

## A case study on achieving defined Welding Penetration

<sup>1</sup>Kumar Gaurav & <sup>2</sup>Vikash Kumar

<sup>1</sup>Research Scholar, Deptt. of Mechanical Engineering, PPIMT Hisar (India)

<sup>2</sup>Assistant Prof., Deptt. of Mechanical Engineering, PPIMT Hisar (India)

---

### ARTICLE DETAILS

#### Article History

Published Online: 15 May 2019

#### Keywords

welding current, arc voltage, welding speed, bead height, depth of penetration.

---

---

### ABSTRACT

*In this paper, welding parts fitment are designed and welding parameters, affecting parameters and residual stresses, such as welding torch approach in fixtures and proper part fitment in fixture for controlling longitudinal stresses are taken into consideration. Weld sequence is effective on distortions. First weld seam on the part creates preheating effect on the next weld seam and affect penetration. After analysis of fixture design, inversely proportional to weld angle, penetration increased by increasing heat input, as expected. The various improvements have been done in welding process & in welding parts conditions to increase penetration in welding parts. This Work was done for increasing quality level of welding fixtures.*

---

### 1. Introduction

Welding can be characterized as the way toward joining two similar or unique metallic parts with the utilization of heat, with or without the application of pressure and with or without the utilization of filler metal. The utilized Taguchi technique to configuration process parameters that advance weld weakening for ST-37 steel, utilized for development of aviation wings[1]. The mechanical properties of austenitic hardened steel for the procedure of TIG and MIG welding[2]. GMA procedure with numerous execution targets using full-factorial structure of examinations, relapse investigation and objective programming[3]. Taguchi plan of investigations and symmetrical cluster to locate a particular range and mixes of turning parameters like cutting pace, feed rate and profundity of slice to accomplish ideal estimations of reaction factors like surface completion, instrument wear, material evacuation rate in turning of Brake drum of FG 260 dark cast iron Material[4]. The experimental relationship can be utilized to anticipate the yield quality of inactive gas metal curve welded AISI 1040 medium carbon steel. Response Surface Methodology (RSM) was connected to enhancing the MIG welding process parameters to accomplish the greatest yield strength of the joint[5]. A Symmetrical exhibit, signal to noise (S/N) ratio and analysis of variance (ANOVA) are utilized to research the welding attributes of MS C20 material and advance the welding parameters[6]. The utilized AISI 1020 or C20 material for welding. It is a plain carbon steel and furthermore known as "delicate" or mellow steel[7]. The various welding parameters such as welding speed, voltage and gas flow rate were varied on HSLA steel and the effects of these parameters on weld bead geometry such as penetration, width & height have been studied[8]. They have some drawbacks like the difficulty in welding them and, in last year's, there have been many research works to overcome some of these limitations[9]. The depth of penetrations were measured for each specimen after the welding operation is done on closed butt joint and the effects of welding speed, current, voltage parameters on depth of penetration were investigated[10]. The welded two divergent materials (steel) AH32/STS304L by crossover CO2 laser-gas metal curve welding and enhanced welding parameters by

utilizing grey based Taguchi examination[11]. The high power fibre laser has become one of the most efficient energy sources for deep penetration welding processes used in heavy manufacturing and marine industries[12]. Analysis by utilizing L9 symmetrical Array to discover weld profundity and furthermore perform corroborative Experiment to discover ideal run set of current, voltage speed and gas flow rate[13]. GMAW a process that melts and joins metals by heating them with an arc established between a continuously fed filler wire electrode and the metals[14]. Its displayed extra protecting gas for pay to beat welding absconds, which frequently happen when high temperature strong and fluid stage welds are presented to air[15]. The optimized the gas metal bend welding process parameters on 316L steel by GRA based Taguchi strategy, and the current was observed to be progressively huge parameter than gas flow rate impacting the quality of the welded joints[16]. The impact of groove point, groove profundity and the welding speed on the liquid pool [17]. The deliberate reaction is convexity record and models were created from the gathering of information and checked for their amplexness[18]. The effect of various welding parameters on bead geometry of mild steel specimen having 5.5mm thickness welded by Gas Metal Arc welding process[19]. The focused in the improvement of welding the 6082-T6 aluminium alloy with the process of GMAW or MIG[20]. The use of aluminum alloys is growing in industry especially in the transportation because of their advantages when compared with the traditional iron-carbon alloys, specially related with the lower density and corrosion resistance[21]. The optimized the procedure parameters that influence the weld ability of IS2062, and in their outcome, they referenced that welding current and voltage have critical impacts though gas flow rate has an inconsequential impact on rigidity of the welded joint[22]. In the wake of finishing information pre-handling, all together to express a connection among genuine and perfect standardized qualities, a Grey relational coefficient is resolved[23]. The present examination is to research the impact of welding parameter on the entrance. The impact of welding current, welding voltage and gas flow rate on the profundity of the entrance in gas metal circular segment welding of AISI 1018 gentle steel having 8mm thickness has been going to

