IMPROVING THE WELD QUALITY BY USING WPS STANDARD FOR WELDING CONE AND PIPE OF SILENCER

Yeola Mangesh[1], Khangal Shubham[2], Khairnar Roshan[3], Yadav Kaustubh[4], Patil Tushar[5]

[1] *Student, Mechanical Engineering, Matoshri College of Engg, Maharashtra, India.*
[2] *Student, Mechanical Engineering, Matoshri College of Engg, Maharashtra, India.*
[3] *Student, Mechanical Engineering, Matoshri College of Engg, Maharashtra, India*
[4] *Student, Mechanical Engineering, Matoshri College of Engg, Maharashtra, India.*
[5] *Asst.Prof., Mechanical Engineering, Matoshri College of Engg, Maharashtra, India.*

ABSTRACT

In today's Scenario various welding processes are used such as MIG, TIG, Arc welding etc. In our project the two components of silencer (cone and pipe) of a four wheeler (Mahindra Bolero) were joined by using MIG Welding because of its certain advantages and as it is lot quicker. But we were unable to get the required weld quality due to some reasons. So our task was to find a solution to improve the weld quality by considering the various weld parameters. WPS standard of welding is used in this process which provides direction to the welder for making sound and quality production welds as per the WPS standard. After discussion we came to the conclusion that, by changing the torch angle the weld quality will be improved and the number of defectives will be reduced.

Keyword: - *MIG Welding, WPS, Torch Angle, SUS.*

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1. INTRODUCTION:

Welding is the simplest and easiest way to join sections of pipe. Welded pipe has reduced flow restrictions compared to mechanical connections and the overall installation costs are less. The chief work of this setup is to weld the various components of silencer assembly. In this process the two components i.e. the cone and pipe of silencer are to be joined by using MIG welding process, Stainless steel wire is used as a filler material. Argon is used as a shielding gas it has certain desirable properties such as inflammability, odorless, colorless in both its liquid and gaseous form Etc. The cone and pipe both are made of SUS (stainless steel) material. A special purpose welding machine (SPM) is used for this process. Welding procedure specification (WPS) standard is used to give the welding direction to the welder and it is a formal written document describing welding procedure. The final weld quality is inspected by examining the weld penetration under the stereo microscope Rework Procedure is used for provide guideline to rework of the non-conforming part and this procedure is applicable for the reworking of all rework able non-conforming parts.

1.1 Problem Statement:

In the previous setup the torch angle was perpendicular with respective to work piece. But it was unable to provide the required fusion and weld penetration, which resulted in the failure (breakage) of the silencer front pipe assembly at the cone and pipe interface. Approximately 5 out of 50 silencers produced failed to serve the requirements.

1.2 Objective:

- To improve the weld penetration by changing torch angle.
- To obtain the required weld penetration (min. 20% of pipe thickness).
- To get proper weld fusion.
- Eventually reducing the waste of time and money due to the rework on defectives.

2. LITERATURE REVIEW:

[1] Satish.B. G[1] Prof, Arunkumar Jeergi[2] stated that a welding procedure Specification (WPS) is the formal written document describing welding procedures, which provides direction to the welder or welding operators for making sound and quality production welds as per the code requirements.

3. METHODOLOGY:

3.1 Previous Setup:

Fig 3.1 Previous Setup

In the previous setup the torch is perpendicular w.r.t work piece, but it is unable to provide the required fusion and weld penetration. Which leads to the failure of front pipe of the silencer assembly at cone and pipe interface.

Process Specifications

- Machine used: SPM welding machine.
- Filler wire diameter: 1.2mm.
- Wire material: Stainless steel.
- Shielding Gas: Argon.
- Current: 190-210A.
- Voltage: 19-21V.
- Gas flow: 15LPM.
- Drive speed: 30-50rpm.
- Welding used: MIG welding.
- Gas Pressure: 5-6 bars.
- Cone and pipe material: SUS (stainless steel).
- Tip to work piece distance: 15 mm.

3.2 Current Working Setup:

Fig 3.2 Current Working Setup

In this current working setup initially we changed the work piece fixture position up to angle of 6^0 to 8^0 thereby changing the torch angle which gave us 18% weld penetration which was less than the minimum required weld penetration (20% of pipe thickness), so we further changed the work piece fixture position to 11.2^0 which gave us 44% weld penetration which was in the required range.

