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WELDING TESTS ON THIN SHEET METAL (0.5 MM TO 2.0 MM) USING VARIOUS PARAMETERS IN MIG WELDING

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ABSTRACT

The paper is basically for the mechanical production industry whose manufacturing product is made by using Welding. Welding is a widely used manufacturing process in a Mechanical Industry to join two metals together. Metal Inert Gas [MIG] welding is an arc welding process in which continuous solid wire electrode melt and fed into the joining job from a welding gun. The gun is used to feeds a shielding gas alongside the electrode and helping protect the weld pool from environmental air Using this mechanical principle it needs to analyze the proper current and voltage required for sheet metal thickness of about 0.5 mm to 2 mm to weld without any welding defect. For that it needs to take the tests by changing the various parameters under consideration like Current, Voltage, Base material Thickness, Gas flow rate, after completion of all the tests it is easy for an operator to select proper Current, Voltage, Base material Thickness, Gas flow rate, according to the new standard chart.

I. INTRODUCTION

There are lots of welding process are existing in industry right now but as per our paper title requirement, It is need to focusing on the Metal Inert Gas (MIG) welding. Metal Inert Gas (MIG) welding was firstly discovered and patented in the USA in 1949 to weld aluminium. That time the arc and weld pool formed using a bare wire electrode was protected by helium gas, which is available easy. From 1952 onwards, the process became popular in the United Kingdom to weld aluminium using argon as the shielding gas, and for carbon steels using CO2.

Welding is a widely used manufacturing process in many industries such as the automotive, construction, aviation, and many more industry. So many things are joint using welding process, including many buildings, gates, and fences, small kitchen appliances and vehicles. The commonly used welding process for automotive applications are resistance spot welding, resistance seam welding, metal inert gas welding, tungsten inert gas welding as also laser beam welding , friction welding , and plasma arc welding. In auto industry is widely uses more welding robots than ever before, but skilled welders are still needed to handle special purpose welding jobs and supervise the welding robots.

Laser welding and Metal Inert Gas welding this two techniques is mostly used in the automobile industry, as they are mostly used on aluminum, a metal that is increasingly being utilized in the manufacture of all automobile vehicles. Laser welding is important to learn because it is used for sheet metal processing and can enable one to land a job manufacturing not only standard cars but also the energy efficient ones that will come to dominate the market in the future.

Automobile industry is certainly one industry which is available to those with welding training. Skilled welders is more in demand in Automobile industry and they can also earn more money however, it is important to know exactly what type of welding skills are required in the welder to work for a car manufacturing company. This knowledge can able toward the right training upon graduation from a welding college and, ultimately, a profitable career

II. METHODOLOGY

To perform tests on the workpiece it is need to do trial and error method, as using this method it is easy to analyze the result by doing visual inspection of the workpiece, and easy to prepare result table for the required current and voltage setting.

Objectives

The following are the objectives of the research work under consideration:

1. To study basic requirements of welding, its type, technology used for manufacturing industry.
2. To reduce human effort require to handle the workpiece and ultimately to reduce the production time and increase rate of production by doing some experiments on welding parameters.
3. To select the proper current and voltage setting as per the experimental analysis chart and standard chart to reduce the tore of workpiece and welding defect.
4. Using old welding process it is to modify new welding technology using available techniques.

Experimental layout for testing

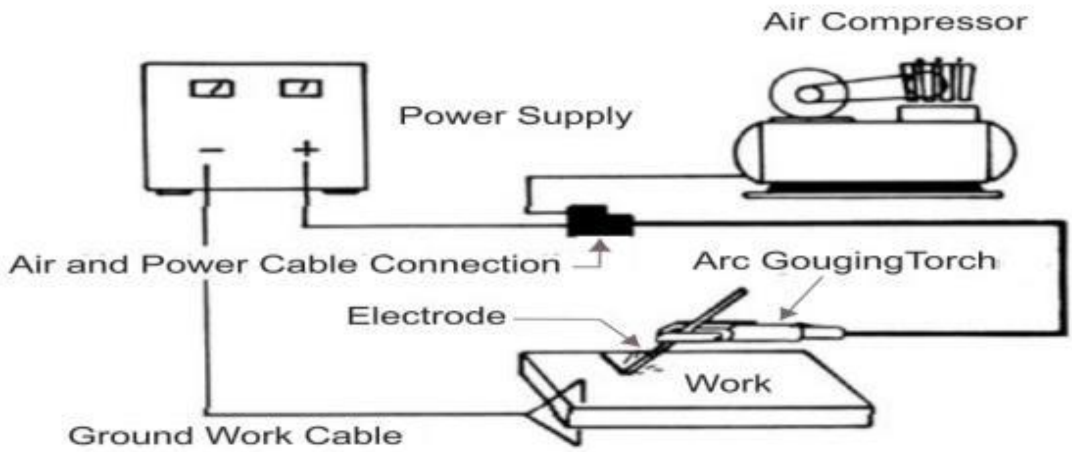

Figure 1: experimental layout for test

Above figures are describe the required test set up for the testing. The fig. shows the general layout of the welding gun and welding principle to be used for welding. In general layout the components to be used as compressor, torch, workpiece, power supply and power cable is to be used using all this welding to be done on a workpiece.

Procedure for testing the workpiece

- Set up the welder and torch as per welding standard.
- Choose the skilled person which is perform the test with the all safety kit.
- Start the machine and perform the test as per the requirement.
- Note down the time and observations in observation table.
- Repeat the process until all the tests are to be completed.