contemplate through tests and examination, and research the improvement procedure parameter[24]. The present article describes an experimental analysis of a robotized GMAW in aluminium alloy, using MIG in its transfer method variation Standard and pulsed Cold Metal Transfer (CMT+P), developed in order to optimize the penetration depth, width and reinforcement of the weld bead. The base metal was the aluminium alloy 6082-T6 and the filler metal was aluminium alloy 5754[25]. They have some drawbacks like the difficulty in welding them and, in last year's, there have been many research works to overcome some of these limitations[26]. This work centre around the improvement of Taguchi technique and enhancement utilizing flag to clamour proportion for deciding the ideal/close ideal GMAW process parameter for getting the ideal weld globule geometry amid welding of MS IS2062[27]. This examination explored the flow of three welding parameters (wire feed speed, circular segment voltage, and protecting gas flow rate) for SS 304H by utilizing Taguchi based Grey relational analysis. In this exploration work, unadulterated argon was utilized as protecting gas[28].

## 2. Case study

This study is based on weld shop. How to improve penetration with better quality in weld shop. By improving quality of finished product & by process validation capacity of line increase which one is itself a great achievement for the point of process standardization. By process standardization lot of cost save by rejection control in weld shop. This project will be beneficial for the two wheelers industries as it will make easy to required quantity on time. This part was made in a way that it is easy to use and reliable to the user without limiting the user need. To begin the process for the first time, think about a small but important problem that is likely to be resolved with some thought and work. Moving in this direction of problem solving there are few steps one has to follow:

- Identifying the problem—which problem should be addressed? If there are several, how to choose the most important one?
- Describing the problem — how to accurately and completely describe the problem?
- Analysing the problem—what are the different causes of the problem, and which causes are most important to solve right away?
- Planning the solutions—what are the different alternative solutions for solving the problem?

In the following part of the report using this terminology we will increase penetration by improvements in weld shop for controlling rework & rejection at JBM Group Company Neel Metal Private Limited Gurgaon. No 1 tire 1 company in India which deals in sheet metal parts for two-wheelers industries.

### Scope of work

The general Scope of work that will be considered throughout this work is given as under.

1. Select a particular frame line for improvement.
2. Select a penetration percentage for controlling welding
3. Welding parameter setting for penetration up 10%

## 3. Motivation

A frame assembly is most typical and complex system in manufacturing of two wheelers, for which quality is dimensional integrity for frame assembly, which has great functionality and effects on the quality of the vehicle. Frame assembly geometrical accuracy in automotive is one of the most important quality factors.

Some design and manufacturing induced variation in inevitable, so variation in accuracy of geometrical can stem from both assembly and design of a frame. It is important to have a methodology for identifying root causes of market complaint as well as thoroughly understanding the sources of variation in geometry.

## 4. Methodology

A Brief study was done on angular distortion and longitudinal shrinkage. Both distortion are correlate with each other for controlling angular distortion torch angle should be proper or welding approach of torch in welding fixture should be as per requirement. And for controlling longitudinal shrinkage proper part holding jigs required called welding fixture. Welding fixture design should be proper by understanding profile and design of part to be weld. We are trying to make better design of welding fixture by collecting previous parts data. Data of similar part collected in which after welding all dimensions found out of tolerance while a part weld in a welding fixtures at different stations.

## 5. Objective of the present Work

After defining Scope it is important to identify the objective. As well-known no target can be successfully achieved without defining the objective. The identified objectives for the present work are given as under

1. Pin pointing the frame body components problems
2. To understand the Current quality level of Frame body.
3. Defining key product characteristics for frame body.
4. Applying welding parameter setting technique for 10% penetration.

