

# Welding Operations and Related Fixtures – A Review

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**Abstract:** To reduce the cycle time for loading and unloading of component, SPM can be effective using the latest design softwares like CAE/CAD, considerable enhancement can be achieved. To assure the requirements of multifunction and high performance, optimum design approach is implemented. This developed SPM with fixture will significantly improve production target and increase productivity. This new SPM ideally reduces operation time, reduces accidents, and gives high quality of operation. The motive of new SPM welding machine is to increase the weld strength, load bearing capacity, and to decrease the rejection rate of the product. The conventional machine use 4 torches which required four different machines to run welding. Thus, due to fluctuations, different current & voltages are distributed to these 4 torches which results in different quality welds. Hence these four torches are replaced by single torch in new SPM welding machine with modification in fixture.

**Keywords—**Welding, efficiency, performance, quality, rejection, SPM

## I. INTRODUCTION

Welding is a material joining process in which two (or more) parts are mixed (or joined) at their contacting surfaces by suitable application of heat and/or pressure. The final part that is obtained by joining is known as 'weldment'. Weldment results in homogeneous material and usually has same compositions and characteristics as that of two parts with which joining is done.

Some welding processes require only heat while some require heat and pressure. In some other processes, external filler material is required to obtain coalescence (or joint).

The fixture is a special tool for holding a work piece in proper position during manufacturing operation. For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process is eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a work piece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts. In existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process functionality.

## II. LITERATURE SURVEY

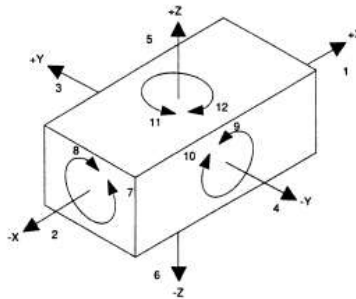
Ajit Hooda, Ashwani Dhingra and Satpal Sharma(2012)<sup>[1]</sup> have made an attempt to develop a response surface model to calculate tensile strength of inert gas metal arc welded medium carbon steel joints. They have also studied the process parameters such as welding voltage, current, wire speed and gas flow rate. On the basis of four factors, three level, faced centre composite design matrix, the experiments were conducted. To achieve the maximum yield strength of the joint, Response Surface Methodology (RSM) was implemented to optimize the MIG welding process parameters.

N. P. Maniar, D. P.Vakharia(2012)<sup>[2]</sup> presented design of rotary fixture for industrial usage which has been proved to save millions of rupees. As these operations are performed in there project were grooving, outside diameter turning, boring, back facing, etc. Actually they say tha HMC was the best machine to perform these operations, but it costs too high as compared to CNC turning centres, hence they have designed a fixture which can be used for CNC turning centres which will ultimately save millions of rupees. They have mainly focused on calculating the unbalanced masses on the rotary fixture. In this paper, they have also provided alternate methods for mass balancing of rotary fixture.

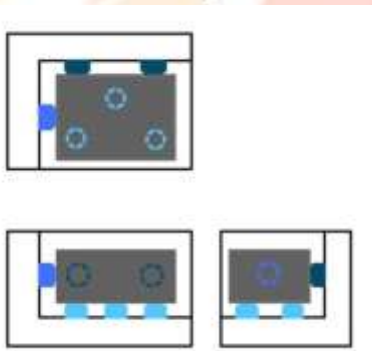
Sheikh Irfan and Prof. Vishal Achwal(2014)<sup>[3]</sup> says that quality, productivity and cost of welded joint depends on MIG welding characteristics also weld's size and shape depends on the same. A lot of research work was done regarding the effects of these

variables on the process. After checking all the specimens for its depth of penetration the effects of welding such as its speed, current, voltage were investigated for the quality of depth of penetration.