III. MAIN TESTS AND SUB TESTS REQUIRED TO BE PERFORMED

1. Material Thickness

1.1. 0.5 mm

1.2. 1.0 mm

1.3. 2.0 mm

2. Shielding gas flow rate

2.1. 10 LPM

2.2. 15 LPM

2.3. 20 LPM

3. Constant voltage

3.1. 12 V

3.2. 15 V

3.3. 17 V

IV. TEST IMAGES AND OBSERAVTION TABLE

0.5 mm thickness sheet

In this test, thickness of the sheet is 0.5 mm and current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

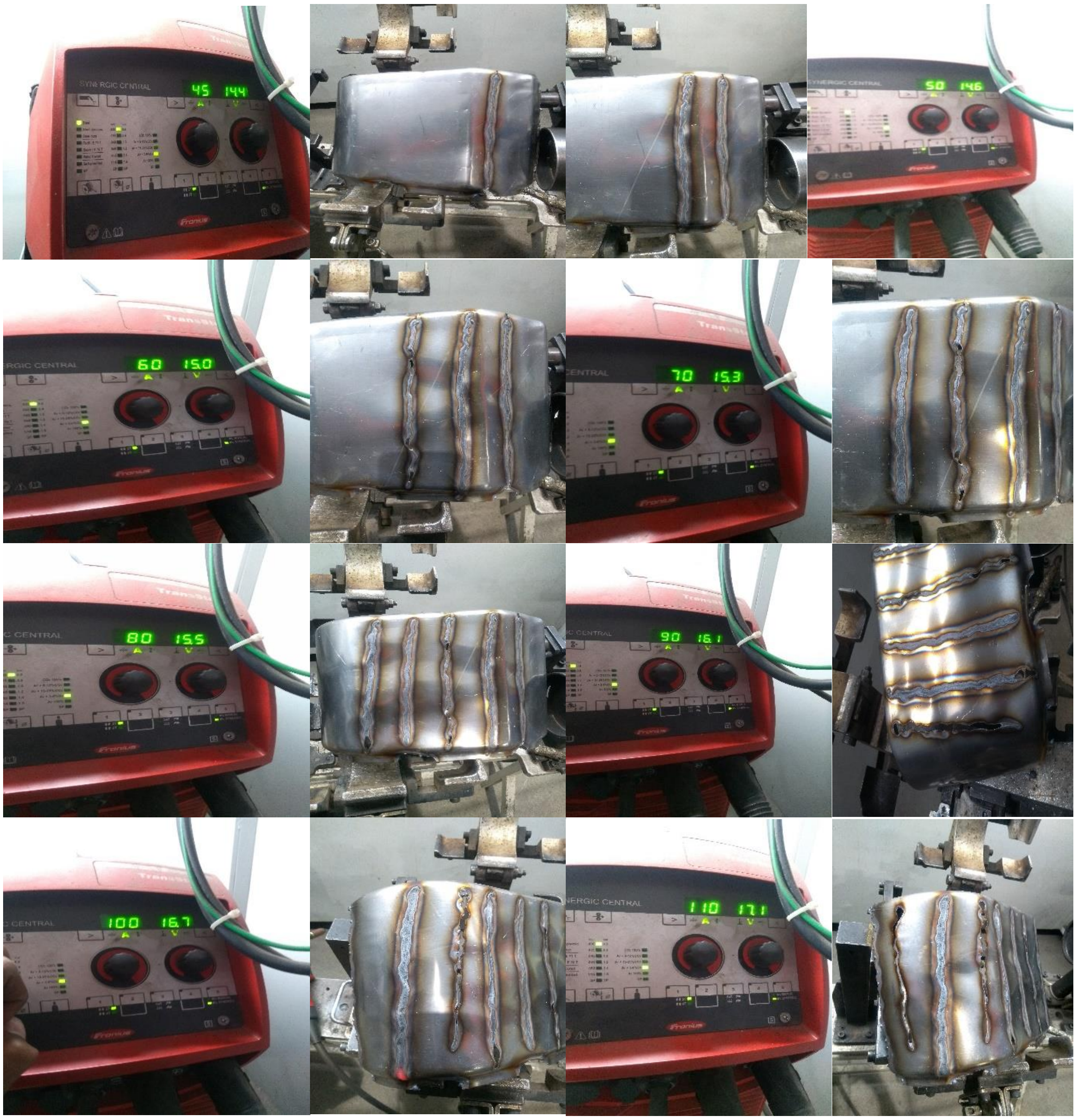

Figure 2: 0.5 mm thickness sheet testing photos

Table 1.0.5 mm thickness sheet observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	14.4	6.4	Good welding no tore
2	50	14.6	5.6	Good welding no tore
3	60	15.0	6.0	Tore of workpiece
4	70	15.3	5.4	Good welding just penetration
5	80	15.5	5.4	Good welding penetration
6	90	16.1	5.6	Tore of workpiece
7	100	16.7	5.2	Good welding penetration

8	110	17.1	5.4	Tore of workpiece

1.0 mm thickness sheet

In this test, thickness of the sheet is 1.0 mm and current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