## 6. Pin pointing problems

We select a report of frame in which more problems occur regarding part broken & market complaint. First we check penetration regarding complaints, on behalf of penetration we found few points having low penetration level from selected.

**FRONT FRAME ASSY.**

No	Part welded with thickness	Bead Penetration std. > 10 % of min sheet thickness	Observation (Penetration In mm)	Photo	Result
1	Pipe Steering Head (4.0 mm)+	0.40 mm	0.70 mm		OK
	Stopper Steering (6.0 mm)-Upper		1.0 mm		
2	Pipe Steering Head (4.0 mm)+	0.40 mm	1.3 mm		OK
	Stopper Steering (6.0 mm)-Lower		0.40 mm		
3	Pipe Steering Head (4.0 mm) +	0.40 mm	0.30 mm		NG
	Guide Handle Lock (4.0)- Upper		4.0 mm		
4	Pipe Steering Head (4.0 mm) +	0.40 mm	0.30 mm		NG
	Guide Handle Lock (4.0)- Lower		1.3 mm		
5	Pipe Steering Head (4.0 mm) +	0.20 mm	0.33 mm		OK
	Brkt. ( 2.0 mm )-LH Upper		1.60 mm		

**REAR FRAME ASSY.**

No	Part welded with thickness	Bead Penetration std. > 10 % of min sheet thickness	Observation (Penetration In mm)	Photo	Result
107	Seat Rail 2 (2.0 mm) +	0.20 mm	1.0 mm		OK
	Brkt Reinf. Seat (3.2 mm) Front		0.90 mm		
108	Seat Rail 2 (2.0 mm) +	0.20 mm	0.90 mm		OK
	Brkt Reinf. Seat (3.2 mm) Rear		1.10 mm		
109	Seat Rail 1 (2.0 mm) +	0.20 mm	0.10 mm		NG
	Brkt Rear Fender (2.6 mm) Front		1.10 mm		
110	Seat Rail 1 (2.0 mm) +	0.20 mm	0.30 mm		OK
	Brkt Rear Fender (2.6 mm) Rear		2.60 mm		
111	Seat Rail 2 (2.0 mm) +	0.20 mm	0.20 mm		OK
	Brkt Rear Fender (2.6 mm) Front		2.60 mm		

**REAR FRAME ASSY.**

No	Part welded with thickness	Bead Penetration std. > 10 % of min sheet thickness	Observation (Penetration In mm)	Photo	Result
112	Seat Rail 2 (2.0 mm) +	0.20 mm	0.30 mm		OK
	Brkt Rear Fender (2.6 mm) Rear		1.60 mm		
113	Seat Rail 1 (2.0 mm) +	0.20 mm	0.80 mm		OK
	Brk. 8 (2.0 mm) Front		1.40 mm		
114	Seat Rail 1 (2.0 mm) +	0.20 mm	1.10 mm		NG
	Brk. 8 (2.0 mm) Rear		0.10 mm		
115	Seat Rail 2 (2.0 mm) +	0.20 mm	1.20 mm		OK
	Brk. 8 (2.0 mm) Front		1.00 mm		
116	Seat Rail 2 (2.0 mm) +	0.20 mm	1.00 mm		OK
	Brk. 8 (2.0 mm) Rear		0.50 mm		

Figure 1: Welding penetration report.

First of all we find potential cause for broken frame parts during assembly or in market by actual gemba and decide level of problems.

Table No 1:- Potential cause

SI.No.	Potential Cause	Actual at Gemba	Judgement
1	Pipe Steering Head (4.0 mm) + Guide Handle Lock (4.0 )-Upper welding penetration NG	Aim angle of touch not in between selected frequency	⊙
2	Pipe Steering Head (4.0 mm) +Guide Handle Lock (4.0 )-Lower	Gap in between matching parts not as per standard and aim angle not set	⊙
3	Seat Rail 1 (2.0 mm) + BrktRear Fender (2.6 mm) Front	Wire length ejection and advance angle not set	⊙
4	Seat Rail 1 (2.0 mm) + Brk. 8 (2.0 mm) Rear	Advance angle of touch not in between selected frequency	⊙

⊙ - Strong Relationship, ○ - Medium Relationship, □ - Weak/No Relationship

**Potential Cause 1: Problem 1:** During welding of two parts aim angle is most important part for controlling welding quality, while during regular run of line due to hitting or due to variation in matching parts reprogramming done which affects

aim angle but in regular practice no body know about aim angle or other setting of welding parameter operator just teach robot for proper welding bead but not justify how much deep welding penetrate in part.