Shailesh S. Pachbhai, Laukik P. Raut(2014)<sup>[4]</sup> says that fixture is a main component for any type of machine. Fixture is required in various industries according to their application. For which location of its elements such as clamps and locators selected should be optimum. Due to fixture, installation of component is made easy as it is done manually. Fixtures help system to improve its productivity and operation time. They have also discussed the steps required for fixture design viz. a) Define requirements; b) Gather/analyze information; c) Develop several options; d) Choose the best option; e) Implement the design; f) Use of standard components; g) Use of pre finished materials; h) Eliminate finishing operations; i) Keep tolerances as liberable as possible. The have also elaborated the 3-2-1 principle of location as under:-



The Twelve Degree of Freedom



3-2-1 Locating Principle

- Six Points Location of a Rectangular Block Considering the six degree of freedom of a rectangular block as shown in Figure It is made to rest on several points on the jig body.
- Provide a rest to work piece on three points on the bottom x-y surface.
- This will stop the movement along z-axis, rotation with respect to x-axis and y-axis.
- Supporting it on the three points is considered as better support then one point or two points.
- Rest the work piece on two points of side surface (x-z), this will fix the movement of work piece along y-axis and rotation with respect to z-axis.
- Provide a support at one point of the adjacent surface (y-z) that will fix other remaining free movements.
- This principle of location of fixing points on the work piece is also named as 3-2-1 principle of fixture design as numbers of points selected at different faces of the work piece are 3, 2 and 1 respectively.

Javed Kazi1, Syed Zaid, et.al.(2015)<sup>[5]</sup> says that, quality and productivity are considered to be the main points in today's manufacturing market. The main agenda of today's companies is to produce better quality products at minimum cost. Welding is known to join the two or more similar or dissimilar metals together. In this paper they have attempted to study and understand different types of welding techniques, especially TIG welding and MIG welding. Various characteristics such as strength, hardness, modulus of rigidity, % elongation, etc. Were studied at constant voltage on hardness testing machine and UTM. They have compared TIG and MIG welding in following manner:-

Difference between TIG and MIG welding

MIG Welding	TIG Welding
This welding is known as metal inert gas welding	This is known as tungsten inert gas welding.

Metal rod is used as electrode and work piece used as another electrode.	Tungsten rod is used as electrode.
It is gas shielded metal arc welding	It is gas shielded tungsten arc welding.
Continuous feed electrode wire is used which are fast feeding	Welding rods are used which are slow feeding.
The welding area is flooded with a gas which will not combine with the metal.	Gas is used to protect the welded area form atmosphere
MIG can weld materials such as mild steel, stainless steel and aluminum. A range of material thicknesses can be welded from thin gauge sheet metal right up to heavier structural plates.	TIG weld things like kitchen sinks and tool boxes. Pipe welding and other heavier tasks can also be performed, you just need to have a unit that is capable of putting out the amount of power that you need.
MIG requires consumable metallic electrode.	It used non consumable tungsten electrode
Electrode is feeded continuously from a wire reel.	It does not require electrode feed.
DC with reverse polarity is used.	It can use both A.C and D.C.
Filler metal is compulsory used.	Filler metal may or may not be used.
It can weld up to 40 mm thick metal sheet.	Metal thickness is limited about 5 mm.
MIG is comparatively faster than TIG.	TIG is a slow welding process

OI Kenji, Murayama Masatoshi(2015)<sup>[6]</sup> described that as there is a huge competition between companies for their respective products, the demand of best quality products are required which can be generated by the parameters such as strength, hardness, ductility, tensile strength, and these parameters need to be enhanced by innovation of various welding techniques. Now a days, weight reduction of automobile bodies to reduce the environmental load and to increase the international competitiveness is making a huge improvement in automobile industries. So to compete with these requirements steel materials has to withstand super high tensile strength and should also e able to deal with complex structure of parts with high efficiency.

M. Mukherjee, J. Saha, et.al.(2015)<sup>[7]</sup> describes the effects of various shielding gases mixtures on metal's properties such as microstructure and mechanical properties like hardness, toughness, etc. the mechanical properties are affected by variations in microstructure. They have also stated that as th percentage of CO<sub>2</sub> is increased in the shielding gas it results in flatter, wider and literally deep penetrated profile which further increases dilution.