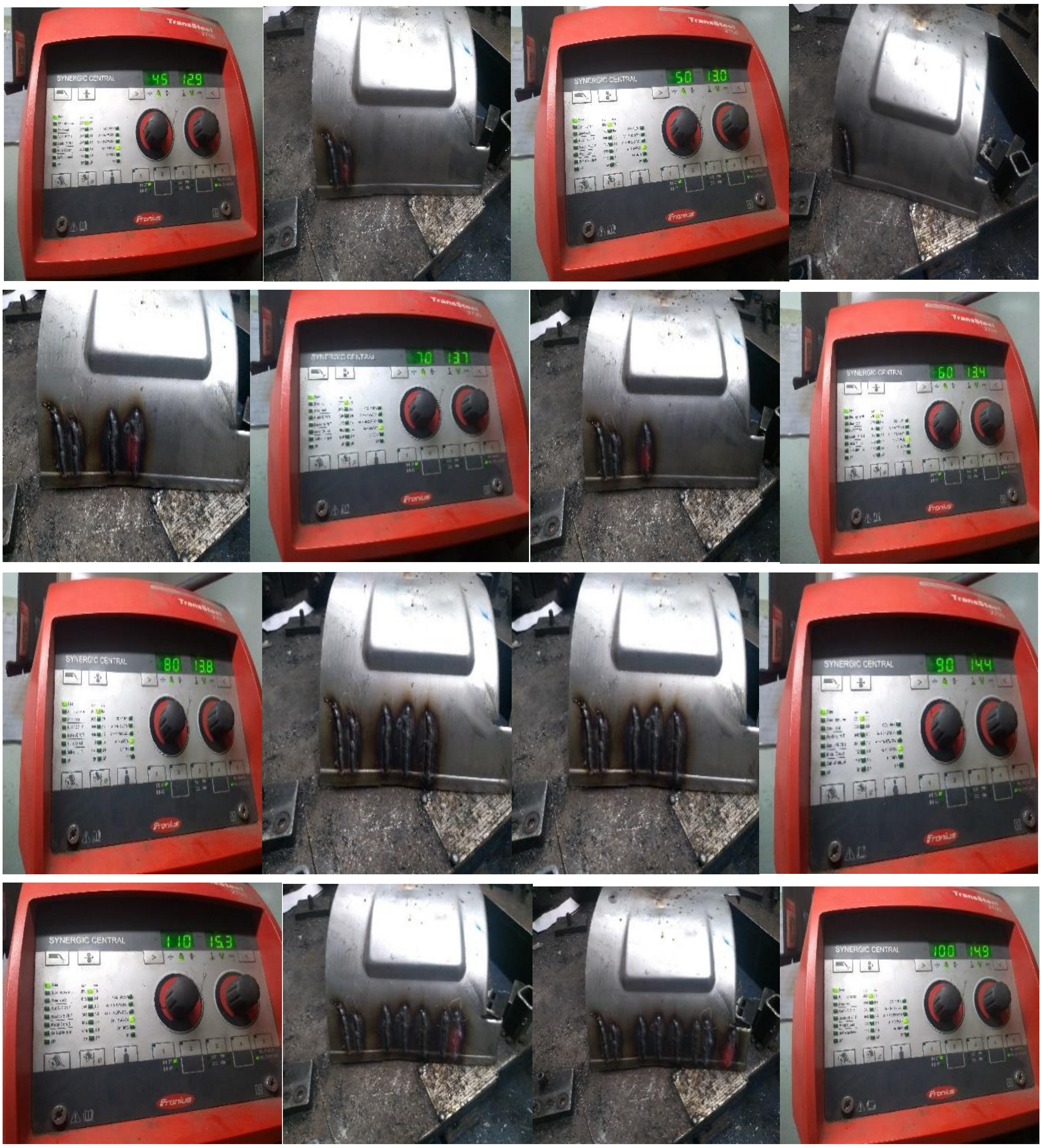

Figure 3: 1.0 mm thickness sheet testing photos

Table 2. 1.0 mm thickness sheet observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12.9	7.8	Good welding no tore
2	50	13.0	7.2	Good welding no tore
3	60	13.4	6.6	Good welding no tore
4	70	13.7	6.6	Good welding just penetration

5	80	13.8	6.3	Good welding no tore
6	90	14.4	6.2	Good welding small penetration
7	100	14.9	6.0	Good welding penetration
8	110	15.3	6.2	Good welding penetration

1.0 mm thickness sheet

In this test, thickness of the sheet is 2.0 mm and current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

Figure 4: 2.0 mm thickness sheet testing photos

Table 3. 2.0 mm thickness sheet observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12.9	8.4	Good welding no tore
2	50	13.0	8.0	Good welding no tore
3	60	13.4	7.9	Good welding no tore

4	70	13.7	7.7	Good welding no tore
5	80	13.8	7.5	Good welding no tore
6	90	14.4	7.5	Good welding just penetration
7	100	14.9	7.6	Good welding just penetration
8	110	15.3	7.5	more penetration

10 LPM gas flow rate

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 10 LPM, According to that current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