Welding Parameter Check Sheet for Defect Free		Issue Date	Model	Equip.	Process	Unit Name	Issue																														
		2018- Nov				HEAD PIPE COMP	Kumar gaurav																														
Eva. Column input ○ X																																					
Weld Sequence	Prog. No.	Process Co (Torch Centering OK + NG) Gap Under 0.5mm						Equipment				Work				Fixture(Jigs)				Remarks (Comment of Problem)	Defect n=20																
		Work Angle		Torch Angle		Aimed Angle		Torch Length		Access		Ampage	Voltage	Speed	Proc. Command	Heat Input	Macro Eva.	Parts Gap	Thickness			movement of part after clamping	Interfere	Number of Fixed Point		Pin Dia.											
		Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.	Act.	Eva.			Act.	Eva.	Act.	Eva.	Act.	Eva.										
1	P3	○	○	25	○	55	○	12	○	○	180A	17.8	50cm		3845J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
2	P12	○	○	10	○	60	○	12	○	○	190A	18.0	50cm		4104J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
3	P33	○	○	25	○	55	○	12	○	○	180A	17.8	50cm		3845J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
4	P37	○	○	10	○	95	X	12	○	○	170A	17.8	70cm		2565J/cm	○	X	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
5	P45	○	○	15	○	50	○	12	○	○	180A	17.8	50cm		3845J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
6	P48	○	○	5	○	60	○	12	○	○	170A	17.8	70cm		2565J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
7	P51	○	○	12	○	35	○	12	○	○	170A	17.8	70cm		2565J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
8	P55	○	○	5	○	55	○	12	○	○	170A	17.8	60cm	L	2992J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
9	P55	○	○	5	○	55	○	12	○	○	170A	17.8	60cm	L	2992J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
10	P61	○	○	20	○	30	○	12	○	○	160A	17.2	60cm	L	2752J/cm	○	○	0.0	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	

Figure. 2 Welding parameter check sheet for problem 1.

**Parameter setting for achieving 10% penetration:** As we already discuss we define penetration level 10% for achieve this level we set aim angle in between defined level of welding.

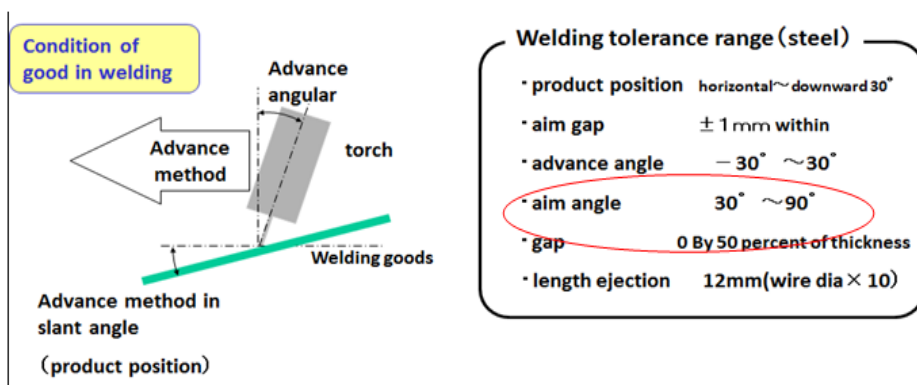


Figure.3 Aim angle of welding for problem 1.



Welding Parameter Check Sheet for Defect Free															Issue Date	Model	Equip.	Process	Unit Name	Issue				
															2018-NOV					kumar gaurav				
															Eva. Column input		<input type="radio"/>	<input checked="" type="radio"/>						
Weld Equip No.	Proc. No.	Process Condition (Torch Centering: OK + NG) Gap Under 0.5mm						Equipment					Work				Fixture(Jigs)			Remarks (Comment of Problem)	Defect			
		Work Angle		Travel Angle		Advance Length		Amps	Voltage	Speed	Prod. Command	Heat Input	Macro Eva.	Parts Gap		Thickness	movement of part after clamping		Interfer.			Number of Fixed Point		Pin Dia.
		Act.	Eva.	Act.	Eva.	Act.	Eva.							Act.	Eva.		Act.	Eva.				Act.	Eva.	
1	P5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	170A	17.5	75cm	L	2394J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
2	P11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	170A	17.5	75cm	L	2394J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
3	P16	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	150A	17.0	60cm	L	2550J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
4	P19	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	150A	17.0	60cm	L	2550J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
5	P22	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	150A	17.0	60cm	L	2550J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
6	P26	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	70cm	L	2359J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
7	P32	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	160A	17.2	50cm	L	3149J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
8	P34	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	50cm	L	3149J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
9	P38	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	150A	16.4	50cm	L	2952J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
10	P41	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	150A	16.4	50cm	L	2952J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
11	P45	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	50cm	L	3302J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
12	P48	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	50cm	L	3302J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
13	P51	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	50cm	L	3302J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
14	P56	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	60cm	L	2752J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
15	P61	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	170A	17.5	60cm	L	2992J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
16	P67	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	60cm	L	2752J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
17	P72	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	160A	17.2	60cm	L	2752J/cm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		

