

# Identification of the Quality Spot Welding used Non Destructive Test-Ultrasonic Testing: (Effect of Welding Time)

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**Abstract.** Resistance Spot Welding (RSW) is frequently used as one way of welding is used in the manufacturing process, especially in the automotive industry [4][5][6][7]. Several parameters influence the process of welding points. To determine the quality of a welding job needs to be tested, either by damaging or testing without damage, in this study conducted experimental testing the quality of welding or identify quality of the nugget by using Non-Destructive Test (NDT) –Ultrasonic Testing (UT), in which the identification of the quality of the welding is done with parameter thickness of worksheet after welding using NDT-UT with use same material worksheet and have more thickness of worksheet, the thickness of the worksheet single plate 1mm, with the capability of propagation Ultrasonic Testing (UT) standard limited > 3 mm [1], welding process parameters such as the time difference between 1-10s and the welding current of 8 KV, visually Heat Affected Zone ( HAZ ) have different results due to the length of time of welding. UT uses a probe that is used with a frequency of 4 MHz, diameter 10 mm, range 100 and the couplant used is oil. Identification techniques using drop 6dB, with sound velocity 2267 m / s of Fe, with the result that the effect of the Welding time affect the size of the HAZ, identification with the lowest time 1s show results capable identified joined through NDT - UT.

## 1. Introduction

Resistance Spot Welding (RSW) is a technology of welding is used in industry, especially the Big Industry automotive[4][5][6][7]. Several parameters affecting the process of spot weld that impact on the quality of the weld, some method or means determines the quality of the weld, either by damaging the material or without material damage, in this study conducted a test without damaging the material. The method for inspecting welds result is the one that does not damage the test (NDT) ultrasonic methods. Ultrasonic Testing (UT) is one of the test does not damage the material. Method of Non-Destructive Test (NDT) is widely used practically in welds Shielded Metal Arc Welding (SMAW), to find out the defects that occur in the weld SMAW, in this study conducted experimentally to determine quality welds welding spot welding using a standard probe Ultrasonic Testing ( UT ) that limits the identification of > 5 mm, to determine the level of ability of the probe based on the parameters of the Welding time and the thickness of the worksheet spot weld, it is intended that the identification of the quality of the spot welding can be performed used.



## 2. Methodology and Materials

### 2.1. Methodology

In this study, several steps undertaken include setting up multiple specimen electrodes and a worksheet, the determination of several parameters of the experimental process of spot welding, some parameters of spot welding is used geometry diameter of the tip electrode adapted to the thickness of the worksheet, the welding time and welding current, then do the process identification of the quality of the weld. Identification of the quality of welding is done using Non-Destructive Test (NDT) with ultrasonic testing (UT) with normal frequency probe has a diameter of 10 mm, the frequency of 4 MHz, a sound velocity of 2267 m / s, range 100 and couplant use oil. Identification techniques using a 6 dB drop. The tools used Ultrasonic Flaw Detector Karl Deutsch Echograph 1090, the spot welding process is done with the following parameters;



**Figure 2.1** Size Diameter of Tip Electrode

Selection of electrodes using material Fe, with a large diameter tip electrode refers to the thickness of the worksheet used by equation  $5\sqrt{t}$  [2], then with a thickness of 1 mm can be used worksheet large diameter electrode tip that is used by 5 mm.

**Table 2.1** Specification Machine of Spot Welding WIM MC-8

Input Voltage	230 / 240V
Input Current	65A
Welding Current	8 KVA
Taper Max.	2 (1+1) mm
Duty Cycle	50%

### 2.2. Materials

The material used for welding specimen is Fe that has been on the market with the composition of the test results spectrometri as follows;

**Table 2.2** Composition of Worksheet (Fe)

Composition	Percentage (%)
C	0,05
Si	0,01
S	0,05
P	0,01
Mn	0,22
Ni	0,06
Cr	0,02
Cu	0,01
Al	0,04
Fe	99,65

Material worksheet used Fe with a thickness of 1 mm, and the test results using the ARL 3460 spectrometri testing machine, At room temperature of 25 C, with 51% indicating Humidity 99.65 % and large dominate kompoisis C <0.25%. And the material used to form Cu elektorda with spectrometri test results as follows:

**Table 2.3** Composition of Electrode (Cu)

Composition	Percentage (%)
Sn	0,03
Zn	0,02
Pb	0,03
Fe	0,03
Ni	0,01
Al	0,03
Si	0,02
Cu	99,83

The tables show the dominating content of 99.83% Cu composition, it shows the electrode Cu used for pure category.