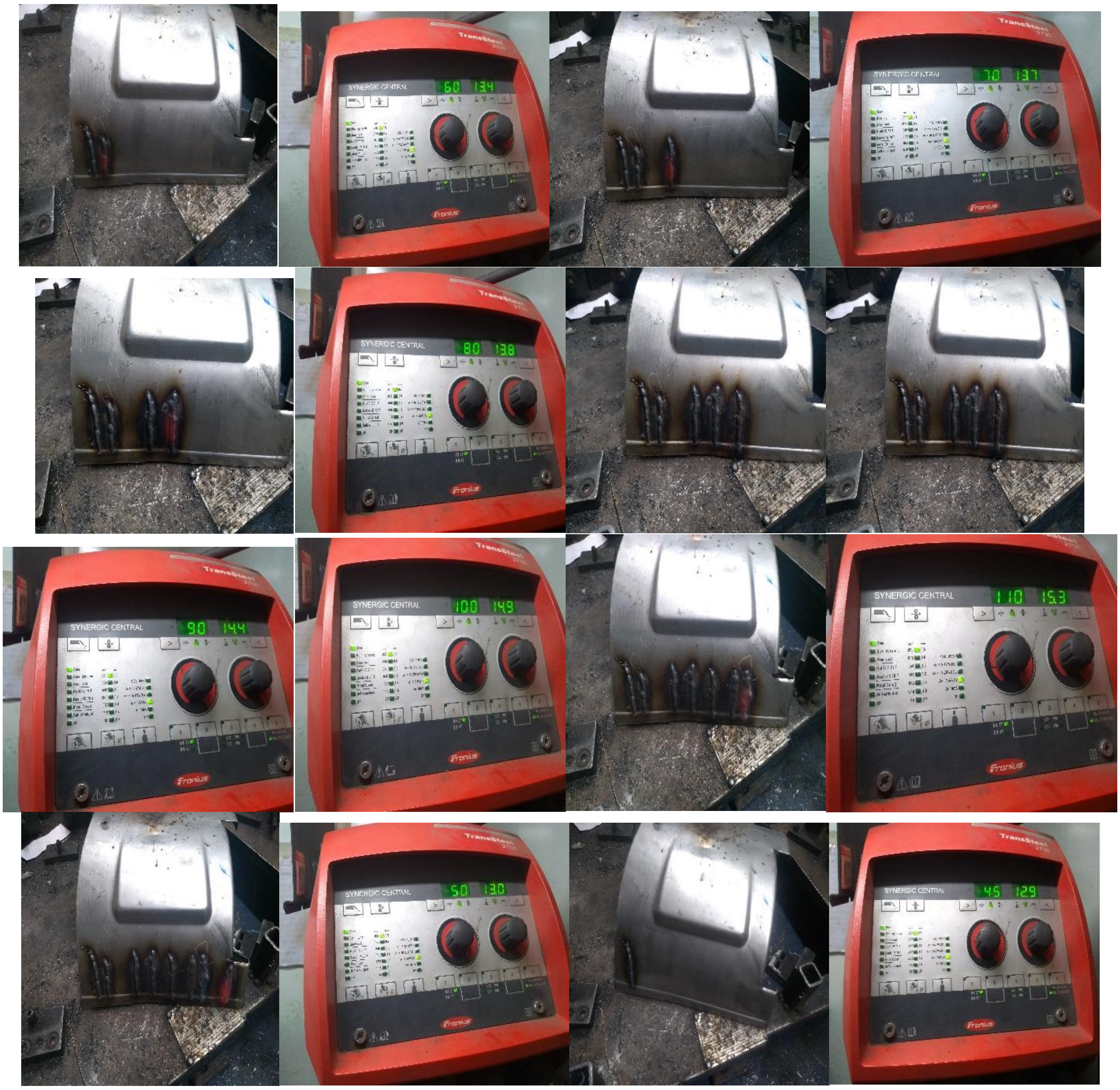

Figure 5: 10 LPM shielding gas flow rate

Table 4. 10 LPM shielding gas flow rate observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12.9	7.8	Good welding no tore
2	50	13.0	7.2	Good welding no tore

3	60	13.4	6.6	Good welding no tore
4	70	13.7	6.6	Good welding just penetration
5	80	13.8	6.3	Good welding no tore
6	90	14.4	6.2	Good welding small penetration
7	100	14.9	6.0	Good welding penetration
8	110	15.3	6.2	Good welding penetration

15 LPM gas flow rate

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 15 LPM, According to that current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