Figure 7: Welding parameter check sheet for problem 3.

**Parameter setting for achieving 10% penetration:** As we discuss we define penetration level 10% for achieve this

level we set advanced angle and wire ejection in between defined level

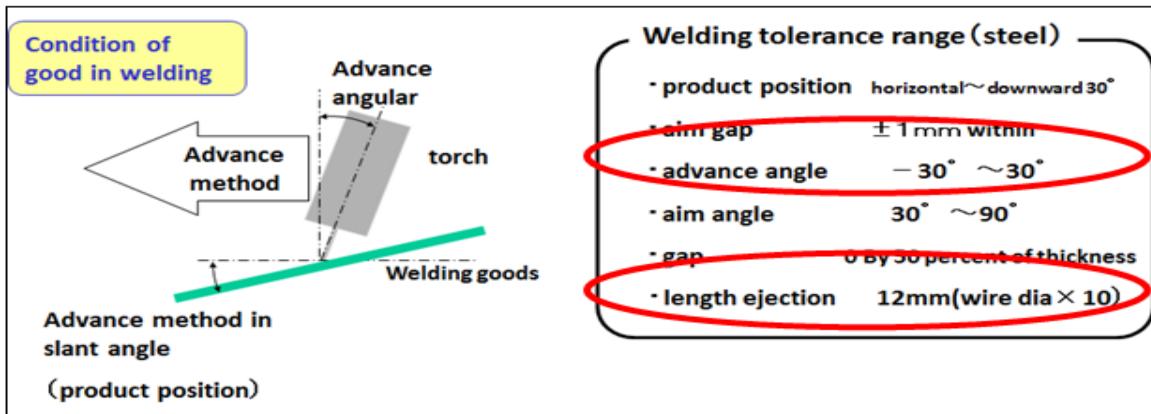


Figure 8: Advance angle and length ejection defined for problem 3.

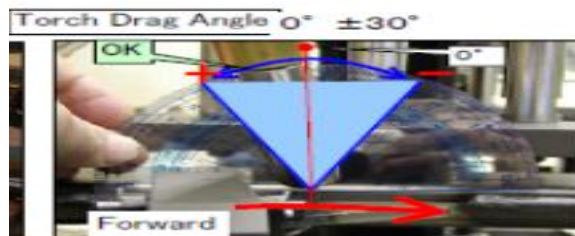


Figure.9: Advance angle setting for problem 3.



Figure.10: welding wire setting for problem 3.

**Problem 4:** Seat Rail 1 (2.0 mm) + Brkt 8 (2.0 mm) Rear when we check as per welding parameter check sheet than we

found, Wire length ejection less as per defined level and advance angle not set as per requirement.