Calculations

Workpiece fixture position angle calculated as follow,
Let,

L=length of fixture base=35cm
H=Height between machine bed and work piece fixture=6.80cm
Sin Ɵ =height/length
Sin Ɵ =6.80/35

$\Theta = 11.20^0$

4. TEST PROCEDURE:

The testing procedure involves metallographic inspection, which is the art and science of preparation and examination of material for their microstructure using microscope. The Success of examination and interpretation of microstructure depend on the quality of the surface preparation. The surface preparation includes cutting, grinding, mounting and polishing the Specimen to a high degree to get a mirror like reflective surface free from scratches.

The specimen preparation consists of the following steps:

1. Cutting the specimen from the workpiece.
2. Mounting the specimen in plastic mould for convenient preparation.
3. Polishing the Specimen.
4. Inspecting the specimen under the stereo microscope.

1. Cutting the specimen from the workpiece:

   The specimen which is to be examined is cut from the workpiece weld interface of pipe and cone using BAINCUT-M machine which uses a abrasive wheel for cutting.

SPECIFICATIONS:

- Cutting Size 60mm diameter
- 3HP motor, 3 Phase
- Spindle Speed 2800 rpm
- Wheel dia. 10" max.
- Internal illuminator
- Double vise design
- Quick-action cam vise option
- Ergonomic cutting handle
- 1/3 HP Coolant Pump
- Quick-action cam vise option
- T Slot Bed: 60mm X 190mm with 8mm T-Slot
- Machine Size: 850mm X 170mm 1550mm (L x D x H)

Fig 4.1 BAINCUT-M Machine

2. Mounting the specimen in plastic mould for convenient preparation:

   The specimen is then mounted in a phenolic mould for easy handling of the specimen. BAINMOUNT-H machine is used for mounting the specimen.

SPECIFICATIONS:

- 1200 Watts Mould Heater
- Provision to accommodate 1 1/2" and 2" dia.
- 1 1/4" dia. comes with the Machine as Standard
- Quick heater for speedy operation
- Digital Temperature indication/control
- Timer and buzzer for Heating and Cooling cycles

Fig 4.2 BAINMOUNT-H Machine

3. Polishing the Specimen:

   The specimen is grinded using emery paper and then polished using Billiards cloth (rough polishing), Velvet cloth (fine polishing), Micro cloth (ultra-fine polishing) in BAINPOL-ETD machine.

SPECIFICATIONS:

- Rigid table top corrosion proof FRP cabinet
- 8" disc polisher(10" disc optional)
- 0.5HP AC Motor
- Corrosion resistant wash bowl
- Free flow drain system
- Flexible water jet with control valve
- Aluminium Disc 8" Diameter (Interchangeable)
- S.S Holding Ring (Press Type)
- Holding Band
- Power supply: 230 V / 50Hz.

Fig 4.3 BAINPOL-ETD Machine

4. Inspecting the specimen under the stereo microscope:

   The stereo microscope is often used to study the surfaces of solid specimens. They are thus widely used in manufacturing industry for manufacture, inspection and quality control.

Fig 4.4 Stereo microscope

SPECIFICATIONS:

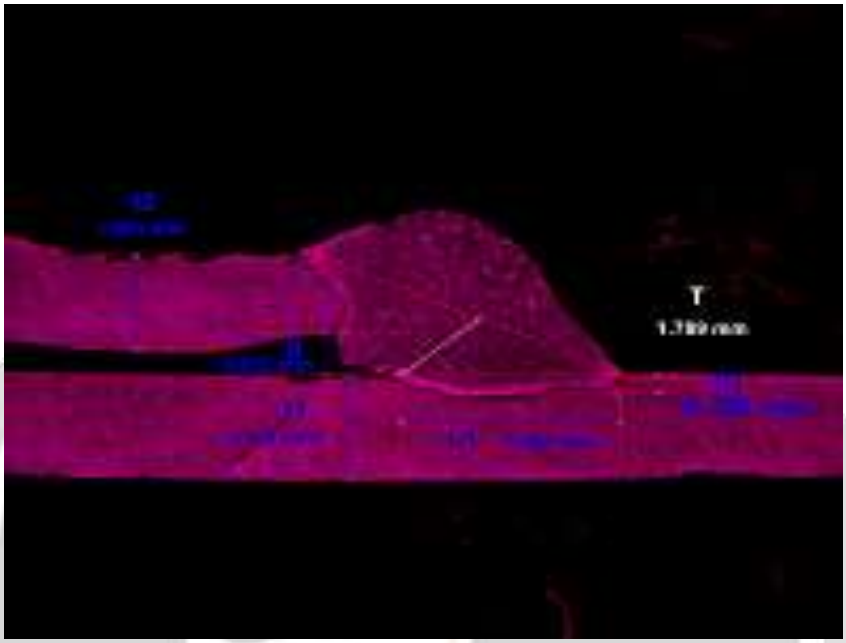
Magnification range of:	
Eyepiece	10X
Magnification knob	0.62-5X
Interchangeable objective	0.5/2/1X
Current magnification setting	3.1X