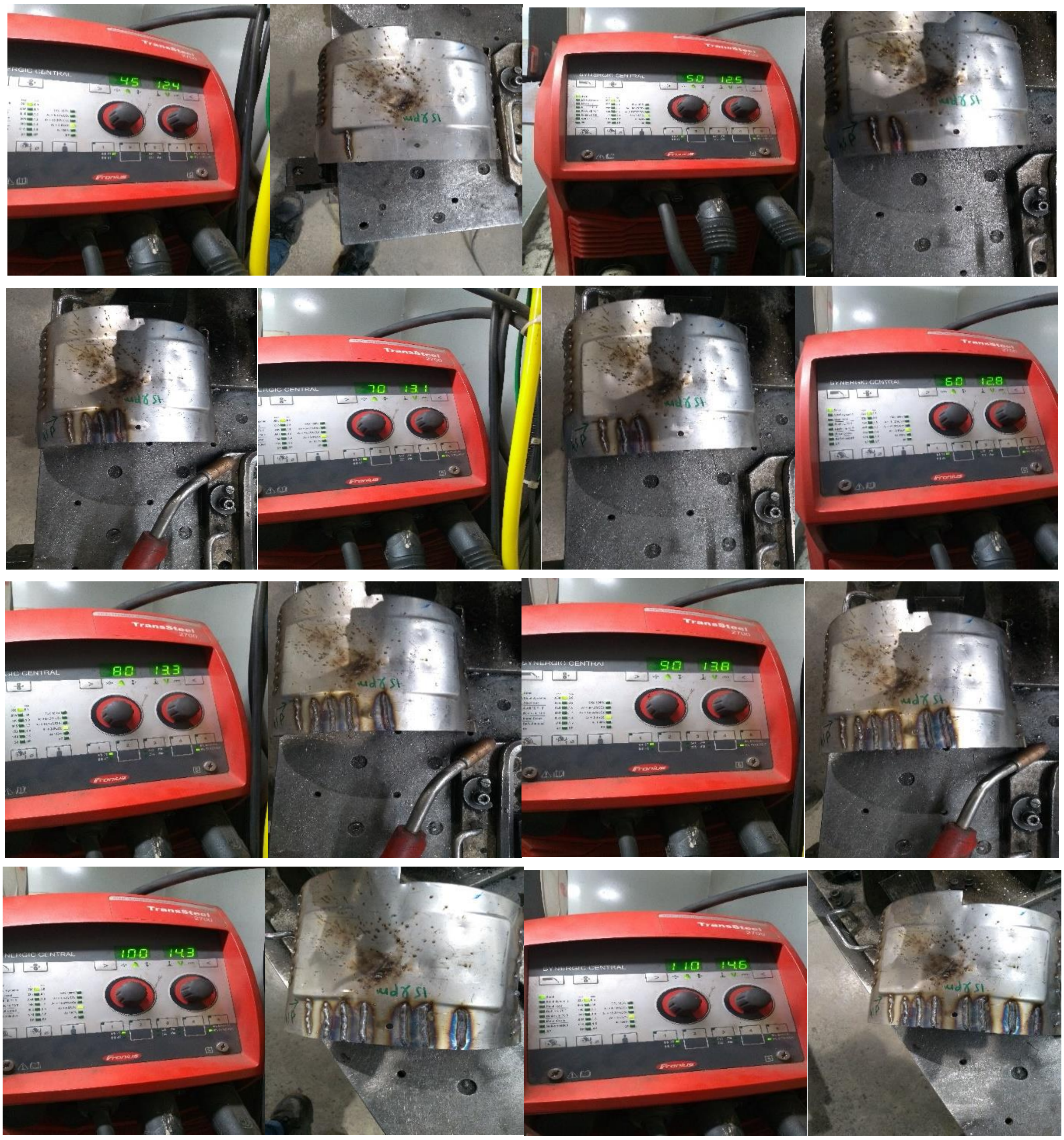

Figure 6: 15 LPM shielding gas flow rate

Table 5. 15 LPM shielding gas flow rate observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12.2	9.8	Good welding no tore
2	50	12.5	9.8	Good welding just penetration
3	60	12.8	9.2	Good welding no tore
4	70	13.1	8.9	Good welding no tore
5	80	13.3	8.8	Good welding penetration
6	90	13.8	8.4	Good welding more penetration
7	100	14.3	8.0	more penetration
8	110	14.6	8.4	more penetration

20 LPM gas flow rate

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 20 LPM, According to that current is vary from 45 A to 110 A and visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

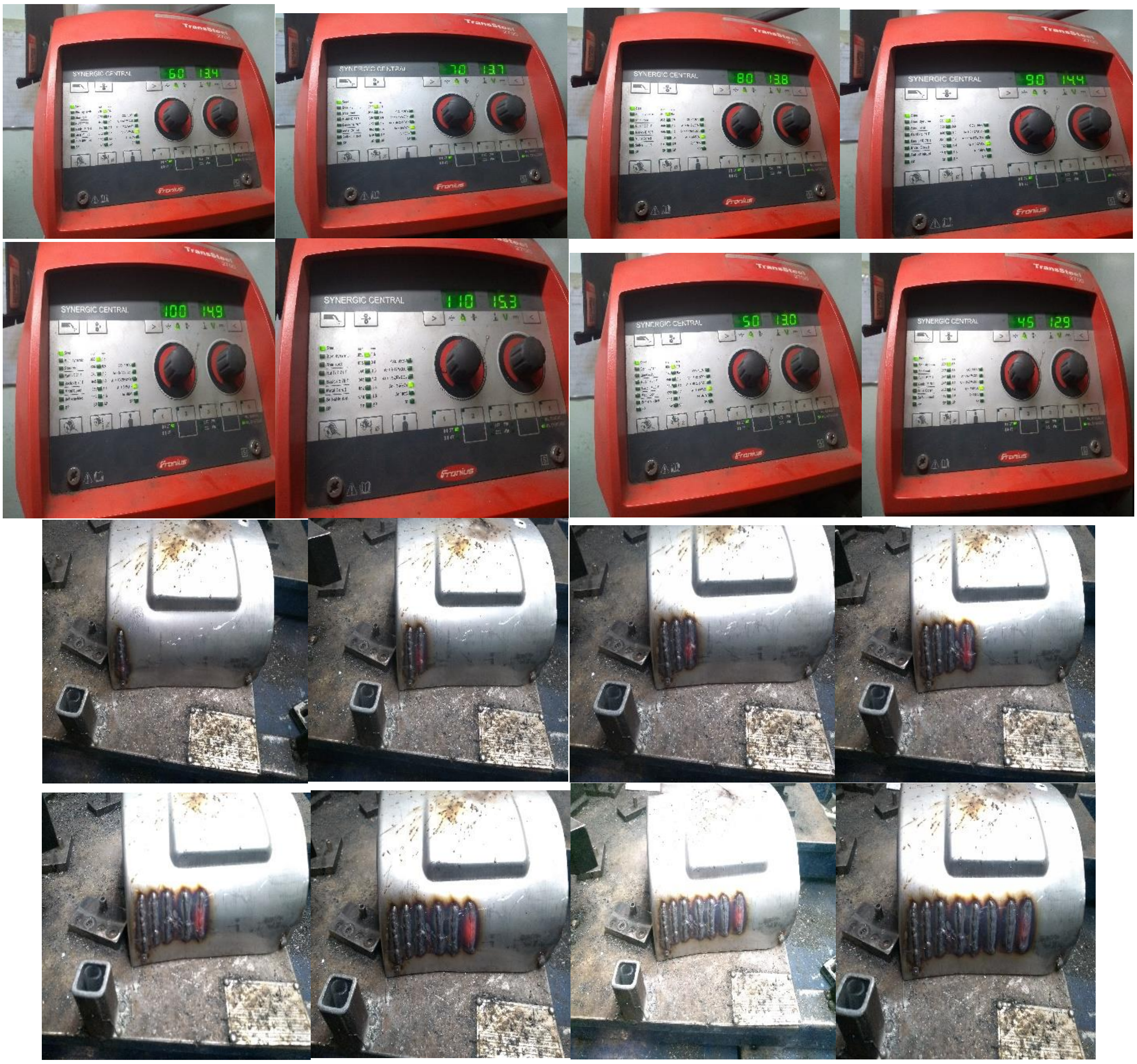

Figure 7: 20 LPM shielding gas flow rate

Table 6. 20 LPM shielding gas flow rate observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12.9	8.8	Good welding no tore
2	50	13.0	8.2	Good welding no tore
3	60	13.4	7.8	Good welding just penetration
4	70	13.7	7.8	Good welding no tore
5	80	13.8	8.0	Good welding just penetration
6	90	14.4	7.2	Good welding penetration
7	100	14.9	7.0	Good welding penetration
8	110	15.3	6.7	Good welding penetration