Welding Parameter Check Sheet for Defect Free															Issue Date	Model	Equip.	Process	Unit Name	Issue																	
															2018-NOV					kumar gaurav																	
Process Condition (Torch Centering OK + NG) Gap Under 0.5mm															Equipment					Work				Fixture(Jigs)			Remarks (Comment of Problem)	Defect									
Weld Sequence	Proc. No.	Work Angle		Aimed Angle		Stick-out Length		Adv. Eject. Rate	Amperage	Voltage	Speed	Prog. Command	Heat Input	Macro Eva.	Parts Gap		Thickness	movement of part after clamping		Interfere	Number of Fixed Point			Pin Dia.													
		Act.	Eva.	Act.	Eva.	Act.	Eva.								Act.	Eva.		Act.	Eva.		Act.	Eva.	Act.	Eva.	Act.	Eva.			Act.	Eva.	Act.	Eva.	Act.	Eva.			
1	P5			-30		80		12		170A	17.6	75cm	L	2394J/cm																							
2	P11			10		75		12		170A	17.6	75cm	L	2394J/cm																							
3	P16			-5		80		12		150A	17.0	60cm	L	2550J/cm																							
4	P19			-5		80		12		150A	17.0	60cm	L	2550J/cm																							
5	P22			-5		80		12		150A	17.0	60cm	L	2550J/cm																							
6	P26			10		75		12		160A	17.2	70cm	L	2359J/cm																							
7	P32			-45		85		8		160A	16.4	50cm	L	3149J/cm																							
8	P34			5		85		12		160A	16.4	50cm	L	3149J/cm																							
9	P38			52		85		12		150A	16.4	50cm	L	2952J/cm																							
10	P40			5		85		12		150A	16.4	50cm	L	2952J/cm																							
11	P45			5		85		12		160A	17.2	60cm	L	3302J/cm																							
12	P49			5		85		12		160A	17.2	50cm	L	3302J/cm																							
13	P51			5		85		12		160A	17.2	50cm	L	3302J/cm																							
14	P56			10		85		12		160A	17.2	60cm	L	2752J/cm																							
15	P61			5		75		12		170A	17.6	60cm	L	2992J/cm																							
16	P67			5		55		12		160A	17.2	60cm	L	2752J/cm																							
17	P72			10		65		12		160A	17.2	60cm	L	2752J/cm																							

Figure.11: Welding parameter check sheet for problem 4.

**Parameter setting for achieving 10% penetration:** As we discuss we define penetration level 10% for achieve this level we set advanced angle and wire ejection in between defined level.

techniques for improving welding torch movement design. One more benefit by doing this activity design for future also improves. Capacity of line also increased. Now part inspection was only as per sampling base.

**7. Result**

After some correction in welding torch angle and aim angle again we study about data for those particular areas. We are surprise to find better results as we expected. Our target is to increase welding penetration and reduce rejections or longitudinal shrinkage. We got success to achieve all of four area for welding penetrate as targeted after applying all

After parameter setting as per defined std. in weld shop four process problem eliminate for ever. For regular improvement on weld line weld parameter sheet implement on shop floor on every line filled by supervisor or engineers works on particular weld line during program set up. By Applying this weld parameter sheet more problems find and better ideas comes out for achieving better penetration.

No	Part welded with thickness	Bead Penetration std. > 10 % of min sheet thickness	Observation (Penetration in mm )	Photo	Result
3	Pipe Steering Head (4.0)+	0.40 mm	0.80		OK
	Guide Handle Lock (4.0)- Upper		0.50		
4	Pipe Steering Head (4.0) +	0.40 mm	0.40		OK
	Guide Handle Lock (4.0)- Lower		1.7		
109	Seat Rail 1 (2.0 mm) +	0.20 mm	0.28		OK
	Brkt Rear Fender (2.6 mm) Front		0.45		
114	Seat Rail 1 (2.0 mm) +	0.20 mm	2.00		OK
	Brk. 8 (2.0 mm) Rear		1.20		

Figure.12: Welding penetration report after setting.

All four points found ok as per defined standard of penetration greater than or equal to 10%. It's known that we can fabricate better parts with help of setting four factors which affect penetration.

## 8. Conclusions

The time spent in reworks and efforts spent in identifying affects for less penetration adversely on quality of fabricated parts, its cost and hence the reputation of the product manufacturer. The competitiveness of auto industry today has forced every company to re-look at its processes involved in controlling accuracy of fabricated products and reduces the variability of products. The present work was an effort to have a look at the existing quality level of the fabricated part and weld line and then implement the corrective measures for the non-conformities of fabricated parts. Welding Process & welding Fixture, its use and requirements of its quality of penetration was studied in depth during the investigation of the present work. For controlling the accuracy of the welded part validate welding process & validate fixtures and part conditions. The sample product considered for the proposed work are the welding parts which are used for sheet metal components of part to arrive at final assembly. Welding process & welding torch angle design and its component have been studied critically in the present work. Any defect in the welding torch angle affects adversely on the vehicles assembly and hence it is very important to get fixtures, its components and welding conditions exactly confirming to design specifications. The various improvements have been done in