### 3. Experimental Spot Welding

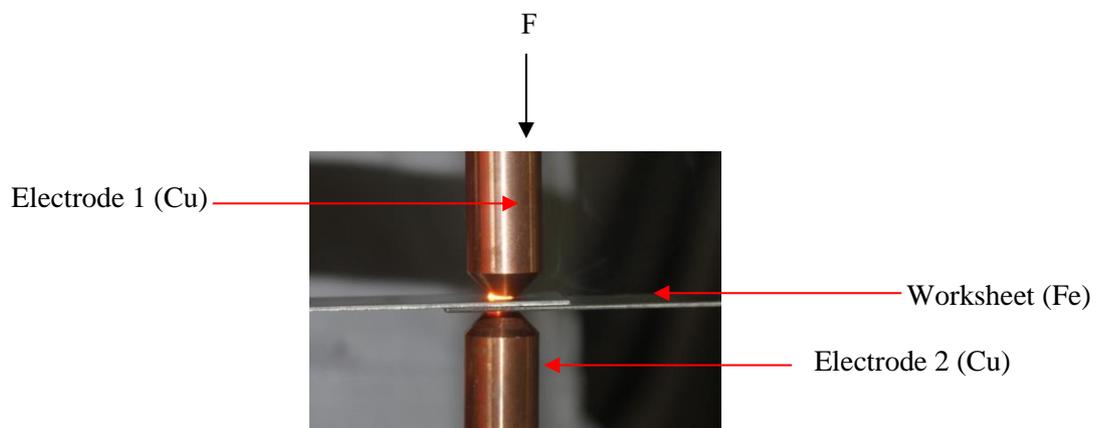
The process of the experiment, the spot welding process is performed using several parameters as follows;

**Table 2.4** Parameters of Spot Welding

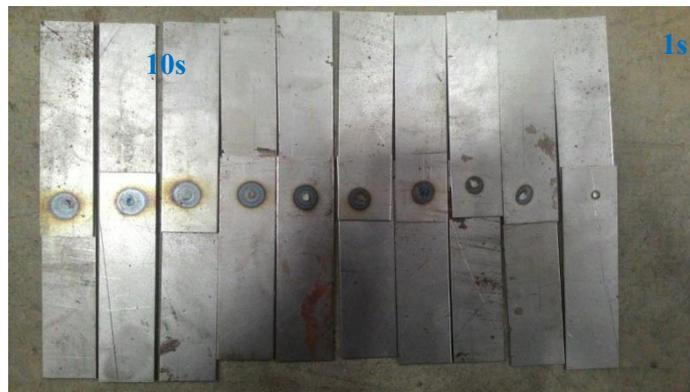
HoldingTime (s)	Welding Current (KVA)	Force (Kg)	Diameter Tip Electrode (mm)	Thickness Worksheet (mm)
10	8	2	5	1
9	8	2	5	1
8	8	2	5	1
7	8	2	5	1
6	8	2	5	1
5	8	2	5	1
4	8	2	5	1
3	8	2	5	1
2	8	2	5	1
1	8	2	5	1

Spot welding process is done, with some of the following steps;

- The first step determines the welding current (On)
- Then in the next step to determine the parameters spot welding
- The third stage worksheet position in line with the electrode
- The next stage connecting worksheet by moving both electrodes (Force)

**Figure 2.2** Spot Weld Process

Influence diameter tip on the spot welding process that impact on the quality of spot welding, using electrodes angle on the electrode temperature cooling conditions at 761-718 °C no effect on tip diameter size change [6].



**Figure 2.3** Results Process Spot Welding (1s - 10s)

In the Figure shows the Heat Affected Zone (HAZ) which different from variable Welding time 1s-10s, the time condition 1s shows Heat Affected Zone (HAZ) is very small, but so is contrary to the conditions of time 10s HAZ showed than greater, the results visually indicates the use of electrodes Cu and worksheet Fe, showed HAZ area larger than size nuggets.