12 V constant voltage

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 15 LPM as default, According to that current is vary from 45 A to 110 A and voltage keeping constant which is 12 V then visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

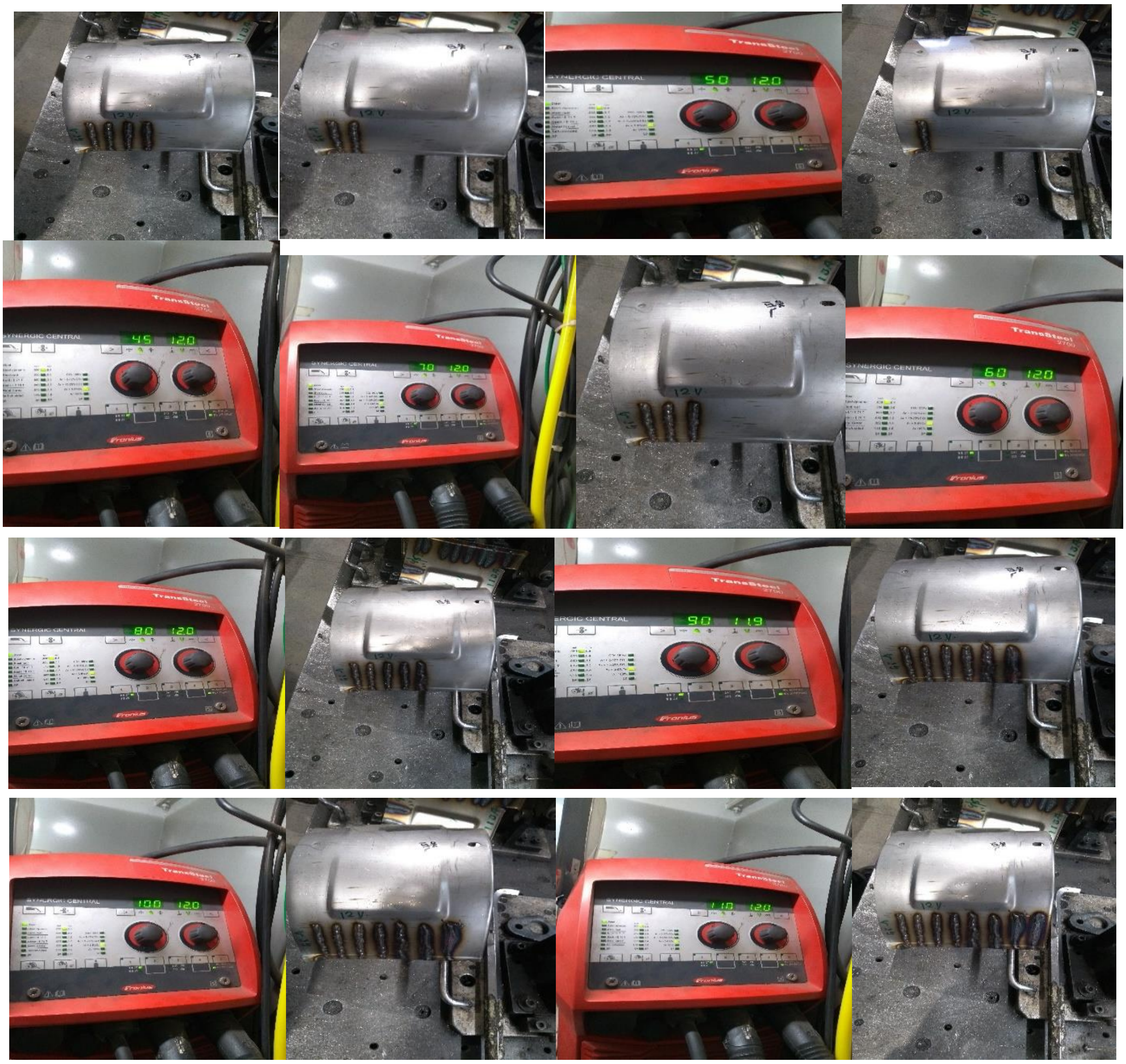

Figure 8: 12 V constant voltage

Table 7. 12 V constant voltage observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	12	8.8	Good welding no tore
2	50	12	8.6	Good welding no tore
3	60	12	8.4	Good welding no tore
4	70	12	8.4	Good welding no tore
5	80	12	8.1	Good welding no tore
6	90	11.9	8.4	Good welding just penetration
7	100	12	8.0	Good welding penetration
8	110	12	8.2	More penetration

15 V constant voltage

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 15 LPM as default, According to that current is vary from 45 A to 110 A and voltage keeping constant which is 15 V then visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