Table 4.4 Specifications of microscope

5.TEST RESULTS:

1. For previous setup:

Joint type: Lap fillet.

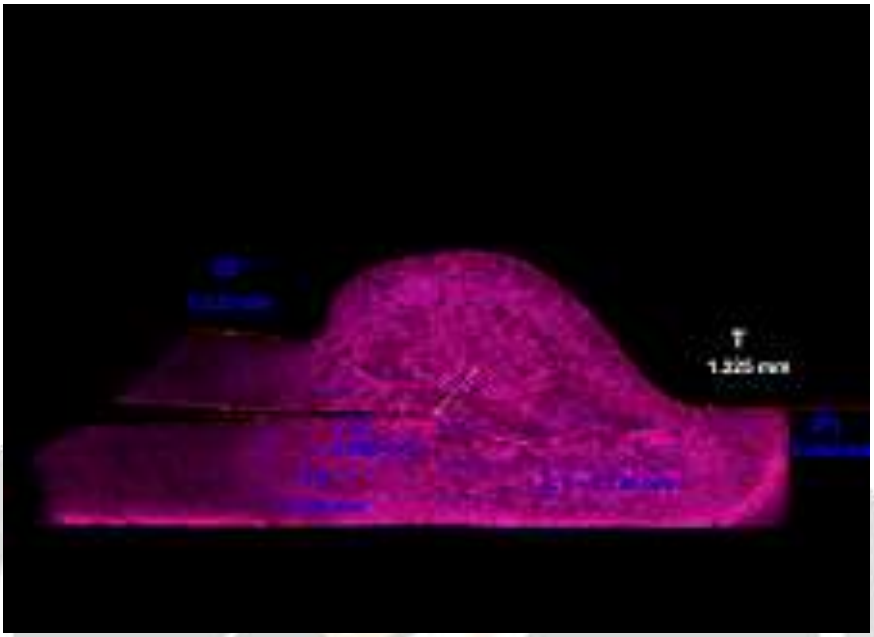


Weld Parameters	Specifications	Actual value	Remarks (Ok/Not Ok)
%P1 (Penetration depth)	It should be min. 20%	0.355(18%)	Not Ok
g (Root gap)	1mm max. for static joints	0.853	Ok
L1 (Length of side wall fusion)	Min. 3mm (for section thickness) <6.5mm & 4.8mm (for section)	3.951	Ok
t1 (Plate thickness)	Plate thickness	2.00	Ok
t2 (Plate thickness)	Plate thickness	2.00	Ok
T (Throat)	T>0.7*t (Where 't' is min thickness of two weld plates)	NA	--

Table 5.1 Weld qualification sheet for previous setup.

2. For current setup:

Joint type: Lap fillet.



Weld Parameters	Specification	Actual Value	Remarks(Ok/Not Ok)
%P1 (Penetration depth)	It should be min. 20%	0.658(44%)	Ok
g(root gap)	1mm max. for static joints	0.093	Ok
L1(length of side wall fusion)	Min. 3mm (for section thickness) <6.5mm & 4.8mm (for section)	5.276	Ok
t1(Plate thickness)	Plate thickness	2.00	Ok
t2(Plate thickness)	Plate thickness	2.00	Ok
T (Throat)	T>0.7*t (Where 't' is min thickness of two weld plates)	1.225	Ok

Table 5.2 Weld qualification sheet for current setup

6.ADVANTAGES:

1. Improved weld penetration.
2. Reduced failure of the joint.
3. Reduced defective part and rework.
4. Increased production rate due to reduced defective parts.
5. Increased productivity and reduce production time.

7. CONCLUSIONS:

1. Weld quality has improved by changing the parameters such as torch angle and work piece fixture position.
2. There is proper fusion and weld penetration which helps to reduce the rework due to defectives.
3. From the test results we can conclude that by changing the torch angle weld penetration is increased.

8. REFERENCES:

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