicle, In resistance spot welding its parameter play a vital role in vehicle strength. During the spot welding process, current losses usually observed, to prevent these losses, The purpose of this study to validate a range of spot welding parameter. The study is conducted on 0.6 mm thick Colled Rolled Close Annealed material grade JSC270C. This study shows that to validate a range of parameter multiple combinations needs to be made.

Keyword*: - Resistance Spot Welding, Weld Current, Weld Time*

1. INTRODUCTION

Resistance spot welding [1] is defined as a process where merging is formed by the heat gained from the resistance of the workpiece to the flow of low-voltage, high-density electric current in a circuit of which the workpiece is a part. Pressure is always applied to ensure a continuous electrical circuit and to forge the heated part together. Heat is developed in the assembly to be welded, and welding machine applies pressure through the electrodes. During the welding cycle, the material surface of the parts is heated to a plastic state just before melting and are compressed together. The parts are usually merged as a result of heat and pressure and not they're being melted together. Fluxes or filler metals are not needed for this welding process.

Heat Generation [2]
The amount of heat produced in an electrical conductor depends on the following factors:
1. Amperage,
2. Resistance of the conductor (including interface resistance),
3. Duration of current.

These three factors affect the heat generated, as expressed by the following equation:
$Q = I^2Rt$

Where Q = Heat generated, joules (J); I = Current, amperes (A); R = Resistance of the workpiece, ohms (Ω); and t = Duration of current, seconds (s).

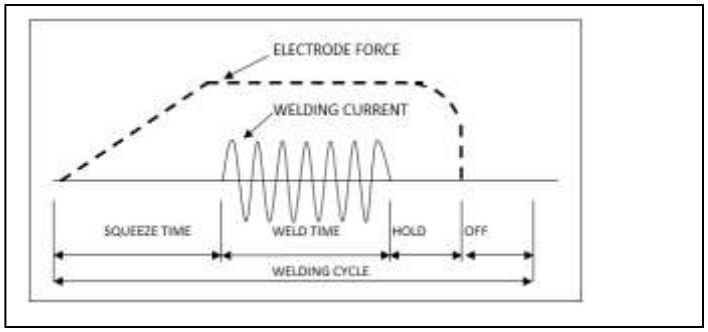

Fig. 1 Single Impulse Welding Cycle

The heat generated is proportional to the square of the welding current and directly proportional to the resistance and the time. Some of the heat is used to make the weld, and some is lost to the surrounding metal

1.1 LITERATURE REVIEW

H. Luo and all [3], in this study Resistance spot welding (RSW), was carried out on Magnesium Alloys AZ31B and AZ91D. The similarities and differences between these two materials about their welding characteristics and defect formation were investigated. A. Aravinthan [4], this experiment was carried out to analyze the growth of a spot weld in a mixed joint of mild and 302 austenitic stainless steel sheets. Manoj Raut [5] this experimental study is based on an investigation of the effect and optimization of welding parameters on the tensile shear strength in the Resistance Spot Welding (RSW) process. S.A.Jadhav [6], this paper is directed towards the optimization process parameter of resistance spot welding process and simultaneously consider multiple quality characteristics tensile strength and nugget diameter using Multi-Objective Taguchi Method. A. K. Pandey [7], This paper represents the optimization of various parameters of resistance spot welding. The experimental studies have been conducted under varying pressure, welding current, pressure, and welding time. In this investigation, the quality characteristic (tensile strength) has been considered using Taguchi Method. Manjunath R. Rawal, [8] An experimental study is conducted under various levels of process parameters. Spot welds are carried out on Cold Rolled Close Annealed (CRCA) material. Welding current, Electrode force and weld time are selected as process parameters with three levels of each. Taguchi quality design concept of L9 orthogonal array has been used to determine S/N Ratio, Analysis of Variance (ANOVA). Dipak V. Patil [9] the aim of this study is to find out the effect of spot weld parameters on the strength of spot weld. The effect factors of multiple spot-welded joints strength are analyzed including spot weld arrangement, the distance between two spot welds, spot weld diameter, and thickness based on finite element analysis (FEA) and experimental results. Y.Y. Zhao [10] The aim of this study to analyze the growth of a spot weld in a mixed joint of mild and 302 austenitic stainless steels

2. EXPERIMENTAL PROCEDURE

2.1 MATERIAL

Colled Rolled Close Annealed sheet 0.6 mm thick material used to conduct this study. Mechanical & Chemical properties of this material are as given in Table 1 & Table 2.

Table -1: Material Mechanical Properties

Material Grade	Mechanical Specification						
	YS	***UTS***	***EL***	***HRB***	***RA***	***BEND***	***ECB***
JSC270C	Mpa	Mpa	%	%	µm	%	MM
	223	325	53	52	1.2	OK	9.4

Table -2: Material Chemical Specification

Material Grade	Chemical Specification						
	C	Mn	Si	S	P	AI	N
JSC270C	%	%	%	%	%	%	%
	.044	.21	.008	.018	.019	.036	34

2.2 MACHINERY

Following machines were used to conduct this study

1. Integral Transformer Resistance spot welding machine "36 KVA" shown in Fig-2, used for this study, specification of this machine is as given in Table 3
2. Weld Checker
3. Vernier Caliper

Fig-2 **Integral Transformer Resistance Spot Welding Machine**

Table -3: Resistance Spot Welding Machine Specification

Resistance Spot Welding Machine Specification									
Throat Depth	Throat Gap	Air Pressure	Electrode Force	Initial Opening	Retraction Stroke	Total Stroke	Transformer Rating	Gun Model No	Weight (Approx.)
396 mm	120 mm	5 Bar	287 Kgf	32 mm	61 mm	93 mm	36 KVA	3024	75Kg

2.3 RANGE OF PARAMETER

A range of Resistance spot welding parameter given in Table-4, which needs to be validated.