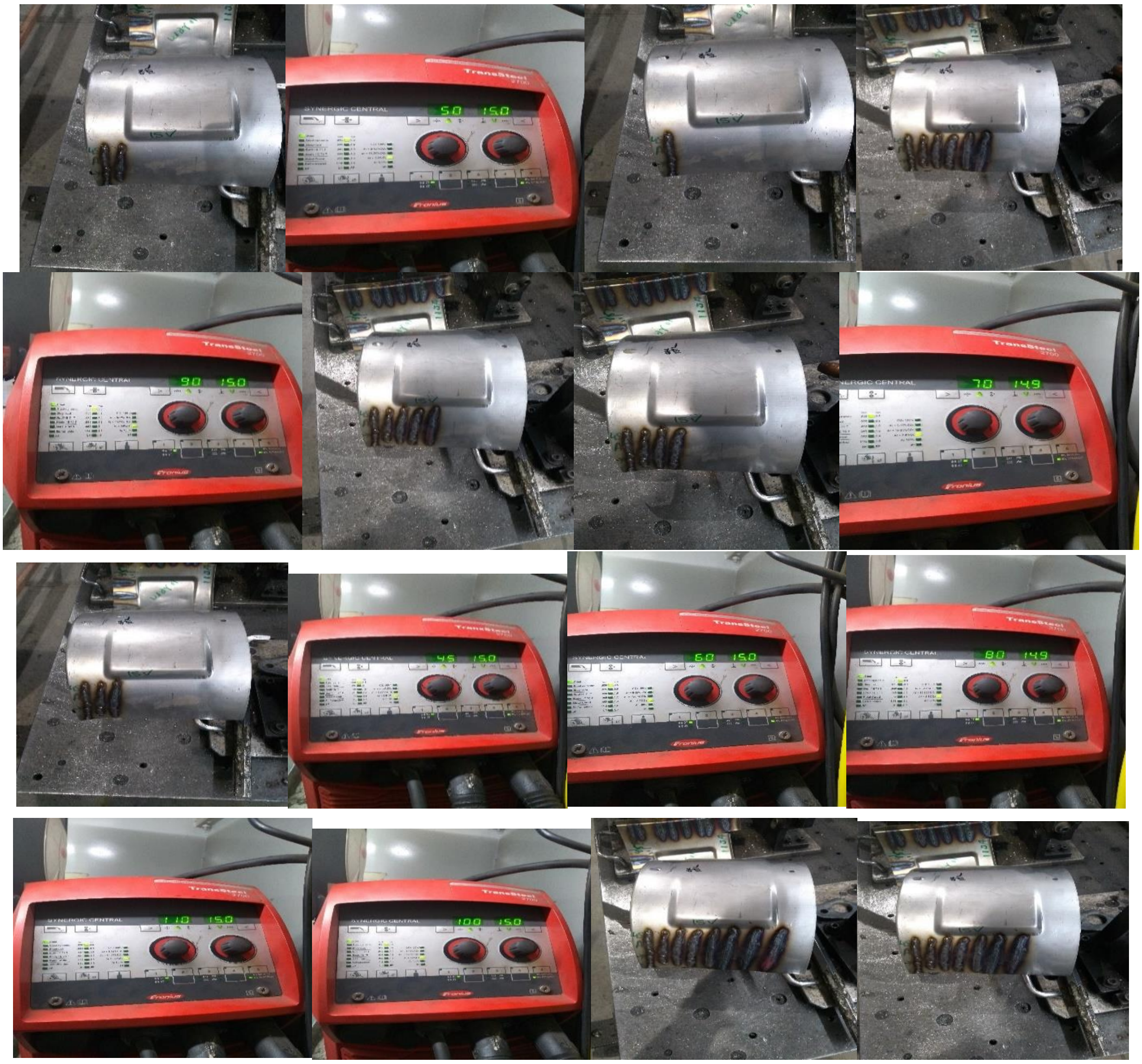

Figure 9: 15 V constant voltage

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Table 8. 15 V constant voltage observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	15	8.0	Good welding no tore
2	50	15	7.5	Good welding just penetration
3	60	15	7.8	Good welding penetration
4	70	14.9	7.6	Good welding penetration
5	80	14.9	6.6	Good welding penetration
6	90	15	6.8	More penetration
7	100	15	6.2	More penetration
8	110	15	6.2	More penetration

17 V constant voltage

In this test, thickness of the sheet is 1.5 mm keeping constant and gas flow rate is 15 LPM as default, According to that current is vary from 45 A to 110 A and voltage keeping constant which is 17 V then visual observation is done also time is require to weld of 50 mm run is note down in the table. The test photographs for the test is below