V. R.Basha, J.J. Salunke(2015)<sup>[8]</sup>explains about the fixture applications for various industries. In this paper, fixture design and automation from the past decade has been studied. The work done in design, requirement and principles are also been discussed.

Jim lee(2016)<sup>[9]</sup> describes about the use of six sigma for the design of the various fixtures used for specific applications. Various tests are done on a fixture by using design tools such as 3DModeling and Finite Element Analysis (FEA). The tested fixtures resulted in 25% improvement in process cycle efficiency and decrement in overall cost.

Shivaji Mengawade, VaibhavBankar, et.al.(2016)<sup>[10]</sup> says that fixture design is a tough part which requires knowledge. The fixture is a special tool for holding a work piece in proper position during manufacturing operation. For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process is eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a work piece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts In existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process functionability. Fixture design plays an important role for enhancing quality parameters such as accuracy, surface finish, precision. Better the fixture design lesser will the time required for operations. Better fixture provides the manufacturer to optimize design for machine operation as well as process functionability

### III. SUMMARY

Some authors have stated the relationship between the transverse and longitudinal yield strength by comparing their values and studying their microstructure.

Some authors concluded that increasing the speed travel and maintaining the constant arc voltage and current will increase penetration until an optimum speed is reached at which penetration will be maximum. Increasing the speed beyond this optimum value will result in decreasing penetration.

Some authors elaborated that if modern CAE, CAD are used in designing the systems then significant improvement can be assured. To fulfil the multi-functional and high performance fixturing requirements optimum design approach can be used to provide comprehensive analysis and determine an overall optimum design.

Some authors proved that hardness and ductility of MIG welding than TIG welding. They also presented the trends in basic research on the microstructure of the weld metal, which has continued from an early date.

After referring above 10 reference papers, it proved MIG welding to be the best suited for our special purpose welding machine. Also hardness of MIG welding is greater than TIG welding, furthermore, the ductility is also higher than TIG welding. It has also been concluded that maintaining a constant arc of voltage and current increases the weld penetration until an optimum speed is reached. If we increase the speed beyond the rated optimum value, it will decrease the penetration.

Using a fixture improves handling which allows user friendly welding procedure (specifically) and/or other manufacturing processes. It also reduces or sometimes avoids the use of measuring, marking and setting of workpiece on machine and maintains the accuracy of performance.

If we increase the CO<sub>2</sub> content in the shielding gas it will lead to an alteration in fluid flow resulting in flatter, wider and literally deep penetrated bead profile, which will ultimately increase dilution. In recent days, weight reduction in automobile bodies which is used to reduce environmental load substance and workability improvement is highly preferred, hence the weld joints in the parts has to be developed to increase the strength and to achieve the same.

Fixture design also plays an important and vital role during manufacturing phase. Proper fixture design is crucial for developing product quality in terms of accuracy, precision and surface finish of the respective parts. Due to rigidity of clamping of tools and workpieces by fixtures increases production capacity and also operating conditions like speed, feed rate and depth of penetration and/or depth of cut can be set to higher values.

#### IV METHODOLOGY

The conventional welding machine implies 4 independent torches which requires 4 different servo motors resulting in variations in current and voltages due to which the weld nuggets sustains less loads. Also, due to unstable weld at start, initial cracks are developed. These problems leads to shorten the wheel rim life. Due to above factors, the amount of rejections of wheel rims are more. In conventional 4 torch machine, the required weld strength is 150 KN which is not achieved sometimes which resulted in rejection of the product to a great extent. So, 150 KN being the weld strength we need to develop a machine which will at least achieve the required strength or more.

Thus the new welding machine consists of only one torch and one servo motor. Also the fixture plate on which the wheel rim is mounted is being slightly inclined by 45°, pneumatic clampers are also provided to hold the wheel rim in place. Due to this construction all the four welds would weld by equal amount of current and voltage. Also initial cracks are neglected resulting in strong welds. The strength of the welds are being tested on UTM which shows the load bearing capacity as high as 470KN. This means the welds are highly strong and reliable if being welded on single torch welding SPM.

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