**4. Results and Discussion**

*4.1. Results Non Destructive Test*

Identification of the quality of spot welding is done by using Non-Destructive Test using instruments as follows;

**Table 2.5** Instrument Non Destructive Test

Ultrasonic Flaw Detector (Karl Deutsch 1090)	
Probe	Single normal size of 10 mm, 4 MHz probe
Cable probe	MPKL
Couplant	Oil
Calibration block	IIW Block (V1)

Several steps should be taken to conduct testing Non Destructive Test (NDT) using normal probe Ultrasonic Testing (UT);

- Place the first step Standards UT probe on the surface of the reference specimen (Calibration block)
- The second step Ultrasonic Testing Turn on the device and choose the menu type normally used probe
- In the third step select menu with a range of 50 mm
- Select the two-point calibration at display menu and make sure the velocity of material for steel 2267 m / s and the input path 1 in 5 mm and 10 mm 2 on the path and select "next"
- Ensure step to five pulses will appear on the display scale of 2.5, 5.0, 7.5, and 10.0
- Place the six steps to the probe on the surface of the nugget and the identification results would show on a display with scale 10.0
- The final stage probe readings will appear on the display instrument



**Figure 2.4** Identification Quality of Spot Welding used Non Destructive Test (NDT)-UT

4.2. Discussion

Results of identification by using NDT- Ultrasonic Testing, it can be seen visually graph readout power ultrasonic propagation material identified with the visual results as follows;



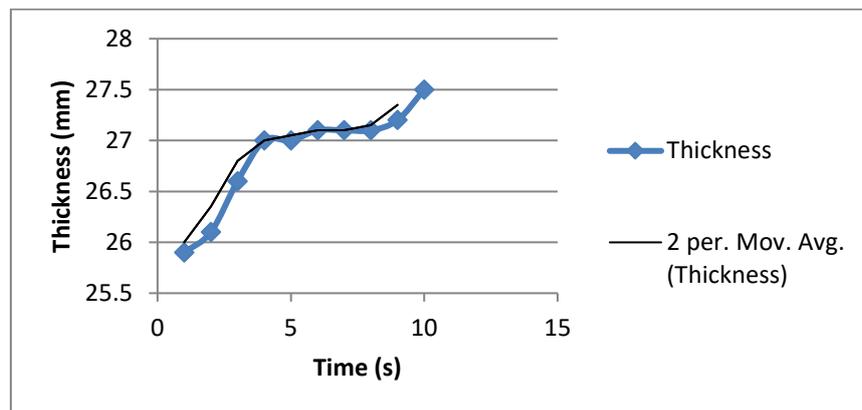
**Figure 2.5** Visualisation of result identification Welding time of 6s,7s, and 8s (Material Thickness (25 mm media, 1+1 mm worksheet )

The propagation probe readings with the same value of 27.1 mm in the Welding time 6s, 7s, and 8s



**Figure 2.6** Identification results at the Welding time of 10s (Material Thickness (25 mm media, 1+1 mm worksheet)

From the picture above can be seen in the graph the signal propagation generated by NDT-UT on material worksheet in the Heat Affected Zone (HAZ), especially on nugget welding spot weld, showing the first signal shown in the results of the red shows the results of propagation of nuggets in the worksheet where its thickness > 26 mm (Media + Single worksheet) on the results of the identification with the value of Welding time of 10s, with readings of 27.5 mm



**Figure 2.7** Graph of the identification results of spot welding (Welding time 1s-10s)

The graph above is the result of measuring the thickness of the weld nugget worksheet, which is measured on several specimen welds, used different Welding time of 1s-10s, with the result a time of 1s showed value of the thickness of the measurement results of 25.9 mm, and measurement results on the welding time 10s showed the value 27.5 mm, so it is can be seen that small welding time, that is produced small size nuggets and the greater value of the welding time, so it is the greater the size nugget, the effect of weld time on result quality of spot welding measurement on nugget area by using Nondestructive Test using normal ultrasonic probes, with showed that the value of time affect the quality results of weld.

## 5. Conclusion

Results of experimental process of spot welding on a worksheet material Fe with a thickness of 1 mm, and the electrode used Cu, with the diameter of the tip electrode 5 mm, then the identification of quality weld spot welding, the parameter Welding time different 1s up to 10s, Voltage 8KV, duty cycle of 50%, shows the Heat Affected Zone (HAZ) is different, but the result of identification of welding with the approach of the Non Destructive Test using a probe Ultrasonic Testing (UT) with a frequency of 4 MHz, Sound velocity of 2267 m / s, with detection capability > 3 mm [7] so done experimentally with the help of media material Fe has a thickness of 25 mm, it can be concluded that the welds can be identified even though the time difference welding different, and there is the effect of time on a weld that is the quality of the weld produced, with a Welding time most low 1s had value propagation signal propagation by showing the thickness of 26.1 mm, and the maximum Welding time shows the value of propagation material to show the thickness of 27.5 mm of propagation.

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