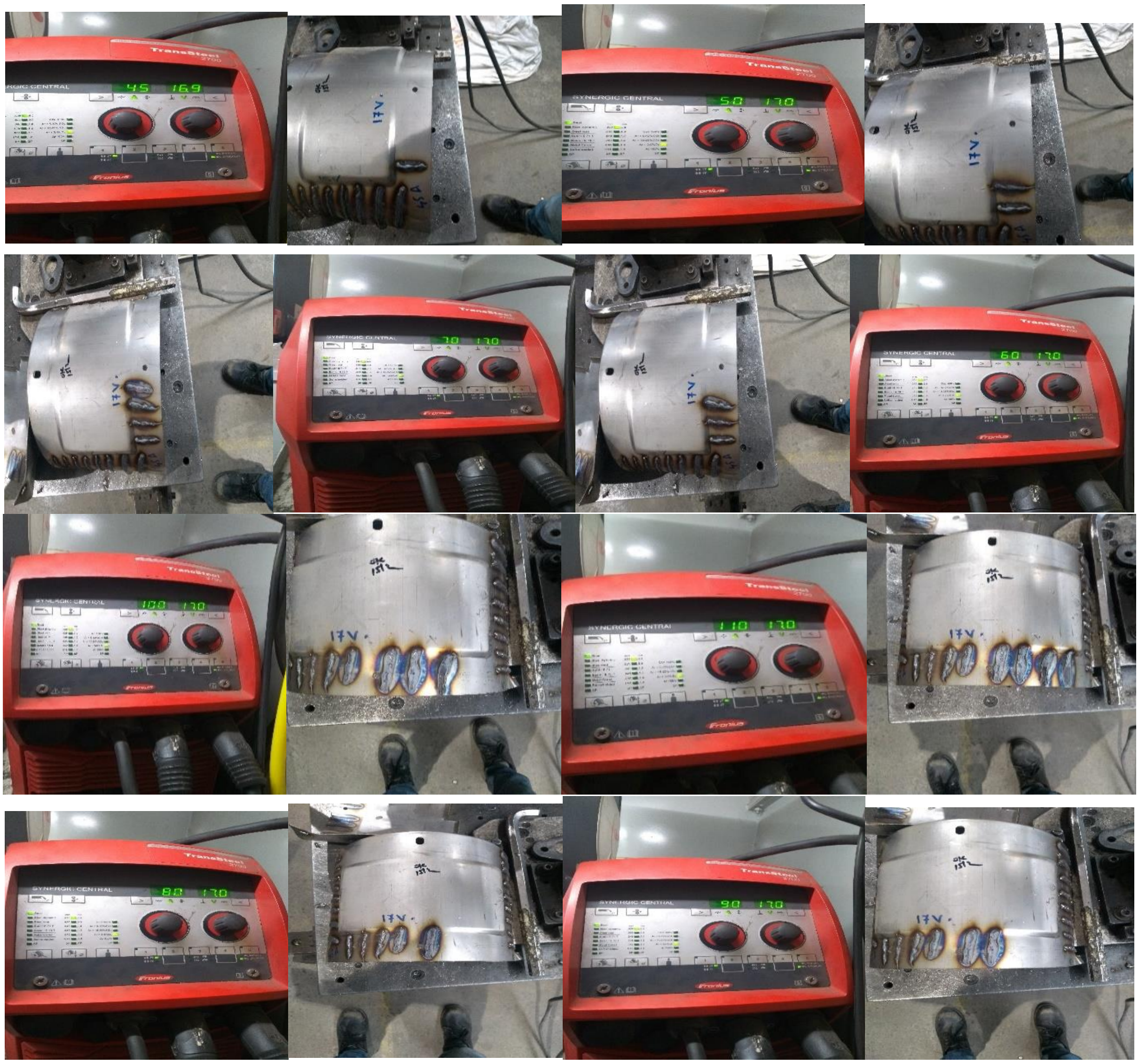

Figure 10: 15 V constant voltage

Table 9. 17 V constant voltage observation table

SN.	Current (A)	Voltage (V)	Time (Sec.)	Remark
1	45	16.9	6.5	Good welding just penetration
2	50	17	5.5	Good welding just penetration
3	60	17	5.2	Good welding just penetration
4	70	17	5.0	More penetration
5	80	17	4.8	More penetration
6	90	17	4.8	More penetration
7	100	17	5.0	Tore of workpiece
8	110	17	4.8	More penetration

V. RESULT TABLE AND CALCULATIONS

While combining the all results in one table it is easily understand the acceptable current and voltage required for the particular thickness.so the combined table is as below

Table 10. Combined result table for current and voltage

SN.	Test name	Acceptable limit		Travelling Speed (mm/sec.)	Not Acceptable limit		Travelling Speed (mm/sec.)
		Current (A)	Voltage (V)		Current (A)	Voltage (V)	
1	0.5 mm	70	15.3	9.2	80	15.5	9.2
2	1.0 mm	80	13.8	7.9	100	14.9	8.3
3	2.0 mm	80	13.8	6.6	110	15.3	6.6
4	10 LPM	80	13.8	7.9	100	14.9	8.3
5	15 LPM	70	13.1	5.6	80	13.3	5.6
6	20 LPM	70	13.7	6.4	90	14.4	6.9
7	12 V	80	12	5.7	90	11.9	5.9
8	15 V	45	15	6.5	50	15	6.5
9	17 V	45	16.9	8.3	50	17	9.0

Travelling speed

As per the above final result table it is easy to find out the travelling speed of the torch and can be able to calculate the total time required to weld the workpiece. The formula to calculate travelling speed is below,

$$\textbf{travelling speed} = \textbf{total travel (mm)} \div \textbf{total time (sec.)}$$

In this test case, considering total travel run is 50 mm

E.g. Consider total time=6.2 sec.

Total travel=50 mm

$$t\textbf{ravelling speed} = \textbf{total travel (mm)} \div \textbf{total time (sec.)}$$

$$travelling\ speed = \frac{50}{6.2}\ \text{mm/sec}$$

travelling speed =8.06 mm/sec

If the workpiece is loaded as circular section the required calculations are as follows

Welding time and motor rpm calculation

Consider the case,

Current (A) =80 A, Voltage (V) =12 V, Gas specification=15 lpm, 0.5mpa, 20°C, Workpiece dia. =300 mm, travelling speed=6.1 mm/sec.

$$\textbf{Welding time (T)} = \frac{\textbf{Circumference of workpiece}}{\textbf{travelling speed}}$$

By putting the above values,

$$\text{Welding time (T)} = \frac{300*3.14}{6.17}$$

Welding time (T) =153.42 sec.

Welding time (T) = 2.55 min.

If it is need to calculate the motor rpm the following formula can be used

$$\textbf{Motor rpm} = \frac{\textbf{1}}{\textbf{Time in min.}}$$

By putting the values,

$$\text{Motor rpm} = \frac{\mathbf{1}}{\mathbf{2.55}}$$

Motor rpm = 0.3921 rpm

VI. CONCLUSION

From the above tests it is easily understand the requirements of welding, its type, technology used for manufacturing industry. In result table it is concluded that to achieve good welding quality like no penetration of the welding, No spatter on the surface also no tore of the workpiece for thin sheet metal which is having thickness is 0.5 mm to 2.0 mm can be satisfied also the required calculations also done. Operator can be able to choose the proper setting as per his/her requirement. No scrap or extra material is waste during welding ultimately cost saving is done, reduces human effort and giving the proper result as required, this result can be implemented in semi-automatic machine also in robot welding.

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