Table -4: Resistance Spot Welding Parameter Range

Squeeze Time (Cycle)	*Welding Current (KA)*	*Welding Time (Cycle)*	*Hold Time (Cycle)*	*Electrode Force (KN)*
20	10 ± 0.5	10 ± 1	06	2.5 ± 0.2

2.4 METHOD

To validate a range of parameter total eleven trials taken at different combinations as given in Table -5, Experimental Parameter. In each trial 200 spots, weld took and after every 100 no of spots weld nugget diameter measures

Table -5: Experimental Parameter

Experiment No.	*Squeeze Time (Cycle)*	*Welding Current (KA)*	*Welding Time (Cycle)*	*Hold Time (Cycle)*	*Electrode Force (KN)*	*Parameter combinations Details* *Where -* *WC- Welding Current* *WT- Weld Time*
1	20	10	10	6	2.5	MEAN VALUES
2	20	10.5	11	6	2.5	W C -MAX, W T-MAX, FORCE-MEAN
3	20	10.5	10	6	2.5	W C -MAX, W T-MEAN, FORCE-MEAN
4	20	10.5	9	6	2.5	W C -MAX, W T-MIN, FORCE-MEAN
5	20	9.5	11	6	2.5	W C-MIN, W T-MAX, FORCE-MEAN
6	20	9.5	10	6	2.5	W C-MIN, W T-MEAN, FORCE-MEAN
7	20	9.5	9	6	2.5	W C-MIN, W T-MIN, FORCE-MEAN
8	20	10	11	6	2.5	W C-MEAN, W T-MAX, FORCE-MEAN
9	20	10	9	6	2.5	W C-MEAN, W T-MIN, FORCE-MEAN
10	20	10.5	11	6	2.3	W C -MAX, W T-MAX, FORCE-MIN
11	20	9.5	9	6	2.7	W C-MIN, W T-MIN, FORCE-MAX

3. RESULT AND DISCUSSION

Table -6: Weld nugget diameter w.r.t no of spot welds at different trials

Experiment No.	*Parameter*					*Parameter combinations Details*	*Weld Nugget Diameter in millimeter*			
	Squeeze Time (Cycle)	*Welding Current (KA)*	*Welding Time (Cycle)*	*Hold Time (Cycle)*	*Electrode Force (KN)*		*Standard Nugget Diameter*	*Actual Nugget Diameter at start*	*Actual Nugget Diameter after 100 spot weld*	*Actual Nugget Diameter after 200 spot weld*
1	20	10	10	6	2.5	MEAN VALUES	3.8	5.6	5.7	5.6
2	20	10.5	11	6	2.5	W C -MAX, W T-MAX, FORCE-MEAN	3.8	6.3	6.3	6.4
3	20	10.5	10	6	2.5	W C -MAX, W T-MEAN, FORCE-MEAN	3.8	5.5	5.6	5.6
4	20	10.5	9	6	2.5	W C -MAX, W T-MIN, FORCE-MEAN	3.8	5.0	5.1	5.2
5	20	9.5	11	6	2.5	W C-MIN, W T-MAX, FORCE-MEAN	3.8	5.5	5.2	5.4
6	20	9.5	10	6	2.5	W C-MIN, W T-MEAN, FORCE-MEAN	3.8	5.4	5.3	5.5
7	20	9.5	9	6	2.5	W C-MIN, W T-MIN, FORCE-MEAN	3.8	4.3	4.3	4.4
8	20	10	11	6	2.5	W C-MEAN, W T-MAX, FORCE-MEAN	3.8	5.3	5.1	5.3
9	20	10	9	6	2.5	W C-MEAN, W T-MIN, FORCE-MEAN	3.8	4.5	4.7	4.6
10	20	10.5	11	6	2.3	W C -MAX, W T-MAX, FORCE-MIN	3.8	6.1	6.1	6.3
11	20	9.5	9	6	2.7	W C-MIN, W T-MIN, FORCE-MAX	3.8	4.4	4.2	4.5

In all the trails weld nugget diameter is more than standard nugget diameter at the initial level. After taking 100 spots again, weld nugget diameter checked and found all nugget diameter more than standard diameter after 200 spots also weld nugget diameter checked & found more than standard diameter as given in Table-6,

4. CONCLUSIONS

Different combination of a range of spot welding parameter made & trial done to validate these parameters. Results on all combination for the complete range of parameter found more than standard. So based on experimental results range of spot welding parameter as per Table-4 is suitable for 0.6 mm thick sheet.

5. ACKNOWLEDGEMENT

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