welding process & in welding parts conditions to increase penetration in welding parts. In this study, welding parts fitment are designed and welding parameters, affecting parameters and residual stresses, such as welding torch approach in fixtures and proper part fitment in fixture for controlling longitudinal stresses are taken into consideration. Weld sequence is effective on distortions. First weld seam on the part creates preheating effect on the next weld seam and affect penetration. After analysis of fixture design, inversely proportional to weld angle, penetration increased by increasing heat input, as expected. Various methods applied to see how they affect the main penetration arising from the welding process. They presented a positive penetration characteristic because of being controlled by torch angle while part was being welded. This characteristic is based on decreasing of yield strength by heating. These results can be used to predict the amount of penetration. This Work was done for increasing quality level of welding fixtures. The roadmap for the improvement was then decided to arrive series of actions namely what is our target? What is the quality of welding penetration at present? Where is the quality of welding penetration going wrong? How much the penetration is required? How to improve further? When and how to implement the suggested improvement? Each of these questions will further involve series of answers that generate many actions which is a subset of an action plan to be implemented for improvement for the quality of welding penetration.

## References

- [1]. M. Aghakhani, E.Mehrdad, and E.Hayati(2011), "Parametric Optimization of Gas Metal Arc Welding Process by Taguchi Method on Weld Dilution" International Journal of Modeling and Optimization, Vol. 1, No. 3.
- [2]. Mr. L Suresh Kumar, Dr. S M Verma, P Kiran Kumar, Dr. T Shiva Shanker(2011), "Experimental Investigation for welding aspects of AISI 304 & 316 by Taguchi Technique for process of TIG & MIG welding ", International Journal of Engineering Trends and Technology, Vol.2, Issue2.
- [3]. Y.T.I.C, F. Elaldi, F. Pakdil, And N. E. İpek(2012), "Design of Experiment and Goal Programming Application for the GMAW Process" 112-s Welding Research, vol. 91.
- [4]. Mr. Ballal Yuvaraj P. Dr. Inamdar K. H. Mr. Patil P.V(2012), "Application Of Taguchi Method For Design Of Experiments In Turning Gray Cast Iron " IJERA Vol. 2, Issue 3, pp.1391-1397.
- [5]. Ajit Hooda, Ashwani Dhingra and Satpal Sharma(2012), "Optimization of MIG welding process parameters to predict maximum yield strength in AISI 1040" Journal Of Mechanical Engineering And Robotics Research, Vol. 1, No. 3.
- [6]. S. V. Sapakal & M.T.Telsang(2012), "Parametric optimization of MIG welding using Taguchi design method" International Journal of Advanced Engineering Research and Studies E-ISSN: 2249-8974.
- [7]. C.N.Patel & Sandip Chaudhary(2013), " Parametric Optimization of Weld Strength of Metal Inert Gas Welding and Tungsten Inert Gas Welding By Using Analysis of Variance and Grey Relational Analysis "International Journal of Research in Modern Engineering and Emerging Technology" Vol. 1, Issue: 3, (IJRMEET) ISSN: 2320-6586.
- [8]. Mohd. Shoeb, Prof. Mohd. Parvez and Prof. Pratibha Kumari (2013), "Effect of MIG welding input process parameters on weld bead geometry on HSLA steel" , International Journal of Engineering Science and Technology (IJEST), ISSN : 0975-5462 Vol. 5 No.01, pp.200-212.
- [9]. Dursun, T.; Soutis, C.(2014), "Recent developments in advanced aircraft aluminium alloys", Mater. Des., 56,pp.862-871.
- [10]. Sheikh Irfanand Prof. Vishal Achwal(2014), "An Experimental Study on the Effect of MIG Welding Parameters on the Weldability of Galvenize Steel", International Journal on Emerging Technologies 5(1): ISSN No. (Online) : 2249-3255,pp.146-152.
- [11].S. M. Joo, H. S. Bang, and S. Y. Kwak(2014), "Optimization of hybrid CO2 laser-GMA welding parameters on dissimilar materials AH32/STS304L using

- Greybased Taguchi analysis”, *International Journal of Precision Engineering and Manufacturing*, Vol. 15, No. 3 ,pp.447-454.
- [12].Anna Unt, Antti Salminen(2015), “Effect of welding parameters and the heat input on weld bead profile of laser welded Tjoint in structural steel”, *Journal of Laser Applications* Volume 27, Number S2, pp.s29002-1 - S29002-7, 1938-1387.
- [13].T. Patel and S. C. Patel(2015), “The Effect of Process Parameter on Weld Depth in GMA Welding Process”*International Journal for Innovative Research in Science & Technology*, Volume 1, Issue 11, ISSN: 2349-6010
- [14].Tarun Patel and Prof. Saumil C Patel(2015), “The Effect of Process Parameter on Weld Depth in GMA Welding Process”, *International Journal for Innovative Research in Science & Technology*, Volume 1, Issue 11, ISSN (online): 2349-6010, pp.36-40.
- [15].C.W. Dong, J.X. Xue, and X.M. Jiang(2016),” Effects of Additional Compensation Shielding Gas on Stainless Steel Pulse MIG Welding”, *International Workshop on Advanced Robotics and its Social Impacts*, July 8-10, 2016.
- [16]. Nabendu Ghosh, Pradip Kumar Pal, Goutam Nandi(2016), “Parametric Optimization of MIG Welding on 316L Austenitic Stainless Steel by Grey-Based Taguchi Method”, *Procedia Technology*, Vol. 25, pp. 1038-1048.
- [17].Peng Jingnum, Yang Lixin(2016), “The mathematical model research on MIG groove welding process”, Published in 2016.
- [18].R Prabhu, T Alwarsamy, R Ramalrishna(2016), “Development of mathematical model for prediction of convexity index in cladding by pulsed MIG welding process”, Published in 2016.
- [19] Rakesh Ranjan, Ajit Kumar, Avinaw Pratik(2016), “Effect of Welding parameters on bead geometry of weld by GMAW Process”, *IJEDR* , Volume 4, Issue 1 , ISSN: 2321-9939, pp.643-651.
- [20].Çam, G.; İpekoğlu, G.(2017), “Recent developments in joining of aluminum alloys”, *Int. J. Adv. Manuf. Technol*, 91, pp.1851–1866.
- [21].Deschamps, A.; Martin, G.; Dendievel, R. Van Landeghem, H.(2017), “Lighter structures for transports: The role of innovation in metallurgy”, *C. R. Phys.*, 18, pp.445–452.
- [22].Saadat Ali Rizvi, SP Tewari, Wajahat Ali(2016), “Application of Taguchi Technique to Optimize the process parameters of MIG wedging on IS 2062 steel”, *International Journal on Emerging Trends in Mechanical & Production Engineering*, Vol. 2, No. 2, pp. 1-11.
- [23].Saadat Ali Rizvi, SP Tewari(2017), “Multi Objective Optimization by Application of Taguchi Based Grey Relational Analysis for GMA Welding of IS2062 Structural Steel”, *Mechanics and Mechanical Engineering*, Vol. 21, No. 3, pp. 717–729.
- [24].Shubham Gothi, Sagar Ramavat(2017), “Experimental Investigation for Parametric Optimization of Gas Metal Arc Welding Process for Welding Of AISI 1018”, *IJARIE- Vol-3 Issue-2*, ISSN(O)-2395-4396, pp,5116-5124.
- [25].Arlindo Pascoal , A. Eduardo Izeda , Vinícius Cecilio , Nuno Mineiro , José Gonçalves and João E. Ribeiro(2018), “Robotic Welding Tests MIG Standard and CMT+P in Aluminum Alloy 6082-T6 for Optimization of Penetration, Cord Width and Reinforcement”, *Proceedings 2018*, 2, 425; doi:10.3390/ICEM18-05295, pp. 1-7.
- [26].Bansal, A.; Pabla, B.; Vettivel, S.(2018), “Effect of TIG Welding Process Parameters on Tensile behavior of 5XXX and 6XXX series Aluminium Alloys: A Review”, *Res. J. Eng. Technol*, 9, pp.1–8.
- [27].Patel Sumit s. , Raval Harshil B. , Gandhi Karan S. , Suthar Chirag D. ,Mr. Sunil J. Patel(2018), “Optimization of process parameter of MIG welding on MSIS2062 Material”, *IJARIE-Vol-4 Issue-2*, ISSN(O)-2395-4396, pp. - 2251-2258.
- [28].Saadat Ali Rizvi and S. P. Tewari(2018), “Optimization of gas metal arc welding parameters of SS304 austenitic steel by Taguchi –Grey relational analysis”, *JCARME*, Vol.7 Iss, 2 pp. 189-198.